# Under the Cover of Rock Snot:
## Understanding the effects of didymo algae in Yukon

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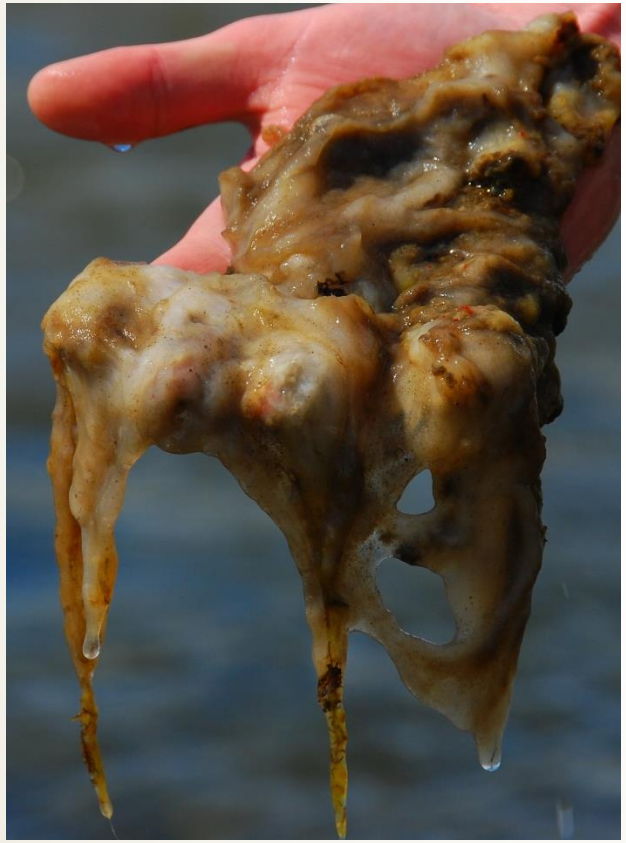
# Outline

- What is Rock Snot?
- Didymo in Yukon
- Methods
- Results
- Discussion

Didymo*sphenia geminata* frustule from Yukon River (From Barraclough 1992)

# Rock Snot



- Didymo algae (*Didymosphenia geminata*)
- Historically rare/hard to detect
- Only freshwater diatom to exhibit large scale invasive behaviour
- Can form dense algal blooms covering rocky stream bottoms
- Ability to alter stream ecosystem function and hydraulics
- Potential to impact salmonid fisheries, tourism and hydropower

# Spread by Anglers?

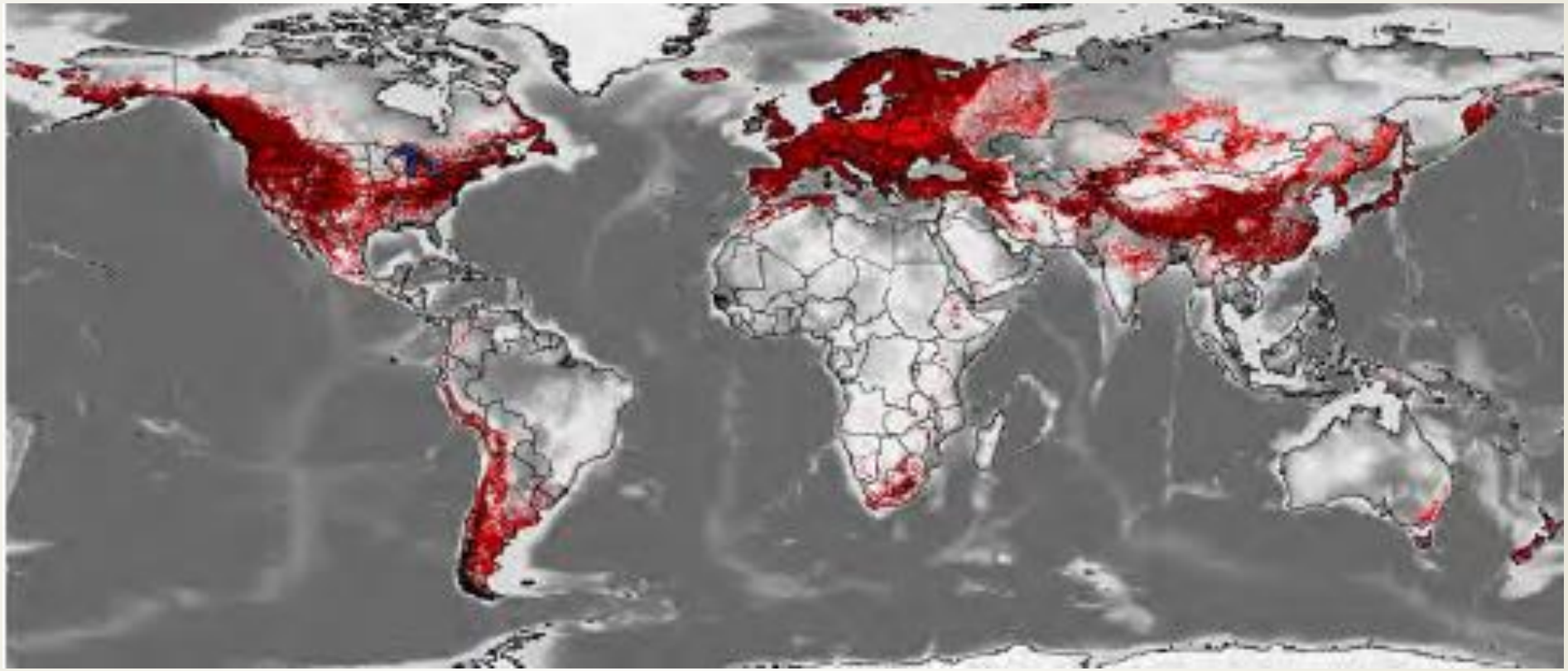
- First nuisance blooms in North America documented on Vancouver Island in late 1980s
- Can live >40 days in cool, dark, damp environments (i.e. wading boots)
- Led to ban of felt-soled waders in 7 US States (including Alaska), Chile and New Zealand

