BIO 182 LAB SIGN OFF PAGE — LESSON 13

Name _______________________________

Please staple all of your lab pages for this Lesson together with this page as the top. You will use this page to get your Labs for Lesson 13 signed off by the Biology Learning Center staff. You need to have all of the following steps initialed by a staff member before you can receive your 15 labs points for Lesson 13 and be allowed to take Exam 7.

After you have obtained all of your sign offs for this Lesson, be sure that a BLC staff member indicates on your Lab Card that you have completed all the Labs. Also, keep this sign off page, along with your completed lab worksheets, as proof of your lab completion. If your Lab Card indicates that you have not completed the required Labs for this Lesson and you believe that you have, it is up to you to provide proof that you have indeed completed the Labs. Keep this page!

__________ Lesson 13, Step 3A: Ecobeaker: Isle Royale (in BLC)

__________ Lesson 13, Step 3B: Ecobeaker: Isle Royale (in BLC)

__________ Lesson 13, Step 3C: Ecobeaker: Isle Royale (in BLC)

__________ Lesson 13, Step 3D: Ecobeaker: Isle Royale (in BLC)

__________ Lesson 13, Step 4A: Ecobeaker: Intermediate Disturbance Hypothesis (in BLC)

__________ Lesson 13, Step 4B: Ecobeaker: Intermediate Disturbance Hypothesis (in BLC)

__________ Lesson 13, Step 4C: Ecobeaker: Intermediate Disturbance Hypothesis (in BLC)

*BLC Staff: After the student receives his/her last initial on this page, please indicate on his/her Lab Card that s/he has completed all the Lesson 13 labs.
Step 3: In Class Activity – Isle Royale

This is the first of four different lab exercises you'll do that use Ecobeaker, software that simulates ecological processes. To complete this activity, you will need to the use computers in the Biology Learning Center. The Bio 182 EvoBeaker/EcoBeaker manual with instructions for this activity is located on the shelf below Model S (the cat skeleton) in the Biology Learning Center. (Be sure you don't accidentally grab a gray notebook that contains Ecobeaker directions for another course.)

Lesson 13, Step 3 Part A: Population Growth and Carrying Capacity
Follow the directions in the Ecobeaker notebook, and answer the questions below:

1. Look at the Population Sizes graph and answer the following questions (the numbers you provide can be approximate):
   a. How big is the stable moose population?
   b. What was the maximum size the moose population attained?

2. Copy the Populations graph that shows the moose population size changing over time. Label one axis “POPULATION SIZE (N)” and the other one “TIME (years)”.

3. During what time period does it appear that the moose population experienced exponential growth (described in the Introduction)? Write your answer below and also circle that section of your graph.

4. Based on your graph, what is the carrying capacity of moose on the island? Write your answer below and also draw an arrow on your graph that indicates carrying capacity and label it “K”.

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5. The following equation should look familiar. It is the logistic growth model from the introduction:

\[ \frac{dN}{dt} = r_i \frac{N(K-N)}{K} \]

a) What does “\(\frac{dN}{dt}\)” mean, in words?

b) Look at the equation and try and figure out what will happen to “\(\frac{dN}{dt}\)” when the population size (\(N\)) approaches the carrying capacity (\(K\)). The simplest case to think about is when the two numbers are the same (\(N=K\)). Try substituting in \(K\) wherever there is an \(N\) on the right-hand side of the equation and write this new equation below.

\[ \frac{dN}{dt} = \]

c) Now complete the following sentence:

When the population size is the same as the carrying capacity (\(N=K\)), the population will ....

6. Now look at the graph in the Introduction depicting an example of logistic growth and compare that to your moose population growth graph. Sketch both curves in the spaces provided below. Don’t worry about the numbers, just show the shapes of the curves.

Moose Population Growth

Logistic Population Growth

7. How do the shapes of the curves differ? Describe the differences in terms of population sizes and carrying capacities.
8. Provide a biological explanation for why the moose population overshoots its carrying capacity when first introduced to the island.

9. If 100 more moose are brought to Isle Royale and 20-30 more years of population data are collected, how would this change the population graph? In the space provided, draw a rough sketch of what you think your new graph with the added time steps would look like. Be sure to label the axes.

10. Now you get to test your intuition by adding 100 more moose to the island. Follow the directions in the notebook to do this.

   a) Did you predict correctly what would happen if you added 100 more moose?

   b) What is the new carrying capacity of moose on Isle Royale?

