FW 364: Ecological Problem Solving

Assignment 7 (two pages)

**Due: Nov. 12**

**Learning objectives**: In this lab, we apply the Leslie matrix again. This lab reinforces the distinction between age and stage structure, the former being a special case of the latter. We use a demographic model to make decisions about the management of a threatened species.

In this exercise, we will use a stage-structured model of the threatened loggerhead turtle population to evaluate two alternative conservation strategies. Loggerhead turtles are difficult to age, so the turtles must be modeled by classifying individuals into stages. We will use five stages: hatchlings, small juveniles, large juveniles, subadults (i.e., small adults), and adults. Hatchlings grow fast and have relatively low survival, while older turtles grow slowly and, therefore, have a high probability of remaining in a particular stage from one year to the next. Fecundity is strongly related to turtle size, with adults producing more than 10 times the number of offspring per year than subadults.

**Part A: Baseline turtle population**

We will create a stage-structured model of the loggerhead population using the following Leslie (stage) matrix:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 0 | 0 | 0 | 4.665 | 61.896 |
| 0.675 | 0.703 | 0 | 0 | 0 |
| 0 | 0.047 | 0.657 | 0 | 0 |
| 0 | 0 | 0.019 | 0.682 | 0 |
| 0 | 0 | 0 | 0.061 | 0.8091 |

Use an initial abundance of 100,000 turtles, distributed among stages as 30,000 hatchlings, 50,000 small juveniles, 18,000 large juveniles, and 2,000 subadults (no adults). Run a 20 year simulation. From this simulation, record the final population size of turtles. This information provides a no-management baseline for the analysis in Part B.

**Part B: Comparison of turtle conservation strategies**

Two management strategies have been used in an attempt to prevent further decline of the loggerhead population. First, shrimp fishermen have been required to include turtle excluder devices (TEDs) on their nets, which reduce the incidental mortality of subadult and adult turtles from shrimp fishing. Increasing all three survival rates (i.e., within and between stage rates) of subadult and adult turtles by 1% costs fishermen about $10,000. The second strategy is to increase turtle fecundity by protecting nesting beaches and transplanting eggs to hatcheries. Increasing both fecundity rates (adults and subadults) by 1% costs the taxpayer about $2,500. Determine which strategy is more effective per dollar expended by testing a range of management expenditures for each strategy (see excel file). As in Part A, run 20 year simulations, and use the same initial abundance. Record your findings in the summary data sheet in the excel file to make a graph using the template, as well as make a recommendation about which strategy you would recommend to policy makers.