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Session B3 - Road crossings as barriers to pearly mussel distribution in the southwestern Lake Ontario basin

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ROAD CROSSINGS AS BARRIERS TO PEARLY MUSSEL DISTRIBUTION IN THE SOUTHWESTERN LAKE ONTARIO BASIN

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U.S. Fish and Wildlife Service**



Pearly Mussels of Western New York

- NYS DEC: 2009-2011
 - 22 Species Found
 - 13 were Species of Greatest Conservation Need (*)

| | | |
|------------------------|-------------------------|---------------------|
| Black sandshell* | Floater / Giant floater | Pocketbook* |
| Creek heelsplitter | Flutedshell | Rainbow* |
| Cylindrical papershell | Fragile papershell | Spike |
| Deer toe* | Green floater* | Squawfoot / Creeper |
| Eastern elliptio | Kidneyshell* | Three-ridge* |
| Eastern pondmussel* | Lilliput* | Wabash pigtoe* |
| Elktoe* | Paper pondshell* | |
| Fat mucket | Pink heelsplitter* | |

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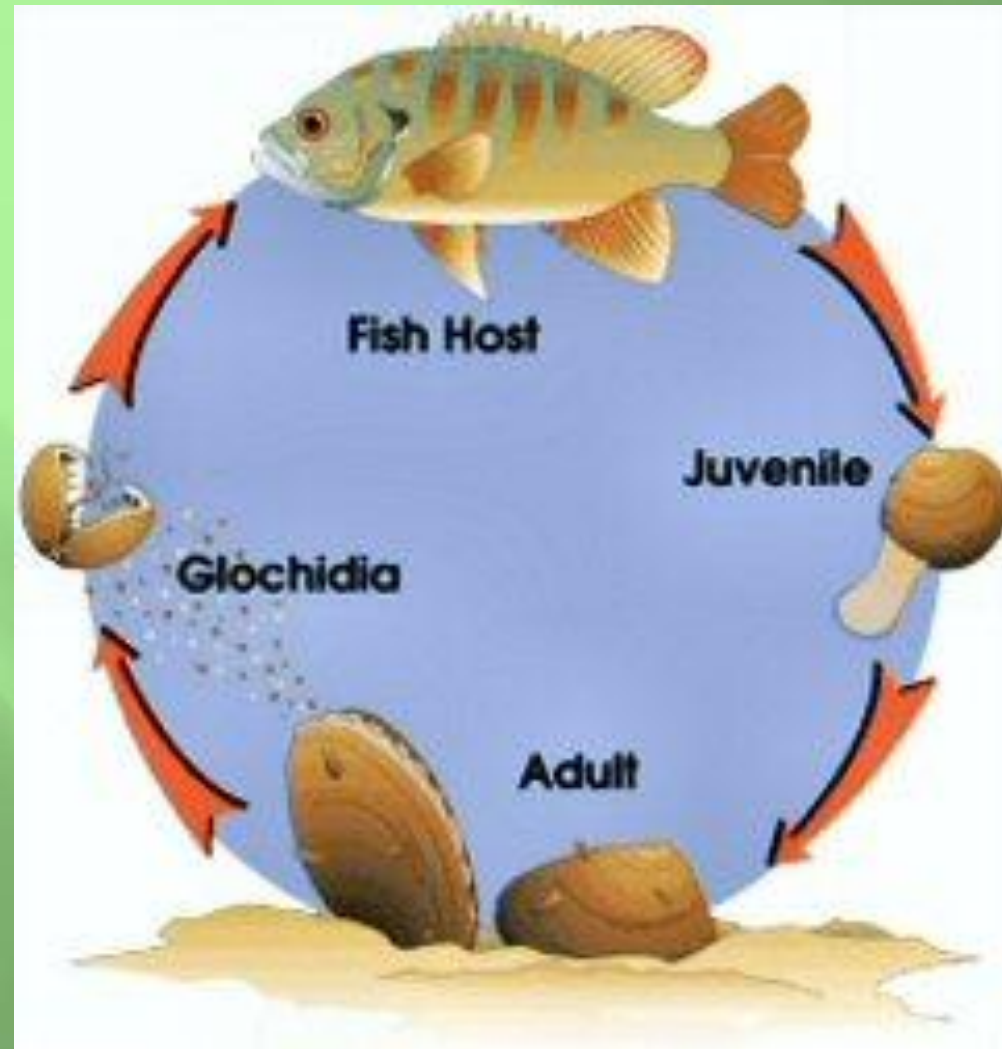
That's almost
60%!

Pearly Mussel Decline

- Pollution
- Invasive Species
- Stream channelization
- **Habitat fragmentation**
 - Impoundments
 - **Road Crossings**