# Caused by Low Phosphorus?

Image by Sarah Kiemle from Spaulding & Elwell, 2007, USGS

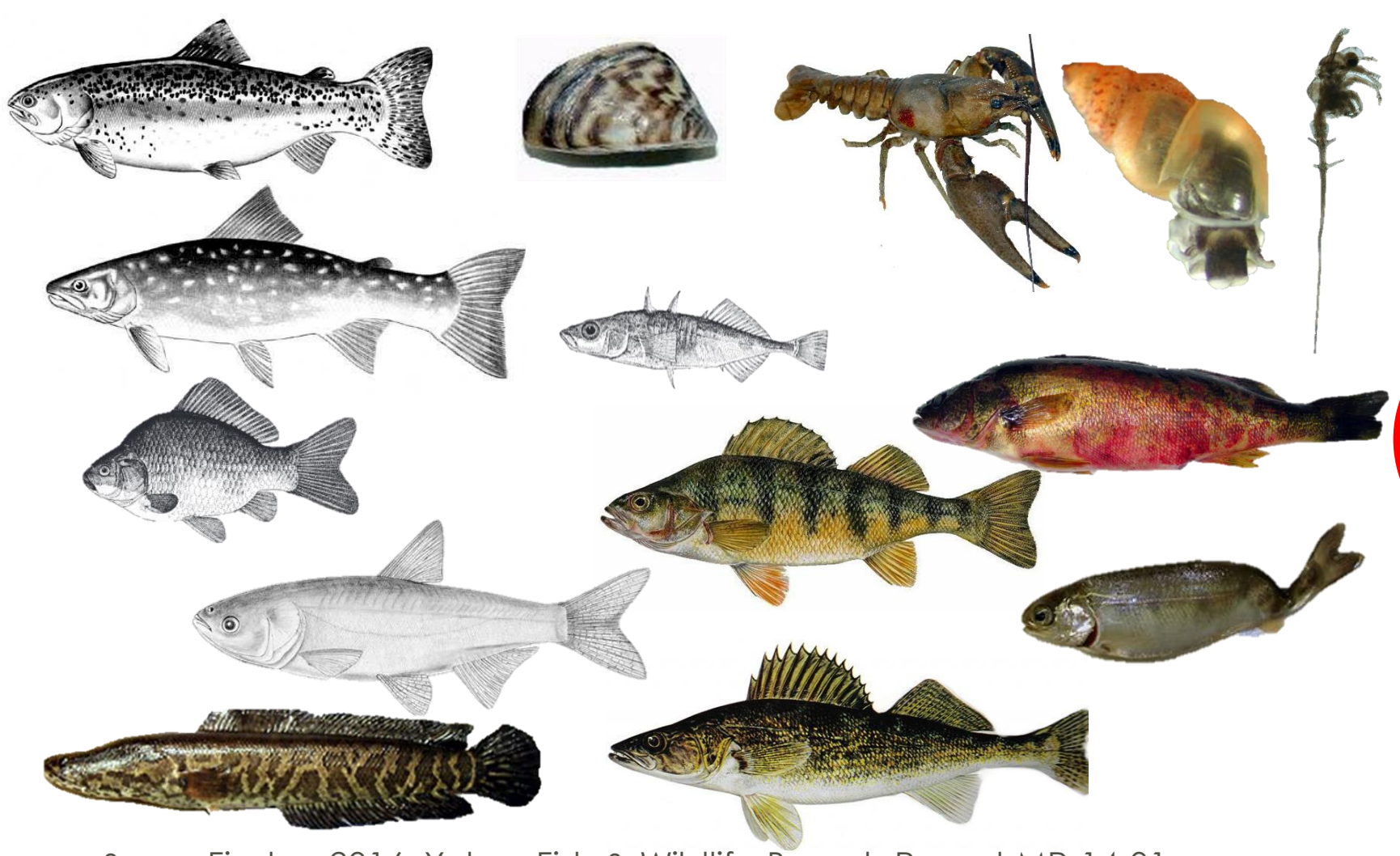
- Blooms occur in rivers with very low dissolved phosphorus levels
- Blooms associated with production of extracellular stalk – which help nutrient uptake
- Caused by changing environmental conditions
- Recent evidence it is a native species in North America
  - Fossil record:  Alaska, New Brunswick, New York (Lavery et al. 2014; Kilroy & Bothwell 2014)
  - Historical records: Quebec (Kilroy & Bothwell 2014)

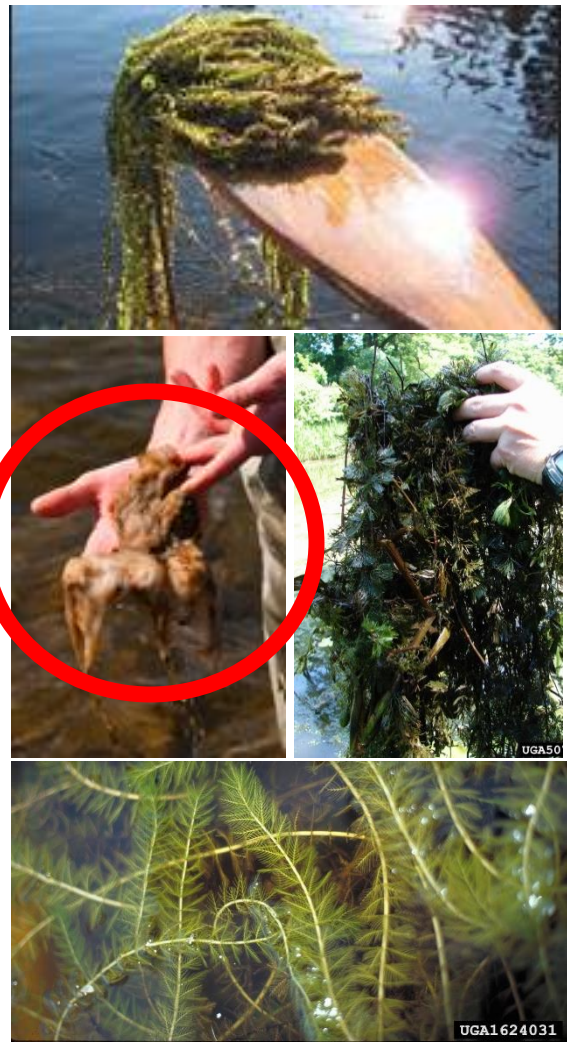
# Widespread?



