Timing and Hydrological Conditions Associated with Bigheaded Carp Movement Past Navigation Dams on the Upper Mississippi River

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U.S. Department of the Interior
U.S. Geological Survey

Why is Dam Passage Important?

- UMR dams vary as barriers for fish passage
- Dams thought to provide some level of impediment to range expansion
- Disruption to reproductive cycle
- Structures provide suitable sites for deterrent technologies (e.g. sound)

http://www.hydroworld.com/articles/2013/08/u-s-seeks-gate-bulkheads-for-mississippi-river-dam.html

USGS

UMR Dams

- 29 from St. Anthony Falls, MN to St. Louis, MO
- Numbered N→S (mostly)

http://www.nap.edu/read/11444/chapter/3#9

Do Bigheaded Carp Move Through UMR Dams?

YES!

- Adults found in St. Croix River
- Established population upstream of L&D 19
- Tripp et al. 2014

http://www.nap.edu/read/11444/chapter/3#9

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How Fish Move Through UMR Dams

1. Through the lock chambers
   - Only way upstream at LD1 & 19
   - Timed with vessel lockage
2. Past lowered gates during “Controlled” conditions
3. Past raised gates during “Open River”

https://en.wikipedia.org/wiki/Lock_and_Dam_No._2#/media/File:Mississippi_River_Lock_and_Dam_number_2.jpg

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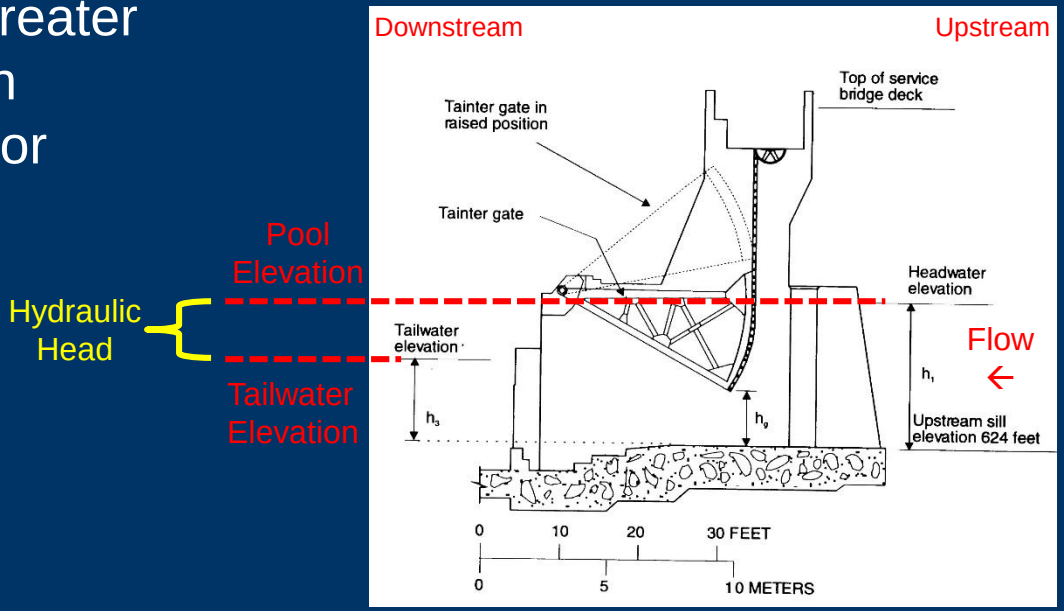
Dam Operation

- Tainter & Roller gates
- Bottom release
- Hydraulic Head
  - Difference between Pool elevation and Tailwater elevation
  - Greater values mean greater water velocities through gates → more difficult for fish to pass

https://en.wikipedia.org/wiki/Roller_dam



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“Open River” Conditions

- Gates raised out of water, minimal head
- Lower water velocities through gates → easier fish passage

