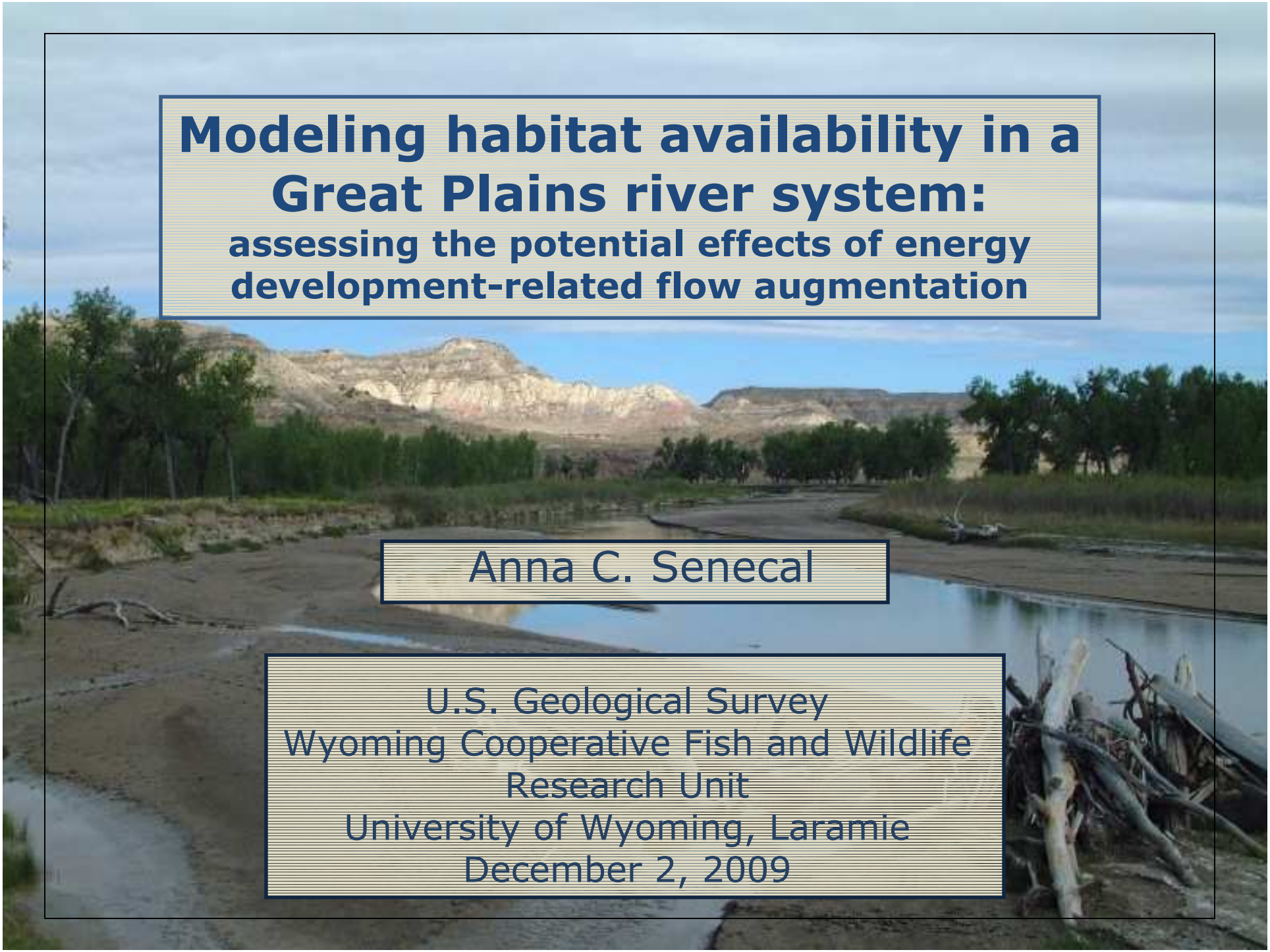

Modeling habitat availability in a Great Plains river system:
assessing the potential effects of energy development-related flow augmentation