Please bring your worksheets to the front desk for lab check-off. (Don’t go to the next section until you have been checked off for this section!)

182 13.3A:
Lesson 13, Step 3 Part B: The Predators Arrive

One cold winter several decades after the moose arrived, a small pack of wolves walked across the ice from Canada to reach Isle Royale. In the next steps, you'll add wolves to the island and see how that changes the moose population.

1. In the space provided below, copy the part of the Populations Graph that shows what happens to the moose and wolf populations over time once the wolves have been there long enough to register on the graph. Be sure to label the axes and lines of the graph.

2. Use your new graph to answer the following questions:
   a) What is the carrying capacity of wolves on the island? Explain how you determined this value.

   b) Did the introduction of wolves cause the moose population size to shrink? If so, how much smaller (on average) is the moose population with wolves present?
3. You should have noticed that the populations of moose and wolves go through cycles. Describe the pattern. Does the moose or the wolf population climb first in each cycle? Which population drops first in each cycle? Provide a biological explanation for the pattern you see.

Predators often go after young, old, and sick members of their prey species. This tends to weed out the weakest of the prey and leave behind the strongest prey. In the model you are using here, there are no sick, young, or old individuals *per se*, but each individual does have a certain level of energy (fat stores) based on how much food they've recently eaten. In the next few steps, you will study how moose energy level is influenced by the presence of wolves.

4. **Energy levels of moose with wolves absent:**

<table>
<thead>
<tr>
<th>sample #</th>
<th>energy level</th>
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<tbody>
<tr>
<td>1</td>
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<td>10</td>
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</tbody>
</table>

   AVERAGE =

5. Next you will see how adding wolves influences the health (i.e. energy level) of moose. But first, write down your prediction of what will happen. Do you think the average energy of moose will *increase, decrease* or *stay the same*?
6. Energy levels of moose with wolves present:

<table>
<thead>
<tr>
<th>sample #</th>
<th>energy level</th>
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</thead>
<tbody>
<tr>
<td>1</td>
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<td>10</td>
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</tbody>
</table>

AVERAGE =

7. Compare the average energy levels of moose with and without wolves. Is there a difference? Provide a biological explanation for your answer.

Please bring your worksheets to the front desk for lab check-off.
182 13.3B:
Lesson 13, Step 3 Part C: Producers and Consumers

So far in this lab you have not been asked to pay much attention to the plants. But the moose and the plants interact much like the wolves and the moose (from the perspective of one of the plants, the moose are vicious predators). Furthermore, the predator-prey dynamics of the moose and the plants can influence the predator-prey dynamics of the moose and the wolves. In the next few steps, you will explore how changing the plant population can influence the moose and wolf populations.

1. Describe how the moose carrying capacity changed when plant growth decreased to half its original rate due to a short growing season.

2. Describe how the wolf carrying capacity and the wolf and moose population cycles changed with the reduced plant growth rate.

3. Next, write down a prediction for what you think will happen to the moose and wolf carrying capacities if plant growth suddenly increases to twice the original rate (i.e., a longer growing season).

4. Now do the experiment. What happens to the cycles when the plant growth rate is increased? Does the situation appear to be stable? Describe your results.
5. In your last set of experiments above, you should have witnessed some extinctions (if not, try again, this time running the experiment through more population cycles). Why might such a large increase in the plant growth rate cause the moose and wolves to go extinct? Provide a biological explanation for your results.

6. Name at least one other factor, besides plant growth rates and wolf populations, that affects moose populations.

Please bring your worksheets to the front desk for lab check-off.

182 13.3C:

Lesson 13, Step 3 Part D: Isle Royale Today

The Ecobeaeker model examined the predator-prey interactions in a “human free” ecosystem. Isle Royale, however, has been impacted by humans, and the results for this unique ecosystem are fairly strong. This section includes an article about Isle Royale published in 2008 by the National Audubon Society and a follow-up column on Isle Royale’s wolves from 2013—you will read these articles and answer related questions on your worksheets.

1. The work done at Isle Royale on predator-prey relationships has provided a baseline for studying wolf-moose interactions in what other places in the world?

2. Explain what is meant by the statement that both wolves and moose are “biological time capsules.” Give examples.
3. What are the two human-related impacts that have had negative impacts on the moose and wolf populations on Isle Royale recently (since the 1980s)?

4. What is YOUR long-term (next 100 years or so) prediction for the moose and wolf populations on Isle Royale? Will they both still be there in 100 years from now? What is your reasoning?

