



# CHAPTER 9

# APPLICATION

# PRACTICE

name \_\_\_\_\_

Please read through the information regarding Dr Jackson's journal writings during her journey to the Galapagos Islands. . Identify the relationships within her journal entry of July 23,1999. Underline in color or highlight the organisms that are identified and what their relationships are. Complete the Ecological relationship chart .

## GALAPAGOS EDUCATION

### DOCTOR BETSY JACKSON'S JOURNAL

My name is Dr. Betsy Jackson and I am a field researcher at the Charles Darwin Research Station in the Galápagos Islands. I have been doing research on the Galápagos giant tortoise, *Geochelone elephantopus*, for six months and plan to continue my work for at least two more years. I am trying to establish a detailed database of the ecological role of the tortoise on Española Island. Española is a small island that is located in the southern part of the Galápagos Archipelago. I have been taking extensive field notes as I observe the habits and the habitats of this magnificent animal. Here are a few of the observations I have made.

July 23, 1999.

Española Island: The giant tortoises have been spotted at last. These tortoises are of the saddleback variety, that is, they have an arched opening in their carapace (shell). The large neck opening allows them to reach the tall cactus pads of the tree-like prickly-pear cactus. In addition to eating the cactus pads, they also eat the pear fruit of the cactus. This behavior of eating the cactus pear is not only good for the tortoise, it is also good for the cactus itself. The seeds of the cactus are protected by a very thick coating and they can only sprout into new plants if they have been eaten, digested, and eliminated by an animal, so the seed coat is worn off. Both organisms benefit from this relationship. This is very similar to the seeds of the Galápagos tomato, which is also eaten by the tortoise. As I observe the tortoises in the field I notice that the ground finches that are found all over the island have been interacting with the tortoises in a very interesting way. Quite frequently I see a ground finch land on the giant tortoise and pick at the small bugs that are bothering it. The finch picks what looks like a mite or a tick from the tortoise and eats it. This way the finch gets some food and the tortoise is cleaned of the small parasites that seem to bother many island animals. The tortoises are not very wary of the other animals around them, including me! I can get extremely close to them without them being afraid. My background research on these

tortoises indicates that this lack of fear is part of the reason their current population numbers are so low. The population was estimated to be more than 250,000 individual tortoises before whalers, pirates, and even explorers captured thousands of them for food. Because the tortoise can go for long periods without water, sailors would take many animals and stack them in the holds of their ships so they could have fresh food for months. The current population of tortoises on the islands is only 15,000- 20,000, but the numbers are improving. But humans killing the tortoises is not the only reason their numbers decreased. As humans came to the islands, they also brought with them dogs, goats, and pigs for food, and rats came ashore from their ships. The pigs and rats eat tortoise eggs, and dogs will prey upon young turtles that can't move fast enough to run away. Goats do not eat the tortoises themselves, but they eat huge quantities of the lush vegetation that the tortoises need so desperately to survive. I have heard that the native Galápagos Hawk preys on the young tortoises too, but I have not observed this behavior since I have been doing my field research. In June I saw a young hawk perch on a large male tortoise to watch the fields for small lava lizards. The hawk was taking advantage of the large perch, but the tortoise was not even aware of it. The best part of my research is knowing that I will be helping the population of the tortoises increase in number. The scientists at the Charles Darwin Research Station have been helping the Galápagos tortoise by collecting unhatched eggs and hatching them in captivity so no other animals can eat them. After raising the young tortoises for two to three years, they are replaced on the same island that the eggs came from. The tortoises benefit from this relationship, even though the scientists don't gain anything directly.