Suitable stream habitat map by Kris McNyset, US Environmental Protection Agency (from Spaulding & Elwell 2007)

# Yukon Risk Assessment of Aquatic Invasive Species



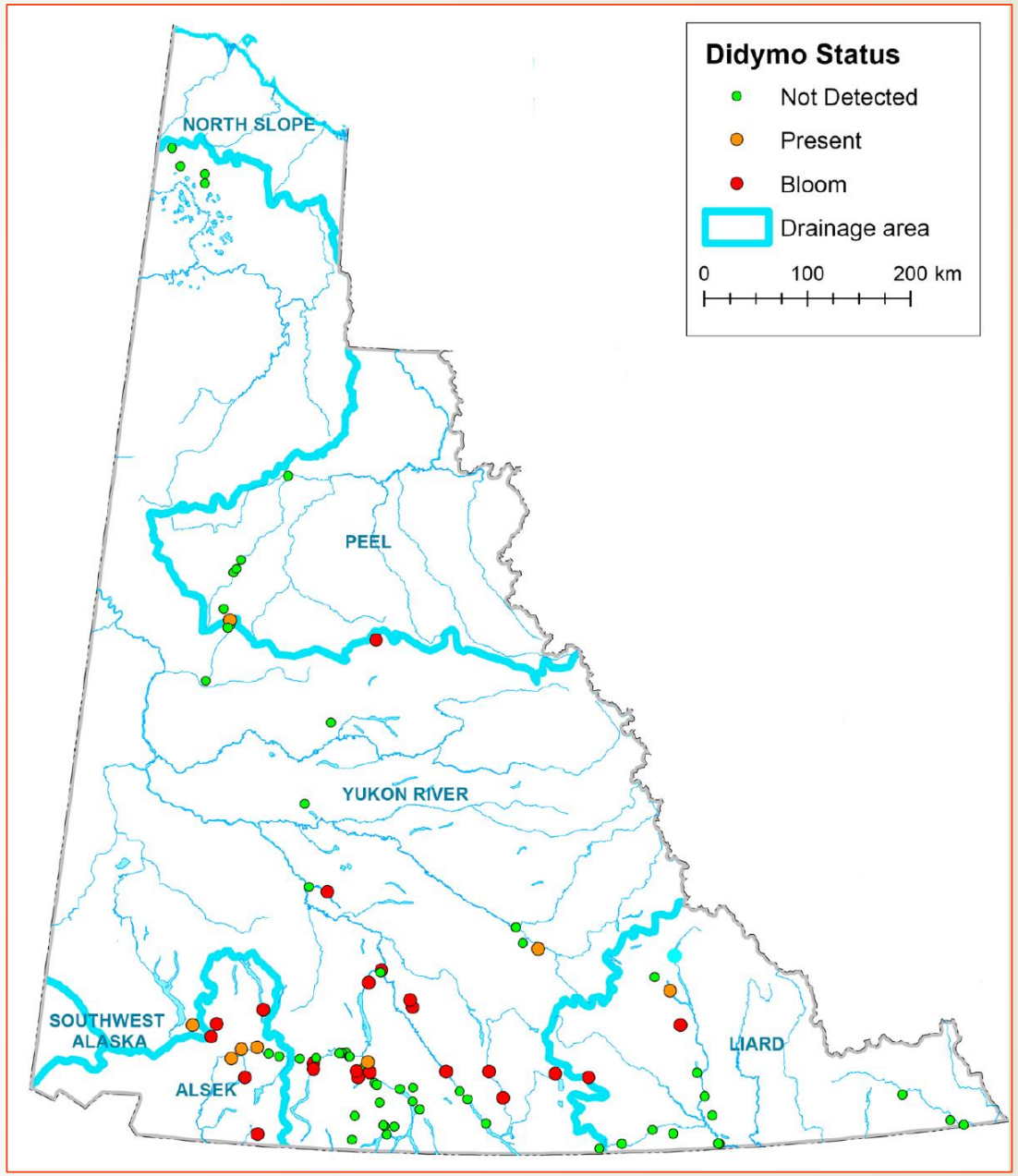



Leung & von Finster, 2016, Yukon Fish & Wildlife Branch Report MR-14-01

# Yukon Didymo Survey: 2014

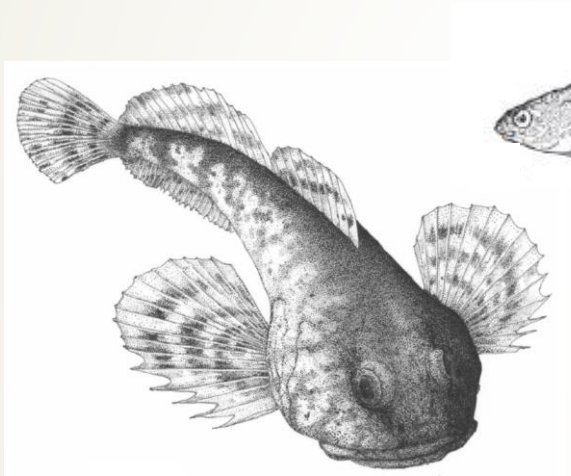
# Didymo in Yukon

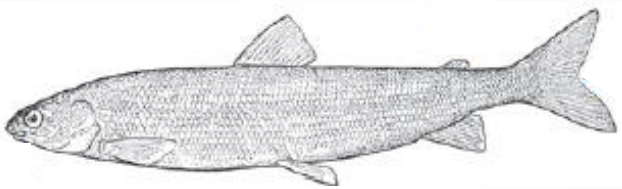
- 1992-2014 records (n=88 sites)
- 22 stream sites with blooms
- 8 sites with didymo identified in algae (present)
- Didymo widespread and detected in all major watersheds
- Unknown impacts to fish habitat and prey species