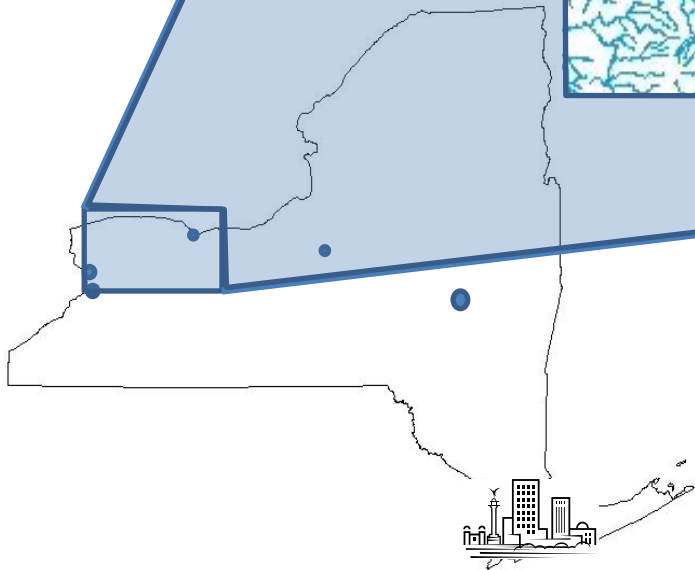
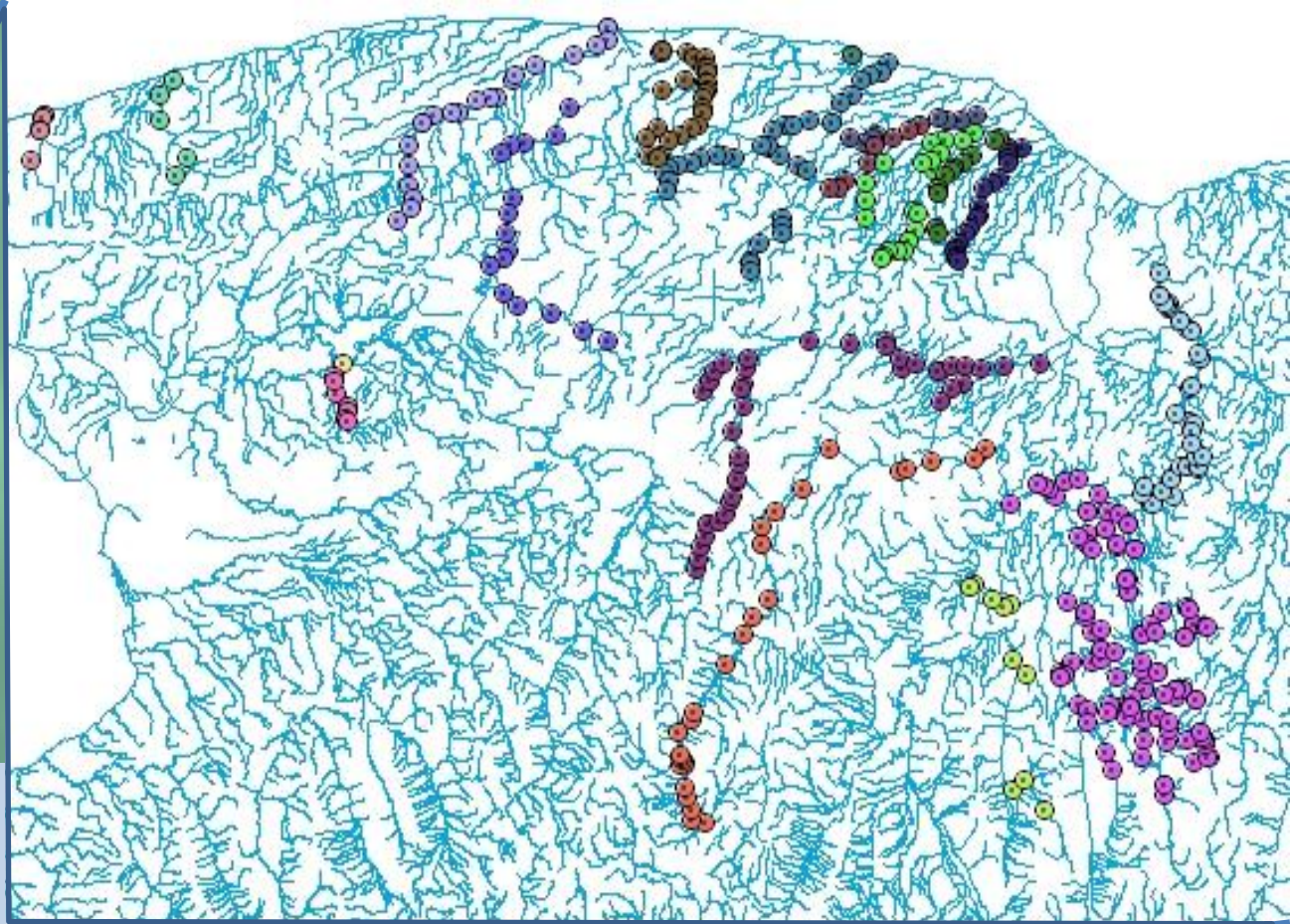
Fish and Mussel Interaction



