

Obvious Negative Impacts

- Formation of Monotypic Vegetation
- Displacement of Native Plant Communities
- Loss of Open Water Recreation
- Irrigation Impediment

Higher Level Impacts Likely

- Increases in Water Temperatures
- Nutrient Releases
- Sediment Transport & Deposition
- Food Chain Alterations / Native Fisheries

A Sampling Methods Pilot Study: Flowering Rush Habitat Suitability for Introduced Fish & Macroinvertebrate Community Changes

Peter Rice and Dave Stagliano, University of Montana
Virgil Dupuis, Jerome O' Brien, and Alvin Mitchell, Salish Kootenai College
Eric Dibble and Neil Branson, Mississippi State University



**These Introduced Piscivorous Fish
Are Adapted to Vegetated Habitats
Invasive Facilitative Commensalism**



Native Salmonids Are Open Water Species



(Dibble et al 1997)
Simberloff & Holle 1999

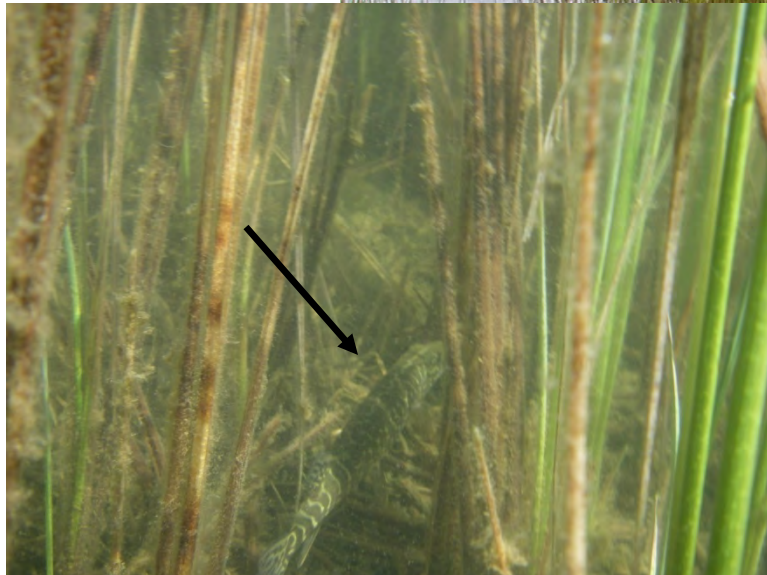
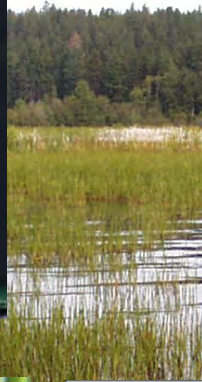
Ducharme Fishing Access (Flathead Lake)

