AMPHIBIAN EXPOSURE TO AQUATIC HERBICIDES

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Introduction

1. Aquatic weed management
2. Amphibian phenology
3. Laboratory exposure

Aquatic Weed Management

- Regulation of aquatic weed management in Washington State is largely fish-centric (based on salmonid life history)
  - Hydraulic Project Approval – WDFW, Aquatic Plants & Fish Booklet – permit manual for weed and small-scale nuisance plant control
    - Priority Species – Oregon Spotted Frog (*Rana pretiosa*), Columbia Spotted Frog (*R. luteiventris*), Northern Leopard Frog (*R. pipiens*)
    - Timing Window – By county, major river system
      - Generally: 1 June – 31 October
      - Isolated lakes: 1 July – 30 September
    - Updated 2010: 15 July – 31 December
      - http://www.ecy.wa.gov/programs/wq/pesticides/final_pesticide_permits/aquatic_plants/permitdocs/wdfwtiming.pdf

Amphibian Phenology

- 1 June – 31 October
- Who is at risk from aquatic weed management?
  - What species?
  - What life stages?
  - What habitats linked to species or life stages?

Amphibian Phenology x Aquatic Weed Management

- WDFW – Oregon Spotted Frog Conservation
  - Washington State Endangered, Federal Candidate for Listing in ESA, Canada Endangered, Vulnerable on IUCN Red List, Imperiled or Critically Imperiled on NatureServe (depending on global, national, or state/provincial statuses)
  - Responsibility for conservation

    Habitat maintenance and restoration is the highest priority

    Open prairie/emergent wetlands – shallow water, connection to channels or deeper aquatic habitats
  - Invasive species a factor
    - Reed Canarygrass (*Phalaris arundinacea*) degrades OSF habitat
      - Treat with herbicide in late summer-fall

Background

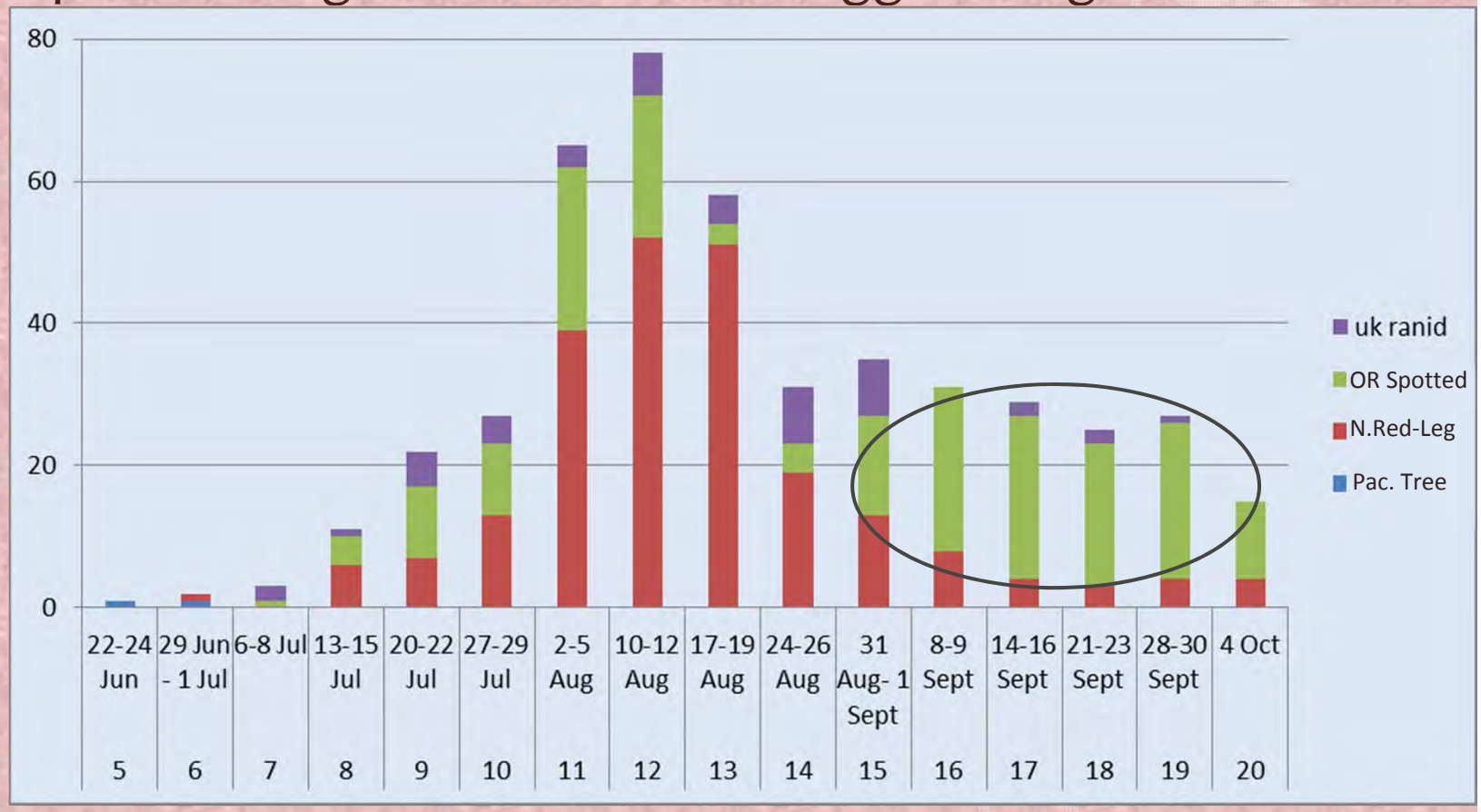
- Collaboration with WDFW
  - Field work– phenology during weed season; all amphibians that are present (May-Oct)
  - Lab exposure – strive for realistic "worst case" exposure scenario with target frog species

Field Study -- Results

When are YOY present?

