Tidal Habitats Support Large Numbers of Invasive Blue Catfish

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Image: Jay Fleming

Acknowledgments

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  - Neal Leatherwood
  - 73$^+$ scientists and students from VIMS
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- Funding
  - NOAA Chesapeake Bay Office
  - Virginia Marine Resources Commission

- Equipment loan
  - Northwest Marine Technology

Task Force Recommendations

1. Provide information to anglers & the public
2. Review current fishing policies & regulations
3. Track distribution & status
4. Consider benefits of dams vs risks of removal
5. Remove from areas of significant ecological interest
6. **Increase harvest by small-scale operations**
7. **Develop large-scale commercial fishery**

Whole Foods Market
Fresh & Wild
Blue Catfish Fillet
$9.99
per pound
Product of U.S.A.

'Invasivorism'

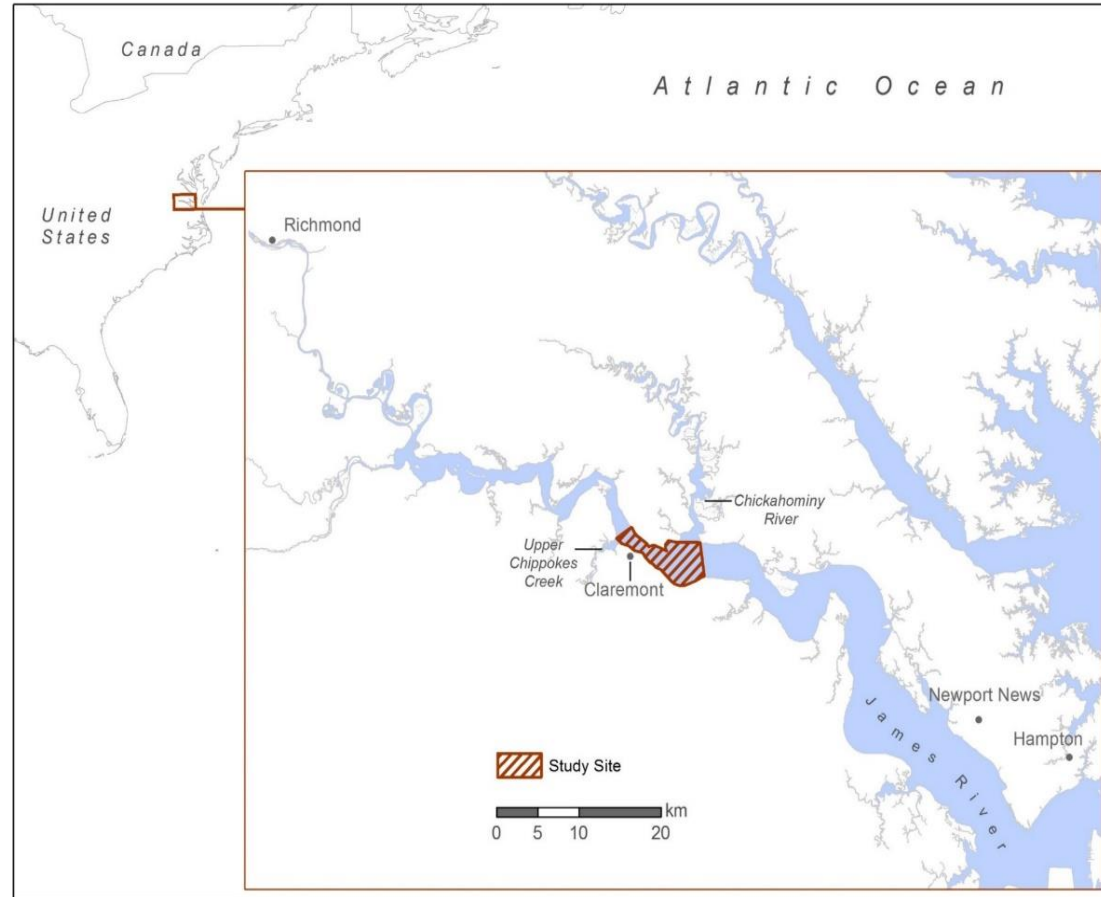**What is the magnitude of fishery removals necessary to reduce predatory impacts?**