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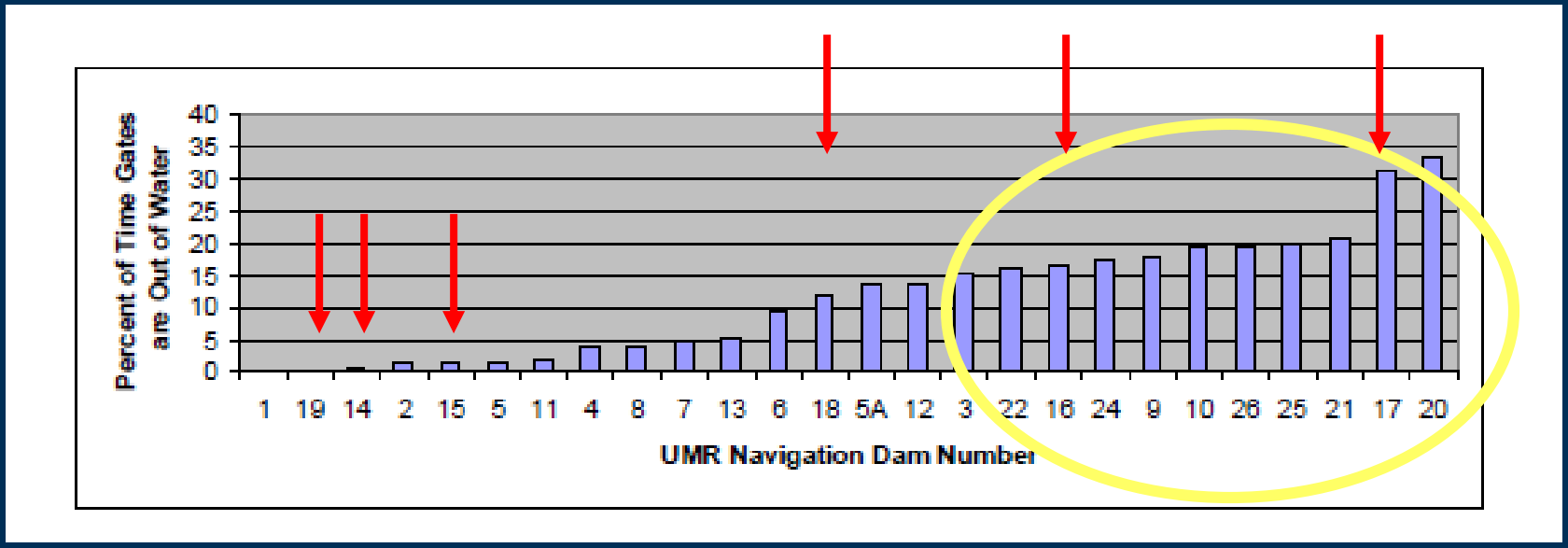
Study Area

http://www.nap.edu/read/11444/chapter/3#9

Dam Characteristics

Not all UMR dams are the same!



