Threats to the Platte River Caddisfly An Endemic Semiterrestrial Insect

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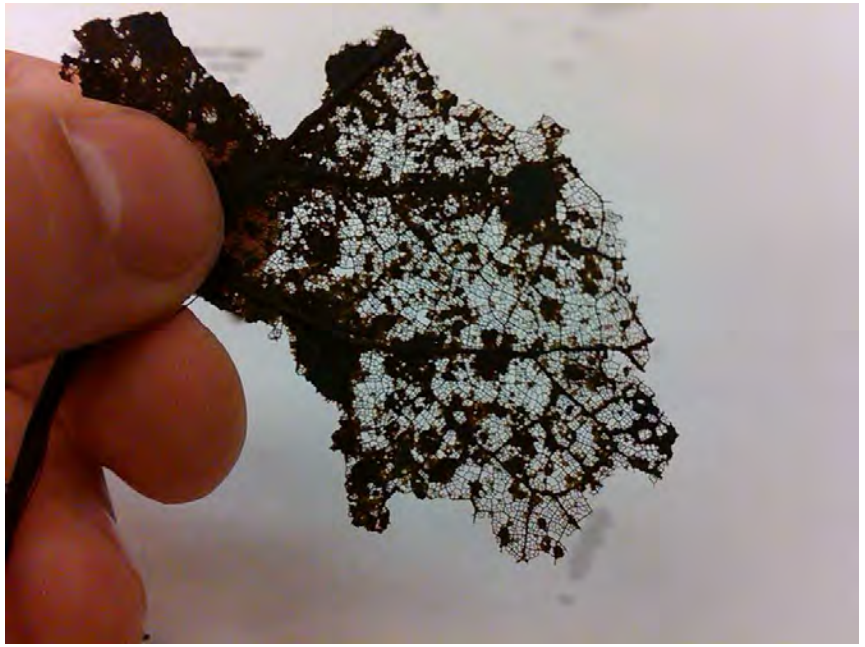
Platte River Caddisfly: Ecological Importance

- CPOM shredder
- Bio-indicator
- Energy link between terrestrial and aquatic ecosystems
- Dominant macroinvertebrate component in systems they occupy



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Platte River Caddisfly: Description

- Discovered at Crane Trust in a slough on Mormon Island (Grand Island, NE) in 1997

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- Described by Alexander and Whiles (2000) as *Ironoquia plattensis*

