I. Annual Cycle of Waterfowl

II. Waterfowl Diet & Nutritional Requirements

III. Moist-soil Management

IV. Agriculture Management

What is the Annual Cycle?

• Series of inter-related events that occur during a year in the life of an animal

• Think about “home range” size

• What is the home range of:
  – A Quail?
  – A White-tailed Deer?
  – A Black Bear?
  – A Mallard?
Annual Cycle of Waterfowl

The complex of physiological & behavioral events experienced by waterfowl during the course of a year.

1. Breeding
2. Fall Migration
3. Winter
4. Spring Migration

The Annual Cycle

What major events happen to a duck during the year?

- Species variation
- Latitudinal variation
- Cross-seasonal effects
- Management at all stages
Nesting

- Most waterfowl nest in the northern U.S. and Canada
  - Exceptions? = CANG, WODU, HOME
- Laying requires lots of protein = invertebrates!
- More resources means more eggs

Brood Rearing

- Same species that nest here
- Requirements similar to nesting phase
- Ducklings need
  - Invertebrates
  - Cover
- Managing some wetland area as summer marsh is beneficial

Post-Breeding

- Females and broods begin to move among wetlands
- Less need for cover
  - Drakes molting
  - Hens nearing molt
  - Switch to plant foods
- Loafing sites
**Molt**

- Energetically costly time of the year
- Wing molt requires lots of protein and essential amino acids
  - Found in natural wetland and plant seeds
- Birds not mobile

**Fall Migration**

- Mid-latitude stopover habitats are very important
- High energy foods (fatty) are very important
  - High carbohydrate foods
  - M.S. / Ag. crops high in fat
- Thermal cover
- Refuge
- Hunting
- Slow & methodical
**Winter**

- Pre-alternate / Pre-basic molt
- Pair bonds
- High energy needs
- Courtship
- Cross-seasonal effects
- Open water
- Hunting

**Fall - Winter:**

**FIXED BIOLOGICAL DEMANDS**

- **Food**
  - Body condition and survival, feather replacement
- **Water**
  - Provides habitat for food acquisition and resting
- **Cover**
  - Forested wetlands & emergent wetlands - Pairing
- **Refuge**
  - Survival, feeding, pair bonding, “source” for hunting, philopatry
Patterns of body mass during WINTER

- Gain Lipids
- Use Lipids
- Migration/Arrival
- Pairing Courtship
- Bulk-up Survive Bulk-up
- Oct Oct Nov Nov Dec Dec Jan Jan Feb Feb Mar Mar

**Spring Migration**
- Often overlooked but critical stage
  - Relationship between spring condition and reproduction
- Spring food low?
- Seeds → invertebrates
- High-speed

**Pre-Nesting**
- Stopover sites and temporary wetlands important
- Some ducks carry reserves to lay eggs (i.e., snow geese)
  - Endogenous resources
- Some get protein at breeding areas (i.e., ruddy ducks)
  - Exogenous resources
- Heavier birds nest earlier and are more successful
Managing Wetlands Throughout the Annual Cycle

Jan Feb Mar Apr May June July
Thermo & Pair Breeding sp Migr Nesting: F
Pre-Basic: Body (M)
Territory: M
Bachelor Groups: M
Broods: F
Pre-Basic: Full Body (M), Wings (M/F)
Amphibian
Pre-Alternate: Body (M)
Pre-Alternate: Body (F)
Staging
Broods: F

July
Breeds: F
Singing
Fall Migration
Pre-Alternate: Body (F)
Pre-Basic: Full Body (M)

Hohman et al. 1992

Managing Wetlands Throughout the Annual Cycle: Southeast

Jan Feb Mar Apr May June July
Waterfowl: Non-Residents Nesting: Wood ducks, hooded merg
Broods: F
Amphibian
Pre-Alternate: Body (M)
Pre-Alternate: Body (F)
Staging
Broods: F

July
Breeds: F
Singing
Fall Migration: Non-residents

Months of Least Activity: March & August

Managing for Waterbirds & Amphibians: In the Southeast

Resident Waterfowl:
• Cavity Trees
• Brood-rearing Habitat
• Protein-rich Foods
  • April – July
Migratory Waterfowl:
• High-energy Foods
  • Moist-soil Wetlands, FW Marshes, & Agriculture
  • Scrub-shrub & Forested
  • Sept - early March (D, J, F)
Resident Amphibians:
• Breeding and Larval Habitat
• Semi-permanent: Fishless
• Ephemeral Vernal Pools
  • April – July (most)
  • Jan – April (some anurans, mole salamanders)
Migratory Shorebirds:
• Invertebrates
  • Mudflats
  • Late July – Nov (A, S)
What do ducks eat?

