
Determinants of Entrainment Risk For Sturgeon

Jan Hoover

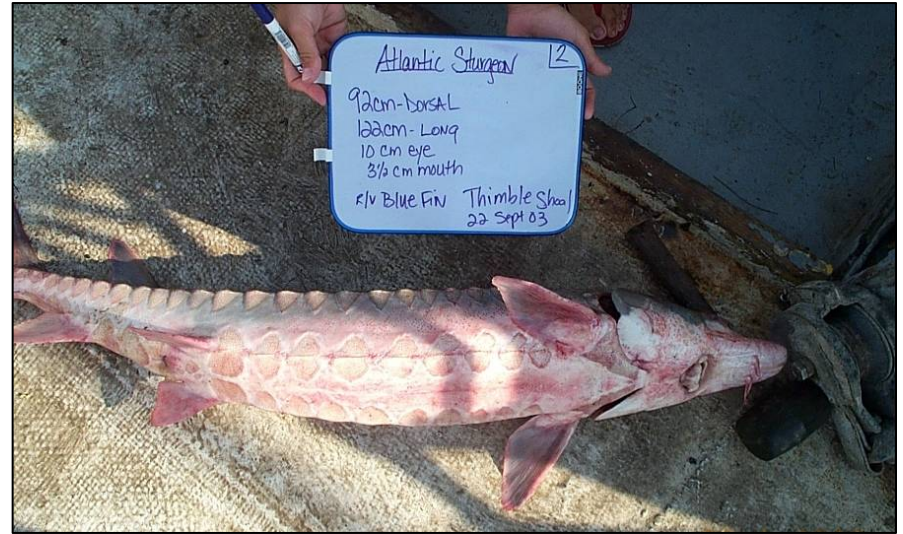
US Army ERDC, Vicksburg, MS

Email: Jan.J.Hoover@usace.army.mil



Issues

- Proximity of dredges and sturgeon
- Endangered status of sturgeon
- Known entrainment of adult sturgeon
- Presumed entrainment of juvenile sturgeon

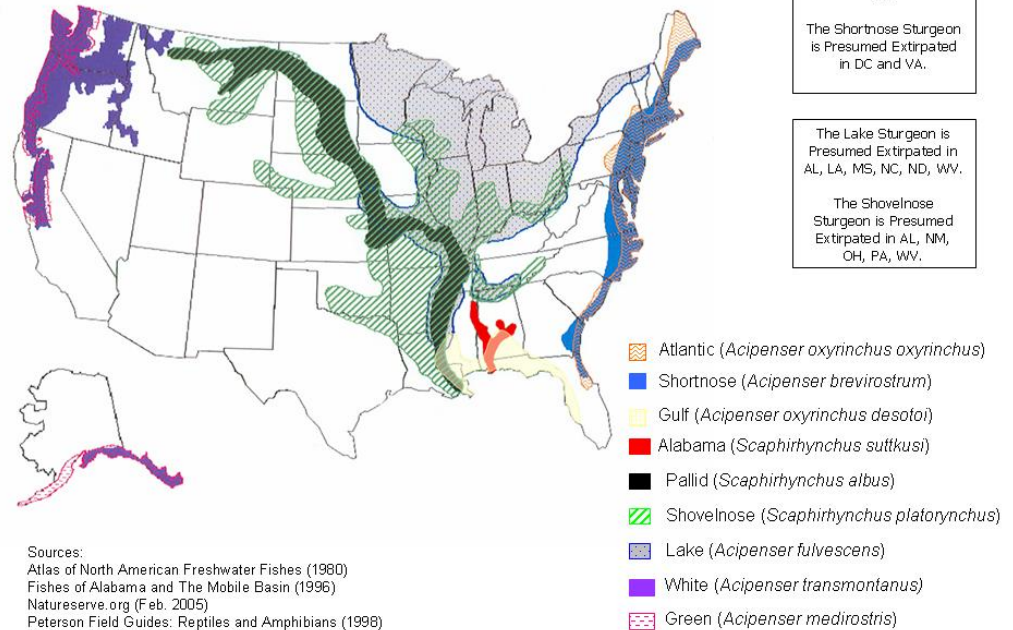


Dredges and Sturgeon

Major Waterways of the U.S.



Distribution of Sturgeon Species in the U.S.



The Atlantic Sturgeon is Presumed Extirpated in DC.

The Shortnose Sturgeon is Presumed Extirpated in DC and VA.

The Lake Sturgeon is Presumed Extirpated in AL, LA, MS, NC, ND, WV.

The Shovelnose Sturgeon is Presumed Extirpated in AL, NM, OH, PA, WV.