Objective

- Estimate population size and survival rates of blue catfish in the James River subestuary
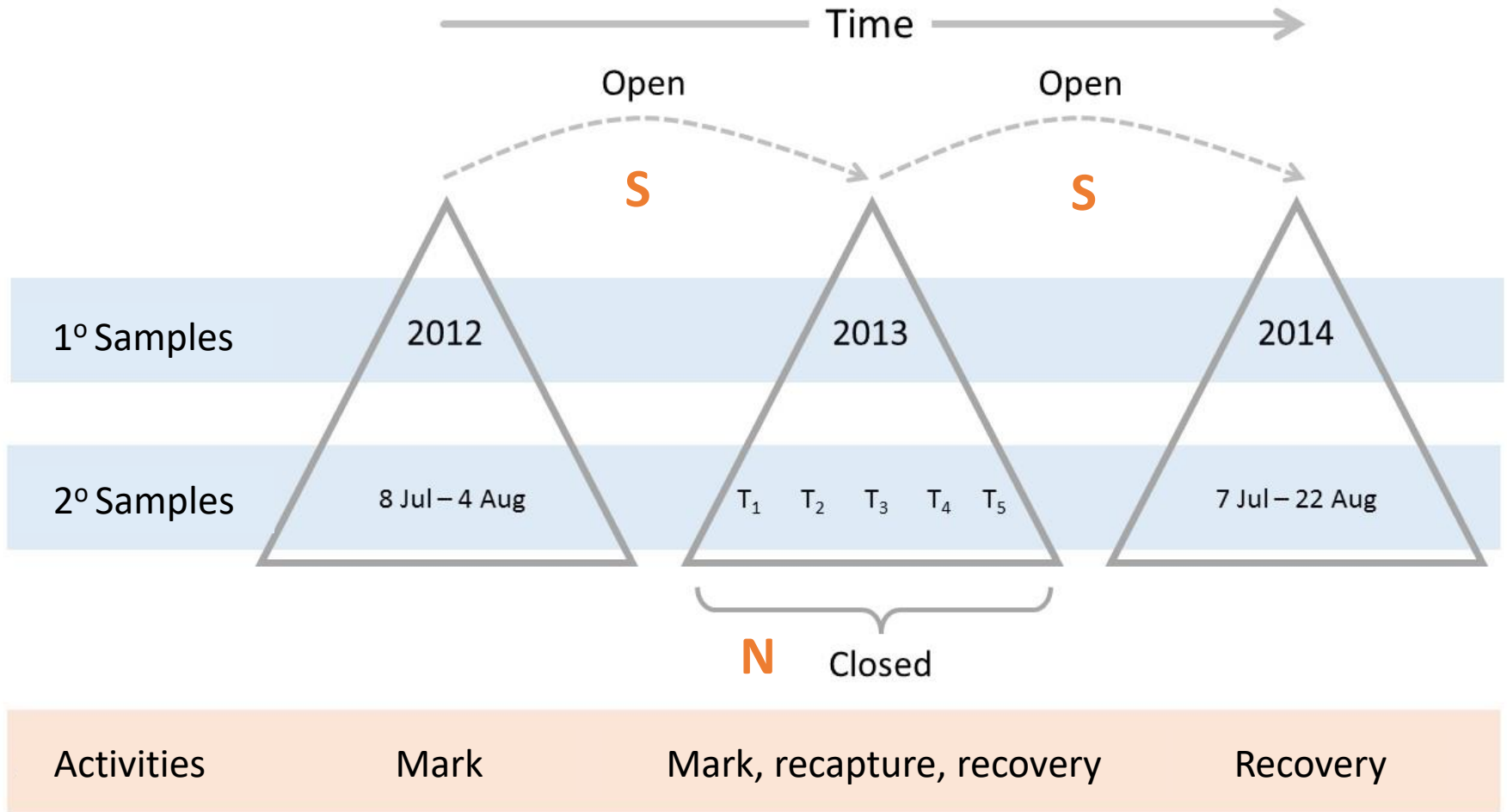
NOAA Chesapeake Bay Office

