1: Monitoring Overview

Session Objectives

- Distinguish *Adaptive Management* monitoring from other similar data-gathering activities.
- Identify the key steps in designing and implementing a monitoring program.
- Draft and critique an ecological model.

Session Outline

Adaptive management
Other data-gathering activities
The monitoring process in a nutshell
Ecological models to support Adaptive Management monitoring

In this section of the binder

1.1 Monitoring Definition
1.2 Adaptive Monitoring Cycle Diagram
1.3 Not Quite Monitoring Descriptions
1.4 Monitoring *vs.* Research
Adaptive Monitoring Cycle Diagram *(revisited)*
1.5 AMC Monitoring in a Nutshell
1.6 What is an Ecological Model?
Example of an Ecological Model
1.7 A Few Good Reasons to Create an Ecological Model
1.8 Some Additional Examples of Ecological Models
1.9 Common Misconceptions about Creating Ecological Models
1.10 Steps in Drafting an Ecological Model

Exercise *1a:* Proposed 'Monitoring' Projects
Exercise *1b:* AMC Monitoring in a Nutshell
Exercise *1c:* Draft an Ecological Model

Related technical reference chapters and appendices

Chapter 1: Introduction
Chapter 2: Monitoring Overview
Chapter 4: Ecological Models (Section *D2* of Technical Reference)
Appendix 1: Monitoring Problems

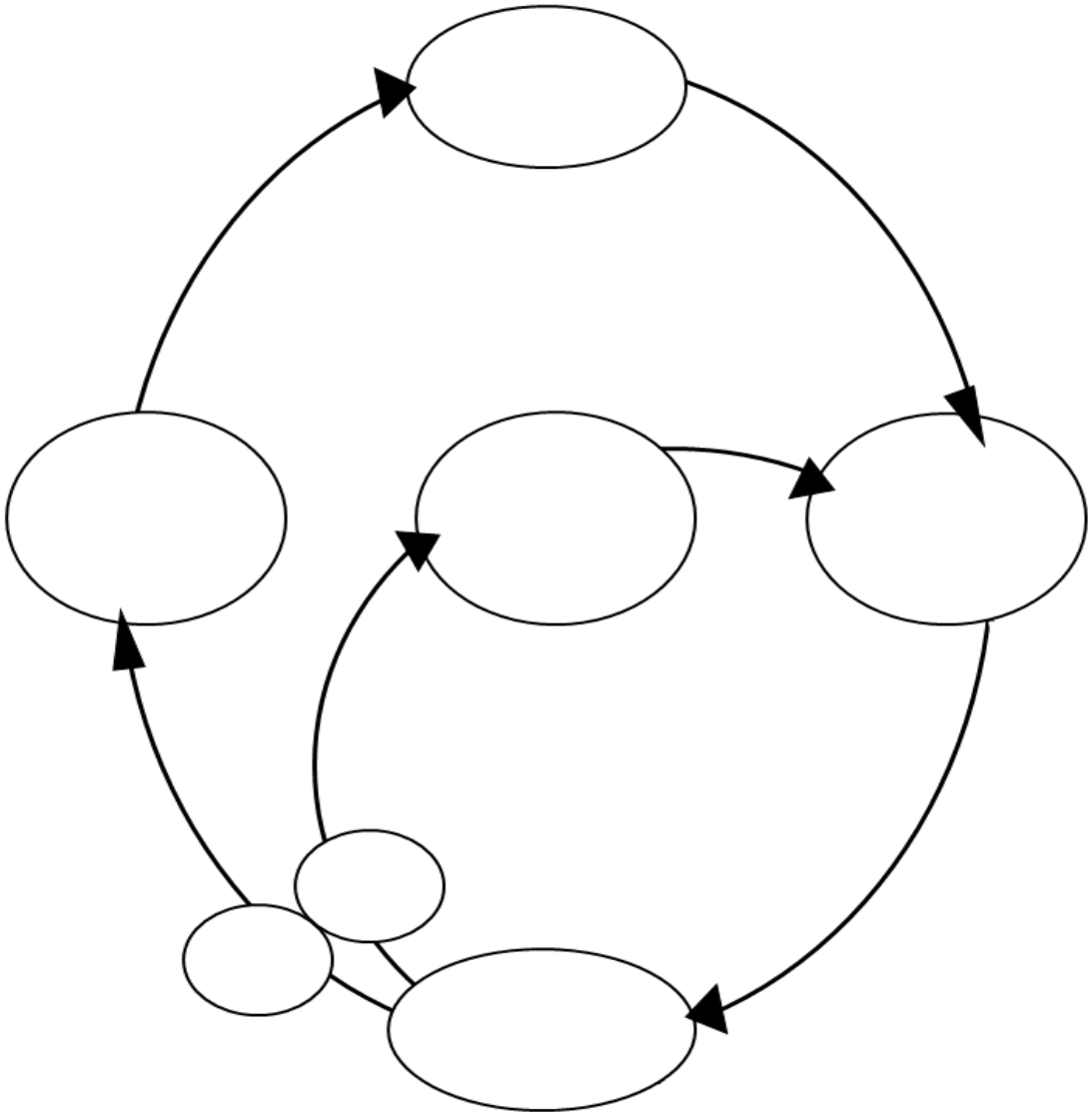
Monitoring in an Adaptive Management Framework