Sources:
 Atlas of North American Freshwater Fishes (1980)
 Fishes of Alabama and The Mobile Basin (1996)
 Natureserve.org (Feb. 2005)
 Peterson Field Guides: Reptiles and Amphibians (1998)



Problem

Determine the likelihood of entrainment of juvenile sturgeon in a flow field created by a dredge



Approach

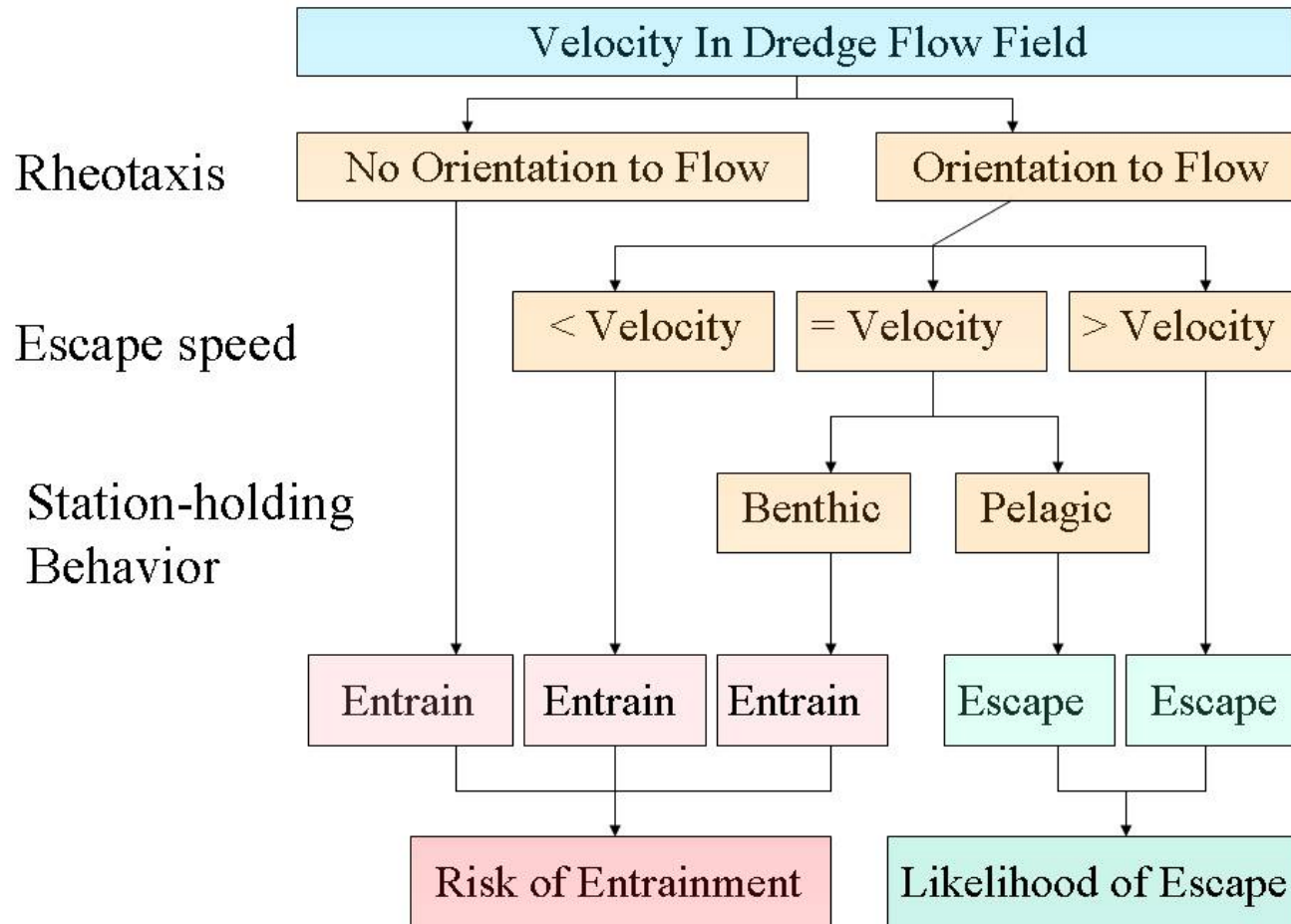
- **Laboratory studies of swimming performance**
- **Risk assessment for specific water velocities based on performance measures**
 - Rheotaxis
 - Endurance
 - Station-holding behavior
- **Evaluation of dredge flow fields**