Wilcox et al. 2004

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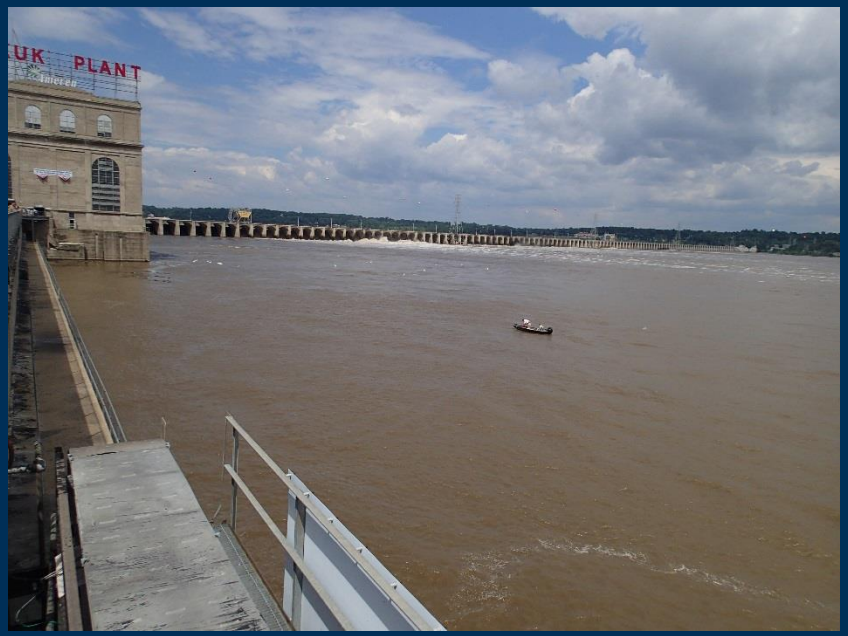
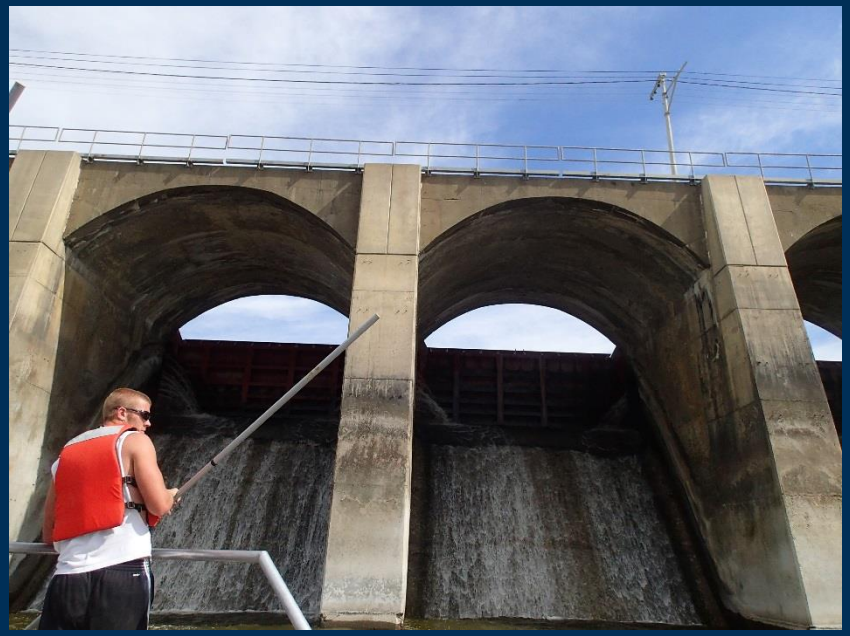
Lock & Dam 19



