James Frakes
Co-founder

THE SALMONFLY PROJECT

Conserving stream insects through **monitoring**, **research**, **preventative management**, and sound **restoration**

Jackson H. Birrell
May 18, 2024

3,500 species

Mayfly

3,500 species

Stonefly

17,000 species

Caddisfly

50,000 species

True flies

5,000 species

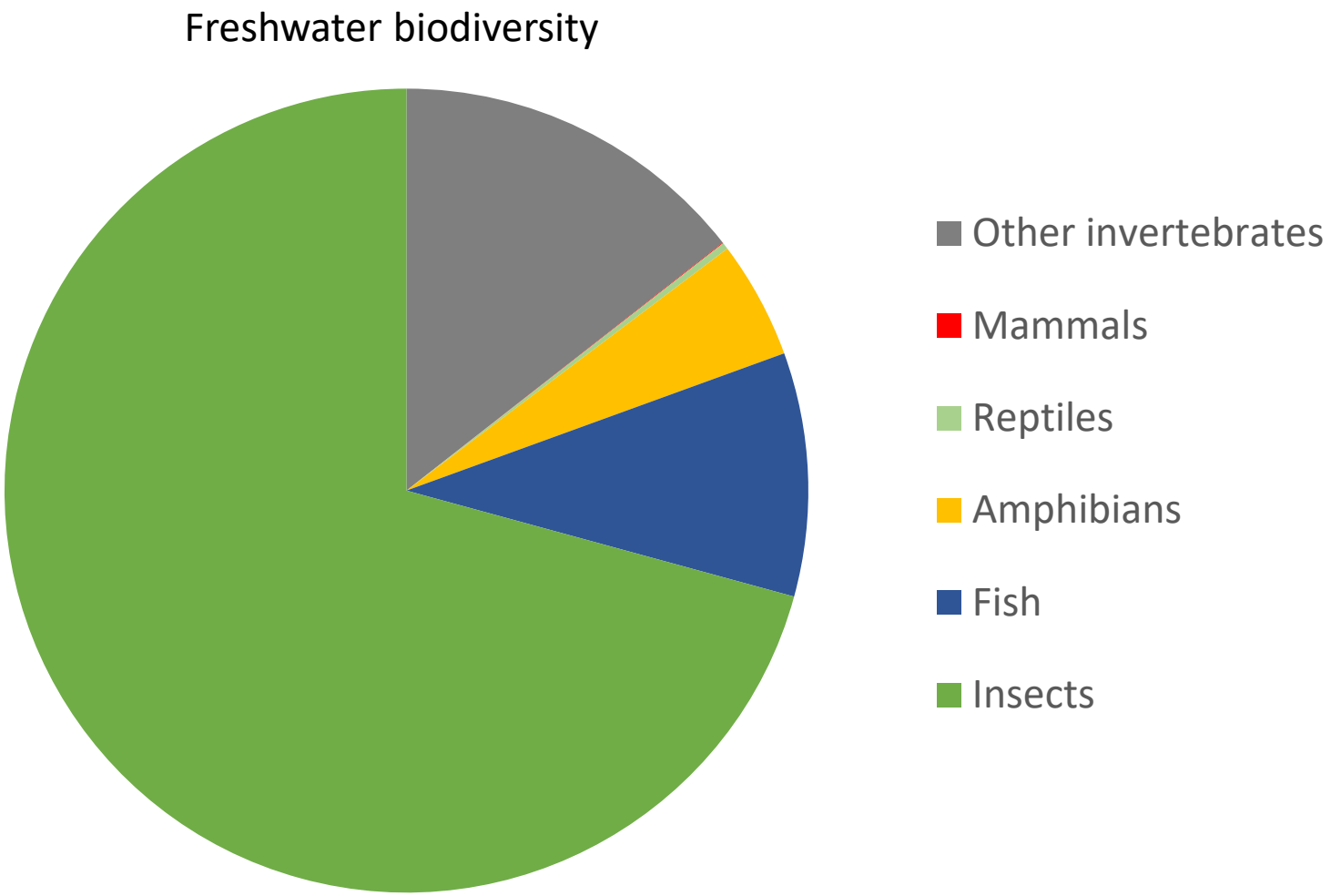
Beetles

Dragonfly

6,000 species

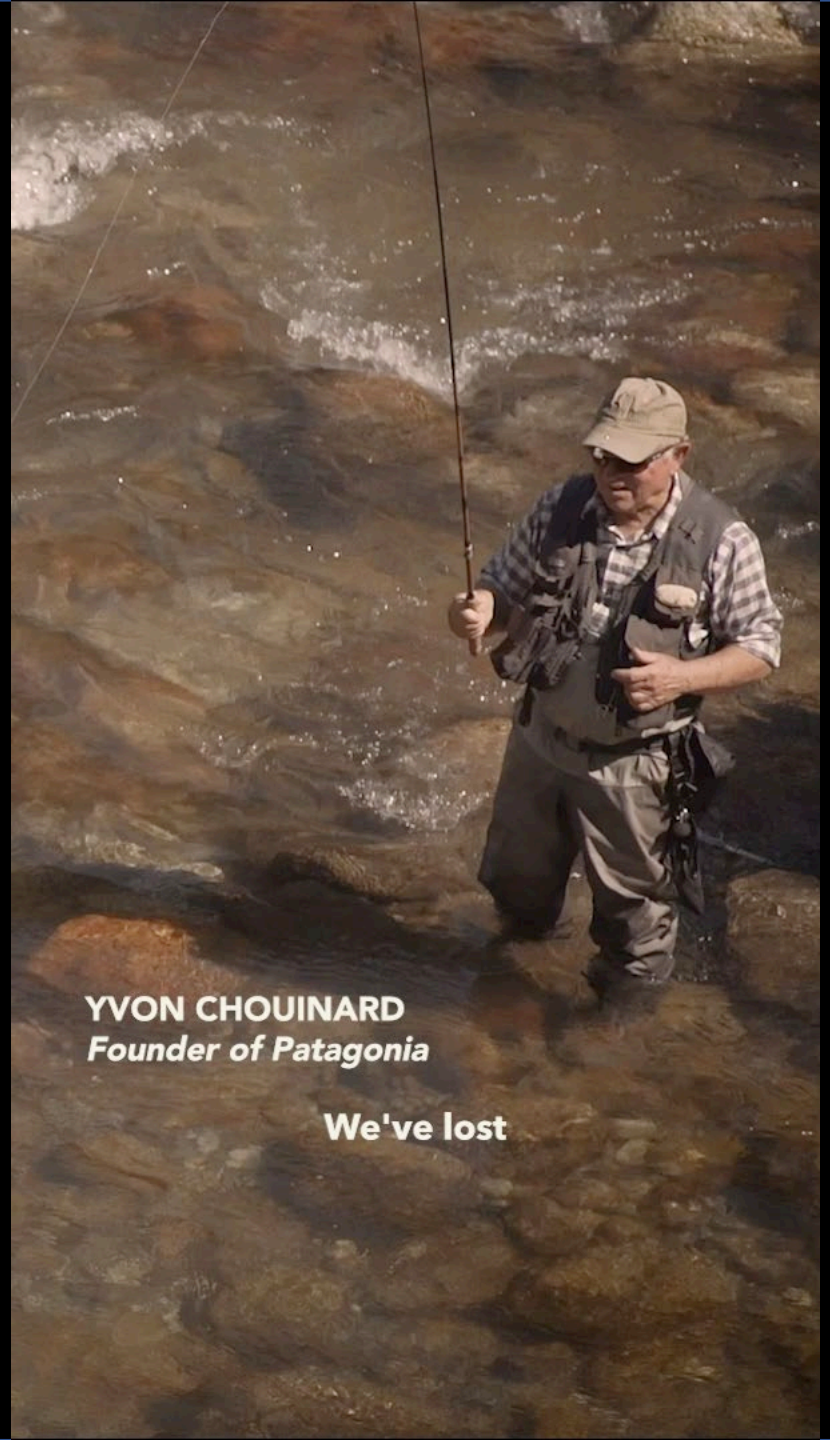
Photos by Joe Giersch, USGS

Over 70% of freshwater animals are insects



Dijkstra et al. 2013

Patagonia: 'No Fly Zones’



The New York Times Magazine

FEATURE

The Insect Apocalypse Is Here

What does it mean for the rest of life on Earth?

Insect decline in the Anthropocene: Death by a thousand cuts

David L. Wagner, Eliza M. Grames, Matthew L. Forister, et al., and David Stopak Authors Info & Affiliations

January 11, 2021 | 118 (2) e2023989118 | https://doi.org/10.1073/pnas.2023989118

patagonia

Dude, Where's My Hatch?

Stephen Sautner / May 31, 2023 / 10 Min Read / Fly Fishing

The decline of aquatic insects should bug everyone.

Insect Declines in the Anthropocene

Annual Review of Entomology
Vol. 65:457-480 (Volume publication date January 2020)
First published as a Review in Advance on October 14, 2019
https://doi.org/10.1146/annurev-ento-011019-025151

David L. Wagner
Department of Ecology and Evolutionary Biology, University of Connecticut, Storrs, Connecticut 06269, USA; email: david.wagner@uconn.edu

What happened to Utah's salmonfly?

By Robert Williamson for KSL.com | Posted - July 27, 2021 at 8:10 p.m.

KSL.com

Contents lists available at ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon

ELSEVIER

Perspective

Scientists' warning to humanity on insect extinctions

The Washington Post

MAGAZINE

The World's Oldest Winged Insect Is in Trouble. How Frightened Should We Be?

Mayflies are among nature's best environmental sentinels — and their current message to us is grim

By Robert O'Harrow Jr.
September 19, 2022 at 10:03 a.m. EDT

The Drake

SALMONFLY QUESTIONS

What's happening to our favorite hatch?

