Native freshwater species get out of the way: Prussian Carp (*Carassius gibelio*) establishment, spread and impact in western North America

Poesch, M.S¹, Ruppert, J.L.W.¹, Docherty, C.¹, Donadt, C.¹, Card, J.¹, Schmidt, B.², & P. Aku².
Prussian Carp

Cyprinid species native to Asia but introduced to Europe in the 17th century

Assessed as the most harmful invasive fish in Eurasia (Kalous et al. 2004; Tarkan et al. 2014)

Morphologically similar to other carp species leading to delayed detection

First found in Alberta in 2000 but genetically confirmed in 2014 (Elgin et al. 2014)
1. Gynogenetic Reproduction
• Decline in native species from reproductive interference

• Most abundant species

• Competition with native and economically valuable species has resulted in population declines in Eurasia
1. Gynogenetic Reproduction

2. Habitat Preferences
1. Gynogenetic Reproduction

2. Habitat Preferences

3. Broad Diet
1. Gynogenetic Reproduction

2. Habitat Preferences

3. Broad Diet
1. Gynogenetic Reproduction

2. Habitat Preferences

3. Broad Diet

4. Habitat Modification
Background

Establishment of Prussian Carp
Assessing the spread and potential impact of Prussian Carp *Carassius gibelio* (Bloch, 1782) to freshwater fishes in western North America

Cassandra Docherty†, Jonathan Ruppert†, Tyana Rudolfsen, Andreas Hamann and Mark S. Poesch*
1) Current distribution and rate of spread

2) Overlap in life history with other fishes
Background

Establishment of Prussian Carp

Impact of Prussian Carp on native fauna
Native freshwater species get out of the way: Prussian carp (*Carassius gibelio*) impacts both fish and benthic invertebrate communities in North America

Jonathan L. W. Ruppert¹, Cassandra Docherty¹, Kenton Neufeld¹, Kyle Hamilton¹, Laura MacPherson² and Mark S. Poesch¹

¹Department of Renewable Resources, University of Alberta, 751 General Services Building, Edmonton, Alberta, Canada T6G 2H1
²Alberta Environment and Parks, Fish and Wildlife Division, 6909-116 Street, Edmonton, Alberta, Canada T6H 4P2
1) Assess impacts of Prussian Carp on:
   • native fishes
   • invertebrates

2) Determine any Before/After differences
Field Study

41 sites, 12 streams

Collected fish community data

Sampled at sites previously sampled in 2005 (Before/After)

Samples sites across an invasion gradient (Recent, Early, None)

Collected habitat & water quality data
Analysis of Prussian Carp

Subsample of 625 specimens

Multiple age classes (0-4)

Average total length was 78 mm; average weight 8.8 g

Gynogenesis
Fish Community

- Brook Stickleback (BRST)
- Fathead Minnow (FTMN)
- Lake Chub (LKCH)
- Longnose Dace (LNDC)
- Longnose Sucker (LNSC)
- Prussian Carp (PRCR)
- White Sucker (WHSC)

![Fish images]

(a) PCA plot with fish species distribution:
- PCA1 (50.3%)
- PCA2 (30.0%)
- BRST
- LKCH
- LNSC
- PRCR
- WHSC

Legend:
- before
- after
Update from 2017 sampling

(Shirton et al., in prep)
Eradication?

(Card et al., in prep)
Outline

- Background
- Establishment of Prussian Carp
- Impact of Prussian Carp on native fauna
- Spread of Prussian Carp
eDNA

Genetic material shed from organisms (ex. skin cells, feces, saliva etc.) found in the environment

Used to detect organism presence

Collected through a water sample

Advantages – Non-invasive, sensitive, time and cost effective, differentiate between similar species

Disadvantages – limited to presence, sensitive sampling protocols
eDNA SAMPLING

Field Collection → DNA Extraction → qPCR → Data Interpretation

Photo: USDA
eDNA SAMPLING

- Sampled throughout province
- Areas where PRCR had previously not been identified
- Easy access sites
- Total of 83 sites
57 Sites No PRCR DNA
12 Sites PRCR DNA
3 Sites Contaminated
12 Sites Inhibited
Range doubles every five years

Found beyond known barriers to movement – suggesting human assisted dispersal

Found in both artificial and natural waterways in Alberta and Saskatchewan

High overlap in life history traits with other well known invasives
Shift in both fish and invertebrate communities

Significant differences in native fish CPUE

No significant differences in environmental variables
Implications

Now present throughout AB and SK

By far the highest biomass in our catch data (~ 65%)

Potential reproductive interference with cyprindids
Likely using canal systems to breach historical watershed boundaries (facilitating spread)

Invasion super highways

Human assisted dispersal

Implications
Implications

Figure 3. Map of CLIMATCH (Australian Bureau of Rural Sciences 2010) climate matches for *C. gibelio* in the continental United States based on source locations reported by Froese and Pauly (2010). 0= Lowest match, 10= Highest match.

(U.S. Fish and Wildlife Service, 2012)
Acknowledgements

Laura MacPherson
Kate Wilson

Field Crew:
Kyle Hamilton
Tyana Rudolfsen
Caitlyn Donadt
Jamie Card
Warren Robb
Kenton Neufeld
Cassandra Docherty
Ed Bork