Great Lakes ANS Panel Spring meeting,
June 25-27, 2024

Signal crayfish (*Pacifastacus leniusculus*) in Minnesota

Don Eaton | Aquatic invertebrate biologist

Signal crayfish | https://www.dnr.state.mn.us/invasives/aquaticanimals/signal-crayfish.html

Invasive Species Unit

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Acknowledgements

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Collaborators:

- Gretchen Hansen & Denver Link – University of Minnesota & Minnesota Aquatic Invasive Species Research Center (MAISRC)
- Eric Larson & Caitlin Bloomer – University of Illinois, Urbana-Champaign | Illinois Natural History Survey
- Justin Swart – Aquatic Invasive Species Prevention coordinator, Douglas County, MN
- Fish and Wildlife Division – MN DNR

Response planning advisors:

- Kathleen Quebedeaux & Lucas Nathan – Michigan DNR, Lansing, MI
- Brian Roth – Michigan State University, East Lansing, MI
- Julian Olden – University of Washington, Seattle, WA
- Amy McGovern & Kate Wyman-Grothem – USFWS, Midwest Region Headquarters, Bloomington, MN
- Lauren Kong – USFWS, Sacramento Fish and Wildlife Office, Sacramento, CA
- Maria Ellis & Jeff Cook – Spring Rivers Ecological Sciences LLC, Cassel, CA
- Nicky Green Associates – Crayfish Conservation and Control Projects, UK
- Martin Hallkvist – Nordic Crayfish Company, Pine City, MN
- Invasive Crayfish Collaborative (ICC) – Illinois-Indiana Sea Grant | Illinois Natural History Survey

Native and Non-native ranges

Pacifastacus leniusculus

Nonindigenous Aquatic Species (NAS) database – United States Geological Survey
https://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=200