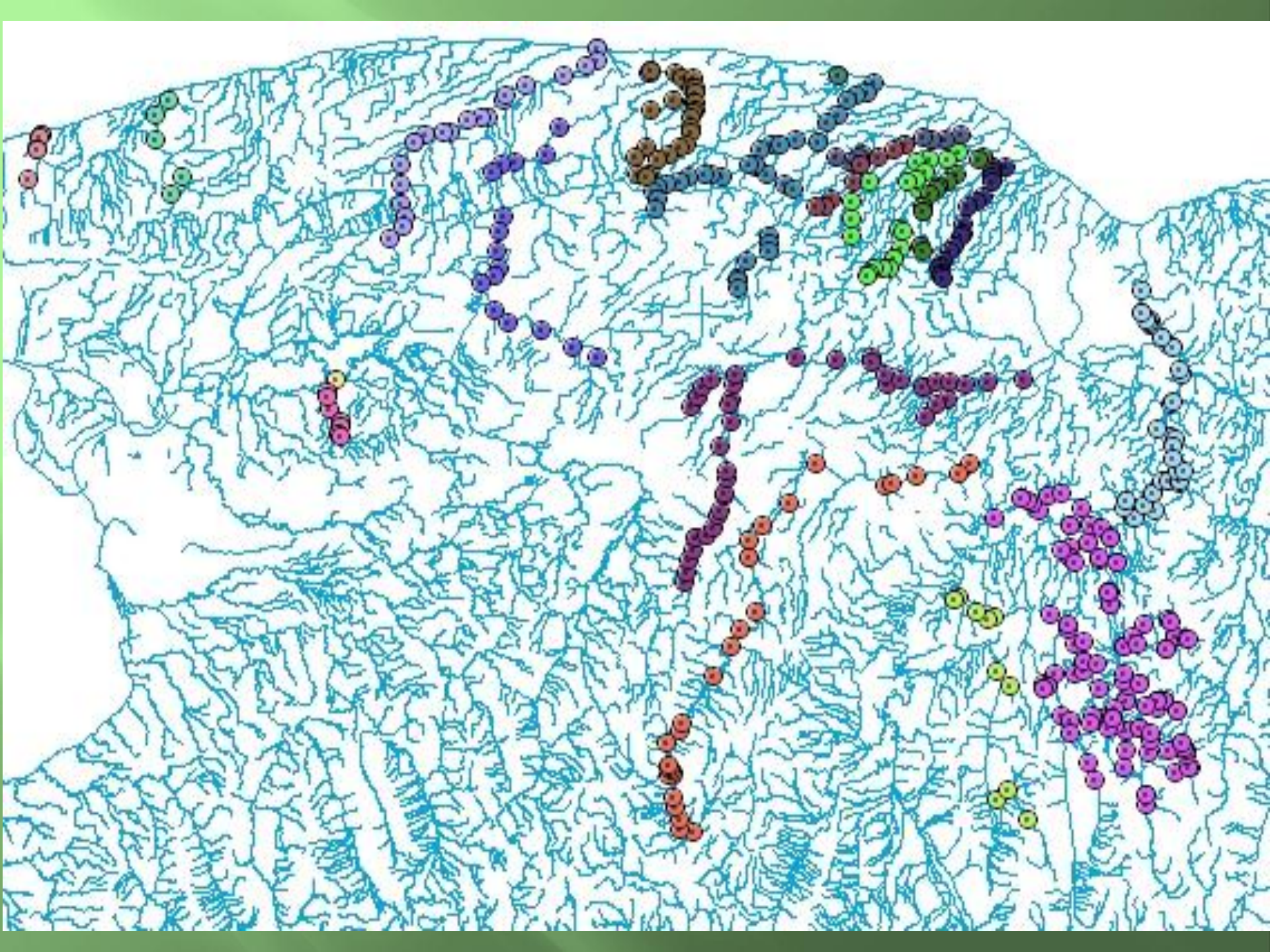
Pocketbook, *Lampsilis ovata*

Road Crossings

- Road crossing field assessments were completed by the USFWS in 2010-2011
 - 437 crossings
- Assessment Protocol included:
 - Physical dimensions of the road-crossing
 - Slope of culvert and a comparison to stream slope
 - Crossing type, construction material
 - Water depth, pool presence, etc.
 - Pictures!

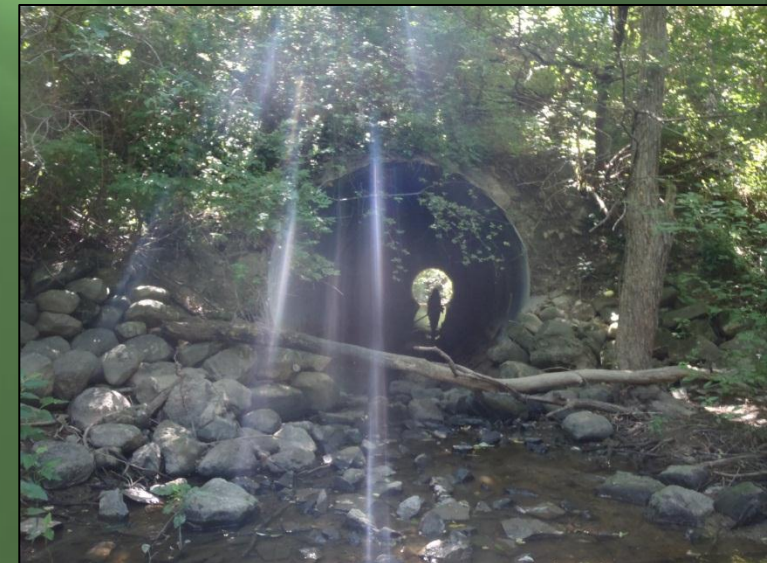


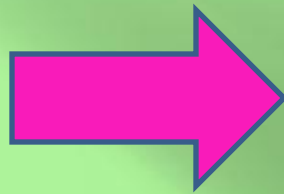
Study Area



Determining Passability

- We looked at numerous models and chose two that would complement each other
 - The Vermont Culvert Aquatic Organism Passage Screening Tool (or the Vermont Model)
 - Vermont Agency of Natural Resources
 - FishXing
 - U.S. Forest Service





