A Decision-Support Tool for Sturgeon Rehabilitation Strategies: Implications for Restoration of Danube River Sturgeons

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Presentation Overview

- Background
  - Lake Sturgeon
  - Impediments to Rehabilitation

- Habitat Sampling and Availability

- Decision-Support Model
  - Rehabilitation Strategies
    • Lake Sturgeon

- Implications
  - Danube River Sturgeons
Presentation Overview

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Lake Sturgeon *Acipenser fulvescens*

**Historical Distribution**

Widest distribution of N.A. sturgeons

- Laurentian Great Lakes
- Mississippi River
- Hudson Bay

*Potamodromous* Periodic Strategists
Lake Sturgeon

Historical Distribution

Potamodromous

Adults: Lake
Spawn: River
Juveniles: River

Periodic Strategists
Lake Sturgeon

Historical Distribution

Potamodromous

Adults: Lake

Spawn: River

Juveniles: River

Periodic Strategists
Lake Sturgeon

Historical Distribution

Potamodromous

Periodic Strategists

Males:
- Maturity: 8 to 13 years
- Spawn: 1 to 3 years
- Lifespan: 80 years

Females:
- Maturity: 15 to 23 years
- Spawn: 4 to 6 years
- Lifespan: 100+ years
Great Lakes – Storied History

Harvest (millions of pounds)

Year

- Erie
- Michigan
- Huron
- Ontario
- Superior

MORATORIUM
Great Lakes – Storied History
Great Lakes – Rehabilitation

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

2. Re-establish extirpated populations within their known historic range
Great Lakes – Options

- Habitat enhancement
- Fish passage
- Dam removal
- Hatchery rearing
- Stocking
- Aggressive Mgmt.
Great Lakes – Options

Which systems?

Which strategy?

Where to implement?
Great Lakes – Rehabilitation

4 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
Habitat Availability

Need to know

- Quantity
- Quality
- Accessibility
- Potential accessibility

Determine strategies
Habitat Availability

Need to know

Quantity

Quality

Accessibility

Potential accessibility

Determine strategies

Lake Michigan

- Optimal
- Excellent
- Good
- Poor
- Fair
Habitat Availability

Need to know
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Determine strategies
Habitat Availability

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Determine strategies

Lake Michigan

- Optimal
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Case Study Objectives

1. Develop and implement a habitat sampling protocol
   - Standardized
   - Objective
   - Quantitative

2. Determine life-stage specific habitat availability

3. Utilize information to determine restoration strategies
Case Study Objectives

1. Develop and implement a habitat sampling protocol

2. Determine life-stage specific habitat availability
   
   Egg and spawning adult

   Staging adult

   Age-0 juveniles

3. Utilize information to determine restoration strategies
Case Study Objectives

1. Develop and implement a habitat sampling protocol
2. Determine life-stage specific habitat availability
3. Utilize information to determine restoration strategies

Objective

System specific

Applicable to other sturgeon species and systems
Objectives 1 and 2

Development and implementation of a habitat sampling protocol

and

Determine lake sturgeon habitat availability in northern Lake Michigan tributaries
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
Methods

Geo-referenced point samples

L, M, R channel segments

Water depth (m)

Water velocity (m/s)
  (Stream gradient – Manning’s Equation)

Substrate size (mm)

Important habitat use factors
Methods

Spatial analyses – ArcGIS© 9.0

Delineated river reaches

Imported habitat data

IDW interpolation

Reclassify using HIS
Methods

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IDW interpolation

4 nearest neighbors
Variable search radius
Power = 0.5 (smooth surface)
Channel polygon mask
Polyline barrier

Reclassify using HSI
Methods

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Reclassify using HSI

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

<table>
<thead>
<tr>
<th>Substrate type</th>
<th>HSI</th>
</tr>
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<tbody>
<tr>
<td>Clay</td>
<td>0</td>
</tr>
<tr>
<td>Silt</td>
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Repeat for other habitat variables 
and life stages
### Spawning Adult – Substrate HSI Values

(Threater et al. 1998)

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Repeat for other habitat variables and life stages.
Composite Model

Life-stage specific estimates

Quality

Quantity

Spatial distribution
Objective 3

Utilize habitat availability information to determine system-specific rehabilitation strategies
Decision Tool

Incorporates available information

Population status/characteristics (previous studies)

Habitat availability/characteristics (this study)

Identifies

System-specific impediments to rehabilitation

Appropriate rehabilitation strategy
Decision Tool

Decision-tree format

Objective, logical approach

Series of sequential questions

Iterative, adaptive

Q1

Q2

Q3

Q4

Outcome

Outcome

Outcome

Outcome
Study Sites

- MICHIGAN
  - MANISTIQUE
  - MENOMINEE
  - PESHTIGO
  - OCONTO
  - PENSAUKEE
  - LITTLE SUAMICO
  - SUAMICO
  - DUCK CREEK
  - LOWER FOX

- WISCONSIN

25 km
Results – Extant Populations

Menominee River

2,005 habitat samples, 142.9 rkm

High-quality spawning habitat = 4.5%

Availability = 10%

Staging habitat = 46%

Age-0 juvenile habitat = 82%

Availability = 4%
Results – Extant Populations

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Lake Michigan
Results – Extant Populations

Menominee River - recommendations

Fish passage

- Increase spawning habitat by 90%
- Increase juvenile habitat by 96%
- Re-establish historic range
- Eliminate isolated stocks
Results – Extirpated Populations

Ford River

- 626 habitat samples, 25.6 rkm
- High-quality spawning habitat = 22.9%
- Staging habitat = 0%
- Age-0 juvenile habitat = 37%
Results – Extirpated Populations

Ford River

626 habitat samples, 25.6 rkm

High-quality spawning habitat = 22.9%

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Results – Extirpated Populations

Ford River

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Results – Extirpated Populations

Ford River - recommendations

Step 1 - Create staging habitat

Current deflectors

Woody debris revetments

Scour pools

Increase potential staging habitat
Results – Extirpated Populations

Ford River - recommendations

Step 2 – Fish stocking

Re-establish population

Initiate natural reproduction
Summary

Critical first step

Lake sturgeon habitat analysis

Incorporation into rehabilitation process

Methods

Standardized

Applicable to other systems and sturgeon species
Applications – Danube River

Impediments to Sturgeon Restoration

Habitat Loss

Fragmentation

Degradation

Channelization

Contaminants

Harvest
Applications – Danube River

Impediments to Sturgeon Restoration

- Habitat Loss
- Contaminants
  - Water quality
  - Sediment pollution
- Harvest
Applications – Danube River

Impediments to Sturgeon Restoration

- Habitat Loss
- Contaminants
- Harvest
- Overfishing
- Illegal harvest
- Bycatch
Applications – Danube River

Challenges

Scale

Spatial magnitude

Time frame

Impediments

Multiple species

Genetic integrity
Applications – Danube River

Challenges

Scale

Multiple species
  Atlantic sturgeon
  Ship sturgeon
  Danube sturgeon
  Stellate sturgeon
  Beluga
  Sterlet

Genetic integrity
Applications – Danube River

Challenges

- Scale
- Multiple species
- Genetic integrity

Wild stocks

Broodstock

Stocking strategy
Applications – Danube River

Utility of the decision-support tool

Framework

- Guidance for rehabilitation

Prioritization

- Objective decision making

Flexible

- System or species specific
Acknowledgments

Robert Elliott, USFWS

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Questions?