Conservation and Management Decisions for Mountain Plovers throughout the Annual Cycle

Problem: How should we invest conservation/management dollars to maximize benefits to Mountain Plovers, considering the full range of the species throughout its annual cycle?

Guidance to a Range of Decision-Makers

Multi-state/International: (e.g., Neotrop Act, National Fish and Wildlife Foundation, USDA Forest Service)

Regional: (e.g., U.S. Farm Bill programs, Mexican government/NGO easement programs, State private lands programs)

Conservation Investors want Positive Population-level Returns

Objectives

Ultimate: Minimize the probability of extinction (i.e. self-sustaining, viable population) for the next 100 years

****definitions!**

Fundamental 1: Maintain, over the long-term, stable or increasing populations ($\Lambda \geq 1$)

Fundamental 2: Maintain species distribution across the breeding range to mitigate against weather variability

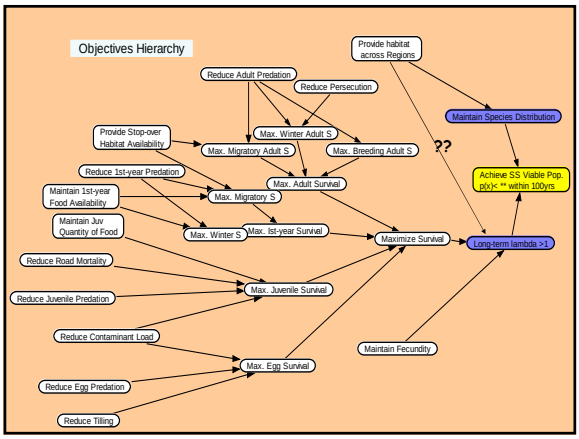
Objectives (Means)

Distribution

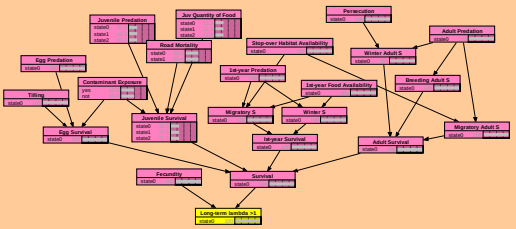
- **Provide regional breeding habitat (wintering and migration unknown)**

$\Lambda \geq 1$

- **Maximize survival**
  - **Egg**
  - **Juvenile**
  - **First-year (migration/winter)**
  - **Adult (breeding/migration/winter)**
- **Maintain fecundity (constant/no control)**



Bayesian (Belief) Network



Reduced Belief Network

Food availability and predation as un-conditional nodes (probability of limiting and not limiting; determine by delphi for next 100 years)

Assigned probabilities for survival states, conditional on food and predation

- juvenile (<0.1, 0.1, >0.1)
- first-year (<0.6, 0.6, >0.6)
- adult (<0.8, 0.8, >0.8)

** realized we need broader categories afterward

Reduced Belief Network – Conditional Nodes

		Adult Survival		
Predation	Food	<0.8	0.8	>0.8
non-limiting	non-limiting	0.00	0.05	0.95
non-limiting	limiting	0.60	0.30	0.10
limiting	non-limiting	0.10	0.20	0.70
limiting	limiting	0.95	0.05	0.00

Reduced Belief Network – Response

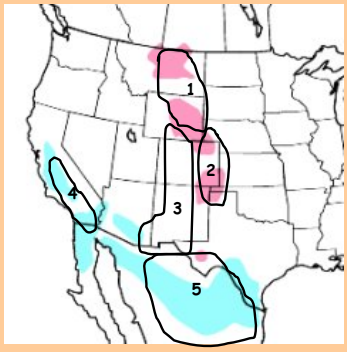
Survival			λ	
Adult	1st year	Juvenile	<1	>1
>0.80	>0.60	>0.10	0.01	0.99
>0.80	<0.60	<0.10	0.20	0.80
<0.80	>0.60	>0.10	0.50	0.50
<0.80	<0.60	<0.10	0.05	0.00

Alternatives (Options/Actions)

Land Protection
- Conservation Easements
- Acquisition
- Zoning
- Identify migratory routes, stop-over habitat, wintering areas

Habitat Enhancement
- Grazing plans (bison, cattle, sheep, goat)
- Burning
- Farm prairie dogs
- Change seed mixes for CRP
- Outreach for habitat conservation

Survival
- Protect nests
- Reduce shelter belts
- Promote Integrated Pest Management
- Erect road signs
- Close roads
- Control predators
- Increase predator prey
- Outreach to reduce trophy hunting
- Enforce wildlife (bird) laws
- Reduce exposure to pesticides
- Understand response to pesticide scenarios
- Understand cause-specific mortality for chicks



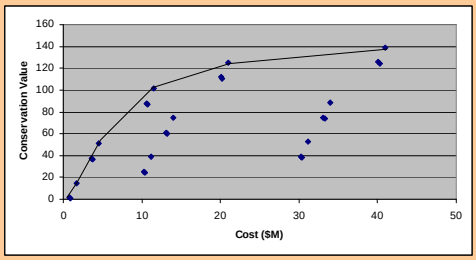
Allocation Model (least to best benefit)

		Cost ($M)	Λ	Distrib.
1. Montana-Wyoming				
	Change grazing practices	0.10	0	20
	Burning	0.25	5	0
	Farm prairie dogs	1.00	100	100
2. Eastern Plains (CO,NE,KS,OK,NM)				
	Nest protection	0.14	0	0
	Seeding mixes for CRP	3.00	40	80
	Easements	10.0	100	100
3. Intermountain (WY,CO,NM,AZ)				
	Farm prairie dogs	0.50	0	0
	Easements	10.0	50	80
	Acquisition	30.0	100	100

Allocation Model (common scale through swinging)

		Cost ($M)	Λ	Distrib.
Montana-Wyoming				
	Change grazing practices	0.10	0	8
	Burning	0.25	5	0
	Farm prairie dogs	1.00	100	40
Eastern Plains (CO,NE,KS,OK,NM)				
	Nest protection	0.14	0	0
	Seeding mixes for CRP	3.00	40	16
	Easements	10.0	100	20
Intermountain				
	Farm prairie dogs	0.50	0	0
	Easements	10.0	50	80
	Acquisition	30.0	100	100

Efficiency Frontier – Normalized weights to determine value of action package for a given cost (all combinations of 1 action each from a region)



Today

Check link of objectives and actions

Expand allocation model to all regions

Modify and expand Bayes Network

Develop demographic model