DEMOGRAPHY

Key Studies

- Natal and Breeding dispersal
- Survival, Reproduction and Population Trend in relation to Landscape Composition and Configuration, Weather, and Barred Owls
- Demographic meta-analysis

Natal and Breeding dispersal

- **Combined data from 12 study areas in western Oregon and Washington (Forsman et al. 2002)**
- **Natal dispersal: the movement of an owl from its territory of birth to a new territory where it may potentially breed.**
- **Breeding Dispersal: the movement of a territorial, non-juvenile owl between territories where it may potentially breed.**

Natal dispersal

- **Followed 324 radio-marked owls for 1-2 years**
- **Reobserved an additional 711 owls first banded as juveniles on demography study areas**
- **Mean dates dispersal began**
  - **19 September in Oregon**
  - **30 September in Washington**
- **median dispersal distance:**
  - **females – approx. 24 km**
  - **males – approx. 14 km**

Natal dispersal

- **Percent of radio marked owls paired (by age):**
  - **1 year: 44% of females and 22% of males**
  - **2 years: 77% of females and 68% of males**
- **9% of owls color-banded as juveniles were first reobserved as territorial at ≥ 5 years of age**

Natal dispersal

- **Owls did not disperse across the non-forested Willamette, Umpqua nor Rogue Valleys, Oregon**
- **Owls did disperse between the Oregon Coast Range and Cascade Mountains through forested foothills**

Breeding dispersal

- **4917 records of 440 color-banded individuals**
- **Mean of 6% of owls exhibited breeding dispersal annually**
- **Probability of breeding dispersal was greater for:**
  - **females**
  - **younger owls**
  - **owls without mates in the previous year**
  - **owls that lost their mates from the previous year through death or divorce**

Breeding Dispersal Distance

- **Greater for 1- and 2-year-old than ≥ 3 year old owls**
- **Did not differ by sex**
- **Median = 3.5 km**

Survival, Reproduction and Population trend in relation to Landscape composition and configuration, weather, and barred owls

- **Presentations by Drs. Alan Franklin, Gail Olson, and Katie Dugger in March**
- **4 Studies in Klamath province, California, and Coast Range, Klamath, and W. Cascades, OR.**
- **4 studies used similar methods**
  - **modeled reproduction, survival as a function of habitat and weather covariates**
  - **Estimated "habitat fitness potential" for individual territories (2 studies)**

Results – Habitat covariates

- **California Klamath Province**
  - **Reproductive output was negatively and non-linearly associated with the amount of interior older forest, had a quadratic (concave) relationship to the number of older forest patches, and was positively associated with the amount of edge between older forest and other vegetation types**

Results – Habitat covariates

- **California Klamath Province**
  - **Survival was positively and non-linearly associated with the amount of interior older forest (>100 m from an edge), the amount of edge between older forest and other vegetation types, and showed a quadratic (convex) relationship to the distance between patches of older forest**

Results – Weather covariates

- **California Klamath Province**
  - **Annual survival was negatively associated with precipitation and positively associated with temperature during the early nesting period.**
  - **Reproductive output was negatively related to precipitation during the late nesting period.**
  - **Weather explained essentially all of the estimable temporal process variation in reproductive output.**

Results – Habitat Fitness Potential (λ_H)

- **Estimates of λ_H ranged from 0.438 to 1.178 (mean = 1.075)**
- **Based on 95% confidences intervals, 69% of owl territories had estimates of λH > 1, indicating owls at these territories more than replaced themselves**

Results – California Klamath Province

- **There appeared to be a trade-off between:**
  - **benefits to survival conferred by interior older forest, and**
  - **benefits to reproduction conferred by less interior older forest and more convoluted edge between the two habitat categories**
- **Interaction between weather and habitat such that sites with higher fitness potential may be able to buffer negative effects of weather**

