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Evaluation of Fish Passage Following Installation of a Rock Arch Rapids at Lock and Dam #1, Cape Fear River, North Carolina

J. Raabe

University of Wisconsin - Madison

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Evaluation of Fish Passage Following Installation of a Rock Arch Rapids at Lock and Dam #1, Cape Fear River, North Carolina

Joshua K. Raabe, Timothy A. Ellis & Joseph E. Hightower



NC STATE UNIVERSITY



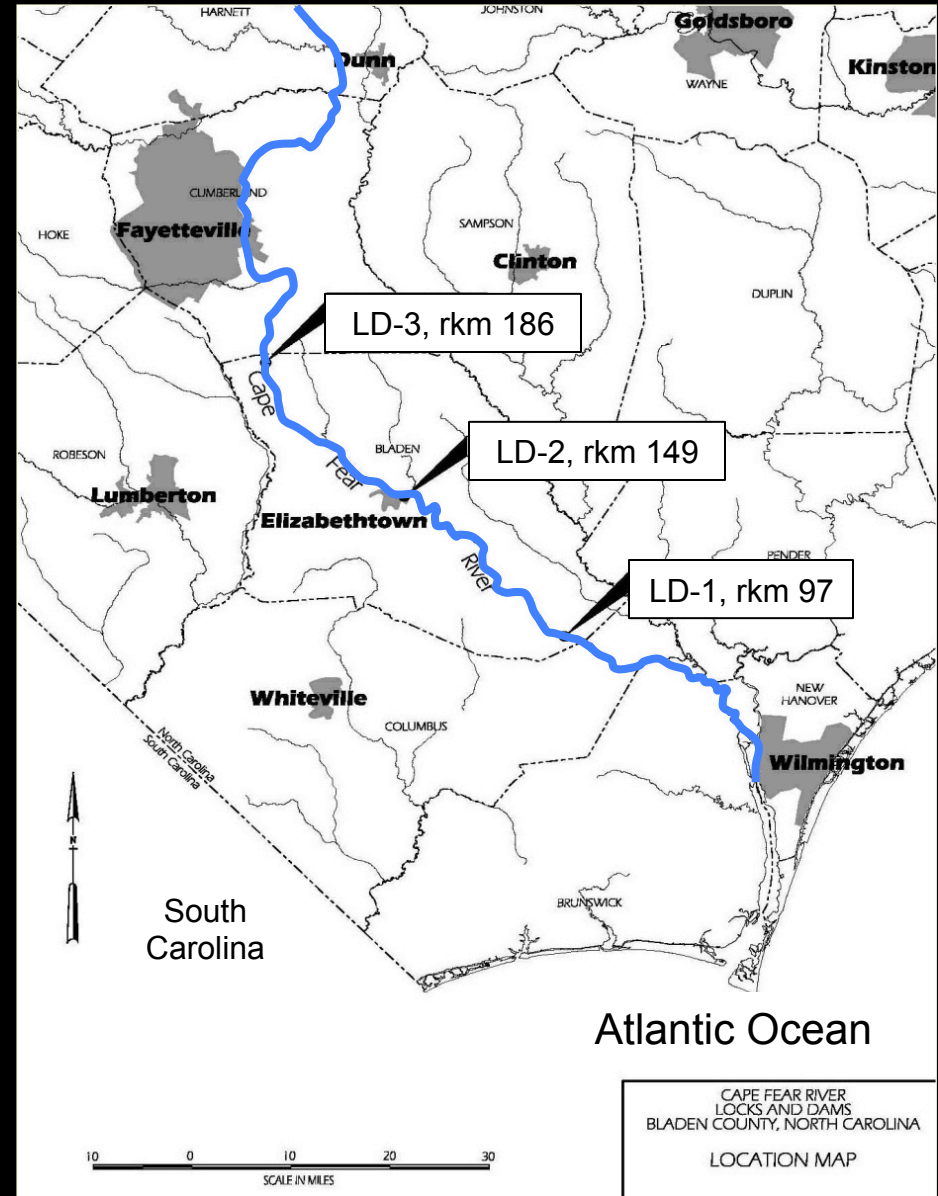
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- NC Division of Marine Fisheries:
 - Chip Collier
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 - Kyle Hussey, Taylor Jackson, Paul Begue
 - NC Division of Marine Fisheries
 - NC Wildlife Resources Commission



CAPE FEAR RIVER

- Coastal river
- Wilmington, NC
- Lock & dams (LD):
 - Limited navigation
 - Water supply
 - Impede fish



