

Sturgeon Protection



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Background

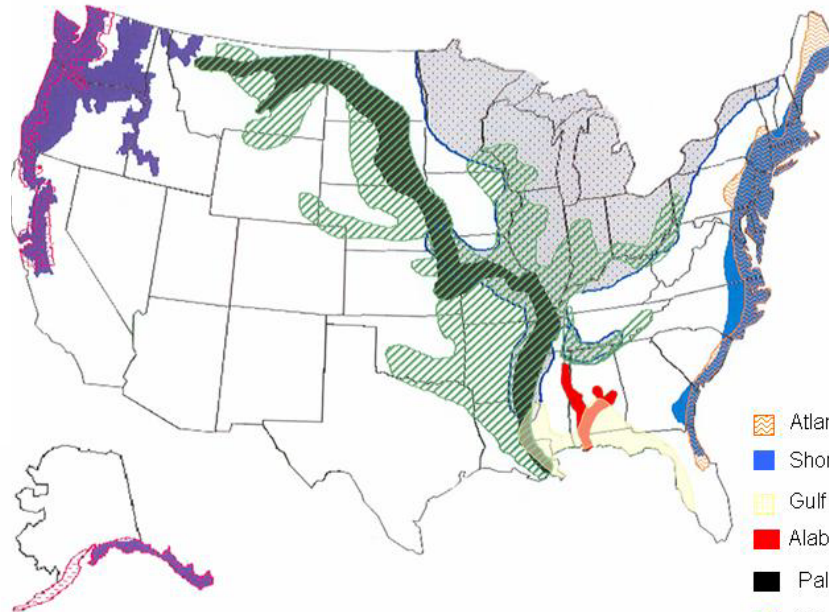
- **Current costs for compliance with the ESA for federal navigation projects exceed \$217M per year**
 - **High budget species**
 - **Birds (e.g., Interior Least Tern, Piping Plover)**
 - **Salmon (e.g., sockeye, pink, Atlantic)**
 - **Sea turtles (e.g., Kemp's Ridley, green)**
 - **Sturgeon (e.g., pallid, shortnose, gulf, green)**
- \$53M**
- **Atlantic sturgeon?????**

Sturgeon Distribution

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.

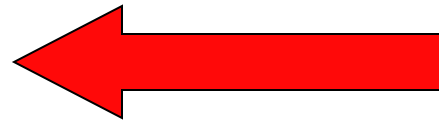
-  Atlantic (*Acipenser oxyrinchus oxyrinchus*)
-  Shortnose (*Acipenser brevirostrum*)
-  Gulf (*Acipenser oxyrinchus desotoi*)
-  Alabama (*Scaphirhynchus suttkusi*)
-  Pallid (*Scaphirhynchus albus*)
-  Shovelnose (*Scaphirhynchus platyrhynchus*)
-  Lake (*Acipenser fulvescens*)
-  White (*Acipenser transmontanus*)
-  Green (*Acipenser medirostris*)

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)



Potential Impacts on Sturgeon

- **Contaminated sediments**
- **Sediment re-suspension effects**
 - **Turbidity and total suspended solids**
- **Sedimentation (dredged material disposal) effects on habitat**
- **Underwater noise**
- **Blasting**
- **Bed leveling**
- **Ship propeller strikes**
- **Hydraulic entrainment**



Topics

- **Determining risk of sturgeon entrainment by hydraulic dredges**
 - **Risk of sturgeon-dredge encounter**
 - **Seasonal occupation of waterway**
 - Conflict with dredging requirements
 - **Diel movement patterns**
 - Vertical movements
 - Time on bottom
 - **Risk of actual entrainment**
 - **Behavior**
 - **Swimming capabilities**



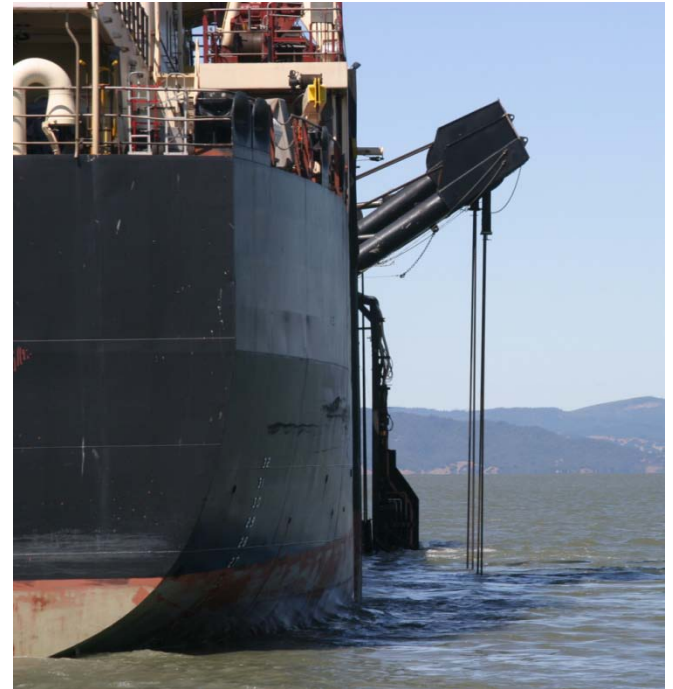
Hopper Dredges

- About 20 in the US





Corps Hopper Dredge *Essayons*



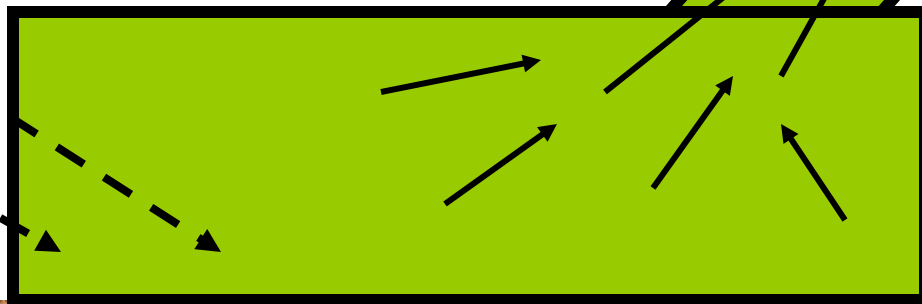
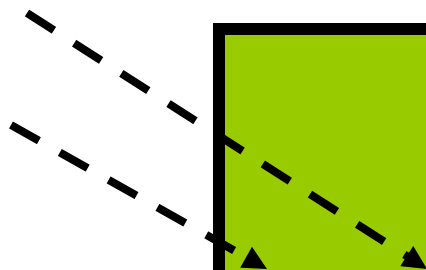
Surge Compensators