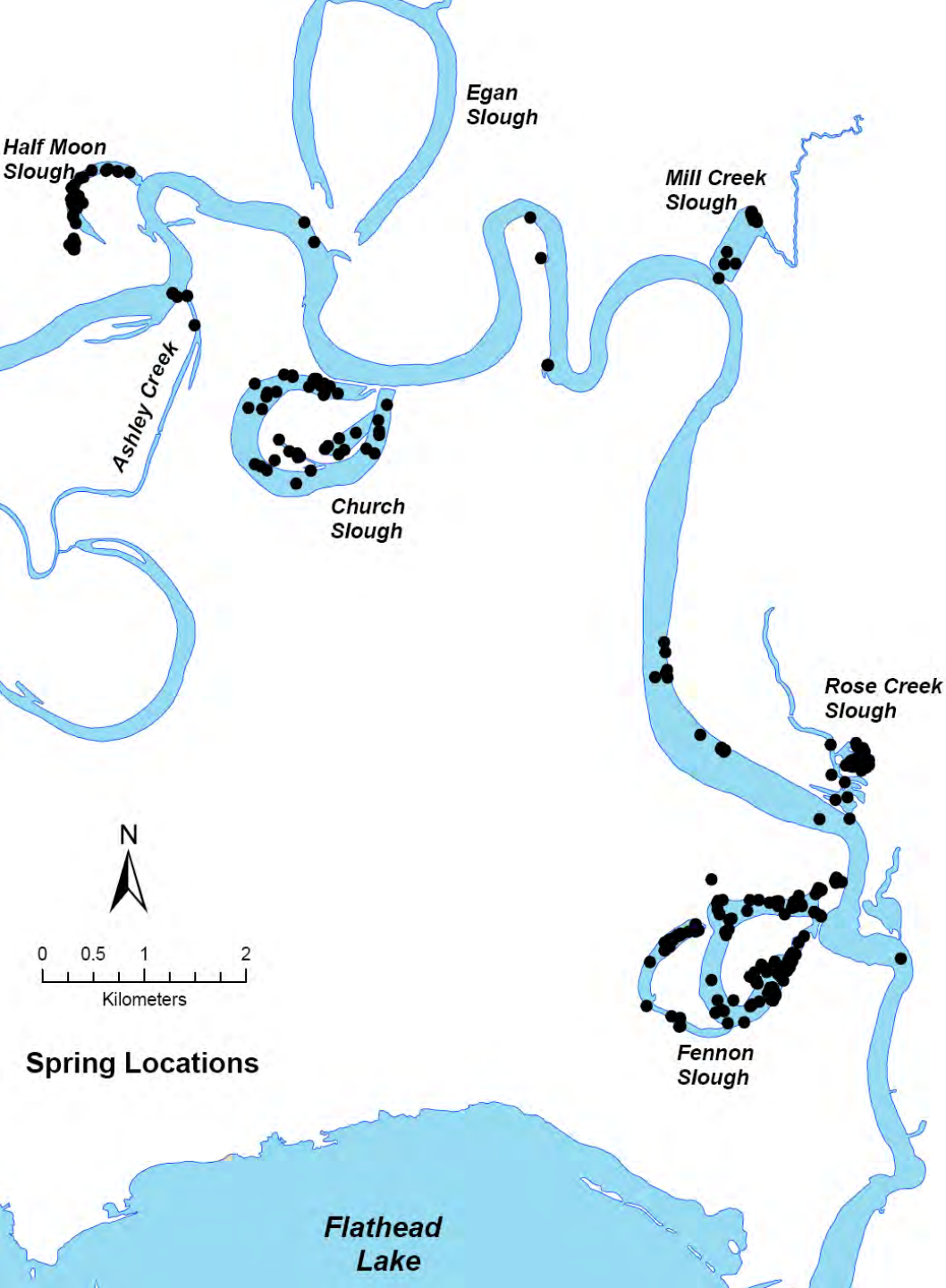


Northern Pike Predation of Salmonids

Miller & Thomas 1957; McMahon & Bennett 1996; Orabutt 2006, Spens & Ball 2008, Spen 2007,

Pierce 2012, Dalton 2002, Hein 2014





Montana Fish, Wildlife & Parks

Radio Tag Study of Northern Pike Distribution in the Upper Flathead River

An aerial photograph of a slough system with a red cross-hatched area indicating a specific zone. Numerous small green and blue dots are scattered throughout this area, representing data points. The surrounding landscape includes fields, trees, and water bodies.

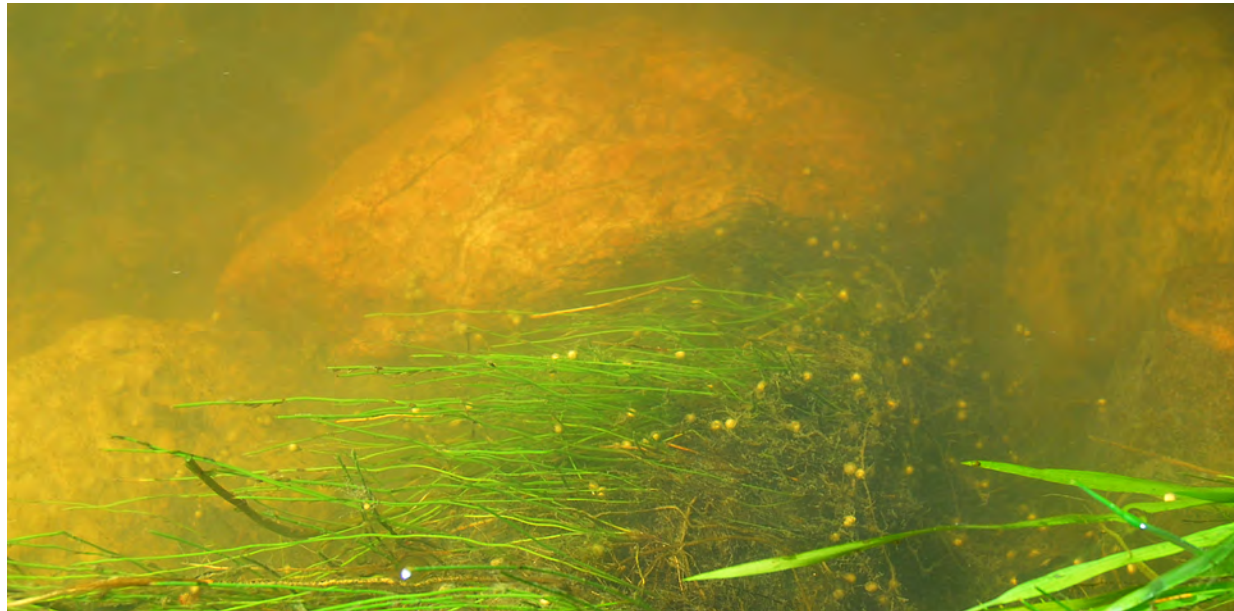
Northern Pike
Utilization of
Flowering Rush
(Fennon Slough)