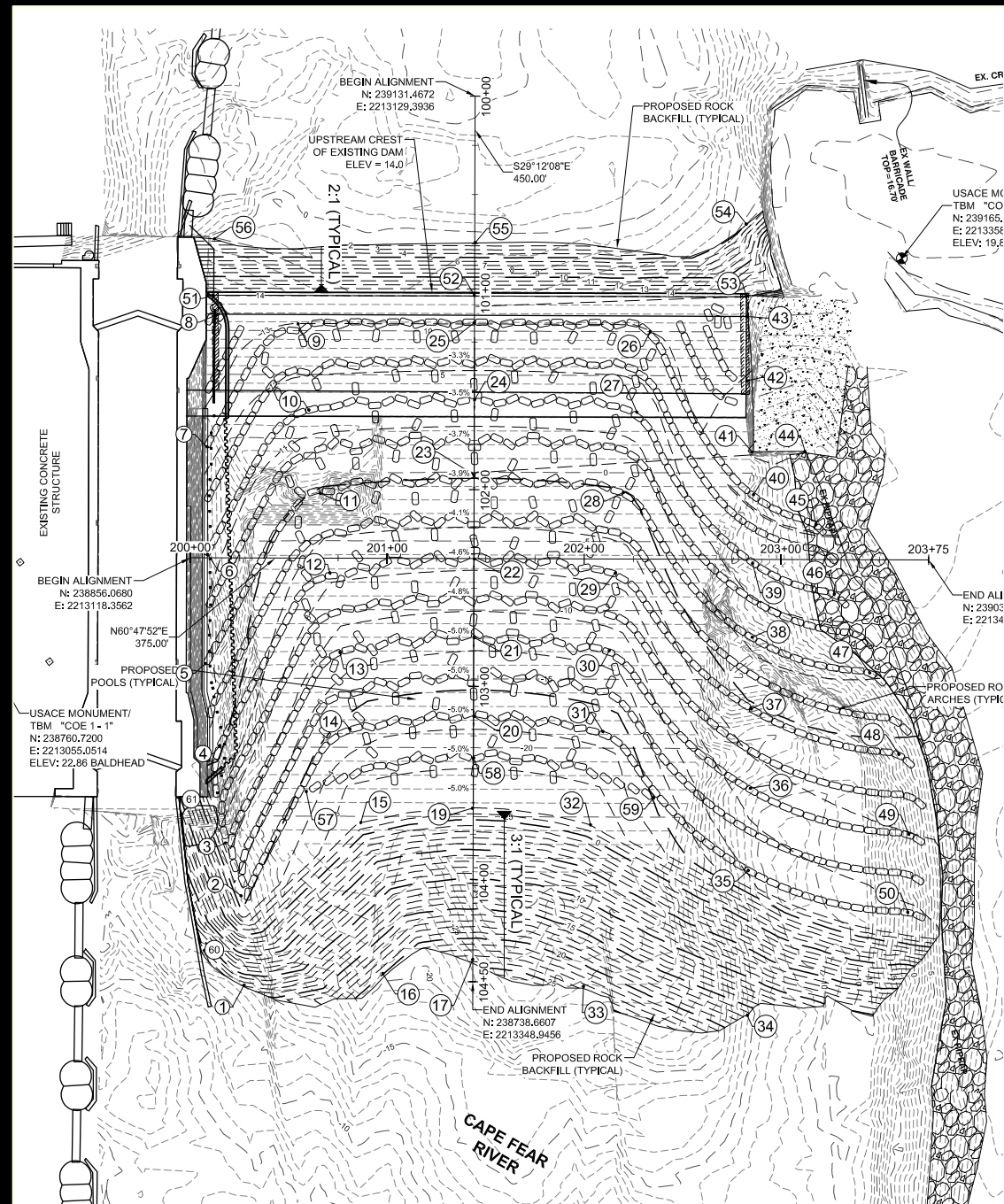
FISH PASSAGE

- Past efforts:
 - Steeppass fishway: limited to no use
 - Locking: modified procedures in spring
- Recent efforts:
 - Mitigation for deepening Wilmington Harbor
 - Endangered shortnose sturgeon
 - Considerations: removal, bypass, fishways

ROCK ARCH RAPIDS



- Series of arches
- Pools in center
- Δ elevation: 4.3 m
- Width: 85 – 110 m
- Length: 75 – 90 m
- Slope: 3.3 – 5.0%
- June '11 - Nov. '12
- \$13 million



ROCK ARCH RAPIDS

- Designed by Dr. Luther Aadland
 - Plenary speaker, tomorrow, 9:15 am
- Successful applications in Midwest
- Cape Fear River:
 - Largest application to date
 - First application on Atlantic coast
 - First quantitative evaluation

OBJECTIVES

- Evaluate passage at LD-1 rock arch rapids
- Evaluate passage at LD-2 & 3 via lockage
 - Percentage passed
 - Environmental factors
 - Rate (rapid, delayed)

SPECIES

- American shad



- Striped bass



- Flathead catfish



ACOUSTIC TELEMETRY

- Primarily captured w/ electrofishing
- Striped bass & flathead catfish:
 - Internal transmitters, >500 days
- American shad:
 - Gastric insertion, >100 days
- Receivers:
 - Continuous monitoring
 - 2013 - present



RECEIVER LOCATIONS

- Lock & Dams:
 - Downstream
 - Chamber
 - Upstream
 - Additional at LD-1
- Additional receivers throughout system



PASSAGE METRICS

- Percent passage: $\text{passed} / \text{available}$
 - Tagged fish detected at LD (after surgery, fallback)
- Rates: time from arrival to passage



