Quiz Questions—Week 7 Key

Forests Through Time and Space

1. *Annual leaf fall in a particular Tennessee forest has been measured to deliver 1370 g leaf biomass per m^2 to the soil surface. These leaves are decomposed by a mixed population of bacteria and fungi with an average C/N ratio of 8/1 and an efficiency (microbial yield efficiency) of 0.4 (40%). The leaves are 50% carbon and the C/N ratio is 30/1. Will nitrogen will be immobilized or mineralized? How much nitrogen will be added or removed per m^2?*

The solution to this problem requires you to calculate the amount of carbon and nitrogen in the fallen leaves that are decomposed, then calculate how much carbon will be incorporated into the microbial biomass and how much nitrogen will be needed by the microbes to incorporate this amount of carbon. Comparing the amount of nitrogen in the leaves with the amount needed by the microbes will determine if there is excess nitrogen in the leaves (mineralization) or if there is insufficient nitrogen, in which case the microbes will take it all and some from the soil (immobilization).

The amount of carbon in the fallen leaves is 50% of their biomass or 0.5 x 1370 = 685 g of C. Use the C/N ratio of the leaves to calculate the amount of nitrogen, 685 g C x 1N/30C= 22.8 g N.

The amount of C taken up by the microbes is the total C in the leaves times the efficiency of the microbes (40%). This means that they incorporate 40% of the carbon they decompose. 685 g C x 40% = 274 g C. the amount of nitrogen needed by the microbes is calculated using the C/N ratio of the microbes, 274 g C x 1N/8C = 34.25 g N needed.

The amount of N needed (34.25 g N) exceeds the amount in the leaves (22.8 g N), so there will be immobilization of nitrogen and nitrogen will be removed from the surface soil/organic matter (11.45 g N) to make up the difference.

2. *In the PNW, clear cuts are often favored by wildlife managers to increase deer and elk populations. However, the attractiveness of clear cuts to large herbivores declines over time. Describe the type of succession that happens and outline the successional sequence that occurs. Give examples of plants that might be found in this sequence if the clear cut was in Evergreen's forest between campus and the Organic Farm.*

To receive full credit, you must have identified this type of succession as secondary succession. The plants listed below are not the only examples of a possible plant sequence. The successional sequence is rapid growth and colonization by early succession stage plants, primarily herbaceous plants and shrubs that either were already on the site or able to get there quickly (e.g. bracken fern, sword fern, salal, evergreen huckleberry, red huckleberry). Invasion by nitrogen-fixing scotch broom is also likely. Mid-stage species and growth of saplings that may have already been on site (e.g. alder, big-leaf maple, Indian plum. cascara) will slowly take over and out compete the early colonizers. Regeneration of the overstory trees may happen quickly if seedlings were already present or more slowly if they need to be seeded. Finally, overstory trees, such as Doug fir, western red cedar, and western hemlock will begin to dominate and close the canopy, with an understory of sword fern, salal, and occasional red and evergreen huckleberries.

After reading your answers and rereading the question, it was obvious that there should have been a Why? after the second sentence. But you aren't mind-readers, so you get full credit for fully addressing the succession. Herbivory is often highest in early to mid-stage succession because rapidly growing early successional plants have high nitrogen contents and a relatively low allocation to plant defense. As competition for nutrients increases during succession, plants allocate more energy to defense compounds/strategies (e.g. production of pitch in conifers and anti-herbivory compounds in needles). In addition, as growth in the shrub layer declines, plant tissues become less palatable to large herbivores