

Lab 3a, 5 Points

Lab 3b, 10 Points

Lab 3c, 10 Points

**Due by 7<sup>th</sup> July, 2005**

### **Biomass and Plant Adaptations**



#### **Objective**

In this laboratory we will explore the difference between standing stock and growth rates, measure biomass of radish plants, and compare the biomass of various plant structures. We will discuss abiotic factors that affect growth rate. Second, we will examine different plant specimens that you identify in your natural areas, and attempt to match plant characteristics (morphology) to their environment.

#### **Overview**

Organisms in a population are affected by a variety of environmental factors. Specifically, a limiting factor is defined by the limiting factor principle which states that too much or too little of any abiotic factor can limit or prevent growth of a population, even if all other factors are at or near optimum range. Some terrestrial limiting factors are temperature, water, light and soil nutrients. Examples of soil nutrients are: nitrogen, phosphorus and potassium. The overall biomass of an ecosystem is directly affected by abiotic factors.

The rate at which an ecosystem's producers convert solar energy into chemical energy as biomass (the total amount of organic matter on earth), is the ecosystem's gross primary productivity (GPP.) In other words, it is the rate at which plants or other producers can use photosynthesis to make more plant materials (biomass.) Productivity varies on a global scale. GPP is generally highest in the shallow waters near continents; rainforests, along coral reefs and

in areas where upwelling currents bring nitrogen and phosphorous from the ocean bottom to the surface.

To survive and prosper primary producers must use some of the total biomass they produce for their own respiration. What is left is called net primary productivity (NPP). NPP is the rate at which energy for use by consumers is stored in new biomass-cells, leaves, roots and stems. It is usually measured in units of the energy or biomass available to consumers ( $\text{kcal/m}^2/\text{yr}$ ).

## **Procedure**

### **Part I (3a)--will be done in two parts on 5<sup>th</sup> and 7<sup>th</sup> July**

Radish seeds were planted during the first week of this quarter in varying soil, nutrient conditions and levels of light.

On July 5<sup>th</sup>:

- Visually compare growth rates for each of the different conditions with the control. Record your observations.
- Record the number of organisms/unit area for a given time (standing stock.)
- Harvest seedlings; try to keep root system intact. Weigh seedlings.

On July 7<sup>th</sup>:

- Dry seedlings.
- Record biomass of the entire plant and then biomass of the individual plant parts (roots, stems and leaves).

### **Assignment for Part I (to be completed in class)**

Please attach all data sheets and answers to the questions. You can submit this as a single group assignment.

### **Questions**

1. Describe the similarities and differences observed between the radish plants grown in the five different physical conditions. What abiotic factor was the most limiting to the growth of the radishes? Each group will be assigned a different growth condition to study and compare with the control.
2. Did your results agree or disagree with your original hypothesis? Explain.
3. Do you think agricultural land is highly productive in comparison to other ecosystems? Why?

### **Part II (3b)**

This lab studies the different patterns of vegetation found in Oregon and the abiotic factors behind them.

Extract a specimen of the dominant plant from your selected natural area in Lab 1.

### **Questions**

- What was your site? Which is the dominant species of your area?

- Record the environmental conditions where your plant was growing: Sunny or shady? What type of soil is there, and how moist is it? How deep is the soil? How steep is the slope?
- What are the characteristic features of the plant that render it suitable to grow in the given abiotic conditions?

Natural Vegetation of Oregon:

### Questions

- What role does climate play in productivity of a given ecosystem?
- How does topography affect Oregon's climate? What is the difference between weather and climate?
- How would you classify Oregon in terms of a biome?

## Part III (3c)

### Net Primary Productivity

#### Objective

To compare two different habitats for non quantitative net primary productivity measurements.

#### Procedure

Choose two sites from the natural area handout you received during Lab 1b.

Prior to arriving at your chosen sites, you must:

1. Visit the website <http://earthobservatory.nasa.gov/Study/Modeling/npp.html> to view NPP for a specific time period. Record when NPP is highest in Oregon and note the time of year you are assessing your sites (what is Oregon's NPP at this time of the year?)
2. Record your hypothesis on which environment of the two natural areas you selected will be most productive and why. (Think of what type of vegetation you are likely to encounter—do you think an open field is as productive as a heavily forested area?)
3. Compile a list of all the abiotic factors you will encounter.

When you visit your sites, record your observations on primary productivity in conjunction with abiotic factors. Although you cannot measure the biomass, try to assess if your sites are high or low in biomass.