LD-1 PASSAGE

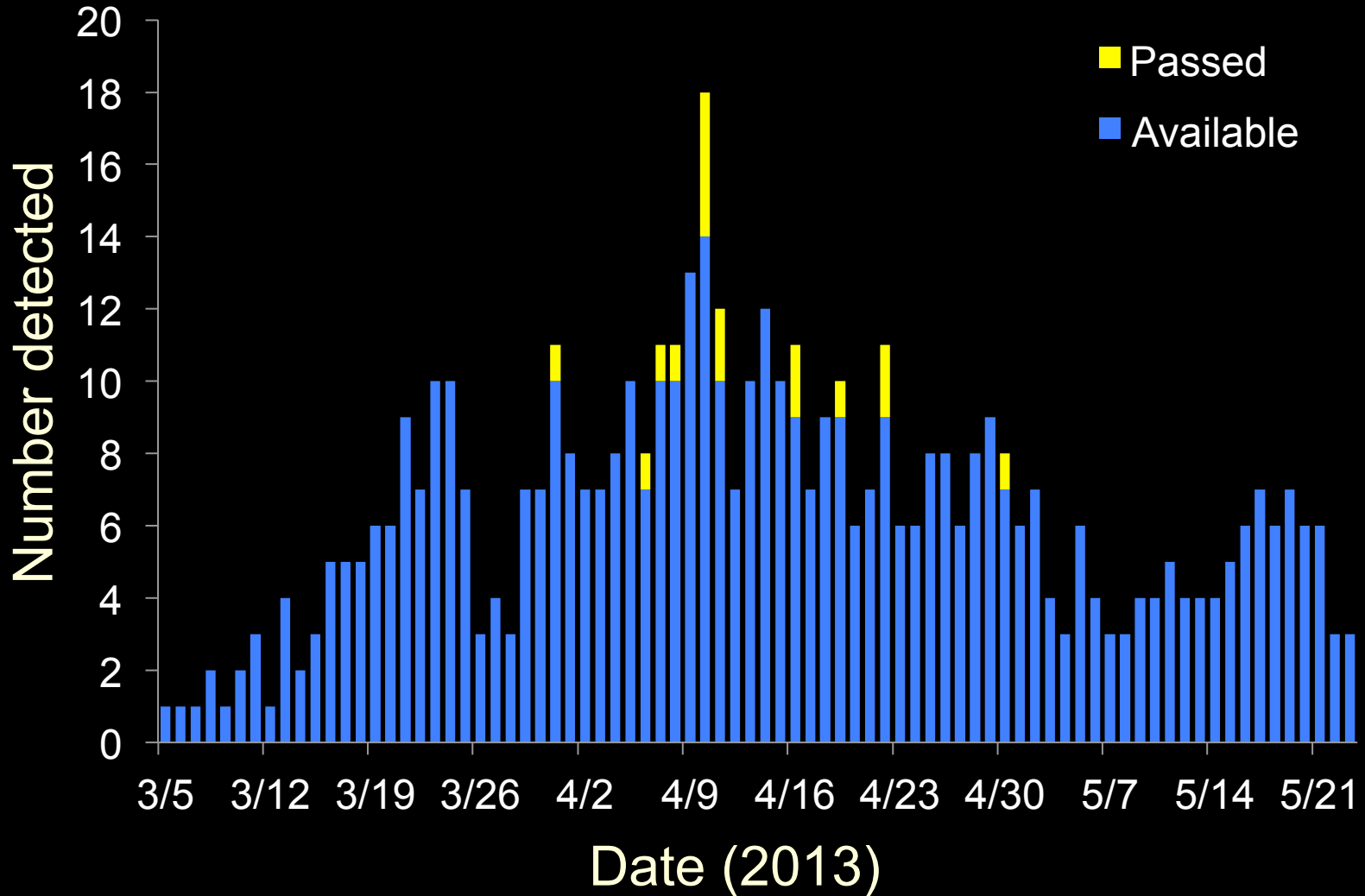
2013:

- American shad: $16 / 32 = 50\%$
- Striped bass: $9 / 43 = 21\%$
- Flathead catfish: $17 / 20 = 80\%$

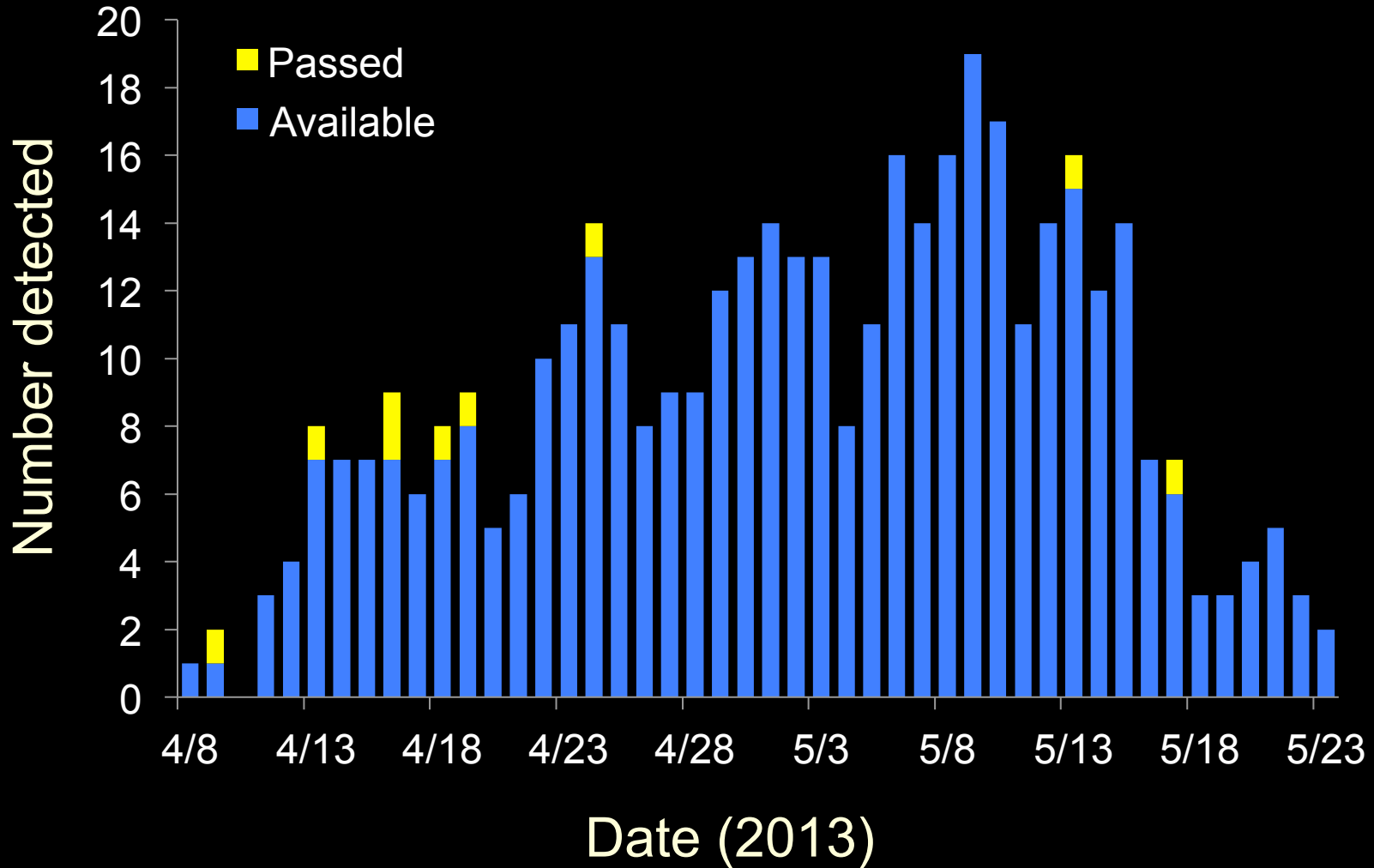
Preliminary 2014:

- $16 / 24 = 67\%$
- $18 / 79 = 23\%$
- $6 / 14 = 43\%$
 - As of May 28

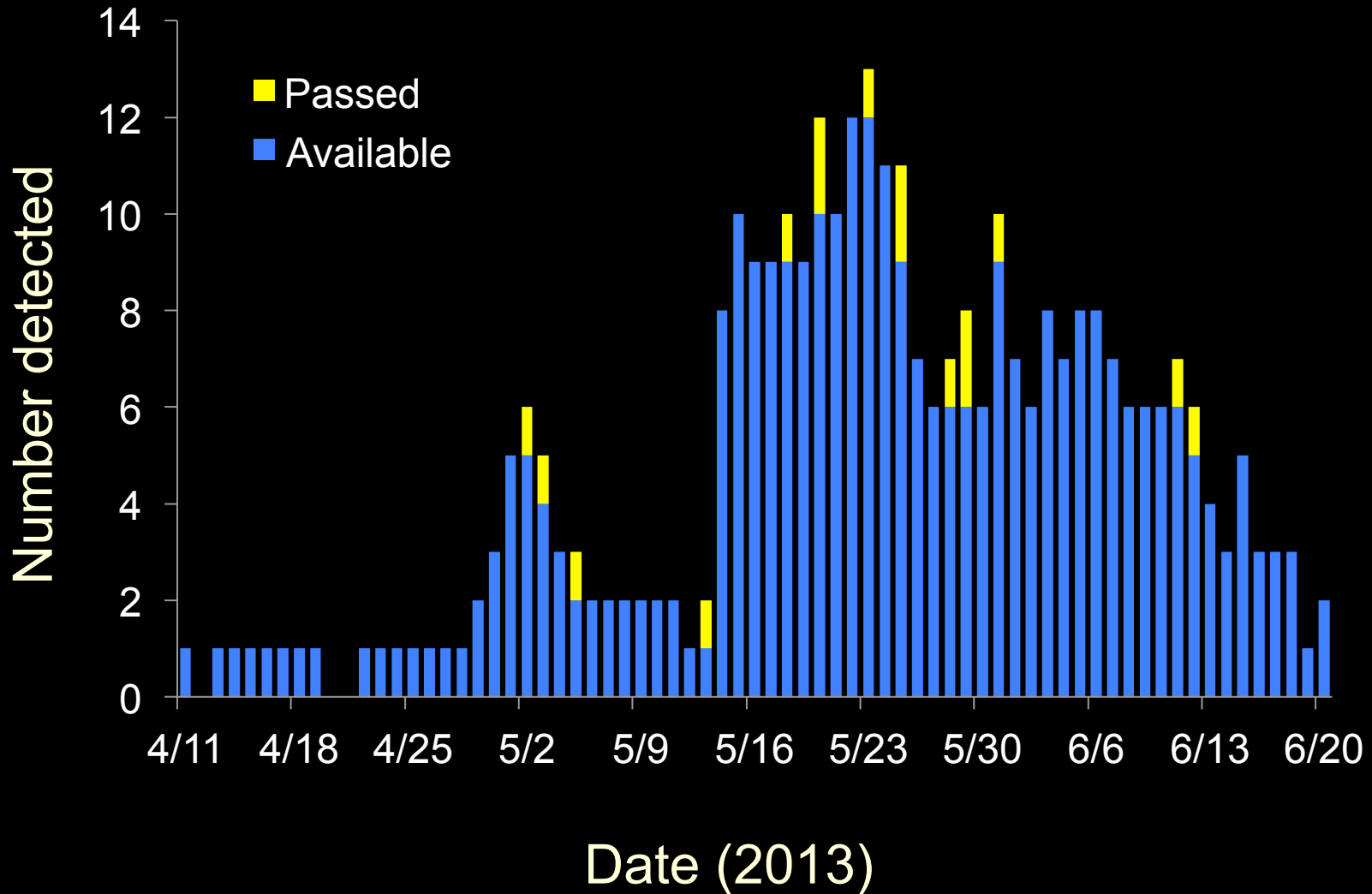
AMERICAN SHAD: LD-1 PASSAGE



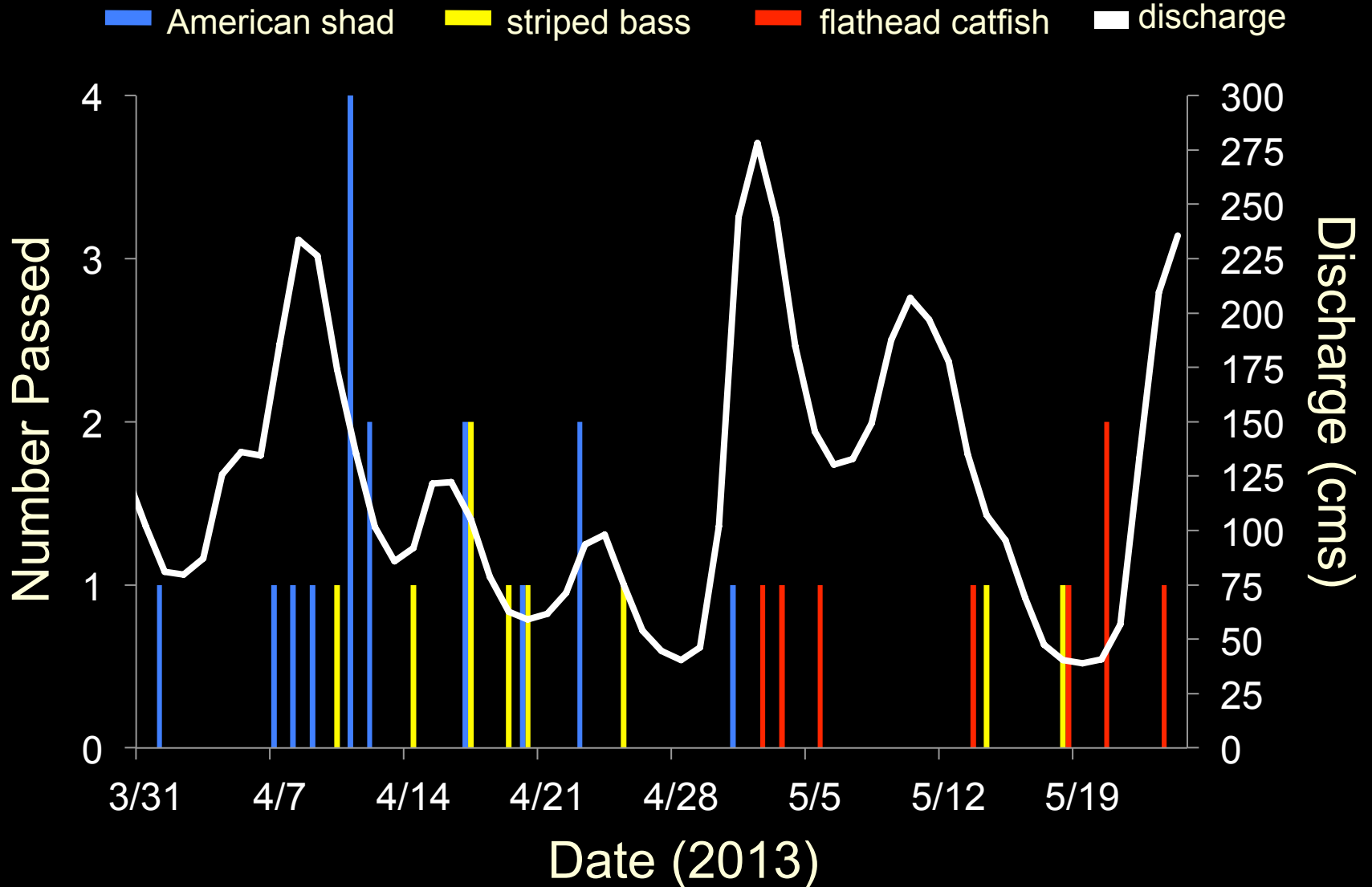
STRIPED BASS: LD-1 PASSAGE



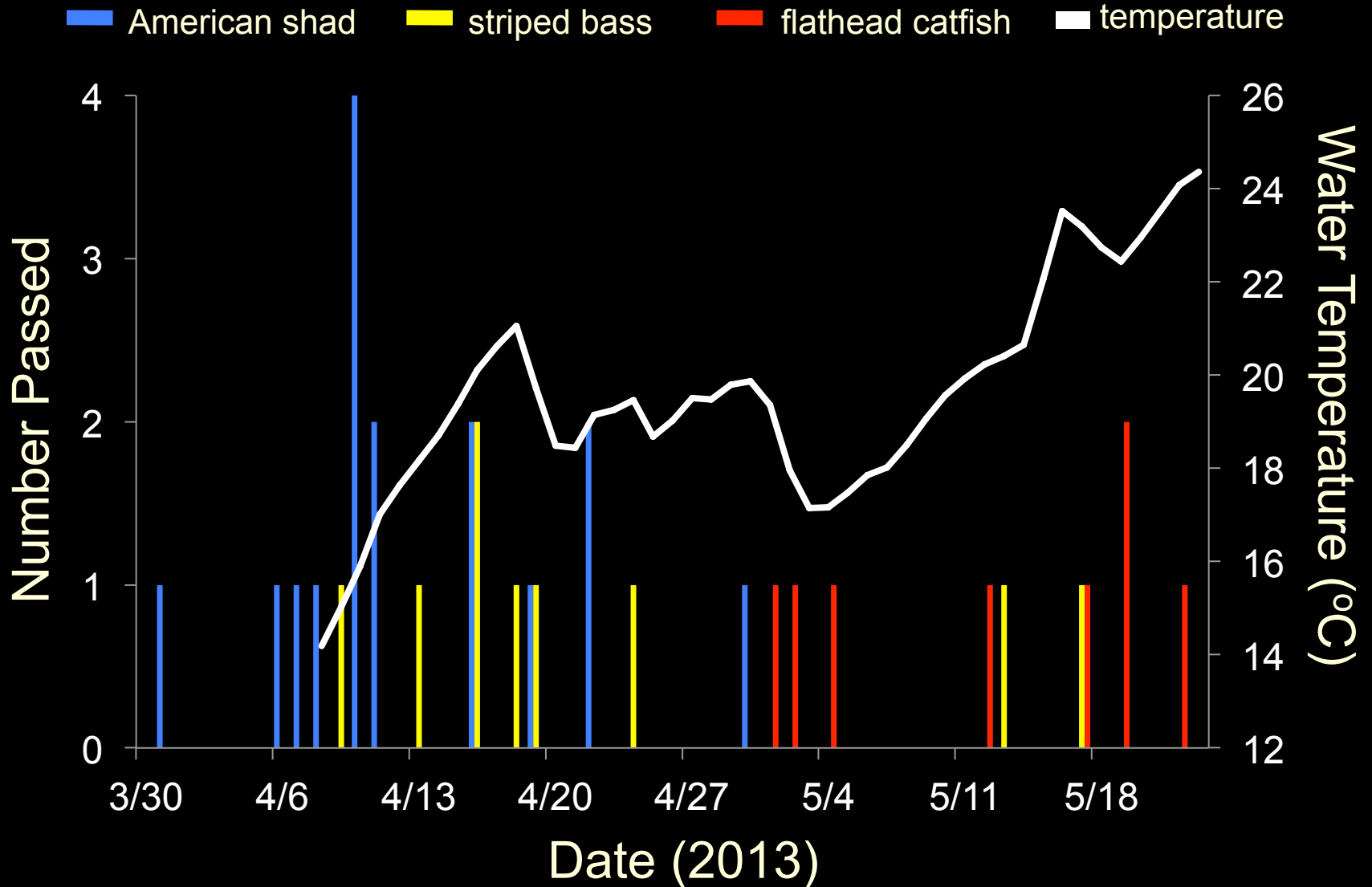
FLATHEAD CATFISH: LD-1 PASSAGE