Vermont Model

Full AOP

Reduced AOP

No AOP

FishXing Model

Lacking Data

Passable

Impassable

Partially
Passable

Visually Check

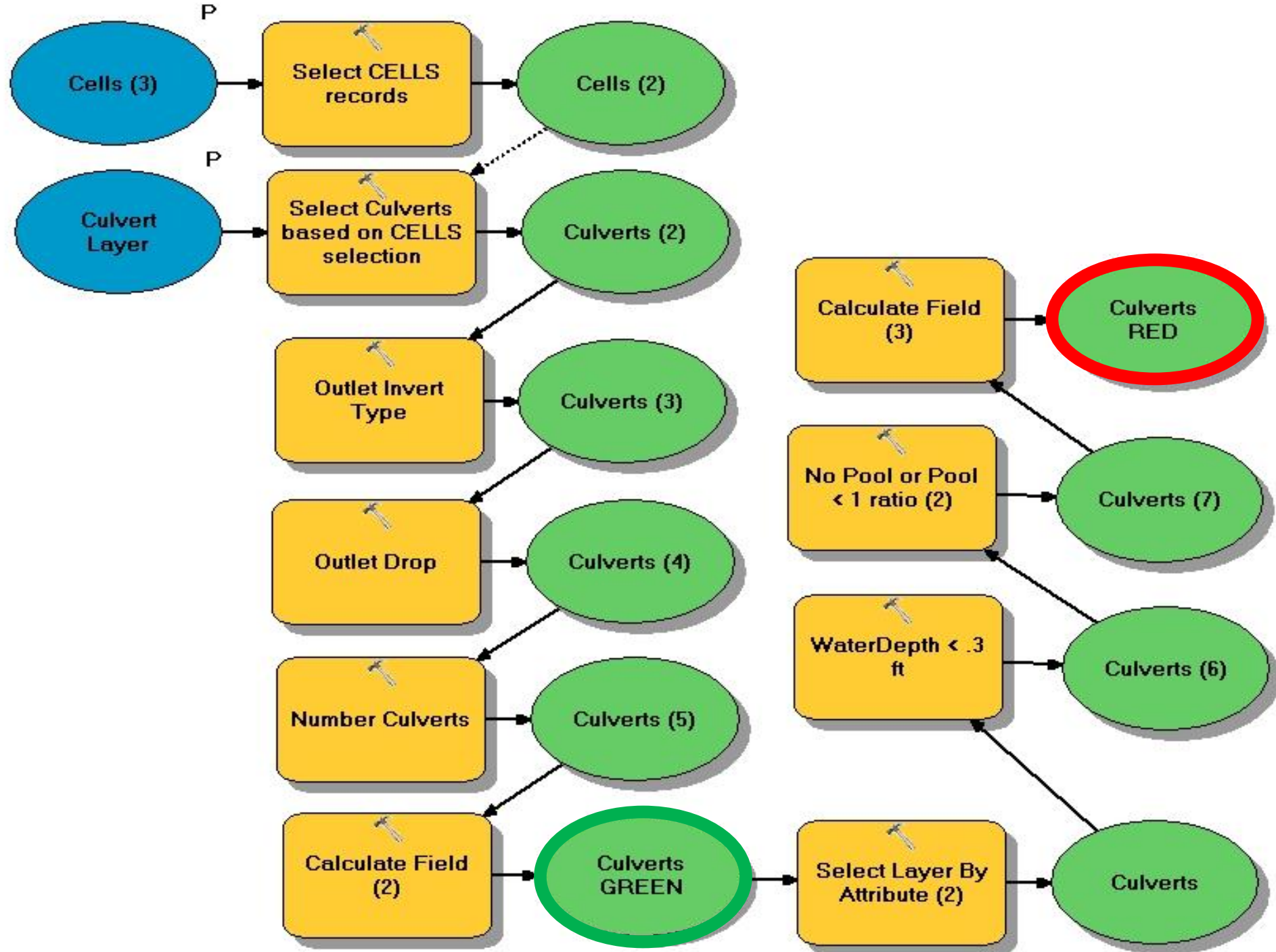
Visually Affirmed
Passable

Unknown (Null)

The First Step: Vermont Model

| VT Aquatic Organism Passage Coarse Screen | Full AOP | Reduced AOP | No AOP | | | |
|--|------------------------------|------------------------------|--|-------------|---|-------------|
| Updated 2/25/2008 | for all aquatic organisms | for all aquatic organisms | for all aquatic organisms except adult salmonids | | for all aquatic organisms including adult salmonids | |
| AOP Function Variables / Values | Green (if all are true) | Gray (if any are true) | Orange | | Red | |
| Culvert outlet invert type | at grade OR backwatered | cascade | free fall AND | | free fall AND | |
| Outlet drop (ft) | = 0 | | > 0 , < 1 ft OR | | ≥ 1 ft OR | |
| Downstream pool present | | | = yes | (= yes AND | = no OR | (= yes AND |
| Downstream pool entrance depth / outlet drop | | | n/m | ≥ 1) | n/a | < 1) OR |
| Water depth in culvert at outlet (ft) | | | | | < 0.3 ft | |
| Number of culverts at crossing | 1 | > 1 | | | | |
| Structure opening partially obstructed | = none | ≠ none | | | | |
| Sediment throughout structure | yes | no | | | | |

- Orange column became gray



Passable Road Crossings

Full AOP (Aquatic Organism Passage)

- No Upstream Obstruction
- Natural Substrate inside the Culvert
- Outlet at grade
- One Cell



Impassable Crossings

No AOP

- Free fall with an outlet drop greater than 1 ft
- OR a free-fall (any size) and no pool
- OR a free-fall and a pool less than 1 ft deep
- OR a free-fall and a water depth less than 0.3 feet inside the culvert at outlet



Reduced AOP: Vermont Model

| VT Aquatic Organism Passage Coarse Screen | Reduced AOP | No / | |
|--|---------------------------|--|-------------|
| Updated 2/25/2008 | for all aquatic organisms | for all aquatic organisms except adult salmonids | |
| AOP Function Variables / Values | Gray (if any are true) | Orange | |
| Culvert outlet invert type | cascade | free fall AND | |
| Outlet drop (ft) | | > 0 , < 1 ft OR | |
| Downstream pool present | | = yes | (= yes AND |
| Downstream pool entrance depth / outlet drop | | n/m | ≥ 1) |
| Water depth in culvert at outlet (ft) | | | |
| Number of culverts at crossing | > 1 | | |
| Structure opening partially obstructed | ≠ none | | |
| Sediment throughout structure | no | | |

Reduced AOP (Nulls)

If ANY of the following is true:

- A cascade is present
- A free-fall less than 1 foot
- A pool is present and is 1 foot or more deep
- There is more than 1 cell
- An upstream obstruction is present
- There is no natural substrate in the structure



Upstream Blockage and Box Culvert



Reduced AOP from Cascade

- If a cascade was present = Automatic Null

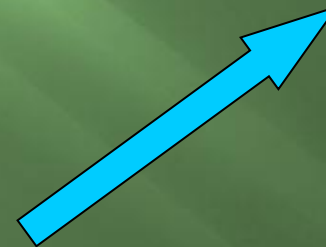


Vermont Model Adjustments

- **Problem: Creates Nulls (grays) if more than one cell is present.**
- **Solution:**
 - If a bridge, it is made passable; barring any obstructions or if it is not at grade.
 - Rerun model with bridges added on with those exemptions