Monitoring Definitions:

To test or sample, especially on a regular or ongoing basis. To keep close watch over.

The collection and analysis of repeated observations or measurements in order to evaluate changes in condition and to measure progress toward meeting a management objective.

Adaptive Management Cycle:



Not Quite Monitoring

1. _____

   A **point-in-time measurement** of the resource to determine location or condition.

2. _____

   A study that **addresses basic ecological questions** about a species, a population, or a community.

3. _____

   A study designed to **determine the cause of some observed ecological phenomenon**.

4. _____

   A study designed to **assess whether proposed activities were carried out as designed**.

5. _____

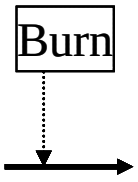
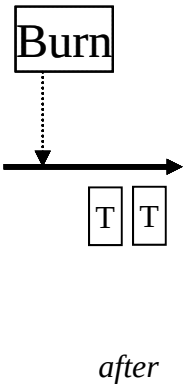
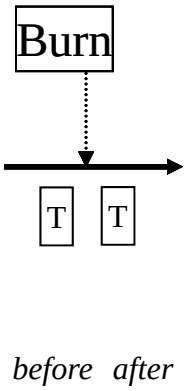
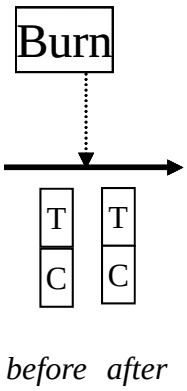
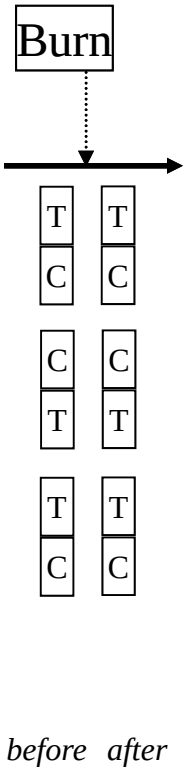
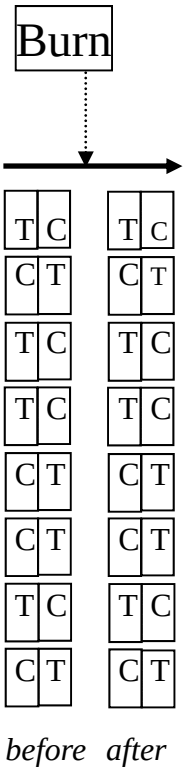
   Studies designed to **measure how a resource is changing over time, without explicit management objectives** for the resource.

6. _____

   Assessments of existing conditions to **provide a standard or "baseline" against which future change is measured.** Commonly, a large number of variables are measured in hopes of capturing within the baseline data set the ones that turn out to be important later.