Methods: Mark-Recapture Study

- James River, 2012 – 2014

- 12-km study area in tidal habitats

- July – August

- Commercial hoop-net

- Coded-wire tags

- 250 – 400 mm FL

- Barker Robust Design
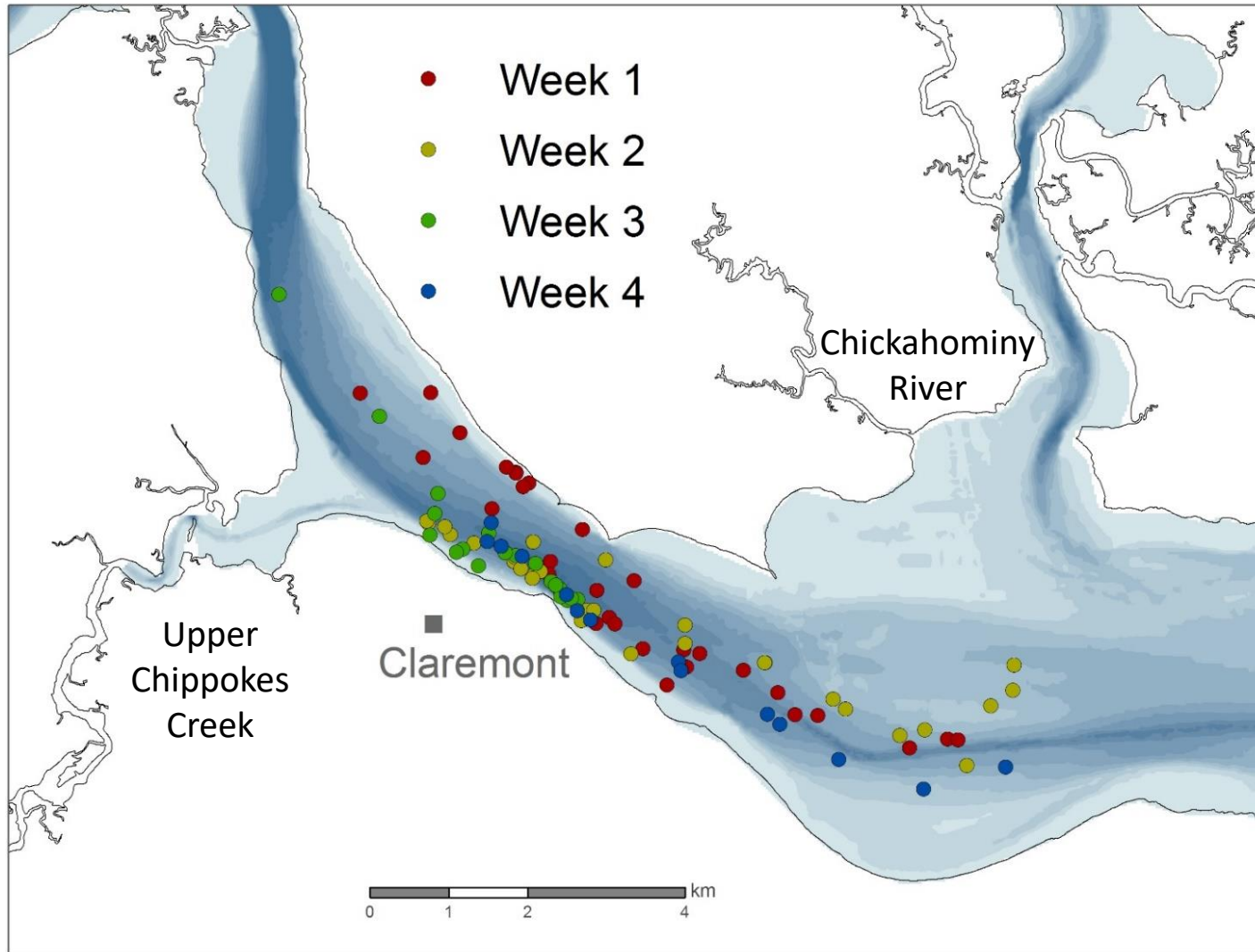 - Population size
  - Annual survival rates

