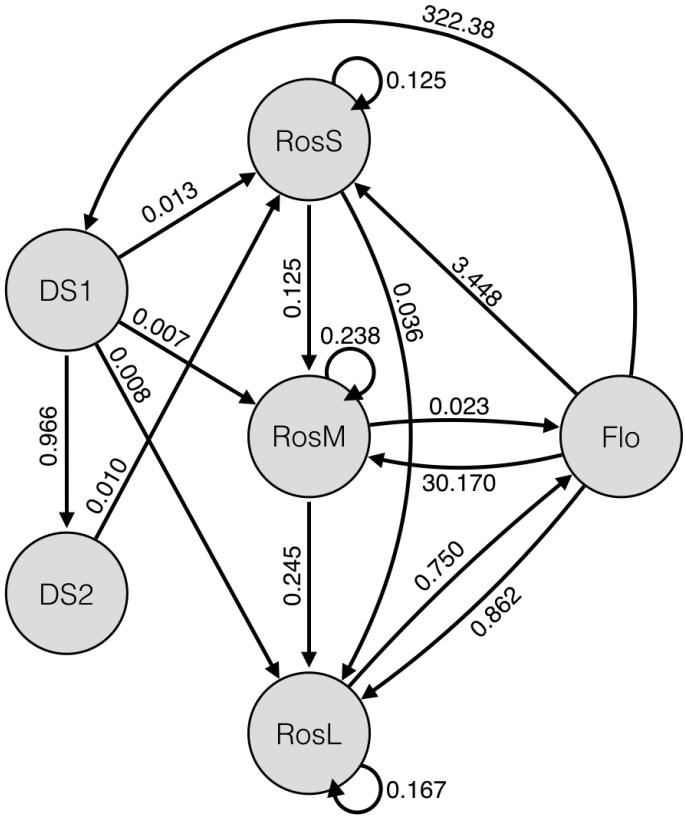
Name: _____

Structured Population Models—Exercise 1

Natural history and life cycle of teasel (*Dipsacus sylvestris*)

Below is the life cycle diagram for a population of the perennial, monocarpic plant teasel. The life cycle consists of six stages: (i) first-year dormant seeds, (ii) second-year dormant seeds, (iii) small rosettes, (iv) medium rosettes, (v) large rosettes, and (vi) flowering plants. Plants can grow to larger sizes or shrink to smaller size. Plants only reproduce when they are flowering through seeds—there is no vegetative or clonal reproduction. Plants flower only once and die shortly after dispersing their seeds.



a. Convert the life cycle diagram into a stage-structured matrix population model, and calculate the stage-specific survival rates.

U – Survival & growth

Time t+1 \ Time t	DS1	DS2	RosS	RosM	RosL	Flo
DS1						
DS2						
RosS						
RosM						
RosL						
Flo						

Survival						

F – Fertility

Time t+1 \ Time t	DS1	DS2	RosS	RosM	RosL	Flo
DS1						
DS2						
RosS						
RosM						
RosL						
Flo						

C – Clonality

Time t+1 \ Time t	DS1	DS2	RosS	RosM	RosL	Flo
DS1						
DS2						
RosS						
RosM						
RosL						
Flo						

A – Projection matrix

Time t+1 \ Time t	DS1	DS2	RosS	RosM	RosL	Flo
DS1						
DS2						
RosS						
RosM						
RosL						
Flo						

Suppose a new population is started (time=0) with 50 first-year dormant seeds and 50 second-year dormant seeds ($N_{DS1}=N_{DS2}=50$).

b. What is the total population size (N) at <u>time=15</u>?

c. What is the equilibrium population growth rate (λ)?

d. What is the equilibrium population size structure (w)?

Stage	Proportion
DS1	
DS2	
RosS	
RosM	
RosL	
Flo	

Assignment:

This matrix model for teasel was constructed in the United States, where teasel is invasive. Propose and evaluate an intervention to reduce the population growth of this species. The intervention strategy can use one or more mechanical, chemical, or biological controls. Please include:

i) A brief description of the intervention.

ii) Matrices (**A=U+F+C**) for a teasel population under the intervention with modified transition rates. The transition rates that are changed by the intervention should be indicated.

iii) A comparison of equilibrium population growth rates, $\lambda_{control}$ and $\lambda_{intervention}$. Do you predict that the intervention will drive the teasel population to extinction?

Submit your assignment as a Word, PDF, or similar file format by email to will.petry@usys.ethz.ch by 17:00 on Monday 1 May.