**GALAPAGOS EDUCATION**

**ECOLOGICAL RELATIONSHIPS [TYPE IN A DIFFERENT COLOR]**

Ecological Relationship	Animal 1	Animal 2	Explanation
<p><b>Competition</b> Two or more organisms vying for the same food source or energy source. Competition can be inter-specific (between individuals of different species,) or intraspecific (between individuals of the same species.)</p>			
<p><b>Predation</b> One organism (the predator) kills and consumes another (the prey) for food (energy).</p>			
<p><b>Parasitism</b> One organism (the parasite) takes food (energy) from another (the host) without actually killing it.</p>			
<p><b>Mutualism</b> A relationship involving two organisms in which both organisms benefit.</p>			
<p><b>Commensalism</b> An ecological relationship in which one organism benefits and the other is not affected by the relationship</p>			

## COMPETITION

In this activity, you will learn about 2 famous examples of competition. Read the descriptions and then answer the questions that follow



### Example 1

On the rocky coast of Scotland, the stones at the edge of the sea are striped by 2 layers of animals known as barnacles. Barnacles, which are relatives of crabs and shrimp spend their entire adult lives attached to 1 spot. The narrow top layer consists of small brown barnacles with smooth shells. The wide bottom layer consists of large white barnacles with ridged shells. The story of these barnacles illustrates how competition can have a powerful effect on the size and location of a population in an ecosystem. Here is the reason: The small barnacles have the potential to live anywhere on the rock. However, the big barnacles crowd them out. The small barnacles can live only where the big ones cannot. Because of competition, the actual niche of the small barnacles is much narrower than their potential niche.

How does competition affect the size of the small barnacle population?

How would the size and location of the small barnacle population change if all the big barnacles were killed by a disease?



### **Example 2**

Warblers are small brightly colored insect-eating birds that live in spruce trees in Canada and the northeastern United States. During the winter, many warblers fly to more southern areas. As a result, a number of species of warblers may live and feed in the same forests.

Careful observation reveals that each species of warbler looks for food in only certain regions of the spruce tree. The Cape May warbler, for example, spends its time in the outermost branches at the very top of the tree. The yellow-rumped warbler, on the other hand, looks for food throughout the bottom third of the tree. The bay-breasted warbler stays for the most part in the middle branches of the tree.

Are the warblers sharing a niche?

How does the behavior of the warblers relate to competition?

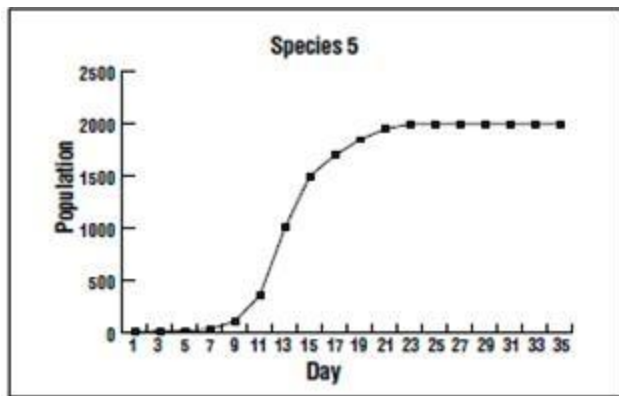
How does the behavior enable 5 species of the birds to live in the same forest at the same time? Predict what would happen if this behavior did not exist

## Carrying Capacity/Limiting Factors

### Background Information:

Most populations of living things go through a number of different growth phases

All living things, need food, water, shelter, and space to survive and will compete with each other and other species of animals for these biotic and abiotic factors. As long as they have all of these things available to them, their population will continue to grow. However their populations cannot grow forever. In any ecosystem, there is only a certain amount of food, water, living space, mates, and other resources. The ecosystem can only support a certain number of individuals. When there are not enough resources, the number of individuals in the population is limited. Resources that limit population growth are called [limiting factors](#). Limiting factors prevent the population from getting too large. When the population stops growing, the ecosystem has reached its [carrying capacity](#). Carrying capacity is the largest number of individuals of one species that an ecosystem can support over time. If a population exceeds the carrying capacity, some individuals will not have enough resources and will die or move to another location.