What do Ducks Eat??

Life Cycle Events

- Egg Production
- Feathers Production
- Pre-Basic
- Growth
- Proteinaceous Foods
- Fall Migration
- Courtship
- Thermoregulation
- Spring Migration
- Energy-rich Foods
- Pre-Alternate: Don’t Forget!

Seeds and Invertebrates!!

<table>
<thead>
<tr>
<th></th>
<th>Pre-Laying</th>
<th>Laying</th>
<th>Post-Laying</th>
<th>Winter</th>
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<tbody>
<tr>
<td>Egg</td>
<td>55</td>
<td>45</td>
<td>25</td>
<td>75</td>
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<tr>
<td>Feather</td>
<td>45</td>
<td>75</td>
<td>25</td>
<td>90</td>
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</table>

Ag. and M.S. Foods

Rice and Millet
Better than Soybean and Corn

3.5 kcal/g vs. 2.5 kcal/g

TME in Ag vs. MS

“Waterfowl cannot maintain body weight on agricultural seeds alone!”

Waterfowl Habitat Management Complex

Moist-soil Wetlands
General Definition

Intermittently to seasonally flooded wetlands that are dominated by annual and/or perennial herbaceous hydrophytes.

Moist-soil Wetlands
Moist-soil Wetlands

Specific Definition: Cowardin et al. 1979

Palustrine

Emergent Wetland

Intermittently Flooded, Temporally Flooded, Saturated, Seasonally Flooded

Late Seral Stage

Early Seral Stage

Persistent

Non-Persistent

Rushes, Vines

Grasses, Sedges

Smartweed

Moist-soil Waterbirds

Croplands – Agriculture

- Rice
- Soybeans
- Corn
- Milo
- Aquaculture
Agriculture Management


Rice and Millet
Better than Soybean and Corn

3.5 kcal/g vs. 2.5 kcal/g

TME in Ag vs. MS

Mallards Metabolize Less Energy from Soybeans than other Ag Grains

Trypsin Inhibitor in Soybeans May Decrease Usable Protein (35%)

Food Available in Rice Fields

Rice Availability in M.A.V.

~71% decrease

Giving-up density (values in 2010 - 2011)

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 Threshold; Groez et al. 2009)

Less Food (DED) Available!!

140 kg/ha 752 DED/ha 325 DED/ha

Seed Fate

Potential Availability 30%

Germination 9%

Decomposition 58%

Granivory 14%

Germination 8%

Potentially Available 20%

Decomposition + Granivory 55%

Greer et al. 2009 (JWM)
Food Available in Rice Fields

Harvested Rice Field vs. Moist-Soil

<table>
<thead>
<tr>
<th>Habitat</th>
<th>Mean (kg/ha)</th>
<th>DUDs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>78 ± 15%</td>
<td>897</td>
</tr>
<tr>
<td>Moist-Soil</td>
<td>496 ± 13%</td>
<td>4,196</td>
</tr>
</tbody>
</table>

** 5-6 times more food and DUDs

Table 1. Carrying capacity of selected foraging habitats (expressed as dry-mass basis, g DUD/m²) for multiple agricultural activities in the Lower Mississippi Valley flood plain area.