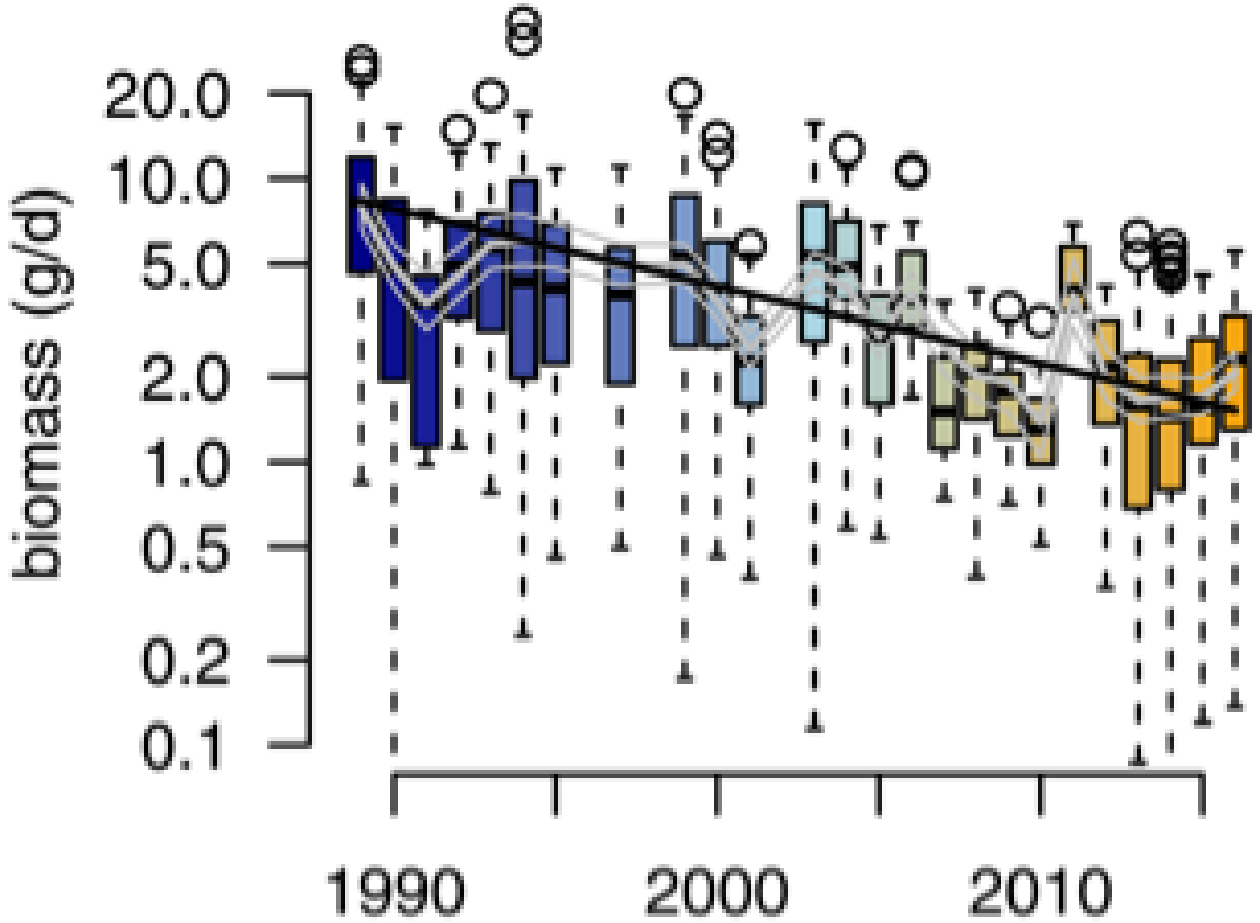
By Beau Davis

More than 75 percent decline over 27 years in total flying insect biomass in protected areas

Caspar A. Hallmann, Martin Sorg, Eelke Jongejans, Henk Siepel, Nick Hofland, Heinz Schwan, Werner Stenmans, Andreas Müller, Hubert Sumser, Thomas Hörren, Dave Goulson, Hans de Kroon

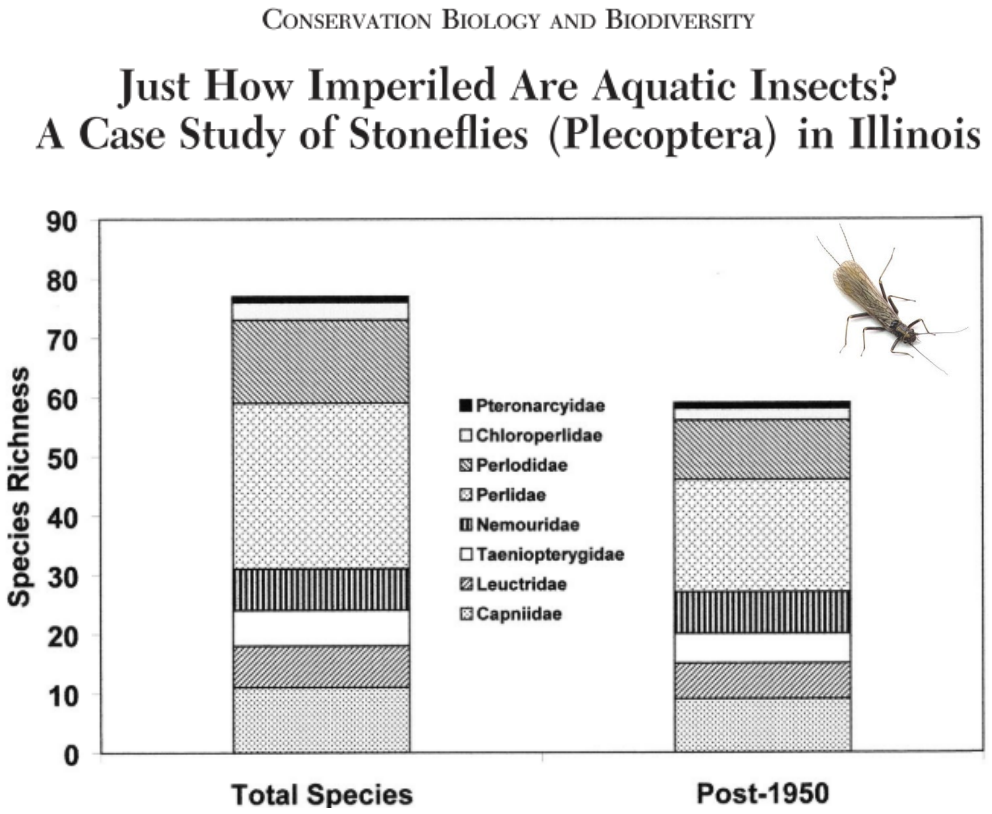
Published: October 18, 2017 • https://doi.org/10.1371/journal.pone.0185809

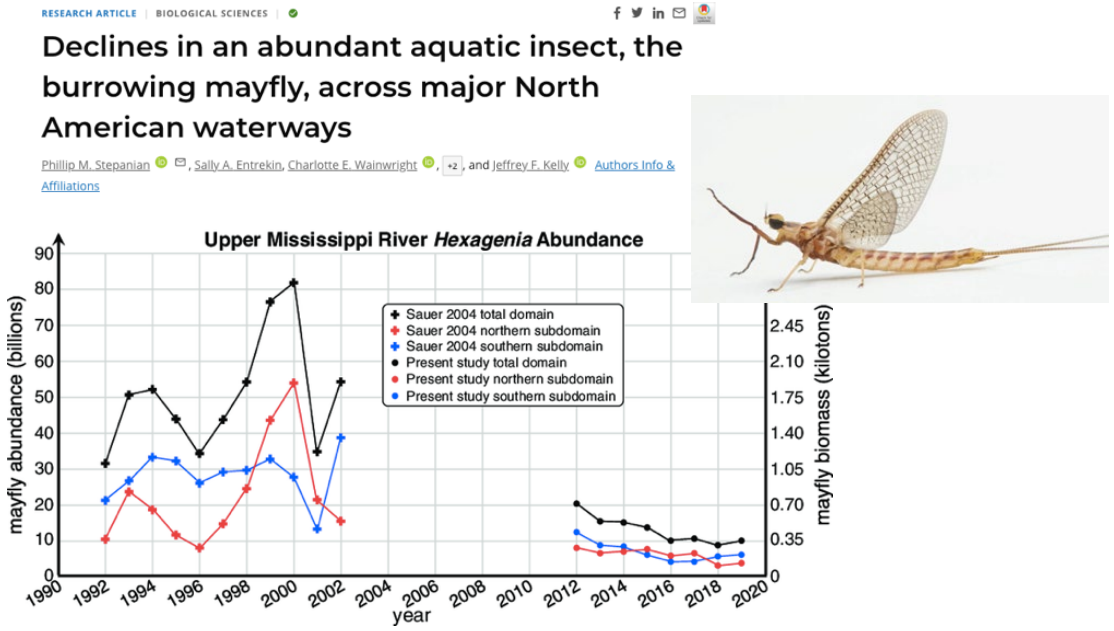
76% decline in flying insects in protected lands in Germany over 27 years.

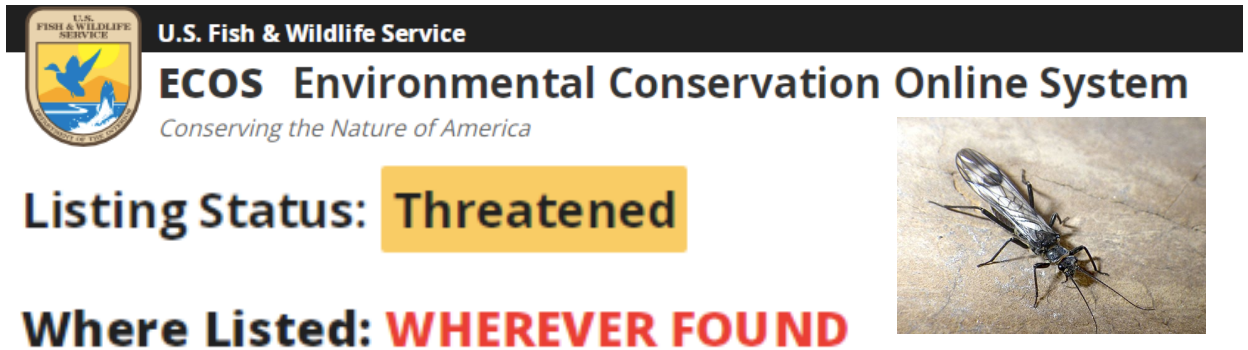


Hallman et al. 2017

Limited aquatic data data shows strong declines







Dewalt et al. 2005; FWS 2019, Stepania et al. 2020; Wagner 2020

Giant salmonfly declines

Declines or extinctions in at least 10 famous Western trout streams

Stagliano 2010; Birrell et al. 2019; Benzel 2016; Nehring et al. 2011; Colburn 1985; Williamson 2021; Vinson 2011

Where is the action?

