BIOL 466: Terrestrial Ecosystems
Writing Assignment #2
Spring 2005

Due: Wednesday, February 23, 2005

This assignment is based on **Beedlow, P.A., et al., "Rising atmospheric CO_2 and carbon sequestration in forests" (Frontiers in Ecology and Environment 2(6): 315-322 [2004]).** Environmental biologists are concerned about anthropogenic increases in atmospheric CO_2 concentration, and the climate change that this may cause. Increasing CO_2 concentration in the atmosphere around plants or trees increases, however, the rate of photosynthesis by increasing CO_2 uptake and its interaction with rubisco; this is particularly true in C_3 plants, which make up most of forest tree species. This proposed increase in productivity in response to increased CO_2 has been dubbed the "fertilization effect." Some ecosystem modelers have incorporated this fertilization effect to predict that increased productivity by terrestrial ecosystems, especially in northern hemisphere forests, will be enough to absorb excess atmospheric CO_2 and to store it in the woody material of standing forests, thus reducing effects of CO_2 on climate.

This review article, however, discusses factors that can ameliorate or even reverse the fertilization effect. The basic thesis of the authors is that increased productivity of terrestrial ecosystems will not be enough to absorb excess atmospheric CO_2, and that human societies must remain conscious of CO_2 production and its potential effects.

1. You are an environmental biologist who has been contacted by the St. Louis Post-Dispatch to summarize the major features of the authors' arguments. You are to prepare a press release of no more than three pages, double-spaced, typed, 1-inch margins which:
   (a) explains the fertilization effect;
   (b) summarizes and explains the three major factors that the authors identify as being important in negating the fertilization effect; and
   (c) summarizes and explains what the authors feel to be the most important component to forested ecosystems that should be managed and protected, given that the fertilization effect will not likely be very strong.

* Things to consider: this must be in your own words; you may not quote directly from the article or any other source. Write your press release to a member of the general public (i.e., staff at the Post-Dispatch are not environmental biologists!). If the reporter did not understand the Beedlow et al. article to begin with, then s/he will certainly not understand your press release if you simply quote from the article.

Far more fun and excitement on the back ☞ ☞ ☞ ☞ ☞ ☞

2. Create a compartment model in the style of Figs. 4.1, 11.1, and 3.1 from your text and Fig. 3 from the article. This compartment model needs to show the pools of carbon in a typical forested ecosystem, including the major factors that the authors identify in their article as having important impacts on the fertilization effect. Your model must include the following pools and show diagrammatically how they are related:

CO_2	Leaf litter
Leaves	Woody litter
Woody tissue (branches, stems, trunks)	Root litter
Flowers/Fruits	Soil organic matter
Fine roots	Coarse roots

However, your model must also include the following pools and their relationships with each other and those above, as discussed in the article:

Organic nitrogen as naturally fixed in an ecosystem	Ozone
	Insect pests*
Fertilizer nitrogen	Calcium
Pollution nitrogen	Magnesium

You need to make four versions of this model:

(a) Show a typical forested ecosystem as it would appear today under current conditions. Then, make three photocopies of this model, and modify the photocopies to show:

(b) what would happen under conditions of heightened CO2 concentrations;
(c) what would happen under conditions of excessive nitrogen deposition; and
(d) what would happen under conditions of excessive ozone deposition.*

* For guidance on what happens to insect pests in the presence of heightened CO_2 and ozone concentrations, find the paper by Percy et al. 2002 in the "References" section of the article.

Simple way of thinking about this assignment: you're just summarizing this article twice: once in a short, press release-style summary, and then graphically.

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Grading Sheet for Writing Assignment #2

Name: _____ **Score:** _____ / 80

#1. Press Release

a. Explanation of fertilization effect:

Increased CO_2 reduces oxygen competition for rubisco	_____ / 1.5
Increased CO2 allows stomata to close reducing water loss	_____ / 1.5
Both phenomena should increase primary productivity, growth of trees and sequestration of carbon	_____ / 1.5

Clarity ___ / 1 Grammar ___ / 1

b. Three factors ameliorating fertilization effect:

[N] Increased growth must be supported by available N	_____ / 1.5
[N] Sequestering carbon requires sequestering some N	_____ / 1.5
[N] Typically very few forested sites have enough N	_____ / 1.5
[P] Excess N can bind with and leach calcium and magnesium	_____ / 1.5
[P] Increased ozone increases foliage mortality	_____ / 1.5
[P] Increased ozone can increase insect pest damage	_____ / 1.5
[R] Increased CO2 tends to result in increased production of labile structures, not refractory structures	_____ / 1.5

Clarity ___ / 1 Grammar ___ / 1

c. Important management component:

Long-term C storage pools already present must be maintained	_____ / 1.5
Large branches, trunks, and existing litter layer	_____ / 1.5
Carbon stored in soils	_____ / 1.5

Clarity ___ / 1 Grammar ___ / 1

#2. Compartment Models

a. Components present with correct inter-relationships (0.5 ea.):

CO_2	Leaf litter	Leaves
Woody litter	Woody tissue	Root litter
Flowers/Fruits	Soil organic matter	Fine roots
Coarse roots	Organic nitrogen	Ozone
Insect pests	Fertilizer nitrogen	Calcium
Pollution nitrogen	Magnesium	

Clarity _____ / 1.5

b. Modification for increased CO2:

Increased allocation to leaves	_____ / 1
Increased allocation to fine roots	_____ / 1
Increased pathway to soil decomposers	_____ / 1

c. Modification for increased N deposition:

Scavenging of calcium and magnesium	_____ / 0.5

d. Modification for increased ozone:

Increased foliage pathway to litter/decomposer pool	_____ / 0.5
Increased pathway to insect pests/consumers	_____ / 0.5