

# Palmer Amaranth is Spreading Throughout the U.S.





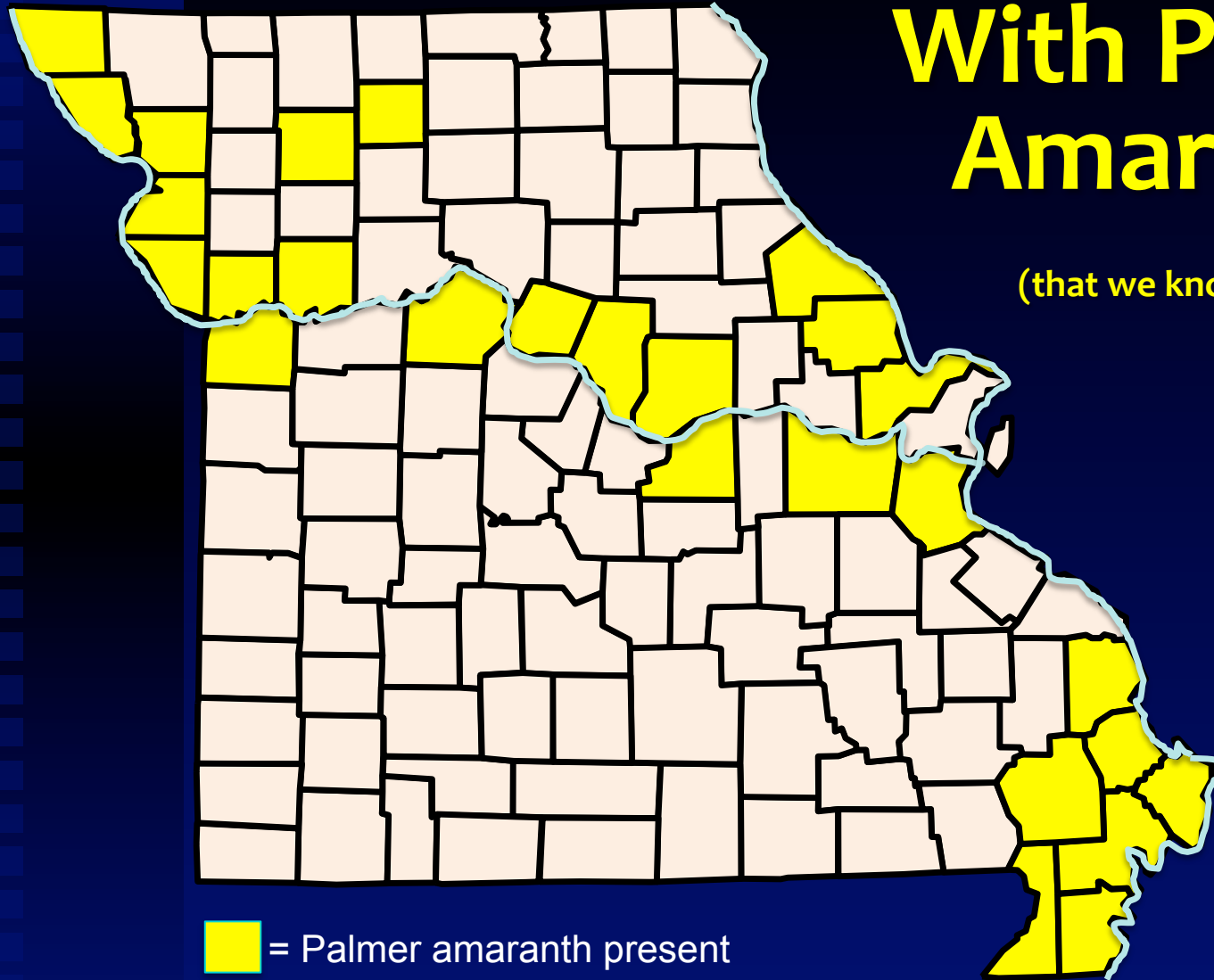
**contaminated  
used equipment  
or custom  
harvesting  
crews from  
other regions**

