Ecological Problem Solving

FW 364

Assignment 2

**Due: 2 weeks from date assigned**

**Learning objectives**: In this lab, we will learn how to create a conceptual model of an ecological system (an aquatic food chain), apply mass balance concepts, recognize and document hidden assumptions, and practice the simple algebra needed to solve mass-balance problems.

Although no one has ever found a live or dead specimen, nor a body part, some people insist that there are monsters in Loch Ness lake, a large, deep and murky lake in Scotland. One argument proposed to explain why no monsters have ever been collected postulates that monsters are extremely rare in Loch Ness, making their detection difficult. You have been hired by LOONI (League Of Objective Nessie Investigators) to determine the validity of this argument because of your expertise in ecosystem analysis. Given **mass balance** considerations and the following information, come up with a **range of estimates** for the total number of individuals of this elusive species in the lake (**constructing a table of estimates will be helpful**). You will, of course, need to make assumptions in order to make your estimates, so be sure to state your assumptions explicitly and clearly. As a start you can assume, based on other aquatic food webs, that there must be **at least** 2 trophic levels between phytoplankton (the principal plants in Loch Ness) and predatory monsters, and that the net production of a trophic level is typically about 10% of the net production of the trophic level below it. Be sure to show all your work and watch the units.

1. Surface area of Loch Ness lake: 57 km2.

2. Total phosphorus concentration (TP) in Loch Ness: ≤ 10mg/m3 (source: Maitland 1981).

3. Empirical relationship between TP (mg/m3) and net phytoplankton production (gC/m2/yr) from lakes around the world (source: Schindler 1978):

log10NPP = 0.83(log10[TP]) + 0.56. equation 1

4. Relationships between turnover time (T, days) and mass (W, g) for different kinds of organisms (source: Banse and Mosher 1980):

for fish: T = 133(W0.28) equation 2

for mammals: T = 32(W0.33) equation 3

5. Average carbon content of animals: 5% by mass.

6. Average mass of an adult elephant: 4000 kg (for a frame of reference).

**For your first combination of assumptions (in class), please assume two trophic levels between phytoplankton and the monster, assume the monster is a fish, and that its average mass is that of an elephant.**

*References*

Banse, K., and S. Mosher. 1980. Adult body mass and annual production/biomass relationships of field populations. Ecological Monographs 50:355-379.

Maitland, P. S. 1981. The ecology of Scotland's largest lochs, Dr. W. Junk, London, UK.

Schindler, D. W. 1978. Factors regulating phytoplankton production and standing crop in the world's freshwaters. Limnology and Oceanography 23:478-486.

Sheldon, R. W., and S. R. Kerr. 1972. The population density of monsters in Loch Ness. Limnology and Oceanography 17:796-797.