Draghead Assembly

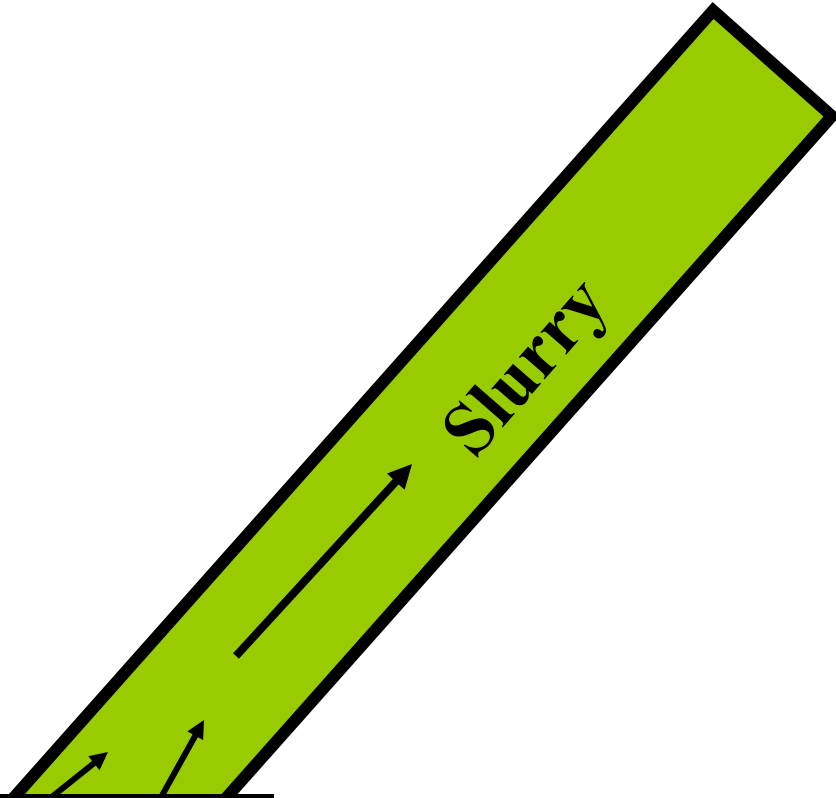
**Direction of
Draghead
Movement**



H_2O



Sand Wave



Slurry

**Direction of
Draghead
Movement**



Slurry

H₂O

H₂O

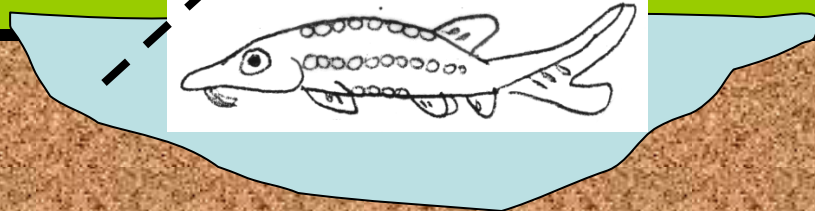
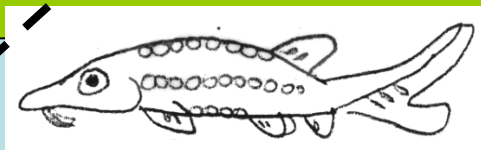
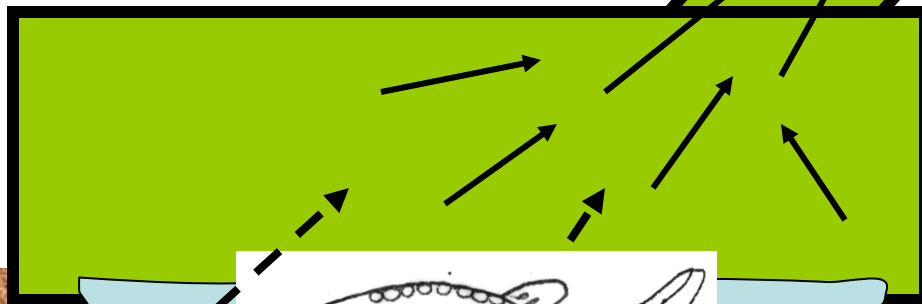
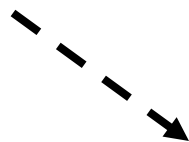