New knowledge

THE SALMONFLY PROJECT

Status, trends, drivers

FOREST SERVICE US DEPARTMENT OF AGRICULTURE

DEQ

MONTANA FISH, WILDLIFE & PARKS

U.S. FISH & WILDLIFE SERVICE DEPARTMENT OF THE INTERIOR

New knowledge

THE SALMONFLY PROJECT

1. Historical data comparisons
2. Citizen science observations
3. New monitoring programs

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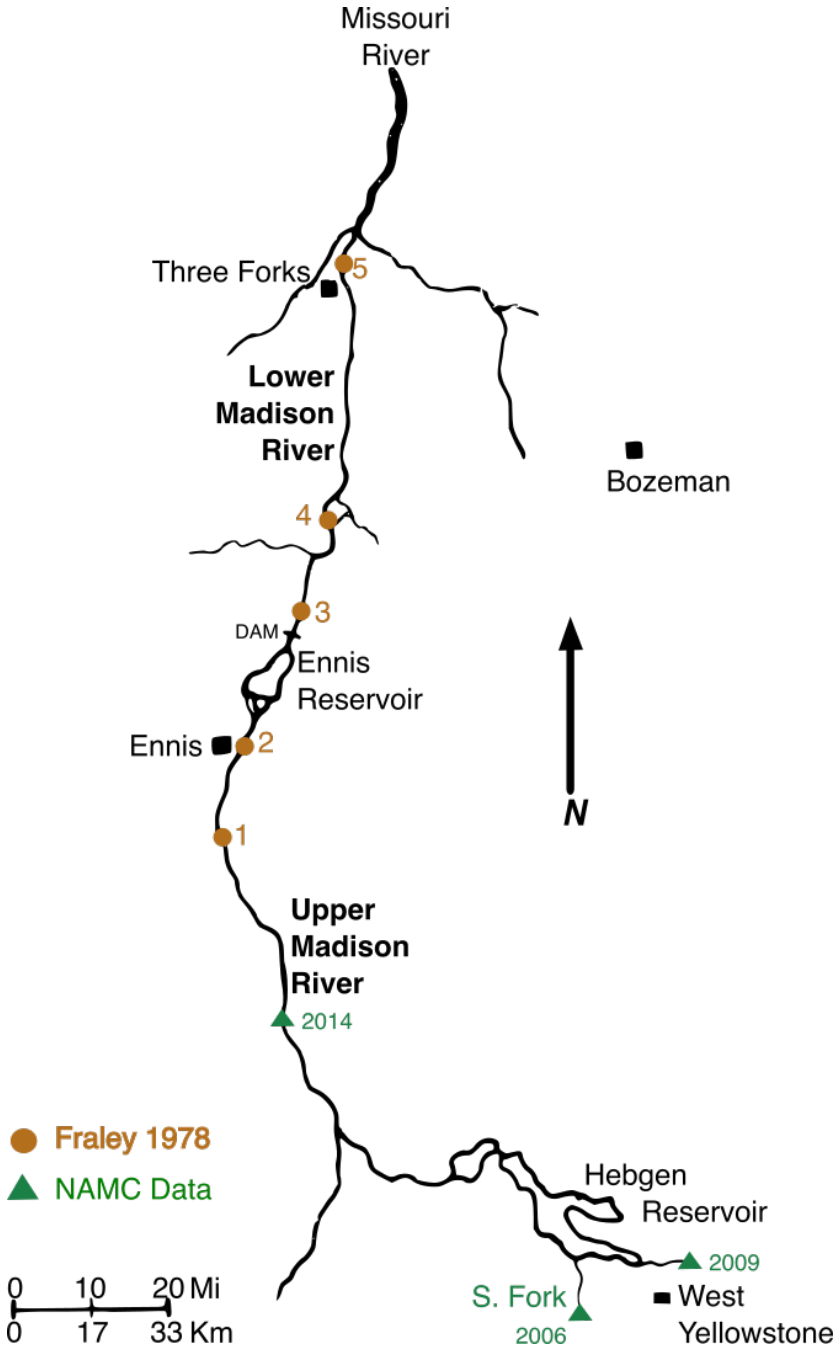


Historical databases

Fraley 1978: MSU Ms Thesis; 1976 survey of Madison River insects – 5 sites

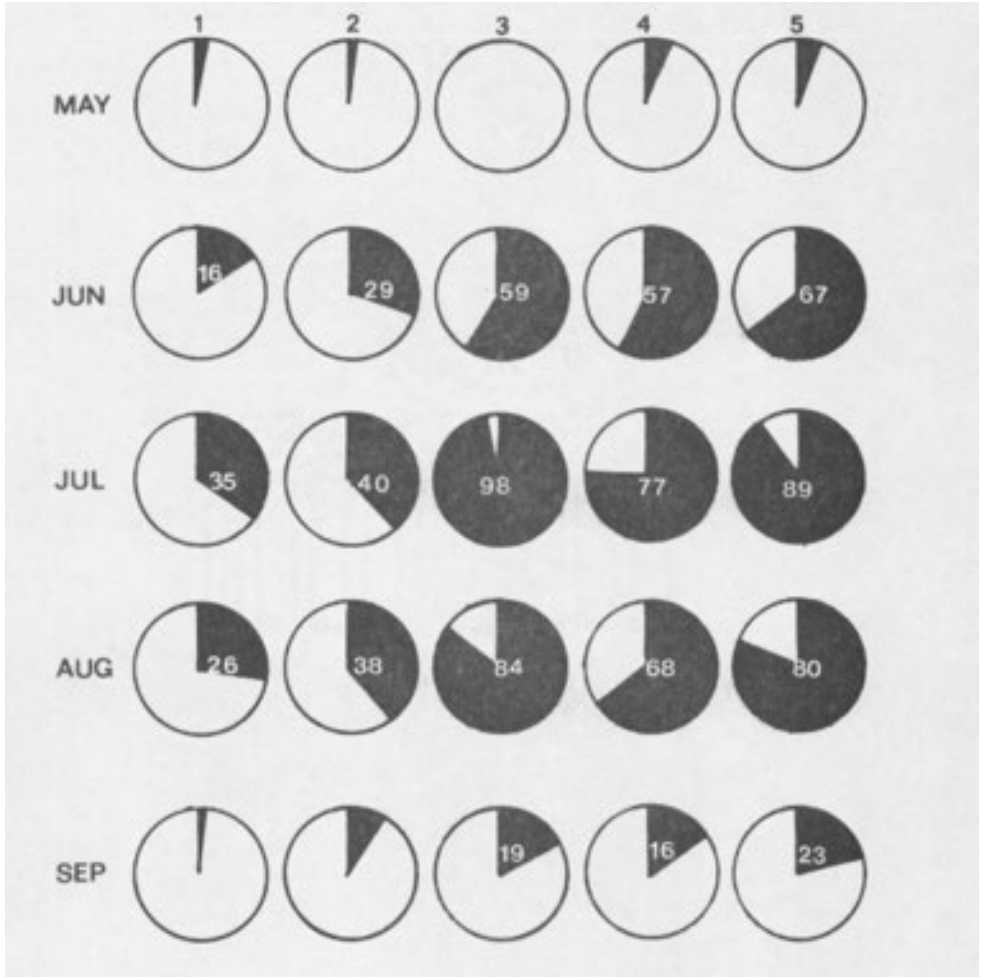
DEQ 2006-2014: 3 additional sites on the upper River

Fraley 1978 – a rare historical dataset of insect and environmental data

Insect community data

Taxon / Sampling date	1976 10/8	1976 11/6	1976 12/1	1977 3/16	1977 4/16	1977 5/14	1977 6/16	1977 7/17	1977 8/17	1977 9/21	Annual Mean
Plecoptera											
Pteronarcys californica	3 (3-3)	1 (0-2)	-	-	1 (0-3)	1 (0-1)	7 (4-8)	3 (0-5)	5 (2-7)	2 (1-3)	2
Claassenia sabulosa	-	-	-	-	1 (0-2)	3 (2-3)	1 (0-2)	2 (1-3)	<1	2 (1-2)	1
Hesperoperla pacifica	1 (0-1)	-	-	-	-	<1	<1	-	-	-	<1
Isoperla spp.	2 (2-2)	1 (0-1)	1 (0-2)	2 (1-3)	4 (2-8)	6 (2-13)	-	-	-	-	2
Cultus tostonus	-	-	-	<1	-	-	-	-	-	-	<1
Skwala parallela	2	1	-	-	-	-	-	-	-	-	<1
Alloperla spp.	-	-	-	-	-	-	-	<1	-	-	<1
Total Plecoptera	8 (7-8)	3 (2-5)	1 (0-2)	2 (1-3)	5 (3-9)	10 (6-17)	8 (7-8)	5 (1-8)	5 (3-7)	4 (2-5)	5
Ephemeroptera											
Ephemerella inermis	6 (3-8)	4 (2-6)	6 (4-8)	2 (1-3)	13 (9-20)	71 (42-93)	6 (4-8)	17 (11-34)	2 (0-4)	-	18
Ephemerella grandis	1 (0-2)	1 (0-1)	<1	<1	1 (0-2)	17 (12-22)	26 (5-49)	1 (0-1)	-	-	5
Baetis intermedius	-	3 (1-3)	22 (6-48)	23 (14-34)	8 (4-18)	1 (0-4)	1 (0-4)	35 (20-58)	24 (15-38)	6 (2-10)	12
Pseudocloeon edmundsi	-	<1	<1	<1	-	-	-	2 (2-2)	1 (0-1)	-	<1
Paraleptophlebia heteronea	-	-	-	<1	-	1 (0-1)	-	-	-	-	<1
Heptagenia elegantula	-	-	-	-	-	-	-	-	<1	-	<1
Rhithrogena undulata	-	-	-	1 (0-2)	-	<1	-	-	-	-	<1
Ephemerus sp.	-	-	-	-	-	<1	<1	-	-	-	<1
Tricorythodes minutus	-	-	-	-	-	-	-	9 (3-25)	2 (2-3)	-	1
Amelotus sp.	-	-	-	-	-	2 (1-3)	<1	1 (0-3)	-	-	<1
Unidentified species	-	-	-	-	-	-	-	1 (0-1)	-	-	<1
Total Ephemeroptera	7 (5-8)	7 (5-11)	28 (12-56)	26 (19-38)	22 (16-35)	93 (62-119)	21 (10-31)	65 (26-130)	29 (18-42)	6 (2-10)	30

Temperatures, flows, etc.



Fraley 1978 – a rare historical dataset of insect and environmental data

Insect community data

Temperatures, flows, etc.

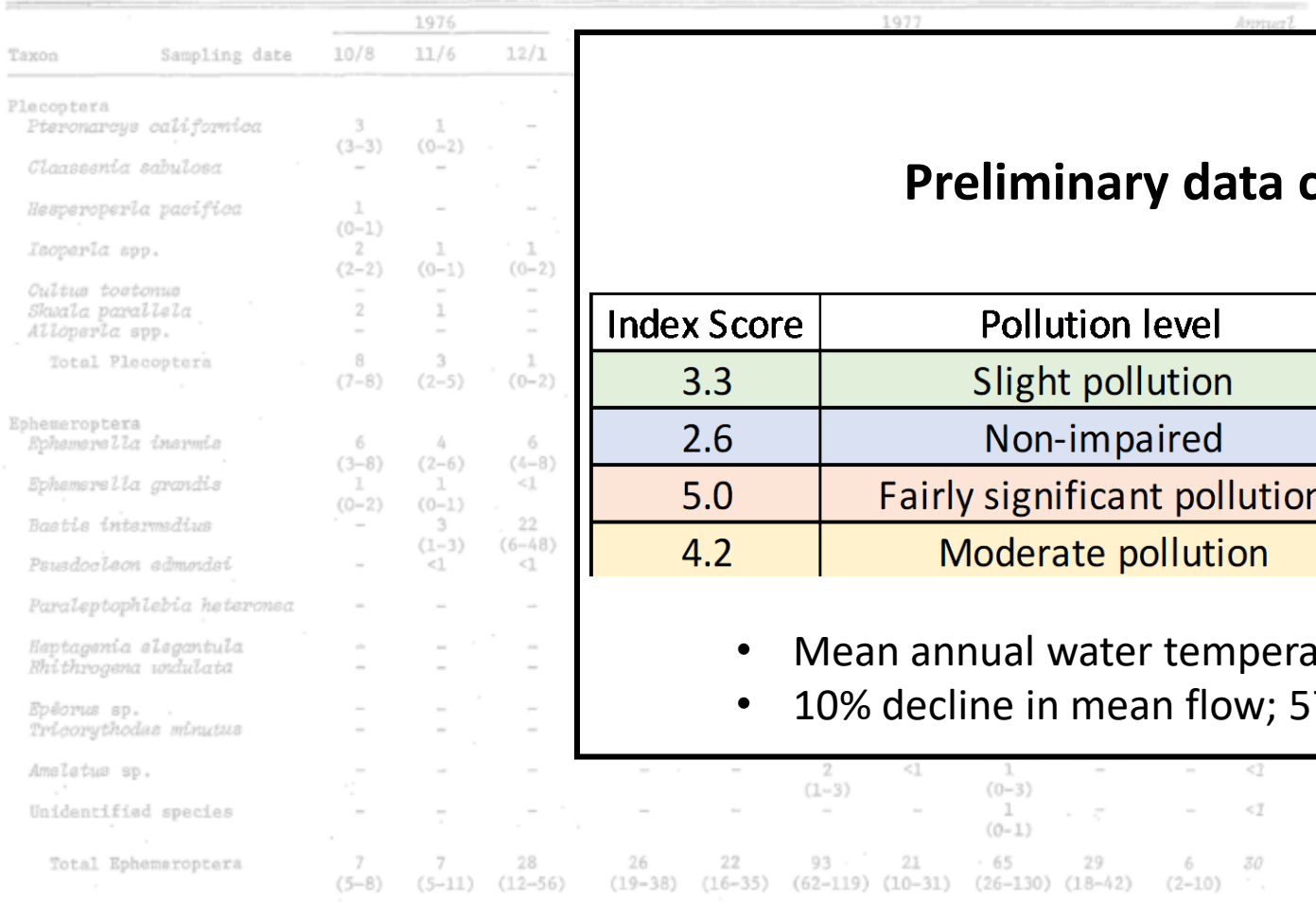
By comparing datasets, we will identify:

1. Insect **status and trends**
2. Changes in **environmental** conditions
3. **Drivers** of insect declines.

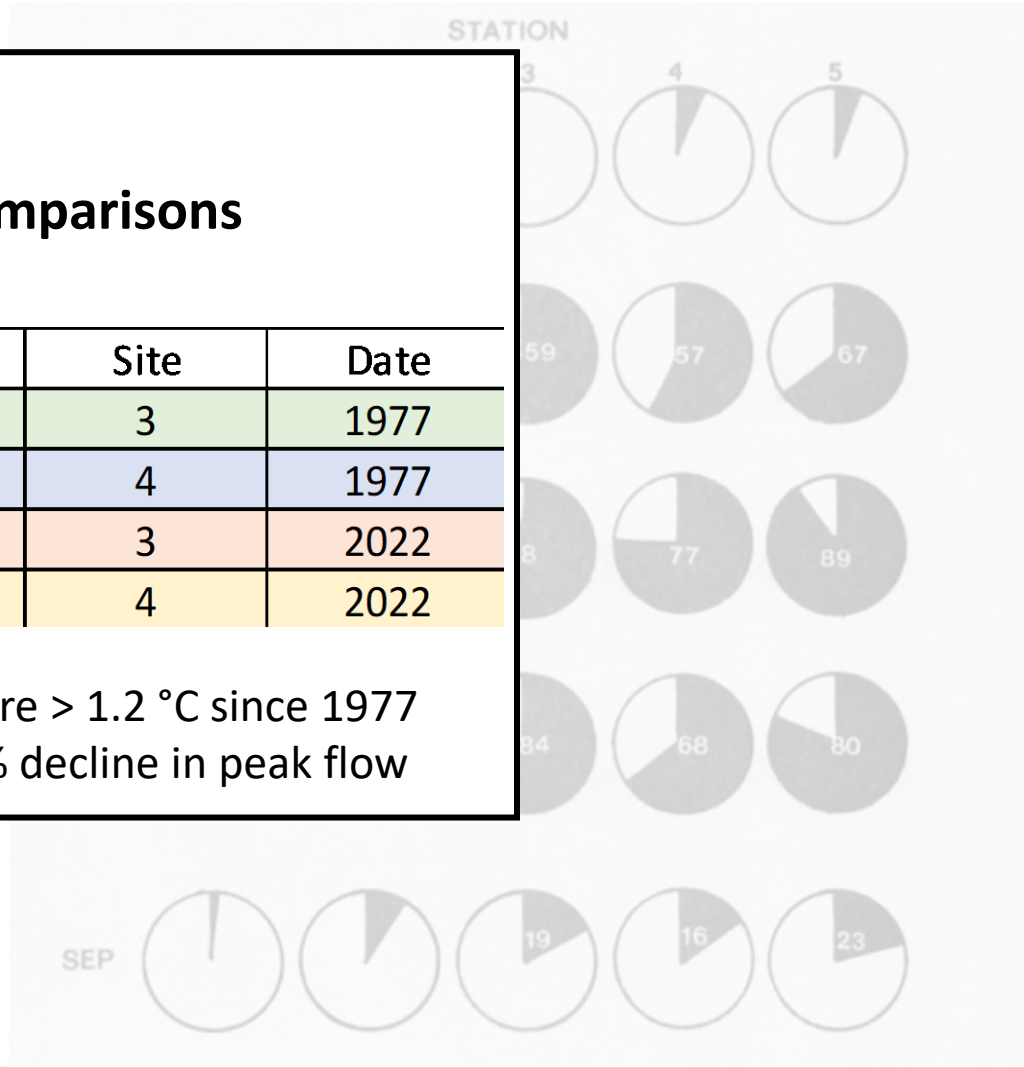
Fraley 1978 – a rare historical dataset of insect and environmental data

Insect community data

Temperatures, flows, etc.



Taxon	Sampling date	1976 10/8	1976 11/6	1976 12/1	1977						Annual
Plecoptera											
Pteronarcys californica		3 (3–3)	1 (0–2)	–							
Claassenia sabulosa		–	–	–							
Hesperoperla pacifica		1 (0–1)	–	–							
Isoperla spp.		2 (2–2)	1 (0–1)	1 (0–2)							
Cultus tostonus		–	–	–							
Skwala parallela		2	1	–							
Alloperla spp.		–	–	–							
Total Plecoptera		8 (7–8)	3 (2–5)	1 (0–2)							
Ephemeroptera											
Ephemerella inermis		6 (3–8)	4 (2–6)	6 (4–8)							
Ephemerella grandis		1 (0–2)	1 (0–1)	<1							
Bastis intermedius		–	3 (1–3)	22 (6–48)							
Pseudocloeon edmundsi		–	<1	<1							
Paraleptophlebia heteronea		–	–	–							
Heptagenia elegantula		–	–	–							
Rhithrogena undulata		–	–	–							
Epeorus sp.		–	–	–							
Tricorythodes minutus		–	–	–							
Ameletus sp.		–	–	–	–	–	2 (1–3)	<1	1 (0–3)	–	–	<1
Unidentified species		–	–	–	–	–	–	–	1 (0–1)	–	–	<1
Total Ephemeroptera		7 (5–8)	7 (5–11)	28 (12–56)	26 (19–38)	22 (16–35)	93 (62–119)	21 (10–31)	65 (26–130)	29 (18–42)	6 (2–10)	30



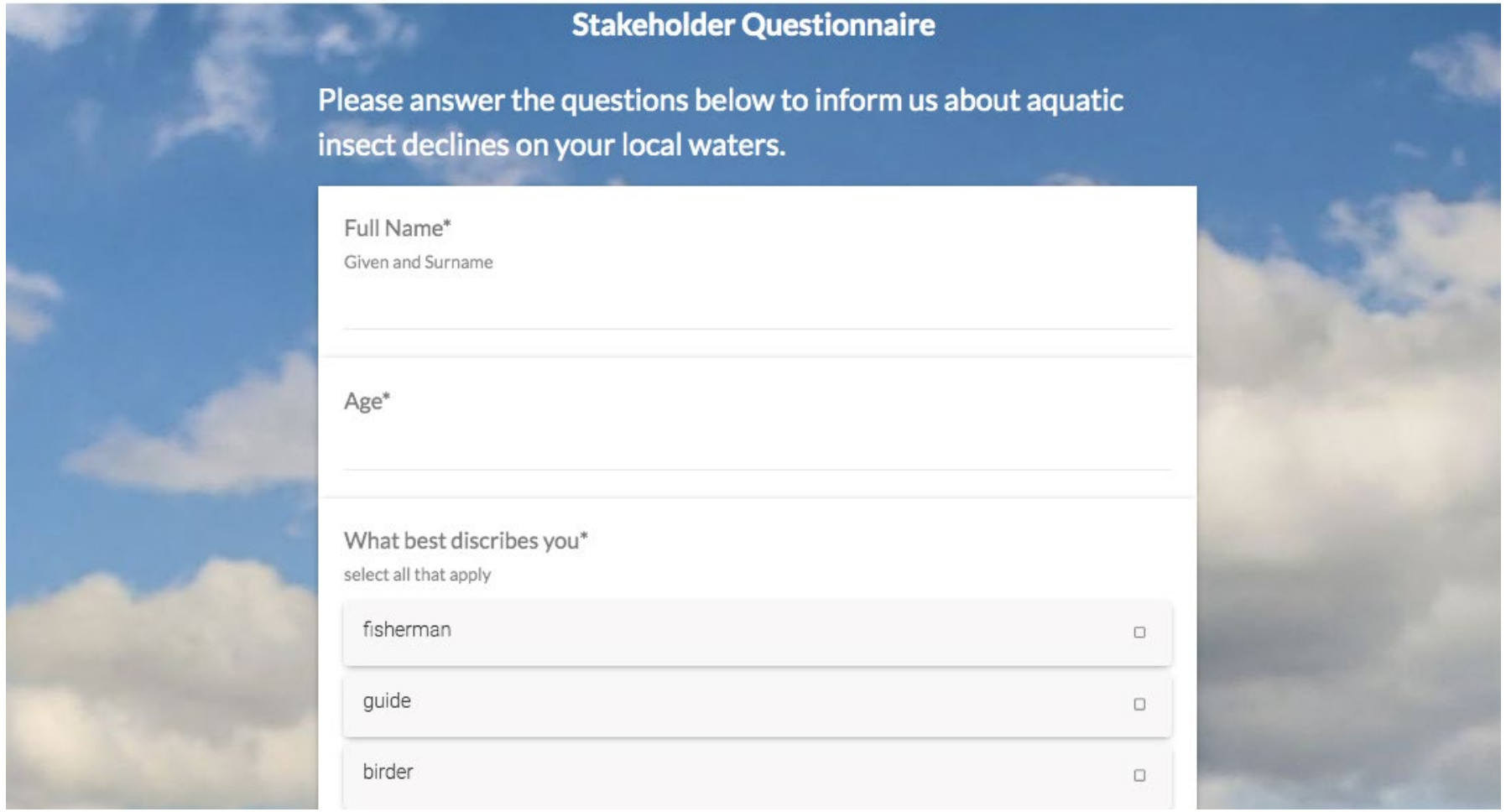
Preliminary data comparisons

Index Score	Pollution level	Site	Date
3.3	Slight pollution	3	1977
2.6	Non-impaired	4	1977
5.0	Fairly significant pollution	3	2022
4.2	Moderate pollution	4	2022

- Mean annual water temperature > 1.2 °C since 1977
- 10% decline in mean flow; 57% decline in peak flow

We need your knowledge

Questionnaire: salmonflyproject.org/citizen-science



Insect declines?

Where?

What species?

Potential causes?