Results –Oregon Coast Range

- A mixture of older forests with younger forests and nonforested areas appeared to benefit owl life history traits
- Barred owl covariate was negatively related to owl productivity,
  - However, the Barred Owl covariate accounted for only 2% of the variation in the model (or roughly 1% of the variation in reproductive output)

Demographic Analyses -- History

- 1990 – results were available from 2 study areas with 6-7 years data
- 1990 – both populations were declining (lambda = 0.95 in CA and 0.86 in Oregon)
- Meta-analyses in 1991, 1993, 1998, 2004

Demographic Analyses -- Recent

- 2004 Results presented by Dr. Robert Anthony last month
  - Standardized mark-recapture methods
  - 14 studies throughout NSO range
  - 6-19 years data from each study
- Estimated fecundity, apparent survival probability, and population trend
  - Separately for each study area
  - Jointly (true Meta-analysis)

Fecundity

- Definition: mean number of female offspring produced annually per territorial female owl
- In all meta-analyses, fecundity (females offspring produced per territorial female) was lowest for one-year-old females (first year subadults), intermediate for two-year-old females (second year subadults), and highest for females ≥ 3 years old (adults).

Fecundity

- Highest in the mixed-conifer region (eastern Cascades) of Washington.
- Lowest rates in the Douglas fir regions of Washington and Coastal Oregon.
- Fecundity rates for all studies combined did not show time trends.
- Individual studies showed alternating higher reproduction in even-numbered years and lower reproduction in odd-numbered years

Fecundity

- No effects were found of Barred Owls on Spotted Owl reproduction.
  - *Anthony et al.* (*2004*) recommended that future analyses use territory-specific Barred Owl covariates.

Survival

- Lowest on the Wenatchee study area (eastern Cascades, Washington), followed Warm Springs (eastern Cascades, Oregon), Marin (coastal California, females only), and Rainier (western Cascades, Washington
- Declined over time on five study areas:
  - the 4 study areas in Washington
  - northwest California (Klamath province)

Survival

- The number of Barred Owls on each study area annually was negatively related to survival for two study areas
  - Olympic Peninsula
  - Wenatchee study area (E. Cascades, WA)

Population Trend

- λ (lambda) estimated using Pradel's "reparameterized Jolly-Seber" (RJS) method

- Interpretation of lambda:

  $\lambda = 1$ indicates a stationary population,

  $\lambda < 1$ indicates a declining population,

  $\lambda > 1$ indicates an increasing population

- Estimated λ_{RJS} ranged from 0.896 to 1.005 and was < 1.0 on 12 of 13 study areas, suggesting declines in Spotted Owl populations

Population Trend

- Evidence of decline was strongest (95% CI (λ) < 1.0)
  - – 2 study areas in the E. Cascades, WA
  - – Warm Springs (eastern Cascades, OR)
  - – Simpson [Green Diamond] (Coastal CA)
- Evidence of decline was moderate:
  - –Rainier and Olympic Peninsula, Washington
  - –Oregon Coast Range
  - –H. J. Andrews (western Oregon Cascades)

Population Trend

- The mean λ_{RJS} for all study areas was 0.959 (SE = 0.024), and for the eight monitoring study areas was 0.975 (SE = 0.023),
- This indicates average annual population declines of 4.1% for all study areas and 2.5% for the monitoring study areas

Population Trend

- Cause(s) of NSO population declines from 1990-2003 are poorly understood.
- Hypothesized reasons for decline include:
  - displacement of Spotted Owls by Barred Owls
  - loss of habitat to wildfire
  - loss of habitat to logging on state, private and tribal lands
  - forest defoliation due to insects
  - advancing forest succession toward climax fir communities in the absence of fire

Suggestions for future research

- Evaluate hypothesized reasons for decline with empirical data.
  - Requires compatible GIS maps for all demographic study areas, including spatially and temporally explicit information on fire, timber harvest, disease, etc.
  - Would not need to wait until next scheduled meta-analysis in 5 years
    - *If appropriate data become available*