Value of Foraging Bats: IPM Far and Wide

John K. Westbrook, Research Meteorologist
U.S. Department of Agriculture
Agricultural Research Service
College Station, Texas
CONSERVATION INNOVATION

“… to stimulate the development and adoption of innovative conservation approaches and technologies while leveraging Federal investment in environmental enhancement and protection, in conjunction with agricultural production.”

USDA, NRCS
INTEGRATED PEST MANAGEMENT (IPM)

Long-term prevention of pests or their damage by managing the ecosystem

Monitoring and correct pest identification help you decide whether management is needed

Combine management approaches for greater effectiveness:

- Biological / Cultural / Mechanical / Chemical controls

*(University of California Statewide Integrated Pest Management Program)*
Bats consume an abundance of insects, many species of which are pests of row crops and biofuel crops. The bats predominantly consume the adult stage of insects that fly at night. Although the adult stage of numerous insect species may not directly consume or infect crops, these adult insects produce progeny that infest crops and may carry pathogens or possess resistance traits.
OBJECTIVES

The WHY: To describe the role of bats in IPM, particularly for row crops and biofuel crops.

The HOW: To describe means that enhance the value of bats in IPM of row crops and biofuel crops.
BACKGROUND

Crop Production
Pest Insects
Bats
CROP PRODUCTION

Row crops and biofuel crops
High-yielding and early-maturing crop varieties
Development and adoption of transgenic crops
Pest eradication
## Crop Production (2013)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Production†</th>
<th>Value‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn, grain</td>
<td>13.9 billion bushels</td>
<td>$62.7 billion</td>
</tr>
<tr>
<td>Cotton, upland</td>
<td>3.0 million tons</td>
<td>$4.7 billion</td>
</tr>
<tr>
<td>Sorghum, grain</td>
<td>0.4 billion bushels</td>
<td>$1.7 billion</td>
</tr>
<tr>
<td>Soybeans</td>
<td>3.3 billion bushels</td>
<td>$41.8 billion</td>
</tr>
<tr>
<td>Hay</td>
<td>0.1 billion tons</td>
<td>$20.2 billion</td>
</tr>
<tr>
<td>Switchgrass</td>
<td>11.8 thousand tons*</td>
<td>$590 thousandΔ</td>
</tr>
<tr>
<td>Canola</td>
<td>2.2 billion pounds</td>
<td>$0.4 billion</td>
</tr>
</tbody>
</table>

* 2012
† USDA, NASS
‡ USDA, ERS
Δ Estimate based on value of $50/ton per AgMRC, Iowa State University, 2012
Key Pest Insects

Estimated 10% average crop loss due to insects

<table>
<thead>
<tr>
<th>Pests</th>
<th>Crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn earworms</td>
<td>Corn, sorghum, cotton</td>
</tr>
<tr>
<td>Fall armyworms</td>
<td>Corn, sorghum, cotton, soybean</td>
</tr>
<tr>
<td>Black cutworms</td>
<td>Corn, soybean</td>
</tr>
<tr>
<td>Corn rootworms</td>
<td>Corn</td>
</tr>
<tr>
<td>European corn borers</td>
<td>Corn, sorghum</td>
</tr>
<tr>
<td>Southwestern corn borers</td>
<td>Corn, sorghum</td>
</tr>
<tr>
<td>Wireworms</td>
<td>Corn, sorghum, switchgrass</td>
</tr>
<tr>
<td>Stink bugs</td>
<td>Cotton, soybean</td>
</tr>
<tr>
<td>Grasshoppers</td>
<td>Soybean, switchgrass</td>
</tr>
</tbody>
</table>
Corn earworm life cycle

- **Egg**: 2-5 d
- **Larva**: 14-18 d
- **Pupa**: 12-18 d
- **Moth Adult**: ≥ 8 d

Role of Bats in IPM of Row Crops and Biofuel Crops
Nocturnal emigration flight activity of corn earworm moths
Wind-aided Moth Migration
BATS

Species distribution

BCI Species Profiles

Tadarida brasiliensis

Mexican free-tailed bat (Molossidae)
Tadarida brasiliensis
Mexican free-tailed bat

Family Name: Molossidae
Genus: Tadarida
Species Name: brasiliensis

Pronunciation: ta-dare-a-dah bra-zill-ee-en-sis
Common Name: Mexican free-tailed bat

Approximate Range:

Source: IUCN Red List
BATS

Habitats

- Caves
- Bridges
- Cliffs
- Mines
- Abandoned buildings
- Trees
BATS

Migration and population dynamics

- Aerial abundance
  - Spring
  - Immigration
  - Nursing females
  - Summer
  - Emigration
  - Adult females and pups
  - Autumn

Role of Bats in IPM of Row Crops and Biofuel Crops
Feeding behavior
INSECT CONSUMPTION BY MEXICAN FREE-TAILED BATS

Individual female Mexican free-tailed bats consume 9.1 g of insects (about 73% of the bat’s body mass), or the equivalent of 114 corn earworm-size moths, per night.

If 50% of the consumed insects are female corn earworm moths, an individual bat may prevent the consumed moths from laying more than 25,000 eggs (and infesting 25,000 corn plants).
INSECT SPECIES CONSUMED BY MEXICAN FREE-TAILED BATS

35 insect families were identified in Mexican free-tailed bat feces

Caterpillar crop pests (e.g., corn earworm and fall armyworm) comprise a substantial portion of the Mexican free-tailed bat diet

(Lee and McCracken 2005)
Estimated $741K (12% of cotton production value) in avoided crop losses and control costs in an 8-county region of central Texas (Cleveland et al. 2006)

VALUATION OF ECOSYSTEM SERVICES

Reduced losses, costs of control, and environmental & ecological risks of common crop protection materials

Estimated $741K (12% of cotton production value) in avoided crop losses and control costs in an 8-county region of central Texas (Cleveland et al. 2006)
CONSERVATION ENHANCEMENT

Management of natural and unintentional roosts and habitats

Establishment of artificial roosts

Enhancements to establish roosts
MANAGEMENT OF NATURAL AND UNINTENTIONAL ROOSTS AND HABITATS
ARTIFICIAL ROOSTS

DESIGN
CONSTRUCTION
WOOD TREATMENT
SUN EXPOSURE
HABITAT
MOUNTING
PROTECTION FROM PREDATORS
AVOIDING UNINVITED GUESTS
TIMING
IMPORTANCE OF LOCAL EXPERIMENTATION
ENHANCEMENTS TO ESTABLISH ROOSTS AND FORAGING ACTIVITY

Heat regulation?
Odor?
Ultrasonic broadcasts?
SUMMARY

Conservation of bats by enhancing natural roosts and habitats, and establishing artificial roosts

Enhancement of IPM for sustainability and profitability of row crop and biofuel crop production
ACKNOWLEDGMENTS

USDA - Agricultural Research Service
University of Tennessee
Boston University
Bat Conservation International
QUESTIONS?

For more information, contact:

Bat Conservation International
http://www.batcon.org/