**contaminated  
feed and/or  
seed from  
other regions**



# Missouri Counties With Palmer Amaranth

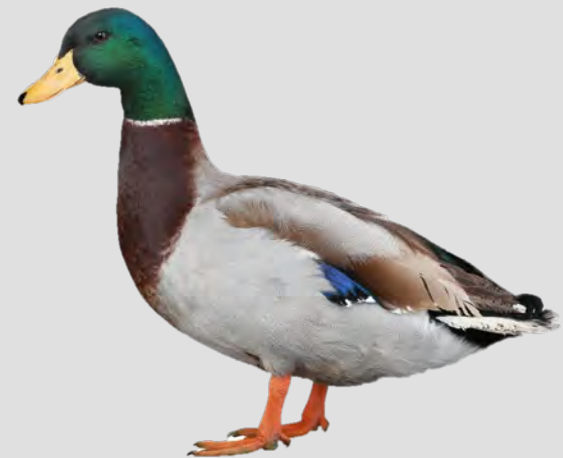
(that we know about)



 = Palmer amaranth present

# Our Hypothesis

Waterfowl, particularly ducks and geese, are spreading agronomically important weeds, including Palmer amaranth and waterhemp.



# Two Experiments:

## 1. Missouri Waterfowl Collection

Objective – Determine what weed species are being consumed and transported throughout Missouri by ducks and snow geese.

## 2. Feeding Study

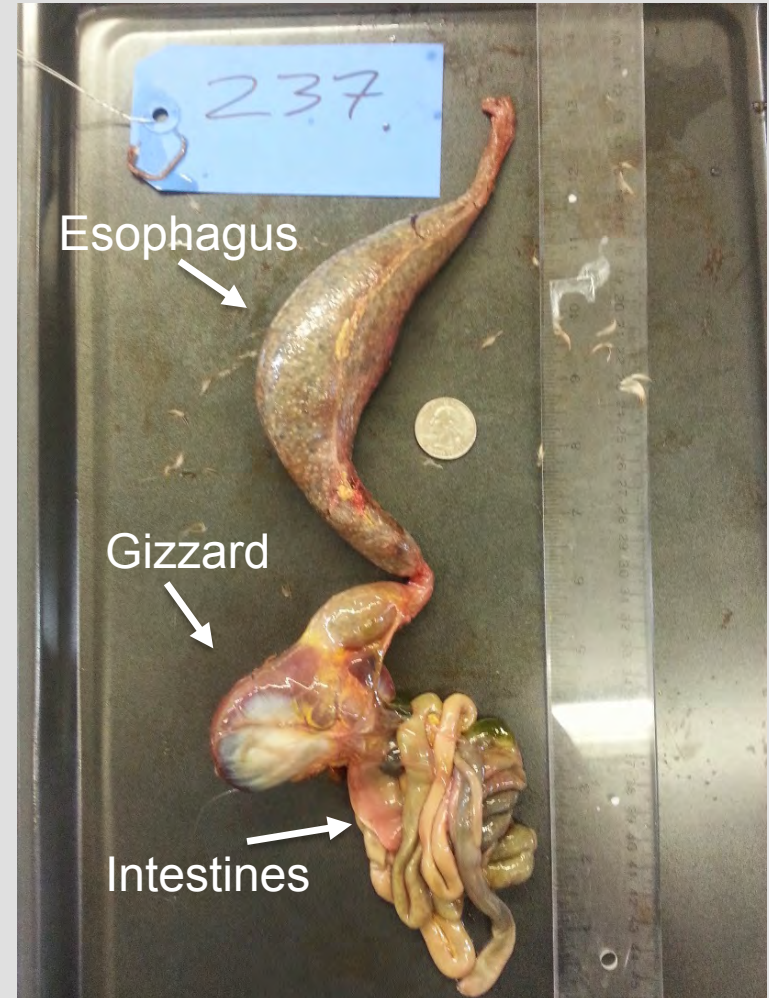
Objective – Determine recovery rate and viability of 13 agronomically important weed species after passage through a duck's digestive system.