Lindsay Vivian

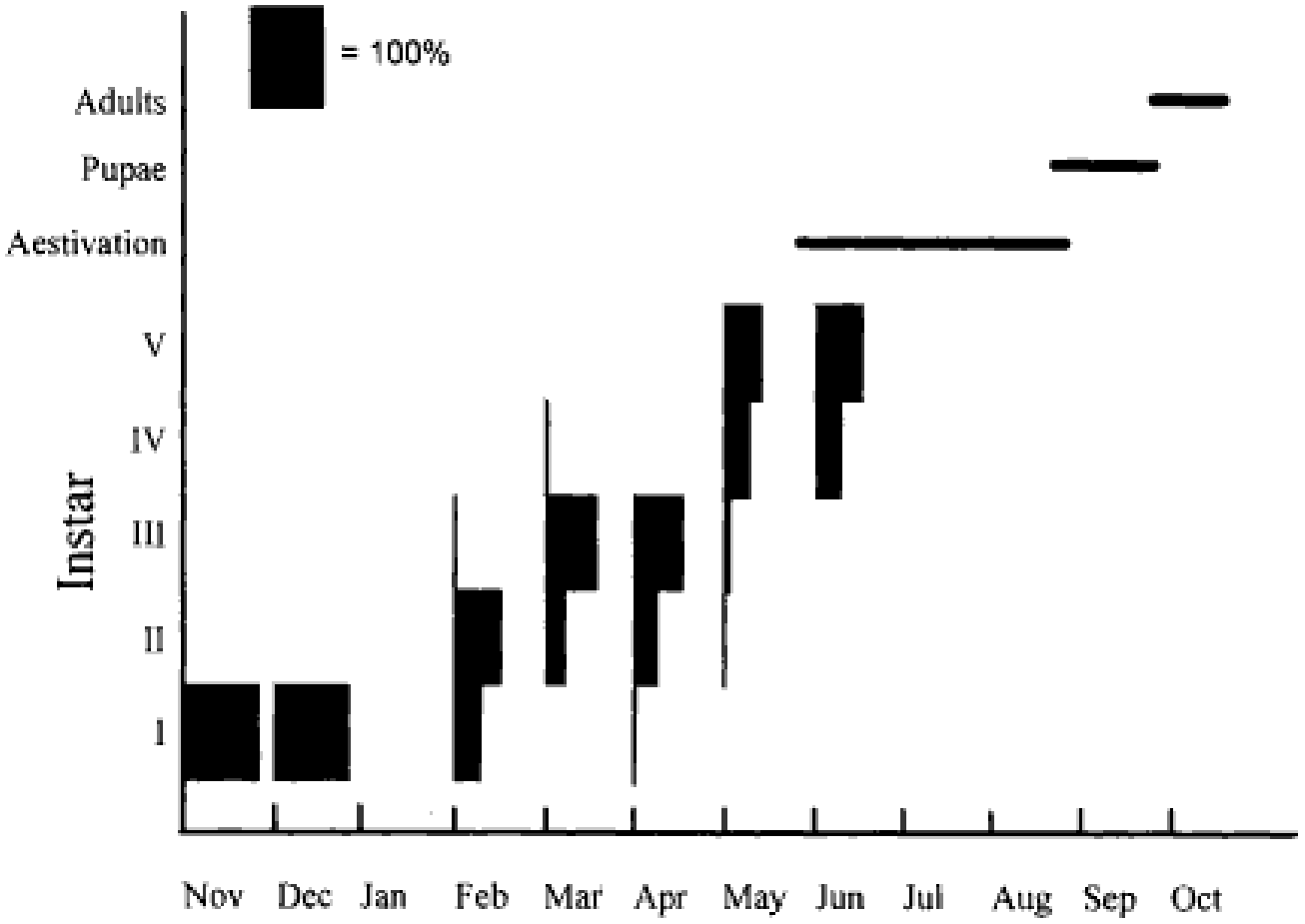
Platte River Caddisfly: Biology

- One generation per year
- Five larval instars
- Rare life history characteristics
  - Terrestrial stage
- Habitat type
  - Backwater sloughs