### Questions

- Which site do you think has the highest NPP and why?
- If you were going to plant a crop which site would you choose and why?
- For each site, compare the mean NPP from the data set below and try to estimate where your sites fit (within any or, maybe, in between two Groupings?)

- List one essential nutrient and give a brief overview of how it is cycled through one of your sites. (This is often illustrated as a drawing, which you may choose to do to answer this question.

Helpful Information for non-quantitative measure of productivity

Of the Earth's various biomes, tropical rainforests and coniferous forests are the most efficient converting between 1% to 3% of the usable solar radiation into biomass. Deciduous forests achieve photosynthetic efficiencies between 0.5% to 1%. The desert biome has the lowest efficiency of solar radiation use. The plants in this biome convert only 0.01% to 0.2% of the photosynthetically active radiation to biomass. \*\*Think about this when you are estimating primary productivity at your sites.

'Net Primary Productivity' (NPP) is defined as the net flux of carbon from the atmosphere into green plants per unit time. NPP refers to a rate process i.e. the amount of vegetable matter produced per day, week, or year and is often reported in units of 'grams of biomass created per square meter per year' ( $\text{g/m}^2/\text{yr}$ ). Note that the given website measures NPP *per day* and the table below *per year*.

Variable	Value	Grouping	Source
Above Ground Net Primary Productivity-C	236 $\text{g/m}^2/\text{yr}$	Max	Law et al 2001
Above Ground Net Primary Productivity-C	76 $\text{g/m}^2/\text{yr}$	Min	Law et al 2001
Above Ground Net Primary Productivity-C	<b>158 <math>\text{g/m}^2/\text{yr}</math></b>	<b>Mean</b>	Law et al 2001

Include the following points in your report

**3a**

Given conditions (0.5)

Expected results (1)

Qualitative observation in comparison to control (1)

Data sheet (standing stock and weight record) (1)

Questions (0.5x3)

**3b**

Purpose of assignment (1)

Questions: See above (1.5x6)

### **3c**

Purpose of assignment (1)

Questions (2x4)

Overall Presentation (incl 3a, 3b and 3c):

Proper heading and subheadings (0.5)

Grammar, spelling, complete sentences (0.25)

Organization (0.25)

Reports submitted without your name, class, subject and date will not be accepted.

#### **Internet Activity for the day:**

In-class group assignment:

To explore the natural vegetation of Oregon we shall look at some of the national parks within the State.

#### Group 1: Willamette National Forest

- Where in Oregon is it located? Provide some interesting facts and figures about the forest.
- Why was this region declared a National Forest? Who is the responsible authority for this Park?
- What is the primary vegetation around the region? How can you relate this with the abiotic/climatic conditions of Western Oregon?
- How does it serve as a natural resource for humankind?
- In your opinion, what is the type of biome that characterizes this National Forest and why?

#### Group 2: Ochoco National Forests and Crooked River National Grassland

- Where in Oregon is it located? Provide some interesting facts and figures about the forest.
- Why was this region declared a National Forest? Who is the responsible authority for this Park?
- What type of habitat characterizes these forests? Why is it important to maintain the grasslands?
- In your opinion, what is the type of biome that characterizes this National Forest and why?

- Crooked River Ranch Fire Department and Crooked River National Grassland officials are seeking public comment on a proposal to cut brush and small trees on 200 acres of federal land to reduce brush and woody debris that can feed wildland fires. Would you lend support to this proposal?

#### Group 3: Malheur National Forest

- Where in Oregon is it located? Provide some interesting facts and figures about the forest.
- Why was this region declared a National Forest? Who is the responsible authority for this Park?
- What type of habitat characterizes these forests? What are the climatic conditions primarily responsible for this?
- How does the forest serve humans?
- What is the issue regarding the 2002 High Roberts Fire?

#### Group 4: Umatilla National Forest

- Where in Oregon is it located? Provide some interesting facts and figures about the forest.
- Why was this region declared a National Forest? Who is the responsible authority for this Park?
- What kind of habitat characterizes this forest and what can you deduce about the wildlife of the region from this information?
- What are the benefits of frequent forest fires in the National forest and why were they suppressed in earlier foresters?

#### Group 5: Crater Lake National Park

- Where in Oregon is it located? Provide some interesting facts and figures about the lake.
- Why was this region declared a National Park? Who is the responsible authority for this Park?
- Give a brief geologic history of the place.
- What is the primary vegetation around the region? How can you relate this with the abiotic conditions of the region?
- Why is the Crater Lake so blue?
- In your opinion, what is the type of biome that would characterize this National Park and why?