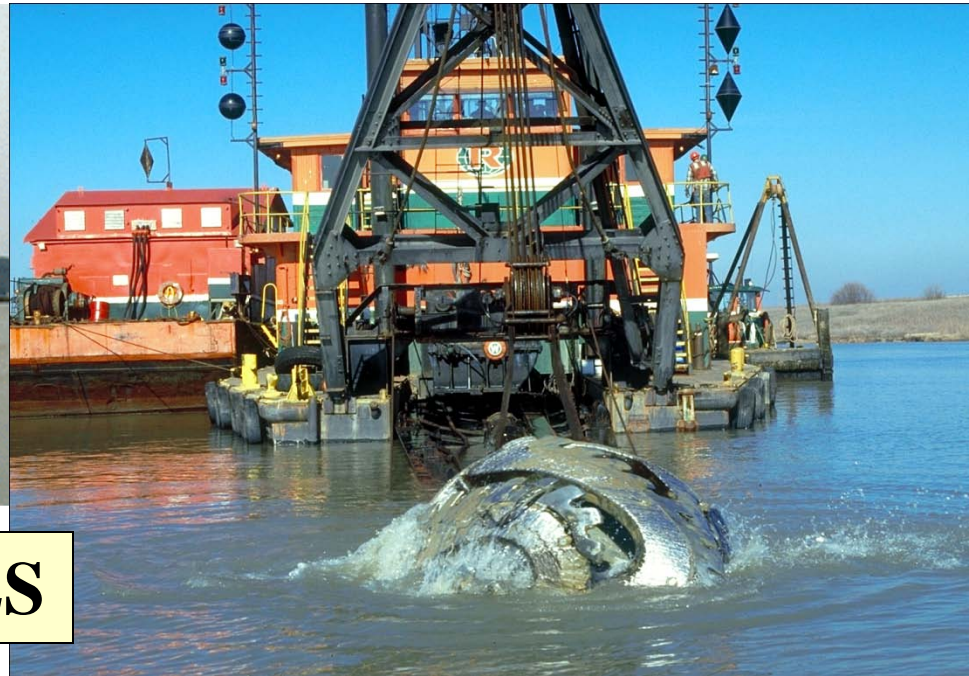
**Direction of
Draghead
Movement**



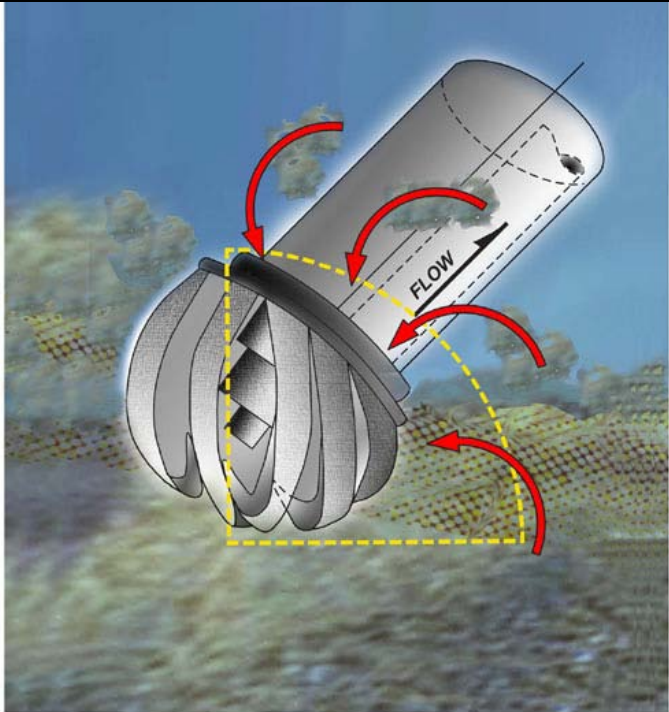
Slurry

H_2O





CUTTERHEAD DREDGES



Cutter Rotation

3 – 10 rpm*

Direction of
Cutterhead
Movement



H₂O

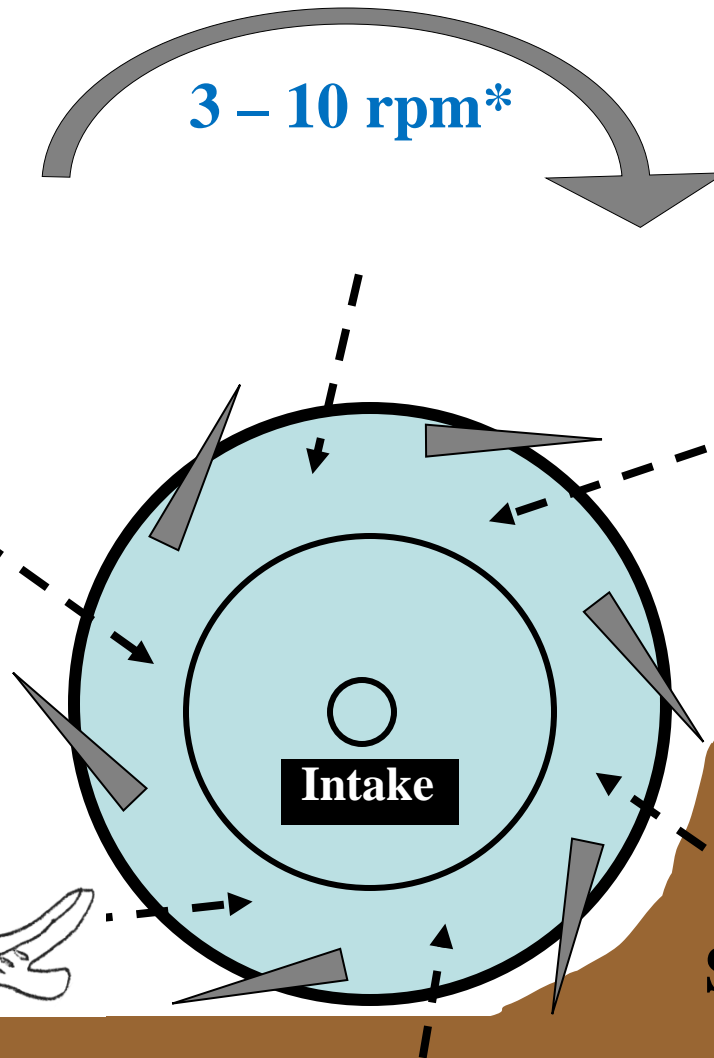
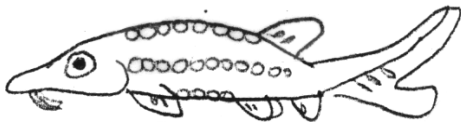
H₂O

Intake

Sediment

Sediment

0.15 – 0.6 m/sec Swing Rate



Assessing Entrainment Risk

- **Risk of sturgeon entrainment by hydraulic dredges**
 - **Probability of encounter**
 - » large spatial scale, long temporal scale
 - **Probability of detrimental outcome**
 - » attraction/avoidance behavior
 - » escape capability

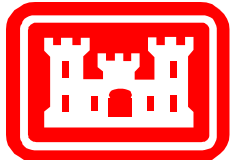
Sturgeon Detection and Biotelemetry

- **Determine Atlantic sturgeon habitat use patterns**

- Seasonality
- Time budget in channels and shoals
- Examine behavior in proximity to active dredging operations



- **In partnership with:**



**USACE Norfolk
District**



**US Fish & Wildlife
Service**

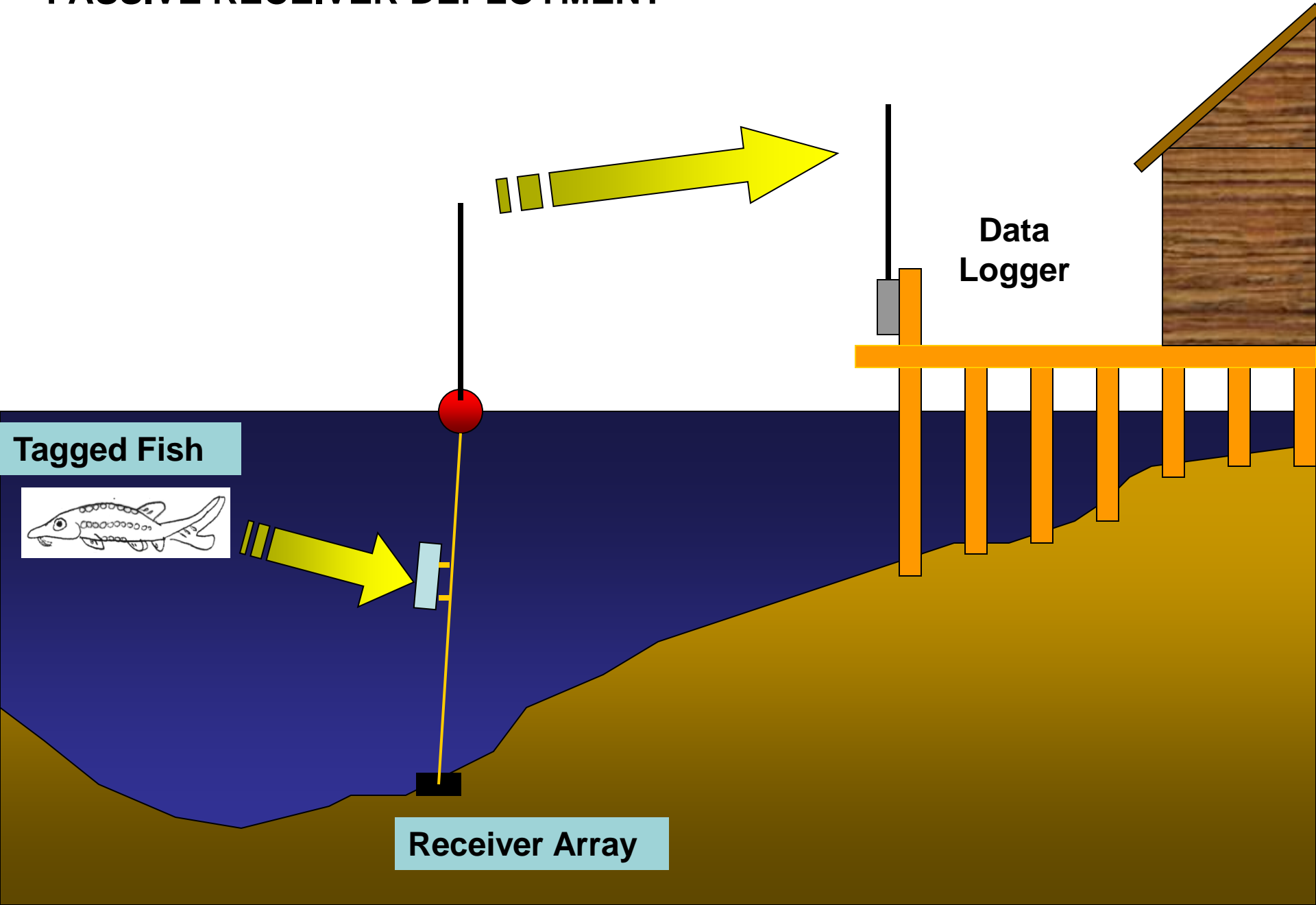
**Virginia
Institute of
Marine
Science**



**Virginia
Commonwealth
University**

**James River Riverkeeper
Association**

PASSIVE RECEIVER DEPLOYMENT



Passive Telemetry

Acoustic array deployed to identify essential sturgeon habitat

- **Assess migratory behavior**
- **Estimate residence time**
- **Identify patterns of river segment occupation by various size classes and document emigration from the system**
- **Determine areas of limited abundance or avoidance**
- **Assess the influence of physical factors (temp., time of day, currents) on migration**
- **Evaluate effects of tagging and handling**