Northern Pike

Obligate Vegetation Spawners



- Eggs Attached
- Sac Fry Attached
- Fingerling Rearing





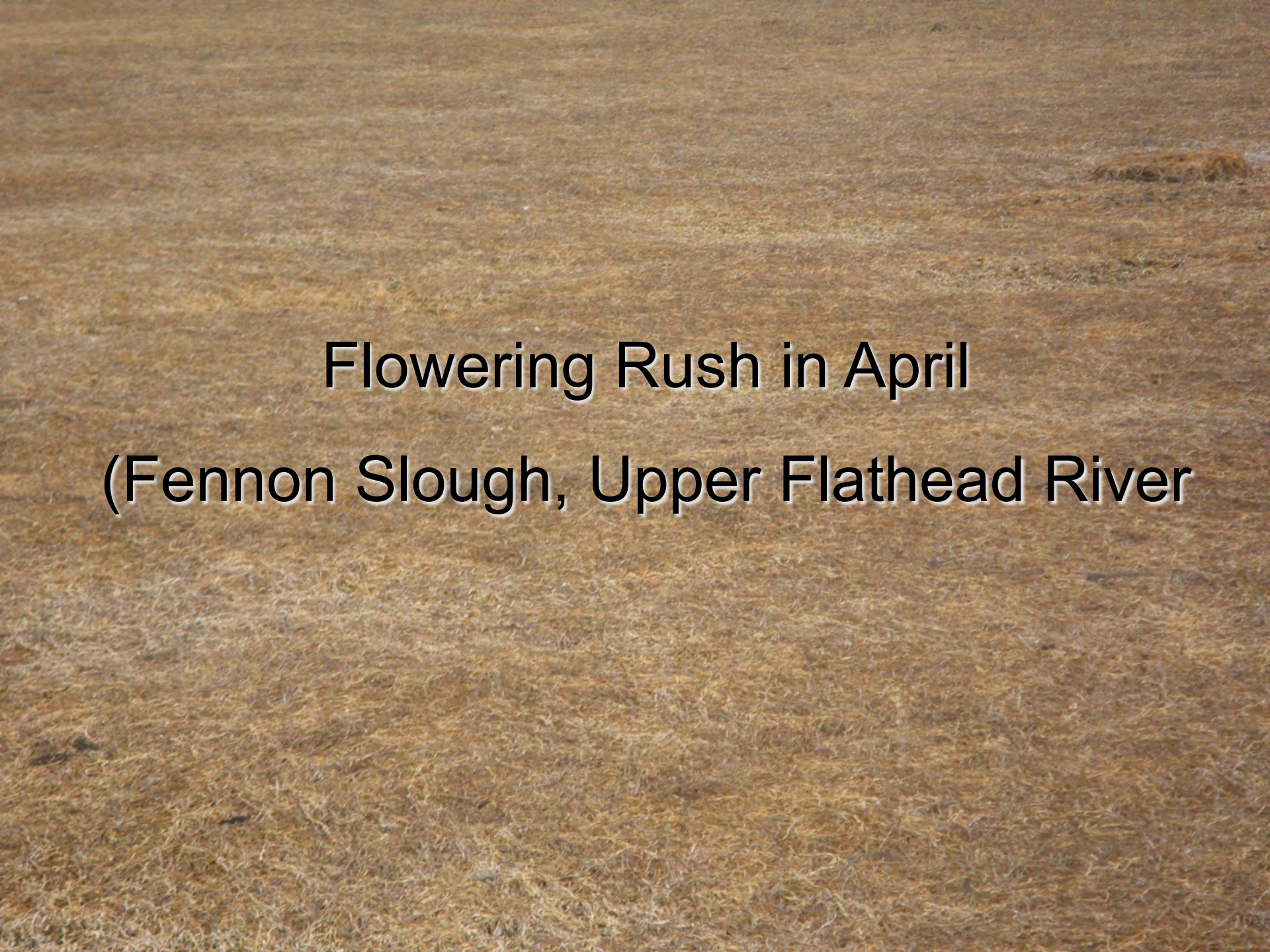
Hunt & Carbine 1951

Mann 1982

Grimm 1983



Flowering Rush in Fall
(Mill Cr. Slough Upper Flathead River)

The background of the image is a vast, flat expanse of a slough filled with flowering rush. The plants are densely packed, creating a textured surface of brown and tan hues. The lighting is even, highlighting the intricate details of the plant stems and flowers. The overall scene is a natural, undisturbed wetland environment.