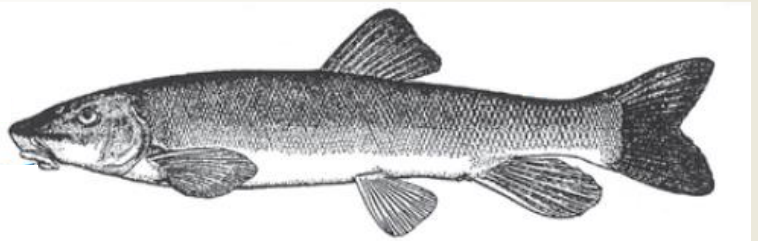


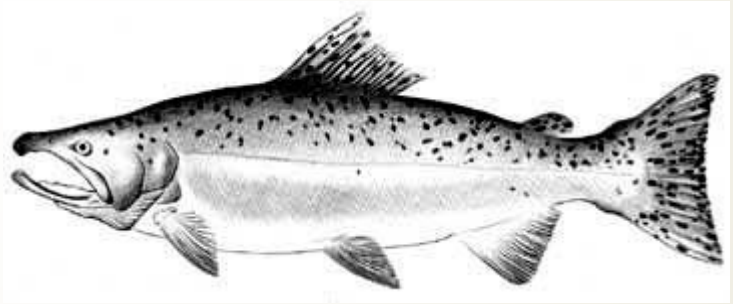

From Milligan, 2015, Yukon Fish & Wildlife Branch Report SR-15-01

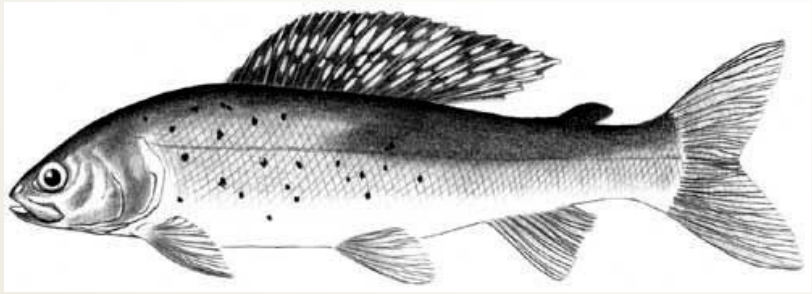
# Research Q: How are benthic invertebrates (fish prey species) affected by didymo?

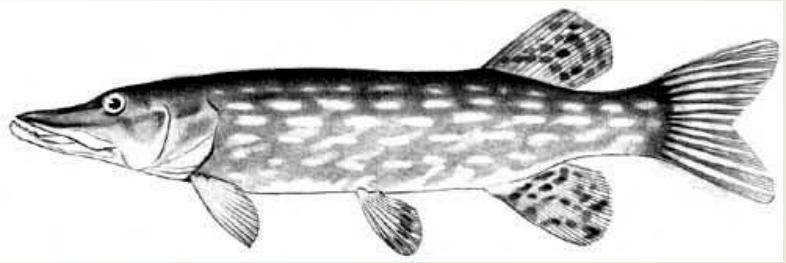




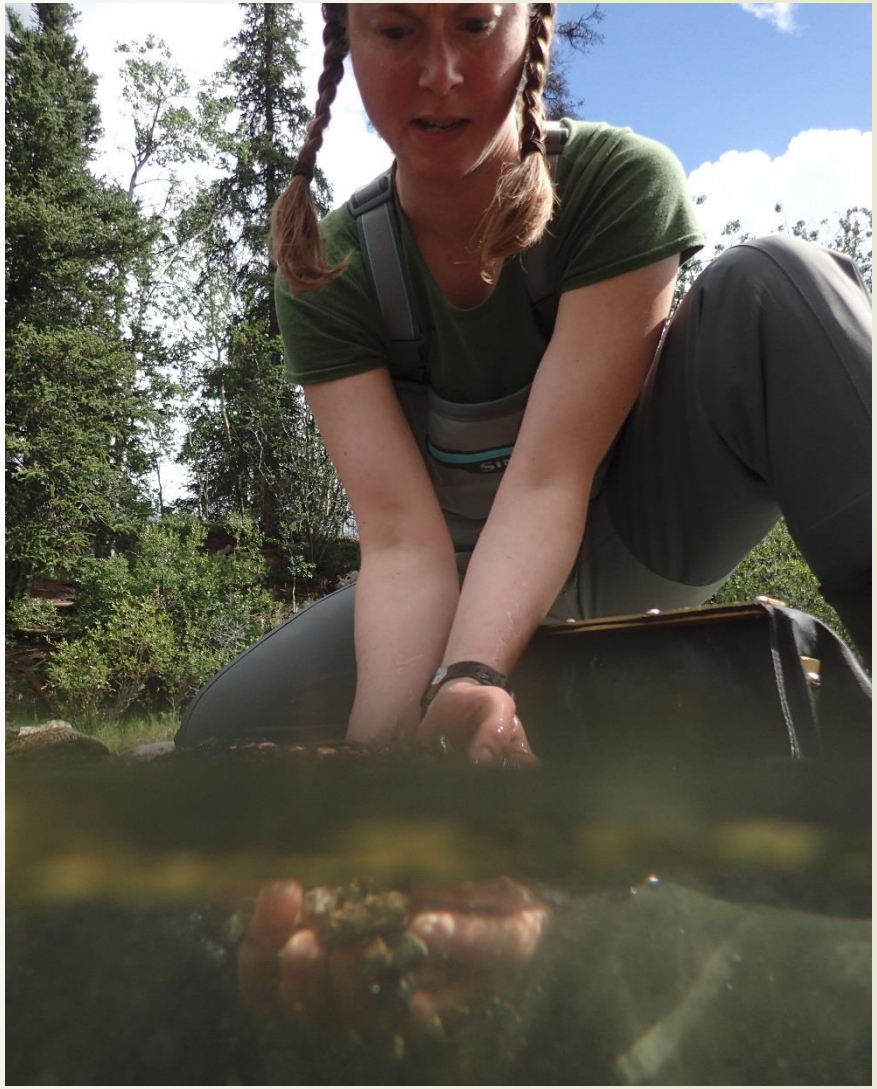








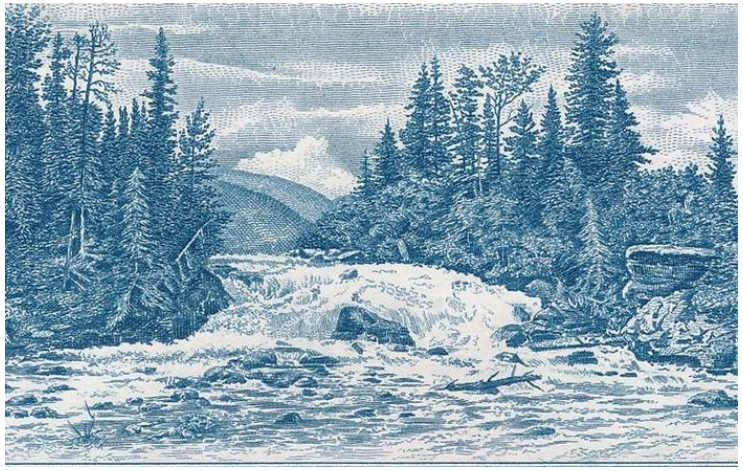
# Methods: Benthic Invertebrate Sampling