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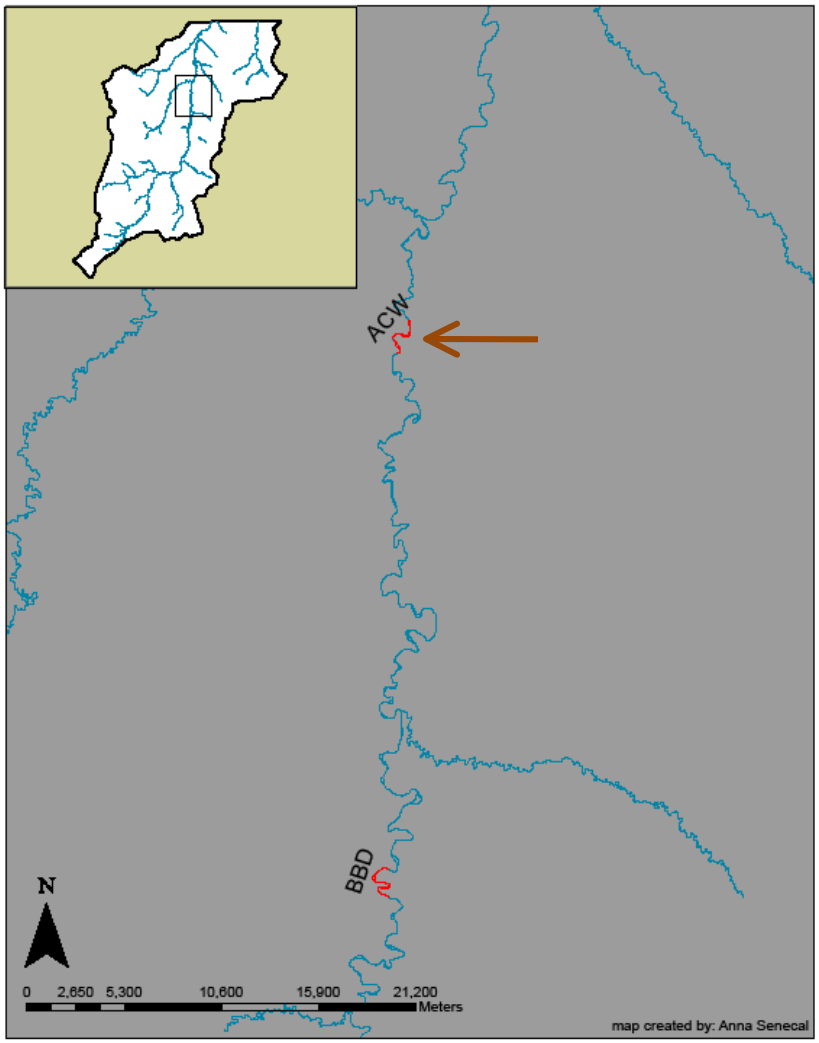
December 2, 2009