Oregon Spotted Frog & Northern Red-Legged Frog YOY

Number of YOY Frog Observations at both sites



June July August September Oct

Laboratory Exposure

Background

- Timing of herbicide application corresponds to presence of 1st year Oregon Spotted Frogs
- Imazapyr is the herbicide of choice at WDFW for reed canarygrass control
- Low toxicity, yet data for native amphibians are lacking
  - Bullfrog tadpole LC50 = 1739 mg a.i./L for aquatic formulation (Habitat ®) AMEC Geomatrix, Inc. June 2009 Imazapyr Risk Assessment for WDOE
- Surfactant and dye may alter toxicity

Methods

- 96 hr static renewal toxicity test
  - 2 Imazapyr (Polaris AQ 28.7%) exposures: High (9.7 ppm a.i.) and Low (4.8 ppm a.i.) Volume Applications
  - Tank mix (Imazapyr, Agri-Dex [44.4 ppm a.i.], Hi-Light [11.2 ppm a.i.])
  - Assuming standard spray mix applied to 2 cm of water with no overhanging vegetation
- YOY Oregon Spotted Frogs
  - Life stage at risk of exposure
  - Access to 45 YOY (15 per treatment) from rearing facility
- 2-month grow-out in clean water

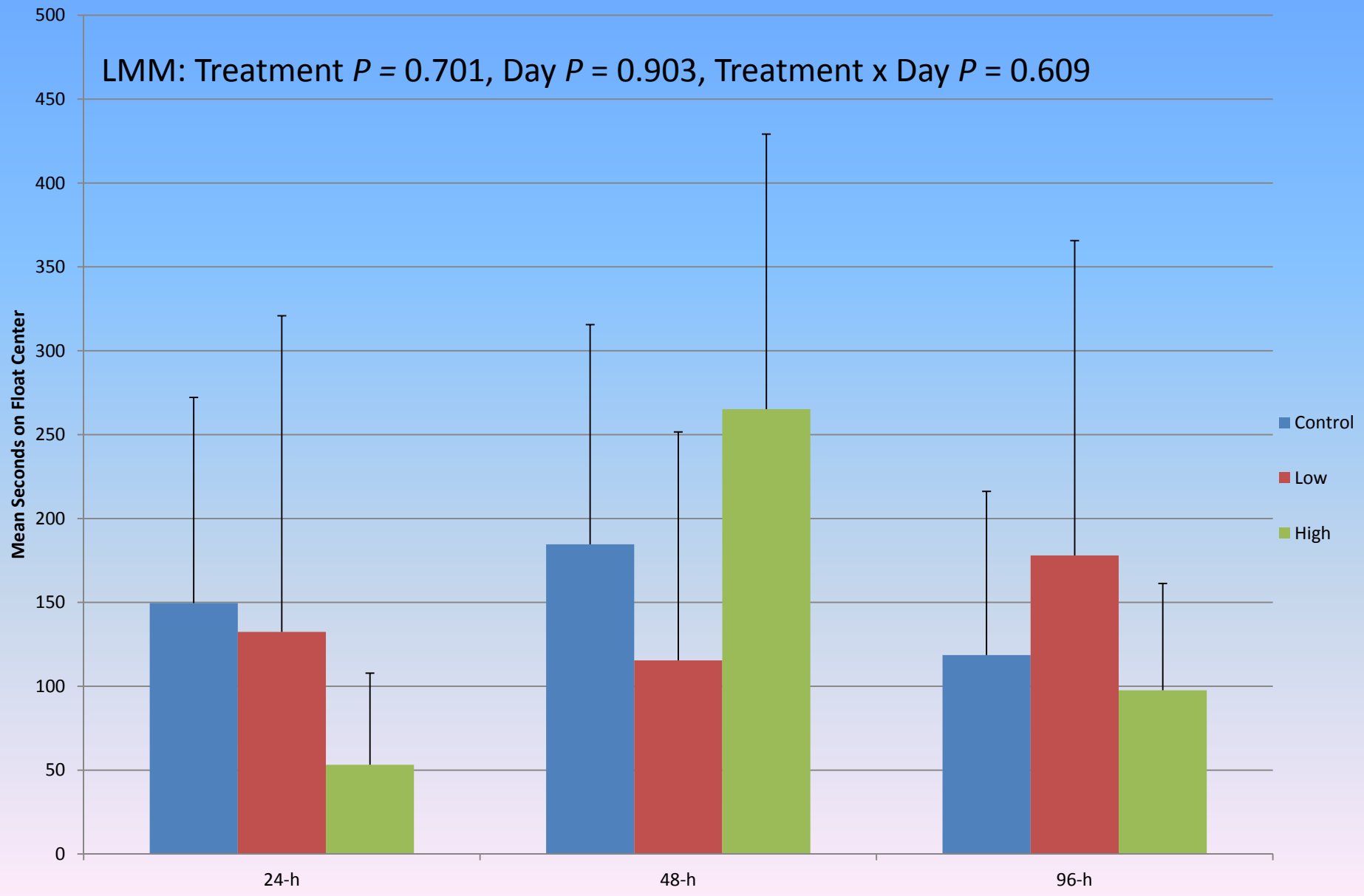
Methods

- 3 frogs per tank, 5 replicates per treatment
- Start of test:
  - Average frog mass : 3.3 ± 1.3 g
  - Average frog length : 29.0 ± 3.4 mm
  - Frogs too young to ID gender
    - Control 5:10 (M:F)
    - Low 7:8 (M:F)
    - High 8:7 (M:F)
- Endpoints:
  - Feeding (# crickets consumed, behavior) – linear mixed model
  - Growth (weight and length -> body condition as scaled mass index) – linear mixed model
  - Liver weight by body condition index– ANOVA
    - General response to toxicity is weight increase
  - Gonad inspection