# Paired Sampling Design

- Surber sampling at each stream:
  - 5 didymo-affected plots (1 composite sample)
  - 5 didymo-unaffected plots (1 composite sample)
  - 5 minutes sampling intensity per plot
  - 500 µ mesh
- N: 7 streams
- Timing: Late July 2015 & 2016
- Protocols: modified from Canadian Aquatic Biomonitoring Network (CABIN)
- Disinfected equipment between streams

# Sites

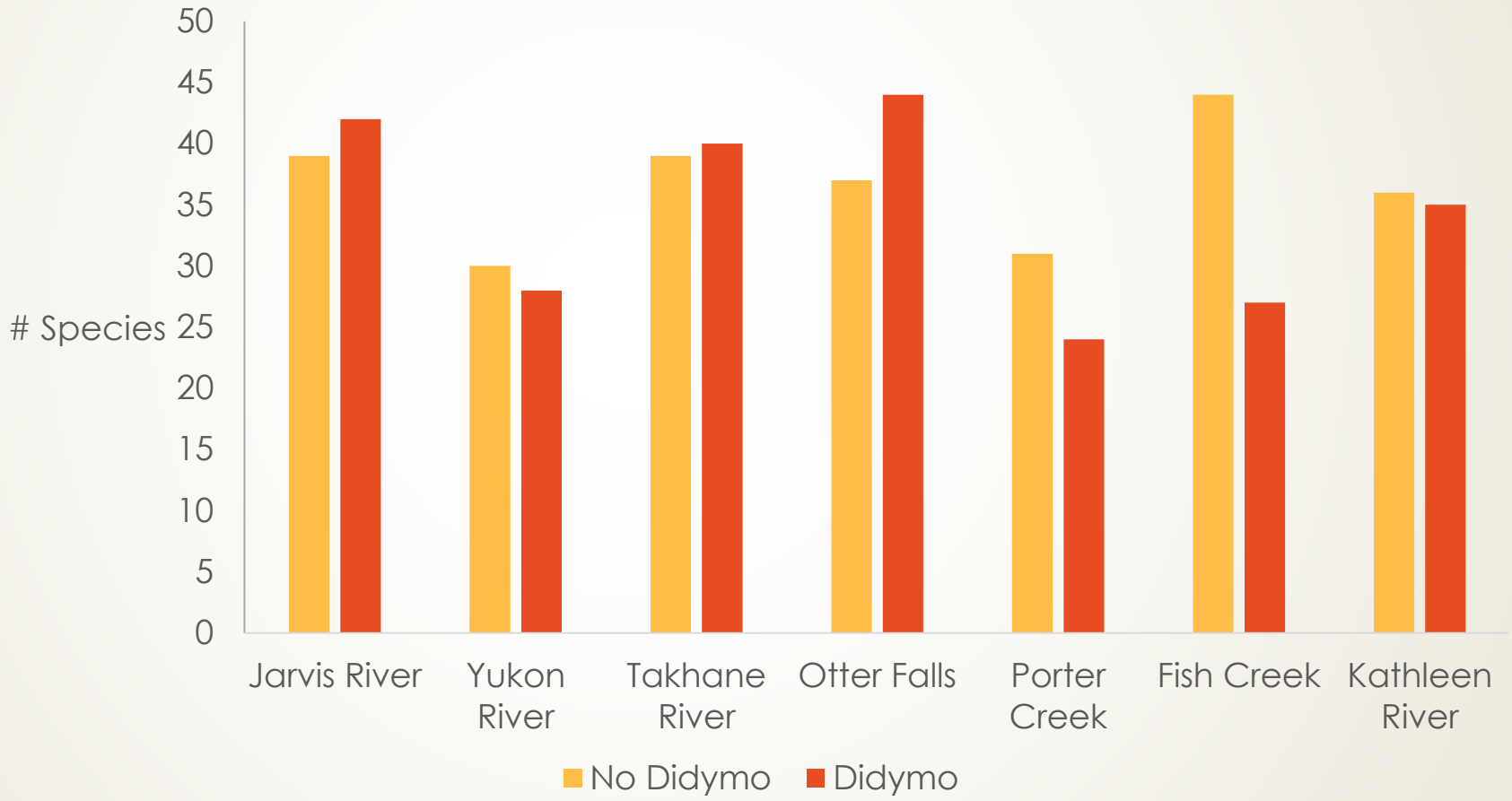