Powder River Basin



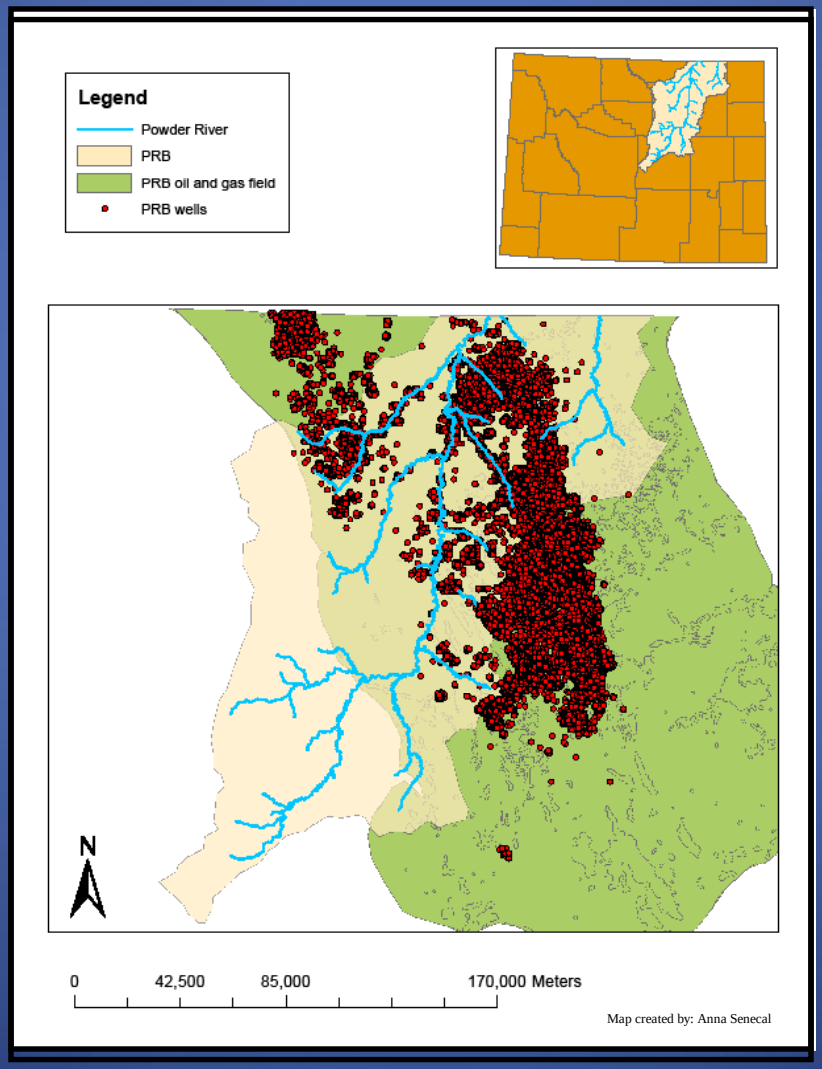
Powder River Basin

- A "relatively pristine" prairie river (Hubert 2003)
- Unregulated for 800 km
- Discharge: 0 – 920 cms (1952)
- Summer temperatures exceed 37°C
- Turbidity: 550 – 5,800 JTU

Fishes of the Powder River Basin

Native fishes		Introduced fishes
Shovelnose sturgeon*	Creek chub	Common carp
Goldeye*	River carpsucker	Plains killifish
Western silvery minnow*	White sucker	Rock bass
Plains minnow	Mountain sucker	Green sunfish
Sturgeon chub*	Shorthead redhorse	Bluegill
Sand shiner	Channel catfish	Smallmouth bass
Fathead minnow	Stonecat	Black bullhead
Flathead chub*	Sauger	
Longnose dace	Burbot	

Coalbed Natural Gas Development



Coalbed Natural Gas Development

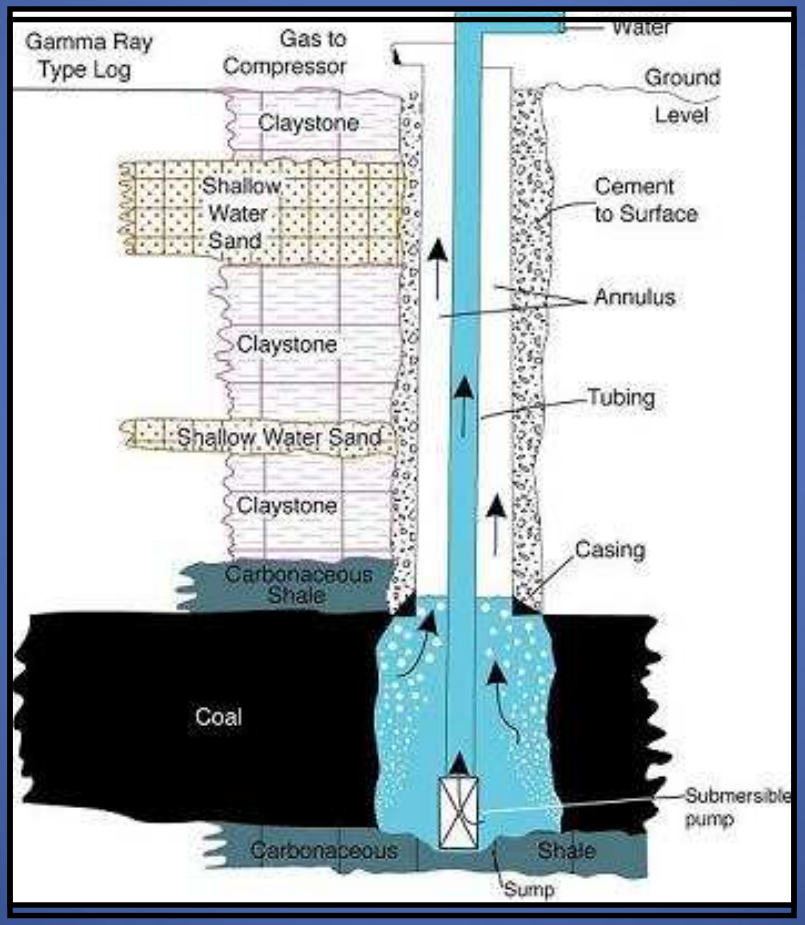


Diagram provided by the Wyoming State Engineer's Office

Product Water Management

Product Water Management

Surface Discharge:

- Relatively "high quality," stable water source
- Potential to moderate a dynamic environment
- Potential to encourage assemblage shifts
  - Colonization of mainstem by centrarchids

Objectives

Goal: to assess potential impacts of altered summer, low flow regimes on the native and introduced fishes of the Powder River, Wyoming

Objective 1: Modify existing instream modeling approach for application on a Great Plains river system;

Objective 2: Model instream habitat for taxa across measured flows.