# Collection Experiment: Materials And Methods

- Over 20 volunteer Missouri waterfowl hunters donated ducks and geese harvested in Missouri
- Ducks were harvested between October 26, 2014 and January 24, 2015
- Snow geese were harvested between March 7-10, 2015
- Birds were frozen until processing
- Proper permits were obtained through the Missouri Department of Conservation and the U.S. Fish and Wildlife Service

# Collection Experiment: Materials And Methods

- Birds identified to species
- Digestive tracts removed and divided into esophagus, gizzard, and intestines
- Seed removed from each section and rinsed
- Recovered seed planted in commercial potting soil and monitored for 3 months
- Emerged plants identified to species



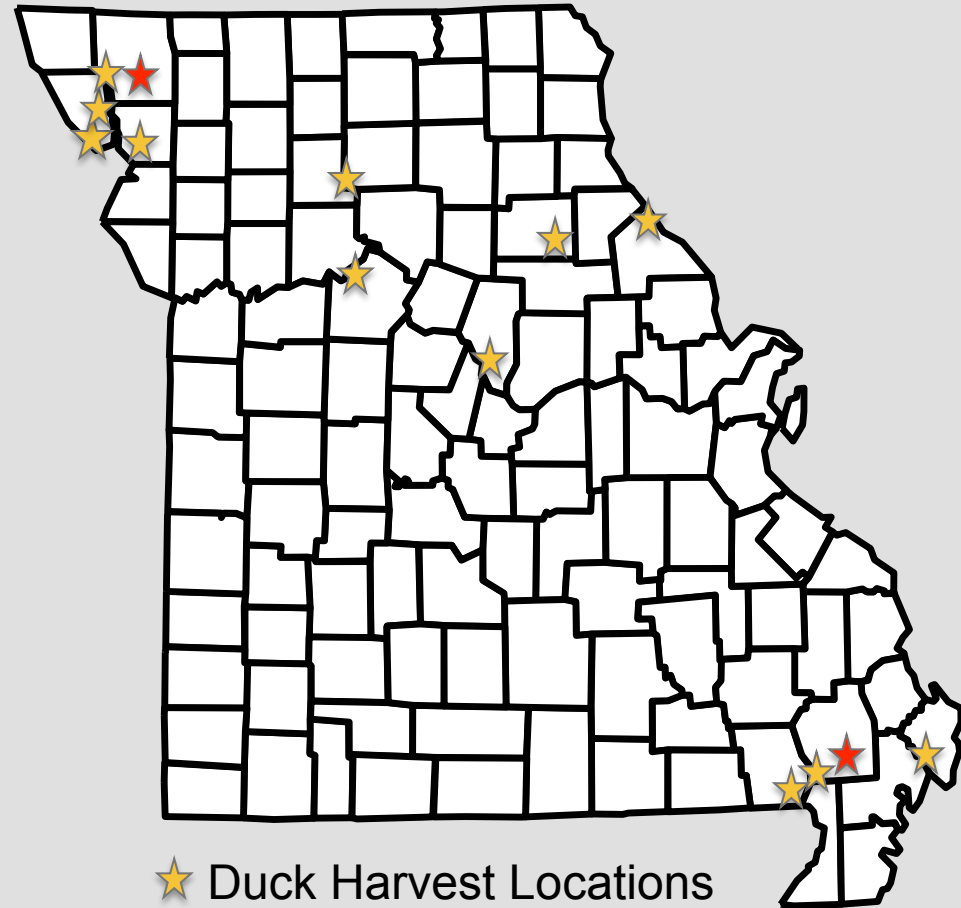
# Results

238 ducks collected  
across 12 species

- 14,500 plants emerged  
(50 species)

111 snow geese  
collected

- Currently 86 plants  
have emerged  
(11 species)