Flowering Rush in April
(Fennon Slough, Upper Flathead River)







Northern Pike Bioenergetics Study (Upper Flathead River)

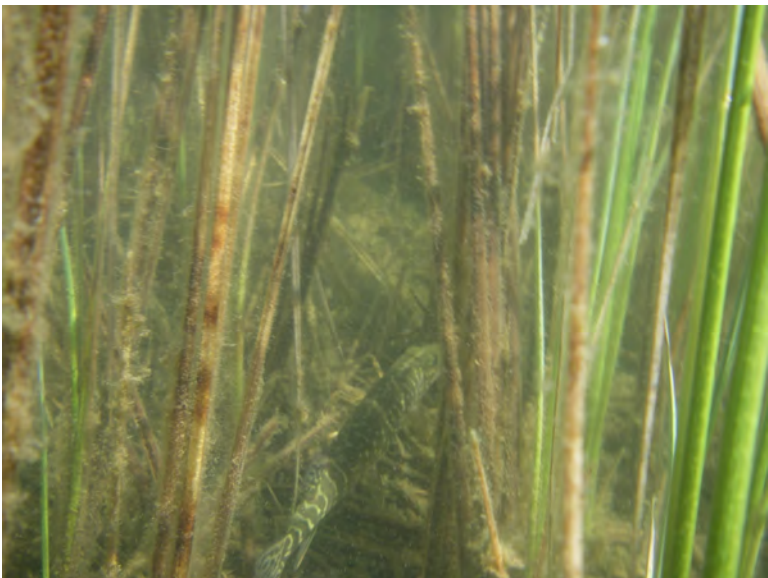


	<u>Prey items</u>	
<u>Season</u>	<u>WCT*</u>	<u>BULL**</u>
Winter	686	380
Spring	2,015	2,922
Summer	9,428	0
Fall	1,250	156
Totals	13,379	3,457

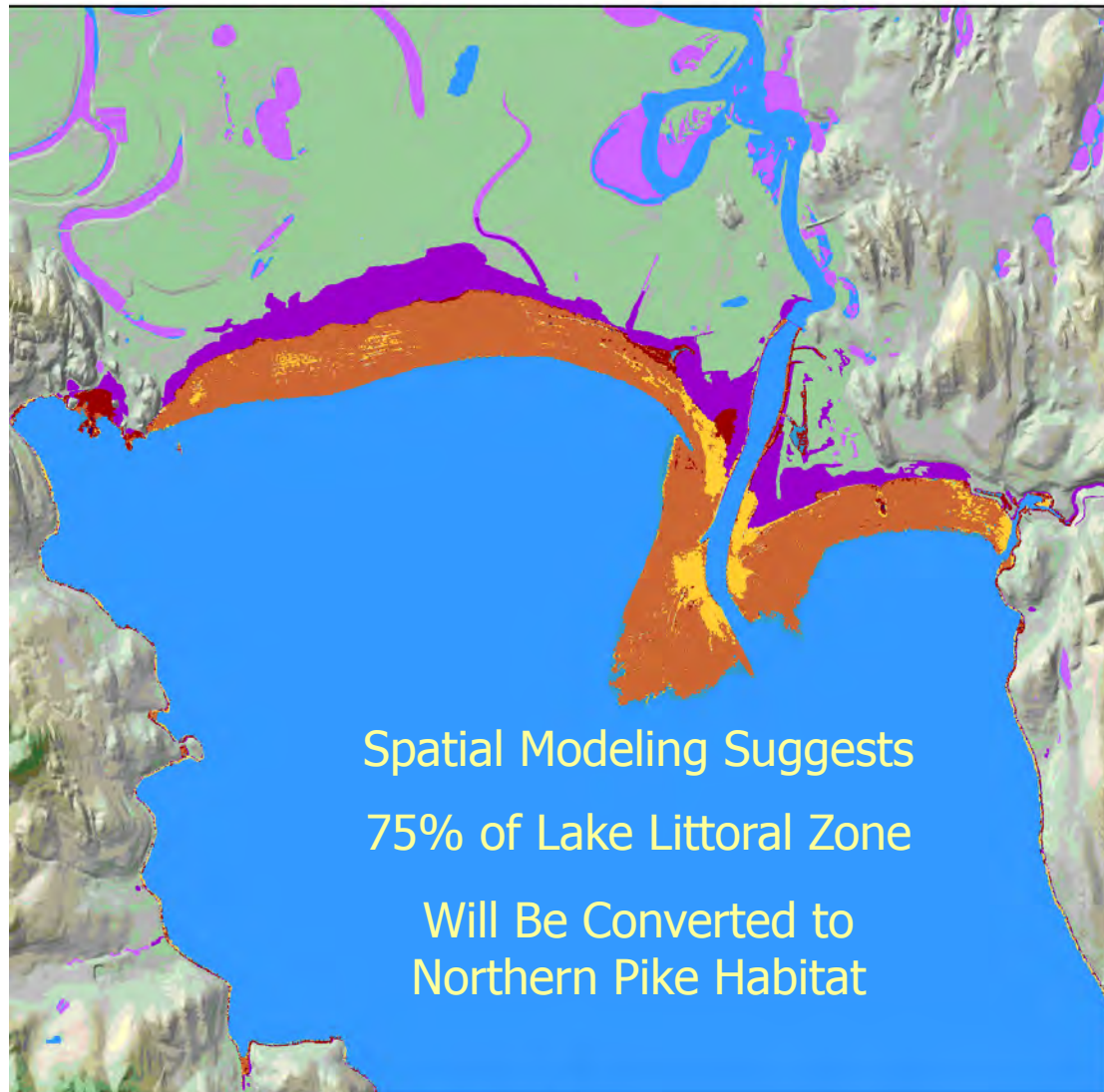
Bull Trout** & Cutthroats* Are
Being Significantly Depredated
by Northern Pike