MesoHABSIM

Mesohabitat

- Parasiewicz 2007
- Spatially explicit
- Scale approximates that of river biota life history requirements
- Avoidance of stable channel assumptions

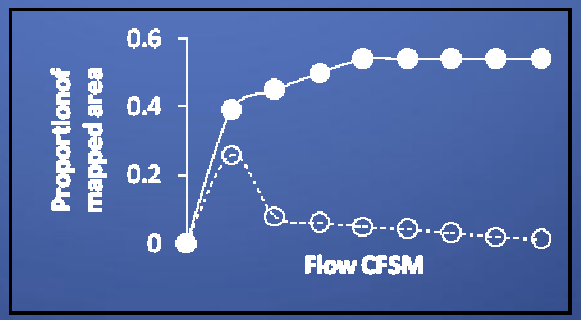
Model

$$P = \frac{e^{z}}{1 + e^{z}}$$

$Z = b_1 * x_1 \ldots b_n * x_n + a$
Where: b = regression coefficient; x = significant variables

+

- Biological model
- Physical model
- Habitat model



Methods

Habitat types sampled

- riffle
- run
- shoal
- pool
- backwater

Methods

Fish sampling

- 7.6 X 1.2 m bag seine with ace netting (4.8 mm)
- Species identification
- Length category assignment


Photo taken by: Jeff Obrecht

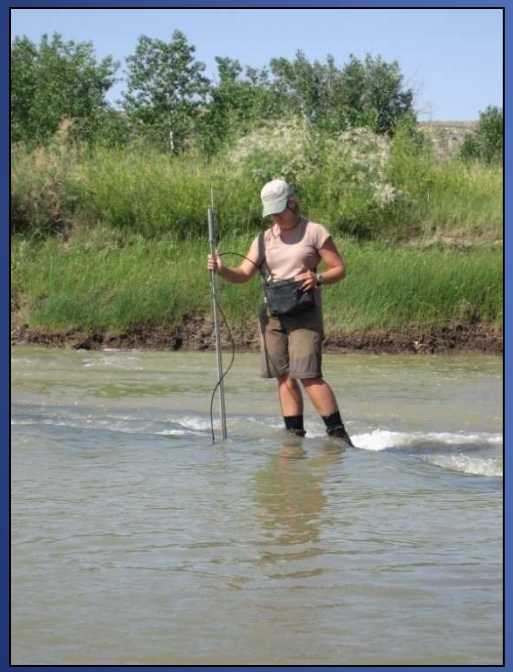

Photo taken by: Gordon Edwards

Methods

Mapping

- Bankful
- Wetted perimeter
- Habitat units

Methods

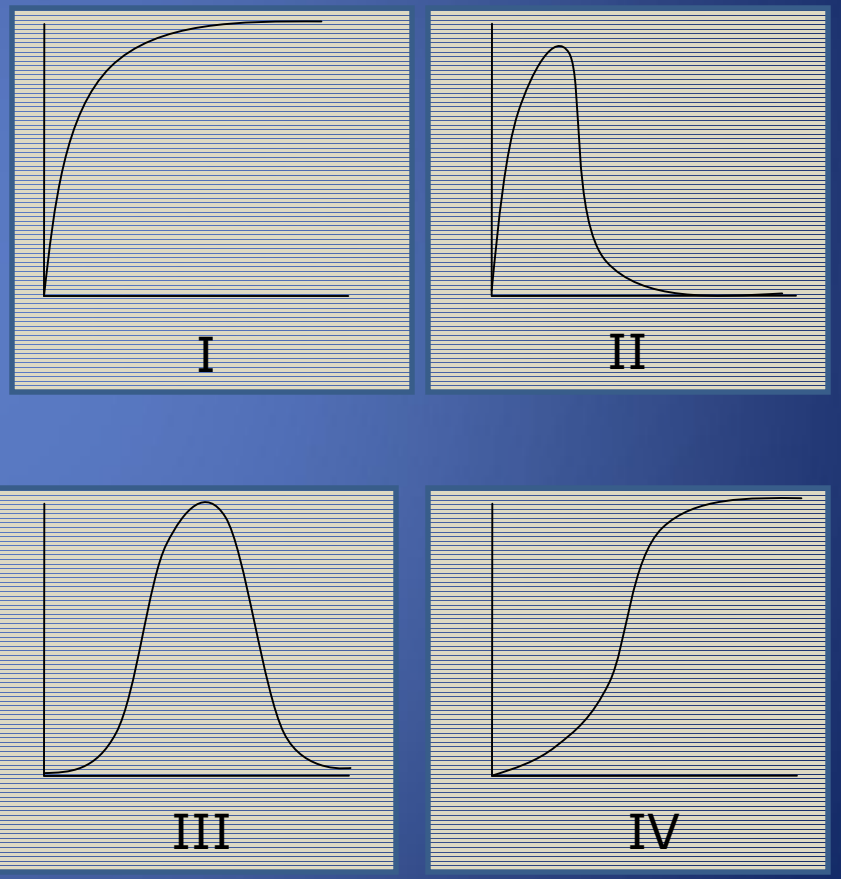


Habitat attributes collected

- Habitat type
- Substrate type
  - Dominant
  - Sub-dominant
- Cover type
- Depth
- Current velocity

