“Obtaining Reliable Estimates of Duck use-days”

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Photo by: R. M. Kaminski

Lecture Structure

• What do ducks eat?
• Duck use-days
• Estimating Food Resources
• Research Needs

What do Ducks Eat??

<table>
<thead>
<tr>
<th>Life Cycle Events</th>
<th>Seeds and Invertebrates!!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg Production</td>
<td></td>
</tr>
<tr>
<td>Feather Production</td>
<td></td>
</tr>
<tr>
<td>Pre-Basic</td>
<td></td>
</tr>
<tr>
<td>Pre-Alternate</td>
<td></td>
</tr>
<tr>
<td>Growth</td>
<td></td>
</tr>
<tr>
<td>Proteinaceous Foods</td>
<td></td>
</tr>
<tr>
<td>Fall Migration</td>
<td></td>
</tr>
<tr>
<td>Courtship</td>
<td></td>
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<tr>
<td>Thermoregulation</td>
<td></td>
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<tr>
<td>Migration</td>
<td></td>
</tr>
<tr>
<td>Energy-rich Foods</td>
<td></td>
</tr>
<tr>
<td>Pre-Laying</td>
<td>65</td>
</tr>
<tr>
<td>Post-Laying</td>
<td>45</td>
</tr>
<tr>
<td>Laying</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>75</td>
</tr>
<tr>
<td>Winter</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>90</td>
</tr>
</tbody>
</table>
**Waterfowl Foraging Carrying Capacity**

(Reinecke et al. 1989)

The number of waterfowl that can be sustained in a given area for a given amount of time.

**Carrying Capacity =**

\[ \text{DUD}_{\text{cropland}} + \text{DUD}_{\text{moist-soil wetlands}} + \text{DUD}_{\text{hardwood bottomlands}} \]

1 DUD = quantity of food necessary to feed 1 duck for 1 day

**Habitat Specific Carrying Capacity**

(e.g., Cropland)

\[ \text{DUD}_{\text{cropland}} = \text{DUD}_{\text{seeds}} + \text{DUD}_{\text{invertebrates}} + \text{Echinochloa crusgalli var. frumentacea} \]

**Quantifying Duck Use-Days**

Prince 1979

Reinecke et al. 1989

Reinecke and Loesch 1996

\[ \text{DUD} = \frac{\text{Food Available (g [dry])} \times \text{TME (kcal/g [dry])}}{\text{Daily Energy Requirement (kcal/day)}} \]

<table>
<thead>
<tr>
<th>Available Food for Waterfowl</th>
<th>TME Constant</th>
<th>DER Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moist-soil Seeds</td>
<td>2.5 kcal/g</td>
<td>292 kcal/day</td>
</tr>
<tr>
<td>Aquatic Invertebrates</td>
<td>3.5 kcal/g</td>
<td></td>
</tr>
</tbody>
</table>
Quantifying Available Food

3 Methods:

1) "Constants"
   • An estimate of mass from previous direct sampling or published yields (i.e., crops).

2) Direct Estimate
   • An estimate of mass from current direct sampling in your wetland or ag areas.

3) Prediction Models
   • An estimate of mass from current indirect sampling in your wetland or ag areas.

Commonly Used “Constants”

Seed:

<table>
<thead>
<tr>
<th></th>
<th>TME</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Reinecke et al. 1989</td>
<td>kg/ha</td>
<td>kcal/g^1</td>
</tr>
<tr>
<td>Croplands</td>
<td>Rice:  (80)</td>
<td>140–223**</td>
</tr>
<tr>
<td></td>
<td>(Post-harvest)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grain Sorghum: (TX)</td>
<td>148–436</td>
</tr>
<tr>
<td>Moist-soil Wetlands</td>
<td>Senescence</td>
<td>450</td>
</tr>
<tr>
<td></td>
<td>(100-400)</td>
<td></td>
</tr>
<tr>
<td>Hardwood Bottomlands</td>
<td>20%:</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>40%:</td>
<td>36</td>
</tr>
<tr>
<td>Aquatic Invertebrates:</td>
<td>All Species Combined:</td>
<td></td>
</tr>
<tr>
<td>Acreage: % Basal Area of Red Oaks</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crop</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>MS</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>HBL</td>
<td>10</td>
</tr>
</tbody>
</table>

Food Available in Rice Fields

Manley et al. (2004), Stafford et al. (2005)

71%, 79-99% Decrease in Seed Availability

271 kg/ha Post Harvest  78 kg/ha Late Autumn (Near 50 kg/ha Theoretical Threshold)

Less Food (DUD) Available!!