Monitoring *vs.* Research

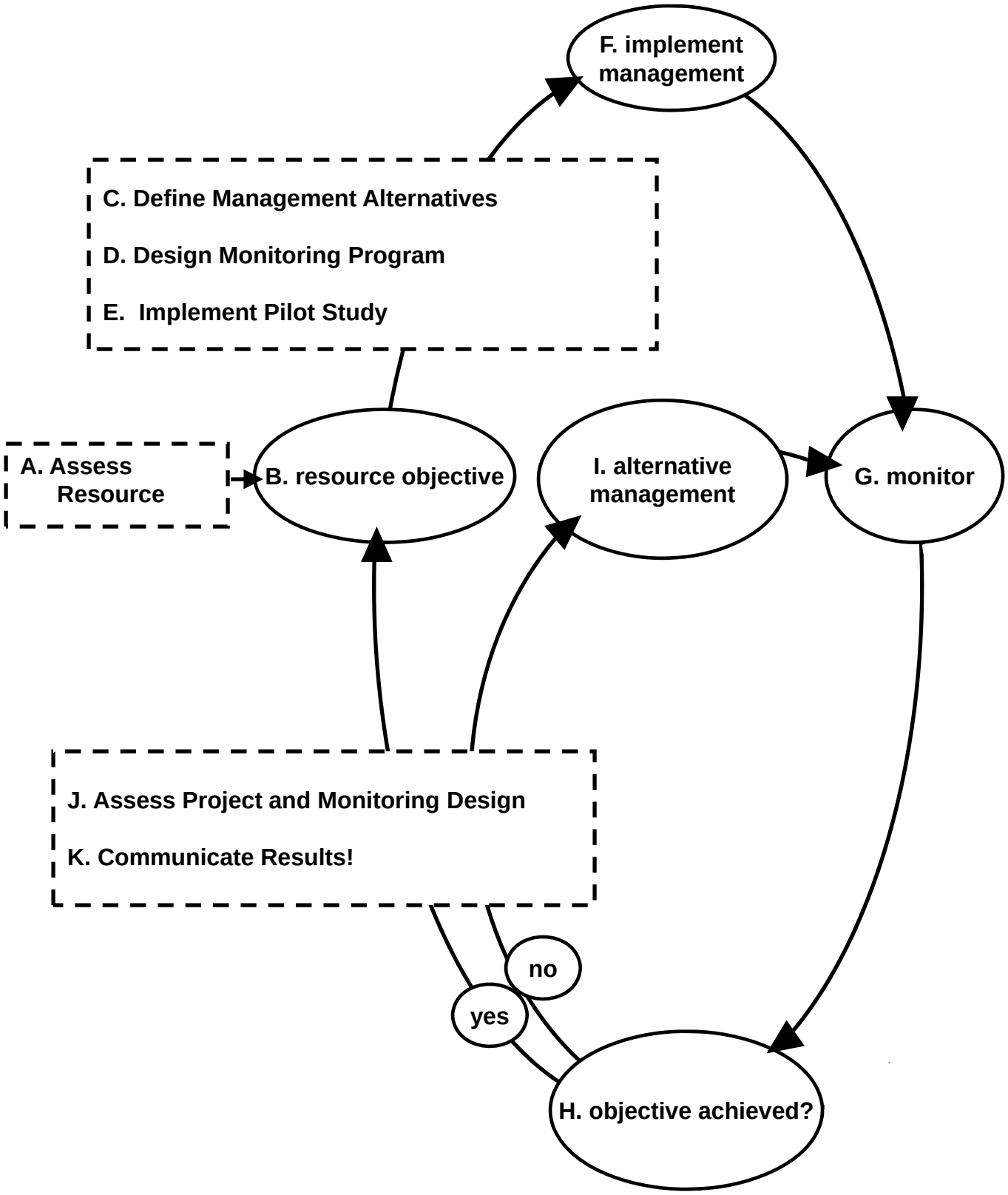
one ← *number of management units* → *many*

A	B	C	D	E	F
• no monitoring	• post monitoring only • no control • no replication	• pre & post monitoring • no control • no replication	• pre & post monitoring • treatment & control • no replication	• pre & post monitoring • treatment & control • minimum replication	• pre & post monitoring • treatment & control • good replication
					

T *unit where treatment is applied*

C *control unit*

Adaptive Management Cycle Revisited



Adaptive Management Monitoring in a Nutshell

A. Assess the resource issue

1. Identify general management goals
2. Develop an ecological model
3. Prioritize any competing goals
4. Discuss

B. Define resource objective

1. Select sensitive indicators and attributes
2. Identify management geographic area and timeframe
3. Specify direction and quantity of desired change
4. Discuss

C. Define management alternatives

1. Complete a comprehensive implementation plan
2. Specify management response based on outcomes of monitoring program
3. Discuss

D. Design monitoring program

1. Decide on general intensity of monitoring program
2. If sampling, develop Sampling Objectives
3. Complete written protocols for data collection, analysis, and management