New knowledge

THE SALMONFLY PROJECT

1. Historical data comparisons
2. Citizen science observations
3. New monitoring programs

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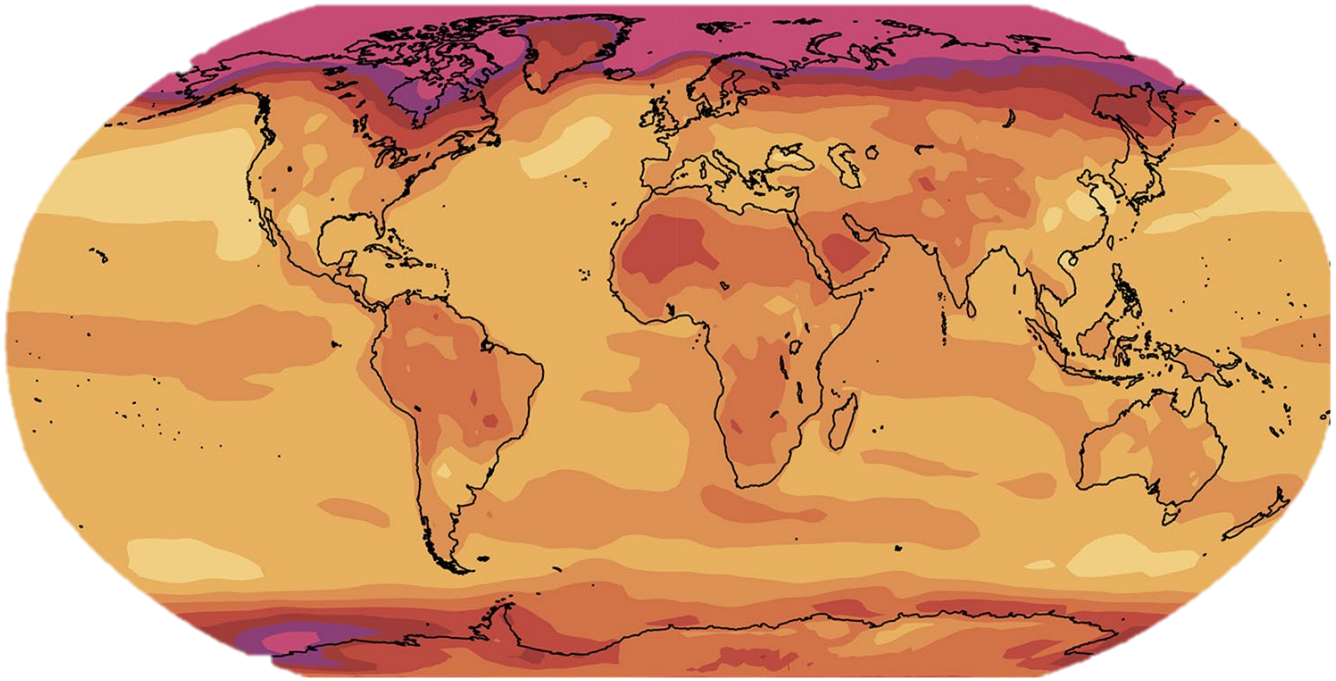
Changes in hatch timing?

INSECTS		SIZE	J	F	M	A	M	J	J	A	S	O	N	D
Black Midge	Midge	18-24												
Capnia	Stonefly	16-18												
Nemoura	Stonefly	14-16												
Blue Wing Olive	Mayfly	16-22												
Skwala	Stonefly	8-12												
Western March Brown	Mayfly	12-14												
Mother's Day Caddis	Caddis	12-16												
Salmon Fly	Stonefly	4-8												
Green Drake	Mayfly	10-12												
Ants & Beetles	Terrestrials	Varied												
Golden Stones	Stonefly	6-12												
Yellow Sallies	Stonefly	14-16												
Pale Morning Dun	Mayfly	14-18												
Pale Evening Dun	Mayfly	14-18												
Tan Caddis	Caddis	12-16												
Hopper & Crickets	Terrestrials	6-14												
Spruce Moth	Terrestrials	10-12												
Tricos	Mayfly	18-22												
Hecuba	Mayfly	8-10												
Blue Wing Olive	Mayfly	16-22												
Mahogany	Mayfly	12-14												
October Caddis	Caddis	8-10												
Tan Midge	Midge	18-24												

Missoulian Angler

Streams warming ~ 0.5 °F per decade



Warming temperatures alter emergence timing and success

inaturalist.org

Citizen science supported database

>172 million observations

>450,000 species observed

iNaturalist.org

How It Works

Record observations; attempt to identify

Share on iNaturalist.org

Observations validated; data used by scientists

OnWater FISH

iNaturalist

OnWater FISH

Observe the hatch, match the hatch, save the hatch

- Distribution models
- Population estimates
- Emergence timing
- **Angler self-education**

New knowledge

THE SALMONFLY PROJECT

1. Historical data comparisons
2. Citizen science observations
3. New monitoring programs

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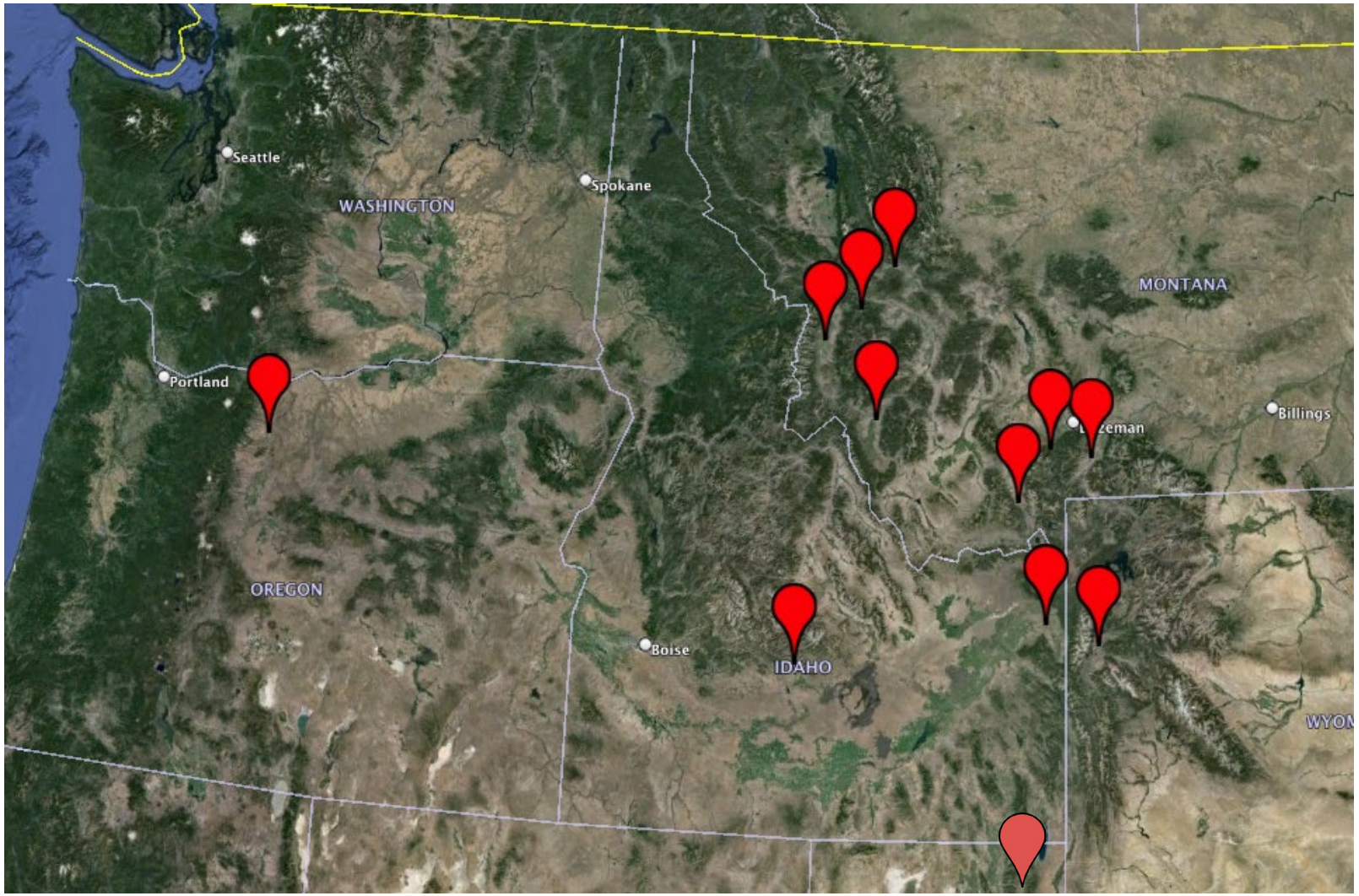
Twelve monitoring programs



Montana:
Bitterroot
Big Hole
Madison
Yellowstone
Gallatin
Blackfoot
Rock Creek

Idaho:
Teton
Big Wood

Oregon:
Deschutes

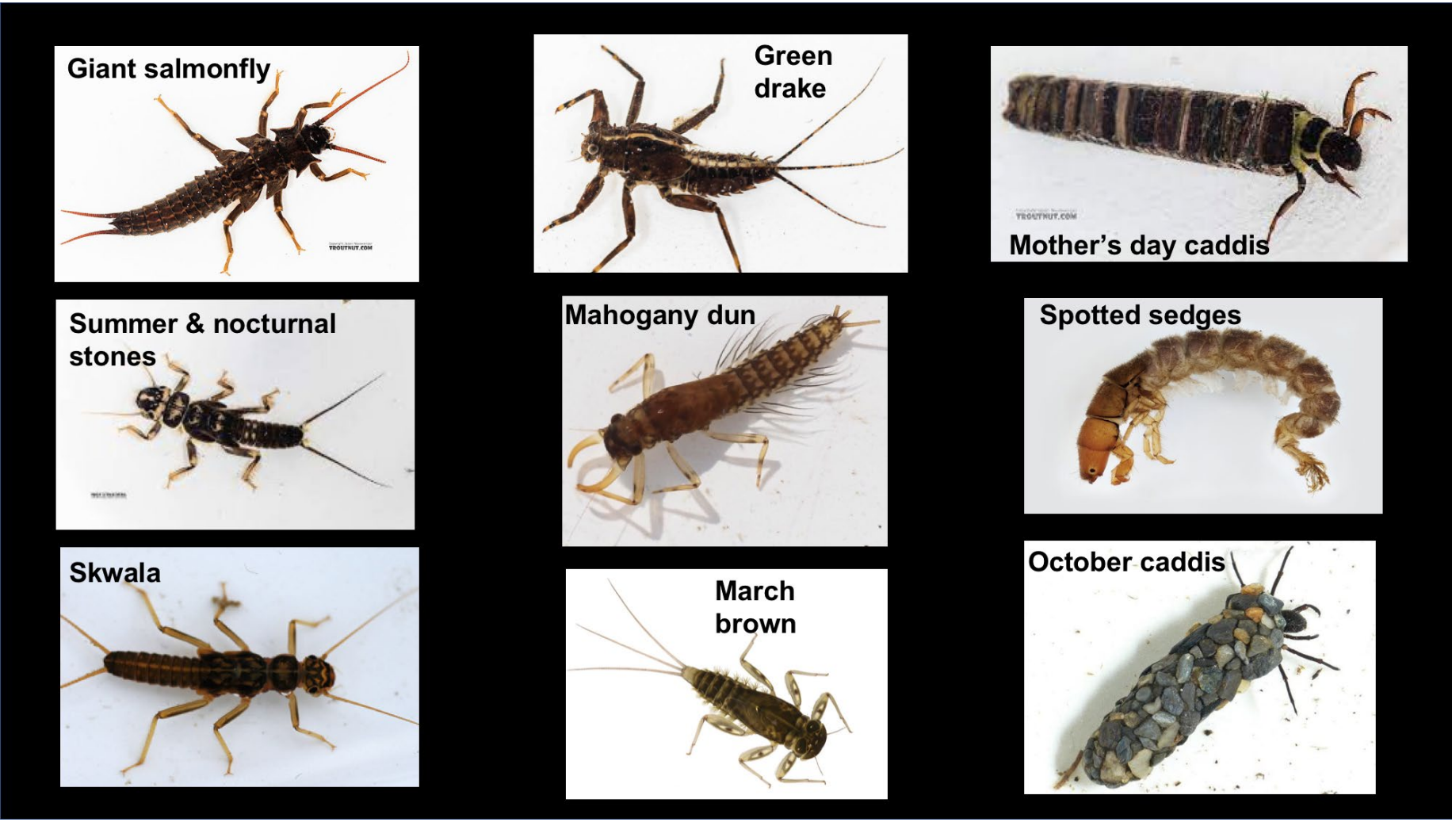
Utah:
Ogden

Wyoming:
Upper Snake

Primary goals:

1. Status & trends 2. Drivers 3. Inform management

1) Insect status & trends



Community metrics:

- Population densities of important species

Benefits:

- Inexpensive; 1/2 the cost of community sampling
- ~ $1000 per site, including analysis & reporting

2) Drivers of insect declines

Warmer temperatures

(Temperature loggers)

Dewatering levels

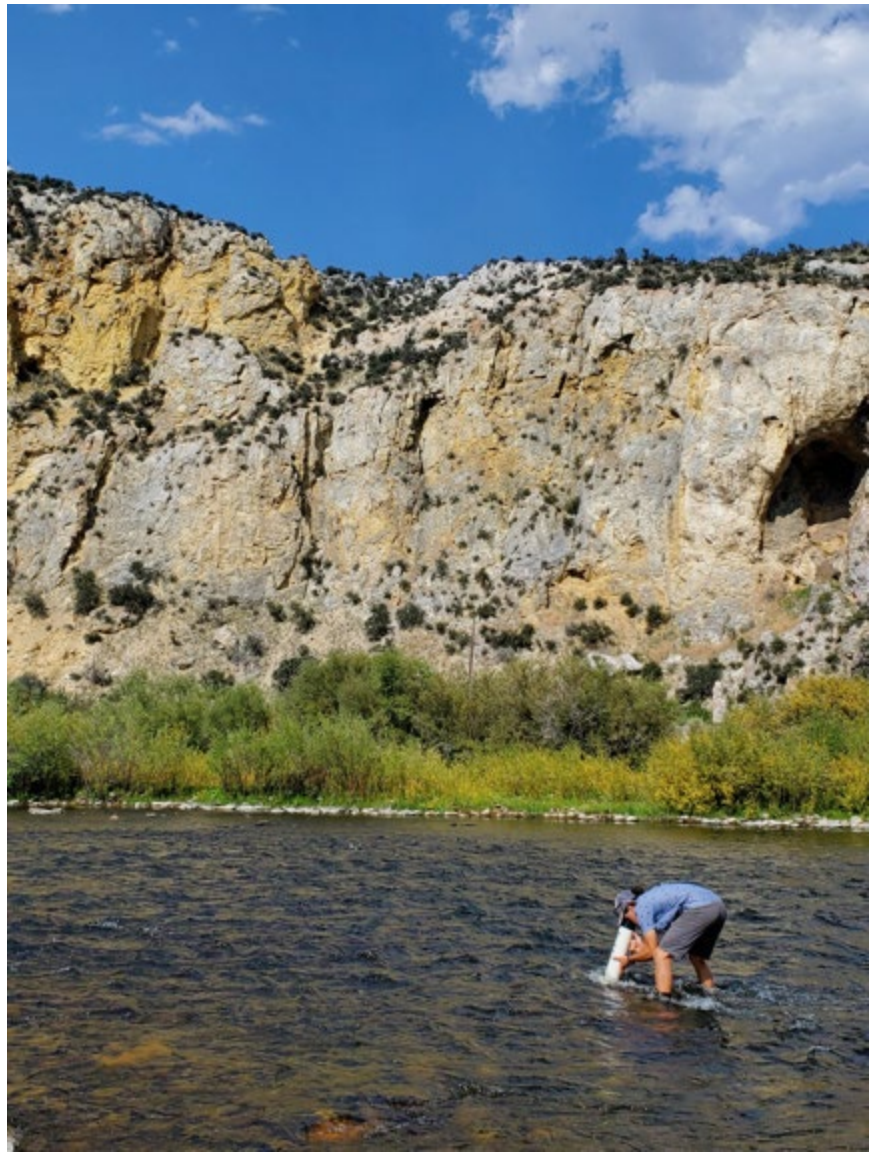
(USGS gages & models)

Sedimentation

(Fine sediment surveys)

Nutrient pollution

(Nutrient sampling)



Insect sampling

Habitat sampling

Preserving samples

All sampling assisted by volunteers

Insect ID

Insect ID

Insect ID

3) Disseminating results to stakeholders and managers

Popular media and angling magazines

The Drake

FLY FISHERMAN

Resource managers and restoration practitioners

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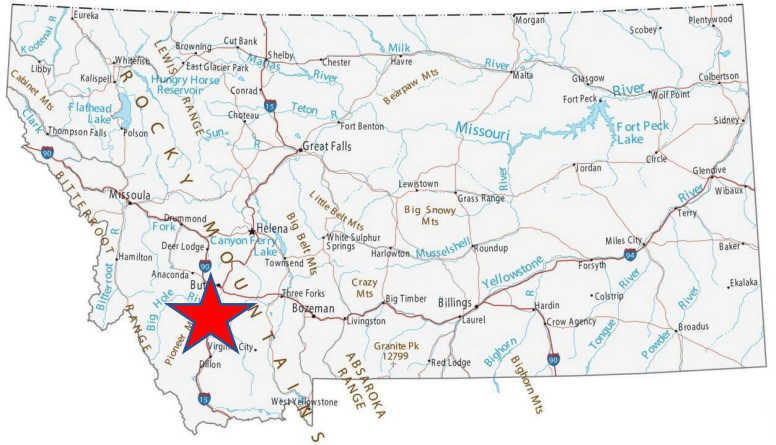
MONTANA FISH, WILDLIFE & PARKS

TROUT UNLIMITED

U.S. FISH & WILDLIFE SERVICE

Monitoring case study

Big Hole River, Montana



Famous for:

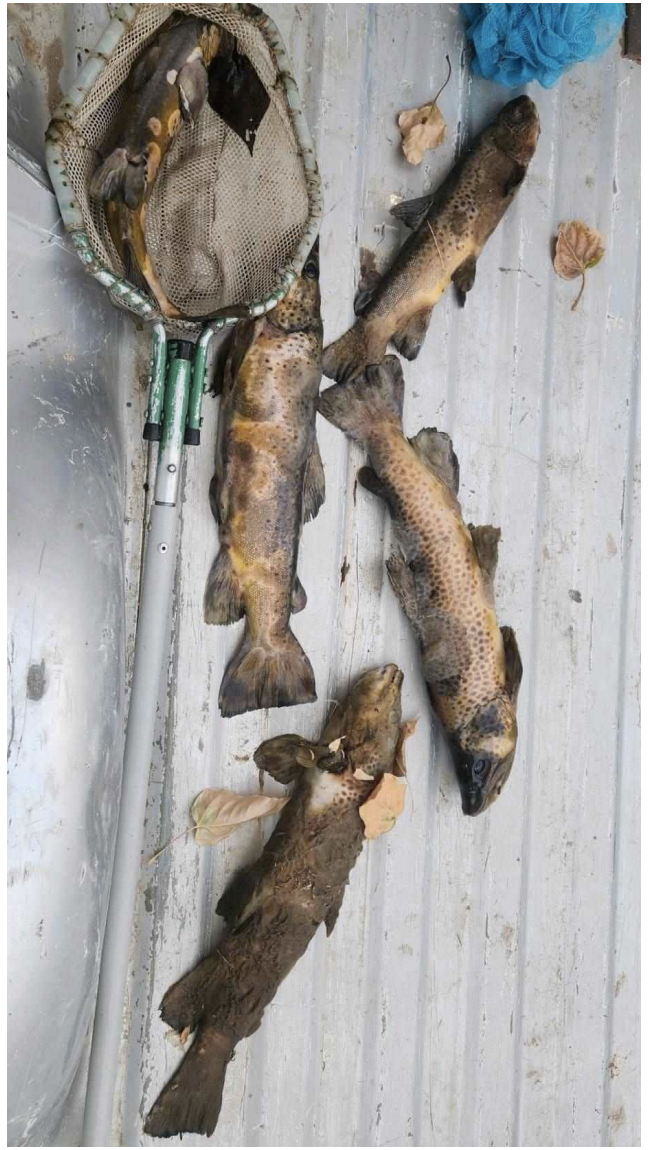
- Big browns & bows
- Native cutthroat and grayling
- Strong hatches & selective trout

Severe trout declines

FLY FISHERMAN

Southwest Montana Trout Populations Continue Alarming Decline

The Big Hole, Ruby, Beaverhead, Jefferson, and Clark Fork rivers are seeing severely reduced trout populations. Where are the Montana officials and agencies?



The New York Times

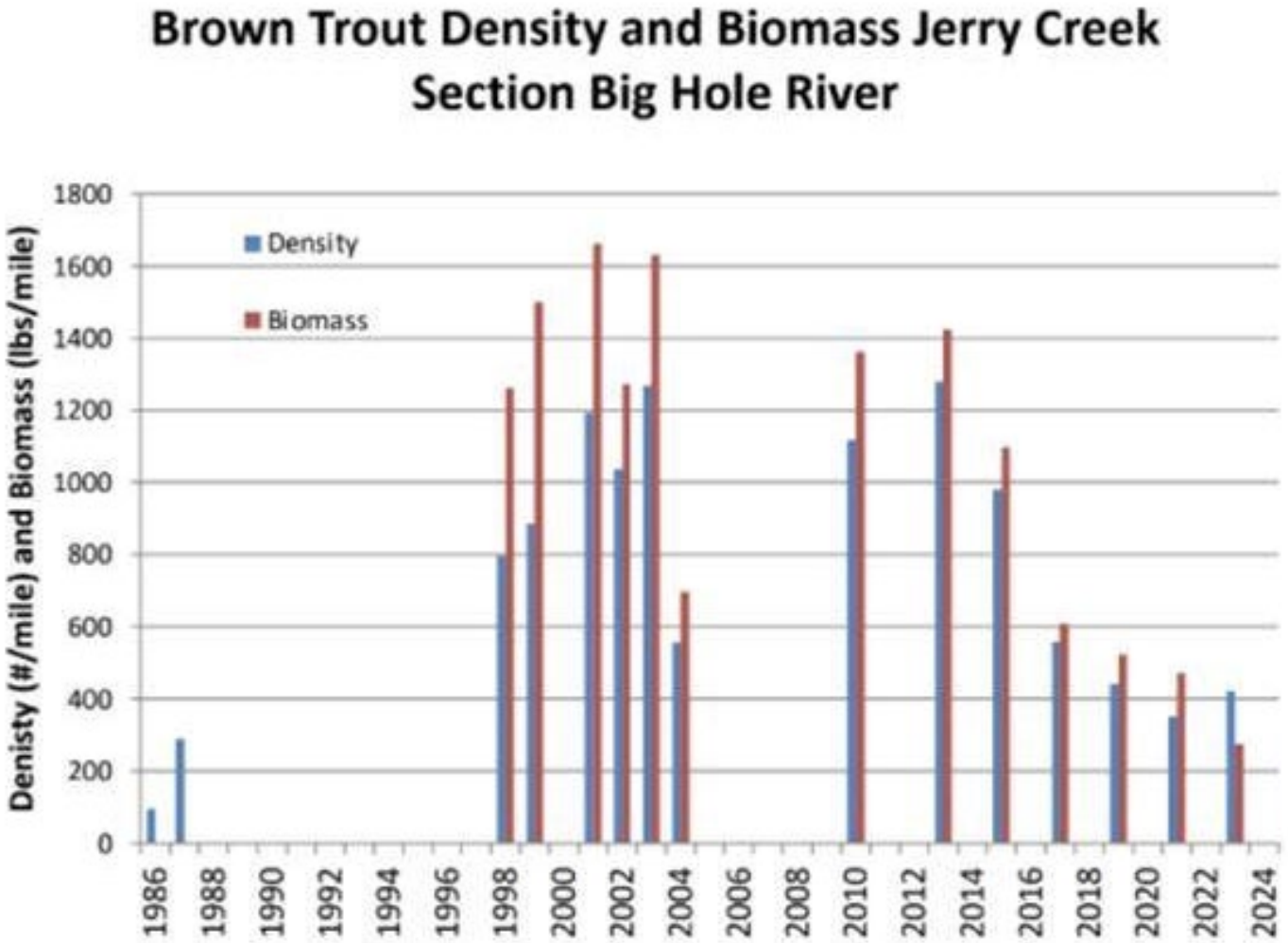
'Zombie Trout' Unsettle Montana, Long a Fly-Fishing Mecca

Warming waters and other factors along the state's rivers like the Big Hole appear to be contributing to alarmingly low numbers of the state's renowned rainbow and brown trout.

