Determination of Lake Sturgeon Habitat Availability in Lake Michigan Tributaries: Applications to the Restoration Process

Daniel J. Daugherty and Trent M. Sutton
Purdue University
Department of Forestry and Natural Resources

and

Robert F. Elliott
U.S. Fish and Wildlife Service
Green Bay Fishery Resources Office

Great Lakes – Rehabilitation

1. Conserve and rehabilitate extant populations to self-sustaining abundance*

2. Re-establish extirpated populations within their known historic range*

3. Establish additional populations within their suspected historic range*

* Hay-Chmielewski and Whelan (1997)

Great Lakes – Options

Habitat enhancement

Fish passage

Dam removal

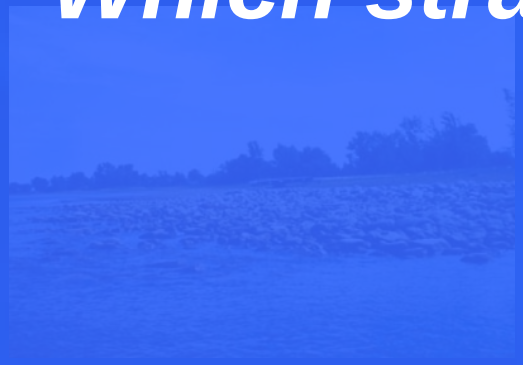
Aggressive management

Hatchery rearing

Stocking

Great Lakes – Options

Which strategy?



Habitat enhancement

Fish passage

Dam removal

Which systems?

Stocking

Where to implement?

Aggressive Mgmt.

Hatchery rearing

Great Lakes – Rehabilitation

Four major impediments identified (Holey et al 2000):

1. Stock status and assessment
2. Adequate fish passage technologies
3. Propagation and stocking techniques
4. Habitat requirements/availability

Great Lakes – Research

4 major impediments (Holey et al 2000):

1. Stock status and assessment
2. Adequate passage technologies
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Great Lakes – Research

4 major impediments (Holey et al 2000):

1. Stock status and assessment
2. Adequate passage technologies
3. Propagation and stocking techniques
4. Habitat requirements/availability

Habitat availability

Need to know:

- Quantity
- Quality
- Accessibility
- Potential accessibility

Critical information

Determining strategies

Habitat availability

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Critical information

Determining strategies

Objectives

1. Habitat sampling protocol

    Standardized

    Objective

    Quantitative

2. Determine life-stage specific habitat availability

3. Utilize information to determine system–specific restoration strategies

Objectives

1. Develop and implement a habitat sampling protocol

2. Determine life-stage specific habitat characteristics

   Egg and spawning adult

   Staging adult

   Age-0 juveniles

3. Utilize information to determine system-specific restoration strategies

Objectives

1. Develop and implement a habitat sampling protocol

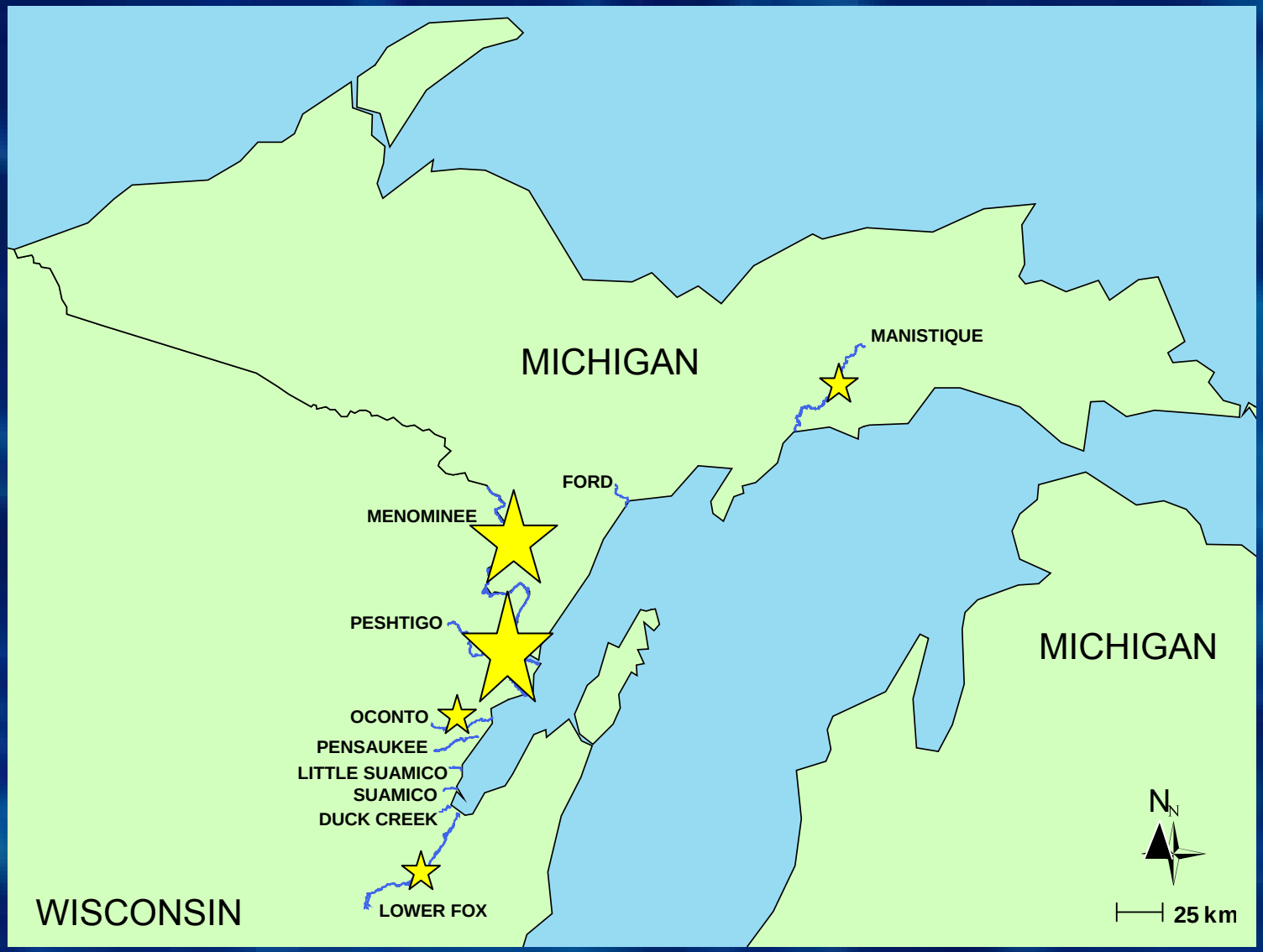
2. Determine life-stage specific habitat availability

3. Utilize information to determine system-specific restoration strategies

Study Sites

MICHIGAN
MANISTIQUE
FORD
MENOMINEE
PESHTIGO
MICHIGAN
OCONTO
PENSAUKEE
LITTLE SUAMICO
SUAMICO
DUCK CREEK
N
WISCONSIN
LOWER FOX
25 km

Study Sites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Study Reaches

Upstream-most historic spawning sites

Site of natural barrier (e.g., falls)