Blazka Swim Tunnel Studies



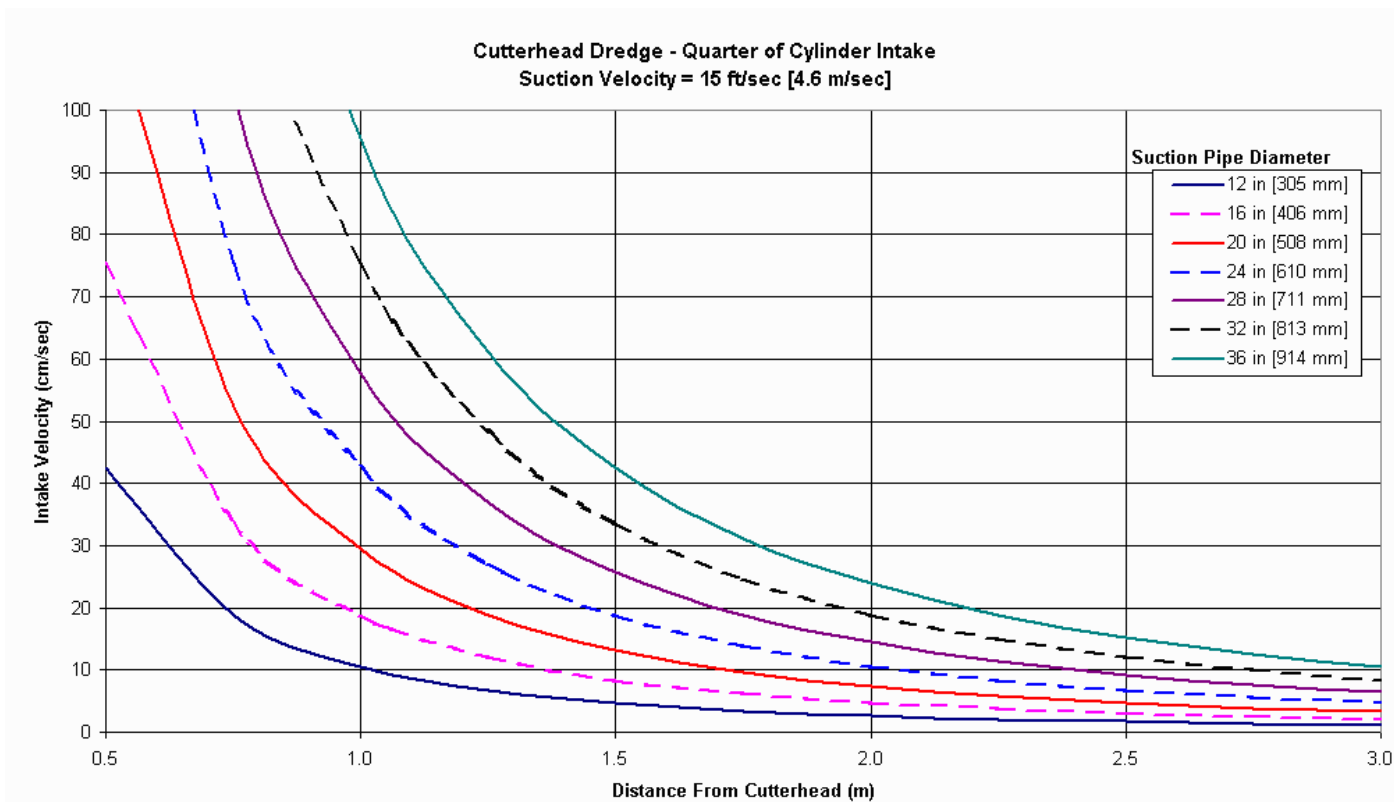
Estimating Risk of Entrainment



Flow Field Models

Predictions of Flow Fields Near the Intakes of Hydraulic Dredges

<http://el.erd.c.usace.army.mil/dots/doer/flowfields/dtb350.html>



Case History: White Sturgeon

- **Sacramento-San Joaquin Rivers**
- **Juveniles 65-121 mm TL**
- **Escape Speeds**
 - **Prolonged (60-sec) swim speed: environmentally conservative**
 - **Burst (6-sec) swim speed: operationally conservative**
- **Pipe sizes**
 - **36 inch diameter**
 - **24 inch diameter**



