Modeling the Spotted Owl Population

Late in the twentieth century, environmentalists raised concerns about possible extinction of the northern spotted owl, whose primary habitat was the old-growth forests in the Pacific Northwest. In an attempt to understand the issues, mathematical ecologists collected data on owl populations in order to formulate mathematical models of the population dynamics. Such models fit the past data fairly well and are then used to predict future populations, and/or identify possible causes of population growth or decline. Typically, such models assume a 1:1 ratio of males to females and count only the females in various life stages at each year.

In this investigation, you will examine one possible model. This model will consider adult and juvenile female northern spotted owls each year. Let:

- k represent time(measured in years)from the beginning of the observation period;
- a_k represent the population of adult female northern spotted owls at year k; and
- j_k represent the population of female juveniles at year k.

According to the model based on the collected data:

- The average birth rate per adult female is 66%, of which 50% are female. Thus, in any year, the number of juvenile females is about 33% of the number of adult females the previous year.
- 60% of the juvenile females survive to become adults the next year.
- 78% of the adult females survive to the next year.

Using this model, assume that in 1990 (Year 0), there were 1000 adult female owls and 310 juveniles (so $a_0 = 1000$ and $j_0 = 310$).

1. How many adult females should there have been in 1991? How many juvenile females?

2. How many adult females should there have been in 1992? How many juvenile females?

3. How many adult females should there have been in 1993? How many juvenile females?

4. How many adult females should there be in 2010? How many juvenile females?

5. How much fun did you have doing the last calculation?

6. What evidence is there that the population is heading for extinction? How long do you think it will take?

7. What do you think could be done to head off extinction?