

# Population Ecology: The Ragwort Plant and Its Seeds

In a text on *Population Ecology*, Begon (1996, p. 7) describes the Ragwort, *Senecio jacobaea*, a biennial plant which generates around 5,000 seeds per year when in the flowering stage. When a seedling is established, the plant spends about one year forming a rosette of leaves. In the second year, the adult plant forms a flowering stem. Observations in a sand dune environment in the Netherlands provide a numerical example with around 1 adult plant and 4 young plants spread over ten square meters.

## The Model

An equilibrium diagram of a ragwort model is shown in Figure 1. Some of the assumptions are close to the numerical example by Begon, but information on the fate of the seeds is quite limited. This model extends Begon's example by assuming that system is in equilibrium with 20,000 seeds in the surface bank and an equal number in the buried bank. Begon suggests that around 1% of the surface seeds germinate each year. Let's assume that 80% of the surface seeds become buried each year, and the remainder is lost due to wind, animals and decay. Seeds in the buried bank may return to the surface or decay. Resurfacing occurs at the rate of 60%/yr; decay is based on a 5 year persistence time, so it occurs at the rate of 20%/yr.

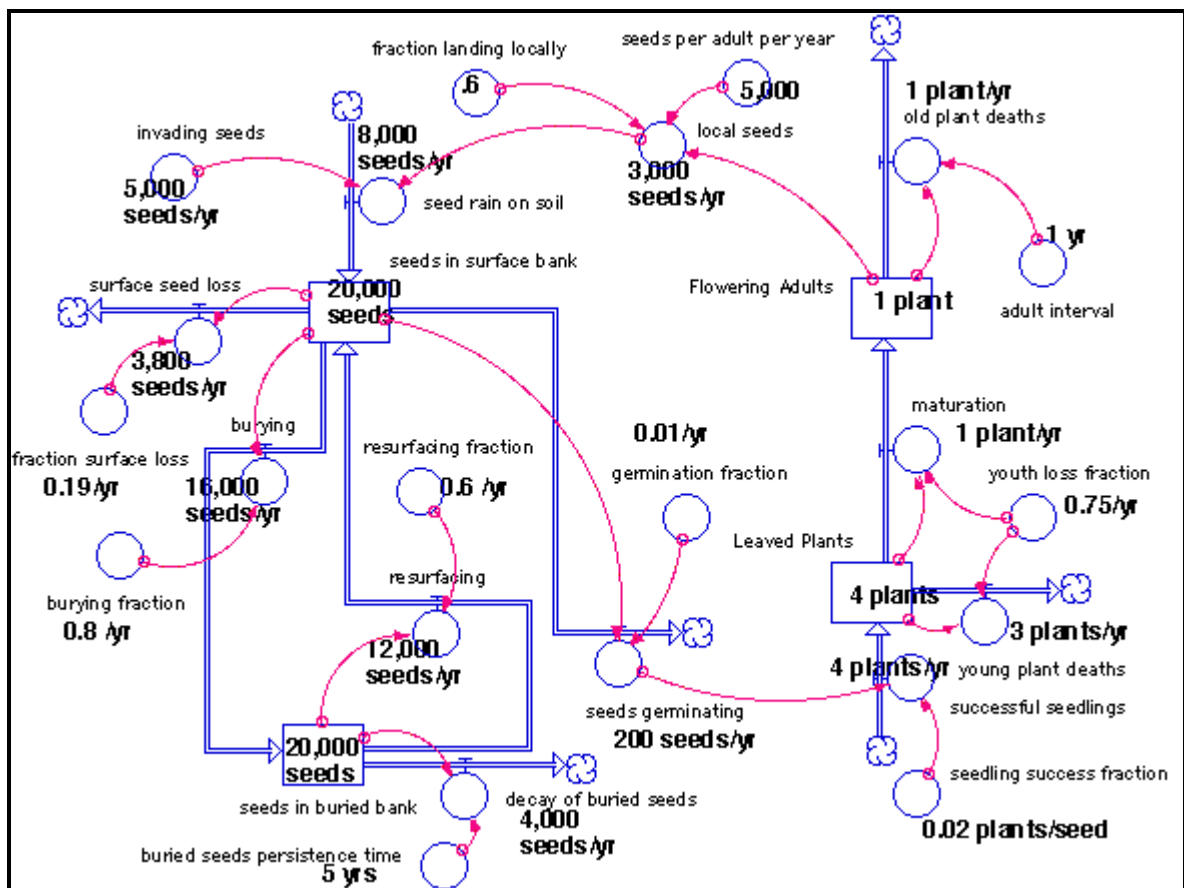


Figure 1. Equilibrium diagram for an adaptation of Begon's model of the Ragwort plant.

Figure 1 shows 1 adult plant which produces 5,000 seeds per year. If 60% land in the test area, we would get 3,000 local seeds. The flow "seed rain on the soil" is the combination of the local seeds and 5,000 invading seeds which also land in the test area. (Begon does not comment on the number of invading seeds, so let's simply assume that the test area is well positioned to receive seeds from upwind plants.) This information is sufficient for you to complete the following exercises.

## **Exercises**

### 1. Verification:

Build the model in Figure 1 and simulate it to verify the results in the equilibrium diagram.

### 2. Stability Test:

Introduce a disturbance flow to add additional young plants in a test year. Do you expect the test to show that the equilibrium is stable or unstable? Run the test and describe what you see.

### 3. Importance of the "Buried Seeds Persistence Time"

Begon does not describe the persistence time for the buried seeds. Conduct a sensitivity analysis with values of the persistence time ranging from a low of 1 year to a high of 9 years.

With a 1-year persistence time, the number of flowering adults should decline to around 0.5 adults per ten square meters within a decade.

With the 9-year persistence time, they should grow to around 1.4 adults per ten square meters. (Be sure to let the simulation run 30 or 40 years to allow the system to reach equilibrium in this situation.)