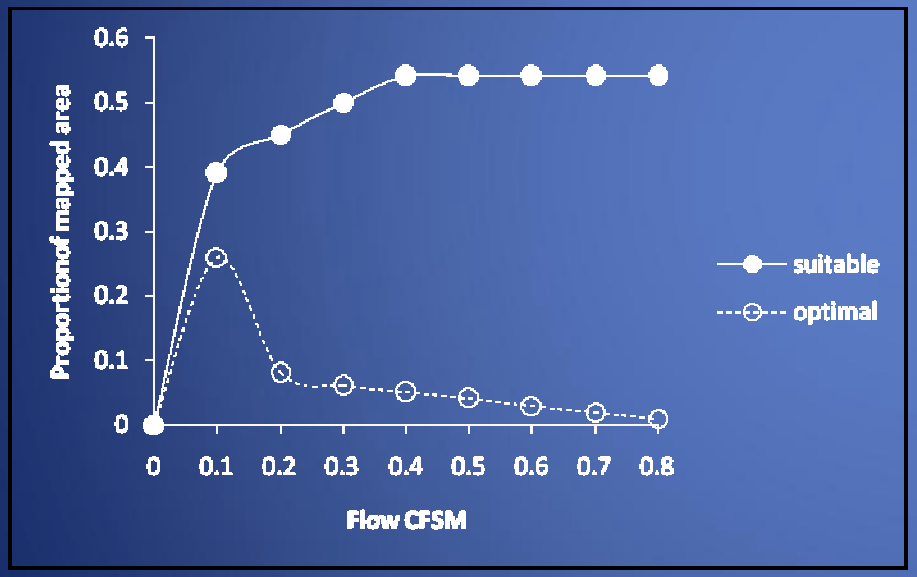
Results

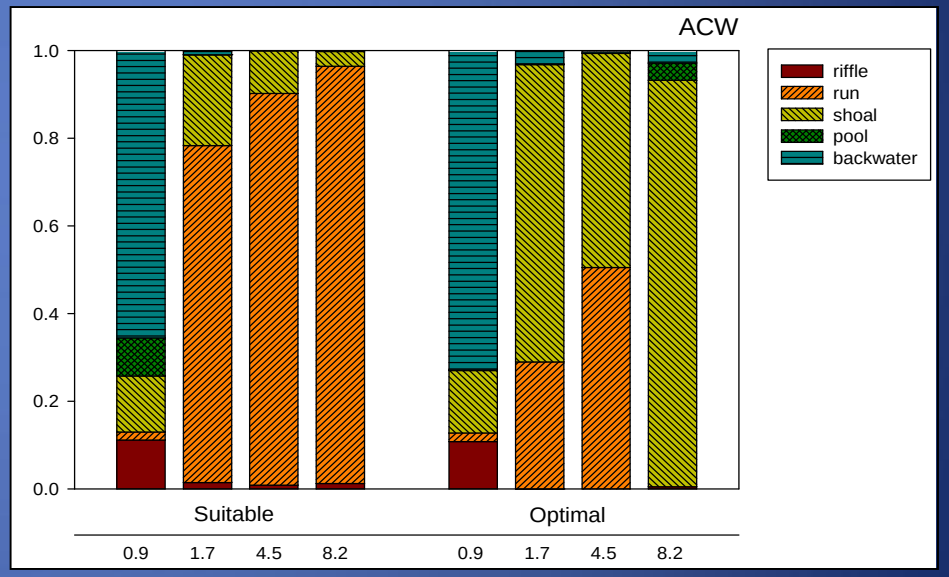
- Fluvial Generalists
- Low flow specialists
- Intermediate flow specialists
- High flow specialists