<table>
<thead>
<tr>
<th>Habitat</th>
<th>Food available (grain/ha)</th>
<th>Total metabolizable energy (TME, kcal/ha)</th>
<th>DUDs/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean-soil</td>
<td>600*</td>
<td>2.67*</td>
<td>38</td>
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<tr>
<td>Harvard crops</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice</td>
<td>60*</td>
<td>1.66*</td>
<td>139</td>
</tr>
<tr>
<td>Sorghum</td>
<td>60*</td>
<td>2.45*</td>
<td>37</td>
</tr>
<tr>
<td>Unharvested crops</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice</td>
<td>5.24*</td>
<td>2.14*</td>
<td>24,025</td>
</tr>
<tr>
<td>Sorghum</td>
<td>3.13*</td>
<td>2.65*</td>
<td>4,765</td>
</tr>
<tr>
<td>Millet</td>
<td>3.85*</td>
<td>2.49*</td>
<td>18,195</td>
</tr>
<tr>
<td>Corn</td>
<td>5.74*</td>
<td>2.47*</td>
<td>28,820</td>
</tr>
<tr>
<td>Japanese millet</td>
<td>1.39*</td>
<td>2.45*</td>
<td>3,485</td>
</tr>
<tr>
<td>Biodiverse habitats</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50% corn, 50% soybeans</td>
<td>84*</td>
<td>2.67*</td>
<td>115</td>
</tr>
<tr>
<td>60% corn, 40% soybeans</td>
<td>64*</td>
<td>2.67*</td>
<td>161</td>
</tr>
<tr>
<td>50% corn, 50% soybeans</td>
<td>106*</td>
<td>2.67*</td>
<td>287</td>
</tr>
<tr>
<td>60% corn, 40% soybeans</td>
<td>110*</td>
<td>2.67*</td>
<td>253</td>
</tr>
<tr>
<td>50% corn, 50% soybeans</td>
<td>131*</td>
<td>2.67*</td>
<td>289</td>
</tr>
<tr>
<td>40% corn, 60% soybeans</td>
<td>143*</td>
<td>2.67*</td>
<td>245</td>
</tr>
<tr>
<td>20% corn, 80% soybeans</td>
<td>108*</td>
<td>2.67*</td>
<td>225</td>
</tr>
</tbody>
</table>

Post-harvest Fates of Agricultural Seed in Tennessee Croplands

Melissa A. Foster, Craig A. Harper, Johnathan G. Walls, and Richard M. Kaminski

Matthew J. Gray
UT Wetlands Program
SEAPWA
19 October 2010
Study Areas

Corn, Grain Sorghum and Soybeans Fields

- Federally-owned (TNWR)
- State-owned (TWRA)
- Privately-owned

Corn, Grain Sorghum and Soybeans Fields

- \( n = 105 \) harvested, \( n = 59 \) unharvested

Harvested Corn Mass: Temporal Declines

\[ P < 0.001, R^2 = 0.51 \]

\[ \text{BIOMASS} = 241.1 \times e^{-0.637 \times \text{TIME}} \]

Giving-up density: 50 kg/ha (Greer et al. 2009)

4.5X Faster than LMVJV Daily Loss Rate

Harvested Soybean Mass: Temporal Declines

\[ P < 0.001, R^2 = 0.66 \]

\[ \text{BIOMASS} = 116.2 \times e^{-0.844 \times \text{TIME}} \]

2.6X Faster than LMVJV Daily Loss Rate
Harvested Grain Sorghum Mass: Temporal Declines

\[
\text{BIOMASS} = 369.8 \times e^{-0.737 \times \text{TIME}}
\]

\[P < 0.001, R^2 = 0.46\]

7.6X Faster than LMVJV Daily Loss Rate

December Estimates: Harvested Fields

<table>
<thead>
<tr>
<th>Crop</th>
<th>Biomass (kg/ha)</th>
<th>DED/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(\bar{x})</td>
<td>SE</td>
</tr>
<tr>
<td>Corn</td>
<td>47</td>
<td>75 14</td>
</tr>
<tr>
<td>Soybean</td>
<td>48</td>
<td>45 8</td>
</tr>
<tr>
<td>Grain Sorghum</td>
<td>9</td>
<td>156 83</td>
</tr>
</tbody>
</table>

Previous estimate = 150 kg/ha
(Iverson et al. 1985)

December Estimates: Unharvested Fields

<table>
<thead>
<tr>
<th>Crop</th>
<th>Biomass (kg/ha)</th>
<th>DED/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(\bar{x})</td>
<td>SE</td>
</tr>
<tr>
<td>Corn</td>
<td>39</td>
<td>6,260 591</td>
</tr>
<tr>
<td>Soybean</td>
<td>16</td>
<td>2,190 439</td>
</tr>
<tr>
<td>Grain Sorghum</td>
<td>4</td>
<td>3,051 601</td>
</tr>
</tbody>
</table>

Moist-soil = 5000 DED/ha
10–64% Greater than LMVJV Estimates
Part II: QUANTIFYING SEED FATE

In harvested fields, there is less available seed and it is disappearing quickly. What is happening to it?

Total Depredation (Harvest - January)

Total Decomposition (Harvest - January)
What have we learned?
1. Less food than we thought…
2. How do we mitigate decreased quality of foraging habitats?