5. What happened to the wolf population in the summer of 2012?

6. What do you think the Park Service should do (with respect to your answer to question 5)?

Please bring your worksheets to the front desk for lab check-off.
182 13.3D:
Step 4: In Class Activity – Intermediate Disturbance Hypothesis

This is the second of three different lab exercises you'll do that use the Simbio Virtual Labs: Ecobeaker, software that simulates ecological processes. To complete this activity, you will need to use the computers in the Biology Learning Center. The Bio 182 EvoBeaker/EcoBeaker manual with instructions for this activity is located on the shelf below Model S (the cat skeleton) in the Biology Learning Center.

Be sure to read the "Introduction" part in your Bio. 182 Ecobeaker notebook. This material is also on the website for this activity.

Lesson 13, Step 4 Part A: Observing Succession

Follow the directions in the Ecobeaker notebook, and answer the questions below:

1. Which of the eight species of plants in this simulation is considered the "climax species"?

2. As successional changes take place, and as taller plants start to grow, the shorter plants die off. Why do the shorter plants die?

3. Describe your observations from running the simulation with the settings described above (number of fires starting each year=1 and chance of fire spreading to neighboring square=0.3.) What is the predominant species of plant?

4. Describe your observations from running the simulation with devastating fires (number of fires starting=20 and chance of fire spreading=0.6.) What is the predominant species of plant (when plants can grow between fires?)?

Please bring your worksheets to the front desk for lab check-off.

182 13.4A:
Lesson 13, Step 4 Part B: Maximizing Species Richness

The Intermediate Disturbance Hypothesis is a theory that says that species diversity will be greatest when the level of disturbance is at an intermediate level. This makes sense, when you think about the species diversity with either NO disturbances or SEVERE disturbances.

1. On your worksheets, make a prediction of the combination of “fires starting” and “fires spreading” that will create an ecosystem with the highest species diversity index.

2. In the table below, document the various combinations you tried and the results of your experiments. Circle the combination that gave you the highest diversity index.

<table>
<thead>
<tr>
<th>Value for:</th>
<th>Resulting diversity index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of fires per year</td>
<td>Chance of fires spreading</td>
</tr>
<tr>
<td>Trial 1</td>
<td></td>
</tr>
<tr>
<td>Trial 2</td>
<td></td>
</tr>
<tr>
<td>Trial 3</td>
<td></td>
</tr>
<tr>
<td>Trial 4</td>
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</tbody>
</table>

Please bring your worksheets to the front desk for lab check-off.

182 13.4B:
Lesson 13, Step 4 Part C: Fire in our Backyard

The Ecobeaker model examined the intermediate disturbance hypothesis in an eastern deciduous forest. The last section of this activity will examine fire in our own ecosystems. This section includes articles from three publications – you will read these articles and answer related questions on your worksheets.

Read the introduction to this section and answer the following question:

1. Why are the mountains near us called Sky Islands?

Read the first article “Fire on the Mountain” and answer the following questions:

2. Name the six ecological zones found in the Sky Island region.

3. Which two of these six ecological zones naturally have fire at least every ten years?

4. Which one of these ecological zones never burns naturally?

The second excerpt is from the U.S. Forest Service’s “Federal Wildland Fire Policy – Executive Summary”. The Forest Service is one of the main public land agencies that deals with wildfires. Read the highlighted sections of this document and answer the following questions:

5. Why does the fire suppression of the last 100 years increase the threat and reality of catastrophic wildfires today?
6. According to the US Forest Service, what is the first priority in wildland fire management?

7. Does the agency support using fire to manage ecosystems?

The third excerpt is from a guest opinion in the _AZ Daily Star_ from Dr. Tom Swetnam, Director of the Laboratory of Tree Ring Research at the University of Arizona. (Tree rings are used to determine natural conditions of trees, including frequencies of fire, before recorded history).

Answer the following question related to Dr. Swetnam’s article:

8. Based upon tree ring evidence, how often does a fire that burned the size of the 2003 Aspen fire on Mt. Lemmon naturally occur?

The last excerpt is from an article in the Arizona-Sonora Desert Museum newsletter from 2011. The article discusses how invasive plant species (particularly buffelgrass) in the Southwest negatively impact low elevation fires in the Sonoran Desert. Answer the following question related to this article:

9. How do grass fires change plant community composition in the Sonoran Desert?

Please bring your worksheets to the front desk for lab check-off.

182 13.4C: