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## Session B4: Ethohydraulics in Turbulence: Fish Behaviour in Turning Pools

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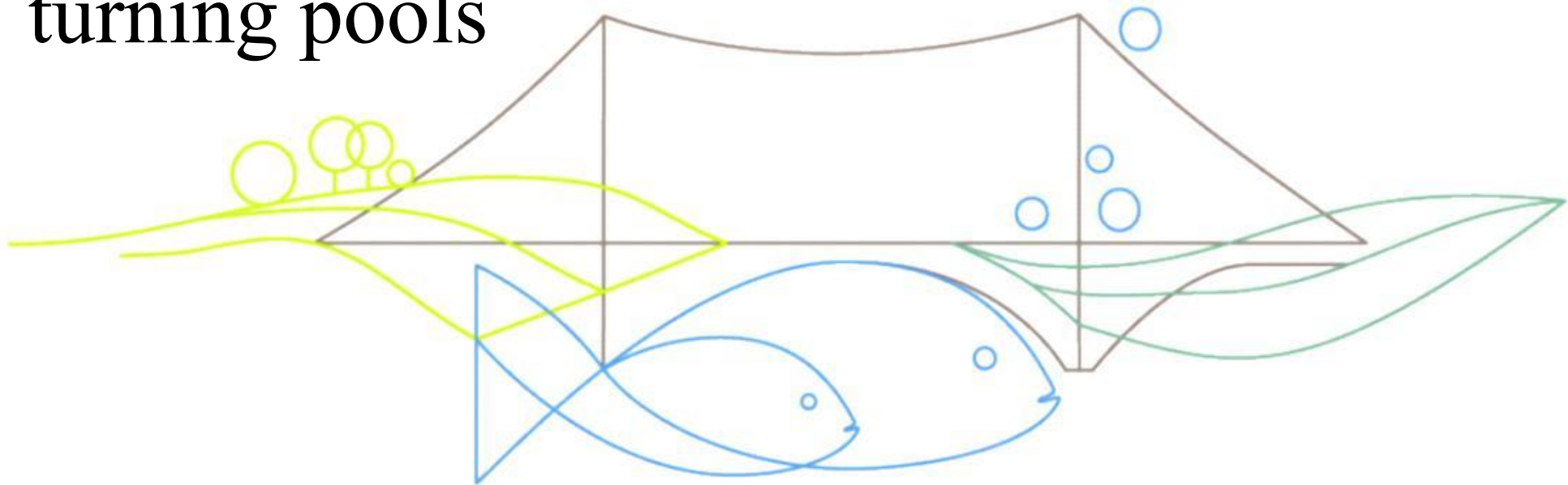
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# Ethohydraulics in turbulence: Fish behaviour in turning pools



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Fish Passage 2015

23<sup>rd</sup> of June 2015, Groningen, The Netherlands

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1. Research Question
2. Experimental Setup
3. Data Analysis
4. Results
5. Conclusion & Discussion

# 1. Research Question

The area available to construct fishways is often limited

→ solution: construct turning basins

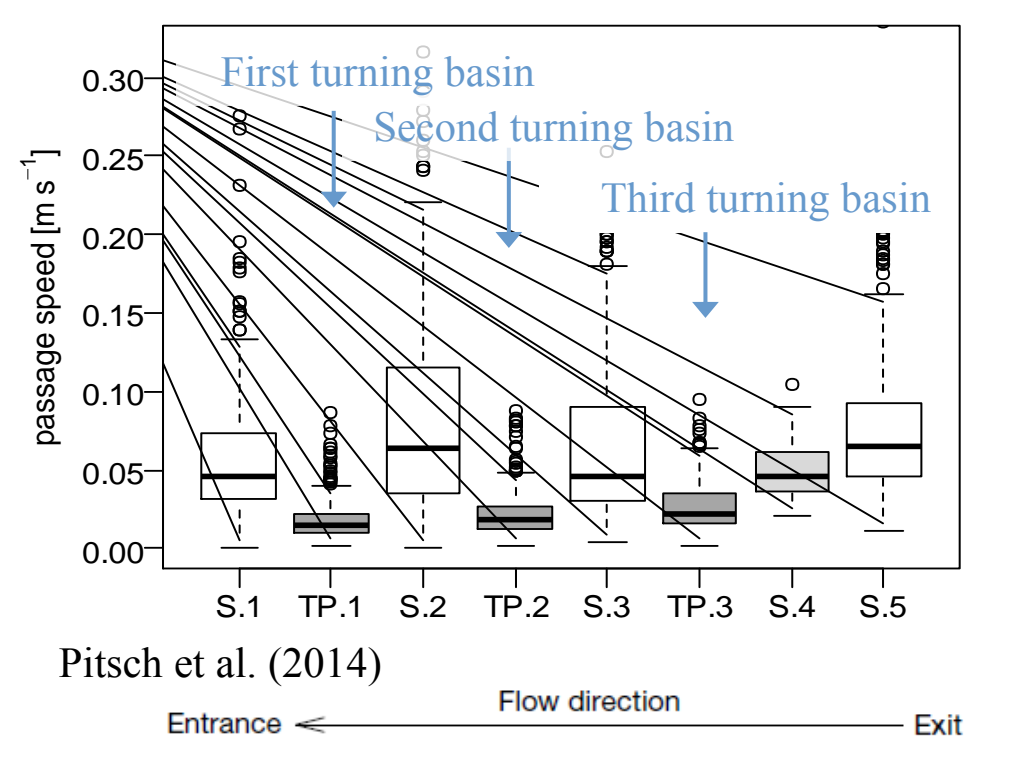
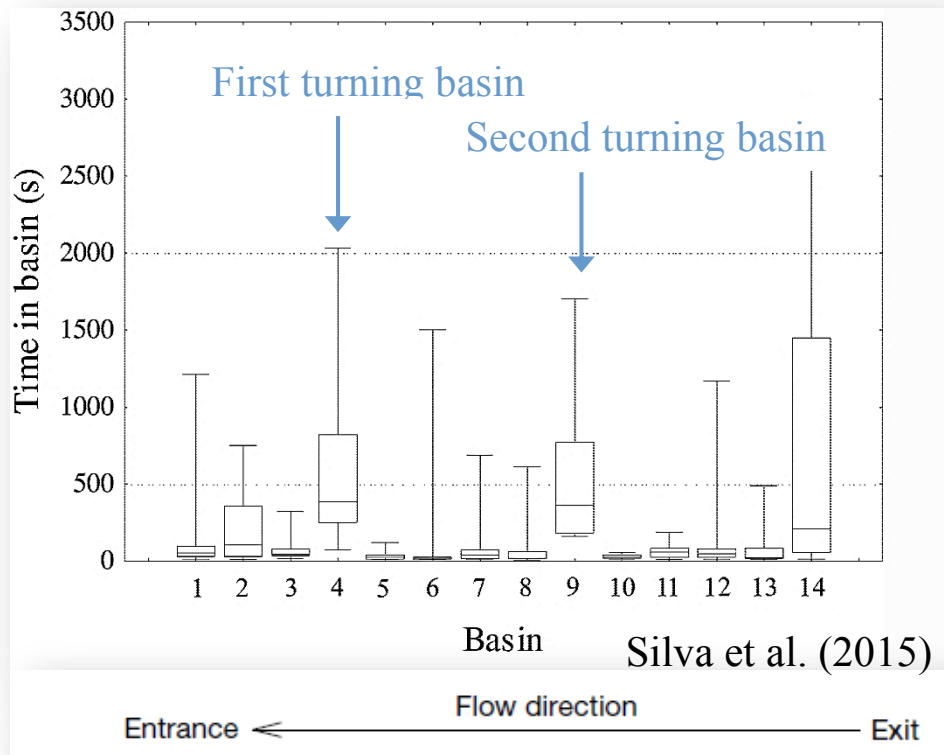
→ problem: delays in fish passage



Koblenz  
Mosel

# 1. Research Question

The area available to construct fishways is often limited  
 → solution: construct turning basins  
 → problem: delays in fish passage



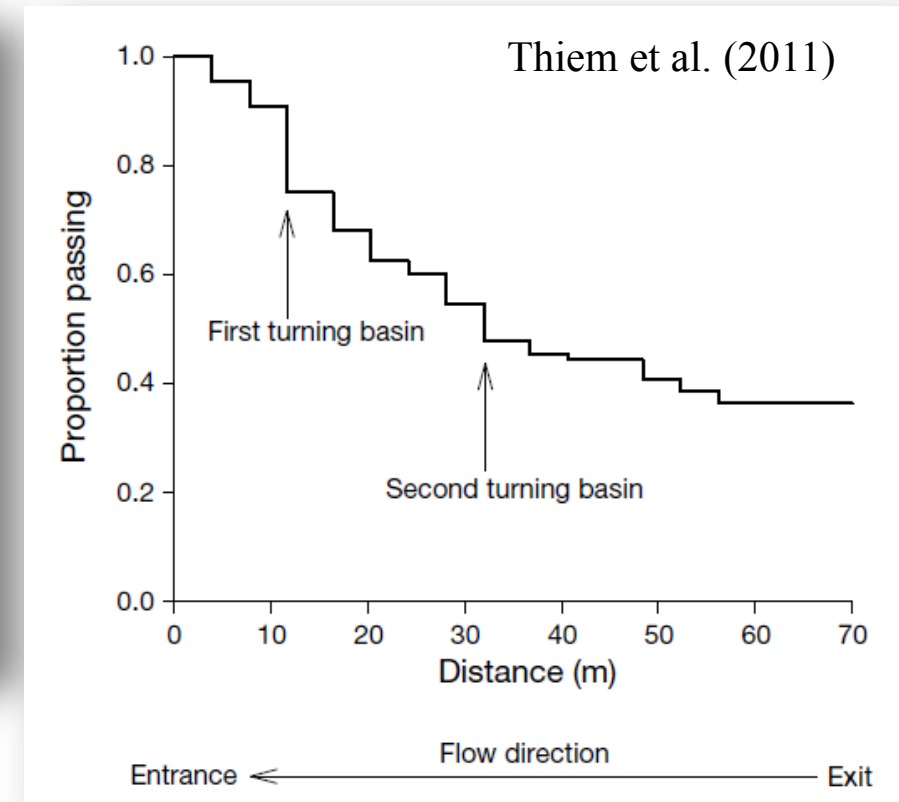


# 1. Research Question

The area available to construct fishways is often limited  
 → solution: construct turning basins  
 → problem: delays and failure of fish passage



Stuart et al. (2003)



# 1. Research Question

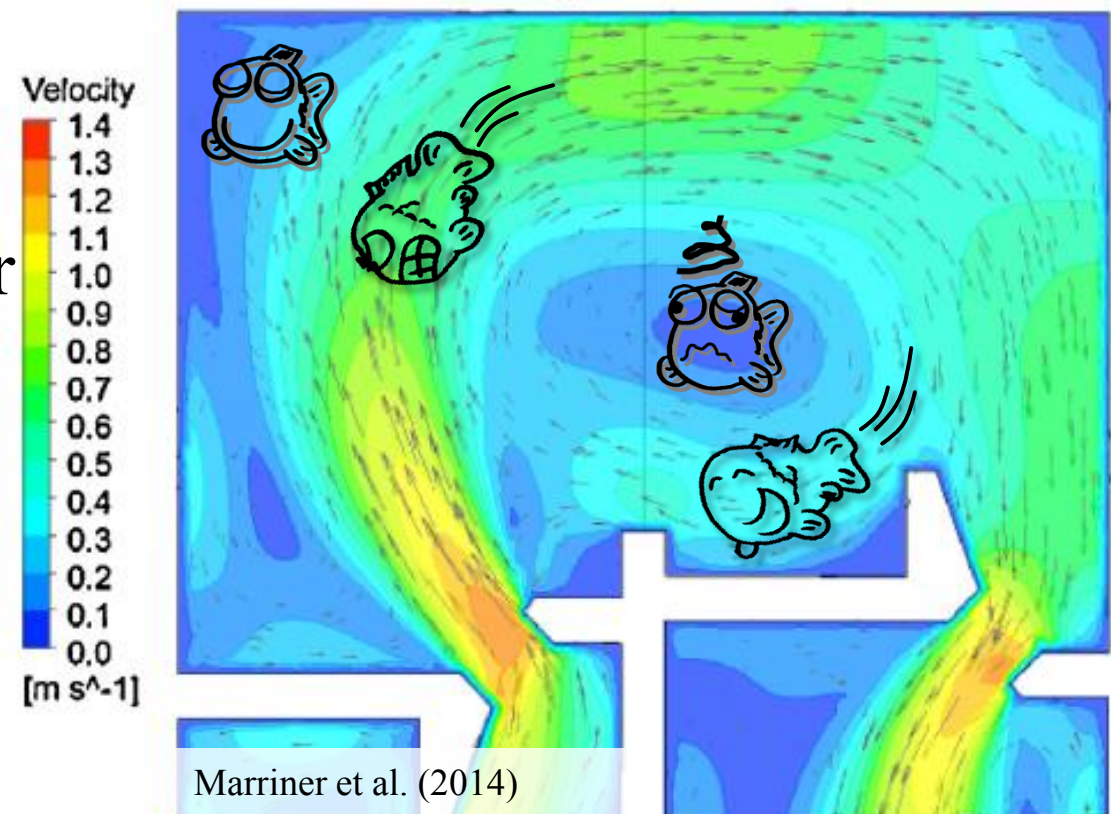
The area available to construct fishways is often limited

→ solution: construct turning basins

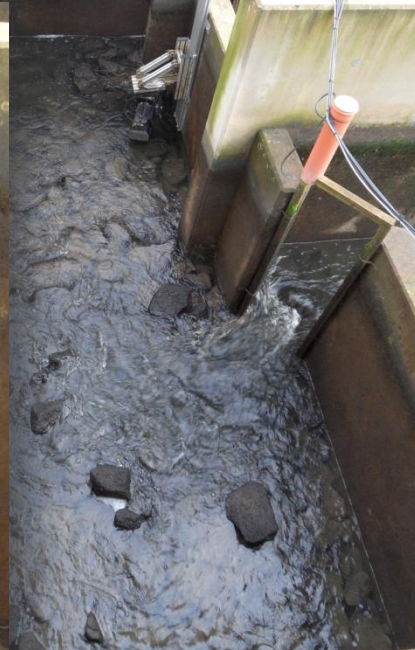
→ problem: delays and failure of fish passage

→ possible causes:

- rest
- main current/detour
- disorientation
- vortex capture

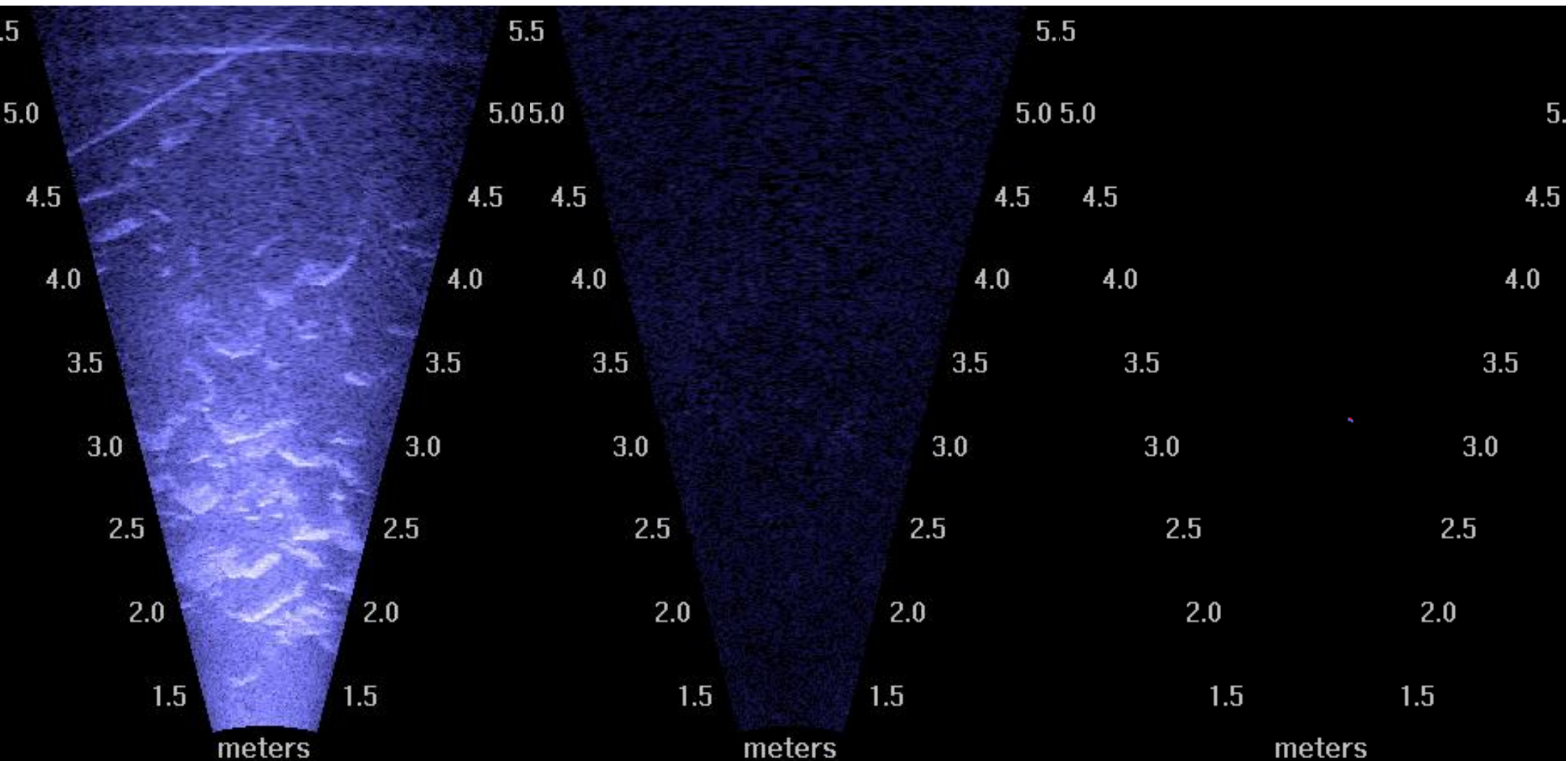






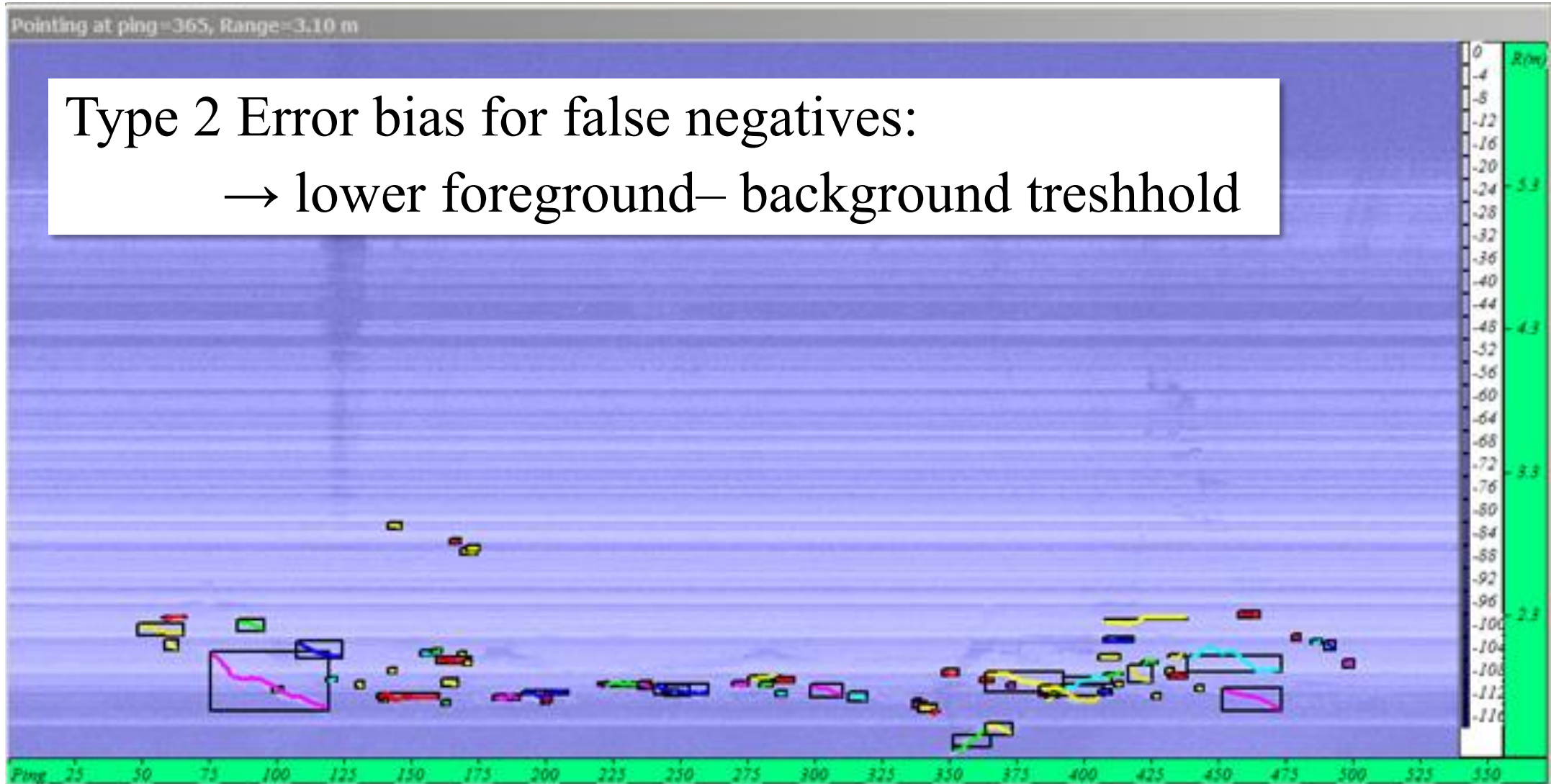


### 3. Data Analysis: Raw Data



### 3. Data Analysis: Echogram

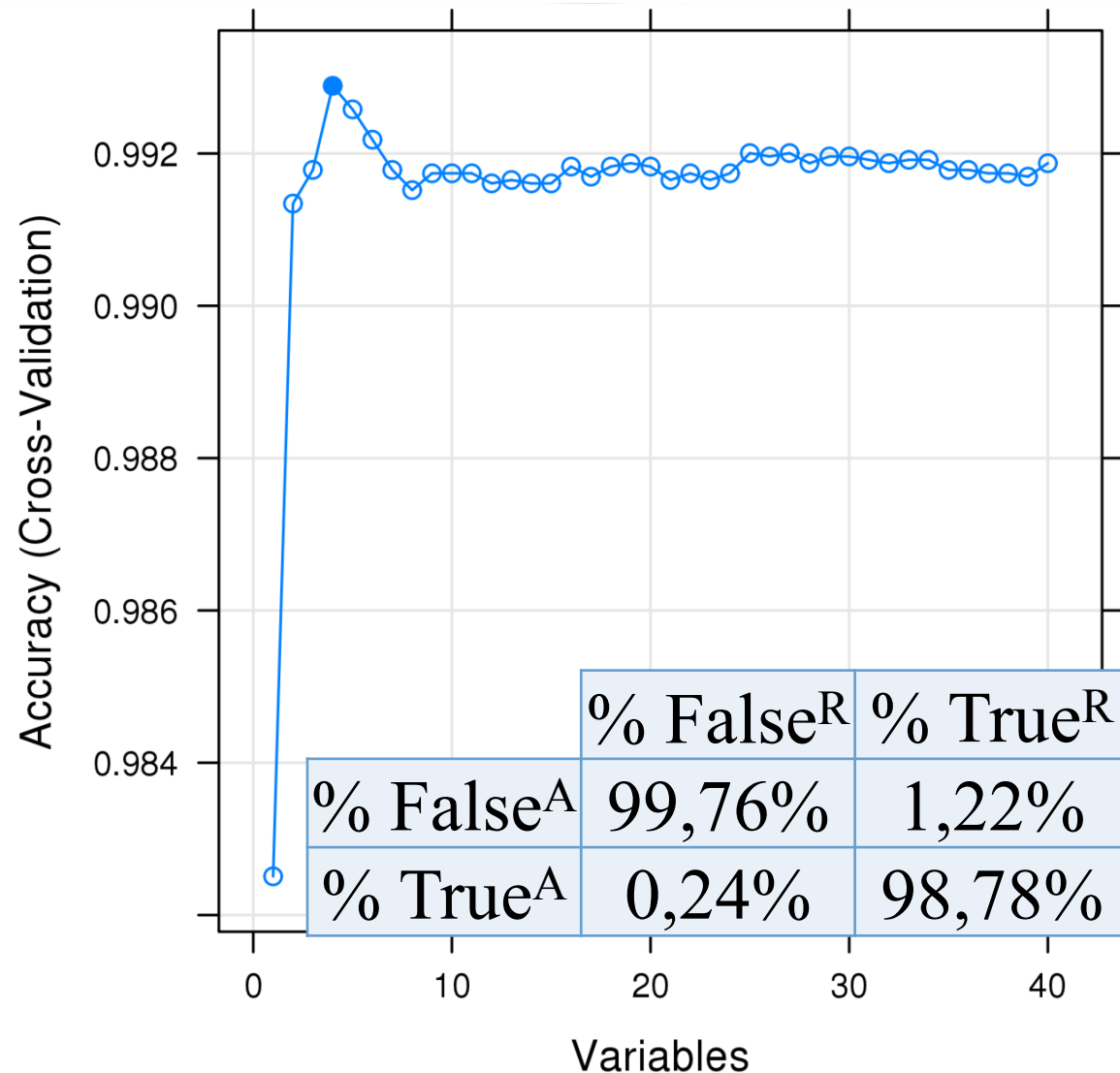
Type 2 Error bias for false negatives:  
→ lower foreground– background threshold



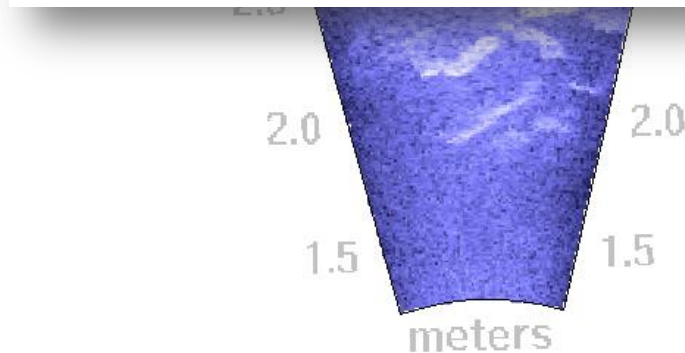
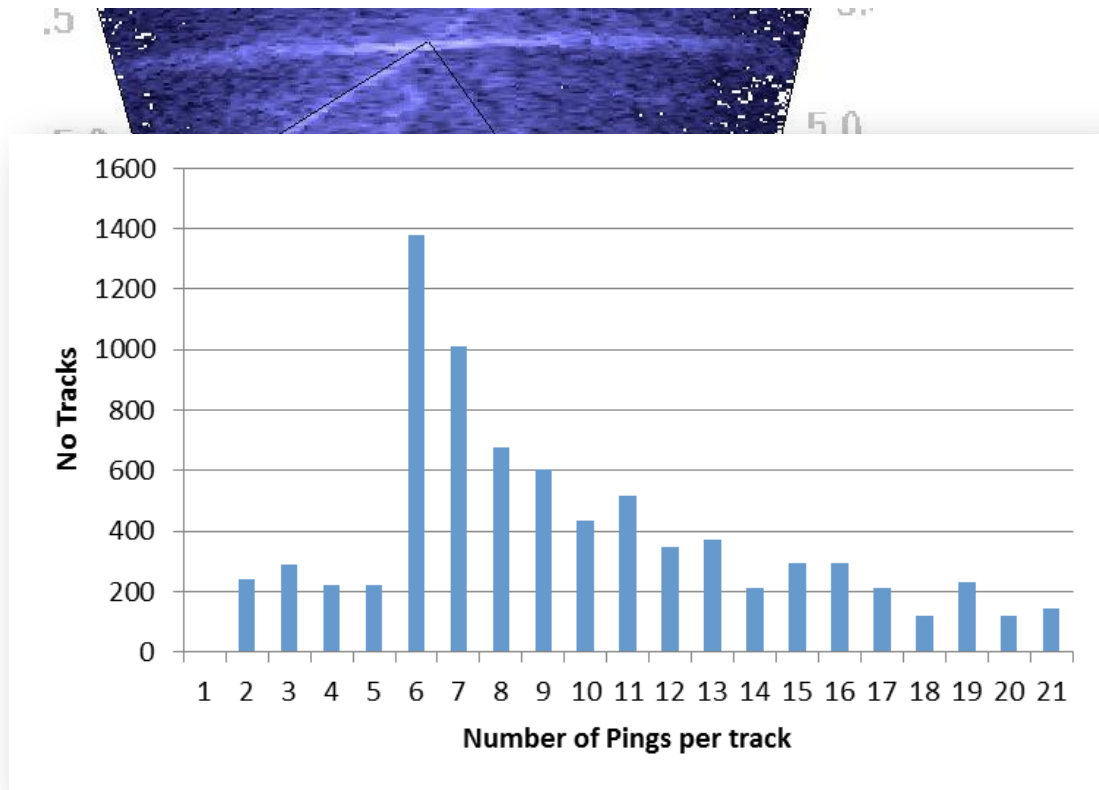
### 3. Data Analysis: Cleanup & MLA



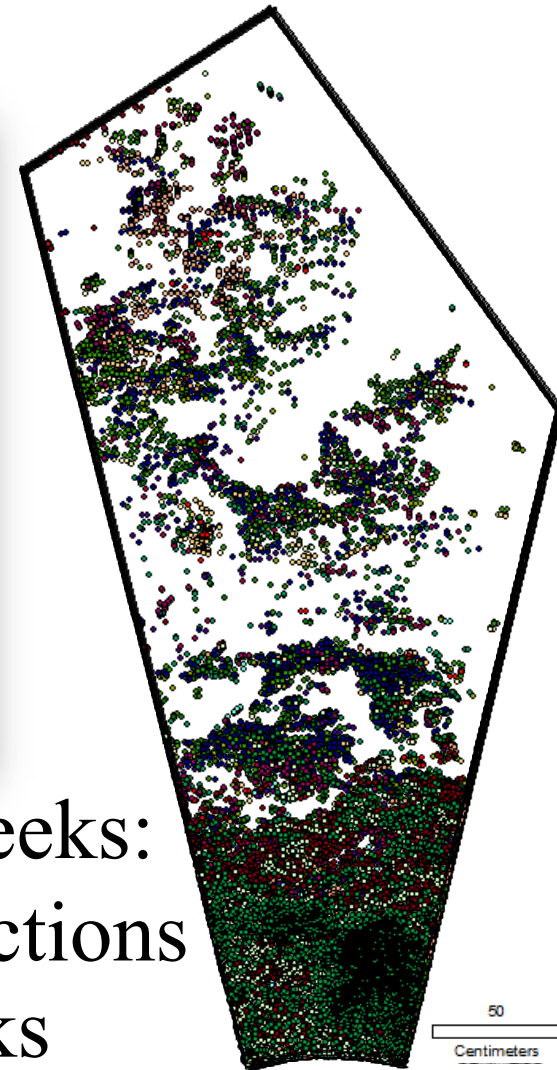
- Connect fragmented tracks
- Remove impossible speeds
- Remove single Ping Tracks
- Remove Air Bubbles  
(drop +20 simultaneous track starts)



## 4. Results: Data



In  $\pm$  three weeks:  
182086 detections  
10100 tracks

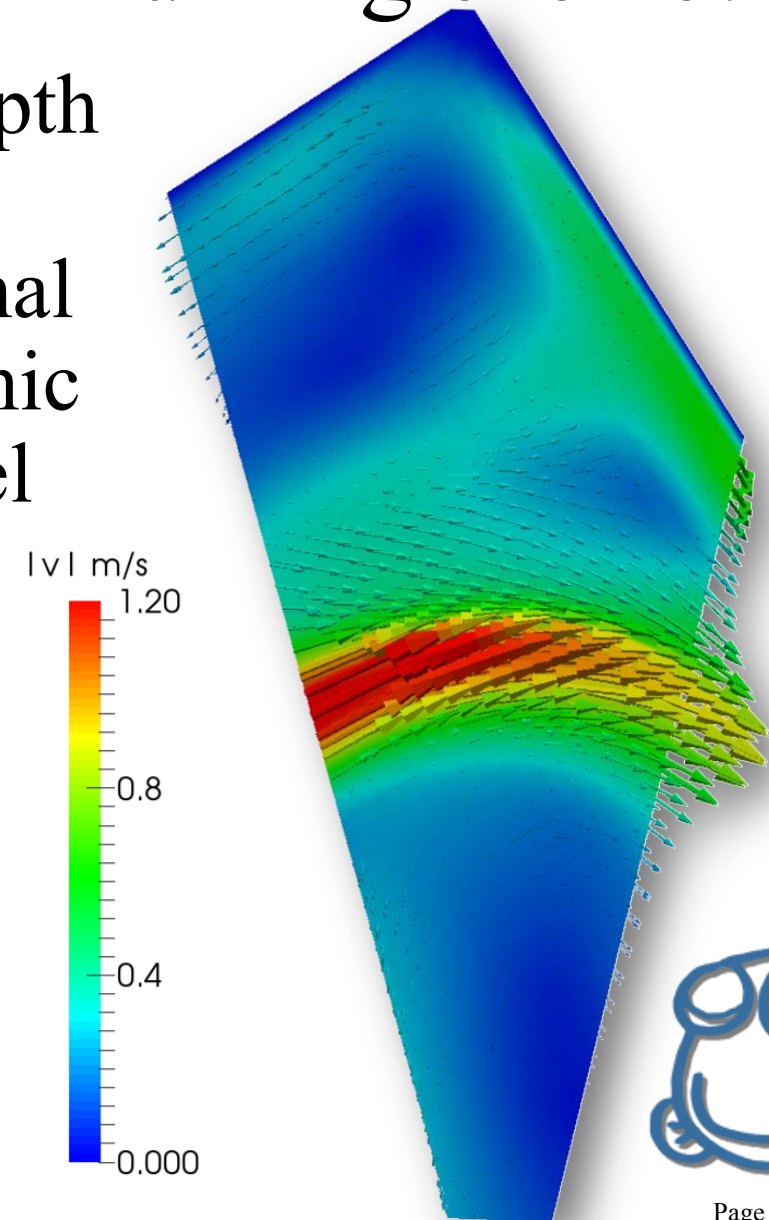
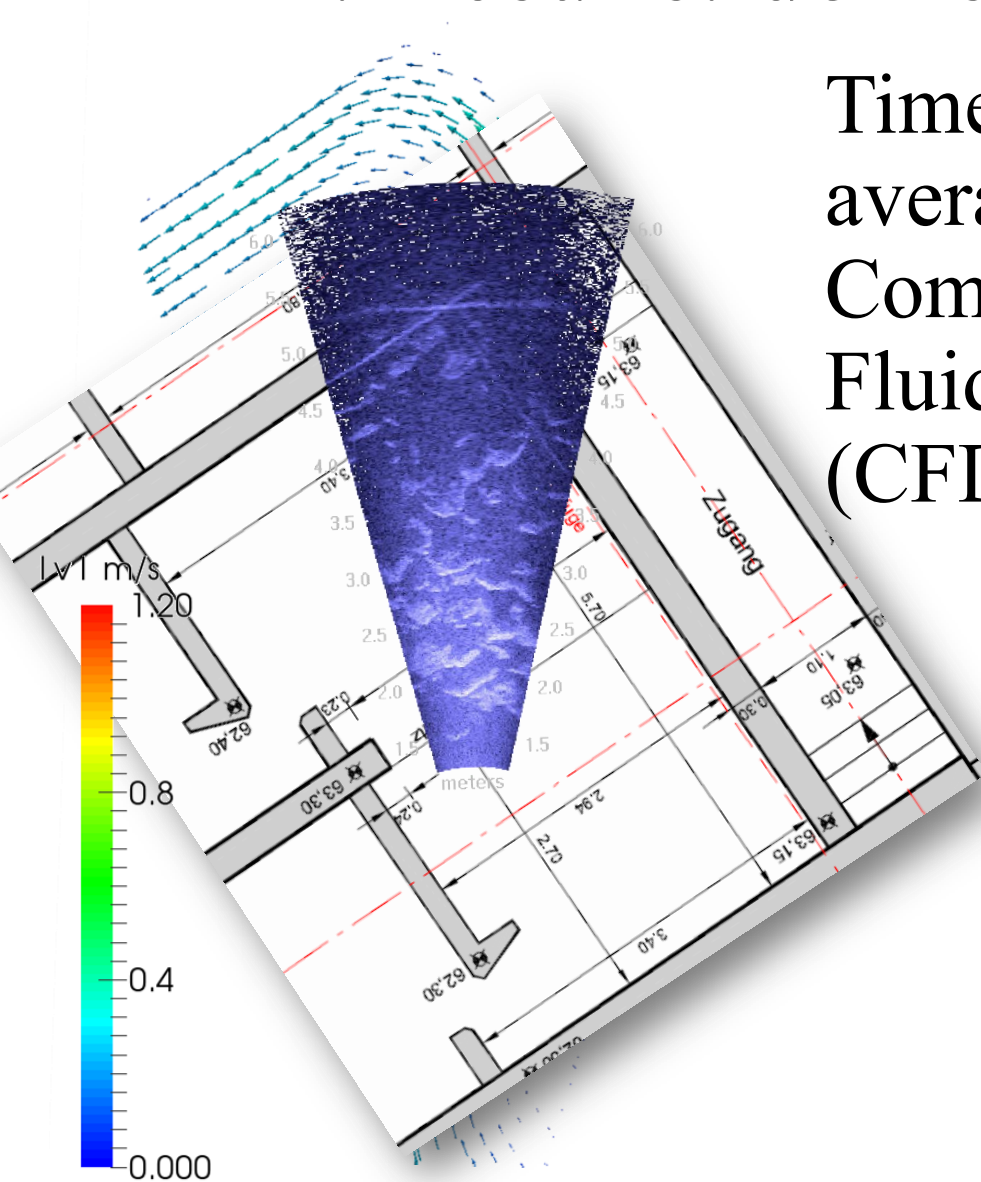


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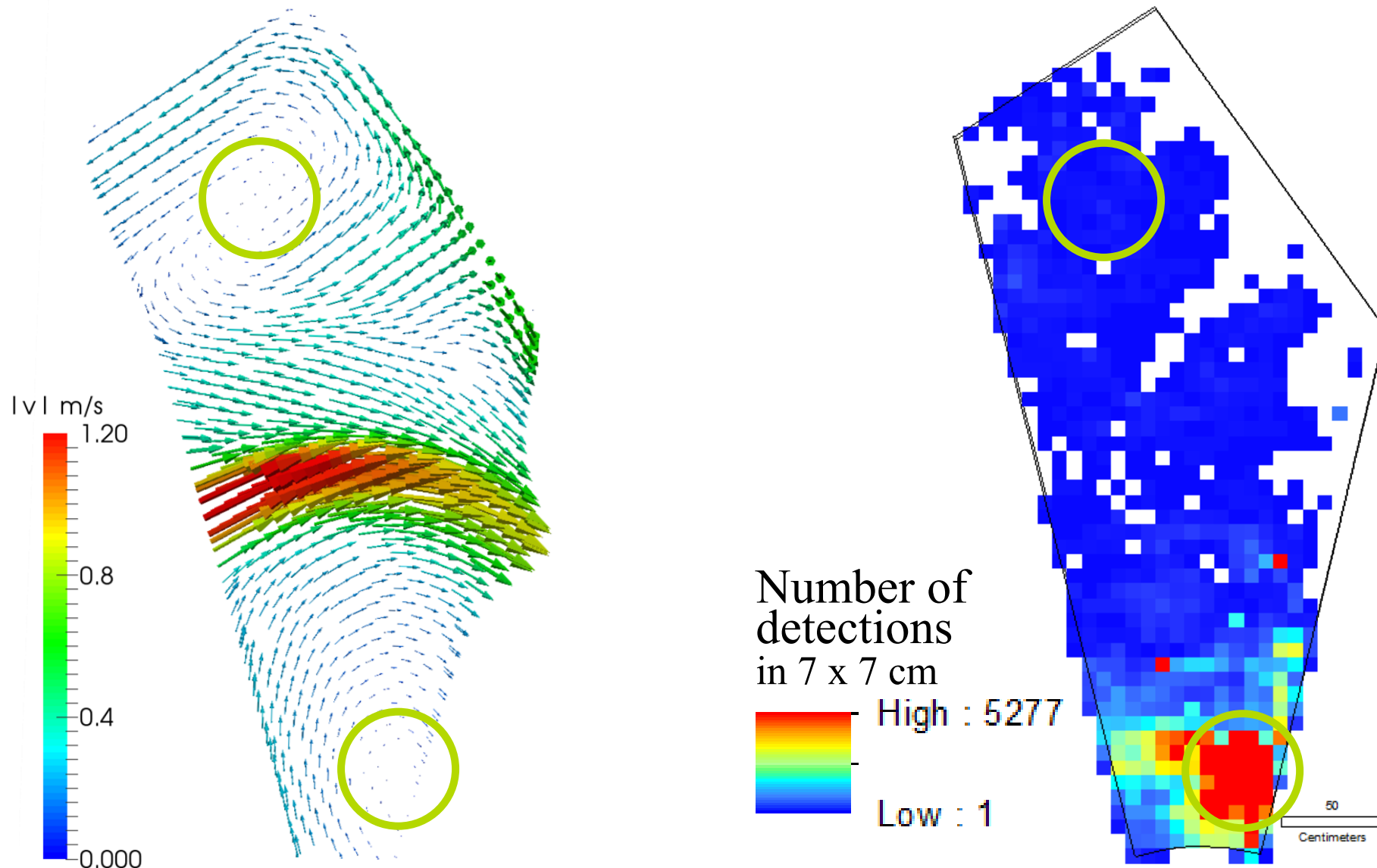


## 4. Results: do fish rest in turning basins?

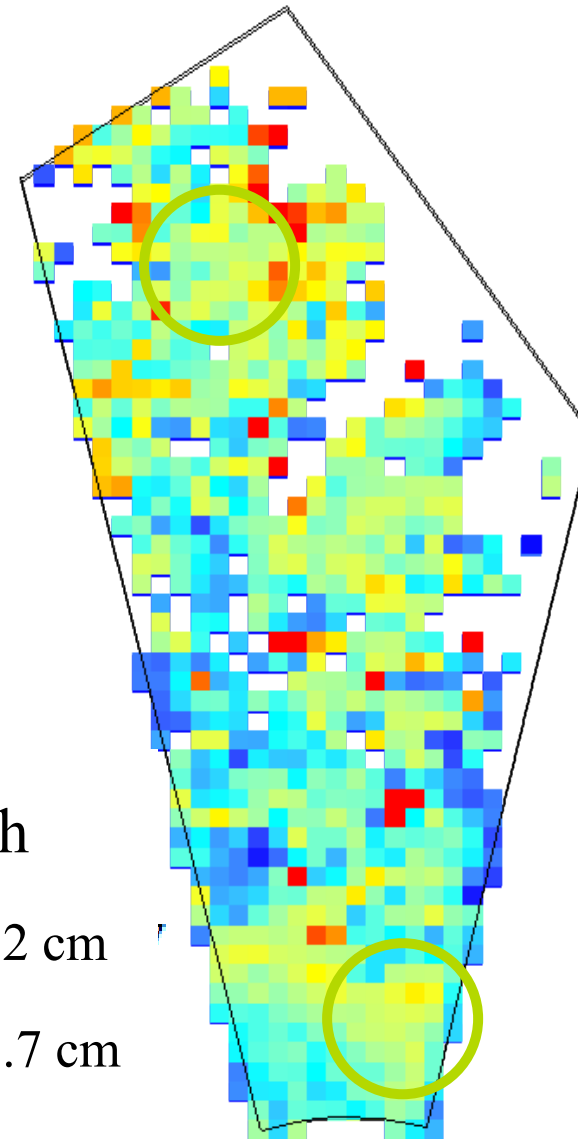
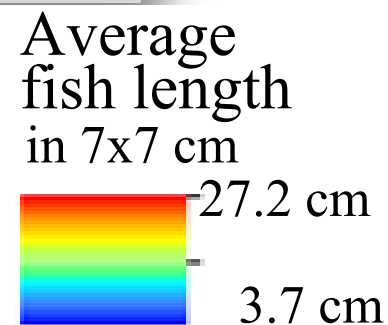
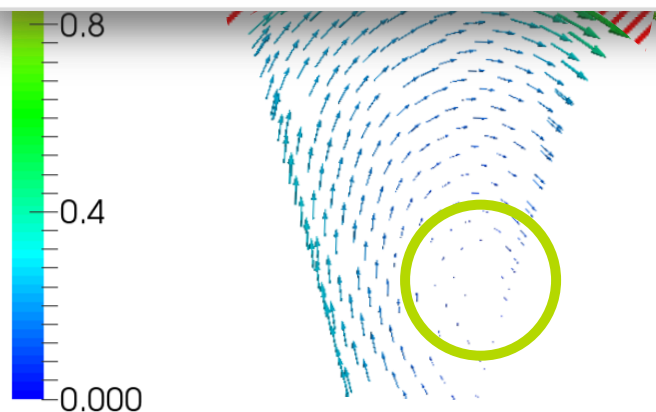
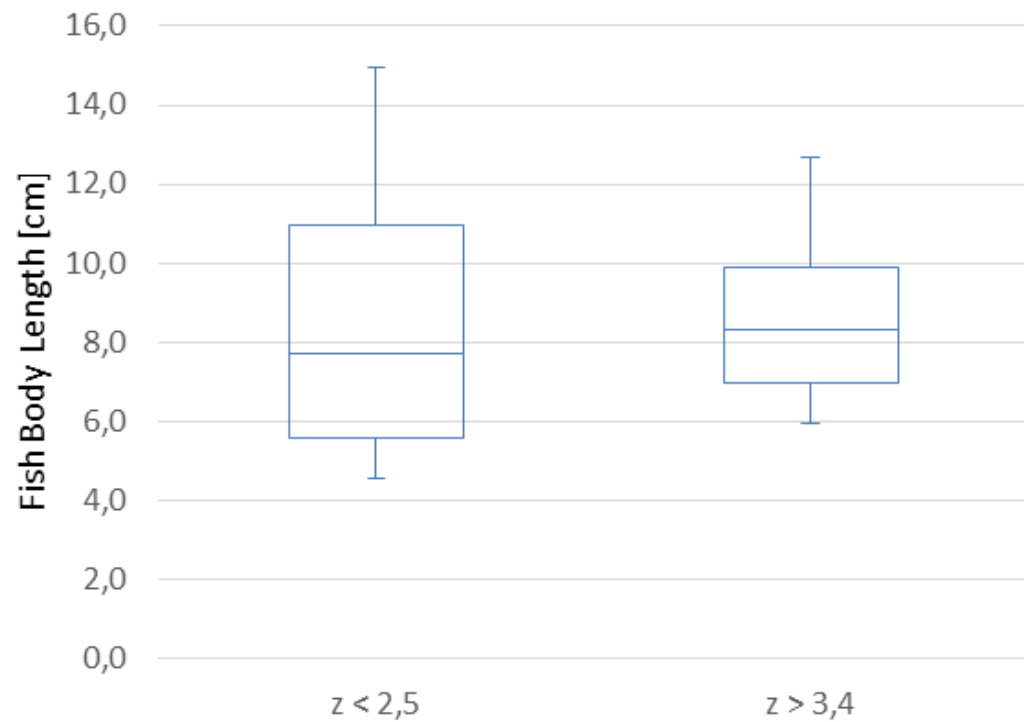
Time and depth  
averaged  
Computational  
Fluid Dynamic  
(CFD) Model