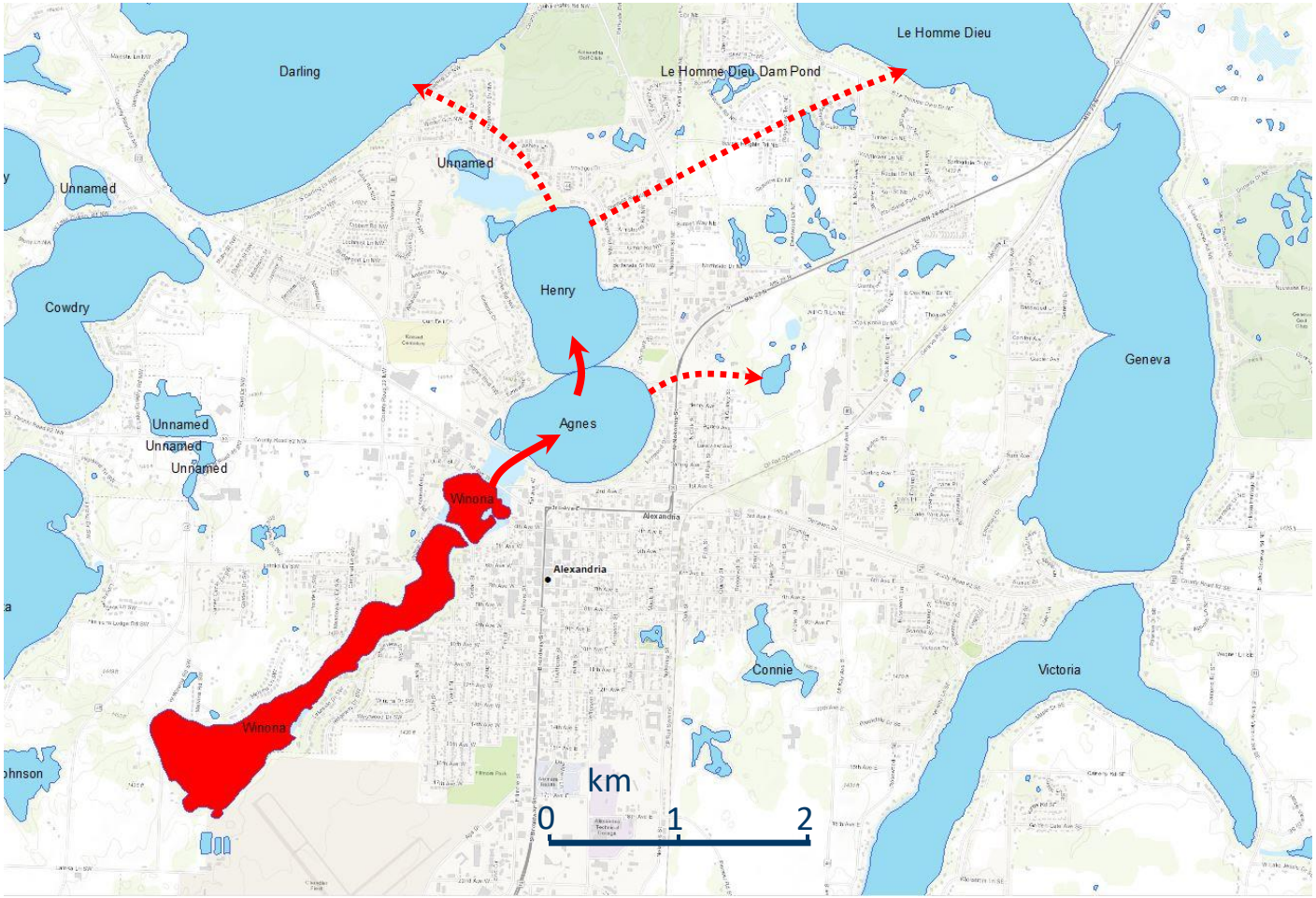
= approximate native range

Introduced to sites in CA (1895), NV, OR, UT and Kodiak Island, Alaska (2002)

27 European territories (1959)

Hokkaido Island, Japan (1929)
- *Holdich et al. (2014)*

Discovery in Lake Winona, Douglas County, MN, Oct 2023



Lake Winona:

- 86 ha (213 acres)
- eutrophic
- Shallow, ave. 1.5 m
- substrate – fine sediment

- 10 large (53 – 65 CL) signal crayfish captured by commercial harvester
  - 9 males, 1 female
  - baited fyke nets, crayfish were not intended target
- Female showed no signs of recent copulation or oviposition
- Record was verified by experts and made public by MN DNR