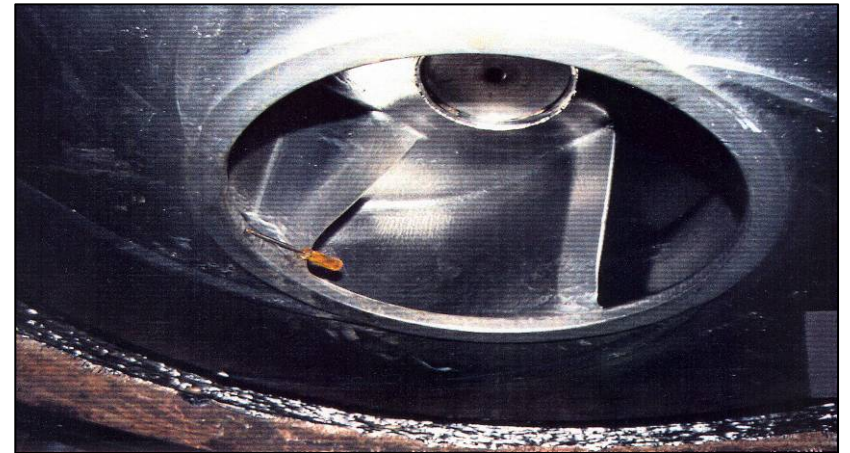
Photo: National Park Service



Previous Sturgeon Entrainment

White Sturgeon

- Columbia River,
Feb 1992
- Modified cutterhead
- 1840+ juveniles
(300-500 mm FL)
- Smaller juveniles
(< 200 mm TL)
at greater risk ?