Courtesy of Jim Lamer

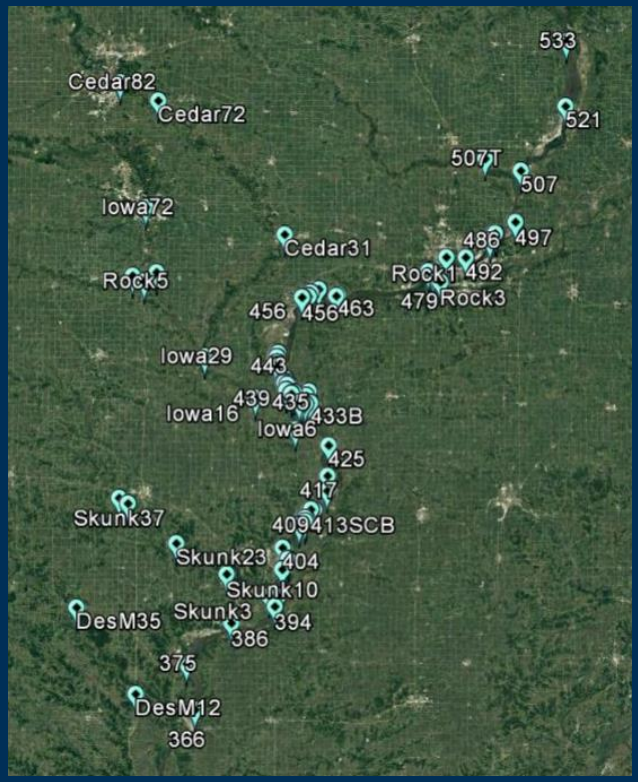


Courtesy of Jim Lamer

Telemetry Background

- Largely Vemco VR2W's
- Effort increasing over time
  - # of fish tagged
  - # of receivers (>90)
  - Manual tracking
- This study not designed to differentiate between method of passage

http://vemco.com/products/vr2w-69khz/



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Fish Tagged

Pool

	16	17	18	19	20	Total
Bighead	34	18	33	38	5	128
Hybrid	2	6	6	7		21
Silver	16	93	11	49		169
Total	52	117	50	94	5	318

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Far & Fast!

57100
Silver Carp
6/25-7/22 2014
275 km in 28 d
Into MO River

24849
Silver Carp
6/19-6/22 2015
366 km in 4 d
Into IL River

20629
Bighead Carp
5/8-5/25 2016
610 km in 18 d
Into IL River

USGS

Observed Passage Events

	Pool				
	16	17	18	19-25	Total
Upstream	24	142	24	0	190
Downstream	24	165	55	12	256
	48	307	79	12	446

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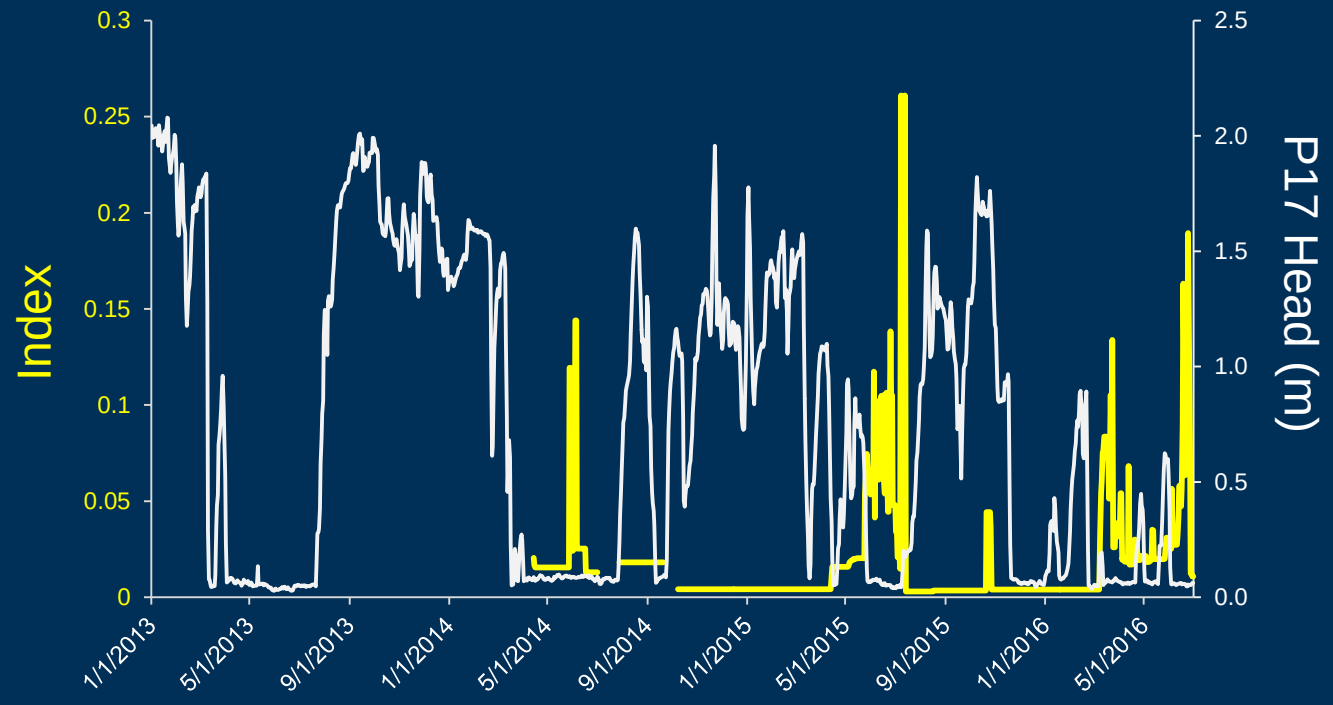
Timing of Upstream Passages