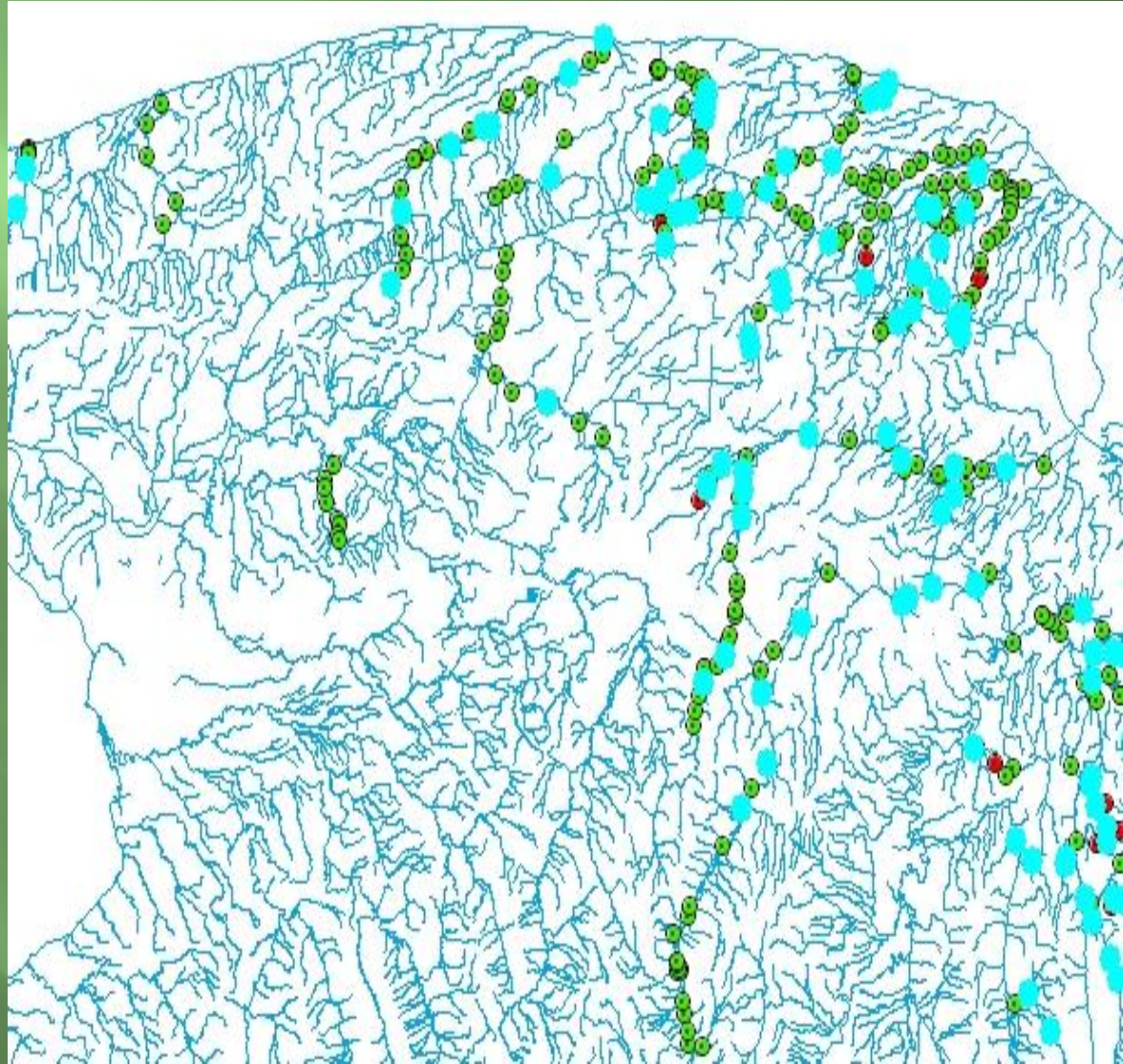
converts_2

| | BarrID ^ | CROSSTYPE | V_Model_Passability |
|--|----------|-----------|---------------------|
| | 20089021 | bridge | green |
| | 20099137 | bridge | green |
| | 20099215 | bridge | green |
| | 20099277 | bridge | green |
| | 20099295 | bridge | <Null> |



Vermont Model Results

- **Full AOP:**
 - 262 of 437 (60.4%)
- **Reduced AOP (Nulls)**
 - 142 of 437 (32.5%)
Nulls
- **No AOP:**
 - 33 of 437 (7.6%)



Vermont Model

Full AOP
262 of 437
60.4%

Reduced AOP
142 of 437
32.5%

No AOP
33 of 437
7.6%

FishXing Model
(All Data Present)
79

Lacking Data

Passable

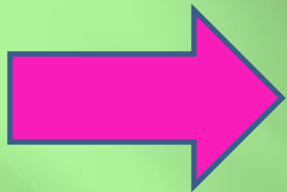
Impassable

Partially
Passable

Visually Check

Visually Affirmed
Passable

Unknown (Null)



Target Species

- Greenside Darter (*Etheostoma blennioides*)
 - Worst swimmer and jumper that is native to the area *and* is a host species for mussels
 - 6 cm length