Identification of probable spawning locations/habitat

Methods

Transect-based, stratified random sample design

Run

0.5 – 1.0 m depth
< 0.3 m/s water velocity

Riffle

< 0.5 m depth
> 0.3 m/s water velocity

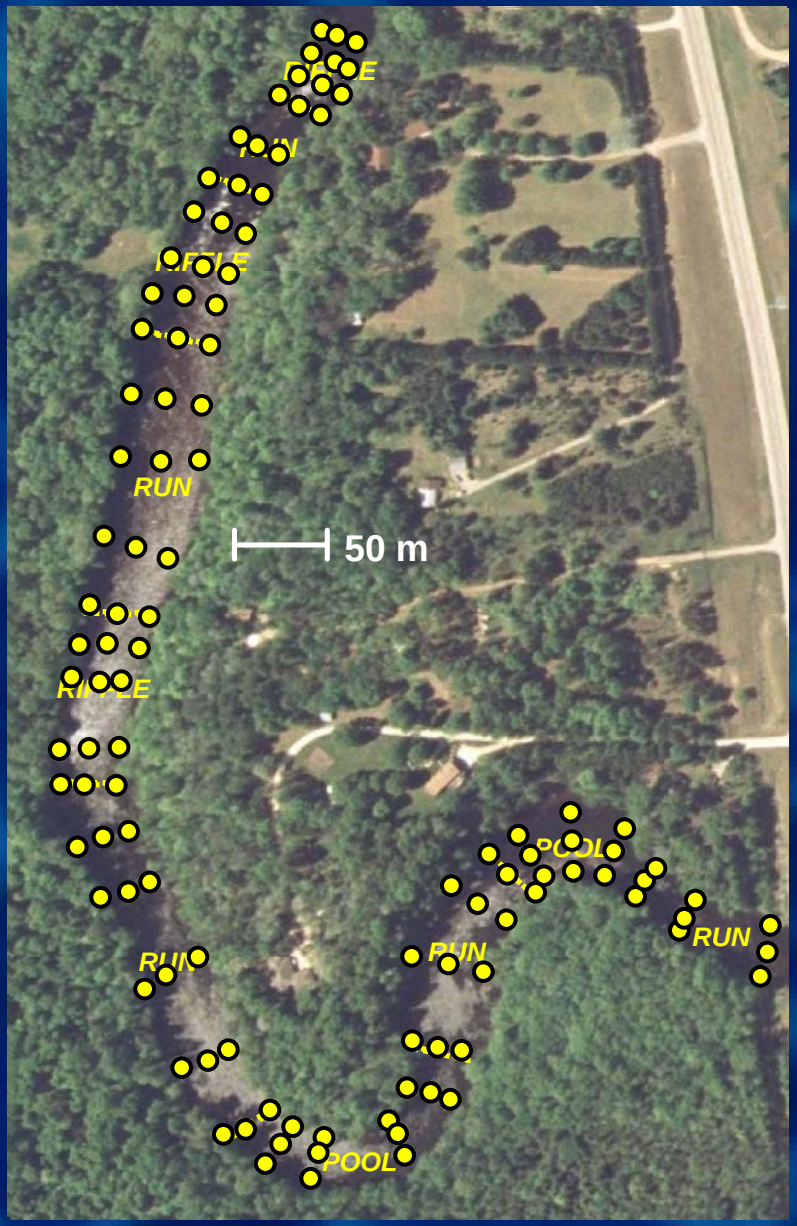
Pool

≥ 1.0 m depth
< 0.3 m/s water velocity

Methods

Habitat sampling

- Randomly spaced transects
  - Runs – 100 to 200 m
  - Riffles – 10 to 50 m
  - Pools – 10 to 50 m
- Transition zones



Methods

Geo-referenced point samples

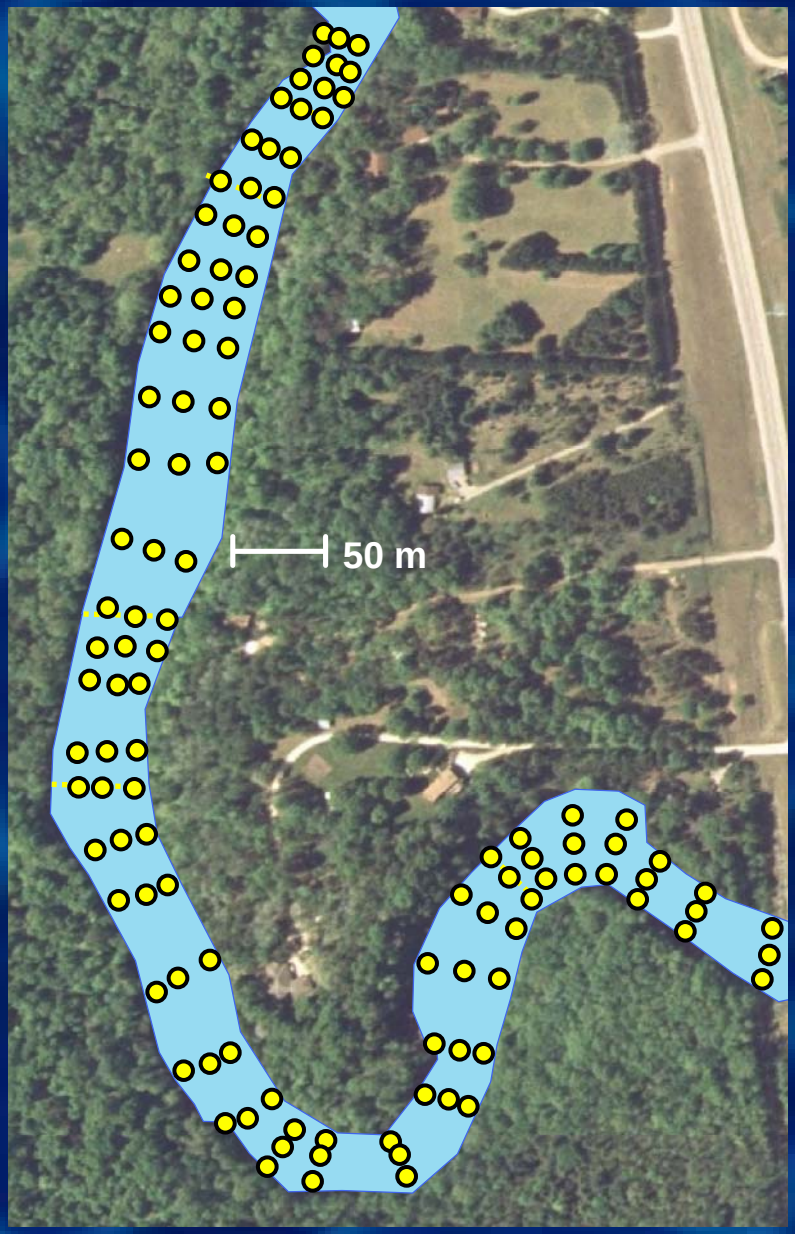
- Water depth (m)
- Channel gradient (m/km)
- Substrate size (mm)

