Orchid PVA Computer Lab

Orchid, western prairie fringed (WPFO)
Platanthera praeclara
Family: Orchidaceae
Group: Flowering Plants

Status:
On September 28, 1989, the Western prairie fringed orchid was designated as Threatened in the entire range. Within the area covered by this listing, this species is known to occur in: **Iowa, Kansas, Minnesota, Missouri, North Dakota, Nebraska, Oklahoma; Canada (Man.)**.

Background information:
Western prairie fringed orchid is a wetland species once locally common west of the Mississippi River in tallgrass prairie. >80% of the original prairie has been converted to agriculture or developed, and many wetlands have been drained. The WPFO is gone from 75% of counties in which it was originally documented. A few areas are managed for WPFO protection, but in most places orchids grow where there are multiple uses (hay meadow, nearby row crops, burning, draining).

Life history:
The **Western prairie fringed orchid** is a perennial, surviving from one year to another as an underground stem. In any given year a living plant can be dormant (stay underground as a stem), vegetative (non-flowering, <15cm tall) or flowering (up to 1.2 m tall). Plants can go back and forth between these three states (e.g. flowering one year, dormant the next etc.) or remain in a given state for several years. To produce seed, a flower must be pollinated, probably by sphinx moths. In a given year seeds can either germinate to produce a seedling, stay a seed, or die. Seedlings either become vegetative or flowering in the next year, or die. New plants may grow for many years before producing flowers.

Your task:
Take the information provided above, and carry out a population viability analysis for the WPFO. You should use this analysis to

a) describe the current state of the population (growing or shrinking),
b) predict the future trend in population size and time to extinction
c) determine which stages of the orchid's life history should be targeted for management intervention
d) recommend one of several management options based on your analysis.

Your report on this computer lab is **due Friday (10-15-04)**. You should turn in answers to all highlighted questions (on a color printer the highlight is yellow and/or **bold**) below, and print-outs or hand-drawn versions of all graphs specified (**highlighted**) below.

Instructions:

Draw a life-cycle diagram for the WPFO:
Start by listing the stages to be included in your model.
Draw the diagram, including arrows for the possible transitions between stages.
Now enter your diagram into Populus (don't worry about transition values yet).
Include a drawing (by hand or from Populus) of your life-cycle diagram in your report.

Briefly describe how you might collect the data you need to build your model.

Calculating transition values:

You have data available in a separate file (return to coursedocs and click on link).
Use the data to determine the average probability that a vegetative plant observed in one year will flower in the next year.
Calculate the number of viable seeds produced per flowering plant.

Fill in all the transition values on your life-cycle diagram in Populus, and assign initial numbers of plants in each stage.

Examine your projection matrix and initial stage distribution vector to make sure they include the right numbers.
Include the projection matrix and initial stage distribution vector in your report.

Determine current status

Is the population growing or shrinking? To support your conclusion, provide the lambda for the first year (current lambda).
Is the population at its stable stage distribution? How can you tell? Choose and provide an appropriate graph to support your answer.
Can you always infer the long-term behavior of a population based on only a few years of calculating lambda as N_{t+1}/N_t? Why or why not?

Determine future status
What will this population do in the future? To support your conclusion, provide the long-term average lambda.
Choose a quasi-extinction threshold (minimum population size you will tolerate).
If the population will go quasi-extinct, roughly how long will that take? Provide a graph of total number in the population over time (long enough to show extinction if it is expected) to support your conclusion. Hint: you can overlay a grid on your graphs using the "options" menu at the top of the graph page.

Determine which life-stages should be targeted for management

Calculate and report the survival elasticity for each life stage (i.e. for each stage in turn change all elements except fecundity by 5% and calculate the elasticity). Recall that

$$E_{r_i} = \frac{\frac{\lambda_{new} - \lambda_{original}}{\lambda_{original}}}{\frac{r_{i,new} - r_{i,original}}{r_{i,original}}}$$

elasticity is calculated as:

Also calculate and report the elasticity for fecundity.
Which stage(s) should be the focus of management?

Management options

There is pressure from local citizens to make use of the areas where the WPFO grows. For example,

1. Use the field as a hay field, which means mowing each year. This results in cutting leaves off of plants, which decreases flowering and vegetative plant survival.
2. Allow spraying of nearby crops with insecticides to reduce agricultural pests, knowing that these sprays will reduce the number of pollinating moths (moths are killed by the insecticide).
3. Drain the field, which will dry out the soil and reduce seed viability and the chances of seed germination.

Which of the above management options seems least harmful to the WPFO? Provide data from your analysis to back up your recommendation.

How might you deal with conflicts that could arise with citizens whose activities might have to be curtailed (e.g. if you chose to allow spraying but not haying)?

What are some possible weaknesses of the model you used for this PVA, and how might they affect your conclusions?

What additional data or analyses might allow you to make a better recommendation for management of this species?

(Spring 2004 Nora Underwood, edited Fall 2004 Peter Beerli)