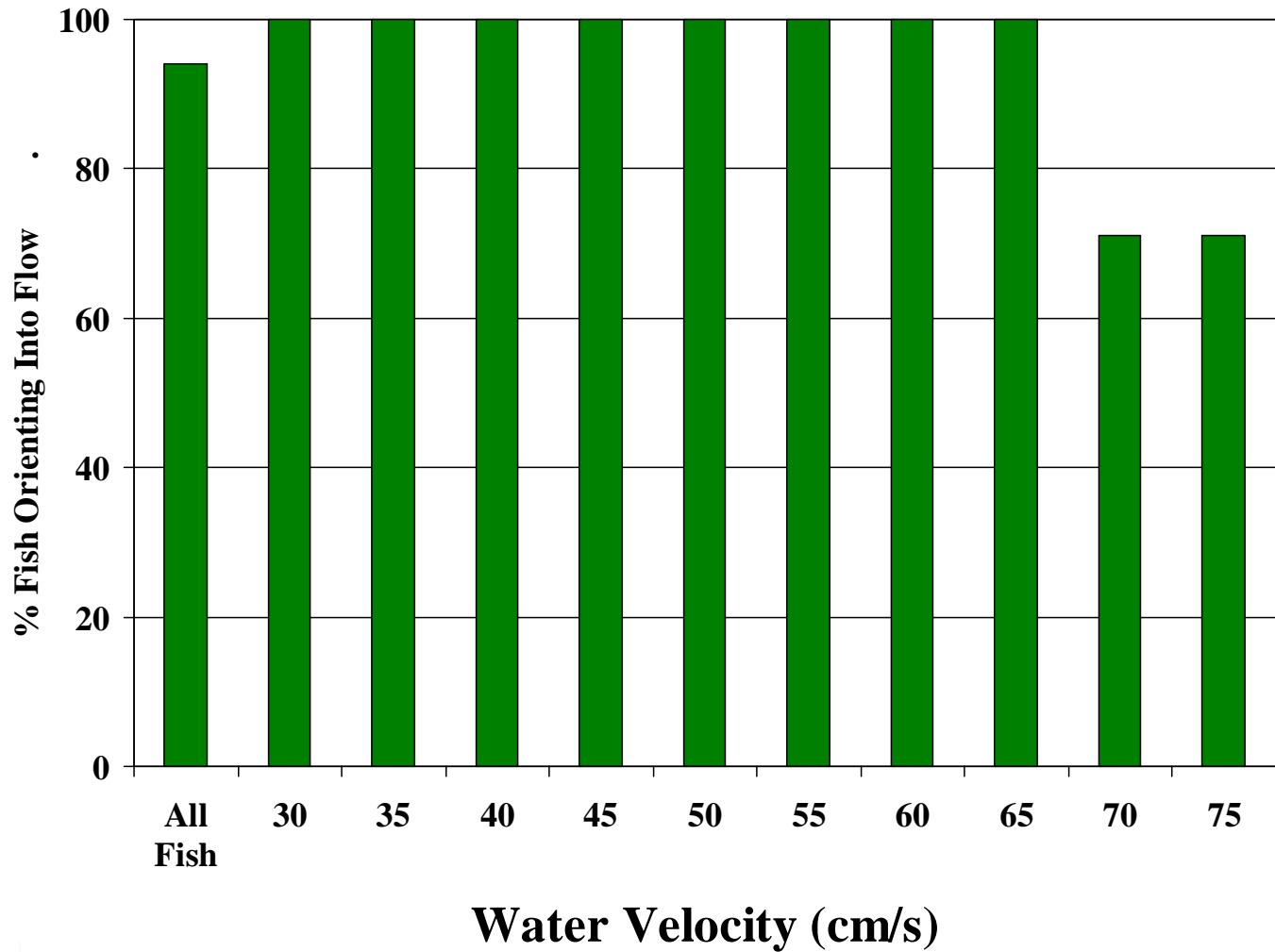


Photos: Buell, 1992

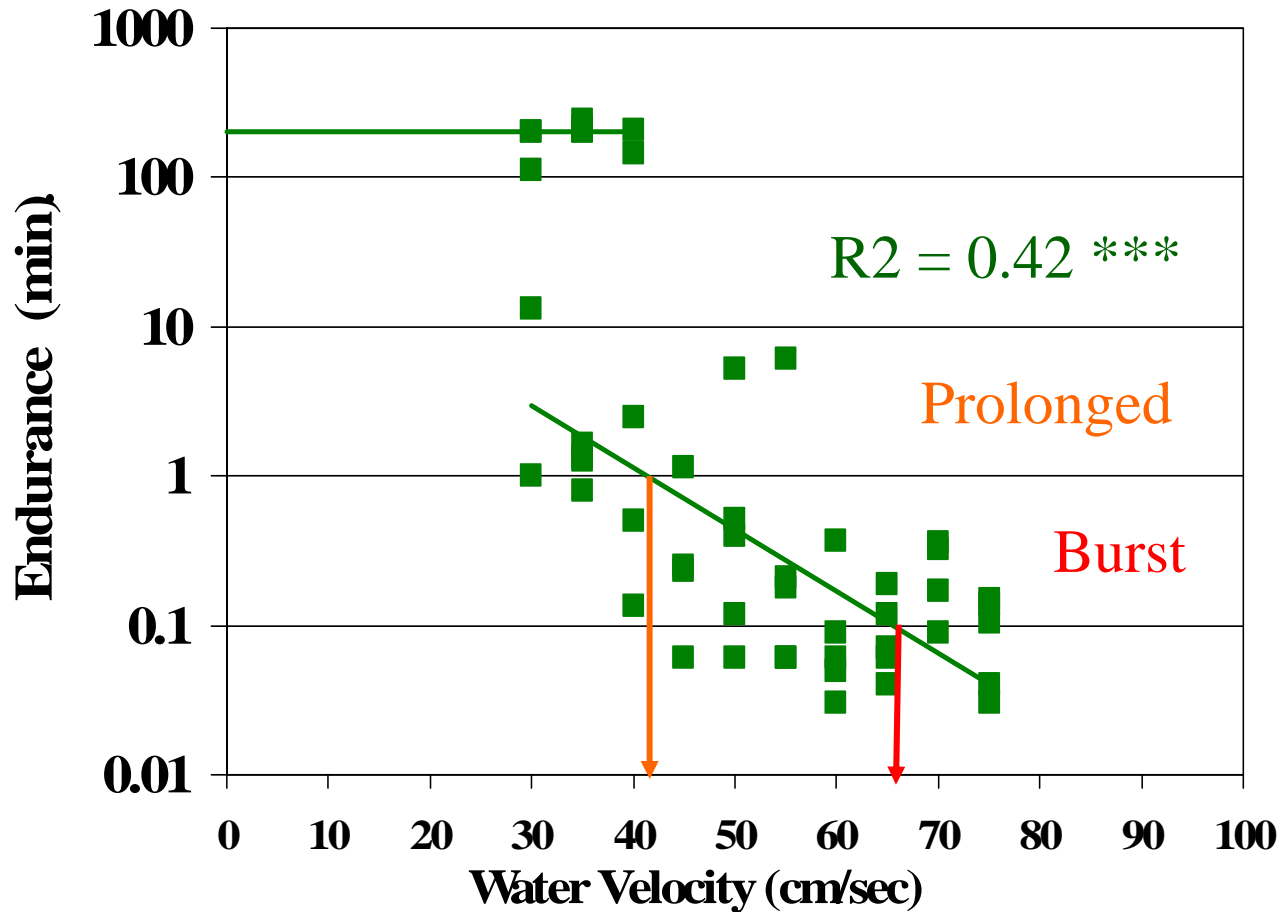
Dredged Material Assessment and Management Seminar
15-17 April 2008, Sacramento, CA