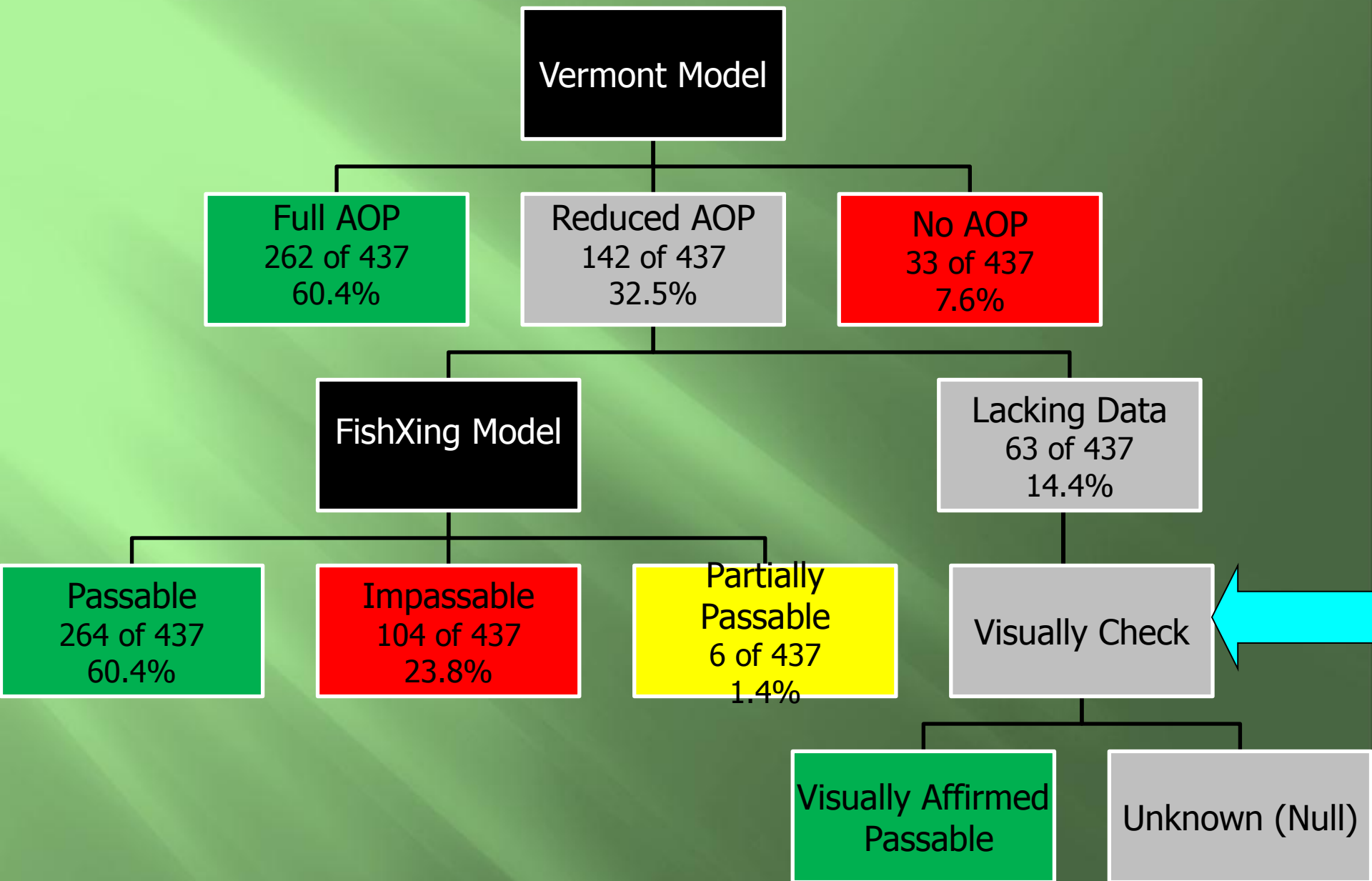


Limitations and Assumptions of FishXing

- Originated from either our data or the software
- In some instances, we set a constant to be used for all crossings to maintain consistency
- Examples
 - Velocity Reduction Factor
 - Embeddedness
 - Presence of Multiple Cells
 - Bottom Roughness (0.035 Manning's "n")

FishXing Results

- Vermont Model + FishXing
 - Passable: 60.4%
 - Impassable: 23.8%
 - Partial: 1.4%



Visual Passability

- **62 Nulls** remained after running FishXing and the Vermont Model
- Visually go through pictures
- Determined passability for bridges and open bottoms based on visual assessment