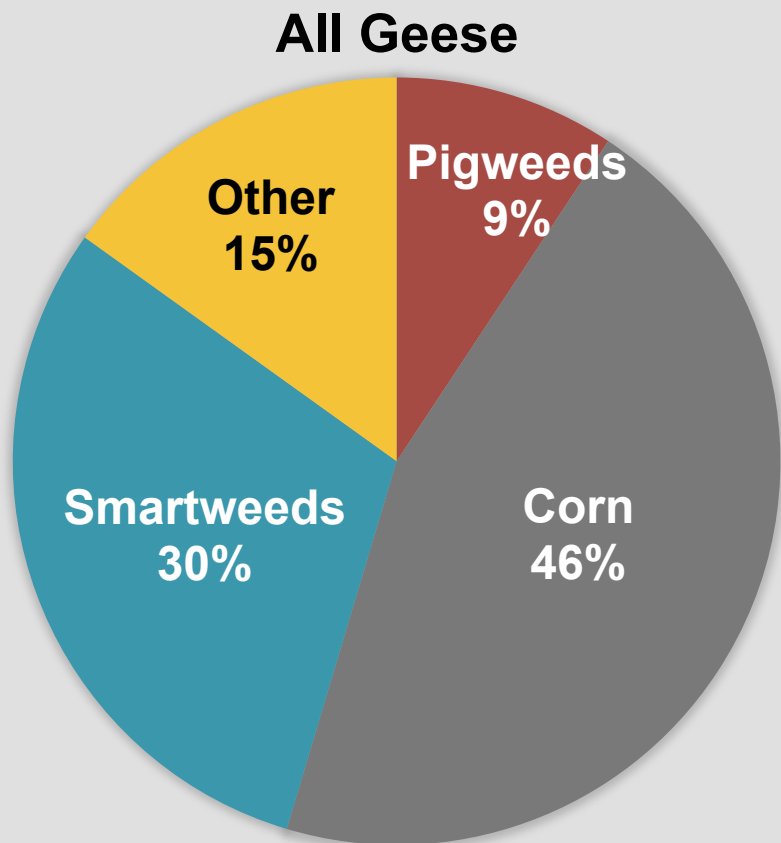
★ Duck Harvest Locations

★ Snow Goose Harvest Locations

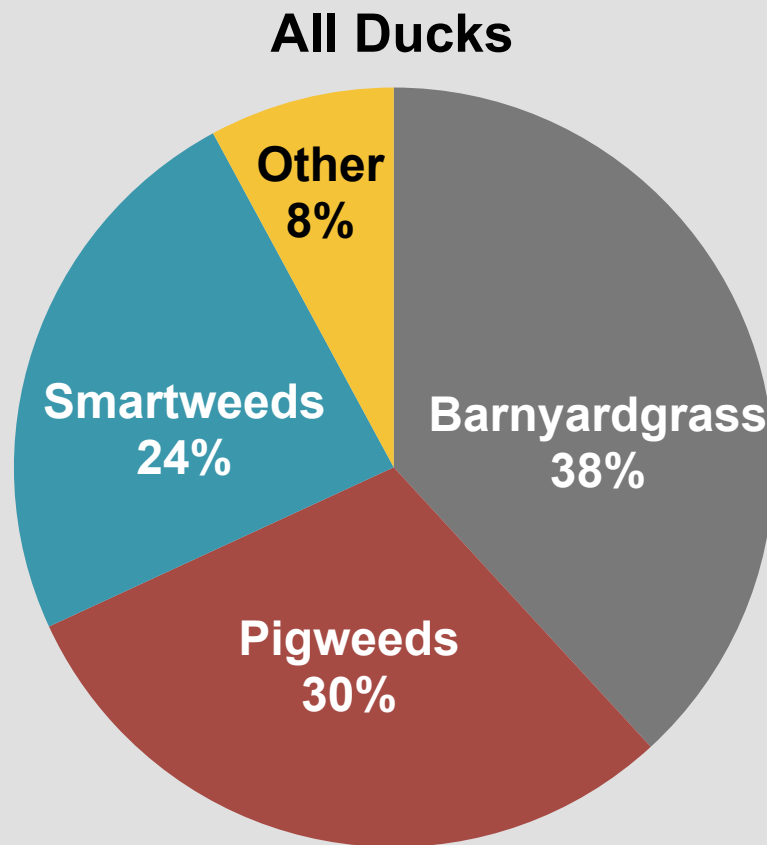


# What Role Do Migratory Waterfowl Play in the Transport of Weed Seed?

## Emerged Weeds And Crops Recovered From Ducks And Geese



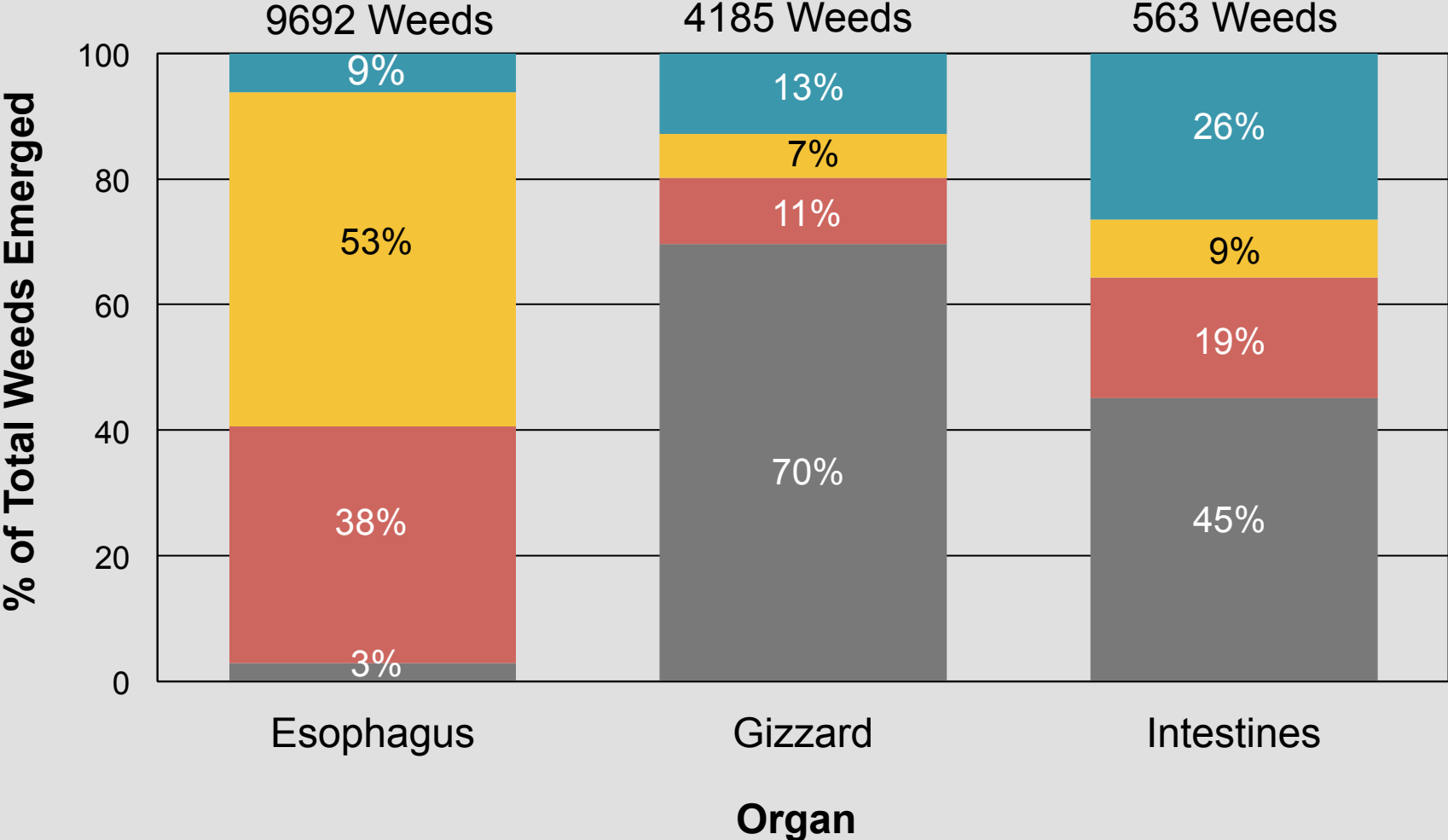
**Weeds Recovered  
86**



**Weeds Recovered  
14,395**

# Emerged Weeds Recovered from Different Portions of Duck Digestive Tracts

■ Smartweed species   ■ Waterhemp   ■ Barnyardgrass   ■ Other



# Conclusions: Collection Experiment

- Waterfowl are consuming a variety of weed seed throughout Missouri
- Ducks consume a larger variety of weed seed compared to snow geese
- Waterfowl have the potential to spread troublesome agronomic weed species like waterhemp and Palmer amaranth throughout Missouri

# Two Experiments:

## 1. Missouri Waterfowl Collection

Objective – Determine what weed species are being consumed and transported throughout Missouri by ducks and snow geese.

