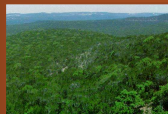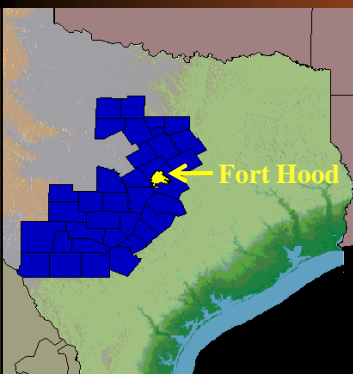Fish and Wildlife Population Ecology:

The End Game…

Golden-Cheeked Warbler
(*Dendroica chrysoparia*)

- breeds in closed-canopy woodlands, primarily Ashe juniper and oak
- declined due to habitat loss and fragmentation from clearing of juniper for urban expansion, agriculture, and commercial harvest

Fort Hood Army Post

Fort Hood

- Largest breeding population

- BIG fire in 1996

- Increased training demands

1

Recovery Credit System

- Fort Hood "buys" the conservation rights to habitat patches on private lands
- Unintentional loss of habitat on Fort Hood is "offset" by these purchases
- Golden-cheek metapopulation remains "unharmed"

How should off-post patches be valued?

The Model

- Stochastic, demographic, metapopulation projection model

Stage	S	Temporal Variance (S)	F	Temporal Variance (F)
HY	0.40	0.058	0	0
SY	0.57	0.010	1.2	0.024
ASY	0.57	0.010	1.3	0.006

The Model

- Ceiling carrying capacity (K)

- Various dispersal scenarios

- Metapopulation Viability
  – After 20 years…
  – Mean final population size

Fort Hood

Balcones NWR
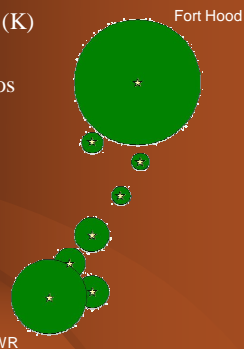
The Model

Characteristics of 10 hypothetical patches used to investigate the relationship between patch importance and patch size or distance from largest patch.

Patch Id	Patch Size (K)	Distance from largest patch
Pop1	238	1
Pop2	250	7
Pop3	300	4
Pop4	350	2
Pop5	400	8
Pop6	550	5
Pop7	700	3
Pop8	1000	6
Pop9	6000	9
Pop10 (i.e., Fort Hood)	12371	0

Dispersal

Scenario	Description
NoD	No dispersal
SymD	15% symmetric dispersal
SurvD	15% symmetric dispersal; disperser survival declines with distance
KD	Excess individuals above K become dispersers
KSurvD	Same as KD; disperser survival declines with distance
KSurvDVitals	Same as KSurvD; Larger pops. have higher survival and fecundity

Predictors of Patch Leverage

Varied each patch size by +/- 200

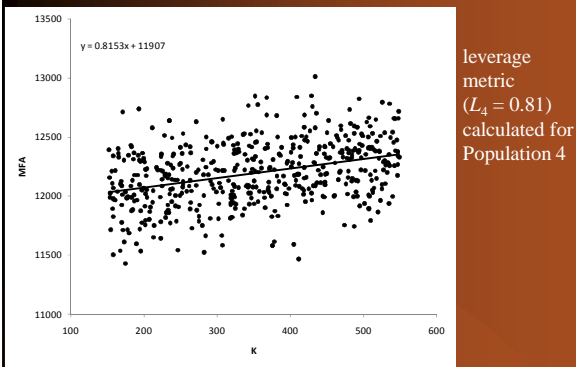$$\text{Patch Leverage } (L_j) = \frac{\text{Change in MFA}}{\text{Change in patch } j}$$

Patch Leverage (L_j)

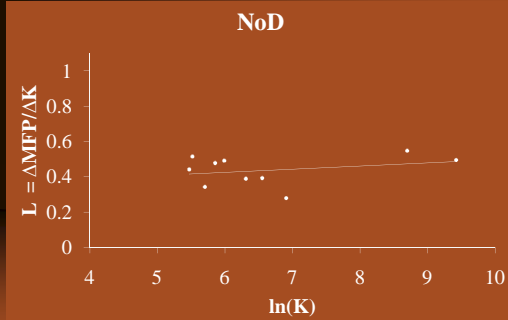$= f$(original patch size and/or distance from largest patch)

Results

Scenario	Mean Final Abundance
NoD	11182
SymD	9870
SurvD	7884
KD	13037
KSurvD	12212
KSurvDVitals	16879

Results

leverage metric ($L_4 = 0.81$) calculated for Population 4

$y = 0.8153x + 11907$

Importance of Individual Populations

NoD

$L = \Delta MFP/\Delta K$

$\ln(K)$

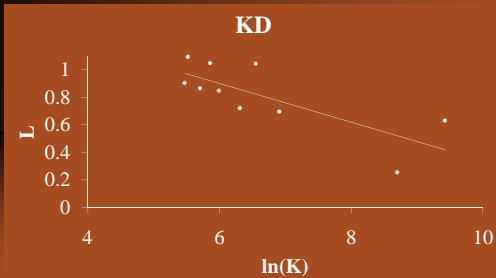## Importance of Individual Populations

With dispersal:
- Original size predicts L
- Smaller populations have greater leverage

KD

(graph: $\ln(K)$ on x-axis from 4 to 10, L on y-axis from 0 to 1)

Importance of Individual Populations

With dispersal and size-dependent vital rates:
- Distance from largest (Fort Hood) predicts L
- Closer populations have greater leverage

KSurvDVitals

(graph: Distance on x-axis from 0 to 10, L on y-axis from 0 to 1)
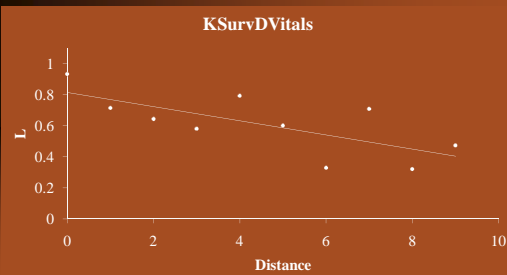
So…

- How much habitat needs to be conserved/added to Patch A to offset loss of 50 territories in Patch B?

$$\Delta_A = \Delta_B \times \frac{\hat{L}_B}{\hat{L}_A}$$

- Under dispersal scenario KD; Patch B initially held 250 territories and Patch A held 6000

$$\Delta_A = 50 \times \frac{1.74 - 0.14 \times \ln(250)}{1.74 - 0.14 \times \ln(6000)} = 93$$