Jeanine Lackey, Service

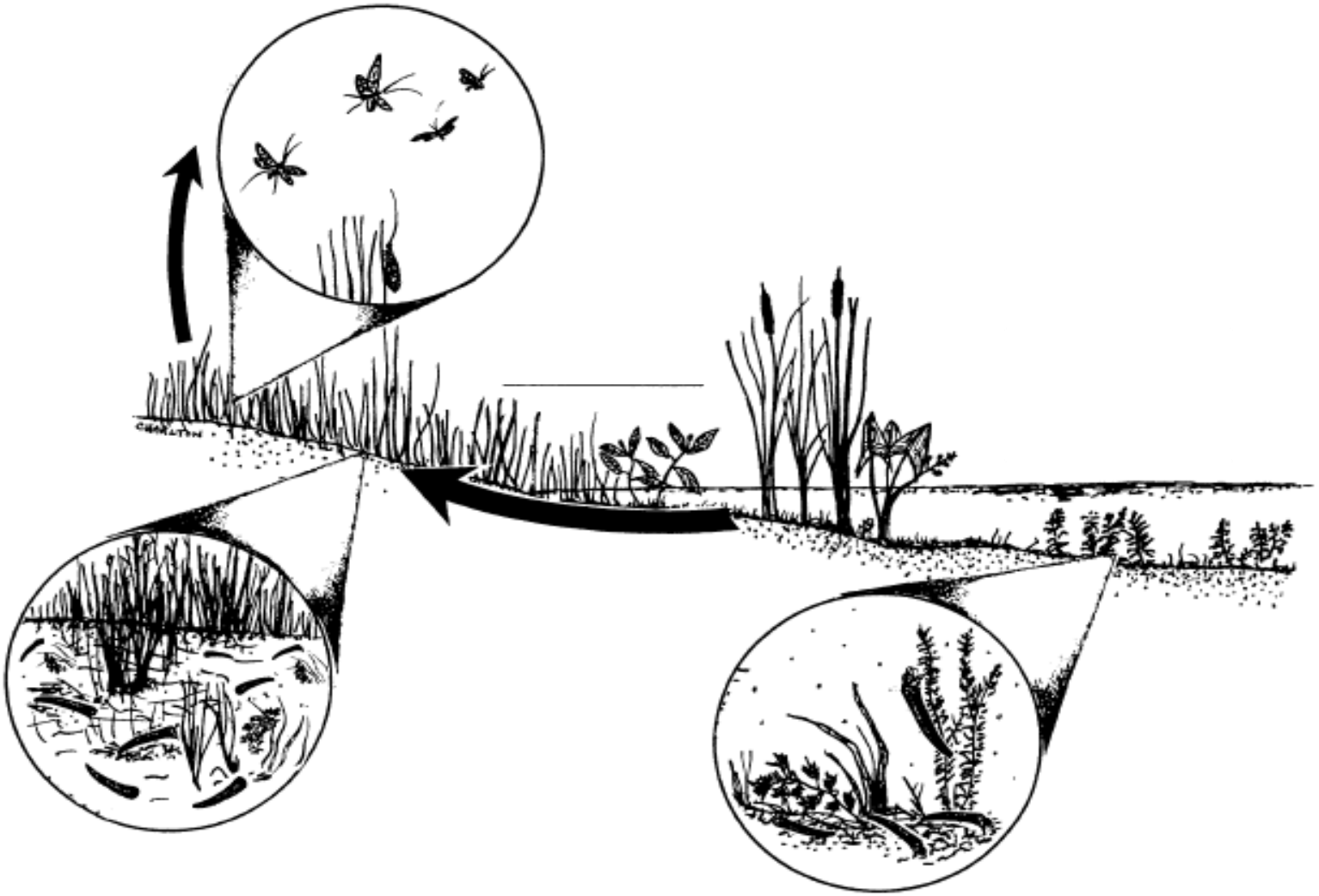
Whiles et al., 1999

Platte River Caddisfly: Life History



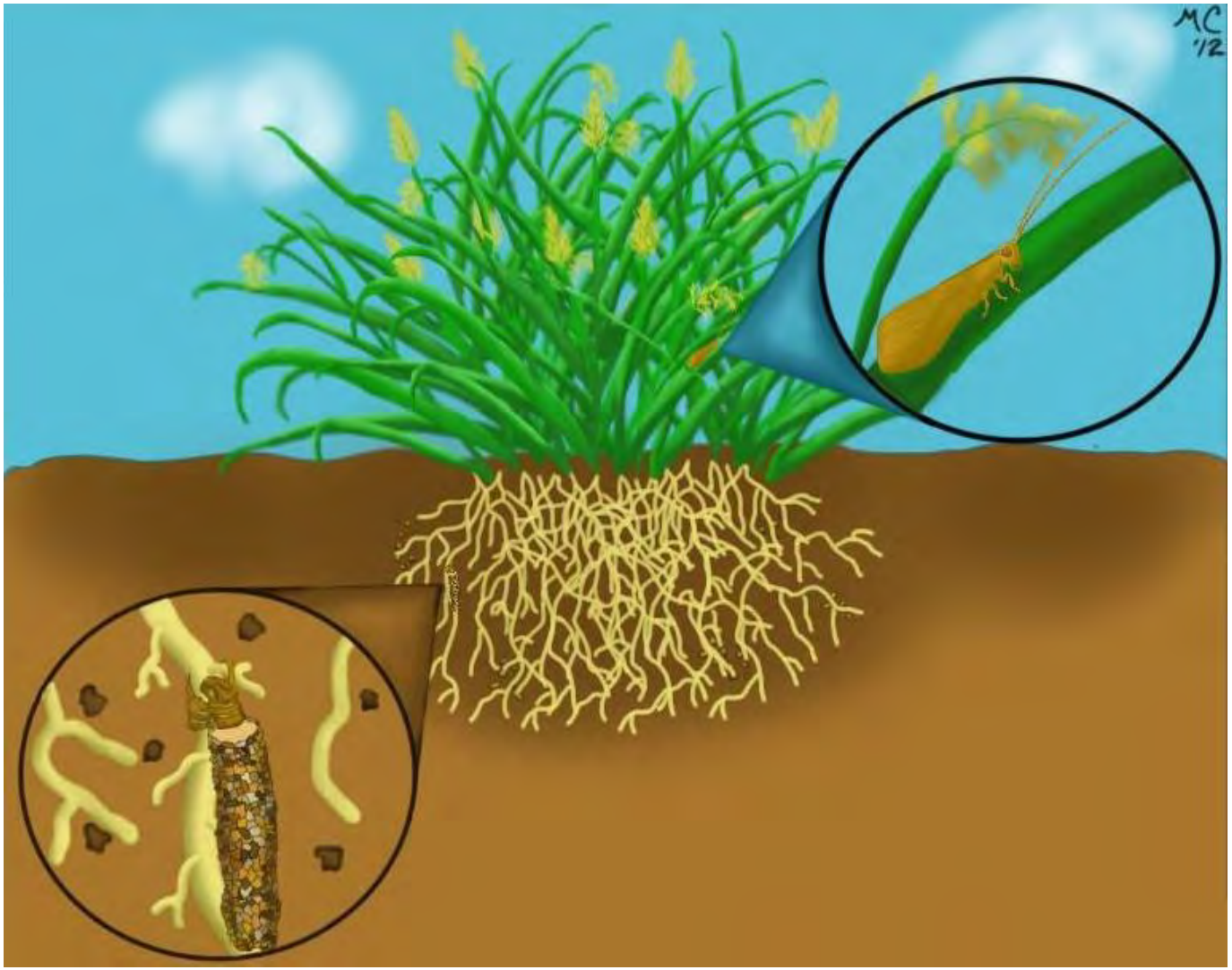
Whiles et al., 1999

Life History



Whiles et al., 1999

Life History



Platte River Caddisfly Potential for Protection

- Populations estimates 6% at best sites from original densities found at the type locality