$P_d = 1 / \text{duration (d)}$

$\text{Index}_d = \Sigma P_d / \#\ \text{Events}_d$



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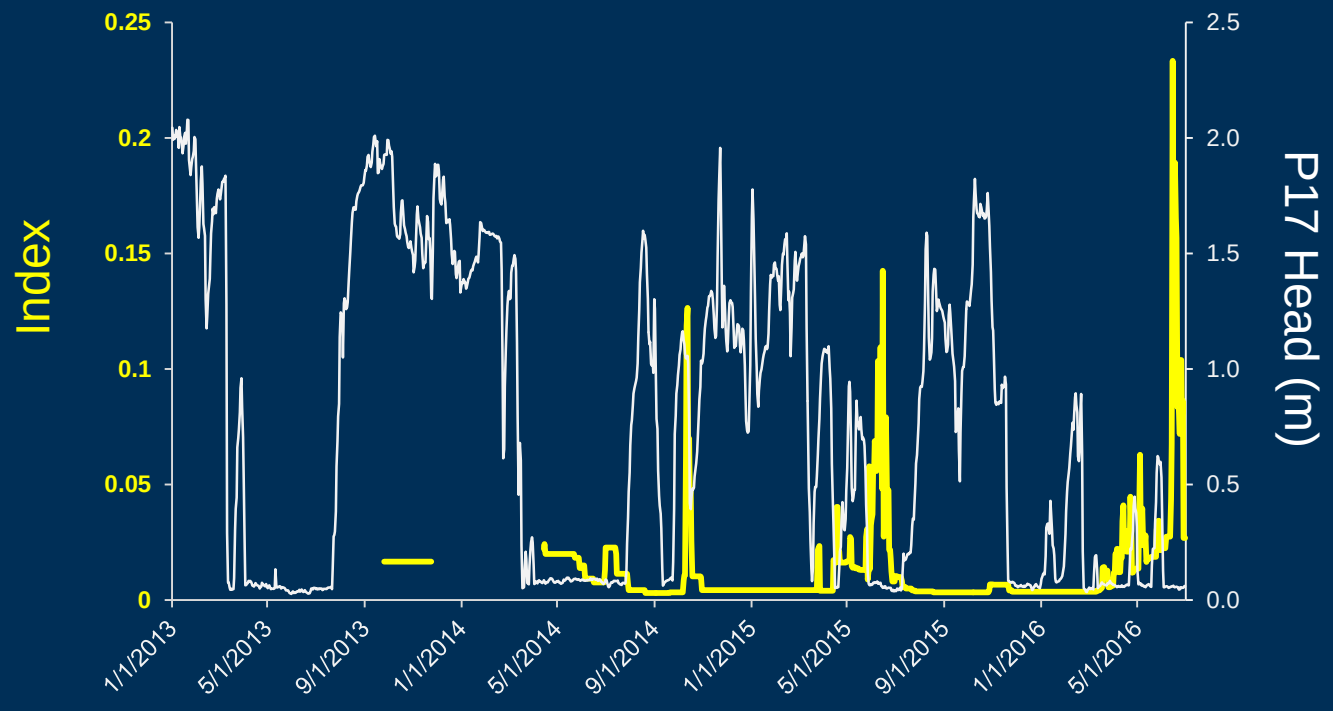
Timing of Downstream Passages