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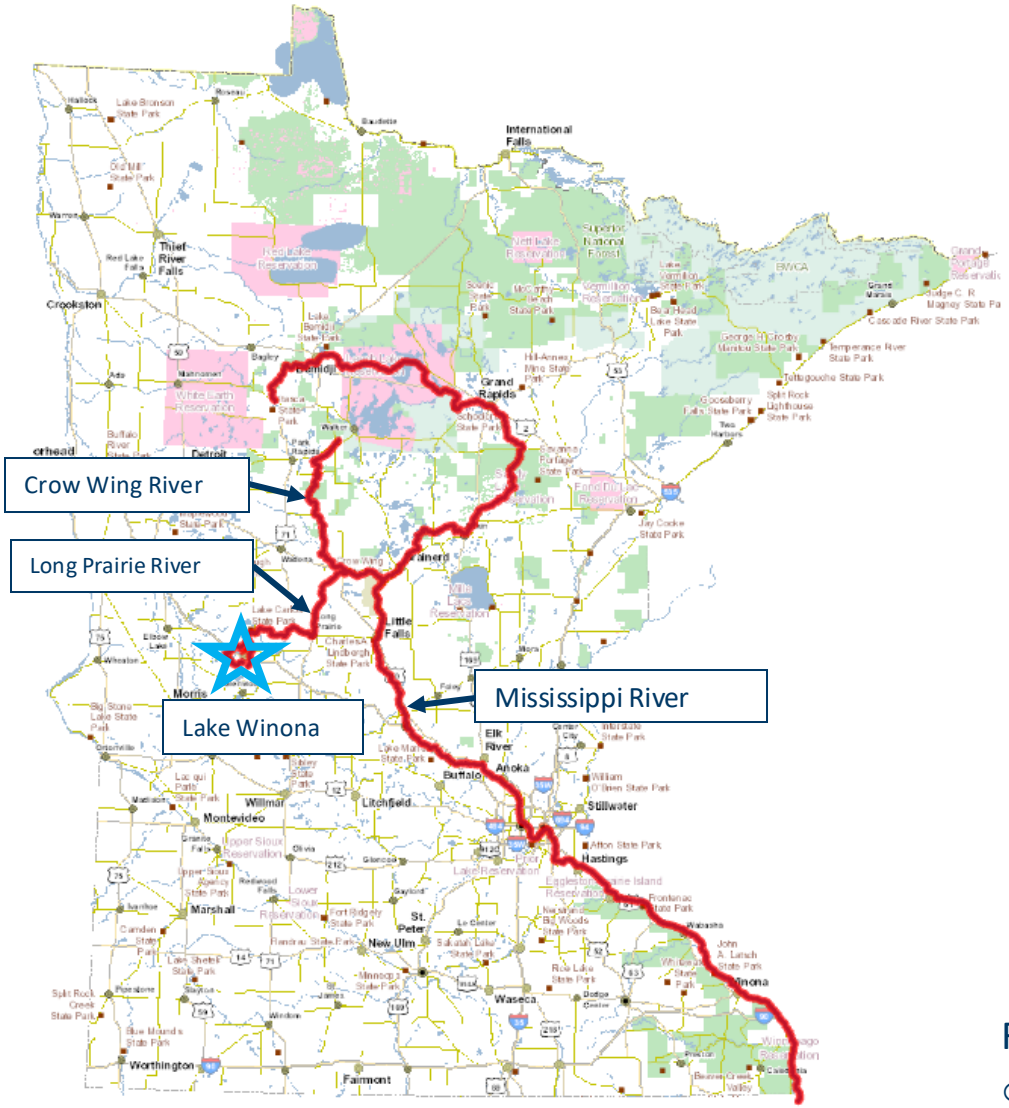
Potential for spread



Connection to Mississippi River basin

Faxonius virilis

Follow-up trapping, Oct 23-25, 2023

- Lakes Winona, Agnes & Henry
- NO signals
- 24 virile crayfish, 5 females, 19 males

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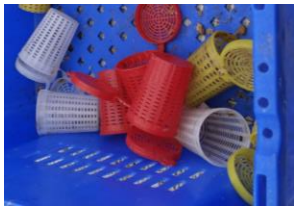
Douglas County – intensive spring trapping campaign, Lake Winona

funnel traps – large apertures



bait

April 23 to May 19, 2024

Nordic Crayfish Company
- Martin Hallkvist
www.nordiccrayfish.com

MAISRC – Apr 30-May 2
Lakes Winona, Agnes & Henry
- refuge traps
- funnel traps
- eDNA