- U.S. Fish and Wildlife Service petitioned in 2007 by WildEarth Guardians to list the caddisfly as endangered.
- 2009-2011:
  - 115 sites were surveyed for PRC larvae
  - 30 new populations identified

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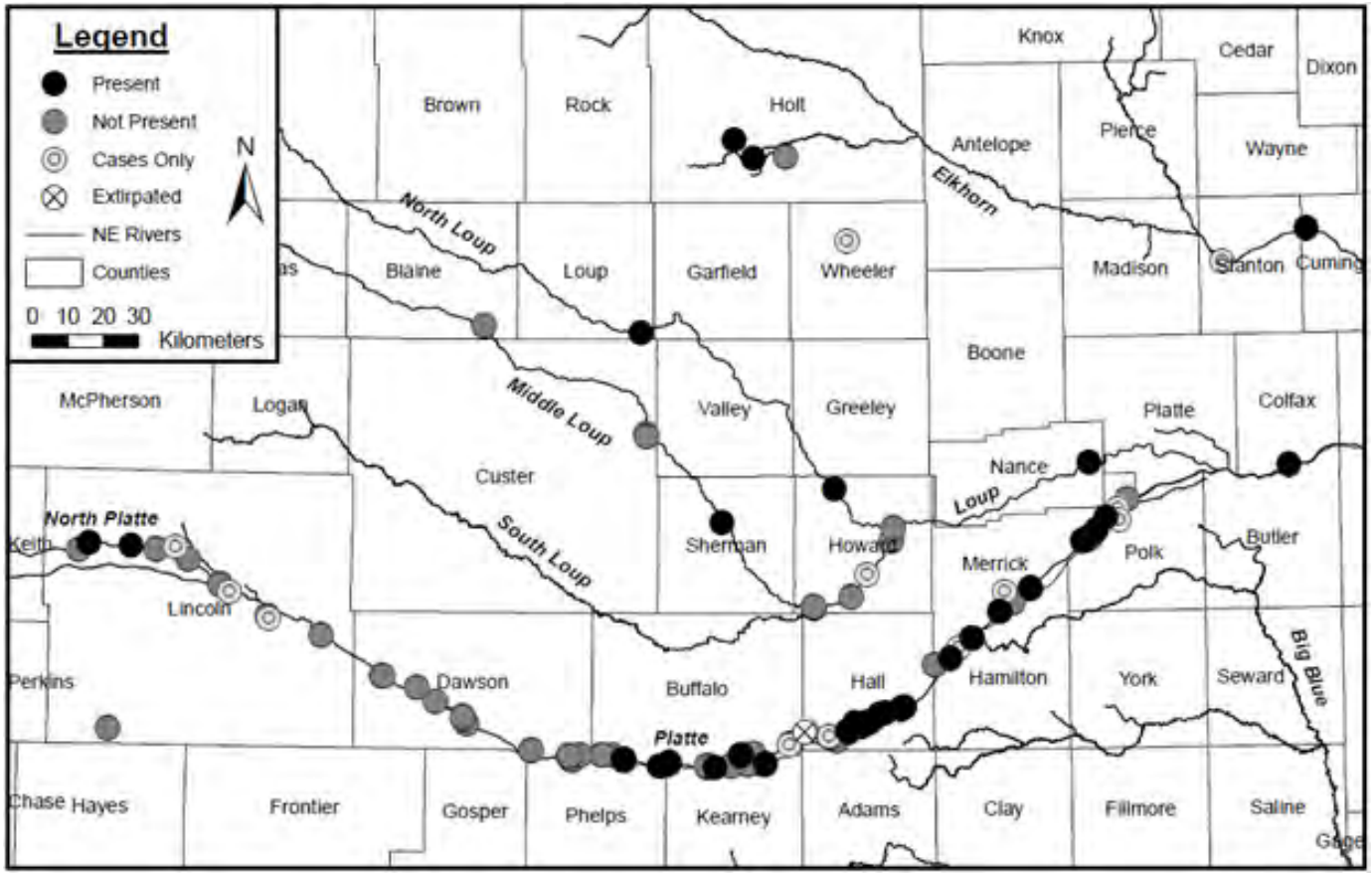
Vivian, 2010