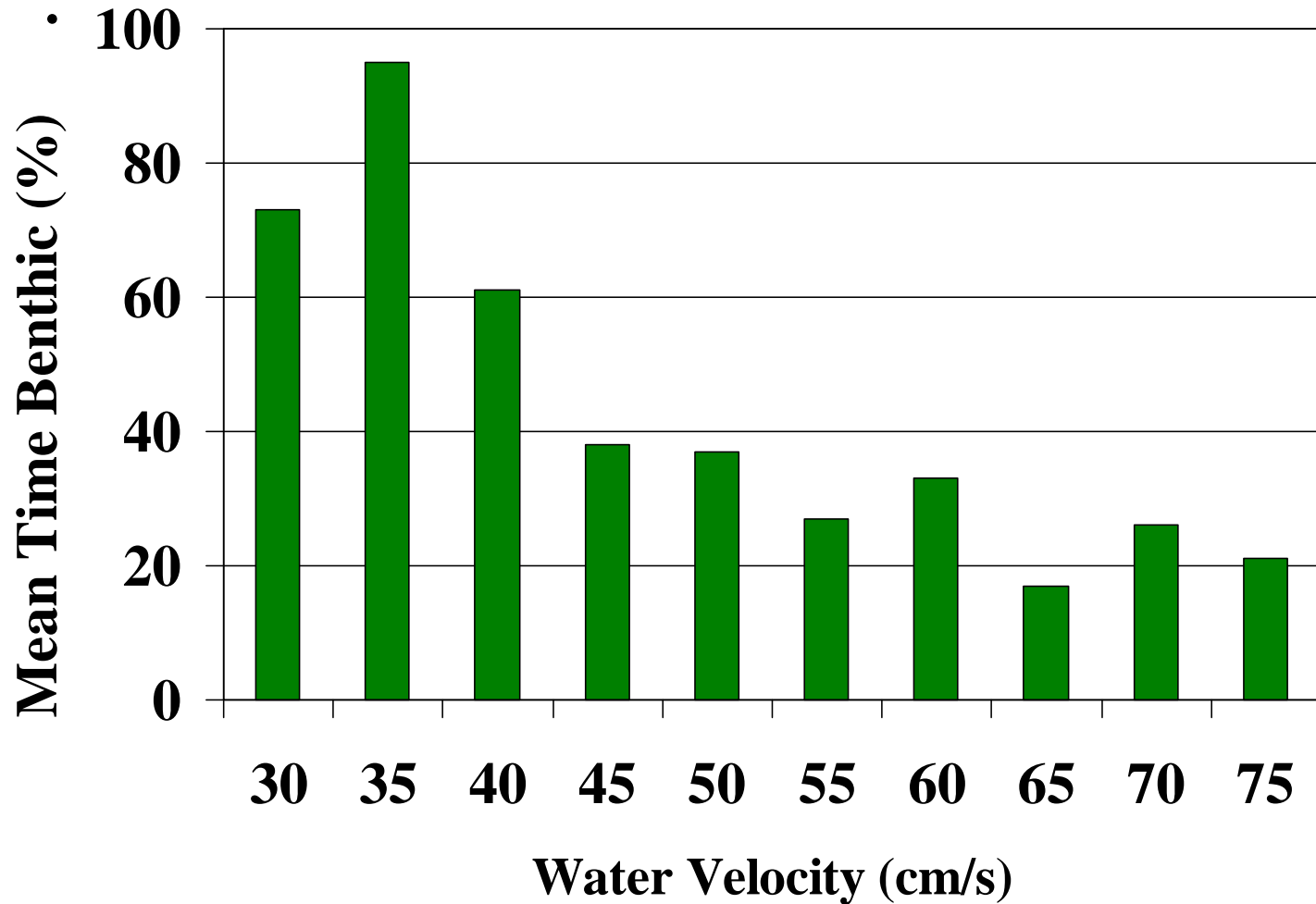
Rheotaxis



Endurance



Behavior



70 cm/s in Dredge Flow Field

Rheotaxis

29 % Non-swimmers

71 % swimmers

Escape speed:
6-sec burst

[Empty box]

65 cm/s

[Empty box]

Station-holding
Behavior

26% Benthic

74% Pelagic

0.29

[Empty box]

0.18

0.53

[Empty box]