Important factors identified in determining lake sturgeon habitat use

Methods

Spatial analyses – ArcGIS© 9.0

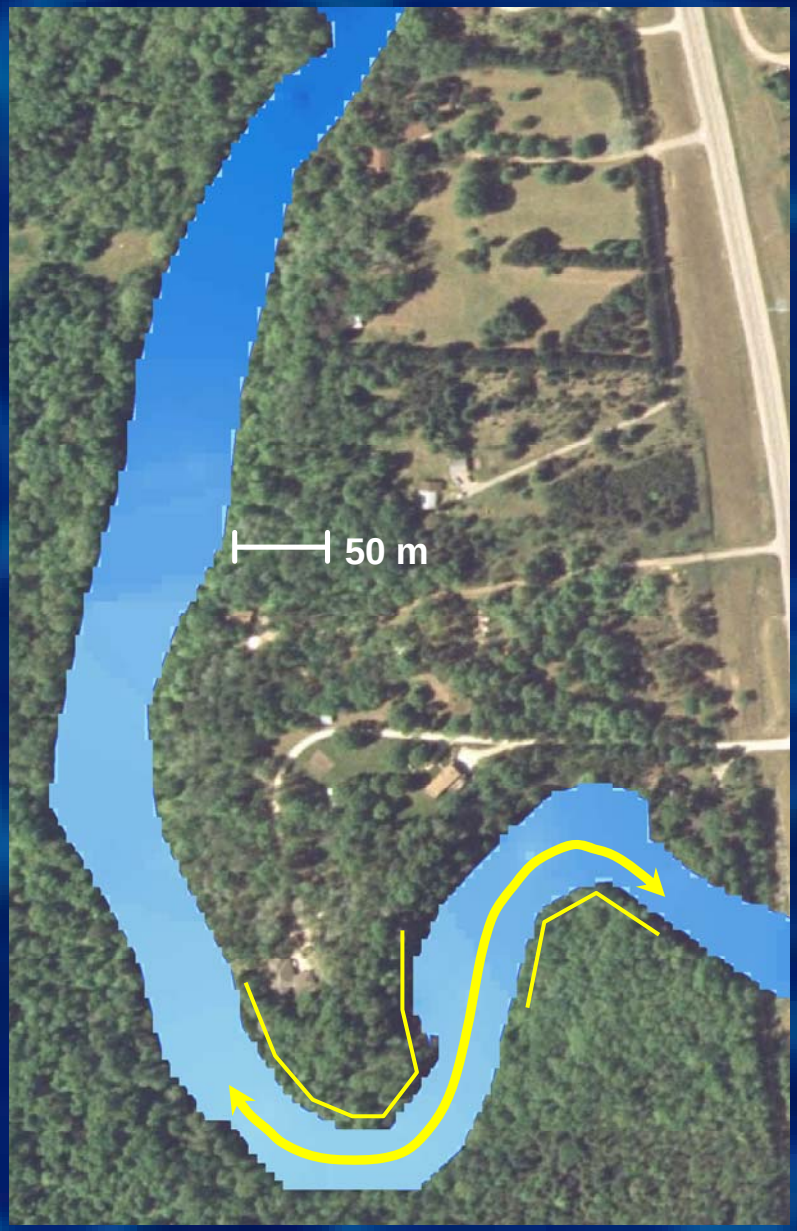
- Delineated river reaches
- Imported habitat data
- IDW interpolation
- Reclassify using HIS
- Geometric mean