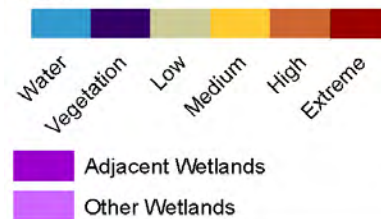
Muhlfeld et al. (2008)



Flowering Rush Invasion Susceptibility



class



Data and Map Produced By:
MTNHP Spatial Analysis Lab
Salish Kootenai College
University of Montana

Rice & Dupuis 2009

Sampling Methods





Gerking Box



Gerking1957, Sychra & Adámek 2010



Ekman Dredge

Hudson 1970



Hudson 1970

Pop Nets



Connolly 1994

Quatrefoil Light Traps

Pierce et al 2007

Floyd et al. 1984

Secor et al. (1992)





Sweep Nets



García-Criado and Trigal 2005

Fixed-Fraction Subsampling



Barbour & Gerritsen 1996

Doberstein et al 2000

Petkovska & Urbanič 2010

Macroinvertebrate Metrics for 2012 Sweep Samples

	Taxa Richness	Density (Ind./sweep)	% Scrapers	% Climbers
100% BUTUMB (n=3)	35.6	357 ± 5 ab**	22	29
100% NATIVE (n=3)	36	432 ± 57 b	21	25
25-90% NATIVE (n=3)	35.7	528 ± 32 bc*	12*	18*
OPEN WATER (n=2)	32	355 ± 10 c	6**	10**