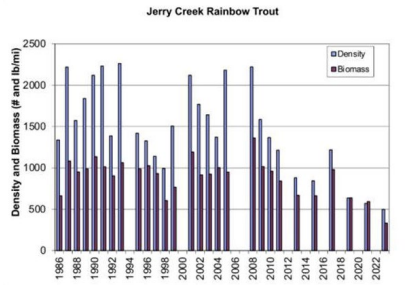
MIDCURRENT

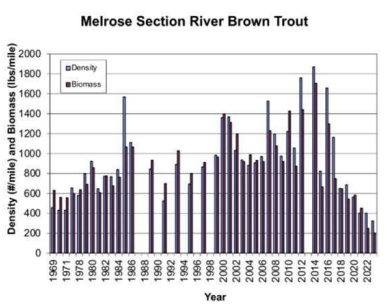
Details on the Big Hole River Trout Decline

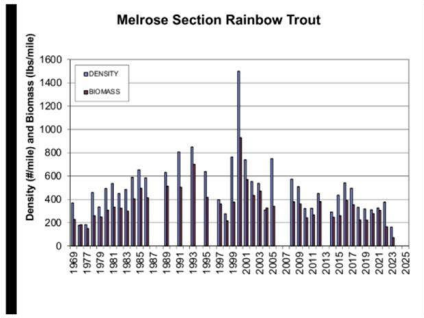
Severe trout declines



Monitored by MT FWP





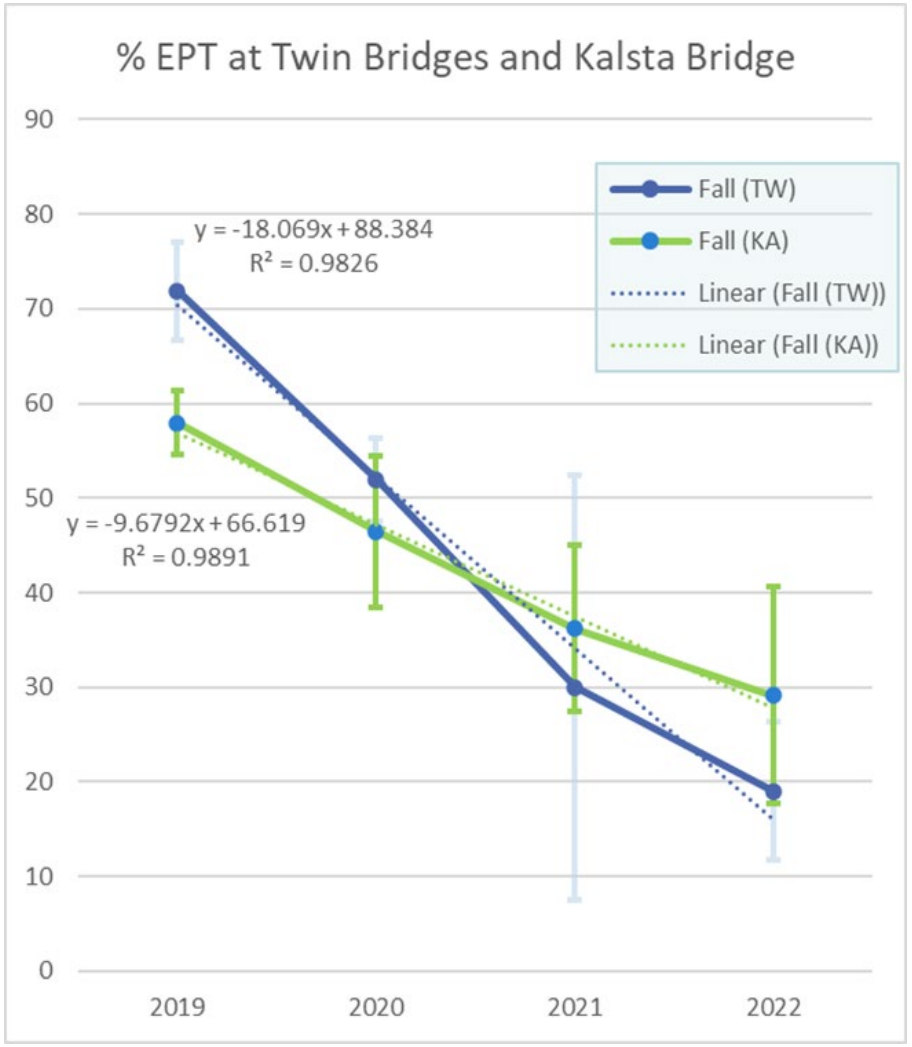


Big Hole River Foundation finds declining insects

BIG HOLE RIVER FOUNDATION

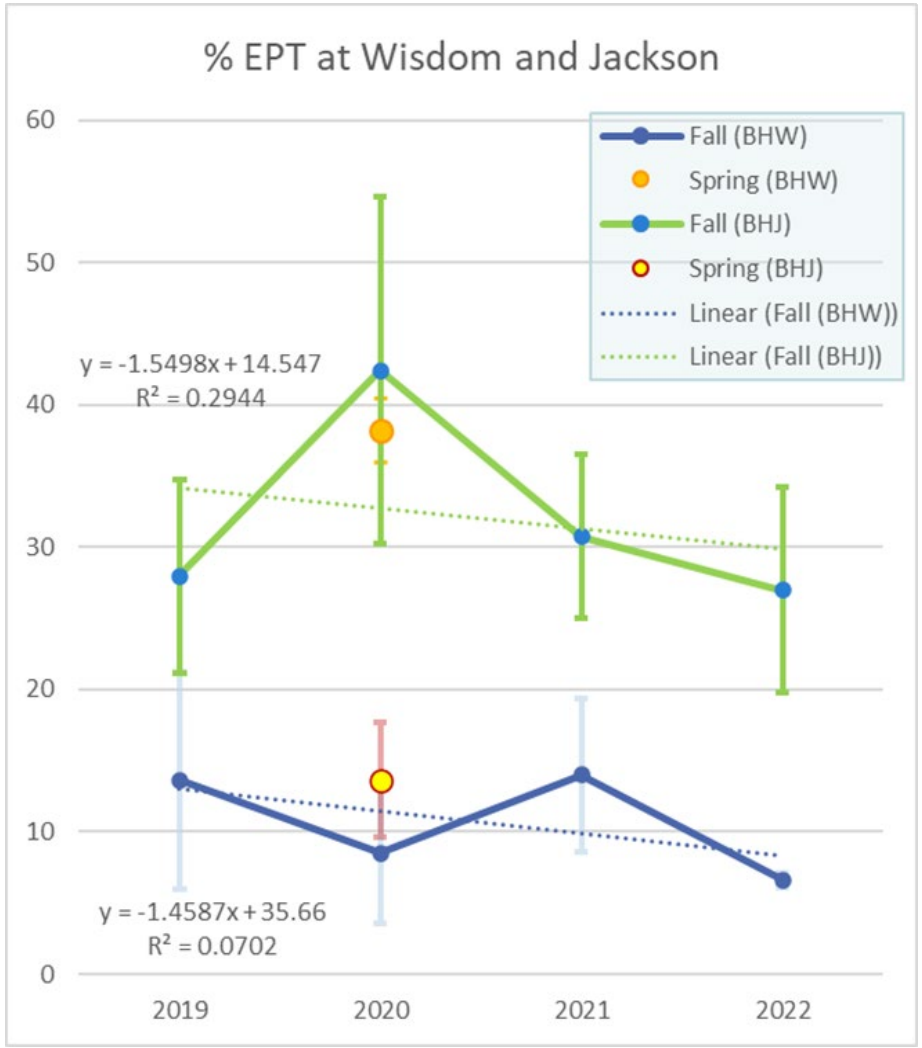
Percent stoneflies, mayflies, caddisflies (%)