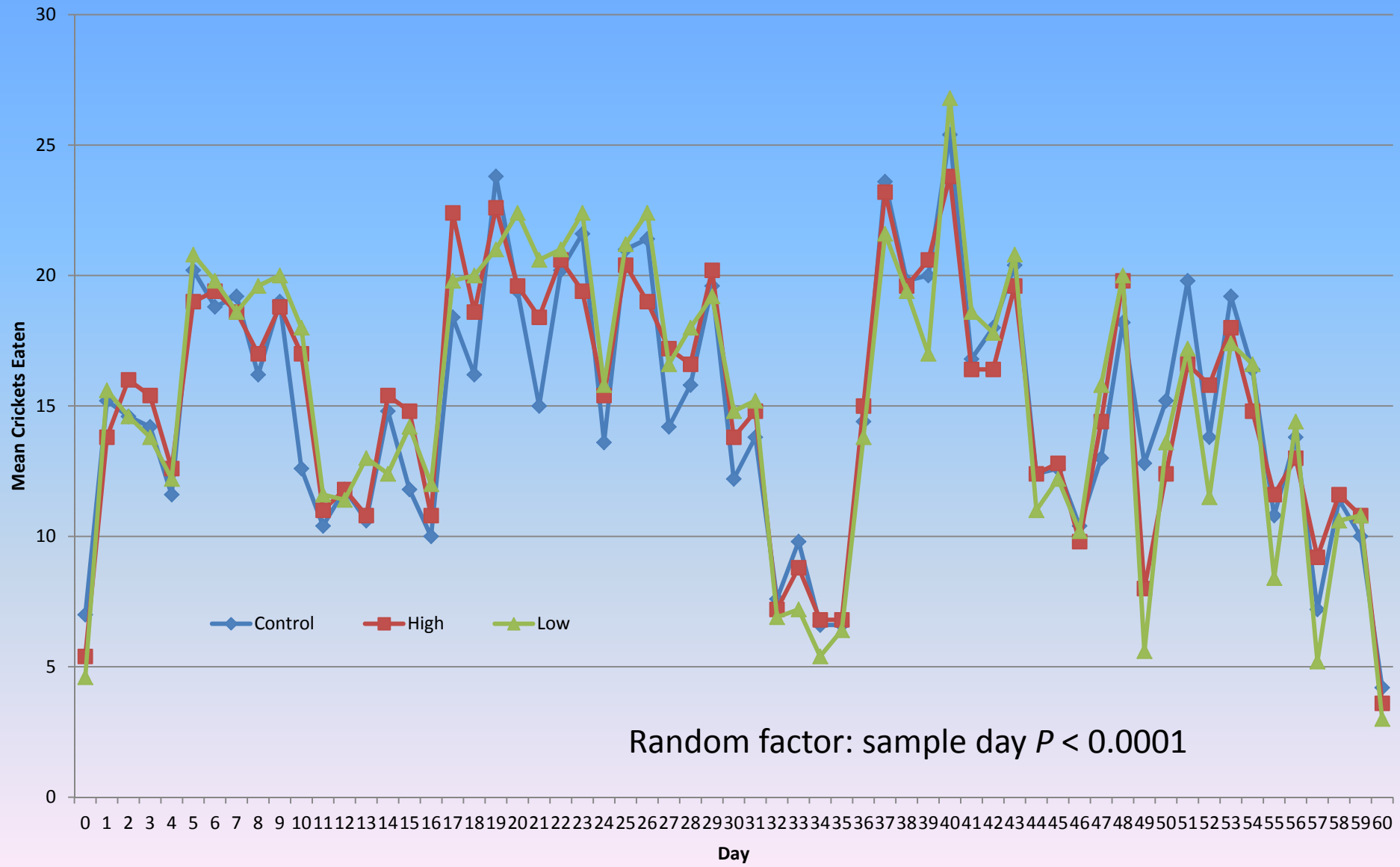
Results

- No mortalities
- No gross anomalies in overall health
- No gross anomalies in gonad structure
  - Except – 1 precocious male in High treatment

