

## Conservation Examples

Population Viability Analysis  
- Butterflies and Restoration

Indicator Species  
- Good idea?

Hotspots

## Endangered Species

Part of declaring a species endangered involves doing a Population Viability Analysis (PVA)

A population is not considered endangered if it has 95% chance of persisting for 100 years.

Once a species is declared endangered, it gets a “recovery plan”

- What will be done to help it
- When is it considered “recovered”

## Fender's Blue Butterfly

Pretty butterfly that lives in western Oregon

Lays eggs on Kincaid's Lupine

Kincaid's Lupine only grows in "old growth" prairies

Prairies are prime land for farms, suburbs, shopping malls, universities...

Both Kincaid's Lupine and Fender's Blue Butterfly were recently listed as endangered species.

Sources: Schultz and Hammond (2003) Conservation Biology 17:1372-1385.  
Schultz (1998) Conservation Biology 12: 284-298  
E. Crone, pers. comm.

## Population Viability for Fender's Blue

Data:

- Yearly population census in different patches

Assume:

- Density independent growth
- No observer error
- No exceptional years

Use exponential growth equation

$$N(t+1) = N(t) + (r + \varepsilon) N(t)$$

$\varepsilon$  = error term

## Growth rate and variance for Fender's Blue

Site	Ownership	Protected status	Number of censuses	Average population size <sup>c</sup>	Population growth rate ( $\lambda$ )	Variance in population growth rate ( $\sigma^2$ )
Butterfly Meadows <sup>d</sup>	Private	Unprotected	8	412	1.06	0.122
Fern Ridge – Eaton Lane	Public	Protected	9	5	2.66	1.461
Fern Ridge – Spires Lane	Public	Protected	9	22	1.92	1.338
Fir Butte	Public	Protected	8	54	1.61	0.861
Willow Creek-Bailey Hill	Private	Protected	9	77	1.34	0.692
Willow Creek-Main Area	Private	Protected	9	738	1.15	0.387
Willow Creek-North Area	Private	Protected	9	43	1.56	0.918
Basket Butte	Public	Protected	8	589	1.12	0.436
Gopher Valley	Private	Unprotected	8	10	0.99	0.468
McTimmonds Valley	Public	Unprotected <sup>e</sup>	9	11	2.02	1.715
Mill Creek	Public	Unprotected <sup>e</sup>	10	17	1.31	0.607
Oak Ridge	Private	Unprotected	9	149	1.21	0.448

Avg. growth rate = 1.49

Avg. variance = 0.79

(for sites with > 25 butterflies = 0.54)

Chance of Persistence							
Site	Site persists 100 years ( $\bar{x} \pm SD$ ) <sup>b</sup>	Local (distance between sites <2 km)		County		Region	
		one site persists 100 years; populations fluctuate independently	persists 100 years; populations act as one site	one site persists 100 years; populations fluctuate independently	persists 100 years; populations act as one site	one site persists 100 years; populations fluctuate independently	persists 100 years; populations act as one site
		Butterfly Meadows	0.92 ± 0.34				
Fern Ridge-Eaton Lane	0.67 ± 0.22	0.20	<0.01				
Fern Ridge-Spires Lane	0.20 ± 0.37						
Fir Butte	0.48 ± 0.40						
Willow Creek-Bailey Hill	0.15 ± 0.39			0.83	0.99		
Willow Creek-Main Area	0.35 ± 0.42	0.59	0.40			0.99	— <sup>c</sup>
Willow Creek-North Area	0.26 ± 0.41						
Basket Butte	0.05 ± 0.41						
Gopher Valley	<0.01 ± 0.42						
McTimmonds Valley	0.03 ± 0.41			0.22	<0.01		
Mill Creek	0.15 ± 0.39						
Oak Ridge	0.34 ± 0.40						

## Multiple Patches = Metapopulation

Chance of survival with no colonization is:

$$\text{survival anywhere} = 1 - \prod_i (1 - \text{survival}_i)$$

Chance of survival WITH colonization will be higher

Metapopulation can survive even when all patches will  
Individually go extinct

## Prairie Restoration

Measure

- Flight paths
- Chance to leave lupine area
- Daily time budget
- Lifespan

Model different habitat configurations and ask which increases survival the most.

### Fender's Blue Butterflies:

Live ~ 10 days

Fly ~ 2.3 hours / day

Disperse within lupine ~ 3 m<sup>2</sup>/s

Disperse outside lupine ~ 15 m<sup>2</sup>/s

Weakly bias flight towards lupine patches

Butterfly might go 0.75 km within lupine  
2 km outside of lupine

Historically, patches ~ 0.5 km apart

Now patches 3 - 30 km apart

## Other Examples of Recommendations

Spotted Owls

Save old growth trees

Sea Turtles

Protect the adults, forget the eggs

Sea Otters

Based PVA on risks of oil spills,  
recommend number and area for  
recovery

## Problem

Fender's Blue study:

- 8 years dedicated study by grad student, TNC personnel
- Undergraduate field assistants
- Lots of volunteers

Impossible to do for very many species

## Indicator Species

A well-studied species whose protection will also protect many other less well-studied species.