For more information see Technical Reference page 13

E. Implement pilot study

1. Collect field data
2. Analyze and evaluate pilot study data
3. Update monitoring program based on pilot data
4. Complete a monitoring plan

F. Implement management

G. Monitor resource

1. Collect data according to monitoring plan
2. Evaluate data after every measurement cycle
3. Write and disseminate periodic reports

H. Evaluate the management action based on monitoring data

I. Implement alternative management if necessary

J. Assess project design and monitoring program

K. Communicate results

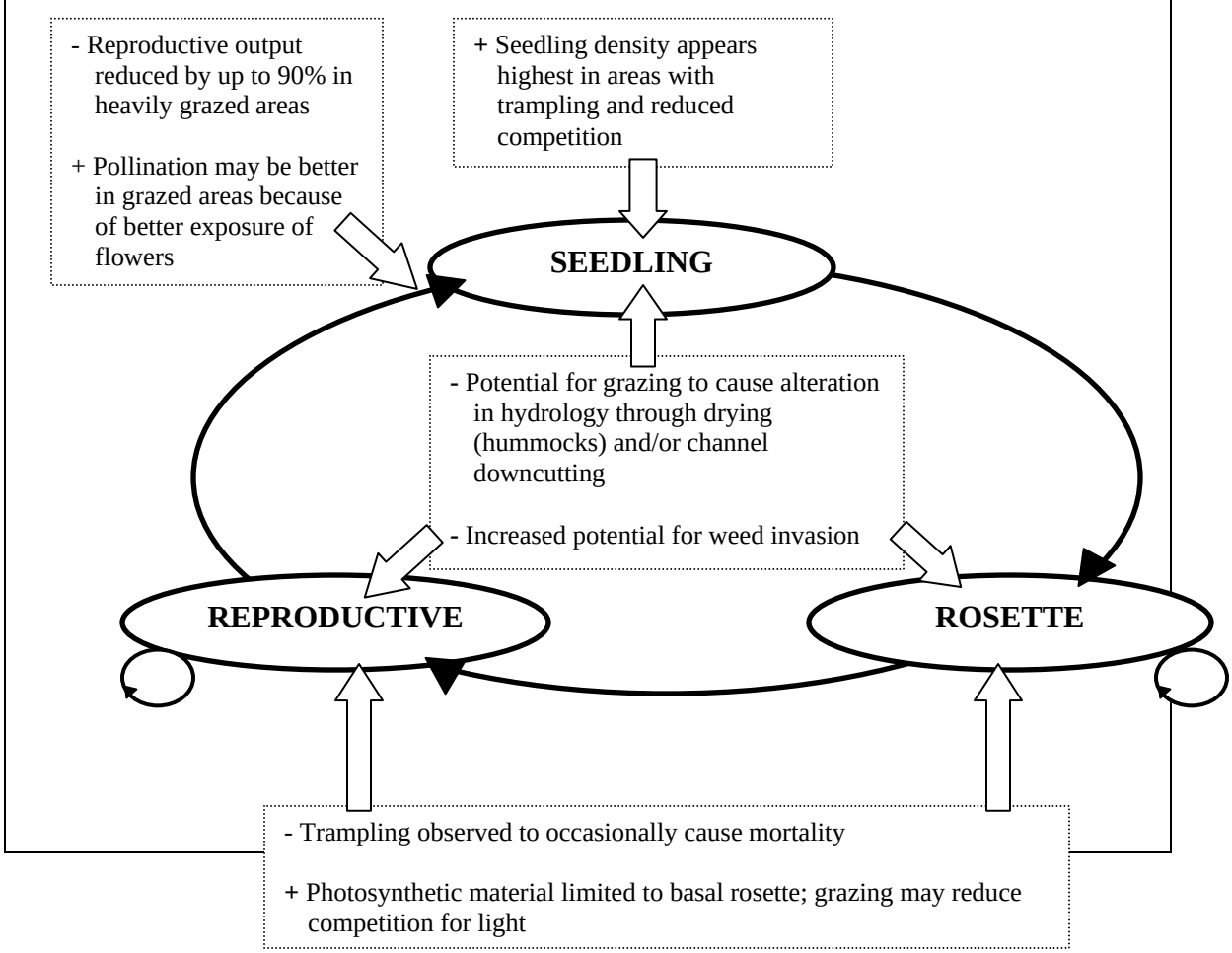
What is an Ecological Model?