## 2. Feeding Study

Objective – Determine recovery rate and viability of 13 agronomically important weed species after passage through a duck's digestive system.

# Weed Seed Chosen Based on Seed Size and Agronomic Impact

## Large Seed Size (6-8 mm)

- Yellow Nutsedge (tuber)
- Sunflower
- Giant Ragweed

## Small Seed Size ( $\leq 1$ mm)

- Palmer amaranth
- Waterhemp
- Common Lambsquarters

## Intermediate Seed Size (3-5 mm)

- Common Ragweed
- Penn. Smartweed
- Morningglory spp.

## Grasses

- Giant Foxtail
- Shattercane
- Barnyardgrass
- Italian Ryegrass

# Feeding Study: Materials And Methods

- Precision fed 1-gram meals of a known quantity of seed from 1 of 13 weeds
- Ducks were placed in individual cages with fecal samples collected every 4 hours for 48 hours
- All practices inspected and approved by MU Animal Care and Use Committee



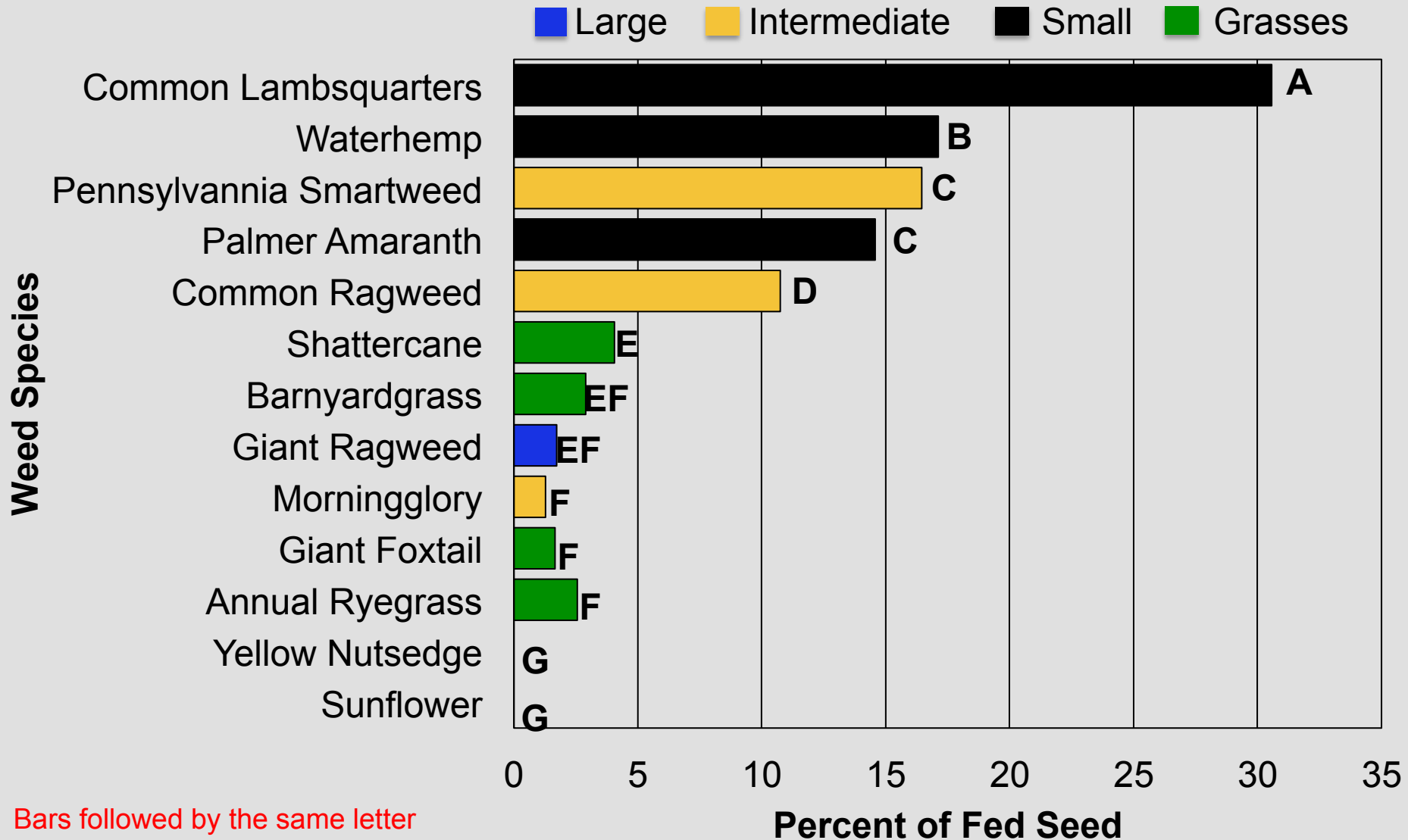
# Feeding Study: Results

Recovered seeds from 11  
of 13 weed species

- No recovery of yellow  
nutsedge tubers or  
common sunflower  
seed