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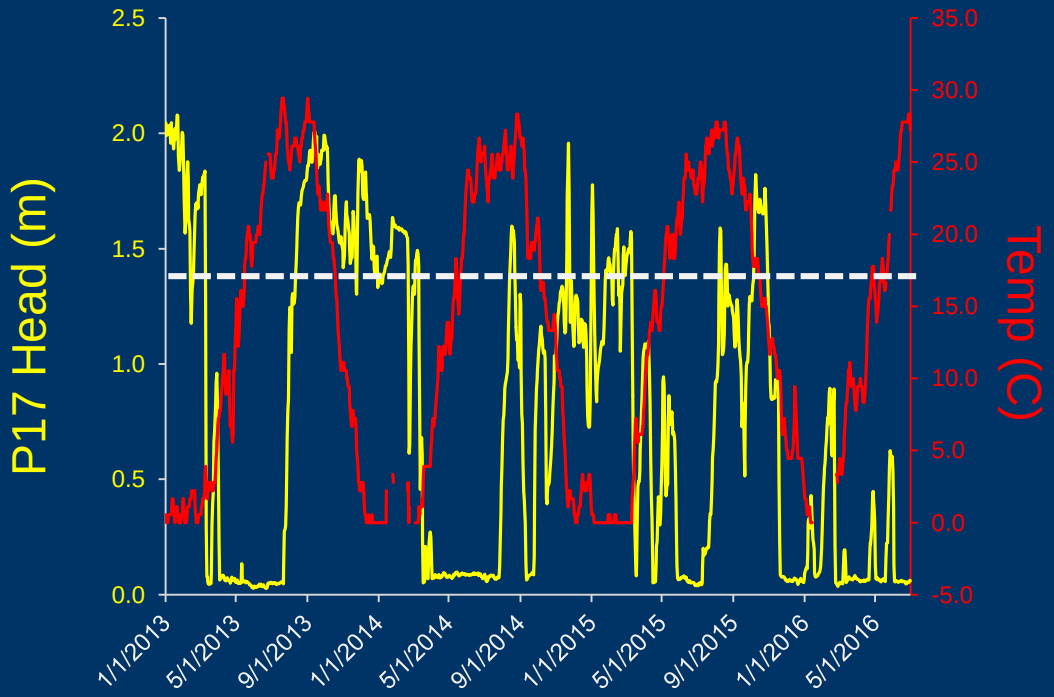
Modeling Hydraulic Conditions

- Cox Proportional Hazards Regression Model
- Model head & water temperature



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Conclusions

- Capable of moving large distances (past multiple UMR dams).
- Rapidity of movement suggests fish are NOT reliant on using locks.
- Dams that frequently experience “Open River” conditions (e.g., L&D 17) are easily traversed.
- Frequency of passage events related to timing of spawning.
- Few downstream passages of L&D 19, no observed upstream passage of L&D 15 → suggests potential for implementation of deterrent devices.

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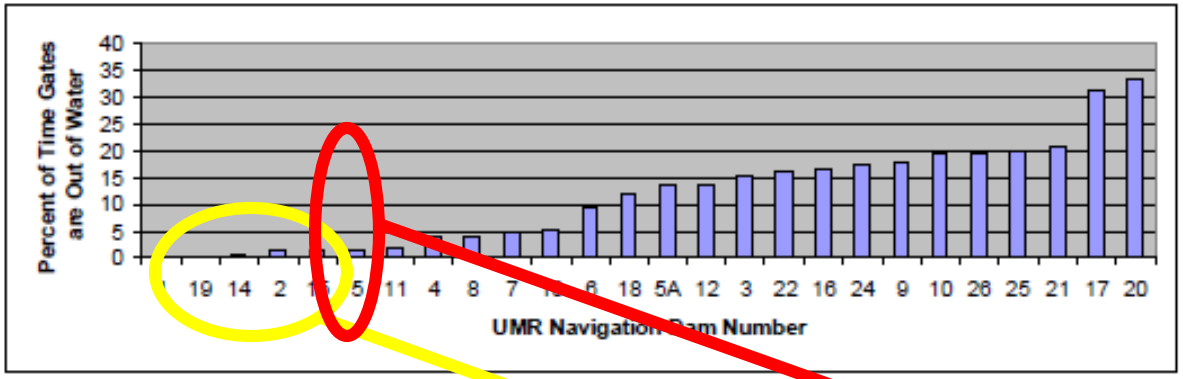
Implementing Controls Now!