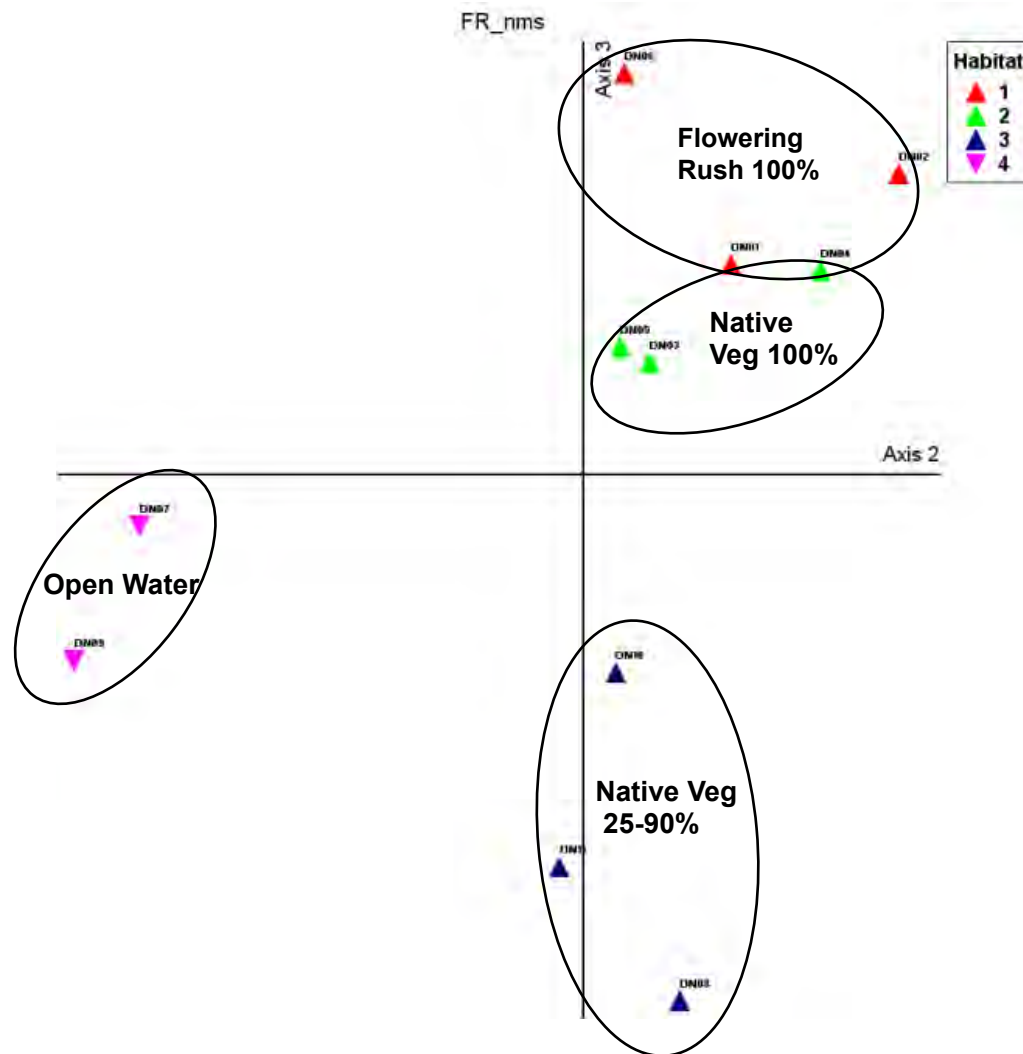
ANOVA *p<0.05, **p≤0.01

Macroinvertebrate Metrics for 2012 Sweep Samples

	Taxa Richness	Density (Ind./sweep)	% Scrapers	% Climbers
100% BUTUMB (n=3)	35.6	357 ± 5	22	29
100% NATIVE (n=3)	36	432 ± 57	21	25
25-90% NATIVE (n=3)	35.7	528 ± 32	12*	18*
OPEN WATER (n=2)	32	355 ± 10	6**	10**

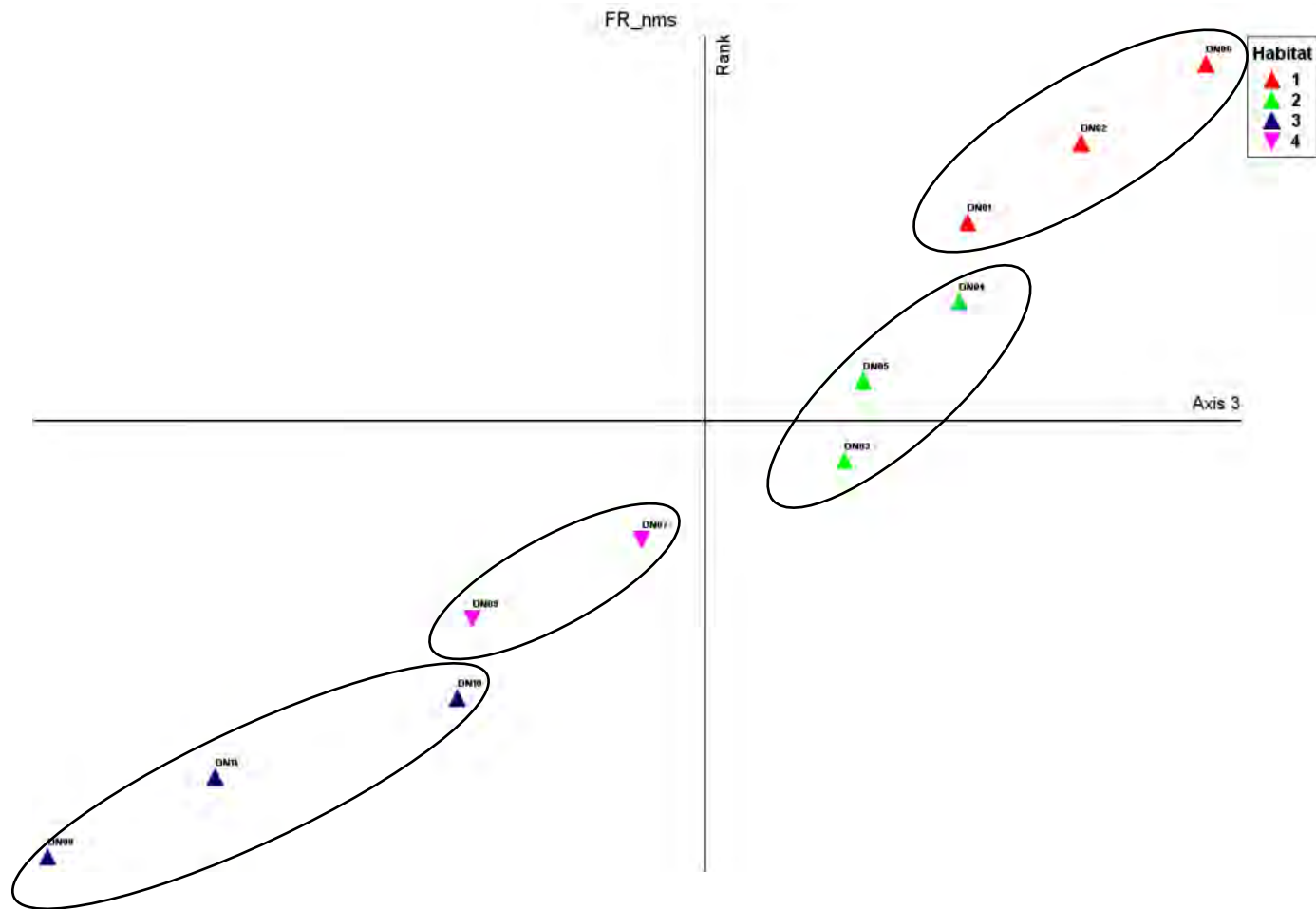
ANOVA *p<0.05, **p≤0.01

Aquatic Community NMS Relationship for 2012 Dip Net Samples



2012 Aquatic Community

NMS Rank Relationships



Stress 14.1

Dip Net Samples (2012)