LD-1 PASSAGE: GAGE



LD-1 PASSAGE: TEMPERATURE



AMERICAN SHAD: LD PASSAGE

LD-1	LD-2	LD-3	Study
50	36	100	Current – 2013
67	TBD	TBD	Current – 2014
18 - 61	33	-	Moser et al. 2000
25	-	-	CZR Inc. 2004
65	85	64	Smith & Hightower 2012

STRIPED BASS: LD PASSAGE

LD-1	LD-2	LD-3	Study
21	78	100	Current – 2013
23	TBD	TBD	Current – 2014
61	-	-	CZR Inc. 2004
77 - 86	75 - 100	44 - 50	Smith & Hightower 2012

COMMON PATTERNS

LD-3

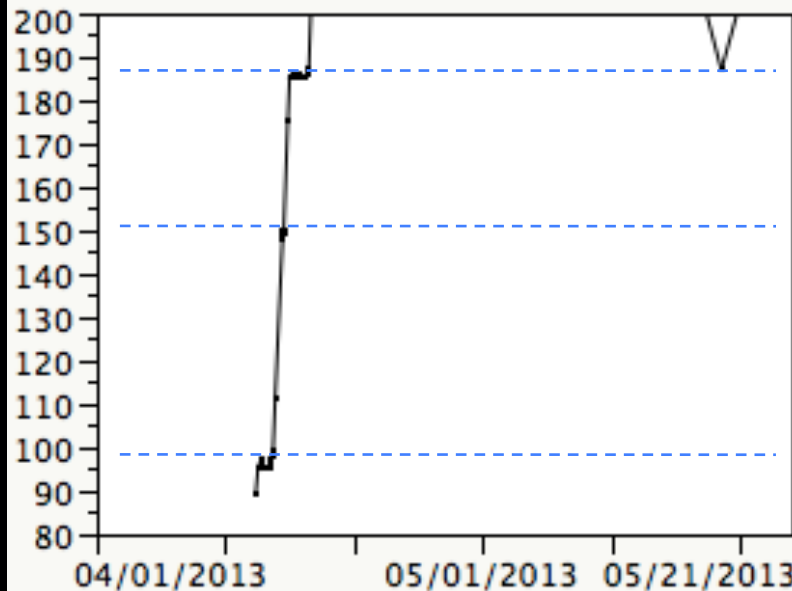
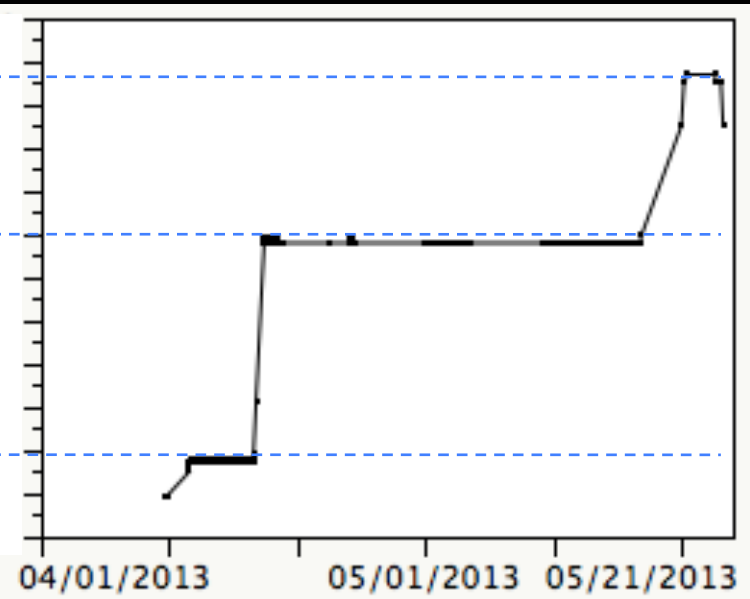
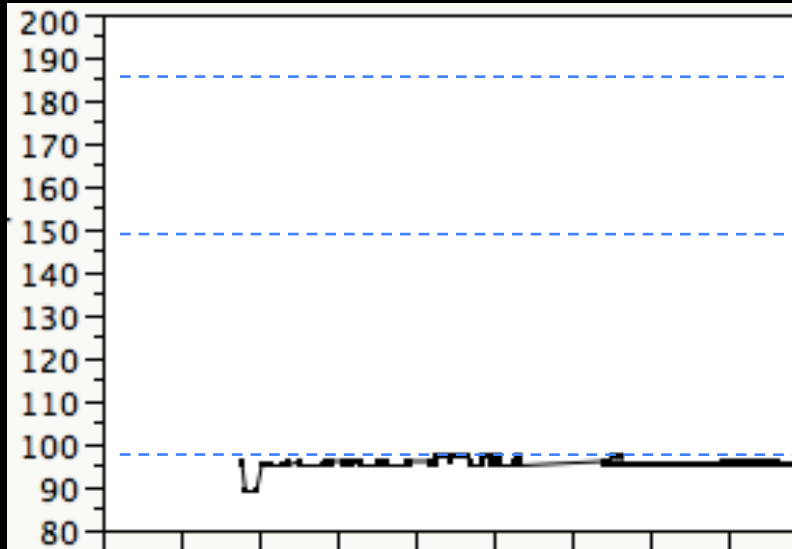
LD-2