Fabrizio et al. 2017. *Estuaries & Coasts*

Image: D. Gauthier

Barker Robust Design
(Implemented in Program MARK)

Time →

Open   Open

S   S

1° Samples   2012   2013   2014

2° Samples   8 Jul – 4 Aug T_1 T_2 T_3 T_4 T_5 7 Jul – 22 Aug

N   Closed

Activities	Mark	Mark, recapture, recovery	Recovery

Image after Kendall 2010

Key Assumptions: Mark-recapture

Assumption	Effect of violation
Tag loss is negligible	$\hat{S}$ biased low, $\hat{N}$ biased high; precision decreases
Fish have independent fates	Overdispersion
Fish have same survival and capture probabilities	(use median-$\hat{c}$ procedure to adjust for lack of independence or individual heterogeneity)
No emigration/immigration during closed period	$\hat{N}$ biased

Mixing of Tagged & Untagged Fish: Drift Releases

Image: D. Gauthier

Summary of Observations

	Tagged	Inspected	Recaptured	Recovered
2012	15,721	-		
2013	18,531	10,797	247	193
2014	0	41,925	-	86
Total	34,252	52,722	247	279

Auxiliary Surveys to Monitor Encounters

Agency	Gear	Begin Date	End Date	Sampling Events	Fish Scanned for CWTs
VCU	Electrofishing	Aug 2012	Oct 2012	7	284
VDGIF	Electrofishing	Jul 2012	Jul 2012	2	145
VIMS/VDGIF	Electrofishing	Sep 2012	Sep 2013	12	935
VCU/VIMS	Electrofishing & trawls	Oct 2012	Oct 2012	12	321
VA Tech	Electrofishing	May 2013	Jun 2013	14	658
VIMS	Trawl	Aug 2012	Dec 2014	316	2,720
VIMS	Gill net	Mar 2014	May 2014	78	1,086
TOTAL				**441**	**6,149**

A single encounter: fish tagged in 2012 and recovered in 2014, about 26 km down-estuary

Estimates of Apparent Survival Rates
(Losses due to mortality, permanent emigration, or both)

Parameter	Estimate	Logit-based CI*	
		LCI	UCI
$S_{2012–2013}$	0.16	0.10	0.24
$S_{2013–2014}$	0.44	0.31	0.58

S = 44.8 – 67.2%   Potomac River   (Tuckey et al. 2017)
S = 67.7 – 79.2%   James River   (Greenlee & Lim 2011)

*CI corrected for overdispersion

Estimate of Population Size

- $\hat{N} = 1{,}639{,}830$ fish   (250 – 400 mm FL)

  95% CI adjusted for overdispersion: 926,307 - 2,914,208

- What does this represent?

  - Study area = 3,017 ha → 544 fish/ha

Species	Density (fish/ha)	Location
Lionfish	101.7	Bahamian reefs
Common carp	35 –255	South Dakota lakes
Brook trout	46.6	Devon Lake, Canada
Lake trout	4.8	Priest Lake, Idaho
Snakehead	3	Potomac River (tidal tributaries)
Round goby	0.00022 - 0.0014	Lake Ontario, Lake Erie

Darling et al. 2011; Weber et al. 2016; Pacas & Taylor 2015; Ng et al. 2016; Love et al. 2015; Pennuto et al. 2012; Barton et al. 2005

Population Size in James River?