Results

Fluvial Generalists: sand shiner





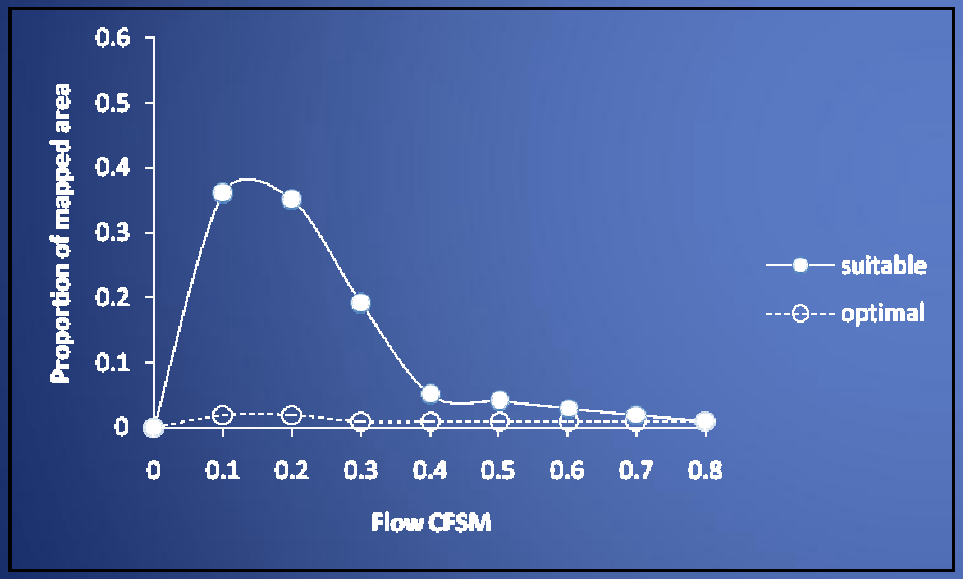
Results

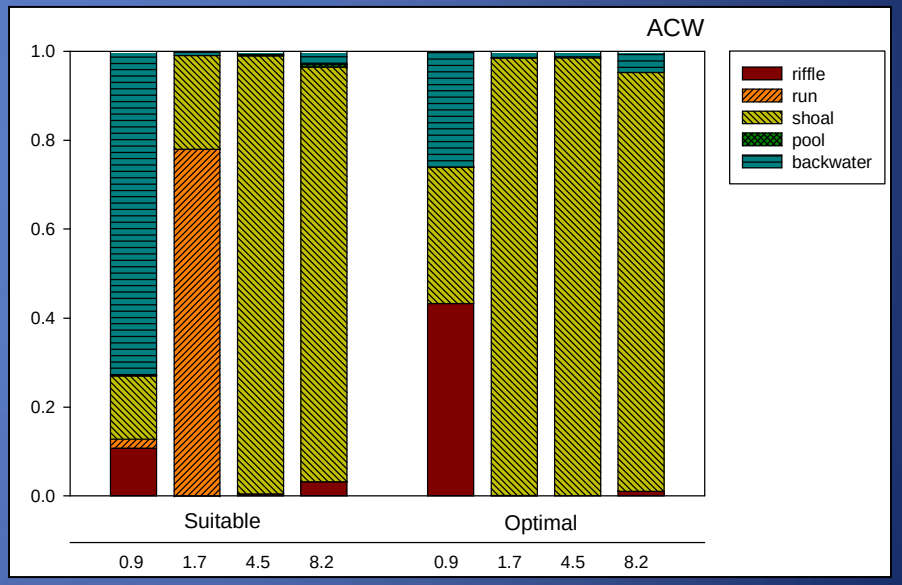
Fluvial Generalists: sand shiner

I

Results

Low flow specialists: juvenile flathead chub



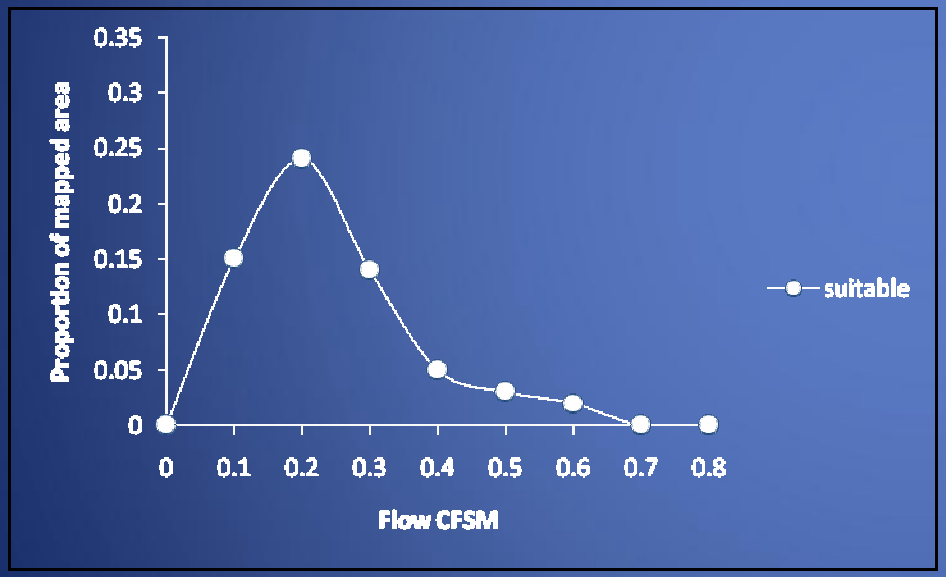