LD-1

LD-3

LD-2

LD-1



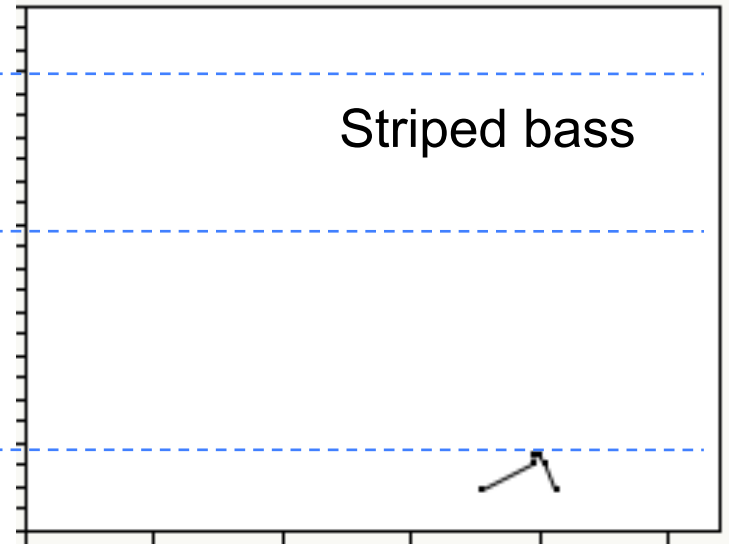
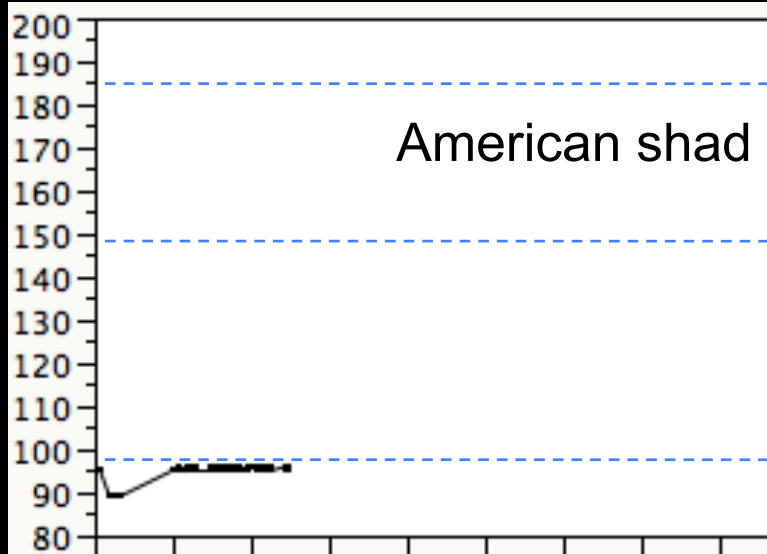
04/01/2013 05/01/2013 05/21/2013