- 12-km section of the James River → **544 fish/ha**

- Assuming same density between Richmond and Burwell Bay → **19.8 M blue catfish**
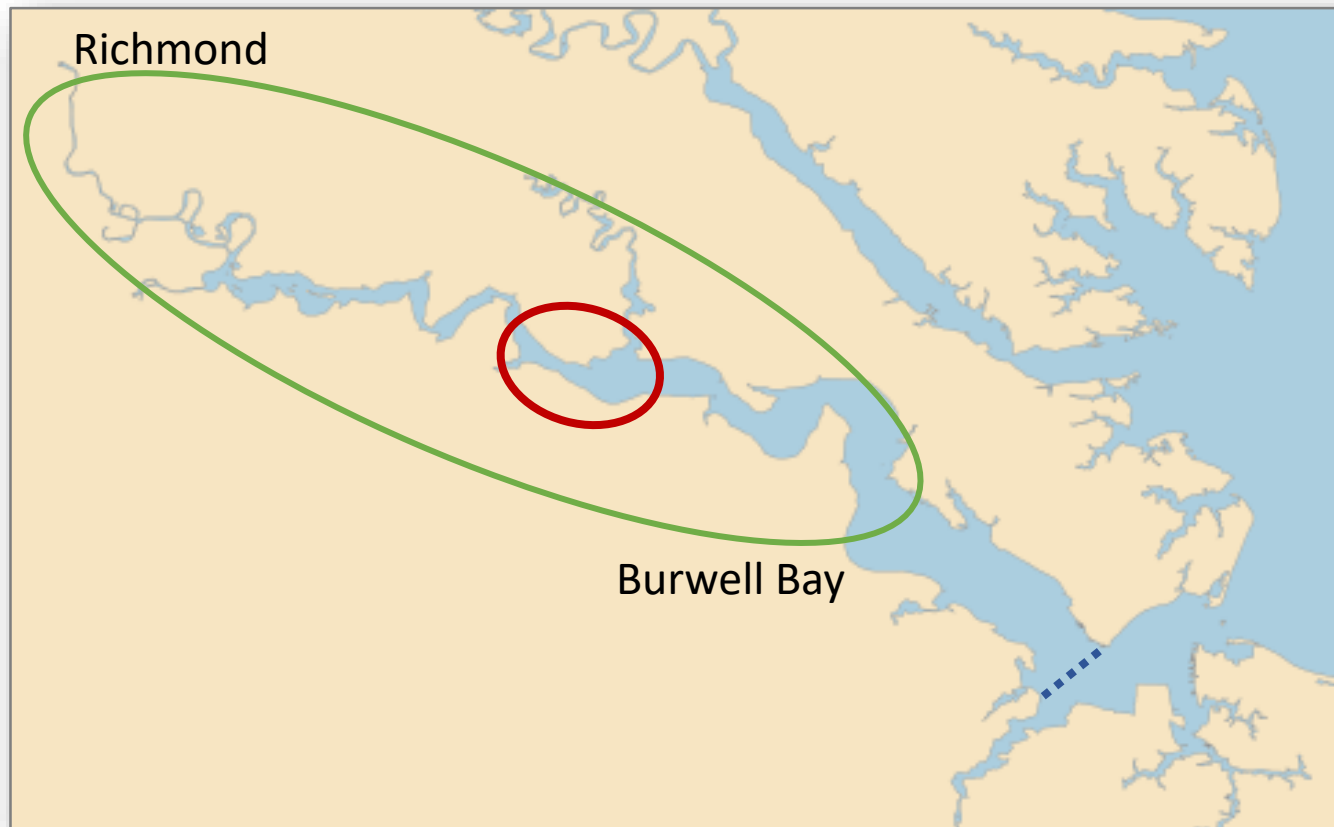
Size-Related Habitat Use

James River
Blue Catfish
(1975-2015)