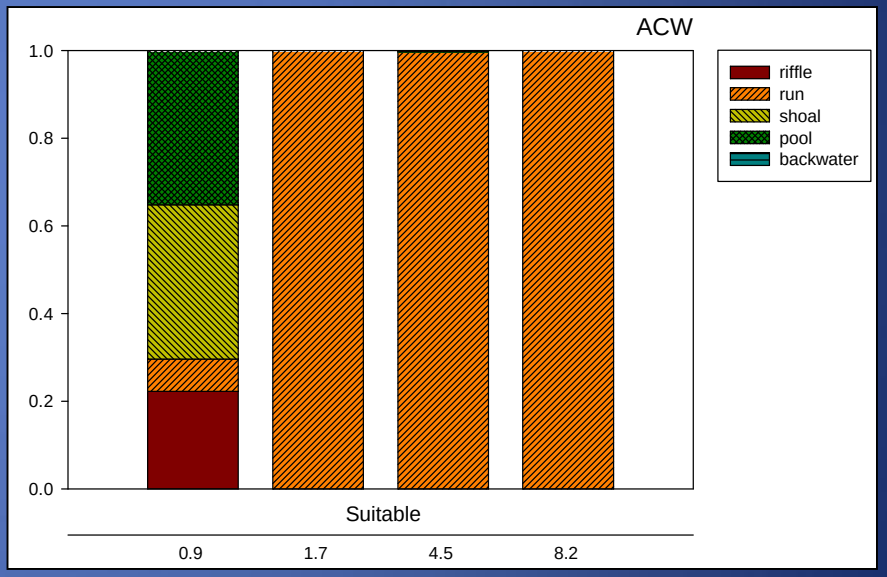
Results

Low flow specialists: juvenile flathead chub

Results

Intermediate flow specialists: adult channel catfish





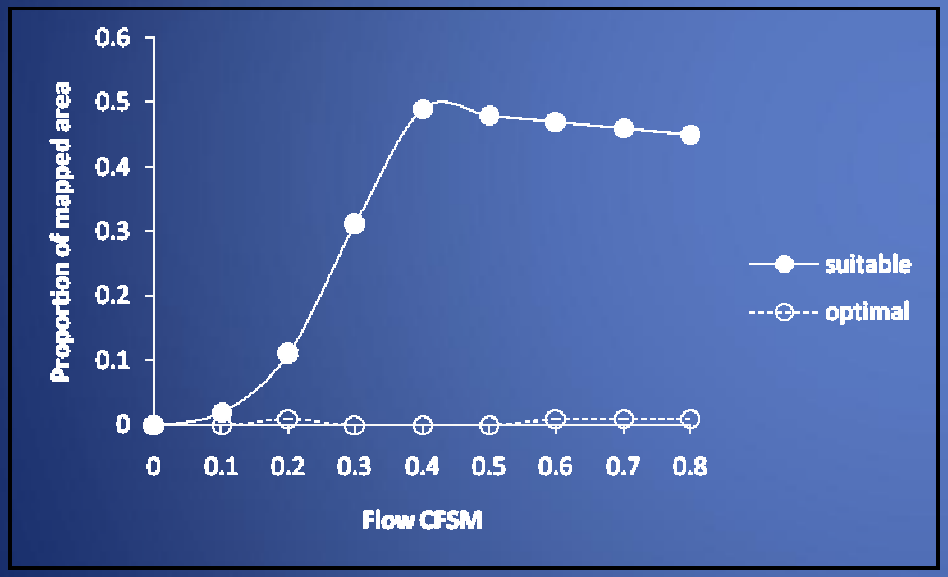
Results

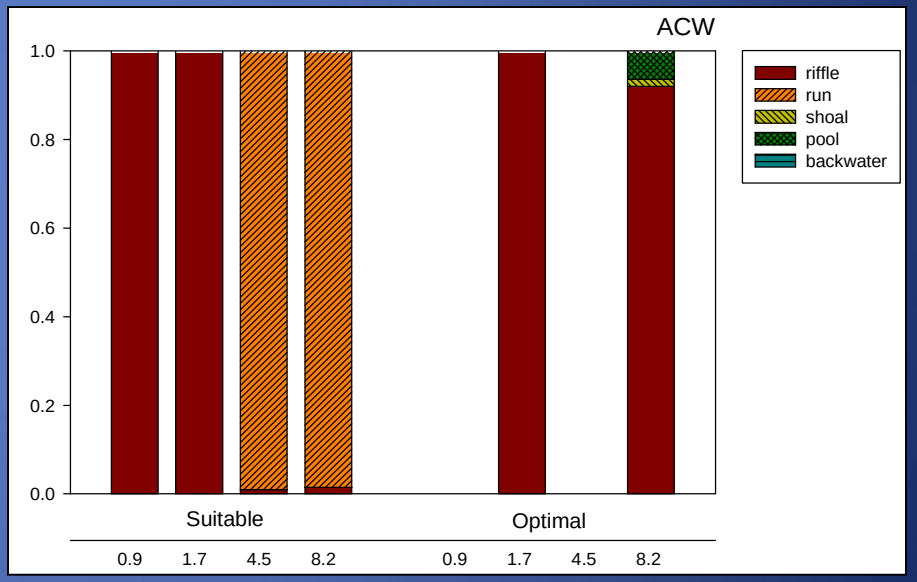
Intermediate flow specialists:

adult
channel
catfish

Results

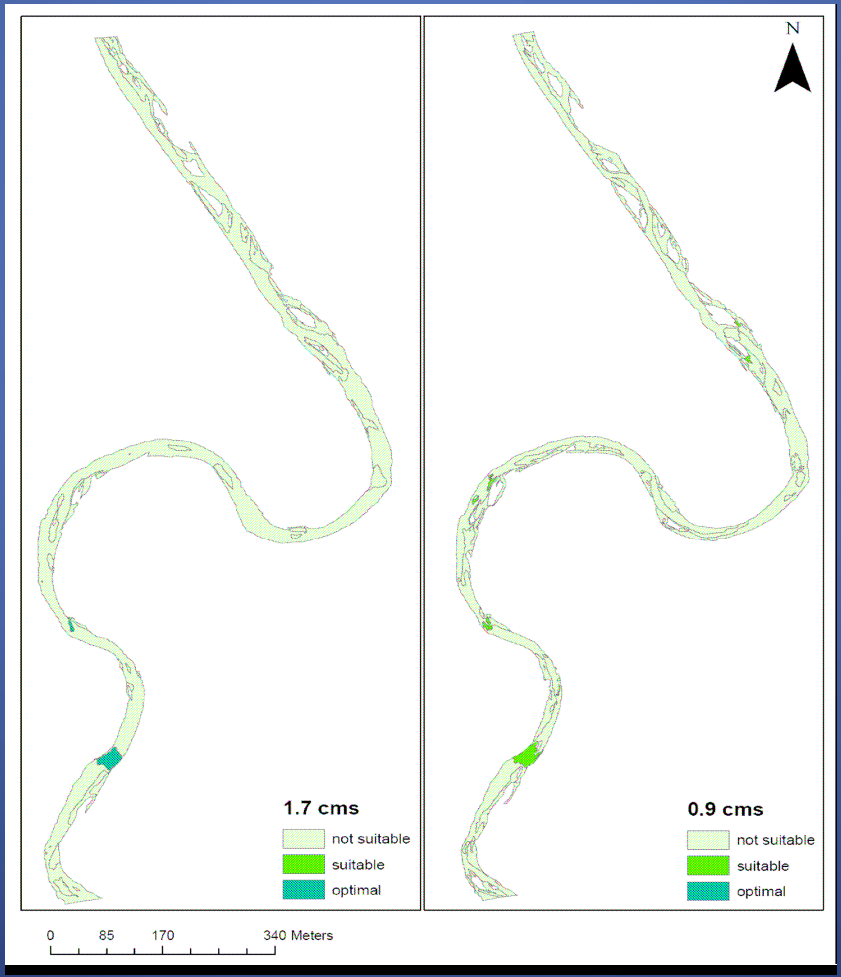
High flow specialists: longnose dace





Results

High specialists: longnose dace



Results

Fluvial Generalists

- Adult *Hybognathus* spp.
- Sand shiner

I

Low Flow Specialists

- Juvenile *Hybognathus* spp.
- Juvenile flathead chub
- Adult river carpsucker
- Green sunfish ←

II

Intermediate Flow Specialists

- Fathead minnow
- Juvenile river carpsucker
- Adult channel catfish
- Plains killifish

III

High Flow Specialists

- Longnose dace
- Juvenile channel catfish
- Stonecat

IV

Conclusions

- Low flows could favor native and nonnative fishes alike;
- Increases in flows could favor fast-water and riffle-obligate species;
- Projected CBNG effluent (~20 cfs) is not likely to have significant impacts on fishes across the range of observed flows;
- A full spectrum of flows is necessary to maintain the native assemblage;
- Model validation is required to develop predictive capabilities.

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  grad students and staff

- **WGFD, funding agency**
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  Dave Zafft
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  Habitat crew:
  Travis Cundy
  Paul Dey
  Tom Annear

- **UW Department of Zoology:**
  grad students and staff

- **Rushing Rivers Institute**

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Questions?