Risk of Entrainment
= 0.47

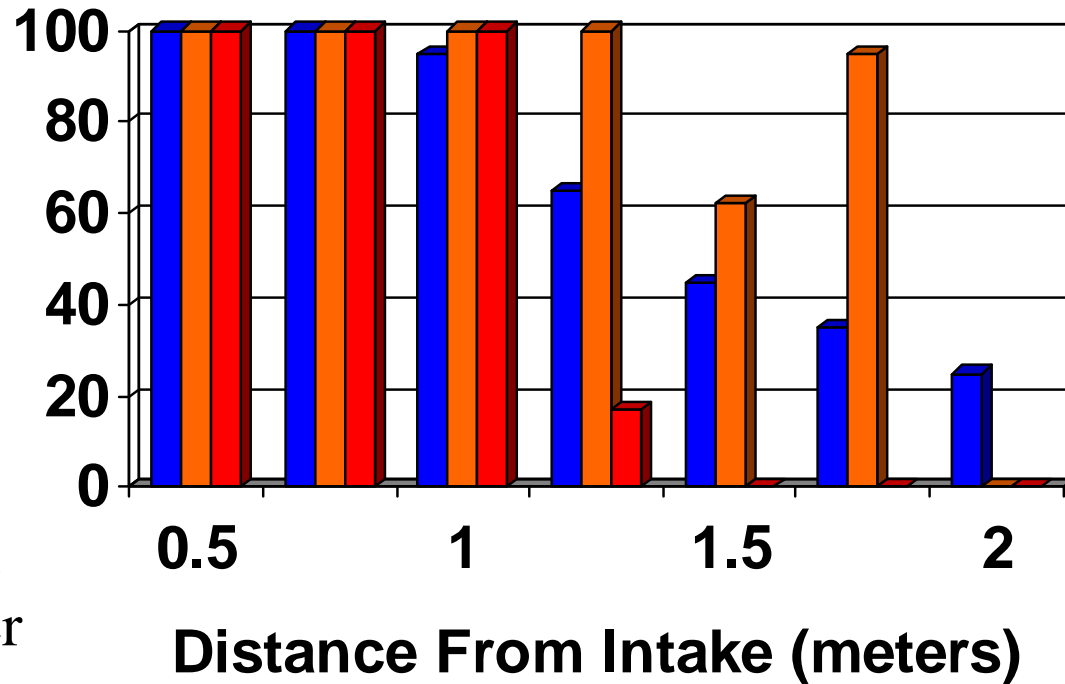
Likelihood of Escape
= 0.53



Entrainment Risk for Sturgeon

Velocity
(cm/s) and
Risk (x100)

Suction = 15 ft./sec
Field = quarter-hemi
Pipe = 36 in diameter



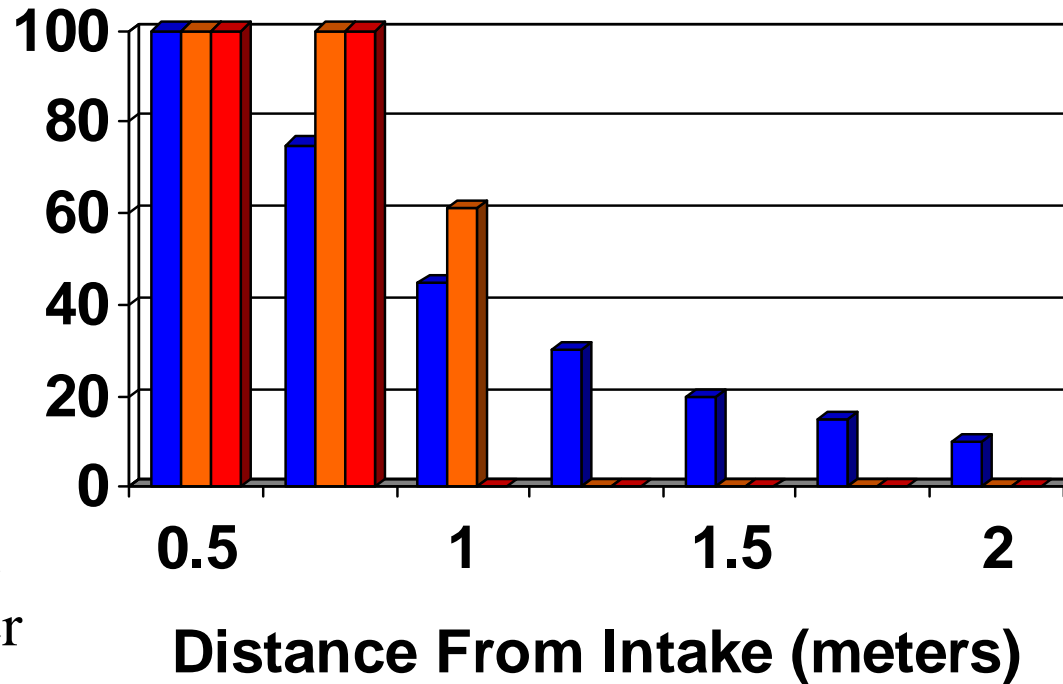
- Water Velocity
- Risk at Prolonged Swim Speed
- Risk at Burst Swim Speed



Entrainment Risk for Sturgeon

Velocity
(cm/s) and
Risk (x100)

