

# Statistical Analysis and Synthesis of Population Surveys for Black Ducks in North America

## The Black Duck Joint Venture Sponsors Population Surveys and Research for Black Duck Populations

Patuxent research has been involved:

- As active participants on BDJV Committees
- In developing new analysis methods for survey data.
- By conducting research about Black Duck population dynamics

Recently, 2 related projects have been initiated:

- Comparative analysis of plot and transect surveys in eastern Canada
- Developing a general framework for analysis of Black Duck survey data and associated environmental data

## Comparative Analysis of Plot and Transect Surveys in eastern Canada

### •Fixed-wing Transect Survey

- Protocols consistent over North America
- Ground-truthing with helicopters on segments
- Conducted 1996-Present (1992-present) in Ontario

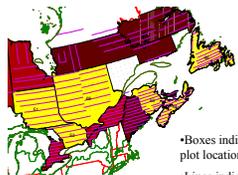
### •Helicopter Plot Survey

- 5x5 km plots conducted 1992-present

### •Extensive Overlap

- Opportunity to compare results

## Analysis of Comparable Areas: Transect Strata 51, 52, 68, 63, 64, 66



• Boxes indicate plot locations,  
• Lines indicate transects

John R. Sauer, William A. Link, and Daniel Endreson  
USGS Patuxent Wildlife Research Center, 12100 American Holly Drive, Laurel, MD 20708-4017

## Simultaneous Analysis of Both Surveys

- Log-linear model with components:
  - Site effects (plots or transects)
  - Permits blocking on sites
  - Area (scale to unit area)
  - Unequal areas of transects
  - Scale plots to area
  - Visibility rates
  - Scaling transects
  - Year effects (year, stratum, survey)

## Estimation of Population Change

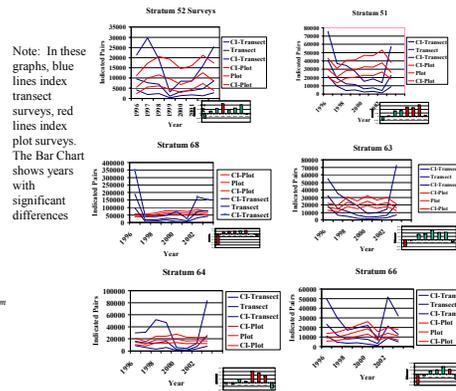
$$\log(\lambda_{i,t,m,s}) = T(i) + V_i(m) + \omega_i + \gamma_{i,m,s} + \epsilon_m$$

- Notation:**
- $\lambda$  is expected value of count
  - $T$  is Area offset
  - $\omega$  is Site effects
  - $V$  is Visibility Adjustment
  - $\gamma$  is Stratum-specific year effects
  - $\epsilon$  is Overdispersion effects

- Model fit using Markov Chain Monte Carlo methods
  - Hierarchical model
  - Program BUGS
- Analysis of visibility rates conducted separately
- Also a hierarchical model
- Alternative modeling provides direct estimation of visibility rates from helicopter plots
- Modeling procedure allows us to construct derived variables
  - Regional totals for each survey are year effects (exponentiated) multiplied by areas
  - Overall total is summed over areas
  - Composite population is average of survey totals
  - Trend is ratio of regional totals
- Upspot: Annual estimates, trends, composite
- estimates all available in a single analysis!

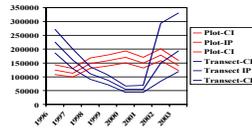
## Results

### Comparisons of Population Change by Strata

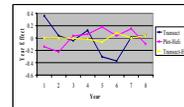


Note: In these graphs, blue lines index transect surveys, red lines index plot surveys. The Bar Chart shows years with significant differences

### Composite (over all Comparable Strata) Population Time Series



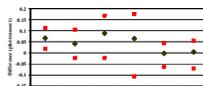
### Year Effect Results from an Alternative Analysis that Treated the Helicopter Segment Data as a Separate Survey



### Trends From Plot and Transect Surveys, 1996 - 2003

Strata	Survey	CI Lower	Trend	CI Upper
51	Plot	-1.31	0.08	0.01
51	Transect	-21.48	-2.08	0.13
52	Plot	-1.08	0.08	0.01
52	Transect	-18.46	-1.8	0.01
63	Plot	-1.11	0.07	0.01
63	Transect	-21	-2.07	0.01
64	Plot	-11.41	0.4	0.01
64	Transect	-9.52	0.31	0.01
66	Plot	-22.49	-0.32	0
66	Transect	-2.7	0.0	0.01

### Differences Between Surveys, by Stratum



## Developing a Framework for a Common Analysis of Black Duck Survey Data

### Several Surveys Provide Population Data for Black Ducks

- Eastern Canada Plot Survey
- Eastern Canada Transect Survey
- Northeastern Waterfowl Survey
- North American Breeding Bird Survey
- Mid-Winter Inventory
- Christmas Bird Count

## These Surveys Provide a Unique Opportunity to Evaluate Factors That Influence Distribution and Population Change of Black Ducks at a Rangewide Scale.

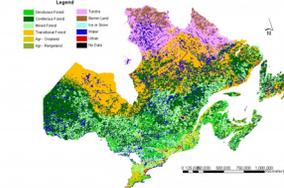
The hierarchical models we use to compare surveys provides a framework for these general analyses, as they can be modified to accommodate both covariates and spatial effects.

We are presently gathering rangewide-geographic information about a variety of environmental factors. These data with be summarized for the sample units of surveys, and used to develop predictive models of Black Duck distribution and relative abundance.

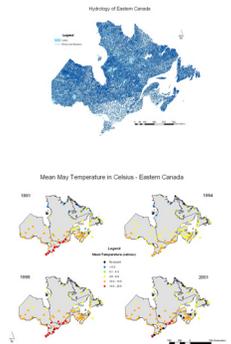
## We have Acquired Remotely-sensed Land Use and Land Cover data For a Portion of The Black Duck Range, and Are Actively Seeking Additional Data for Quebec and Ontario.

• AVHRR data are one of several remotely-sensed datasets that provide landcover information

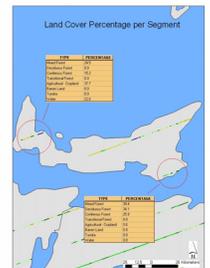
AVHRR Land Cover Classification - Eastern Canada



## Other Data Sets for Eastern Canada and the Northeastern United States Include:



## Data Are Being Summarized for Black Duck Survey Sample Units, and Will be Used to Develop Predictive Models of Population Distribution and Change



- Survey scaling generally similar
- Patterns of population change (year effects)
  - Often inconsistent
  - Often imprecise
- Patterns of trends
  - Imprecise