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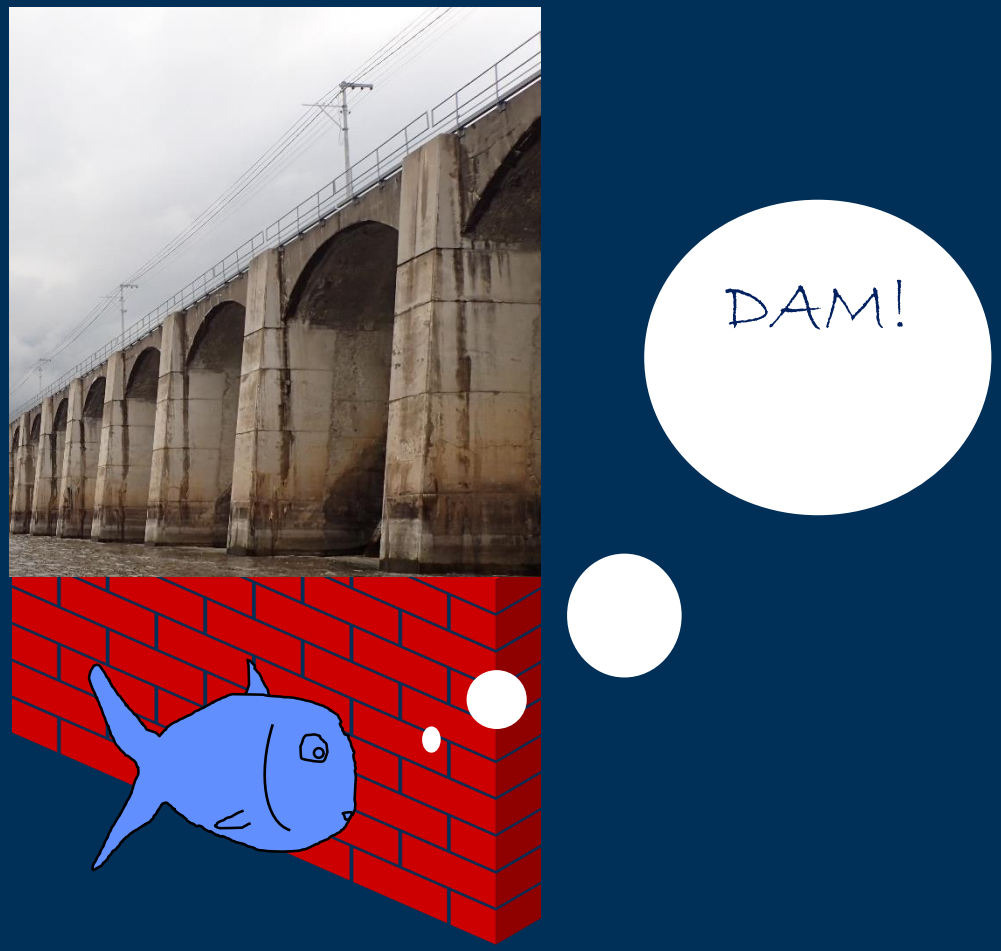
Questions?

What does a fish say when it hits a wall?



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