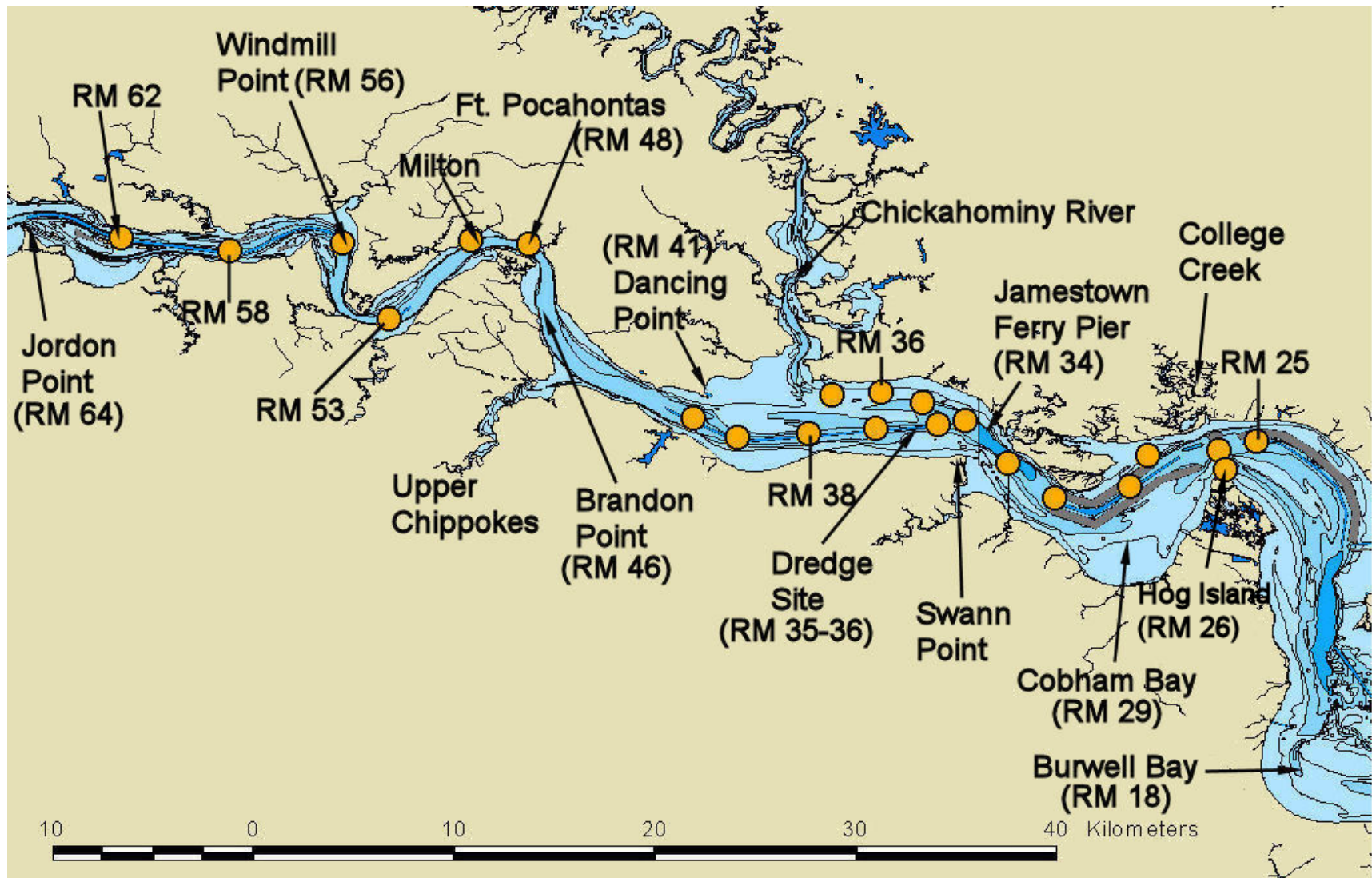


Receiver



Length = 98 mm
Weight (H2O) 16 g
Tag Life = 4.5 yrs
(min)
Depth Tag

Passive Tracking Array

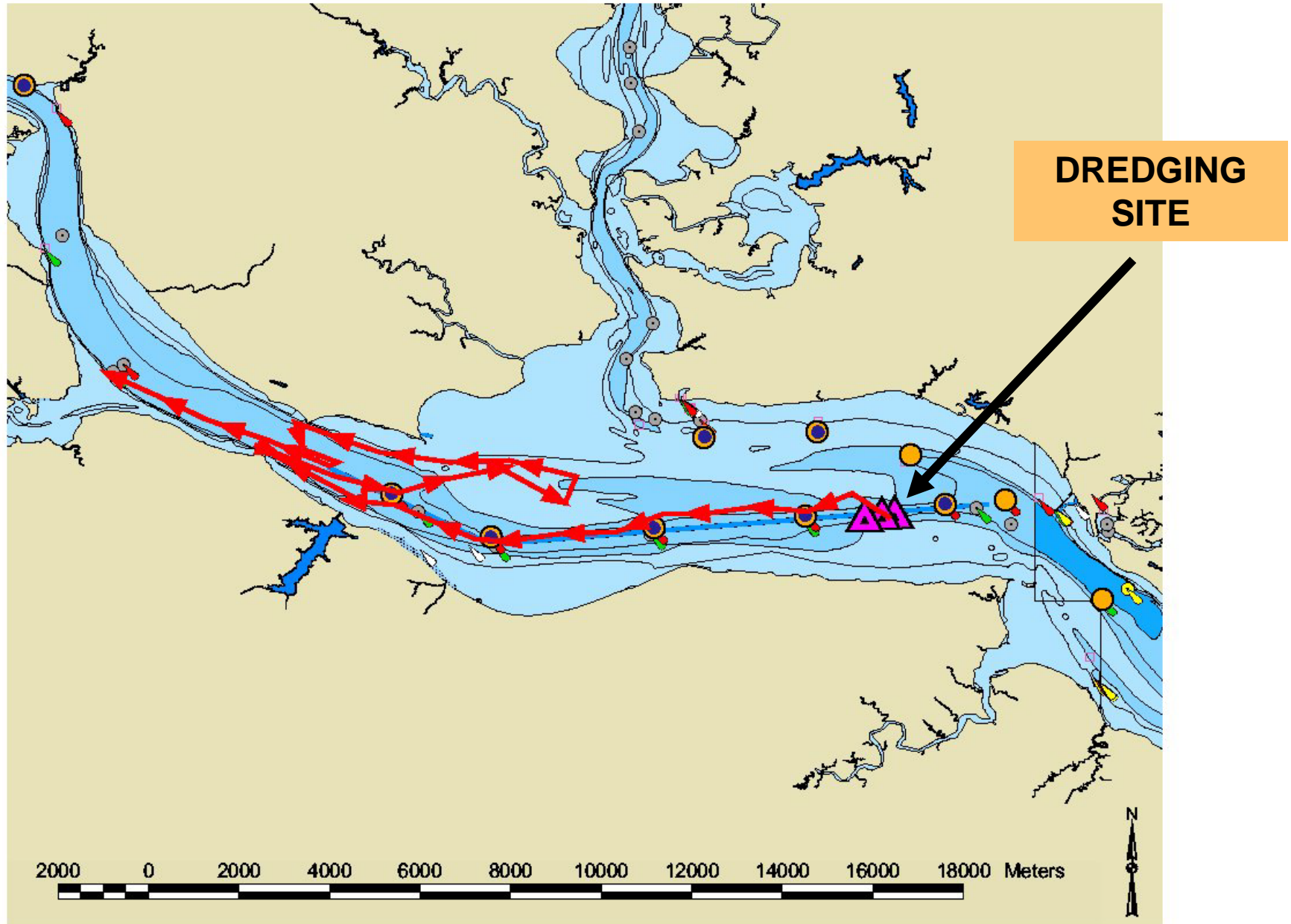


Active Tracking

- Establish movement patterns in proximity to an active dredge (e.g., evidence of attraction or avoidance)
- Day versus night movement patterns
- Influence of tidal phase on movements
- Time budgeting in navigation channel vs. shoals