Methods

Spatial analyses – ArcGIS© 9.0

- Delineated river reaches
- Imported data
- Interpolation
- Reclassify using HSI
- Geometric mean



Methods

Spatial analyses – ArcGIS© 9.0

- Delineated river reaches
- Imported data
- Interpolation
- Reclassify using HSI
- Geometric mean

Water Depth

Substrate

Gradient

Methods

Spatial analyses – ArcGIS© 9.0

- Delineated river reaches
- Imported data
- Interpolation
- Reclassify using HSI
  - Threader et al. (1998)
- Geometric mean
  - Composite model

Water Depth

Substrate

Gradient

Spawning Adult – Substrate HSI Values
(Threader et al. 1998)

Substrate type	HSI
Clay	0
Silt	0
Sand	0
Gravel	0.5
Cobble	1
Boulder	1
Bedrock	0.3

RECLASS

Substrate

Repeat for other habitat variables and life stages

Spawning Adult – Substrate HSI Values
(Threader et al. 1998)

Substrate type	HSI
Clay	0
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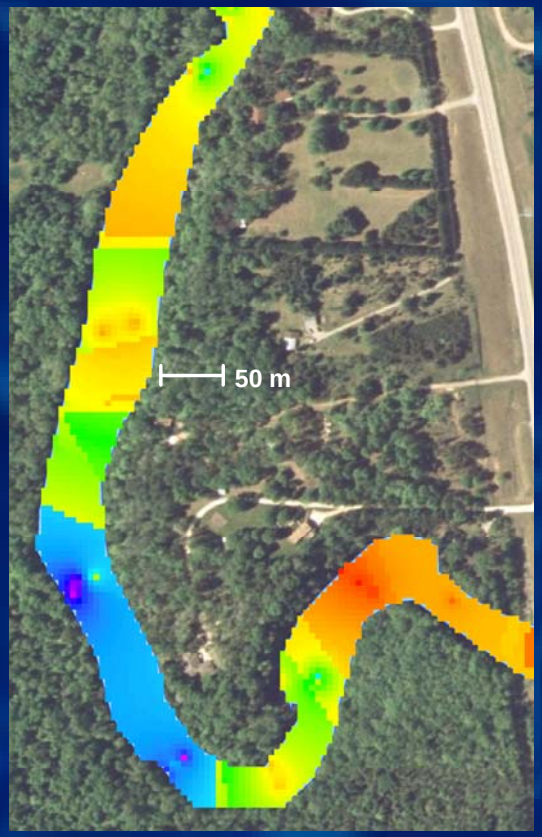
RECLASS