Platte River Caddisfly: Distribution

- 35 known populations along the Platte, Loup, and Elkhorn River — 32 on the Platte and Loup



Vivian et al., *in review*

Potential Threats to the Platte River Caddisfly

- Platte River hydrology
  - Hypoxia adaptations
- Changes in plant community
  - Exotic riparian vegetation
- Potential predators
  - Fish and larval amphibians

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Platte River Caddisfly: Hypoxia Tolerance

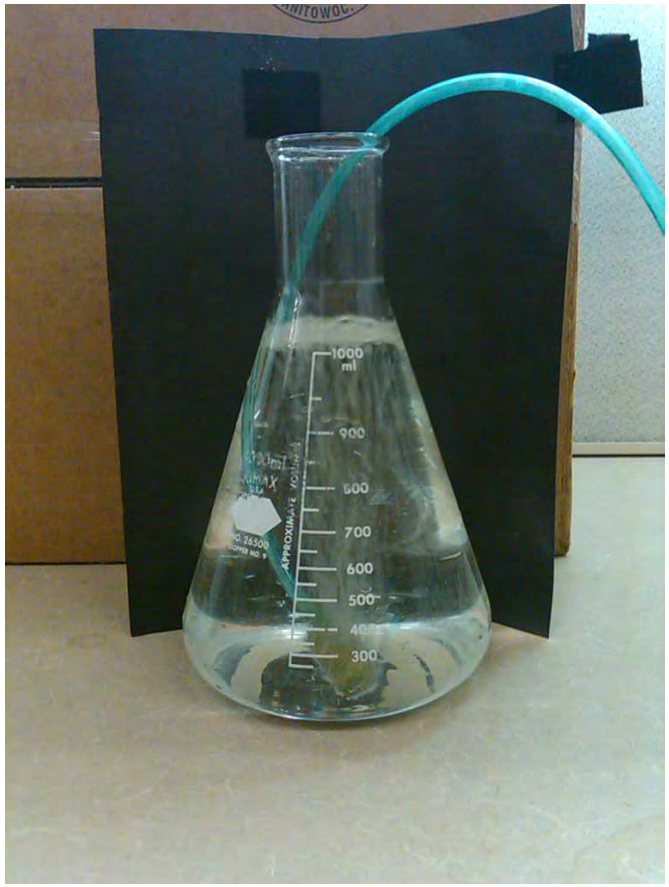
- Depletion of oxygen
  - Algal blooms
    - Nutrient overload
  - Soil flooding*

- Biochemical consequences
  - Anaerobic respiration
    - Lactate build up

water.epa.gov

Hypoxia Tolerance: Methods

- Spring water bubbled with nitrogen gas
  - D.O. (<0.03 mg/L)
- Sets (n=6) with five individuals immersed
- Varying time intervals
- N=30 total per trial (temperature x time intervals)



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Hoback et al., 1998

Hypoxia Tolerance: Methods

- Three life stages tested
  - Aquatic 5th instar
  - Terrestrial 5th instar
  - Pupae
- Tested at 10°C and 20°C
- Analyzed with Toxstat 3.4
  - Mean time to 50% survival (LT50) ±95% C. I.