Management
1. Moist-soil
2. Croplands
3. Complexes
Management of Moist-soil Wetlands for Waterfowl

Matthew J. Gray
University of Tennessee

Moist-soil Management Unit
A location of moist-soil management, often surrounded by levees (impoundments)  < 40 ha, 100 ac

Moist-soil Management Complex
A group of interconnected moist-soil impoundments that can be managed independently

Hydrologic Management
(Fredrickson and Taylor 1982)

<table>
<thead>
<tr>
<th>Spring Drawdown:</th>
<th>Date</th>
<th>Multiple Combinations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast (2-3 days)</td>
<td>Early (April)</td>
<td>Good!</td>
</tr>
<tr>
<td>Slow (2-3 weeks)</td>
<td>Late (July)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Irrigation:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Flooded shallowly (e.g., &lt; 10 cm)</td>
<td></td>
</tr>
<tr>
<td>Offset drought</td>
<td>2-3 Weeks</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Winter Flooding:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood slow (2-4 weeks) &amp; Sequential</td>
<td></td>
</tr>
<tr>
<td>Flood shallow (e.g., 10-20 cm)</td>
<td>Sept.</td>
</tr>
</tbody>
</table>
Hydrologic Management
Fall Flooding & Bird Response

Waterfowl Foods in Moist-soil Wetlands

Hydrologic Management
Water Control Structures

Invertebrates
Seed
Tubers

Drop-board
Flap Gate
Screw Gate

“Tongue-and-Groove”
Hydrologic Management

Moving Water

- Gravity (reservoirs, rivers)
- Diesel or PTO-Pumps & Wells
- Towable PTO-Pumps
- Crisafulli® & Gator®
- Electric Pump & Wells

Crisafulli® & Gator®

www.crisafulli.com
www.gator-pump.com

Evaluating Vegetative Quality and Waterfowl Use on Active and Reduced Management Regimes in Moist-soil Wetlands on WRP lands in Mississippi

Active management with late draw-down (early summer)
- *duck response
- + vegetation response compared to Active

Crayfish Harvest Potential and Ecosystem Services in Managed Moist-soil Wetlands

Active management with late draw-down (early summer)
- *Crayfish Harvest Potential (1 - 7.7 kg/ha/day)
- + water quality benefits
- + wildlife habitat
### Mechanical Manipulations of Moist-soil Wetlands

*(Fredrickson and Taylor 1982; Gray et al. 1999)*

- **Spring Manipulations:** *(Historically: Northerly Approach)*
  - Immediately after Early Spring Drawdown

- **Autumn Manipulations:** *(SE Approach)*
  - As soon as possible after Early or Late Drawdowns

**Primary Goal:** Set back Succession 2-3 Years

**Secondary Goal:** Waterfowl Access

- Heavy Precipitation, Breeding Waterfowl

- Long growing season and climate conditions can produce dense and continuous stands of hydrophytes

**Spring-Manipulations:**

- **Spring Disking:** Best!
  - Rotation

**Fall Moist-soil Management**

**Natural Manipulations of Moist-soil Wetlands**

- **Burning:** (Use w/ Disking to set back succession)
  - Release Nutrients
  - Increase Plant H'
  - Increase Nutritive Quality
  - Increase Aquatic Invert Biomass

- **Grazing:** *(similar to mowing)* (Early Succession)
  - Structural, Aquatic Invertebrates

- **Use Cattle to Open Dense Vegetation**

- Follow by Disking
Natural Manipulations of Moist-soil Wetlands

Rockefeller State Refuge

Other Manipulations of Moist-soil Wetlands

Herbicide Application

Nuisance Plants
- Sesbania, Xanthium
- 2,4-D, Renovate 3, Broad-leaved
- Glyphosate (Rodeo): Non-selective
- Habitat (Imazapyr): Invasive Exotics

Agriculture
- Ag. Var. Hydrophytes
- Higher Elevations
- Mid-June
- 40 kg/ha; $150/ha

Why Forego Mechanical Manipulations until Autumn?

3 Primary Reasons
**Mechanical Manipulations**

**How many Disk Passes are Necessary?**

Usually 1-3 passes is sufficient

**Offset Disk Best!**

**Mechanical Manipulations**

**Autumn Vegetation Responses**

- Disking and Tilling
  - Increased Vegetation Biomass
  - Increased Species Diversity
  - Increased Seed Yield

- Mowing and Control
  - No Change in Vegetation!