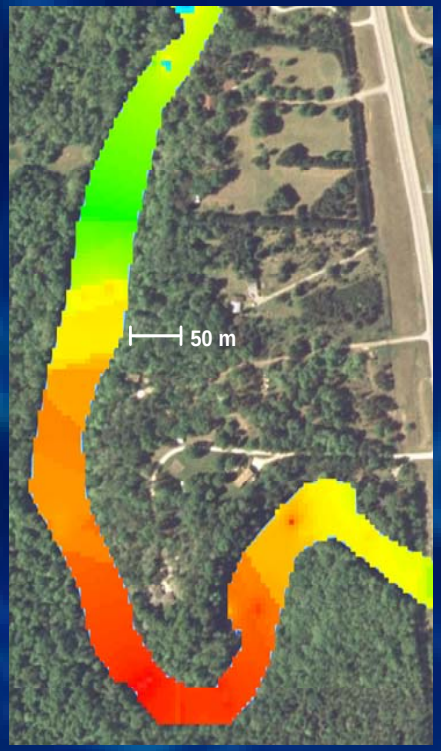
Substrate Suitability



Repeat for other habitat variables and life stages

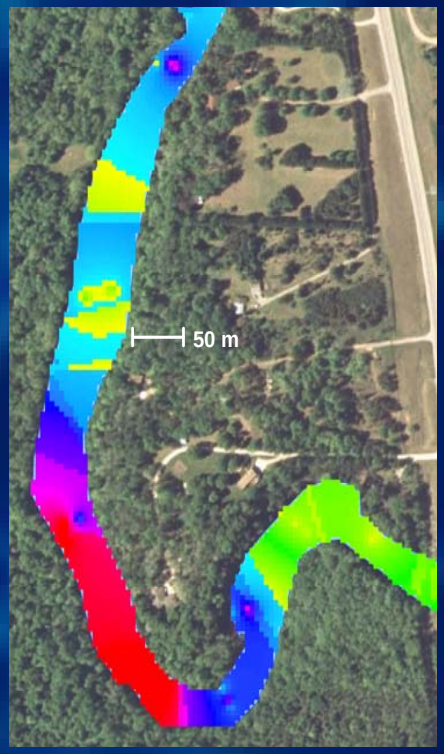
$$\left(\frac{1}{3} \right)$$

Water Depth Suitability



X

Gradient Suitability



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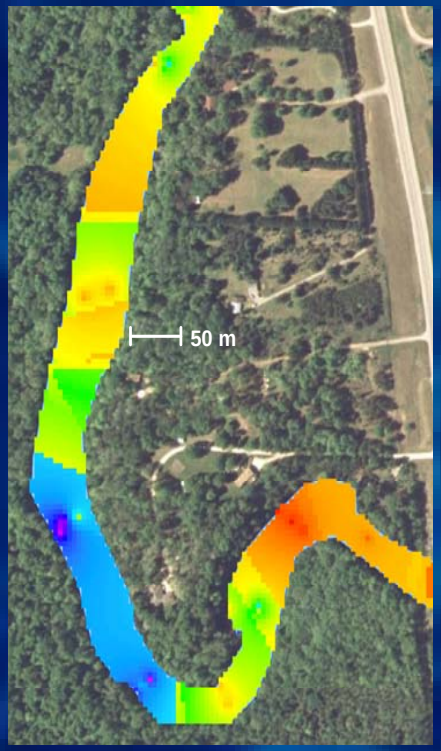
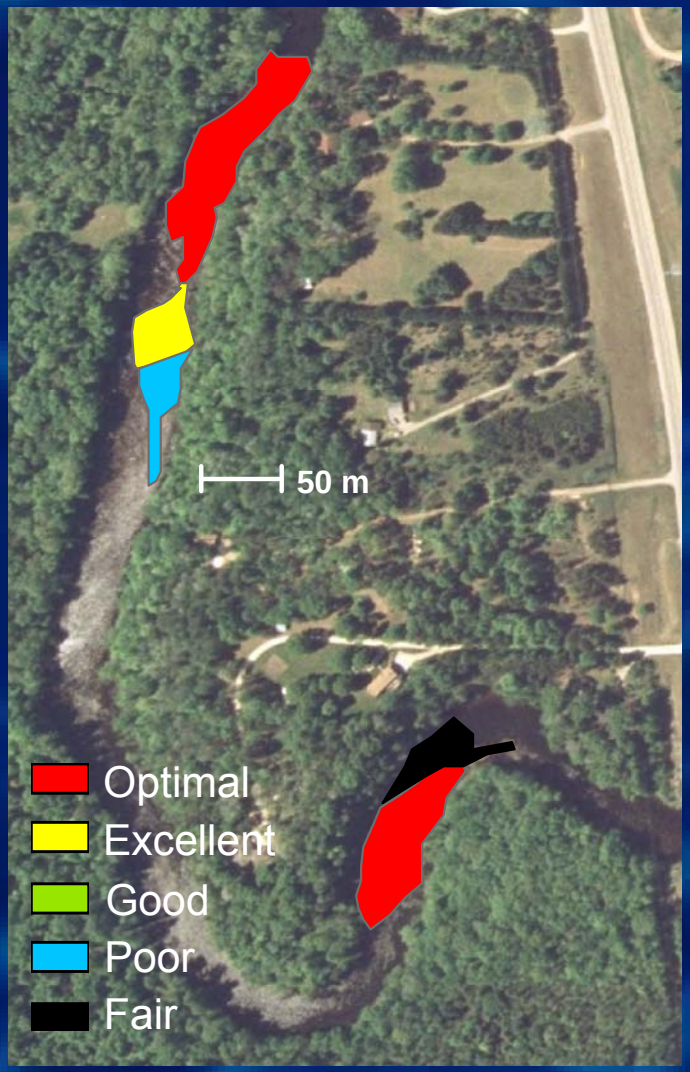
Substrate Suitability