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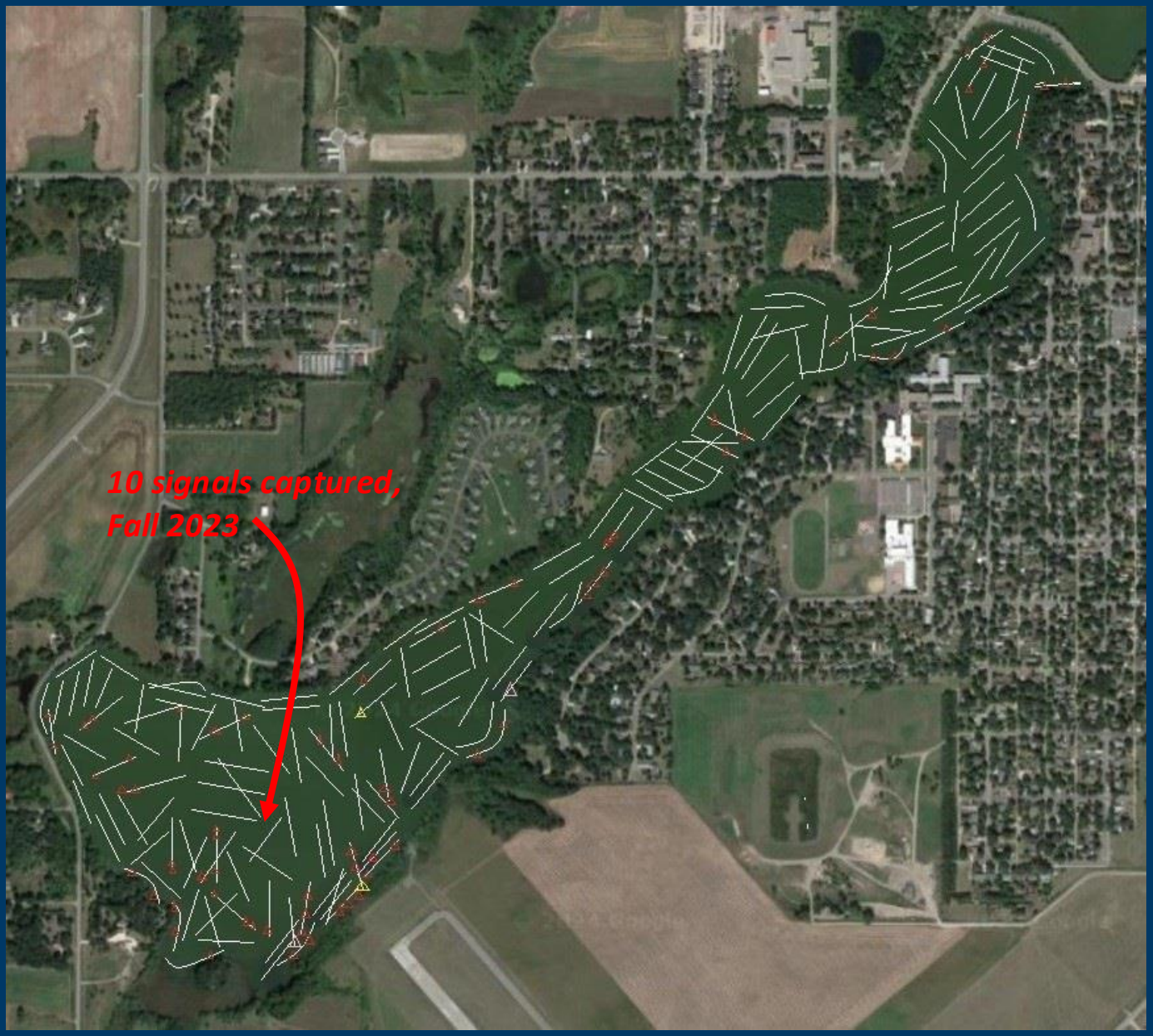
Douglas County – intensive spring trapping campaign, Lake Winona



Cumulative trap lines set, April 23 to May 19, 2024

Daily trapping:

- 10 trap lines
- 160 total traps

North-eastern pool with culvert connection to Lake Agnes:

- 25 traps set

21-day trapping period:

- 2,973 trap days

Douglas County – intensive spring trapping campaign, Lake Winona

▲ = trap with virile crayfish
▲ = trap with berried virile female
▲ = trap with calico crayfish