Visually Affirmed

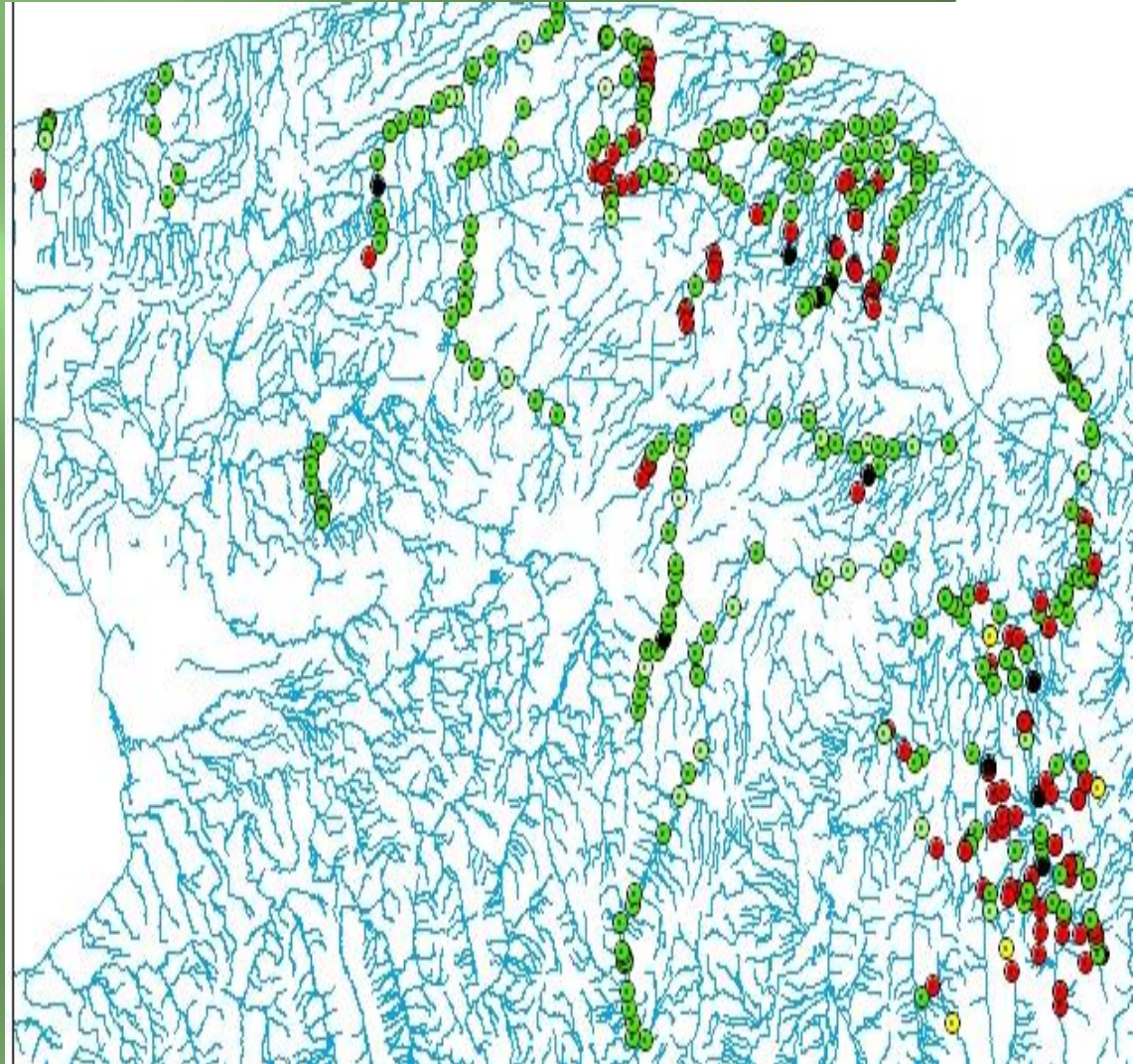


Visually Affirmed

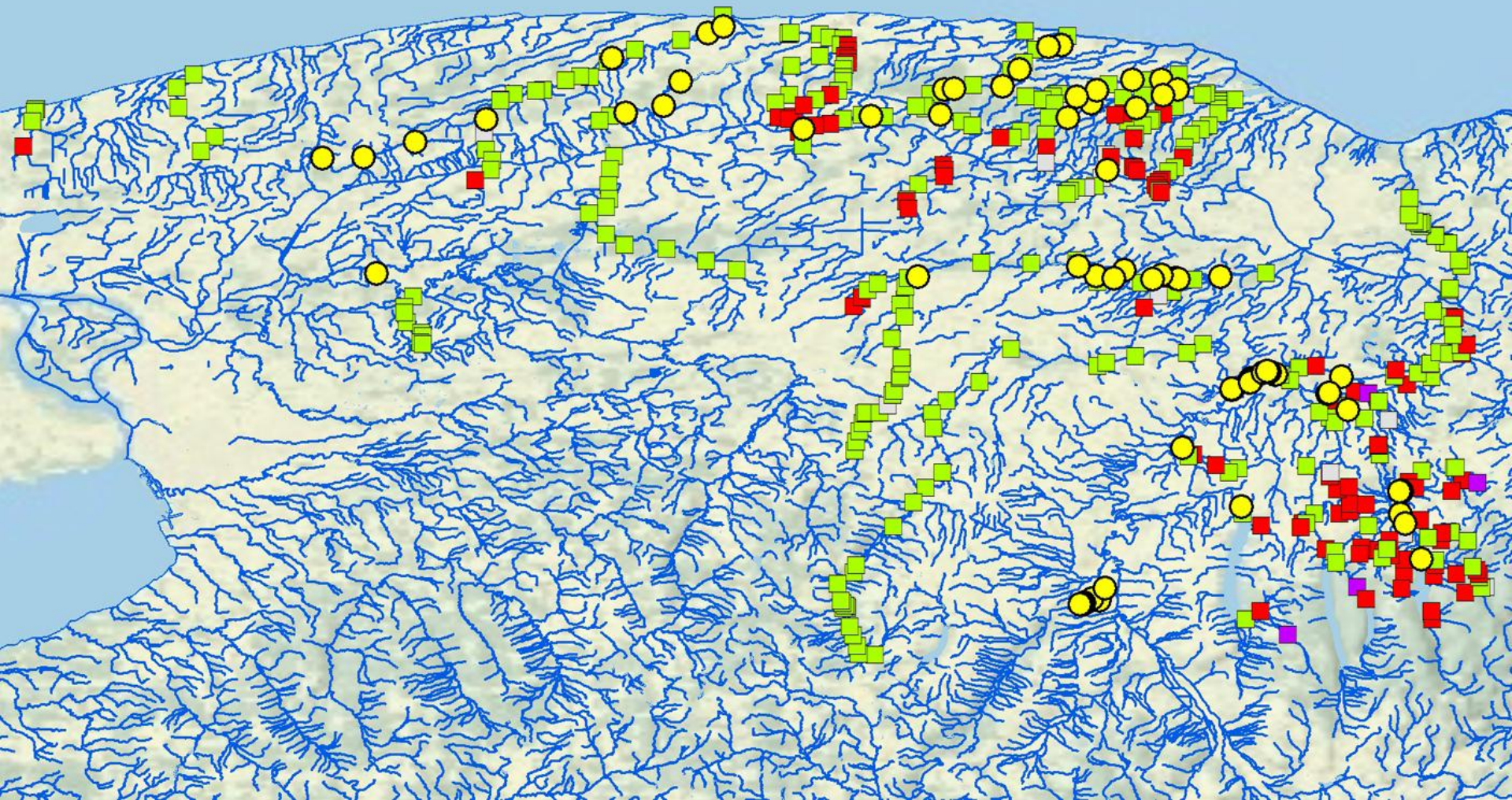


- **Final Passability in ArcMap**

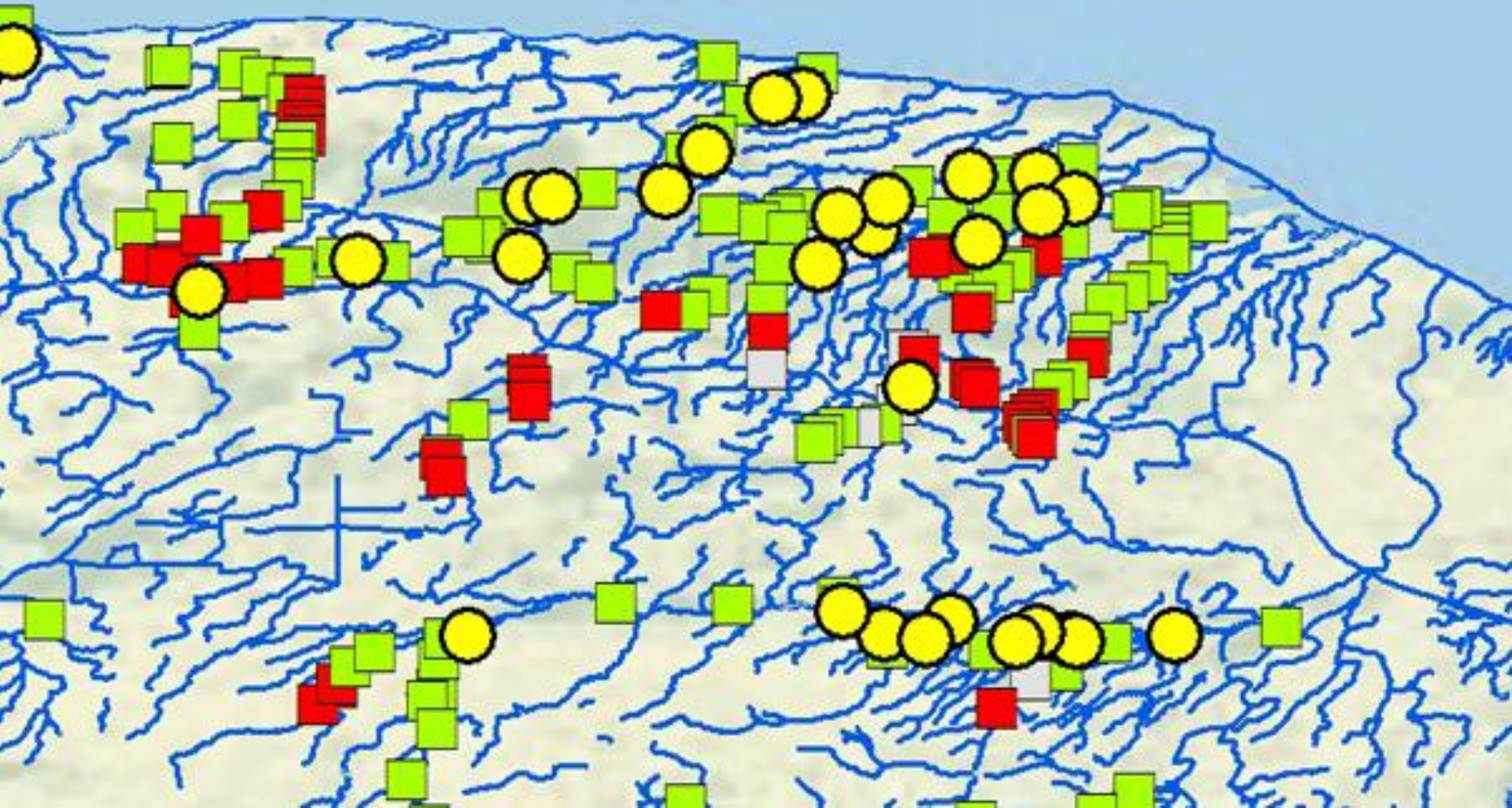
- **V. Model + FishXing + Visual**
- 104 impassable: 23.8%
- 318 Passable: 72.8%
- 6 Partial Passable: 1.4%
- 15 Nulls: 3.4%