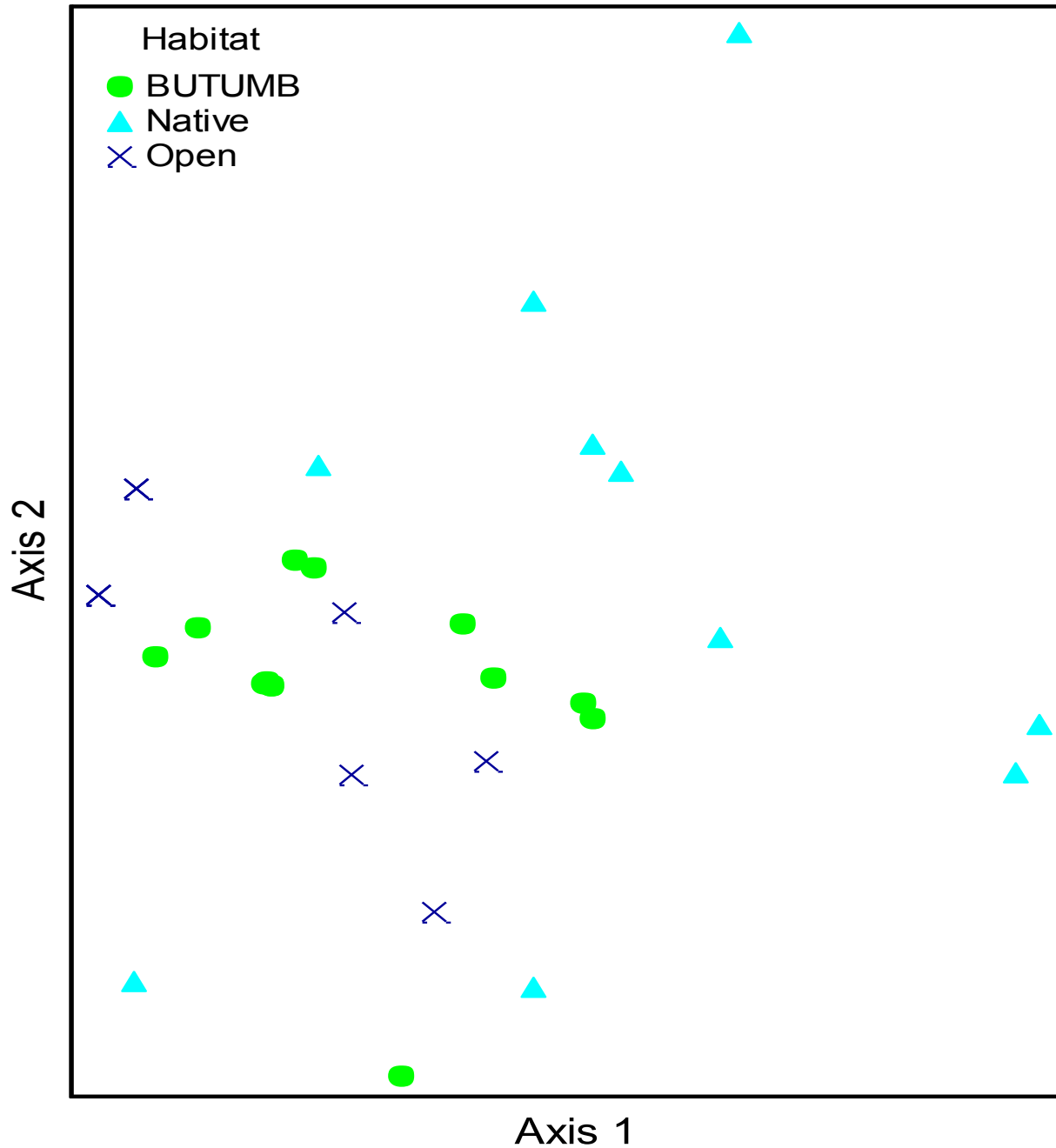
Ecological Effect Size (A)

	BUTUMB	100% NATIVE	25-100% NATIVE
100% NATIVE	.103*		
25-100% NATIVE	.363*	.280***	
OPEN WATER	.370***	.280***	.342***
Multi-Response Permutation Procedure			
*p≤0.05, ***p≤0.001			