Upper Big Hole



Year

Lower Big Hole



Year

Average decline of 40%

Big Hole: Hot and Dewatered

THE SALMONFLY PROJECT

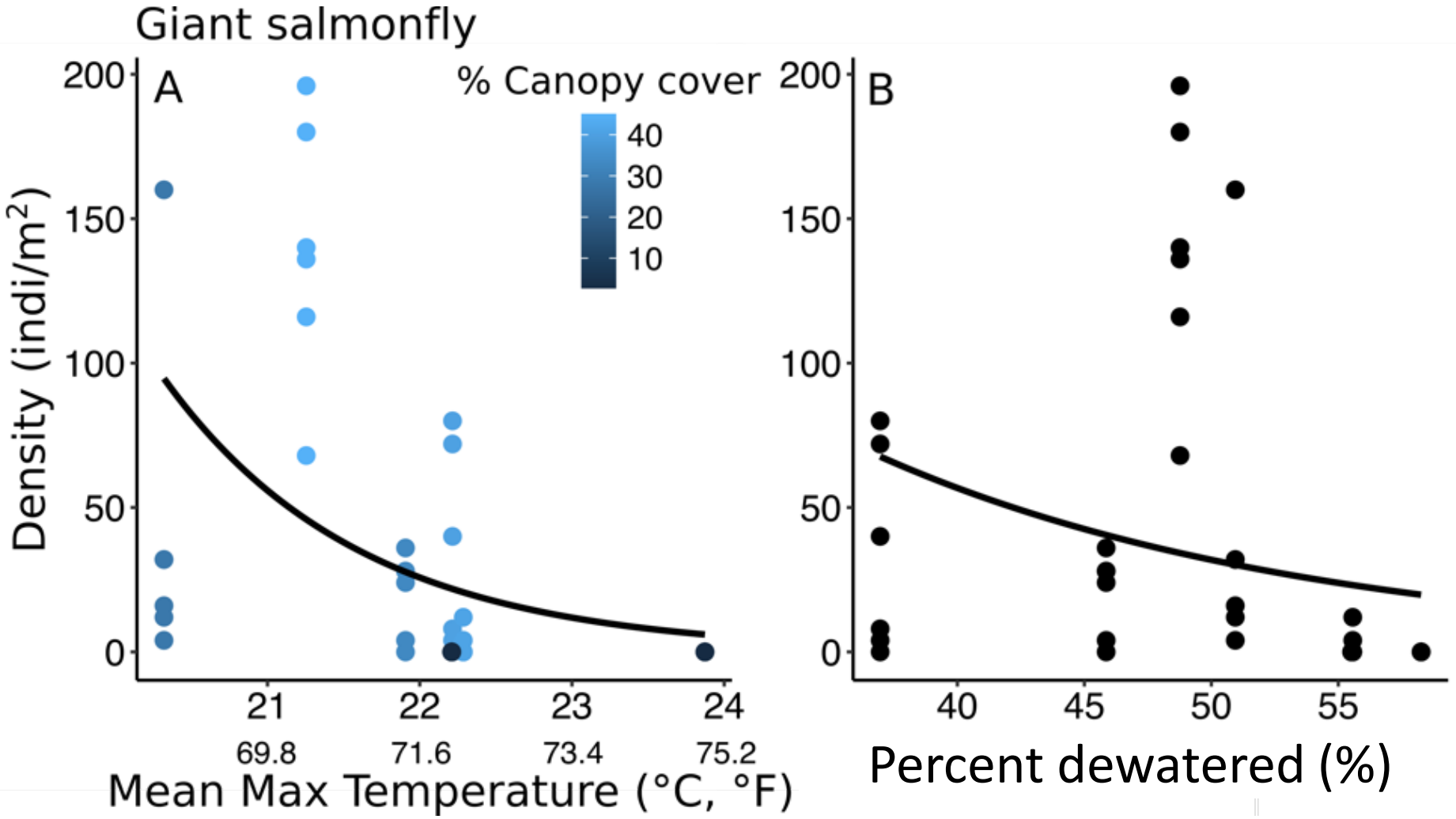
BIG HOLE RIVER FOUNDATION

Maximum monthly temperatures

- Upper river: **72.1°F**
- Middle river: 69.2 °F
- Lower river: **73.25 °F**

Summer dewatering levels

- Upper river: **52%**
- Middle river: **50%**
- Lower river: **49%**



Fewer salmonflies in **warmer** and more **dewatered** reaches

No salmonflies where max summer temps > 75 °F and dewatering > 55%

Green Drakes

Fewer green drakes in **warmer** reaches

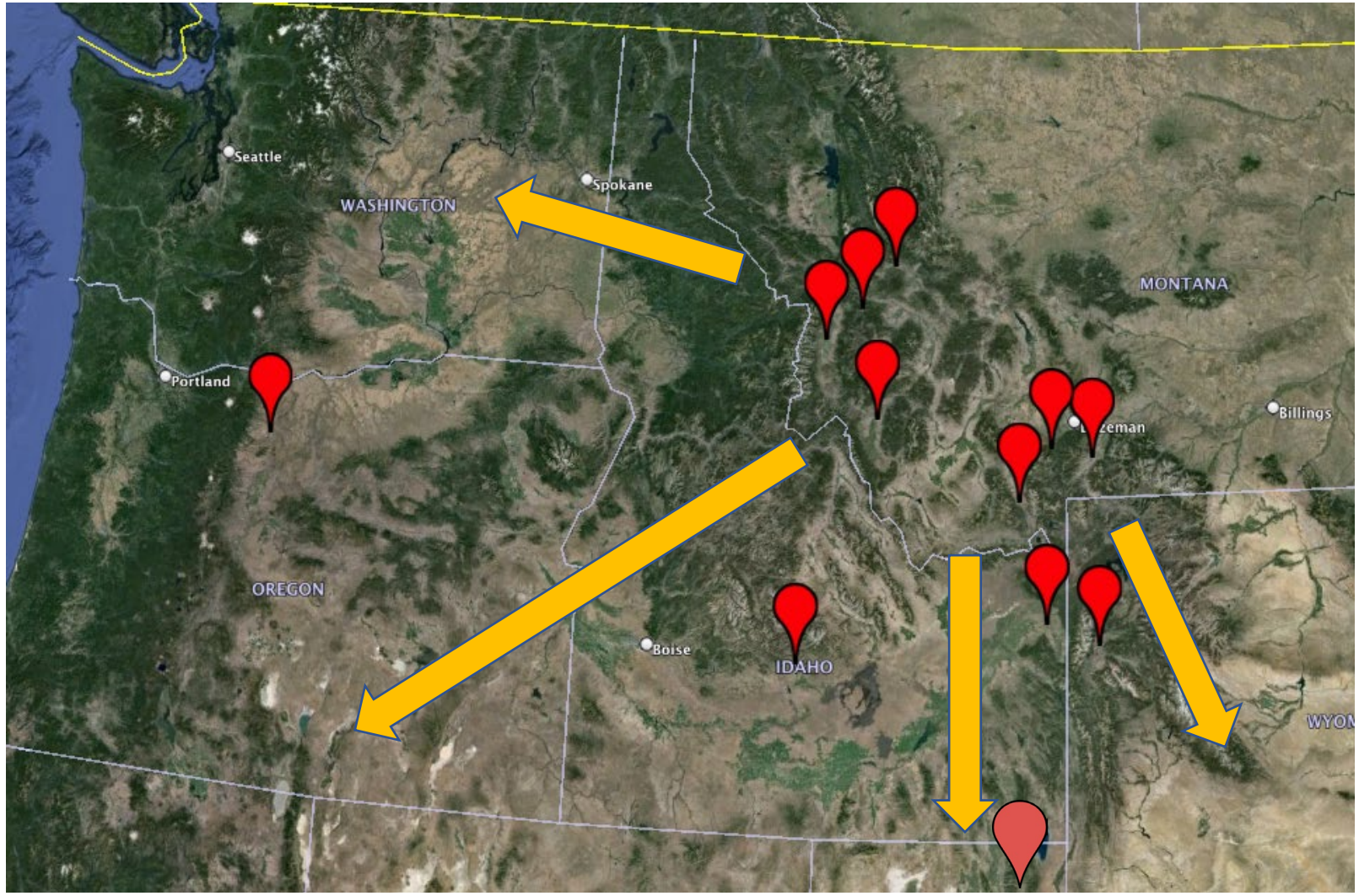
None where mean summer temps = 64 °F and max summer temps = 75 °F

Mother's Day Caddis

Fewer MD caddis in **warmer** and more **dewatered** reaches.

None where max summer temps = 72 °F and percent dewatering > 55%

Twelve current monitoring programs & expanding



Montana:
Bitterroot
Big Hole
Madison
Yellowstone
Gallatin
Blackfoot
Rock Creek

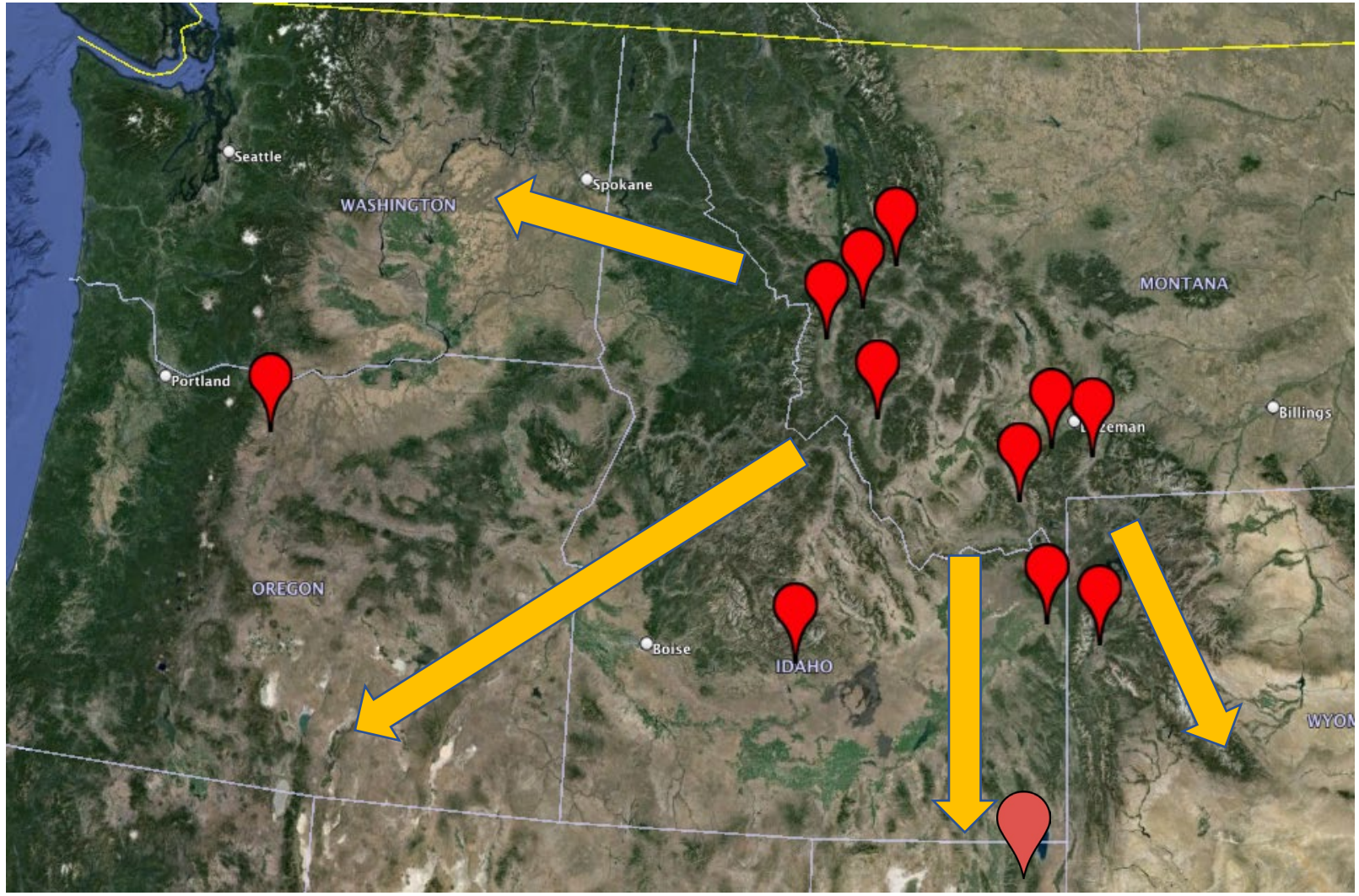
Wyoming:
Upper Snake

Idaho:
Teton
Big Wood

Oregon:
Deschutes

Utah:
Ogden

Streamlining future monitoring programs through TU-partnerships



Chapters take the lead

- Appoint ‘Chapter lead’ or committee
- Organize training events to learn insect and habitat sampling with SFP
- Organize volunteers
- Lead insect and habitat sampling
- Send samples/data to SFP

Maggie Heumann,
Manager of Volunteer Ops

THE SALMONFLY PROJECT

Monitoring committee and working group

TROUT UNLIMITED

Thank you

THE SALMONFLY PROJECT

Want to support our mission? **Donate** at: salmonflyproject.org

Current partners:

George S. and Dolores Doré Eccles Foundation

patagonia

LIFETIME

Trout Unlimited

Forest Service U.S. Department of Agriculture

OnWater Fish

Missoula Butterfly House & Insectarium

ON

University of Montana

Montana Natural History Center
Connecting People with Nature

Hutchings Museum 1955 Institute

Big Hole River Foundation

Friends of the Teton River