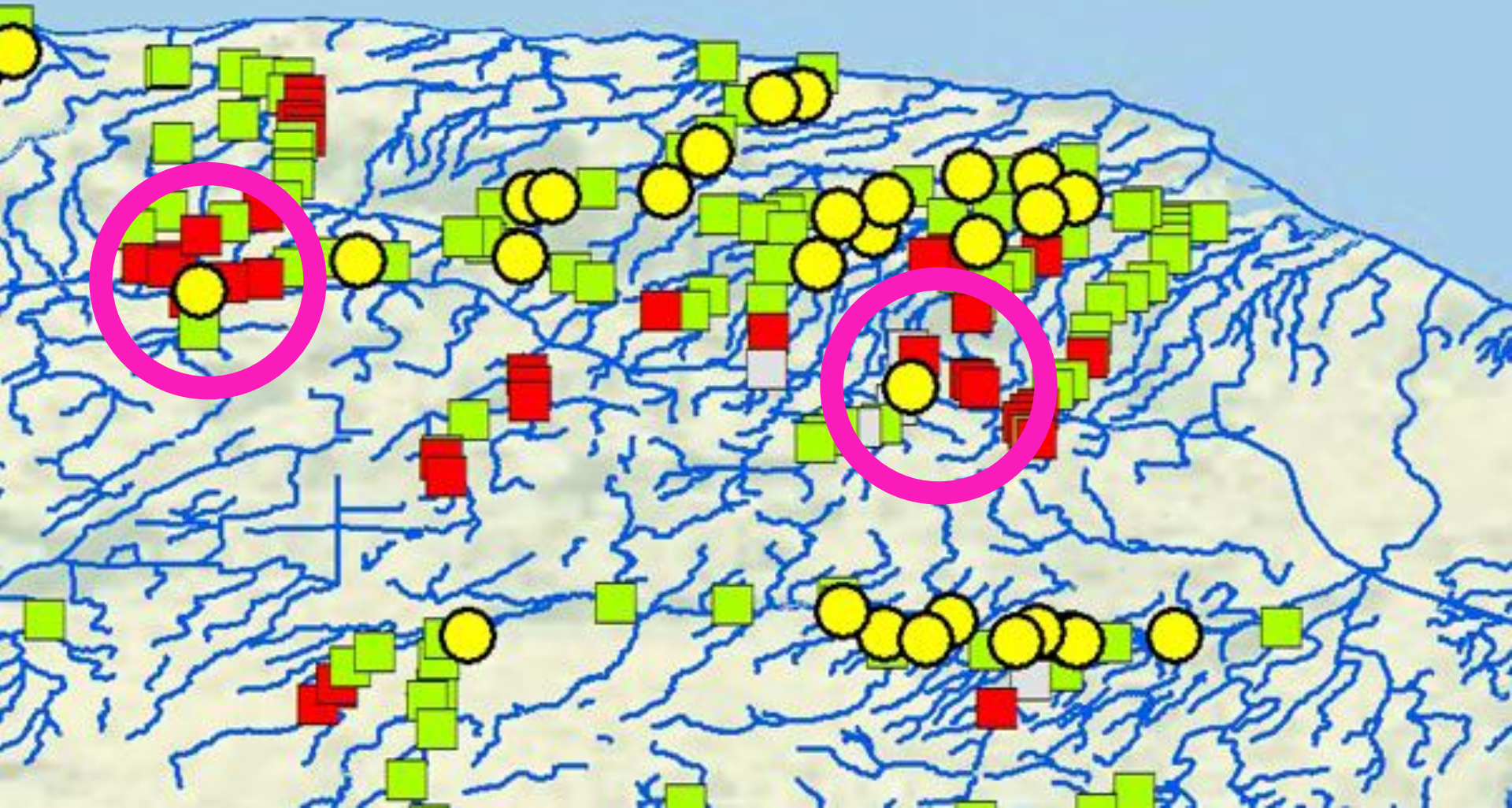
Road Crossings and Mussels



Road Crossings and Mussels



Road Crossings and Mussels



Next Steps

- Reassess crossings with lacking data
- Survey other mussel-bearing streams
- Prioritize barriers
 - Connectivity achieved
 - Mussel SGCN presence
 - Host fish presence
 - Water Quality
- Coordinate restoration



- USFWS
 - Chris Castiglione
 - Raymond Li
 - Karolyn Lock
- NYS DEC
 - Jenny Landry
 - Amy Mahar



Questions?