# Invertebrate Identification

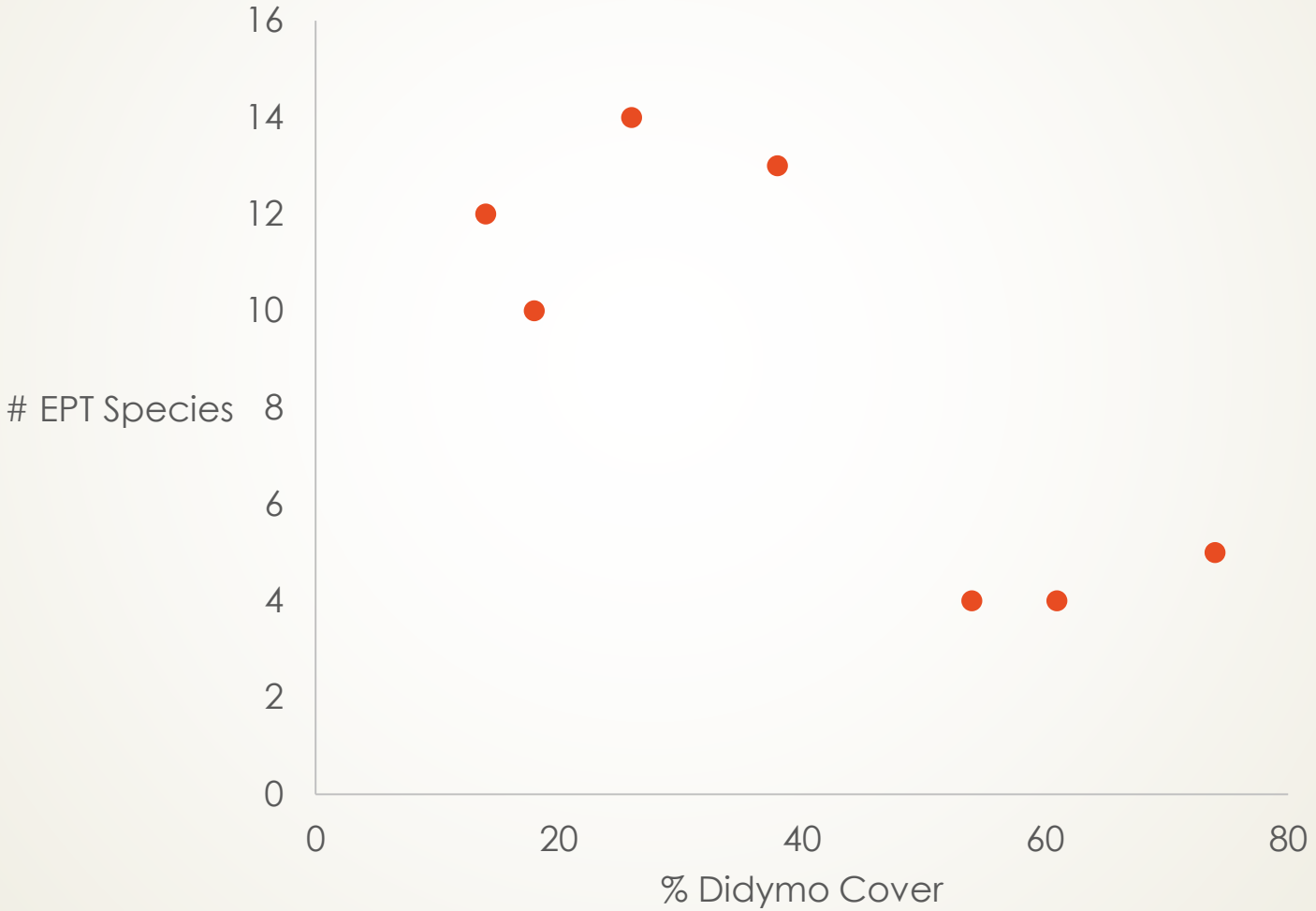
- Taxonomy to genus-species where possible (Cordillera Consulting)

Image by Cordillera Consulting

# Preliminary Results: Species Richness



# EPT Richness




E=Mayflies

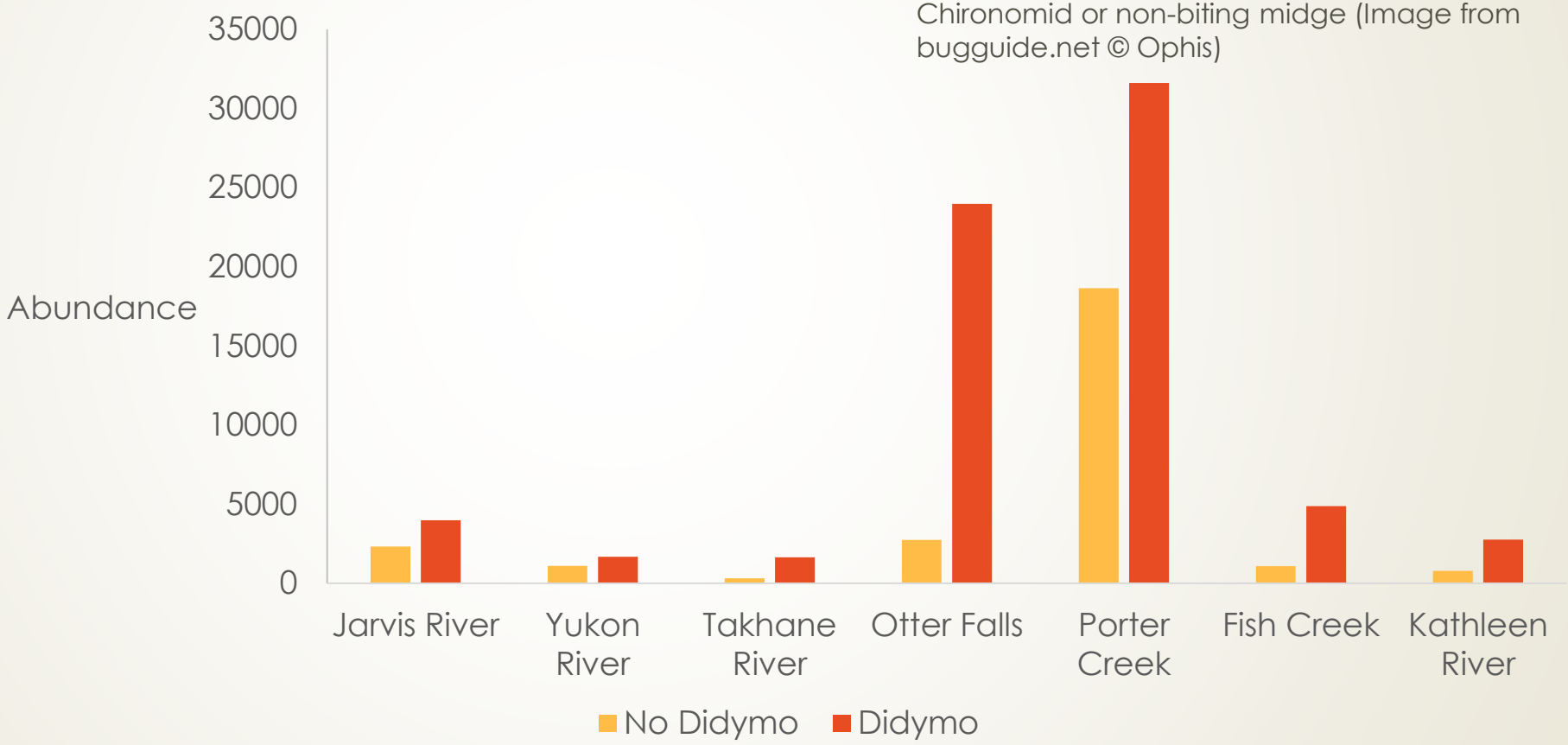
P=Stoneflies

T=Caddisflies

Images from bugguide.net
(Donald Chandler, Joshua Doby, John van der Linden)