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Hypoxia Tolerance: Methods

- Individuals given 24hr to recover

- Assessment of survival
  - Larvae: movement after 24hr
  - Pupae: rolling of abdomen after 24hr

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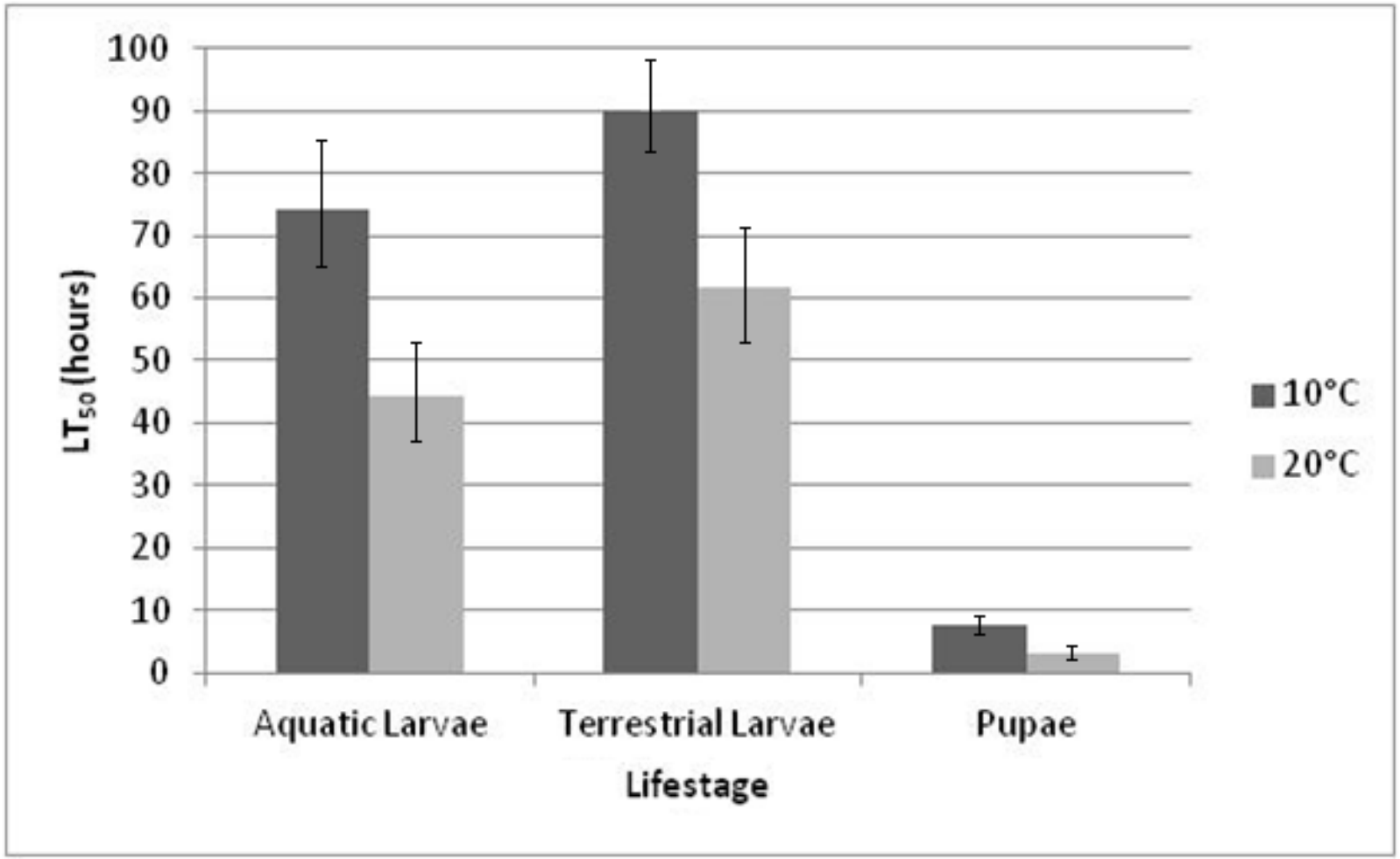
Hypoxia Tolerance: Results



Mean survival times (+ 95% Confidence intervals) of three life stages of PRCF.