Cumulative trap lines set, April 23 to May 19, 2024

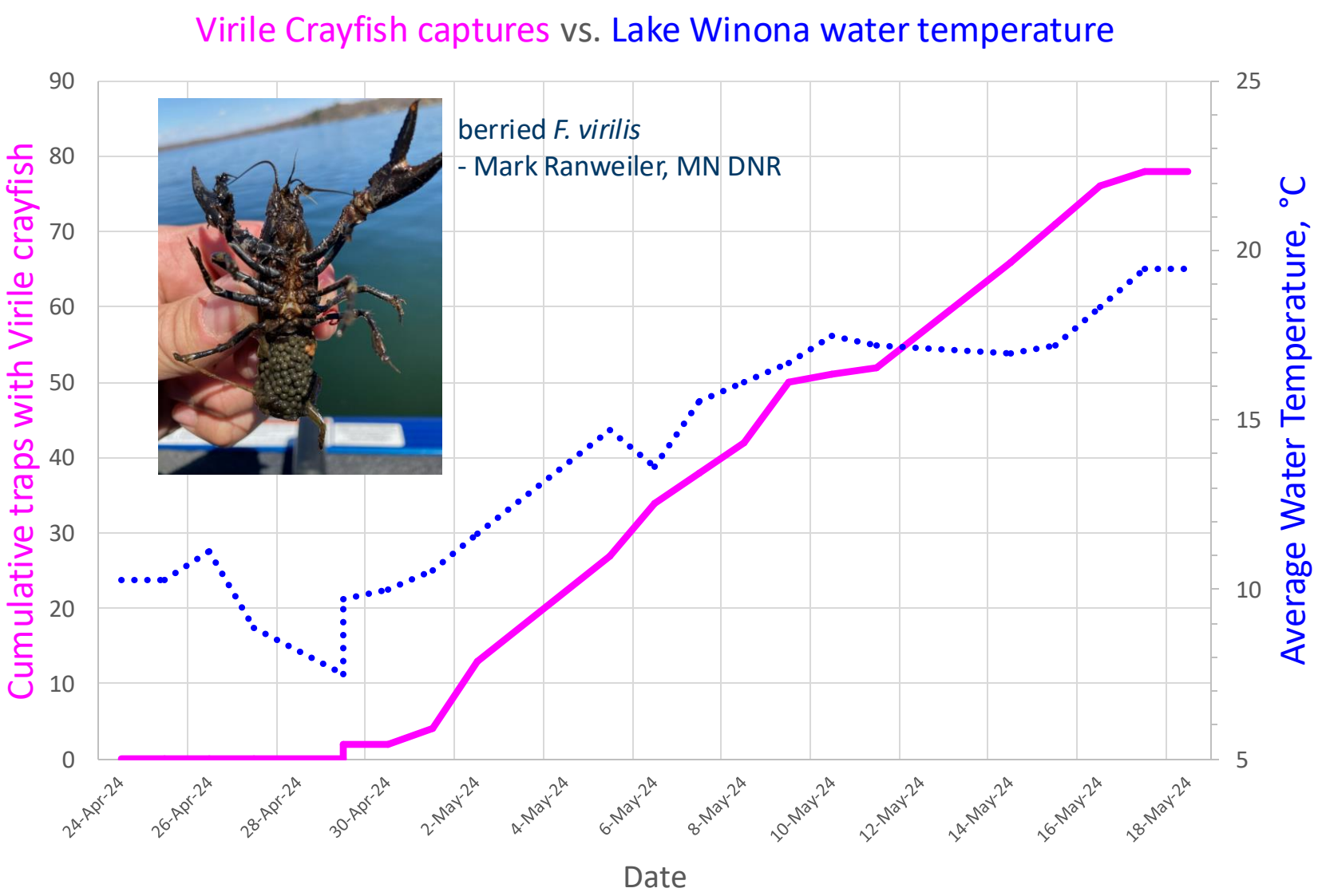
Faxonius immunis

Faxonius virilis

Results:

- NO signals
- 78 traps with virile crayfish (*F. virilis*)
- 2 traps with calico crayfish (*F. immunis*)
- natives stunted?
- poor crayfish habitat, i.e., silt-dominated substrate, minimal structure
- lots of predators

Douglas County – intensive spring trapping campaign, Lake Winona



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Current efforts, MN DNR - USFWS Rapid Response Award for Signal Crayfish

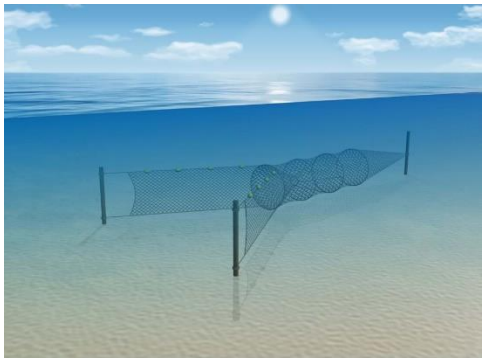
1. Delineate spatial extent & abundance of signal crayfish - Lake Winona & other water bodies

Follow-up trapping & netting targeting all life stages & both sexes (MAISRC, Douglas County)

Baited funnel traps
- medium- to large-sized adults, male biased?