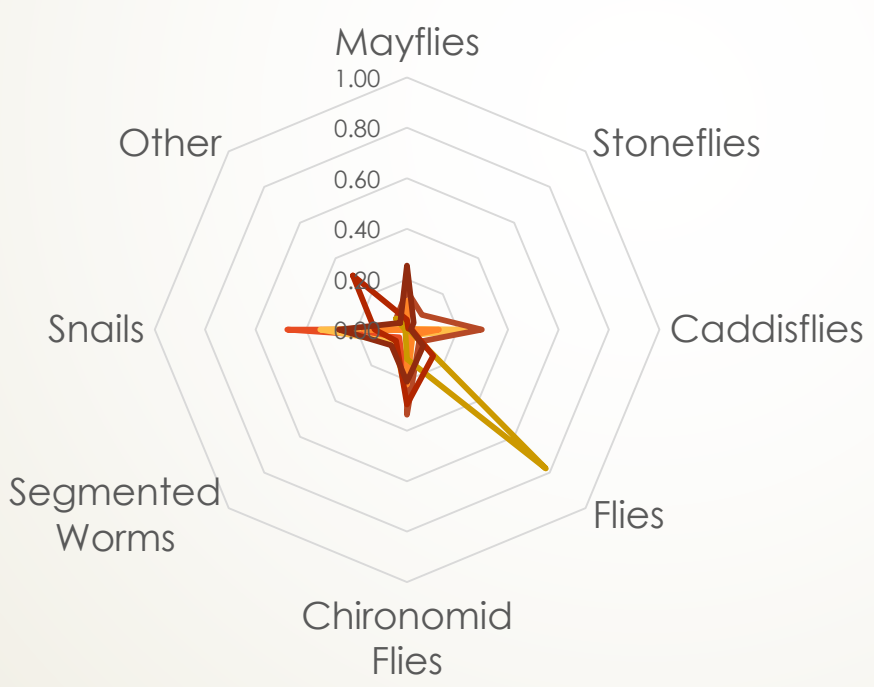
# Abundance

Chironomid or non-biting midge (Image from bugguide.net © Ophis)