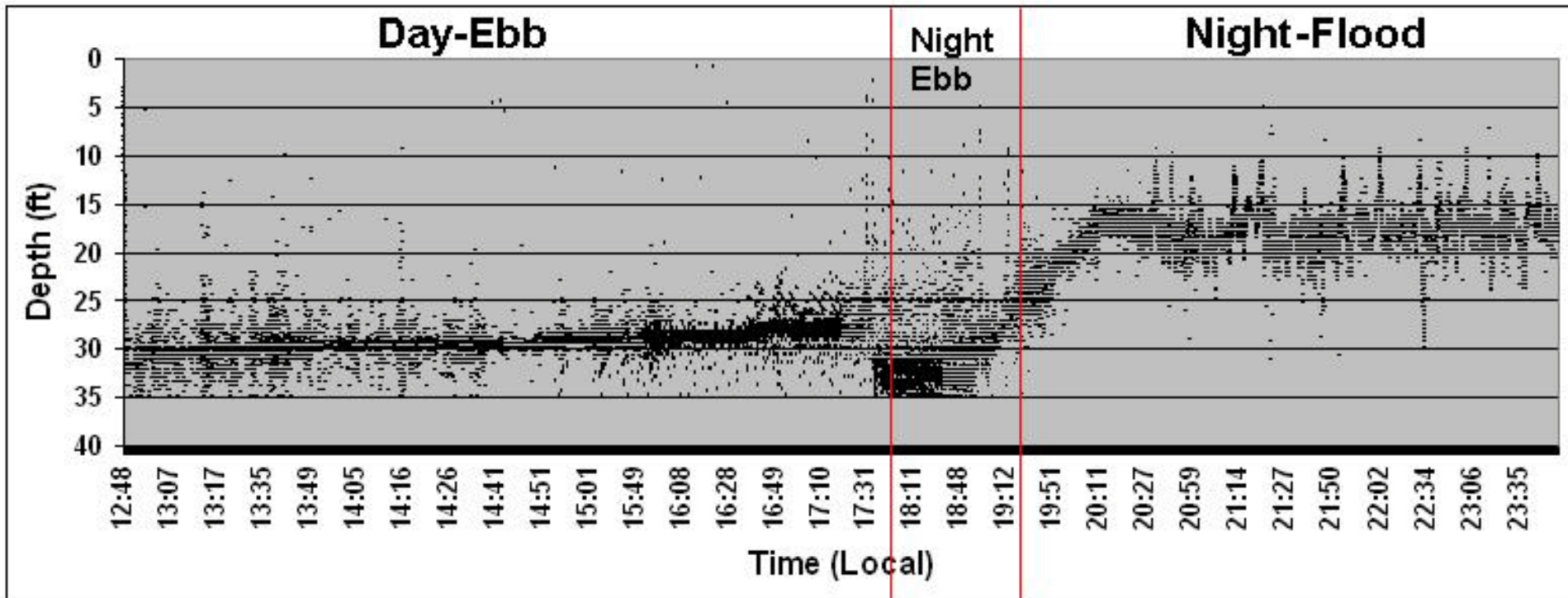


72 HOUR TRACK OF STURGEON RELEASED AT ACTIVE DREDGING SITE



Determining Daily “Time on Bottom” Budget

Atlantic Sturgeon – 81 kHz time/depth tag – February 9, 2009



12 hour time series, ~ noon to midnight

Risk of Sturgeon Entrainment

- **Problem:** Determine the likelihood of entrainment of juvenile sturgeon in a flow field created by a hydraulic dredge