Take a look at the graph above. During days 1-9 the population of species 5 grows quite slowly as it is introduced to a new area. Then you can see a very quick rise in population with slowing down after day 21. After day 21, the rate that individuals are born is the same rate as which the individuals die. This causes the population to reach a steady state in which the population stabilizes.

The size of the population is determined by the ecosystem in which the species lives. Remember that the resources in an ecosystem are limited. Because of this, an

ecosystem can only fulfill the needs of a certain number of individuals and no more. This population represents the maximum number of members of the population that can be supported by the ecosystem which is the *CARRYING CAPACITY*

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Let's apply this...



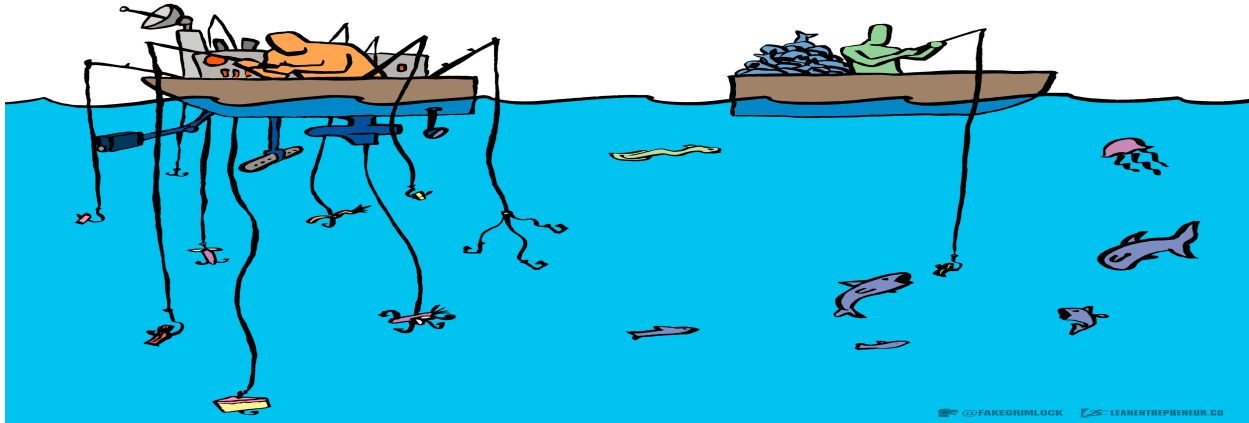
A certain forest ecosystem is able to support a population of 100 rabbits. One year, a lot of baby rabbits are born and the rabbit population soars to 130. What will probably happen to the rabbit population over the course of the next year?

What will happen to the rabbit death rate? Why?

How might the rabbit overpopulation affect other organisms in the forest ecosystem?

This forest ecosystem that has enough food for 100 rabbits, enough water for 200 rabbits and enough shelter for 300 rabbits?

What is the carrying capacity? \_\_\_\_\_ limiting factor? \_\_\_\_\_



In August of 2010, huge schools of pogy fish swam into the Quahog Bay in Maine. The fish soon used up all the oxygen in the water of the bay and suffocated.

How does the increase in the population of the pogy fish in Quahog Bay differ from that of the population of rabbits in the questions above.? Name 2 ways that the size of the population in an ecosystem may increase?

What factor in the bay ecosystem limited the population of the pogy fish?

What do you think was the bay's ecosystem's carrying capacity for pogy fish **after** the oxygen had been used up ?

How do you think this compares to the bay's carrying capacity for pogy fish **before** the huge schools of pogy fish moved in?

Can populations affect the carrying capacity of their environment?



Using the background information as an example, show what a graph would look like that represents the change in population in pogy fish in quahog Bay in 2010. Label and Identify on the graph when the population changes in August 2010.

[ You can draw this in, or perhaps find a graph online that would represent what it would look , without worrying about the labels for each axis ]

What might happen when a population severely overshoots the carrying capacity of its environment? How is this different from normal phases of population growth?