A working hypothesis about system form and function
(Manley, et al. 2000)

Not a statement of "truth" but a representation of our best current understanding of the system
(Maddox, et al. 1999)

Example:

Livestock Effects on *Primula alcalina*



A Few Good Reasons to Create an Ecological Model

- Everybody does it! (at least implicitly) . . . make your assumptions and information gaps explicit

- Failure to make assumptions explicit is a common theme in failed monitoring programs

- Most of us are unable to keep track of what's known and why it's important without an integrating framework

- A model helps to summarize knowledge and information gaps about the resource that you're interested in and associated processes

- A model is a focus for communication with others and a format to synthesize knowledge from many people

- A model is useful in the *planning* stage as a "rack to hang knowledge on" . . . to identify what attribute to monitor, and what the management options are

- In the *data analysis* stage, a model is important for interpretation of results and refinement of human understanding of the system

Steps for Creating an Ecological Model

1. Gather information
    - 1.1. Previously collected data, photos, published research
    - 1.2. The experience of experts
    - 1.3. Your own biological intuition and expertise
    - 1.4. Pilot research

2. Brainstorm
    - 2.1. What are the resources of interest?
    - 2.2. What processes support resource health?
    - 2.3. What are the stressors on the system?

3. Define the scale for the model
    - 3.1. Define the “big” end of the scale: things that happen so slowly or on such a large spatial scale as to be not under your management control
    - 3.2. Define the “small” end of the scale: things that happen so quickly or at such a small spatial scale as to be noise and not address the management issues

4. Define relationships between principle parameters

5. Identify potential indicators of the state of the resource

6. Review, circulate among colleagues, revise, add-on, simplify, scratch-it-out-and-start-all-over

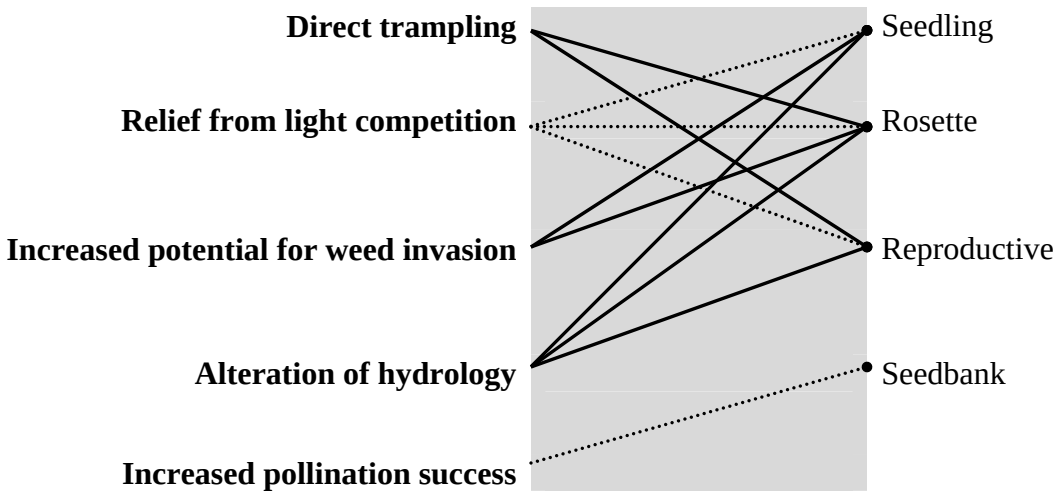
Some Additional Examples of Ecological Models

Livestock Effects on *Primula alcalina*

	Seedling	Rosette	Reproductive	Seedbank
Direct trampling	?	-	-	?
Relief from light competition	++	+	+	?
Increased potential for weed invasion	-	-	-	
Alteration of hydrology	-	-	-	?
Increased pollination success				+