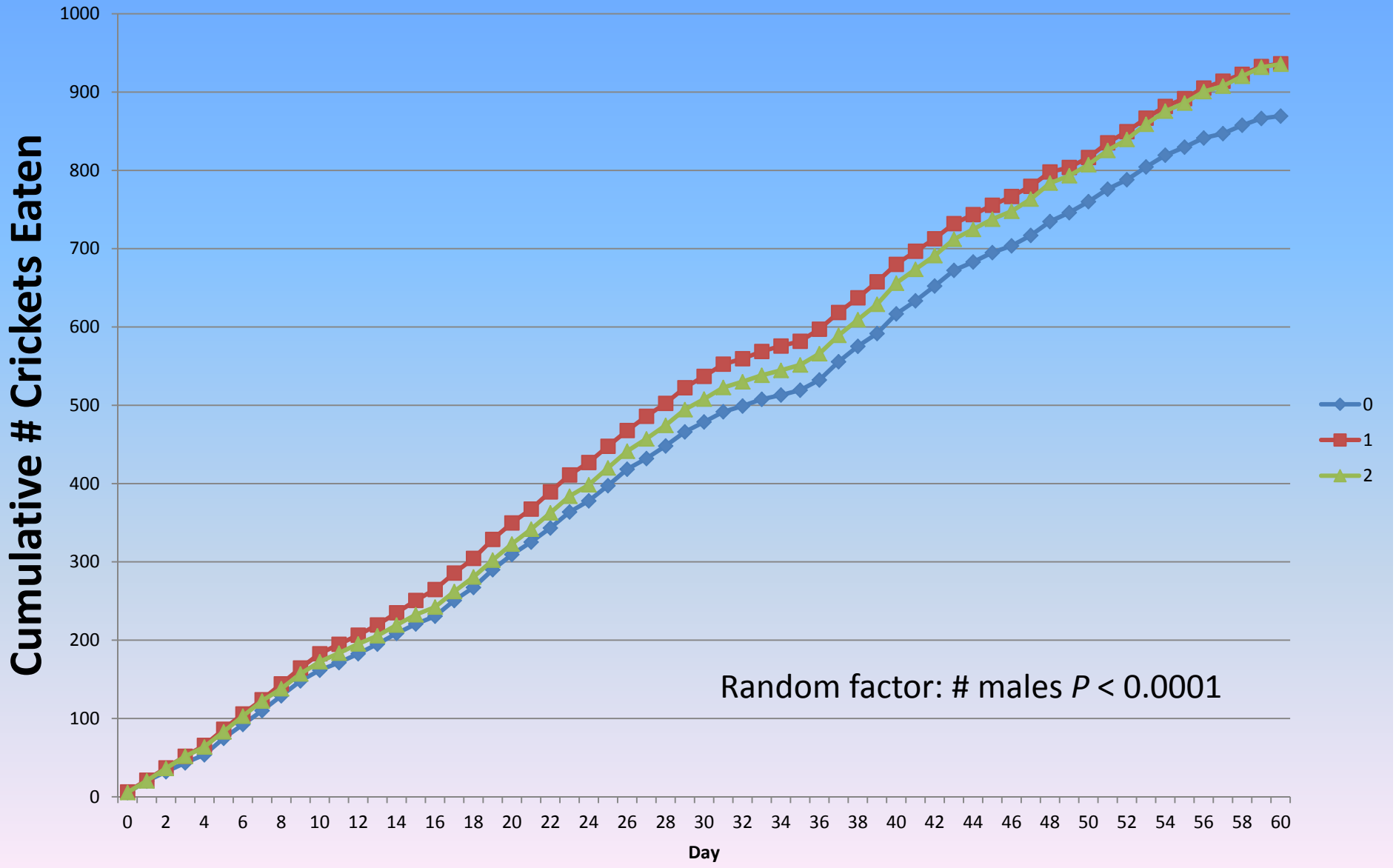
Behavior: Seconds on Float



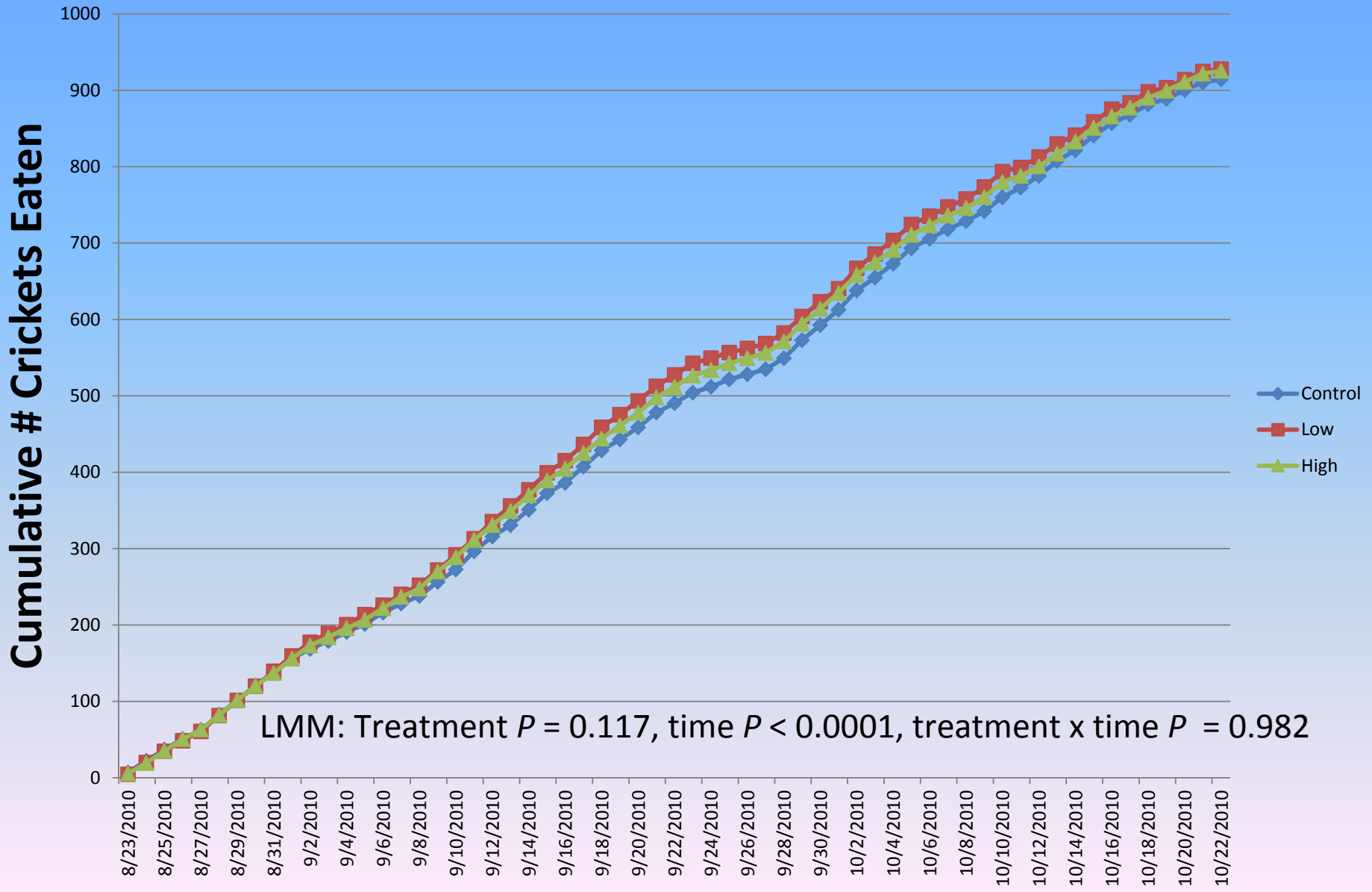
Crickets Eaten: Sample Day



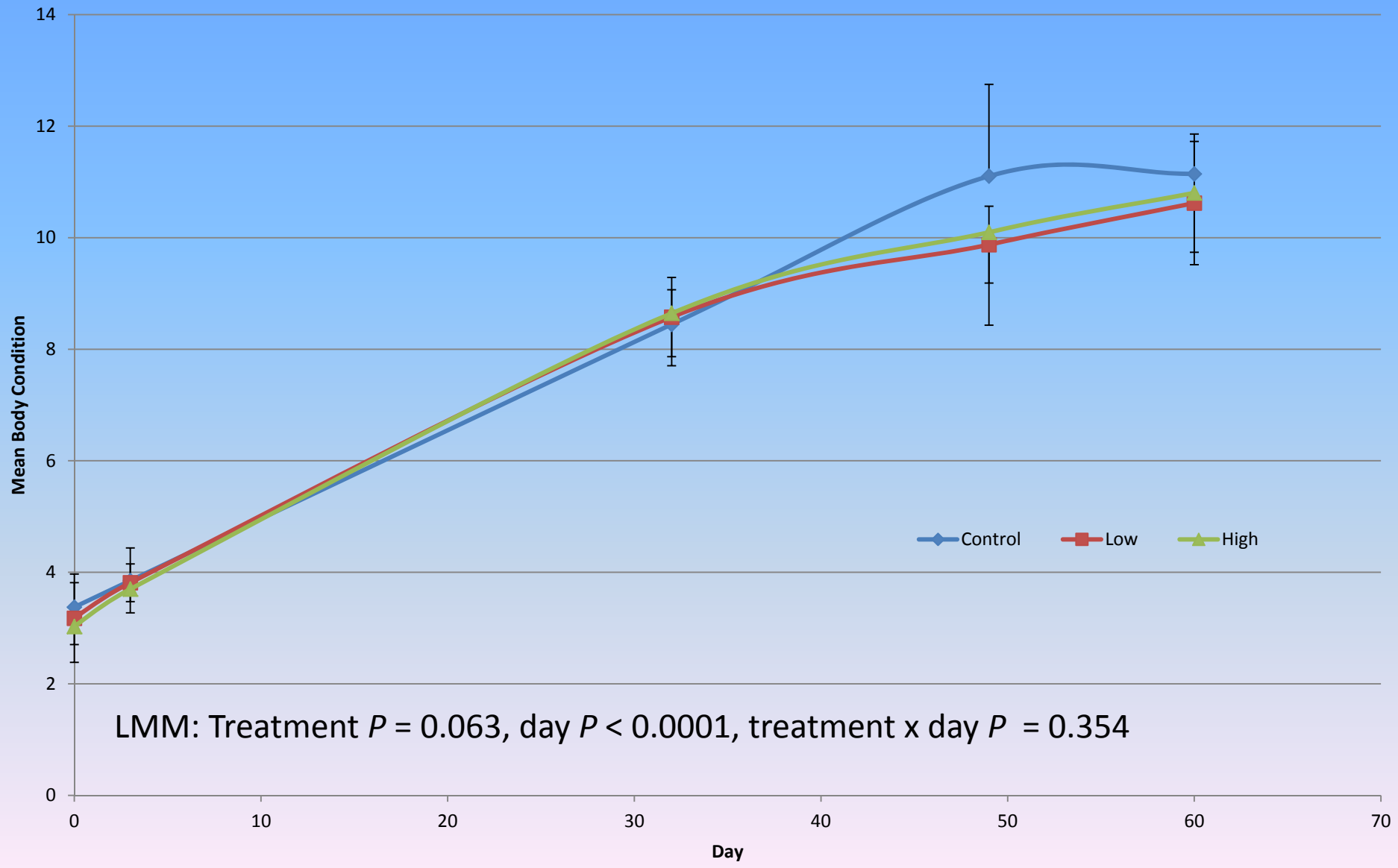
Crickets Eaten: # of Males