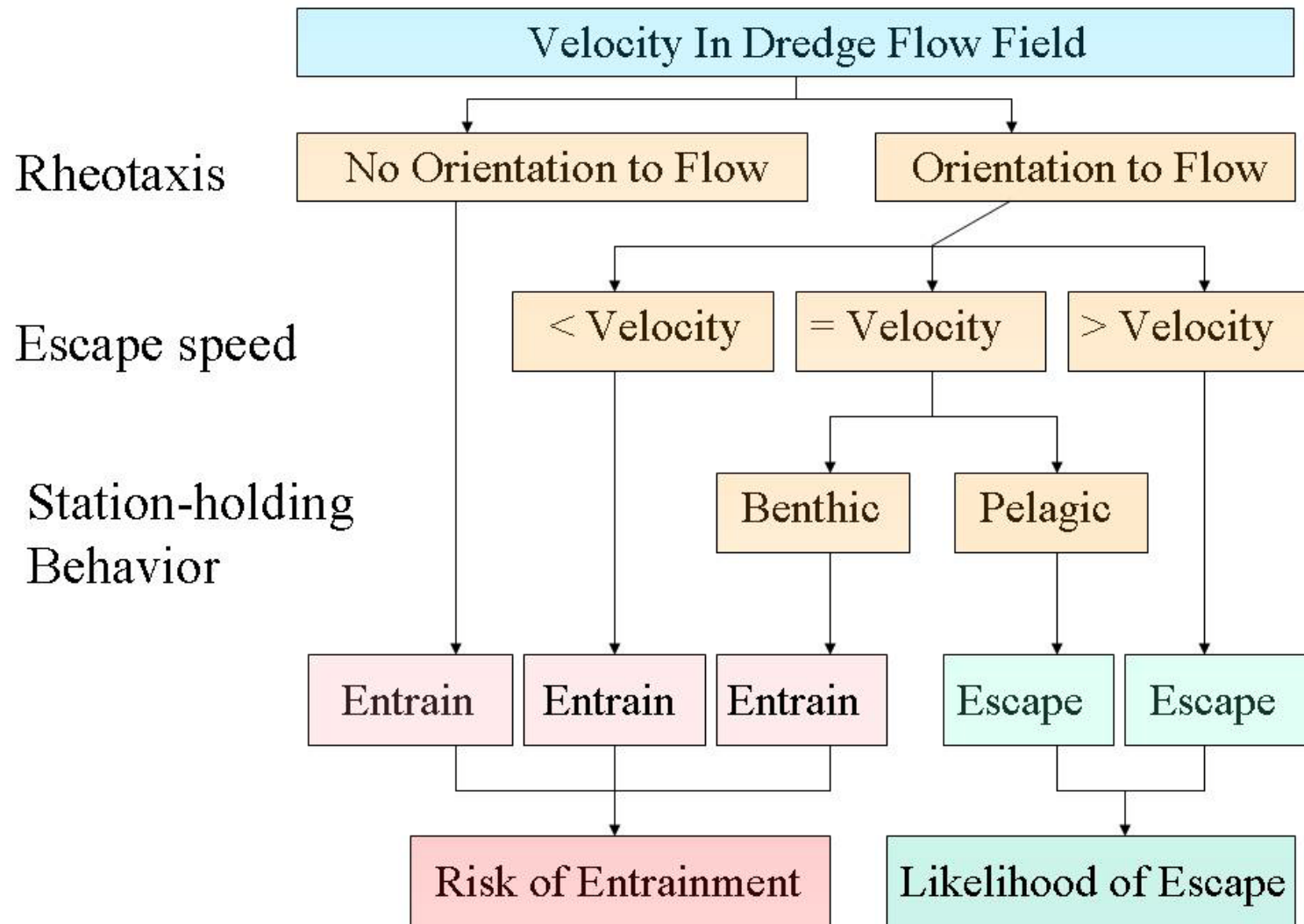
Risk of Sturgeon Entrainment

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



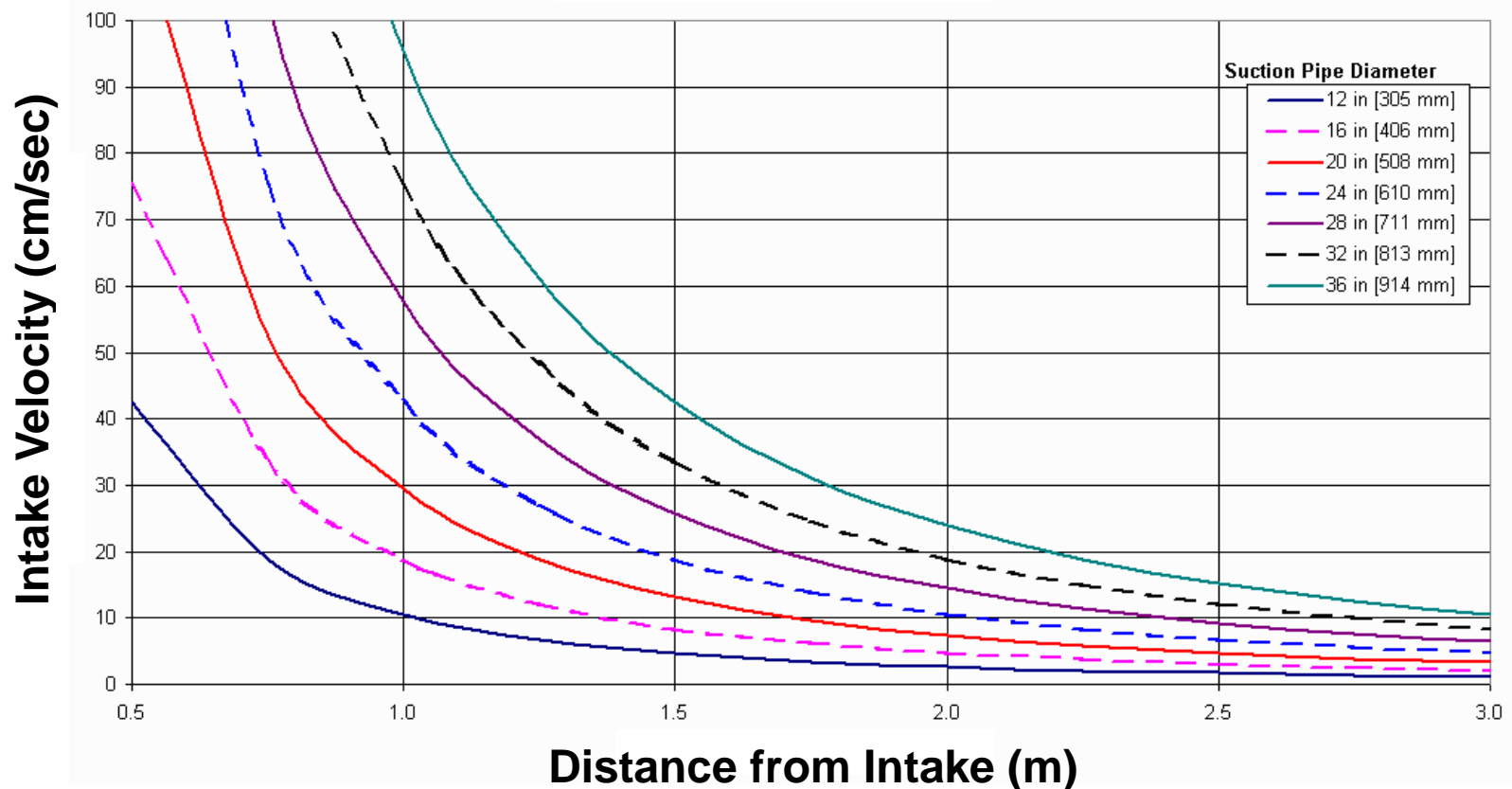
Risk of Sturgeon Entrainment



Risk of Sturgeon Entrainment

Predictions of Flow Fields Near the Intakes of Hydraulic Dredges

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



Cutterhead (1/4 cylinder intake) with suction velocity = 4.6 m/sec

