Increased Downriver Passage of Juvenile Blueback Herring after Reconfiguring an Ultrasonic Field

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Gurshin, C. and Lenz, B., "Increased Downriver Passage of Juvenile Blueback Herring after Reconfiguring an Ultrasonic Field" (2014). International Conference on Engineering and Ecohydrology for Fish Passage. 70.
http://scholarworks.umass.edu/fishpassage_conference/2014/June9/70
Increased Downriver Passage of Juvenile Blueback Herring after Reconfiguring an Ultrasonic Field, Mohawk River, New York

Engineering and Ecohydrology for Fish Passage

June 2014
Background

Dashed = original configuration
Colored = current configuration
Original Configuration (2008) Study Results

- Proportion of herring passing the main channel downriver site = 0.31
- 3x greater than expected based on river flows

Conclusion

Acoustic deterrent effective but needed improvement
Original and Reconfigured Study Hypotheses

1) $H_0: \frac{N_{\text{downriver}}}{N_{\text{upriver}}} = \frac{V_{\text{downriver}}}{V_{\text{upriver}}}$

$V =$ volume of water moving downstream at each site

2) $H_0: \frac{N_{\text{downriver}}}{N_{\text{upriver}}} = 0.5$

$H_1: \frac{N_{\text{downriver}}}{N_{\text{upriver}}} > 0.5$ (majority)

$H_2: \frac{N_{\text{downriver}}}{N_{\text{upriver}}} < 0.5$
Methodology

Data

**Ambient**
- River Flow
  1) ADCP, fixed and mobile
  2) Crescent plant discharge
  3) USGS Cohoes gauge

- Temperature
  HOBO loggers, 15 min.

**Fish Pop’n**
- **Hydroacoustic**
  1) Mobile
     420 kHz split-beam echo sounder
  2) Fixed
     2 arrays, 3 horizontal, 1 vertical split-beams

- **Trawl**
  3 m cone, 95 mm stretch mesh net, 1.8 m x 1.2 m frame

**Supplemental**
- Invertebrate
  Plankton tow nets
- Precipitation
  Albany airport
Field Study Maps
Methodology

**Fixed Hydroacoustic Sites Split-Beam Transducers Coverage**

![Graph showing depth and distance from the eastern shore for upriver and downriver main channel sites.](image-url)
Sampling Schedule

River Flow
- ADCP
  1) Fixed = continuous
  2) Mobile = Daily
- Crescent plant discharge/USGS Cohoes gauge = continuous

Temperature  Continuous, 15 min. intervals

Mobile  7 Day-Time Surveys
  1 Night-Time*

Fixed  Continuous

Trawl  11 Night-Time Surveys
  2 Day-Time**
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Data Analyses

Trawl Surveys
- Abundance Estimate (CPUE)
- Verified with mobile hydroacoustic
- 50 individual subsample per trawl, length

Mobile Hydroacoustic Surveys
- Quantify the backscattering coefficient volume
- Filter for juvenile herring target strength
- Calculate herring target strength density
- Survey maps w/kriging interpolation
- (Dunning and Gurshin 2012)
Data Analyses

Fixed Hydroacoustic Surveys

- Quantify the backscattering coefficient volume
- Filter for juvenile herring target strength
- Filter *Chaoborus* and bubbles
- Calculate herring target strength density
- Spatial and temporal trends
- (Dunning and Gurshin 2012)
Flow Results
Results

Temperature

![Temperature Graph]

Temperature (°C)

15Sep 29Sep 13Oct 27Oct
Results

Trawl Surveys

(A) Mean CPUE (number per 200-m tow)

(B) 9 Sep - 10 Oct 2012

(C) 15 - 25 Oct 2012

- Upriver
- Ultrasound gradient
- Downriver main channel
- Intake channel
Mobile Hydroacoustic Survey

Results
Mobile Hydroacoustic Survey

Results

Juvenile blueback herring
Density (fish/m²)
Results

Mobile Surveys
Results

Mobile Surveys
Results

Mobile Surveys

Juvenile Blueback Herring
Areal Density (#/m²)

- 15.51 - 26.00
- 10.01 - 15.50
- 6.51 - 10.00
- 4.61 - 6.50
- 3.31 - 4.60
- 2.21 - 3.30
- 1.41 - 2.20
- 0.81 - 1.40
- 0.21 - 0.80
- 0.01 - 0.20
- 0
Results

Mobile Surveys

Juvenile Blueback Herring
Areal Density (#/m²)

- 15.51 - 26.00
- 10.01 - 15.50
- 6.51 - 10.00
- 4.61 - 6.50
- 3.31 - 4.60
- 2.21 - 3.30
- 1.41 - 2.20
- 0.81 - 1.40
- 0.21 - 0.80
- 0.01 - 0.20
- 0
Results

Mobile Surveys

Juvenile Blueback Herring Areal Density (#/m²)

- 15.51 - 26.00
- 10.01 - 15.50
- 6.51 - 10.00
- 4.61 - 6.50
- 3.31 - 4.60
- 2.21 - 3.30
- 1.41 - 2.20
- 0.81 - 1.40
- 0.21 - 0.80
- 0.01 - 0.20
- 0

[Map showing survey results with different dot colors indicating density levels]
Results

Mobile Hydroacoustic Survey

(A) Density (Number per m²)

(B) Abundance (Thousands)

Survey dates (2012)

- Upriver extension
- Upriver main channel
- Downriver main channel
- Intake channel
Results

Fixed Hydroacoustic Survey

Upriver-West

Upriver-Center

Upriver-East

JBI $S_p$ (dB)

Range (m)

(A) 0337

(B) 0717

(A) 0032

(B) 0853

(A) 0020

(B) 0730

(C) 1348

(D) 2137

(C) 1222

(D) 1632

(C) 1340

(D) 1950

6-Oct 0000

1200 0000

7-Oct 0000

8 Sep

27 Oct

27 Oct

Time (s)
Fixed Hydroacoustic Survey

Downriver-West

Downriver-Center

Downriver-East

Results
Fixed Hydroacoustic Survey

1) $H_0: \frac{V_{\text{downriver}}}{V_{\text{upriver}}} = 0.49$

$V = \text{volume of water moving downstream at each site}$

2) $H_0: \frac{N_{\text{downriver}}}{N_{\text{upriver}}} = 0.76$

$H_1: \frac{N_{\text{downriver}}}{N_{\text{upriver}}} > 0.5 \text{ (majority)}$

$H_2: \frac{N_{\text{downriver}}}{N_{\text{upriver}}} < 0.5$
Conclusions

1. Deterrence Rate = 76%,
   45% improvement after reconfiguration

2. $18^\circ$ C is limiting temperature at which JBBH complete downstream migration out of Crescent Pool

3. Strong diurnal activity patterns, dawn – early afternoon