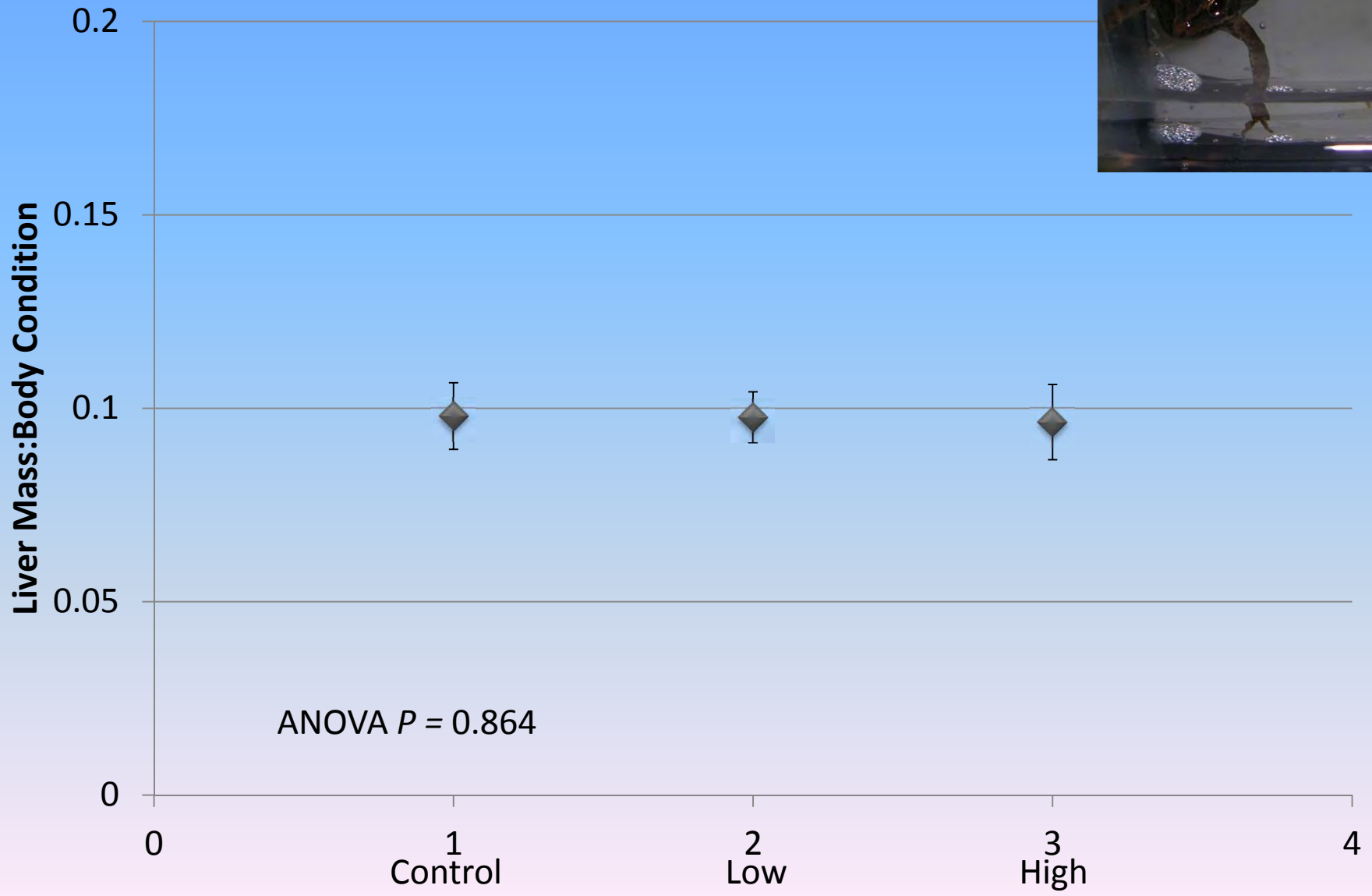
Crickets Eaten: Treatment



Body Condition: Treatment

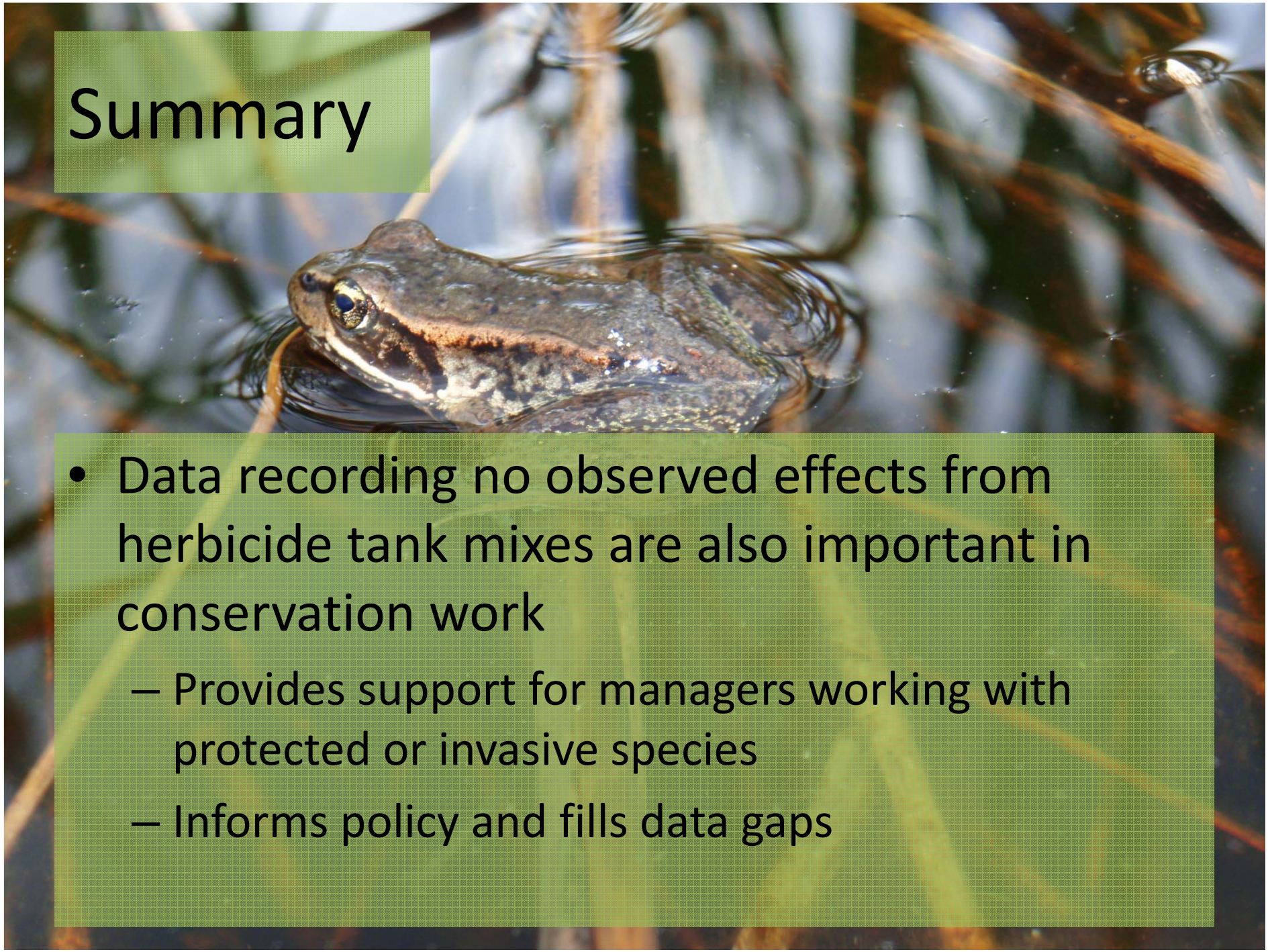


Liver Condition



Summary

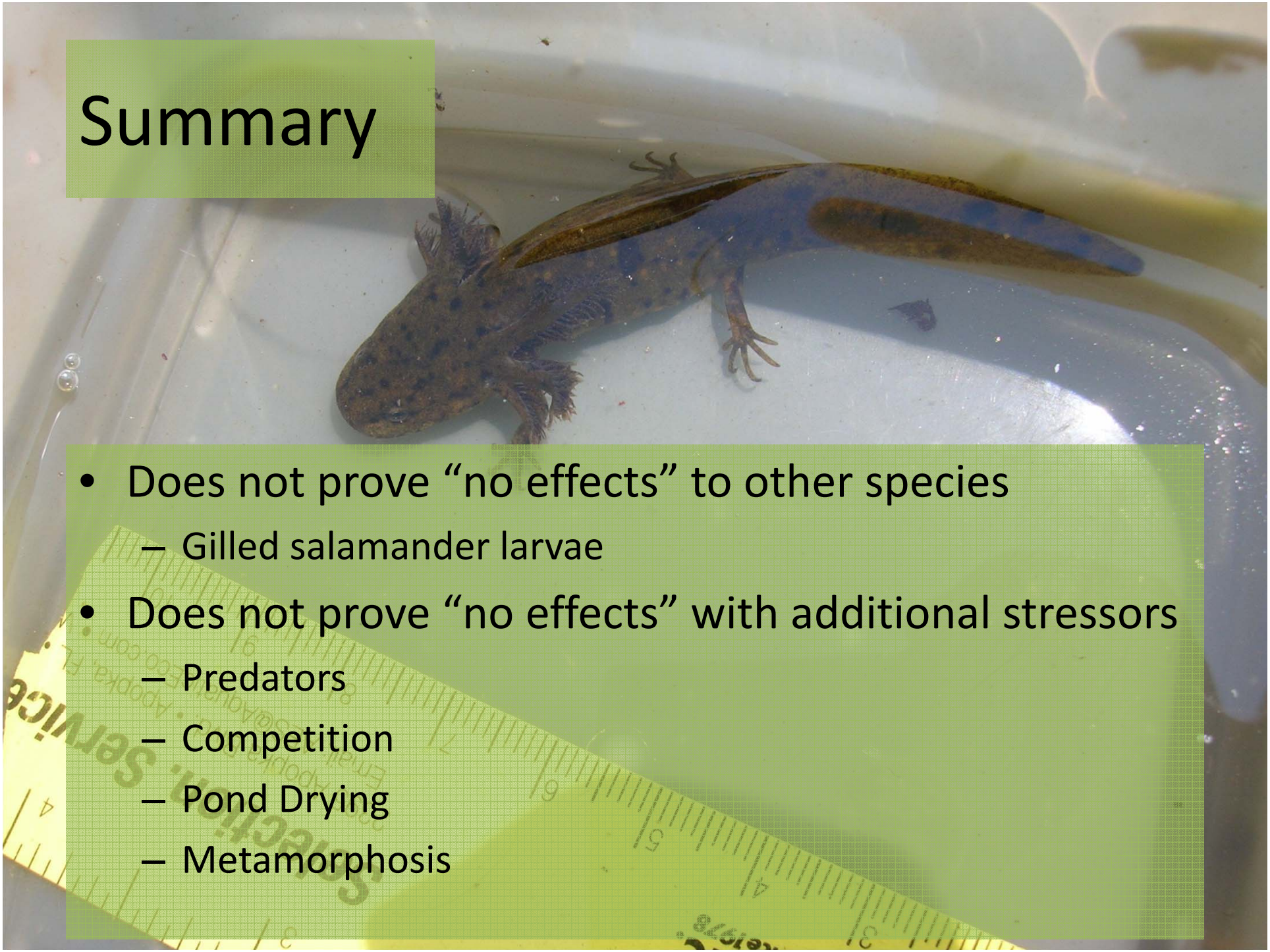
- No overt toxic effects on OSF from Imazapyr tank mixes
- No differences in OSF growth, liver condition index, body condition index
- No differences in OSF behavior (seconds on float and number of crickets eaten)



Summary

- Data recording no observed effects from herbicide tank mixes are also important in conservation work
  - Provides support for managers working with protected or invasive species
  - Informs policy and fills data gaps