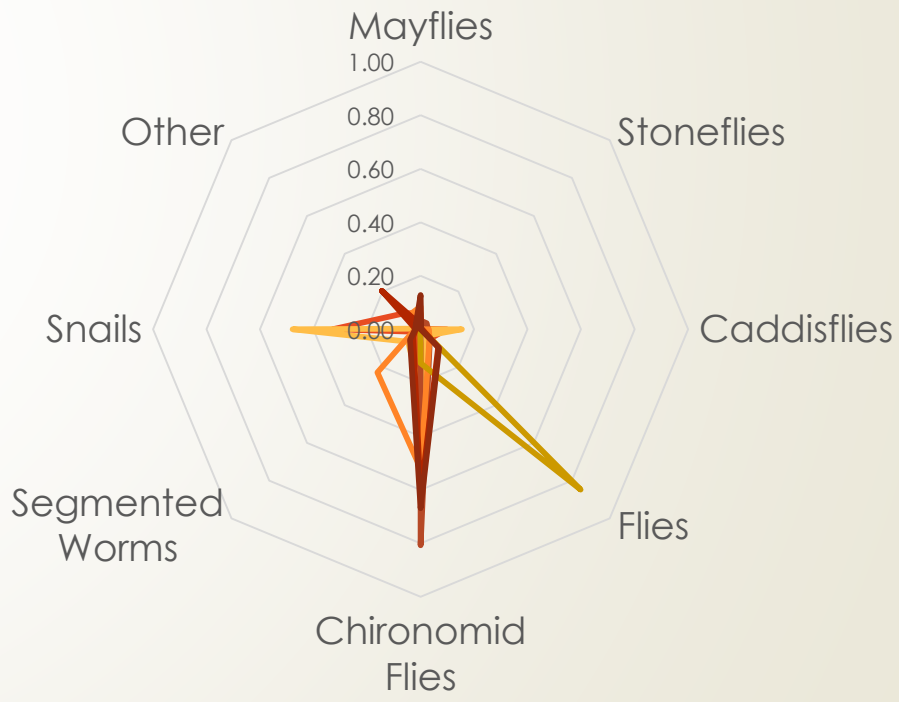


# Community Composition

## No Didymo

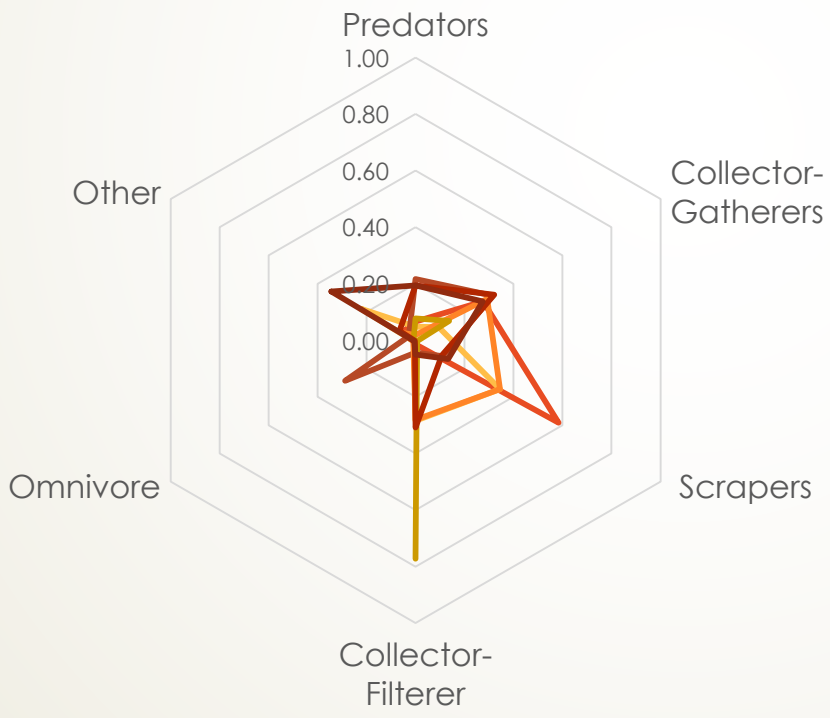



## Didymo

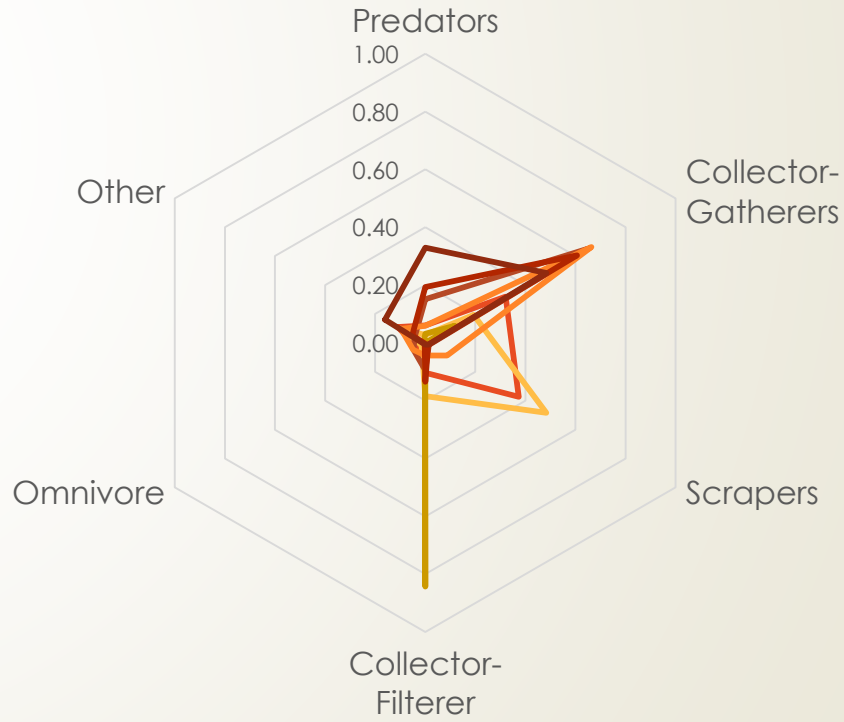


# Functional Group Composition

## No Didymo




## Didymo

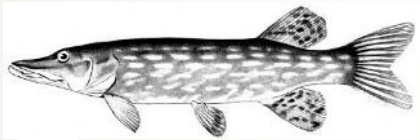


# Discussion

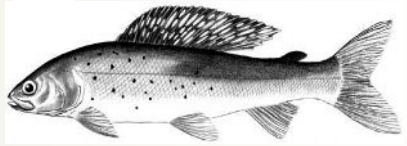
- Didymo associated with:
  - Shift to higher abundance of small-bodied benthic invertebrates (chironomids)
  - Shift to more collector-gatherers (scavengers)
  - No effect on species richness
  - Higher black-fly larvae abundance at one site
  - Increased cover habitat for slimy sculpins at one site
- Observations similar to study in Quebec (Gillis & Chalifour 2009 Hydrobiologia)
- Several studies observed a decreased species richness, mayflies, stoneflies and caddisflies associated with didymo (Spaudling & Elwell 2007)

# Implications

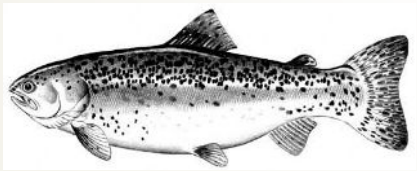
- Didymo blooms may create increased localised food and cover for some invertebrates
- Shifts in benthic invertebrates may affect diet of fish differently:



Northern Pike: piscivores



Arctic grayling: feed a lot on caddisflies and some chironomids (Foos et al., 2010, Yukon Fish & Wildlife Report TR-14-03)



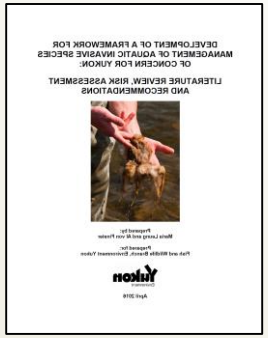
Rainbow trout: feed a lot on chironomids (Foos & Millar, 2011, Yukon Fish & Wildlife Report TR-11-06)

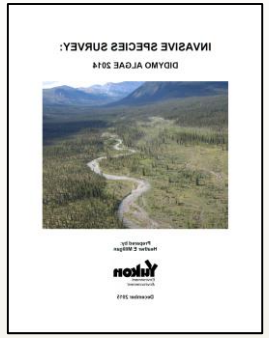
- Although it is unclear whether didymo is native to Yukon and whether it is spreading, it can be found in most watersheds
- Public education: CLEAN, DRAIN, DRY

# Acknowledgements


- Funding: Government of Yukon, Department of Environment
- Yukon Government Staff: Pete Knamiller, Dennison Bohmer, Aaron Foos, Oliver Barker, Angela Milani, Y2C2 Green Team
- Taxonomy: Cordillera Consulting


- Contact
  - Heather Milligan: (867)667-8793, heather.milligan@gov.yk.ca,
  - www.env.gov.yk.ca/animals-habitat/Stop-Aquatic-Invasive-Species.php



# Definition of Invasive Species

- "A species of plant, animal, aquatic life or micro-organism that is not native (to Yukon/an ecosystem) and whose introduction or spread is likely to have net negative effects on our society, our economy, our environment, or our health".

  *From Yukon Government Invasive Species Interdepartmental Working Group (ISIWIG)*

- "The term "invasive" is reserved for the most aggressive species that reproduce rapidly and cause major changes to the areas where they become established".

  *From Yukon Invasive Species Council (YISC)*

# Didymo effects sampling sites