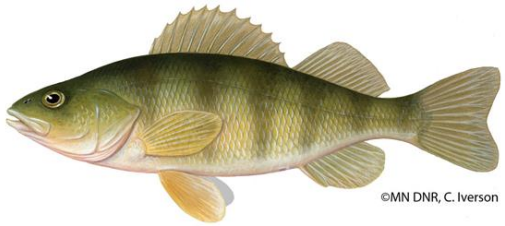
Refuge traps *
- juveniles, YOY, females

Bundle and leaf-pack traps *
- juveniles



Baited fyke net
- large adults in deeper water

Assess potential to enhance crayfish predation
- analysis of population age-size structure
- gut analyses



yellow perch, *Perca flavescens*

bluegill, *Lepomis macrochirus*

* Top right photo: Denver Link - UMN & MAISRC

* Bottom left photo: Nicky Green Associates, https://crayfishuk.org/wp/

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COI mtDNA sequences of nine Lake Winona *P. leniusculus* – Eric Larson & Caitlin Bloomer

Support from MAISRC Rapid Research Response Mini-Grant – Gretchen Hansen & Denver Link

9 signals from Lake Winona sent to **Larson lab** for **COI** mtDNA sequencing

Objectives:
- Identify potential source population(s) of Winona signal crayfish
- Inform and optimize eDNA assay selection

Source of Winona signals?:
- **mtDNA COI** sequencing from **8 Winona signals** showed **>99 to 100%** matches to common, invasive populations known from **Europe** and the **Lake Tahoe region** in **CA** or **NV**
- **1 Winona signal** showed a **>99%** match to a **coastal Pacific Northwest** population

Also important for selecting best eDNA assay:
- many primer and probe sets developed for signals
- will choose assay that best differentiates Winona signals from natives in the family Cambaridae

High genetic variation of invasive signal crayfish in Europe reflects multiple introductions and secondary translocations

Adam Petrusek[1,3], Lenka Filipová[1,2,4], Eva Kozubíková-Balcarová[1,5], and Frédéric Grandjean[2,6]

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[2]Laboratoire Écologie et Biologie des Interactions, Équipe Écologie, Évolution Symbiose, Université de Poitiers, 6 rue Michel Brunet, F-86022, Poitiers, France

PeerJ 2017

Phylogenetic species delimitation for crayfishes of the genus *Pacifastacus*

Eric R. Larson[1], Magalie Castelin[2], Bronwyn W. Williams[3], Julian D. Olden[4] and Cathryn L. Abbott[2]

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CrossMark

TRENDS IN AQUATIC ECOLOGY II

Environmental DNA (eDNA) detects the invasive crayfishes *Orconectes rusticus* and *Pacifastacus leniusculus* in large lakes of North America

Eric R. Larson · Mark A. Renshaw · Crysta A. Gantz · John Umek · Sudeep Chandra · David M. Lodge · Scott P. Egan

Lake Tahoe *P. leniusculus* from Larson et al. 2017

Potential introduction pathways?

Signal crayfish are classified as an "**unlisted nonnative species**" in MN

- Unlawful to release
- Legal for members of public to possess, consume, or keep as pets
- Legal for industries to import live with a DNR permit – signal suppliers in Washington state, Oregon, California, Europe and ?? ***escape risk?***
  - biological supply
  - restaurants – signals larger with better meat quality than cambarids
  - aquarium trade

Other possible pathways:

- classroom release – anecdotal reports from teachers
- transfer from western US with intent to harvest

Photo: Martin Hallkvist

Photo: Martin Hallkvist

Signal crayfish meal, Sweden
Photo: Martin Hallkvist

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Thank You!

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