Hypoxia Tolerance: Discussion

- Significant difference ($p < 0.05$) between survivorship of larvae and pupae
  - Stage-specific metabolic demands
- Terrestrial/Aquatic larvae
  - Behavioral adaptation

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Hypoxia Tolerance: Conclusions

- Late-August flooding could cause pupal mortality
- Terrestrial larvae slightly more hypoxia tolerant
  - Burial behavior
- Aquatic larvae remain active

Joel Sartore, National Geographic Stock

Platte River Caddisfly: Predation Threats

- Ecological nuisance species
  - Western mosquitofish, *Gambusia affinisis*
  - Bullfrog, *Lithobates catesbeiana*
- Similar habitat requirements
  - Larval amphibians
  - Fish nursery grounds
- Easily introduced
  - Bait buckets
  - Intentional release

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Predation Threats: Methods

- Fifteen 10-L aquaria
- Three 2nd-3rd instars per tank with one predator
- Minimum of 15 individuals tested per predator species
- Percival® environmental chambers 10˚C

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Predation Threats: Methods

- Predators tested
  - Potentially introduced
    - Brook stickleback, *Culaea inconstans*
    - Western mosquitofish, *Gambusia affinisis*
    - Bullfrog tadpole, *Lithobates catesbeianus*
    - Fathead minnow, *Pimephales promelas*
  - Native
    - Plains topminnow, *Fundulus sciadicus*
    - Iowa darter, *Etheostoma exile*
    - Green sunfish, *Lepomis cyanellus*
    - Black bullhead, *Ameiurus melas*
    - Brassy minnow, *Hybognathus hankinson*

Geoff Brightling

Predation Threats: Methods

- Monitored for 72hr after predator introduction
- Larvae consumption recorded every 24 hr
- Remaining PRC larvae case lengths recorded

Lifescience.com

Predation Threats: Results

Species	Number Of Fish Tested	Larva Available	Daily Feeding Rates	Total Larvae Consumed	Removed from Cases (Percent Removed from Cases)	Mean Larva Case Length Before (cm)	Mean Larva Case Length After (cm)
Brook stickleback	15	45	0.49 *	22 *	17 (77)	0.59	0.64
Western mosquitofish	15	45	0.08	4	1 (25)	0.58	0.60
Plains topminnow	15	45	0.06	3	0 (0)	0.52	0.54
Iowa darter	15	45	0.00	0	0 (0)	0.53	0.53
Green sunfish	15	45	0.24	11	3 (27)	0.67	0.45
Black bullhead	15	45	0.20	9	0 (0)	0.55	0.44
Bullfrog tadpole	15	45	0.04	2	0 (0)	0.48	0.51
Fathead minnow	15	45	0.11	6	2 (33)	0.49	0.53

* Significant Difference ($p < 0.05$)

Predation Threats: Methods

- Brook stickleback showed aggressive predation
- Prompted experiments with 3cm of leafy detritus (refuge for larvae) using the same methods

Mary Harner, Crane Trust

Predation Threats: Results

Total larvae consumed by brook stickleback, *Culaea inconstans,* (*n* = 15 per condition) in aquaria with leaf detritus as refuge for larvae and without leaf detritus.

Condition	Total Available Larvae	Total Consumed	Percent Consumed
Detritus	45	14	31
No Detritus	45	17	37

Joel Sartore ©

Predation Threats: Discussion

- Significant predation by brook stickleback (*Culaea inconstans*) ($p<0.05$)
  - Detritus vs. no detritus not significant ($p = 0.49$)

- Previously undocumented foraging behavior

dnr.state.oh.us

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Predation Threats: Conclusion

- Type locality (Whiles et al., 1999)
- Invasion of fish in sites with low densities could inhibit populations
  - Brook stickleback
- Substrate could facilitate greater risk of predation
  - Siltation
- More permanent waters

Kearney Hub

Overall Conclusions

- Federal protection not currently warranted
  - More populations than previously known
- Disjunct distribution and low densities
  - 6% of historic numbers at best site

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Threats

- Threats
  - Water regime
    - Avoid fall floods
  - Fish predation
    - Limit introduction of fish outside their natural range

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Overall Conclusions

- Threats
  - Water regime
    - Avoid fall floods
  - Fish predation
    - Limit introduction of fish outside their natural range
  - Exotic vegetation
    - Encourage cattail establishment
    - Reduce Phragmites monocultures

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Questions?