MONT 102N – Modeling the Environment
Information on Midterm Exam
October 21, 2011

General Information and Groundrules

As announced in class and on the revised course schedule online, the midterm exam for our Montserrat seminar will be given in class on Friday, October 28.

- This will be a full period, individual exam. No sharing of information in any form will be permitted during the exam.
- You may use a calculator during the exam, but no other electronic devices.
- There will be three or four mathematical problems (each possibly with a few separate parts). These questions will be similar to things you have seen on the problem sets or the group projects. Some sample exam questions are given later in this document.
- The exam will also include an essay question on a set topic chosen from the topics listed below. This part of the exam should take you about 15 minutes, so it will be necessary to spend some of your preparation time on deciding what you want to say for each topic.

Possible Essay Topics

1. Exactly what does Jared Diamond mean by a "collapse" and what are the five factors he identifies as the major contributors to the collapses he studies. Describe *one* of those collapses (your choice) in a general way and indicate which of the five factors were involved in that particular case.
2. How important are a society's leaders in determining the success or failure (ecological or otherwise) of a civilization? To what extend did bad leadership contribute to the collapse of Easter Island or the Classic Maya (choose one)? Do you think representative democracies (like the U.S. or almost all European countries today) are less, more, or equally vulnerable to collapses, as compared with those societies of the past?
3. What does Diamond say about the role of a society's values in its vulnerability to a collapse. Give an example that illustrate cases where those values led to collapse and another where they fostered long term success. In each case, exactly how did those values contribute to the outcome?

Sample Mathematical Questions

A. (Refer to the tables on pages 6 - 8; something like those would be supplied for your use on a question like this.)

1. A committee on rail freight transport recommends increasing the mass that can be carried in a trailer from 42 to 46 tonnes. How much are these masses in kilograms? In pounds?

2. About 24 million liters of rainwater are discharged by a storm drain into a river. The concentration of toxic arsenic in the rainwater averages 170 micrograms of arsenic per liter. How many kilograms of arsenic are discharged into the river each year.

B. In 2002, 10731 species were listed on the World Conservation Union "red list" of endangered species. In 2004, the corresponding number was 15042.

1. What was the ratio of the size of the 2004 list to the size of the 2002 list?
2. What was the percentage increase in the size of the list from 2002 to 2004?
3. It is not known exactly how many species of plants and animals there are on the Earth today. But say that number is estimated as 12 million. What percentage of that total number appeared on the red list in each year?

C. The following table gives several African countries, their total forest areas, and their areas of legally protected forests (in square kilometers)

Country	Total	Protected
Cameroon	289965	17845
Congo	278979	12935
Gabon	239369	8975
Zaire	1439178	93160

1. Which country has the largest protected forest area?
2. Which country has the largest percentage of protected forest?

D. A cubic meter of air has a mass of about 1.25 kg. About 2 mg of that mass is methane. What is the mass concentration of methane in air, expressed in parts per million?

E. The US EPA Toxic Release Inventory for 2000 includes the following information:

State	Toxics (in 10^6lb)
Nevada	1000
Utah	956
Arizona	744
Alaska	535
Texas	302

1. Construct a bar chart showing this information. Label your vertical axis.
2. Construct pie chart showing the portions of the total toxics from these five states that each state contributes.
3. Which state or states is approximately "twice as toxic" as Alaska.

F. Look at the plot in Figure 3-28 on page 71 of the text, which shows the gray wolf population in Wisconsin from 1980 to 2002.

1. Note that the portion of the graph representing the years 1980 to 1992 looks quite linear. Estimate a linear model for this period by using the line through the two points $(1980, 50)$ and $(1990, 60)$. (Determine the equation of the line through those points.)
2. Do the same for the period 1993-2002 using the two points $(1993, 70)$ and $(2002, 325)$.
3. What are the slopes of these two lines? What are the units of the slope and what do they represent in real world terms?
4. The graph on the following sheet shows the least squares regression line for the whole data set, together with the computed slope and intercept values for the regression line. Which method seems superior in this case – using two different lines for different time periods, or one regression line for the whole time? Explain how you are making this decision.