  - Mowing in Autumn Good for Opening Dense Vegetation and Creating Landing Areas for Waterfowl

**Fall Mechanical Manipulations**

**Moist-soil Wetlands**

- Are Seed Resources Lost? 
  (Gray, Kaminski, Hopkins; 1999)

- Is it Illegal if Hunted Over? 
  (50 CFR Part 22; 1999)

  **No, if any of the following:**
  - Natural moist-soil wetland
  - Natural moist-soil wetland with volunteer crops (including millet)
  - <1 yr since planting

  **Yes, if any of the following:**
  - Agricultural crop (excluding millet) that is manipulated via bush-hog or knocked down
  - Agricultural crop harvested via zone/field technique (i.e., combine)
  - Unharvested agricultural crop
  - Agricultural crop harvested via bone/fade technique (i.e., combine)

<table>
<thead>
<tr>
<th>Seed Mass (g/785-cm^3)</th>
<th>P</th>
<th>0</th>
<th>0.1</th>
<th>0.2</th>
<th>0.3</th>
<th>0.4</th>
<th>0.5</th>
<th>0.6</th>
<th>0.7</th>
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<tbody>
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</tbody>
</table>

**Control Mow Disk**

**Seed Density (n/785-cm^3)**

<table>
<thead>
<tr>
<th>Control Mow Disk</th>
<th>P</th>
<th>0</th>
<th>0.1</th>
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<td>P</td>
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</tr>
</tbody>
</table>

**P** = 0.94

**P** = 0.99
Mechanical Manipulations

Hemi-marsh Configuration

Smith et al. (2004)
Replication on Wintering Grounds
WSB 32:474-480

Hemi-marsh Concept
An approximate equal area of water and vegetation is ideal!
50:50 Ratio

Kaminski and Prince (1981)
Aquatic Invertebrate Biomass Greatest
Greatest Abundance and Richness of Waterbirds are Attracted
Weller (1970)

The Hemi-marsh

Mechanical Management of M.S. Vegetation
Analysis – Waterbird Community

- Waterbirds
  - Mallards
  - All dabbling ducks
  - Dabbling ducks other than Mallards
  - Diving ducks
  - All waterbirds
  - Waterbirds other than dabbling ducks

Results – Waterbird Surveys

**Other dabbling ducks = treatment**

- $F = 6.83$, $P = 0.001$
- $F = 6.27$, $P = 0.001$

Experiment 2

<table>
<thead>
<tr>
<th></th>
<th>Other dabbling ducks, treatment</th>
<th>Other dabbling ducks, (-) water depth</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Disk</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mow</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- $F = 6.83$, $P = 0.001$
- $F = 6.27$, $P = 0.001$
Results – Invertebrates

Fall mowed and disked moist-soil vegetation

Seed and Tuber Use

1. Surveyed food-use literature to identify taxa commonly consumed by dabbling ducks
2. Compared:
   i. observed seed abundances (core sample estimates)
   ii. predicted seed abundances (calculated using decomposition rates and November abundances)
3. Estimated effects of removing taxa not identified as "duck food"
Seed and Tuber Use

<table>
<thead>
<tr>
<th>Type</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abies alba</td>
<td>3</td>
</tr>
<tr>
<td>Acerbarbarea</td>
<td>6, 8, 12</td>
</tr>
<tr>
<td>Betula spp.</td>
<td>1, 3, 11, 14</td>
</tr>
<tr>
<td>Corylus spp.</td>
<td>1, 3, 11, 14</td>
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<tr>
<td>Cynodon dactylon</td>
<td>1, 3, 11, 14</td>
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<tr>
<td>Cyperus spp.</td>
<td>1, 3, 11, 14</td>
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<tr>
<td>Deschampsia cespitosa</td>
<td>1, 3, 11, 14</td>
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<tr>
<td>Eriocaulaceae</td>
<td>1, 3, 11, 14</td>
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<tr>
<td>Filipendula pedunculata</td>
<td>1, 3, 11, 14</td>
</tr>
<tr>
<td>Galax urceiformis</td>
<td>9, 13, 14</td>
</tr>
<tr>
<td>Gaertneria pinetorum</td>
<td>9, 13, 14</td>
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<tr>
<td>Glyceria fluitans</td>
<td>9, 13, 14</td>
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<tr>
<td>Helophorus asper</td>
<td>9, 13, 14</td>
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<tr>
<td>Iris pseudacorus</td>
<td>9, 13, 14</td>
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<td>Juncus effusus</td>
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<td>Juncus articulatus</td>
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<td>Juncus bufonius</td>
<td>9, 13, 14</td>
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<tr>
<td>Juncus phacoides</td>
<td>9, 13, 14</td>
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<tr>
<td>Krigia octopus</td>
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<tr>
<td>Lythrum salicaria</td>
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<td>Myriophyllum sibiricum</td>
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<tr>
<td>Myriophyllum verticillatum</td>
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<tr>
<td>Potamogeton crispus</td>
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<tr>
<td>Potamogeton natans</td>
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<tr>
<td>Potamogeton perfoliatus</td>
<td>9, 13, 14</td>
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<tr>
<td>Pygmaea octopus</td>
<td>9, 13, 14</td>
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<tr>
<td>Scirpus lacustrinus</td>
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<tr>
<td>Schoenoplectus pungens</td>
<td>9, 13, 14</td>
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<tr>
<td>Typha angustifolia</td>
<td>9, 13, 14</td>
</tr>
<tr>
<td>Zizania palustris</td>
<td>9, 13, 14</td>
</tr>
</tbody>
</table>