UNIQUE PATTERNS

LD-3

LD-2

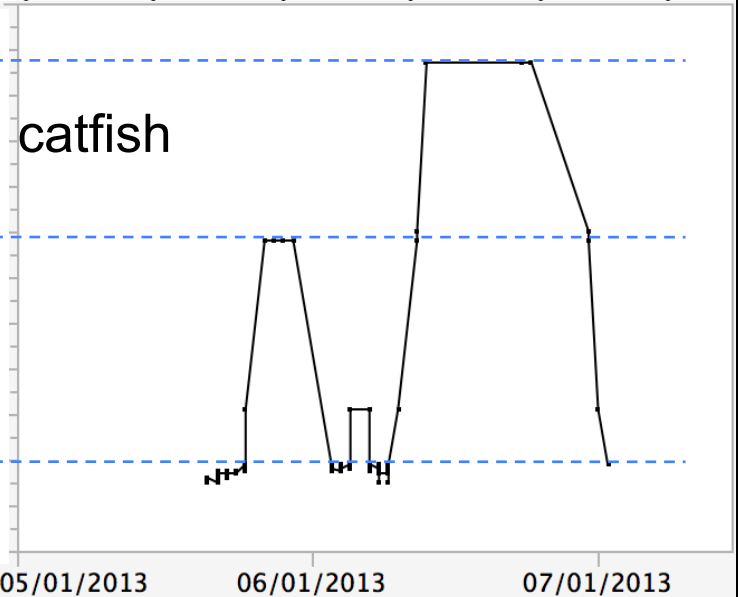
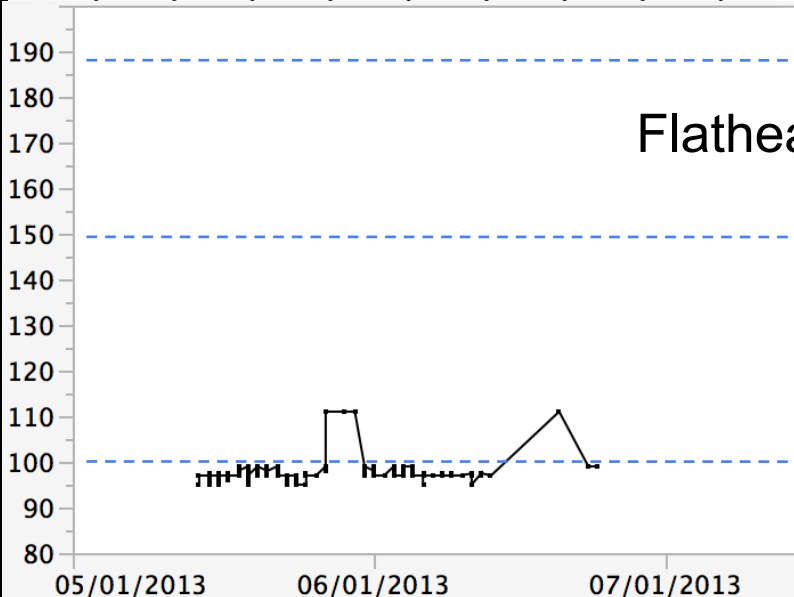
LD-1



LD-3

LD-2

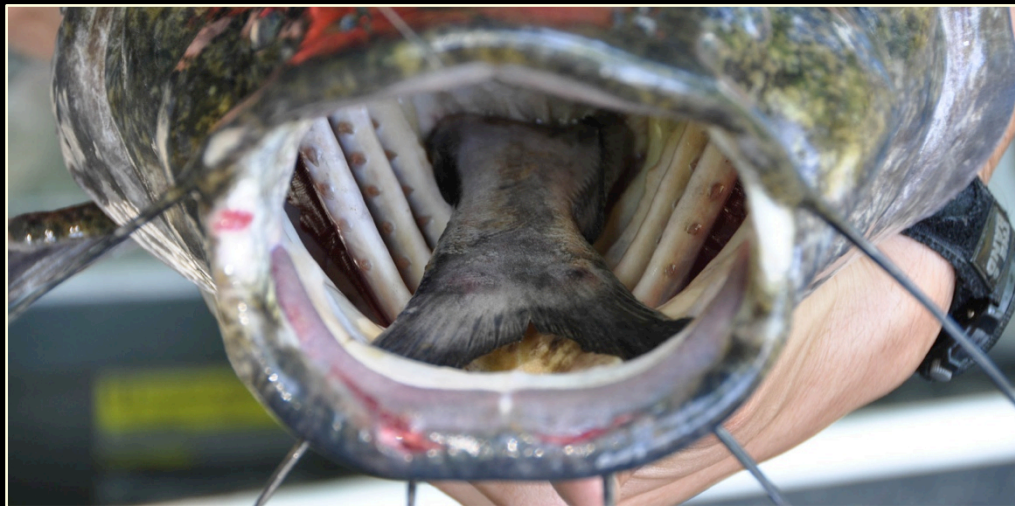
LD-1



2013 LD RATES (DAYS)

	LD-1	LD-2	LD-3
AS	18.4 (2.2 – 36.8)	3.0 (0.8 – 4.9)	4.9 (0.3 – 12.3)
STB	4.1 (0.2 – 15.9)	5.2 (0.1 – 29.5)	5.5 (0.2 – 29.7)
FLC	9.1 (3.4 – 29.4)	5.8 (0.1 – 18.1)	- -

FLATHEAD CATFISH PREDATION



DISCUSSION: ROCK ARCH RAPIDS

- American shad: passage comparable or higher than locking
 - Slightly lower than “nature-like” fishway on tributary (Raabe & Hightower)
 - Higher than pool & weir, lower than vertical slot (Sullivan 2004)
 - Rate of passage a concern (energy, predation, harvest)
- Striped bass: passage lower than locking
 - Limited evaluations at other fishways
 - Depth, velocity, turbulence, spacing?
- Flathead catfish: high passage, no previous comparisons
 - Multiple upstream & downstream movements
 - Predation concerns

FUTURE DIRECTIONS

- Complete 2014 data collection & analyses
- Army Corps of Engineers considering:
 - Modifications to structure, flow measurements & modeling, additional monitoring (tagged fish & egg sampling)