Image: V. Nepal KC
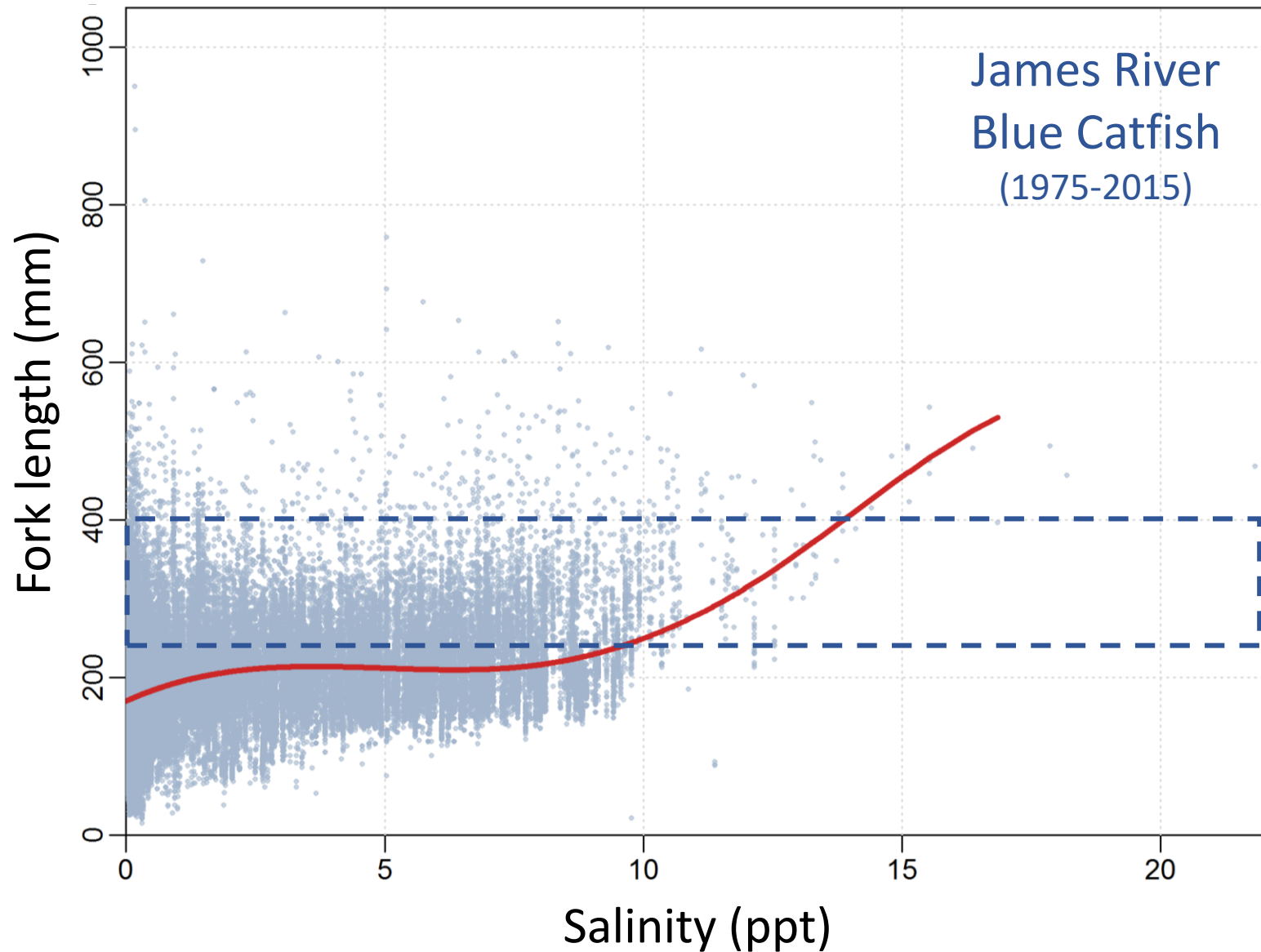
Implications for Management

- Population densities are high
  - Fishery removals may be increased

- Apparent survival rates are low
  - Reflects mortality & emigration from estuarine habitats

- Potential for further range expansion
  - Effects on estuarine species
  - Expansion into new habitats and new systems

- Data/information gaps:
  - Connectivity of habitats
  - Movement ecology

SuperStock/Alamy

Discussion Questions

1. **What is the value of this research to fishery managers?**
   - First published estimate of population size for blue catfish in non-native range

2. **How do you foresee the results being used?**
   - Inform decisions regarding expansion of the fishery (James River)

3. **What modifications should we make to current management strategies?**
   - Implement consistent regulations (e.g., discourage release of live fish)
   - Re-examine goals / resolve conflict between competing interests

4. **Where are there still data gaps?**
   - Movement ecology and habitat use by juveniles and adults relative to salinity regimes
   - Reproductive biology (age at maturity, fecundity, spawning period)

5. **What should be the next steps?**
   - Address data gaps (understanding estuarine habitat use, reproduction)
   - Determine effect of fishery removals on population
   - Obtain estimates of recreational harvest and effort
   - Obtain estimates of commercial effort
   - Consider similar study in another subestuary