Seed Fate

Avail - 30%
Germinated 1%
Others 9%
Direct Estimation of Food Resources

- **Seeds**
  - Field Work: Clipping
  - Lab Work: Threshing
  - Specialized Equipment: Nets, Clippers, Refrigerated Storage, Sieves, Sorting Trays, Dryer, Desiccator, Balance

- **Invertebrates**
  - Field Work: Collecting
  - Lab Work: Sorting

Direct Estimation of Seed Resources

- **A New Technique: The “Seed-vac”**
- 88% Recovery Rate
- Correction Factor = 1.14

Penny et al. (2006)

Estimating Food Resources Using Prediction Models

- **Seed Yield = b + m** (Plant Measurements or Dots)
- **Invertebrate Biomass = b + m** (Water Quality)

(Laubhan & Fredrickson 1992; Grey et al. 1999a,b; Sherfy & Kirkpatrick 1999)
Methods: Plant Morphological Study

5 species: Echinochloa crusgalli, Cyperus erythrorhizon, Polygonum hydropiperoides, Panicum dichotomiflorum, Rynchospora globularis

$n = 60$ plants/species/year, 1993 and 1994

L & F (1992)
- Plant Height
- Inflorescence Length
- Infl. Base Diameter
- Infl. Volume
- # of Inflorescences

New Variables
- Number of Pedicels
- Number of Flowers
- Flower Width
- Flower Height

Seed Processing: followed L & F (1992)

$R^2 > 0.78$

Methods: Dot Study

5 species: Echinochloa crusgalli, Setaria viridis, Panicum agrostoides, Panicum dichotomiflorum, Rynchospora globularis

$n = 30$ plants/species/year, 1994

Preparation
- Plant Press
- 7 days
- Room Temperature
- Pedicels Separated

Processing
- Dot grid (9 dots/cm²)
- Dots Obscured by Seed Counted

Seed Processing: followed L & F (1992)

$R^2 > 0.92$

Summary of Problems with Current DUD Estimates

1) “Constants”
   - May Overestimate.
   - Not site-specific.
   - Cannot Evaluate Management.

2) Prediction Models
   - Not Manager Friendly: confusing, tedious.
   - Should Not Be Used Across Regions.

3) Direct Estimation
   - Costs too much.
Some Ideas for Future Research

Constants

Constants commonly used for seed (moist-soil, acorns, and agricultural grains) and aquatic invertebrates need to be verified.

<table>
<thead>
<tr>
<th></th>
<th>1980s Estimates</th>
<th>Current Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moist-soil:</td>
<td>450 kg/ha</td>
<td>?</td>
</tr>
<tr>
<td>Rice:</td>
<td>140 kg/ha</td>
<td>78 kg/ha</td>
</tr>
<tr>
<td>Corn:</td>
<td>325 kg/ha (Illinois)</td>
<td>?</td>
</tr>
<tr>
<td>Sorghum:</td>
<td>292 kg/ha (Texas)</td>
<td>?</td>
</tr>
<tr>
<td>Acorns:</td>
<td>80 kg/ha</td>
<td>?</td>
</tr>
</tbody>
</table>

Available for Ducks

Some Ideas for Future Research

Prediction Models

Seed-head Area Meter: 0.067 cm$^2$ – ? Resolution

Scanner: $300
Software: $1500

Scanner: $8,200
Scanner: $5,000

Very fast and accurate

15 minutes