Composite model

Life-stage specific estimates:

- Quality
- Quantity
- Spatial distribution



Applications

Utilize available information

- Population status/characteristics (previous studies)
- Habitat availability/characteristics (this study)

Identify:

- System-specific impediments to rehabilitation
- Appropriate rehabilitation strategy

Applications

Menominee River

2,005 habitat samples, 142.9 rkm

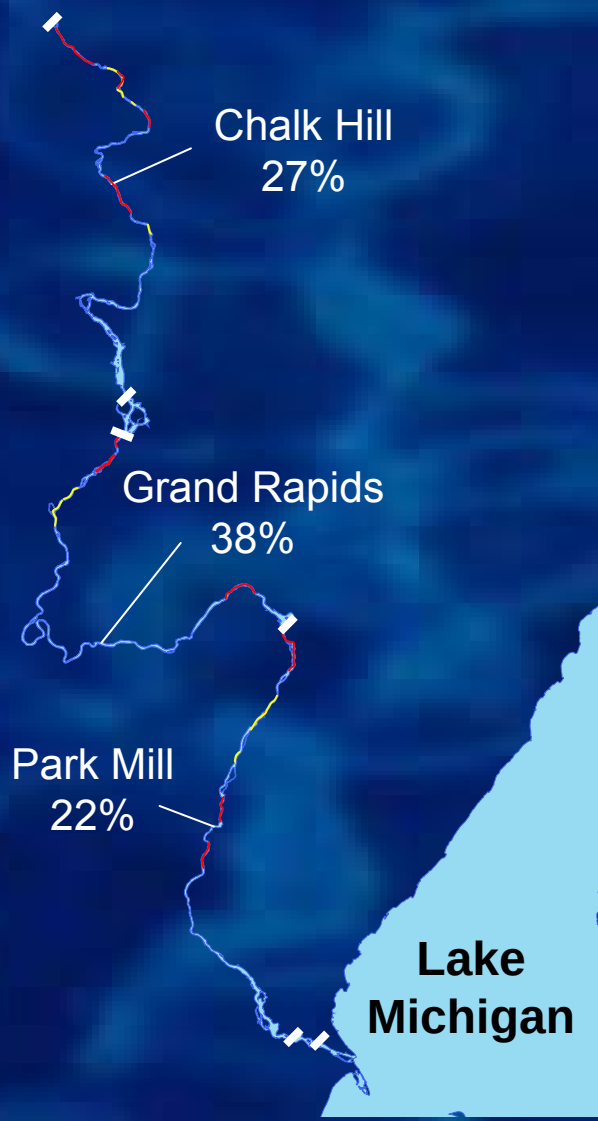
H.Q. spawning habitat = 4.5% (6.4 rkm)

Availability = 10% (0.6 rkm)

Staging habitat = 46% (66 rkm)

Age-0 juvenile habitat = 82% (119 rkm)

Availability = 4% (3 rkm)



Applications

Menominee River - recommendations

- Fish passage
  - Increase spawning habitat by 90%
  - Increase juvenile habitat by 96%
  - Re-establish historic range
  - Eliminate isolated stocks

Other systems

Extant populations:

- Large quantities of habitat
- Limited habitat access (dams)
- Fish passage

Other systems:

- Limited spawning/staging habitat
- Habitat creation/enhancement

Other applications

Identify:

- Appropriate stocking locations
  - Enhance survival, acclimation
- Physical habitat:discharge relationships
  - PHABSIM, Hydrologic models (seasonal changes)
- Habitat:abundance relationships
  - Estimate carrying capacity, develop thresholds

Conclusions

Critical first step

- Lake sturgeon habitat analysis
- Incorporation into rehabilitation process

Methods

- Applicable to other Lake Michigan systems
- Standardized – allows for comparisons

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