Risk of Sturgeon Entrainment



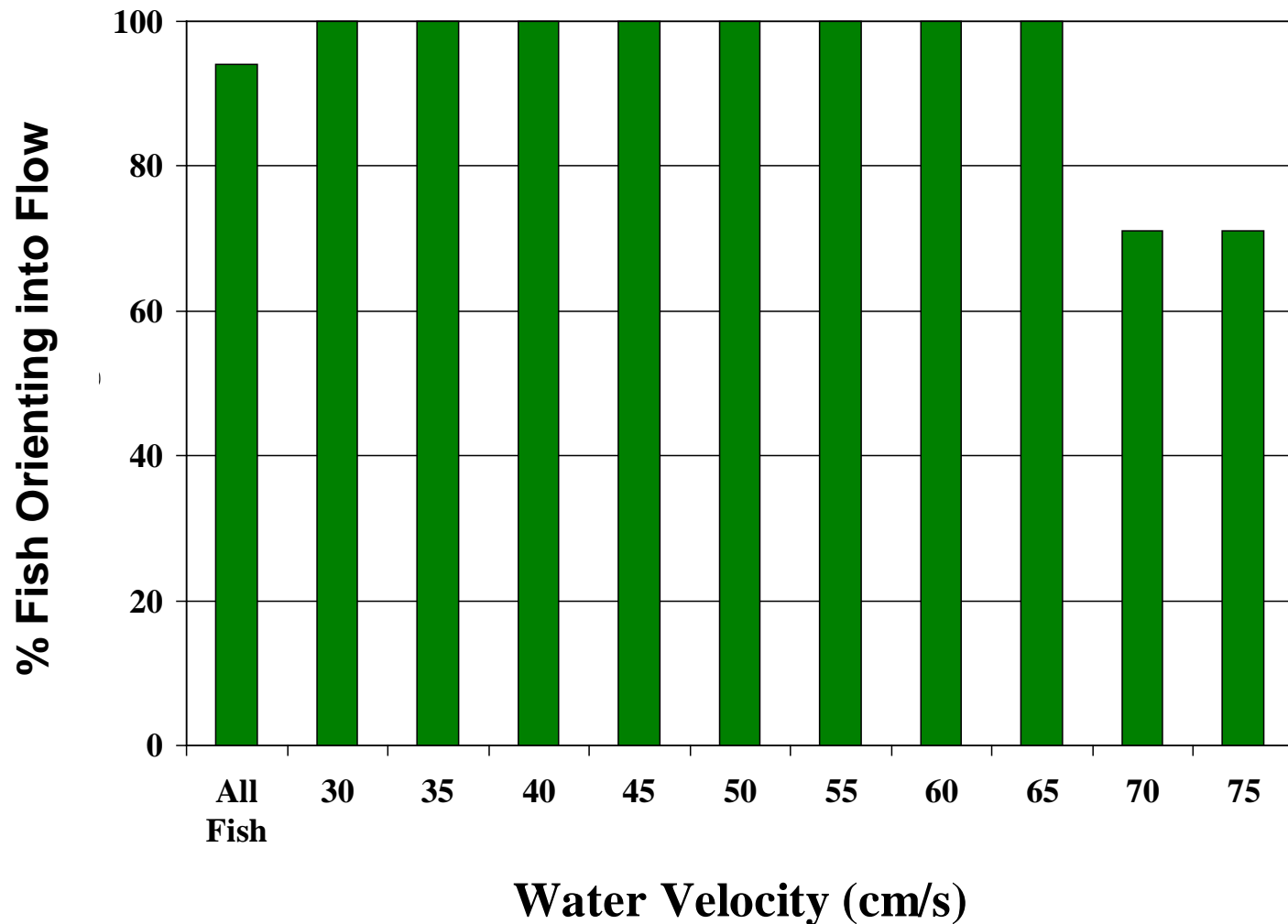
SWIM TUNNEL PERFORMANCE TESTS

- Atlantic sturgeon
- White sturgeon
- Lake sturgeon

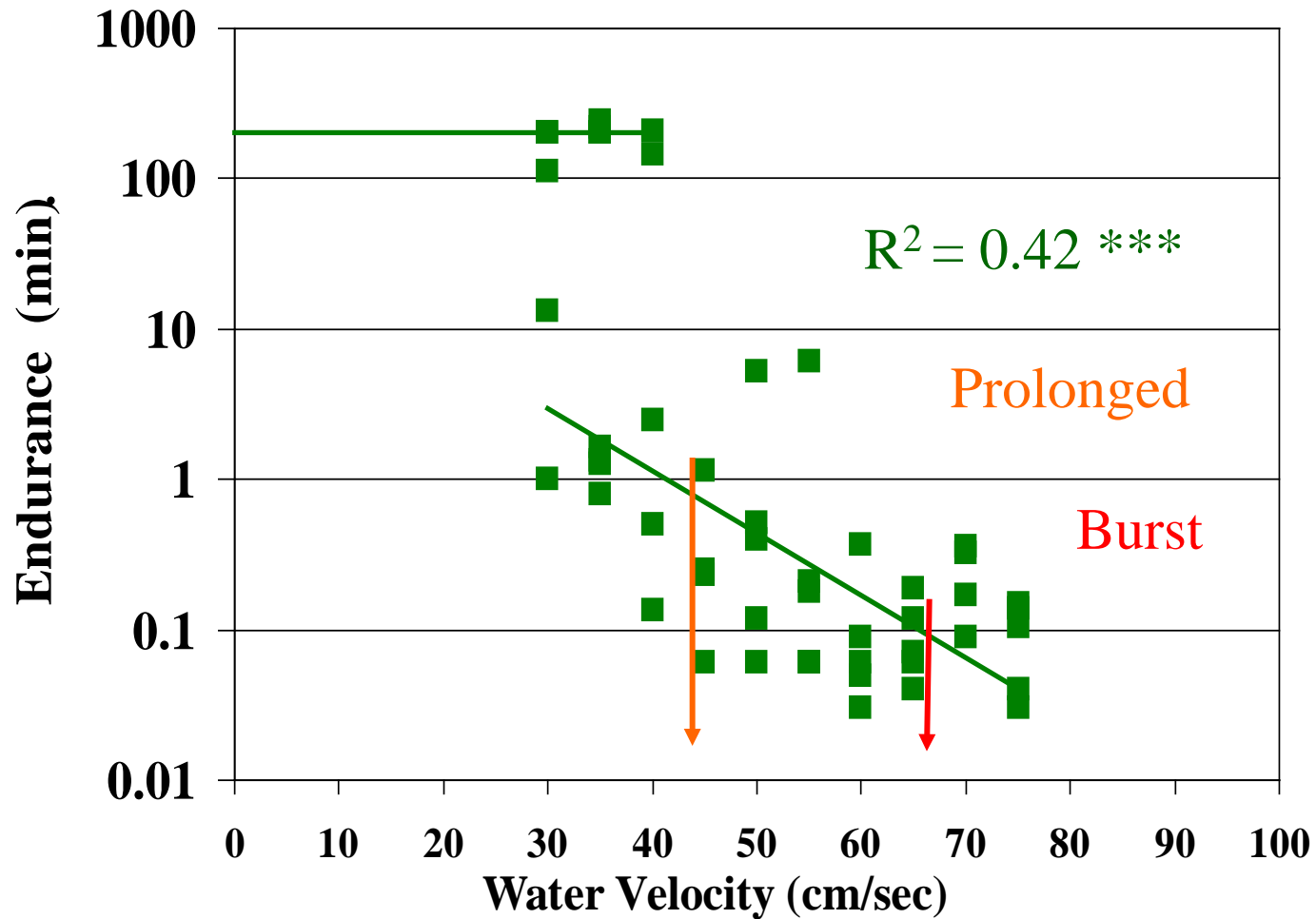
Juveniles and sub-adults



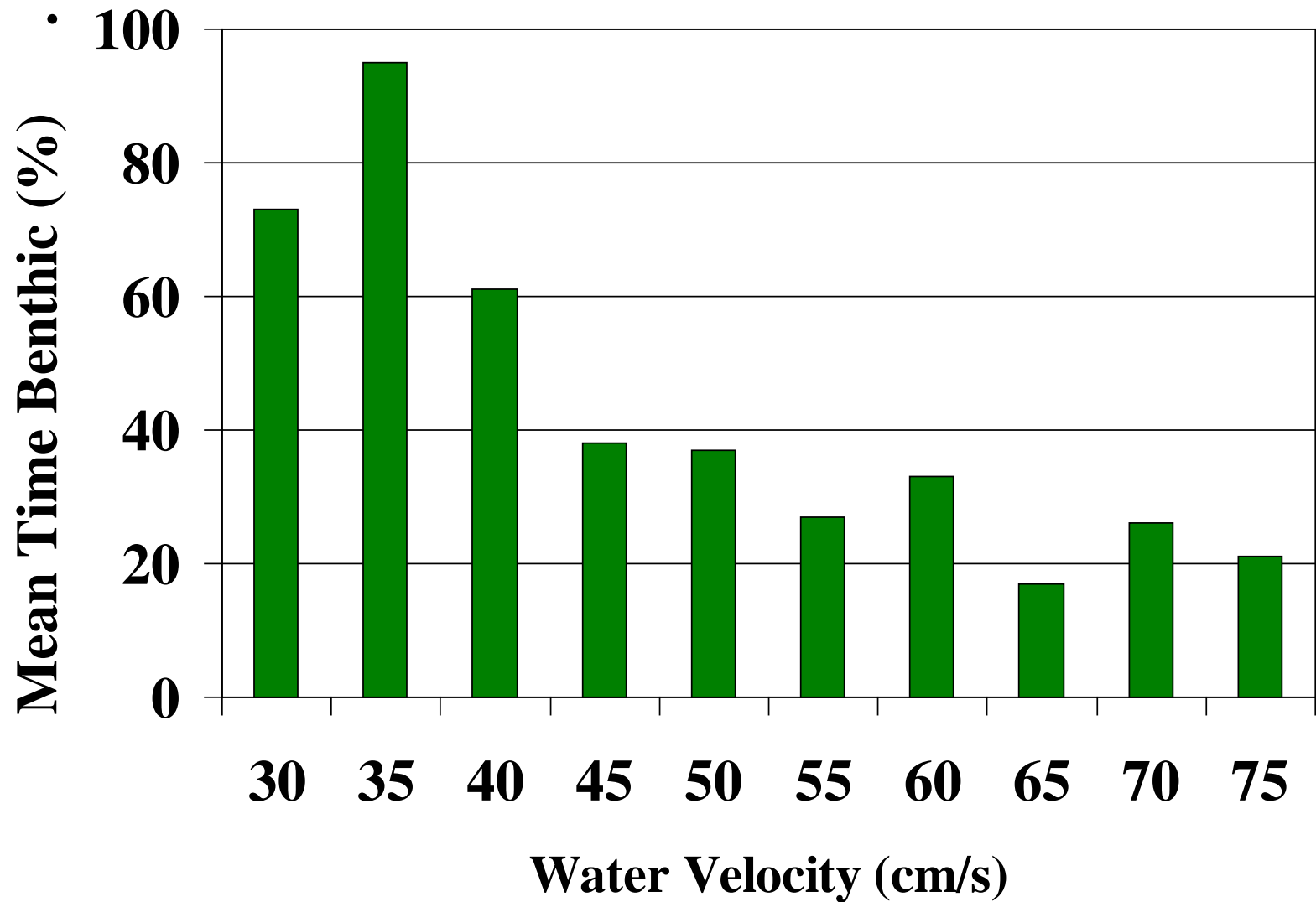
Risk of Sturgeon Entrainment



Risk of Sturgeon Entrainment



Risk of Sturgeon Entrainment



70 cm/s in Dredge Flow Field

Rheotaxis

29 % Non-swimmers

71 % swimmers

Escape speed:

6-sec burst

Station-holding
Behavior

65 cm/s

26% Benthic

74% Pelagic

0.29

0.18

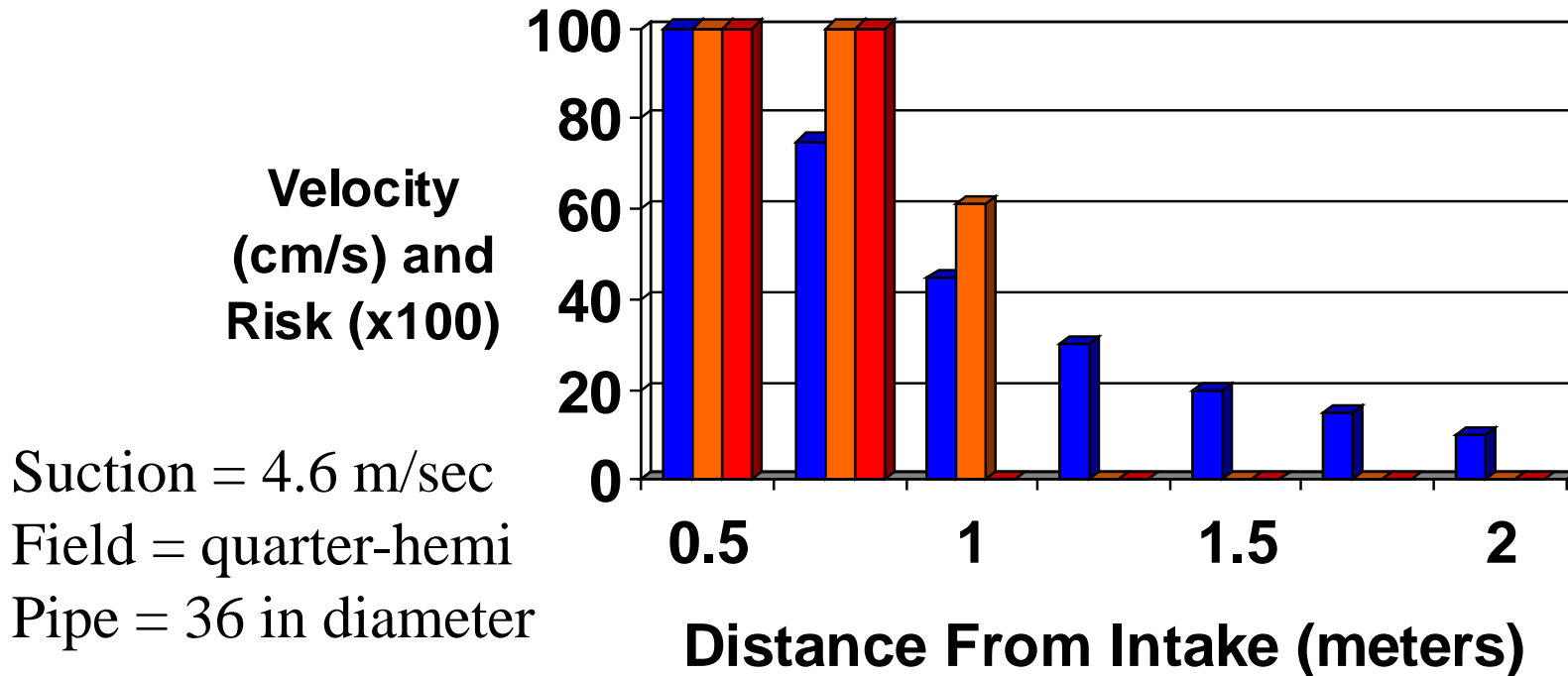
0.53

Risk of Entrainment
= 0.47

Likelihood of Escape
= 0.53

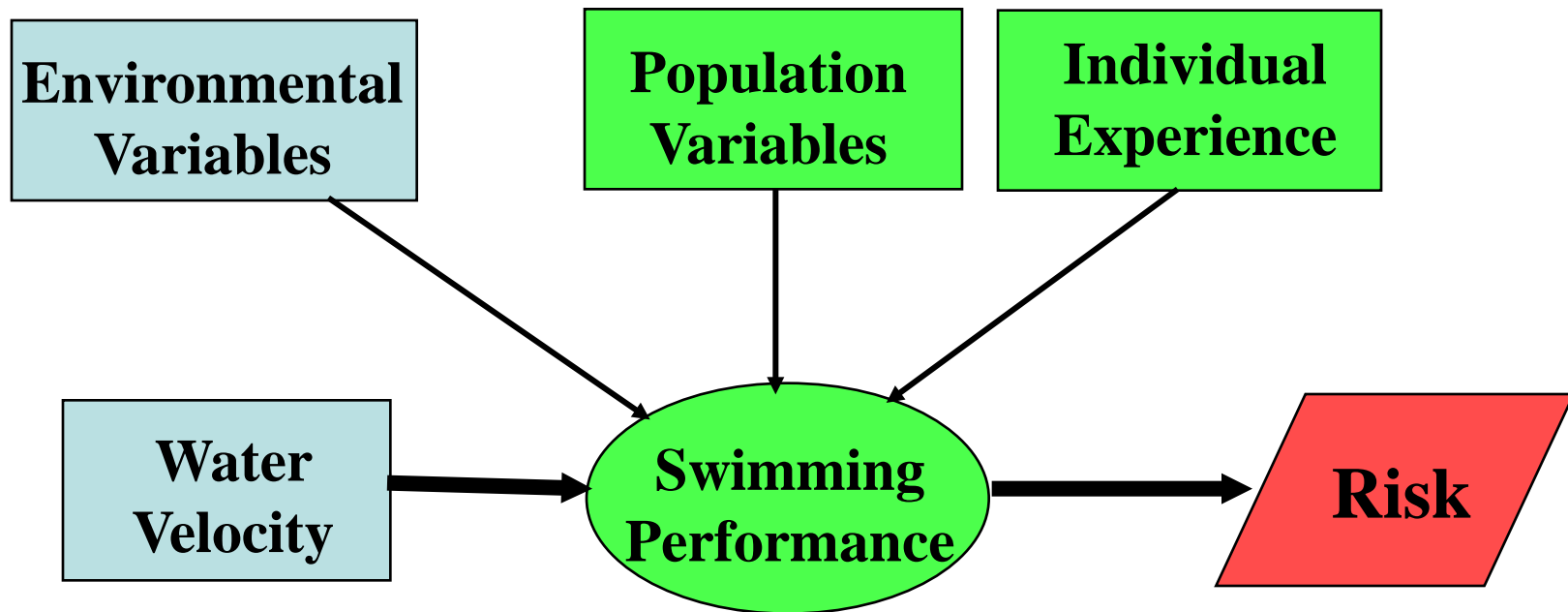


Risk of Sturgeon Entrainment



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

Risk of Sturgeon Entrainment



Conclusions

- Risk of sturgeon entrainment by dredges is difficult to quantify, but progress is being made
- Risk assessment requires detailed knowledge of both the dredging process and species-specific behaviors
- Risk management practices applied should be evaluated in terms of their effectiveness in minimizing risk