% Positive Samples Fennon Slough 2013

	# light traps	Largemouth Bass	Yellow Perch	Pumpkin-seed	Northern Pike
100% BUTUMB	44	77.3	31.8	6.8	11.4
100% Native	36	55.6	2.8	0	0
Open Water	36	25.0	0	0	0

2013 34 Light Traps 19 Taxa



**Full Community
Ordination
Fish
&
Macroinvertebrates**

34 Light Trap Samples (2013)

Ecological Effect Size (A)

	BUTUMB	Native Veg
Native Veg	0.168***	
Open Water	0.092**	0.190***

Multi-Response Permutation Procedure

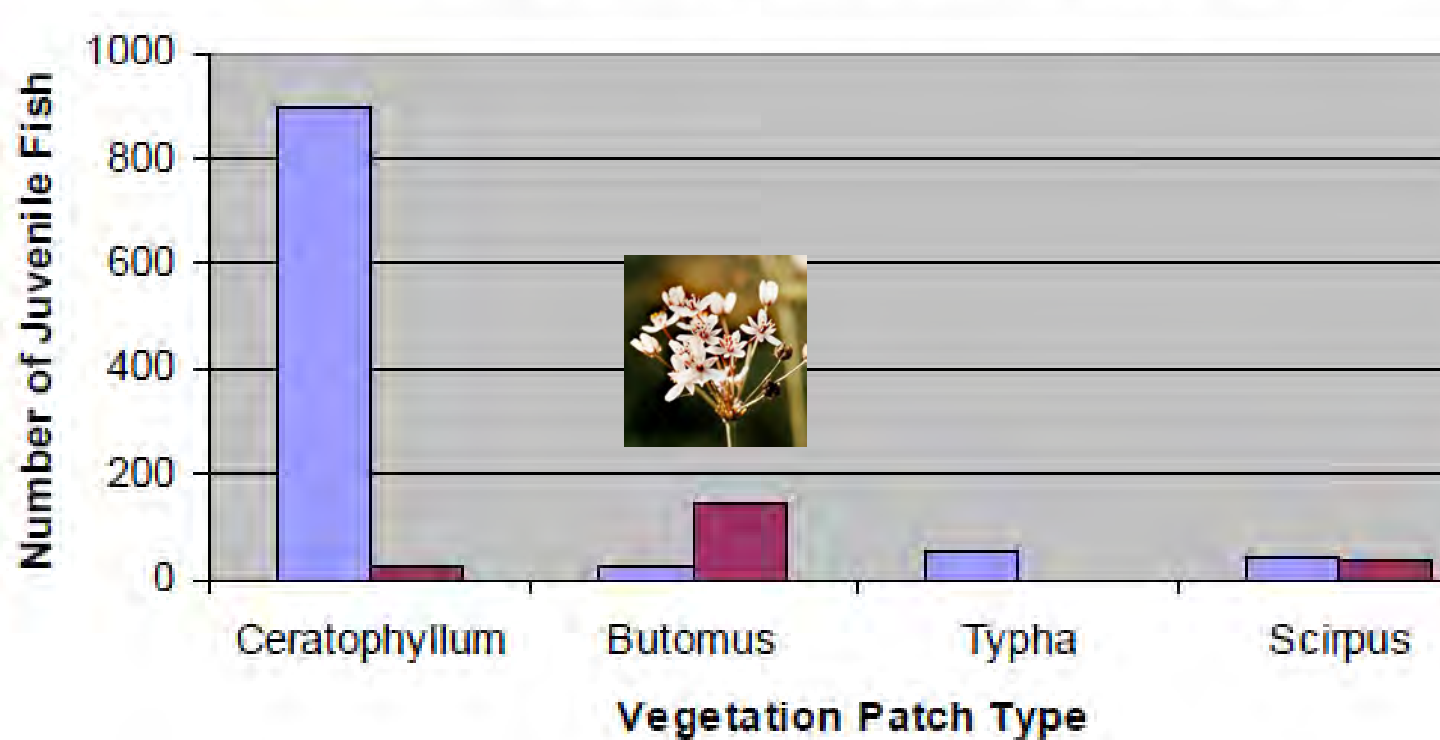
** $p \leq 0.01$

*** $p \leq 0.001$

Summary Points

- Flowering Rush Vegetates Bare Substrates
- Flowering Rush Creates Northern Pike Habitat
- Juvenile Northern Pike Are Associated With Flowering Rush Infestations
- Northern Significantly Depredating Native Cutthroat & Bull Trout Populations
- Fish & Pike Macroinvertebrate Community Composition is Being Altered from the Indigenous Native State

Preference of Vegetation Cover Type of Juvenile Fish



Black Bullhead

■ Ameiurus melas
■ Perca flavescens

Yellow Perch



Bass Predation of Salmonids



Tabor 1993, Fritts & Pearsons 2004, Bonar et al. 2005