# Recovery Rate of Fed Weed Seed



Bars followed by the same letter are not different, LSD=0.05.

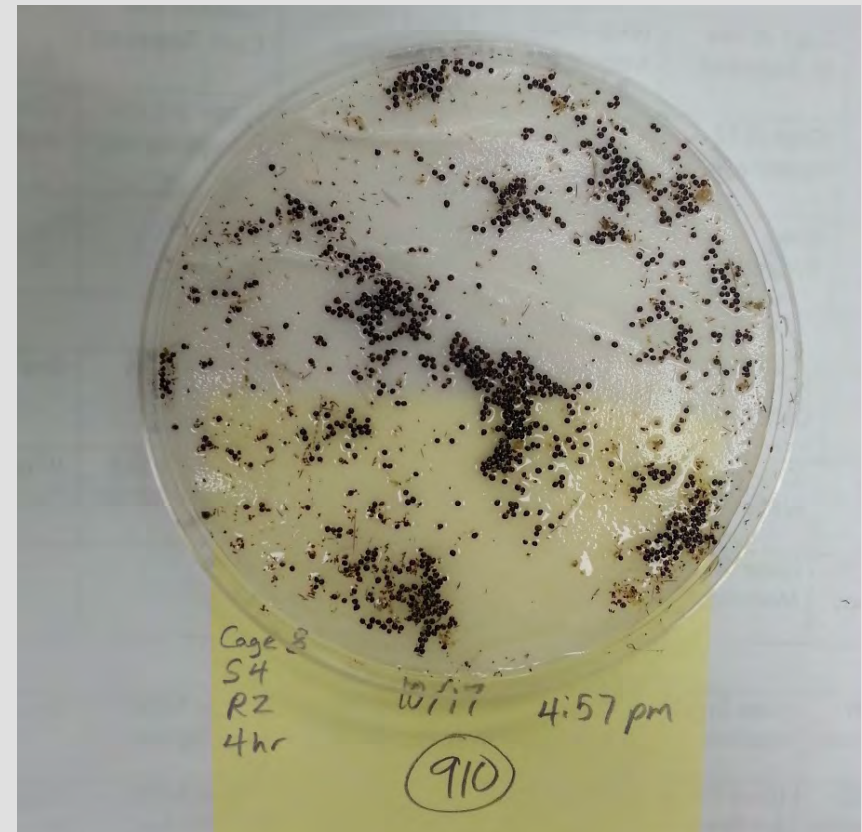


# Feeding Study: Results

Majority of seed recovery occurred between 4 and 16 hours

5 weed species were recovered between 36 and 48 hours

- Palmer amaranth
- Waterhemp
- Common Lambsquarters
- Giant Foxtail
- Pennsylvania Smartweed



4-hour Recovery of Waterhemp Seed:  
910 Seeds recovered out of 3564 (26%)

# Feeding Study: Conclusions

- Weed seeds have the ability to remain intact after passage through the digestive tract of a mallard
- Palmer amaranth, waterhemp, common lambsquarters, giant foxtail and smartweed have the potential to be dispersed over long distances



# Implications

- ~49 million ducks (U.S. Fish and Wildlife Service 2014)
- Average of 18 pigweed seeds emerged per duck
- Potential of ~ 882 million pigweed seed transported!
- Mallards can maintain flight speeds of 48 mph for 38 hours
- Potential to move Palmer amaranth, waterhemp, common lambsquarters, giant foxtail and smartweed ~1,700 miles