What makes a good indicator?

# Hot Spots

Places with high biodiversity, especially many endemic species

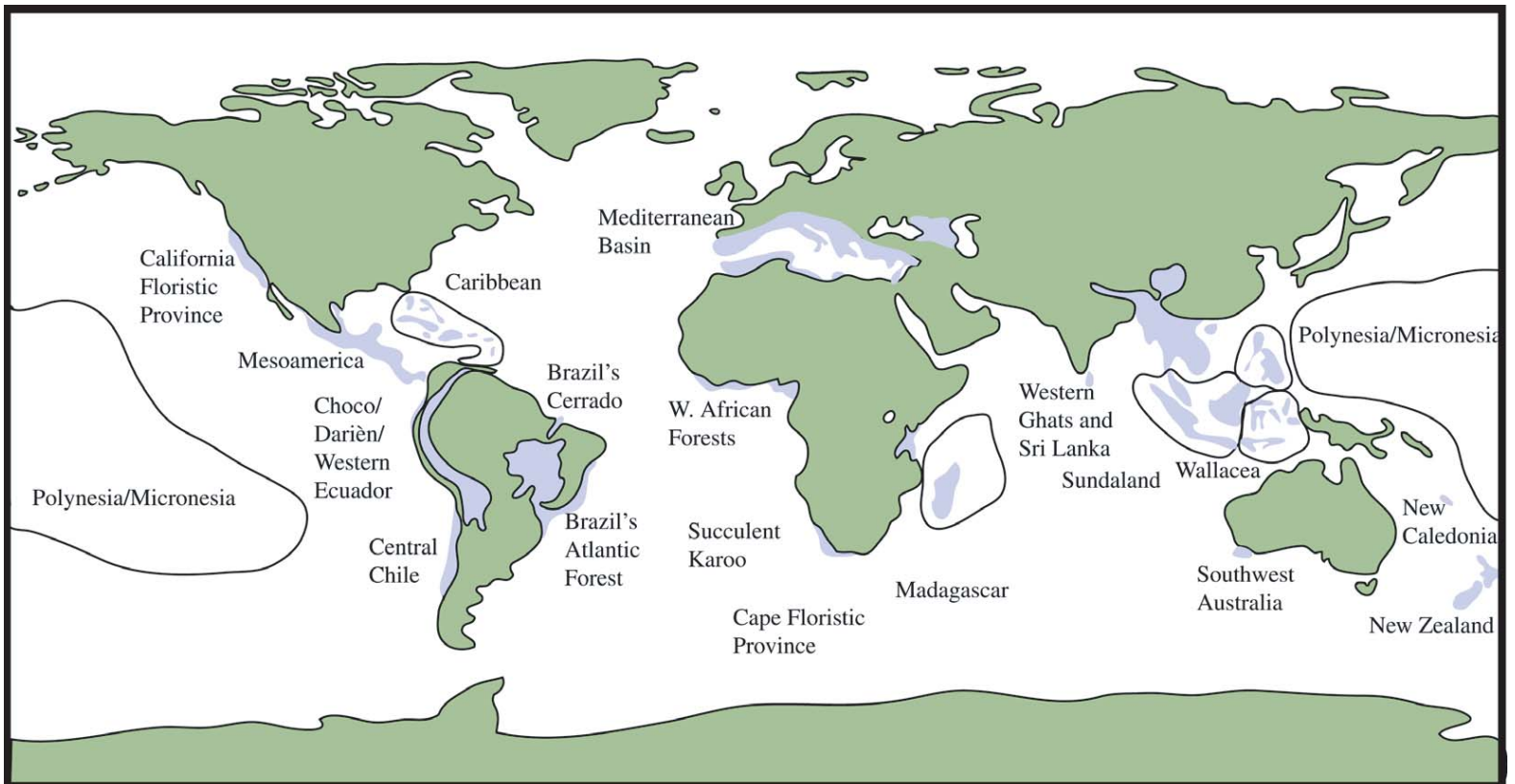
Brooks et al., (2002) Habitat loss and extinction in the hotspots of biodiversity. *Conservation Biology* 16: 909-924.

## Save Hotspots to Save Diversity?

Myers et. al. claim that 1.4% of land area contains 44% of vascular plants and 35% of vertebrates

Save 1.4% and you save a good bit of world's biodiversity

Myers et al., (2000) Biodiversity hotspots for conservation priorities. *Nature* 403: 853-858.



Biodiversity hotspots for conservation priorities

## Conclusions

### Looks good, but...

Tools of ecology help guide small, local decisions

At large scale, tools of ecology also offer guidance, but no easy answers.