Summary

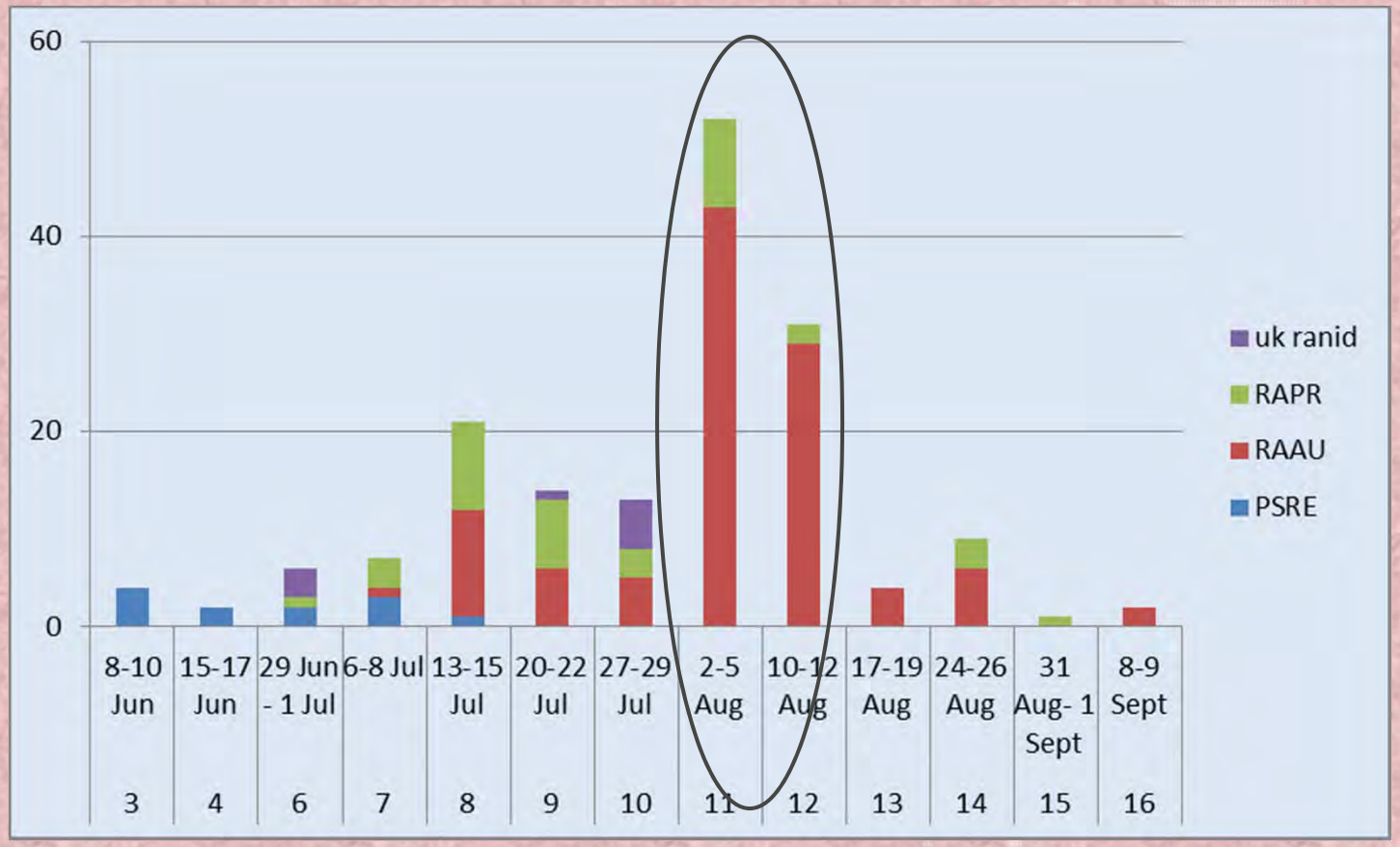


- Does not prove “no effects” to other species
  - Gilled salamander larvae
- Does not prove “no effects” with additional stressors
  - Predators
  - Competition
  - Pond Drying
  - Metamorphosis

Next Step – Stressors?

When is metamorphosis?

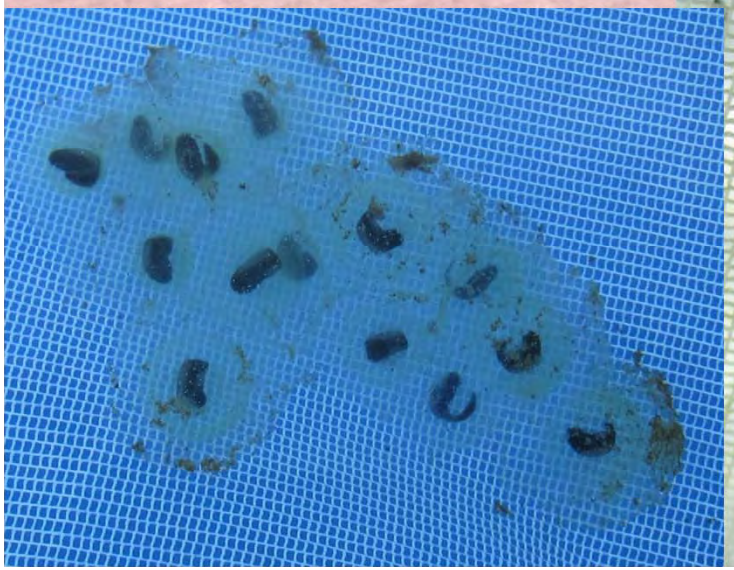
Number of Observations of Metamorphosing Frogs



June July August September

Next Step

- Toxicity tests
  - Northern Red-legged Frogs
  - Metamorphosis
  - Triclopyr + Competitor + Dye



Next Step – Stressors?

Predators?

- Snakes, invertebrates, parasites?
- Metamorphic & juvenile frogs are consumed by snakes
  - Visual cues are important
  - How to stimulate stress associated with fear of predation?
  - How to determine if stress was induced?

Next Step

- Predator stress test
  - Juvenile frogs & snakes
  - Prototype development – "stress arena"
    - Test different designs
    - Ability to incorporate into 96-h toxicity test
    - Metrics include behavior and stress hormones
      - Pending validation – fecal matter may provide a non-destructive, real-time assessment of stress levels

Thank you!

- Washington Department of Ecology, Aquatic Weeds Management Grant
- Washington Department of Fish and Wildlife
  - Cole Roberts, Tiffany Hicks
- Port Blakely Tree Farms
  - Blake Murden
- Washington Cooperative Research Unit, University of Washington
  - Martin Grassley, Mike Smith
- Woodland Park Zoo

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Questions?

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