Summary

• Partial fall mowing
  + seeds and tubers
  + dabbling duck abundance and diversity
  + invertebrate abundance and diversity

• Shallow flooding (<16 cm)

• Similar winter seed and tuber abundances among treatments (260 kg/ha)

• Ducks don’t eat everything!

• Moist-soil wetlands must be managed to maximize food availability
Winter Cropland Management

- Flooding
- Stubble manipulation
- Supplemental seeding
- Moist-soil borders and patches
- Grassy crop remnants
- Ratooning

Manley et al. 2005; 2009

Winter Flooding Benefits

- Food for waterfowl
- Decomposes crop residues
- Reduces winter weeds
- Reduces herbicide use in spring ($25-30/acre)
- Replenishes ground water
- Improves water quality
- Prevents soil loss
- Waterfowl hunting and wildlife watching

Manley et al. 2005; 2009
Agricultural Management

FIGURE 4. WINTER RICE STRAW DECOMPOSITION

FIGURE 5. WINTER WHEAT

Agricultural Management

Crops Should be in Close Proximity to Natural Wetlands!!

Green Browse

Corn + Moist-soil

Thus, birds can acquire high energy ag grains without flying long distances.

(Winter Wheat)

(Energy, Harvest Probability)

Agricultural Management

Grassy Corn

Table 1: Sizes of those 51 wildlife 5x17 and 50 percent were 519 crop management by state collected

National Wildlife Refuges (Refuges), Nature Center, and Tall Grasses (grassland management

Hagy et al. 2011 (SEAFWA)

Grassy Corn
Agriculture Management

Other Common Agricultural Foods
Milo, soybeans, browntop millet, and common buckwheat (*Fagopyrum esculentum*)

Why not Agriculture Only??
Moist-soil seeds decompose more slowly and retain their nutritional quality longer than agricultural grains.

Hunting Agriculture

Flooded Fields
Harvested Fields

Agriculture Management

Nealy (1956)

90 Days

Ag Seed
42–86% Decomposition

Moist-soil Seed
2–21% Decomposition
Burn to conserve waste rice, attract ducks, reduce stubble, & $ave
Ratooning?

“Ratoon” Rice for Ducks

Ratoon Rice
Cropping for Ducks

Making Moist-soil “Hot”
- “Dirty” Rice
- “Grassy” Corn
- “Grassy” Milo

“Dirty Rice”

“Grassy Milo”
“Grassy Corn”

The Grassy Corn Difference

Moist-soil alone
~2,320 DUDs/acre

Unharvested Corn
~23,500 DUDs/acre

Field Borders, Patches, or Margins
Why all of the Habitats?

Habitat Complexes

Mallard Complexes

Pearse 2007 (MSU)
Why manage so intensively?

Succession

Wetland Management Summary

• Pre-human habitat conditions will never be replaced

• Human needs vs.
  – Water Quality
  – Wildlife
  – Space

Less space = Better conditions in remaining natural habitat
Wetland Management Summary

- Natural wetlands have been highly altered or drained completely
- Private entities and conservation initiatives have stopped loss, but not replaced historical areas (e.g., WRP, CRP, Hunters, etc.)
- Natural wetlands may not ever be truly replaced
  - Altered flooding regimes
  - Timber demand
  - Cellulosic ethanol
  - People

Reduction Quantity = Increased Quality
To fulfill Wildlife and Waterfowl Annual Cycle Needs

Create Hunting Access

- Walk-in Access Ramps
- Boat Pull-over Sites
- Hand or Power Winch