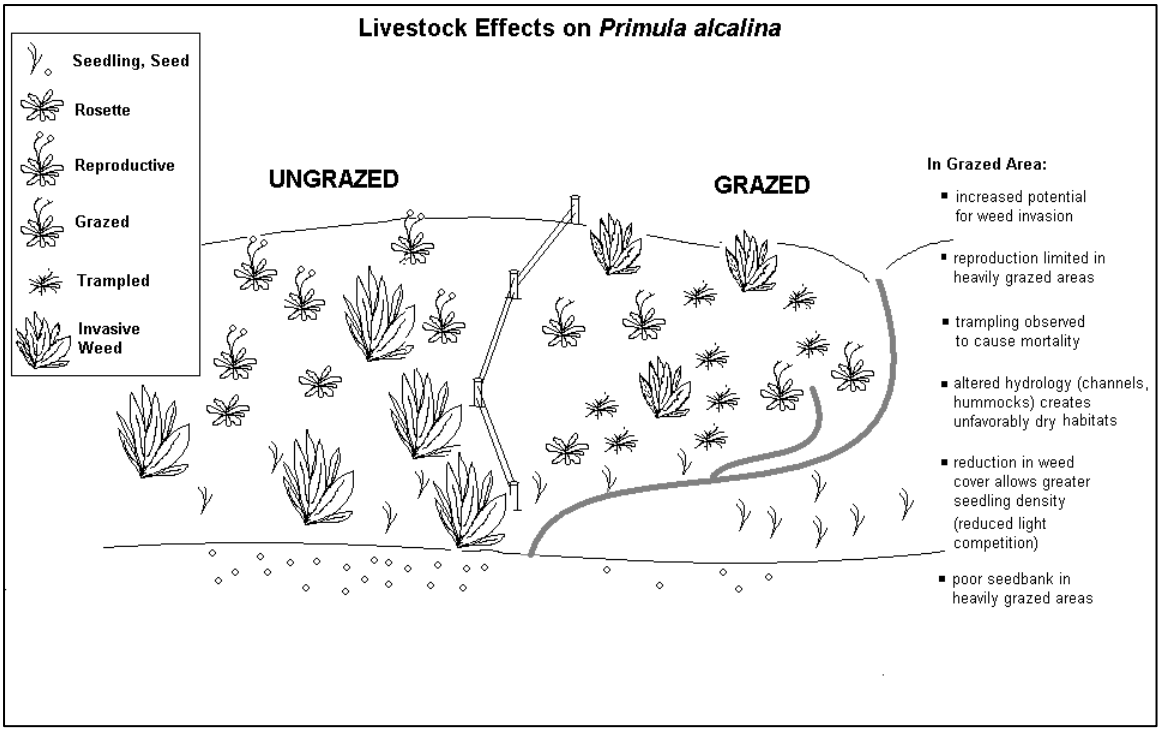
-	negative effect
+	positive effect
++	very positive effect
?	unknown effect
	no direct effect

Livestock Effects on *Primula alcalina*



———	negative effect
·····	positive effect

Some Additional Examples of Ecological Models



Livestock Effects on *Primula alcalina*

Primula alcalina (alkali primrose) is endemic to alkali meadows at the headwaters of three spring-fed creeks in east-central Idaho. While alkali primrose occurs on creek margins, the habitat is fairly stable hydrologically, as the creeks are entirely spring fed and generally experience only minor seasonal or annual fluctuations in flows. The majority of the primrose habitat is heavily grazed, and trampled extensively by anglers and campers.

The plant's basal rosette of light green, wavy-margined leaves ranges from 2- to 8-cm in diameter. Flowers occur on short pedicels emerging from the rosette in reproductive plants, making a compact inflorescence at anthesis. Seedlings begin growth very early in the season, before or immediately after snow-melt. Growth is probably slow at first, but flowering usually occurs by late May. Most plants are in fruit by the end of June; seeds disperse by mid- to late July. The onset of dormancy takes place in late September or October.

Demographic studies of the plant suggest that all three populations will decline over the next five years: long-term viability may be threatened due to heavy cattle grazing and its effect on alkali primrose reproduction. Observers noted that reproductive output may be reduced by up to 90% in heavily grazed areas. Direct mortality of plants due to trampling is also commonly observed. Cattle grazing appears to increase potential for weed invasion - both introduction of new species, and increase in abundance of existing weeds. Alterations in topography and hydrology caused by trampling may unfavorably dry Primrose habitat. However, observers have also noted very high densities of *Primula alcalina* seedlings in moderately grazed areas. Researchers suggest that reduced light competition in grazing allotments may promote seedling success. This effect may also increase vigor of the non-reproductive and reproductive rosette forms of the plant. Finally, grazing may promote increased pollination success due to better exposure of Primrose flowers.