Suction = 15 ft./sec
Field = quarter-hemi
Pipe = 24 in diameter



- Water Velocity
- Risk at Prolonged Swim Speed
- Risk at Burst Swim Speed



DOER Funded Studies

Species	Status	Studies Completed
Atlantic sturgeon	Special Concern	St. John River
Lake sturgeon	State-listed (19 states)	Wisconsin River & Lake Winnebago
Pallid sturgeon	Endangered	Yellowstone River & Atchafalaya River
White sturgeon	Endangered (Kootenai River)	Sacramento River - San Joaquin Rivers

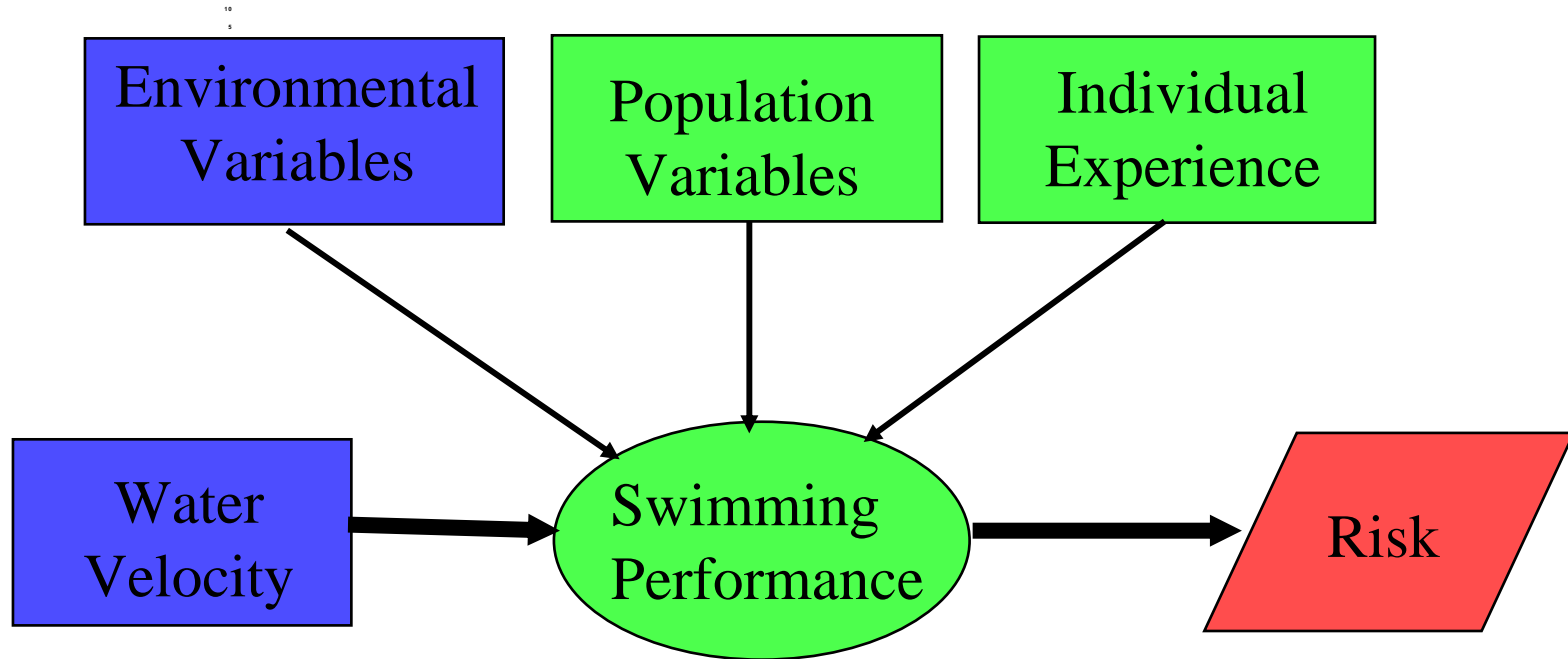


Entrainment Risk for Sturgeon

10
5



Entrainment Risk for Sturgeon



Pallid Sturgeon



Swim Studies with Adult Sturgeon



Dredging at Chain of Rocks

- Start 04 Dec 07
- Stop 08 Jan 08
- Cutterhead
- Intake pipe 24 inches
- Discharge 22 inches
- Rate 15,000 gpm
- Sand pumped to toe of land side of levee
- First (?) confirmed entrainment of river sturgeon (*Scaphirhynchus* sp.)



Forensic Ichthyology



- **Geneticist #1:**
 - Four shovelnose

- **Geneticist #2:**
 - One shovelnose
 - One unidentifiable
 - Two pallids

Morphological/meristic diagnosis pending



Entrainment Risk for Sturgeon