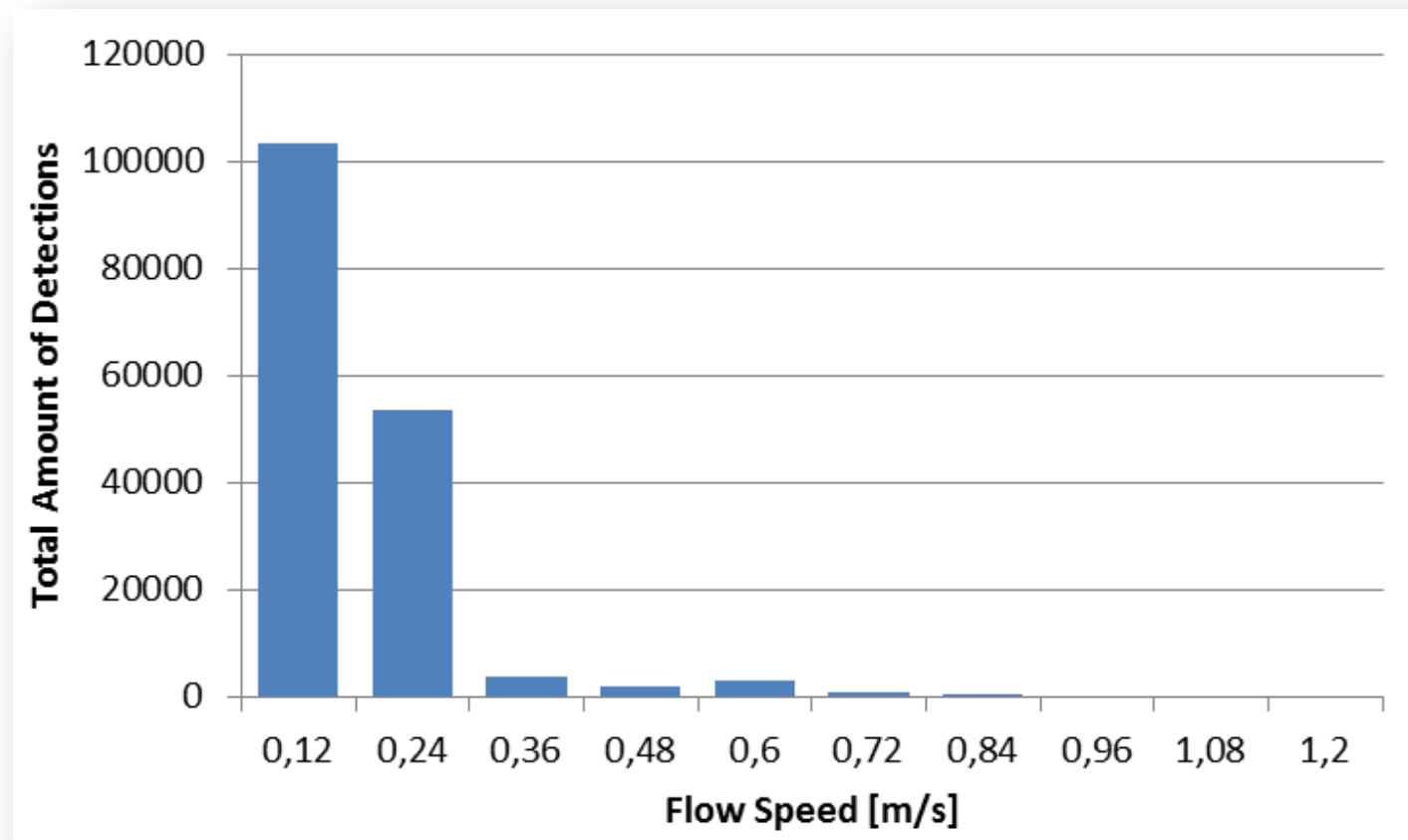
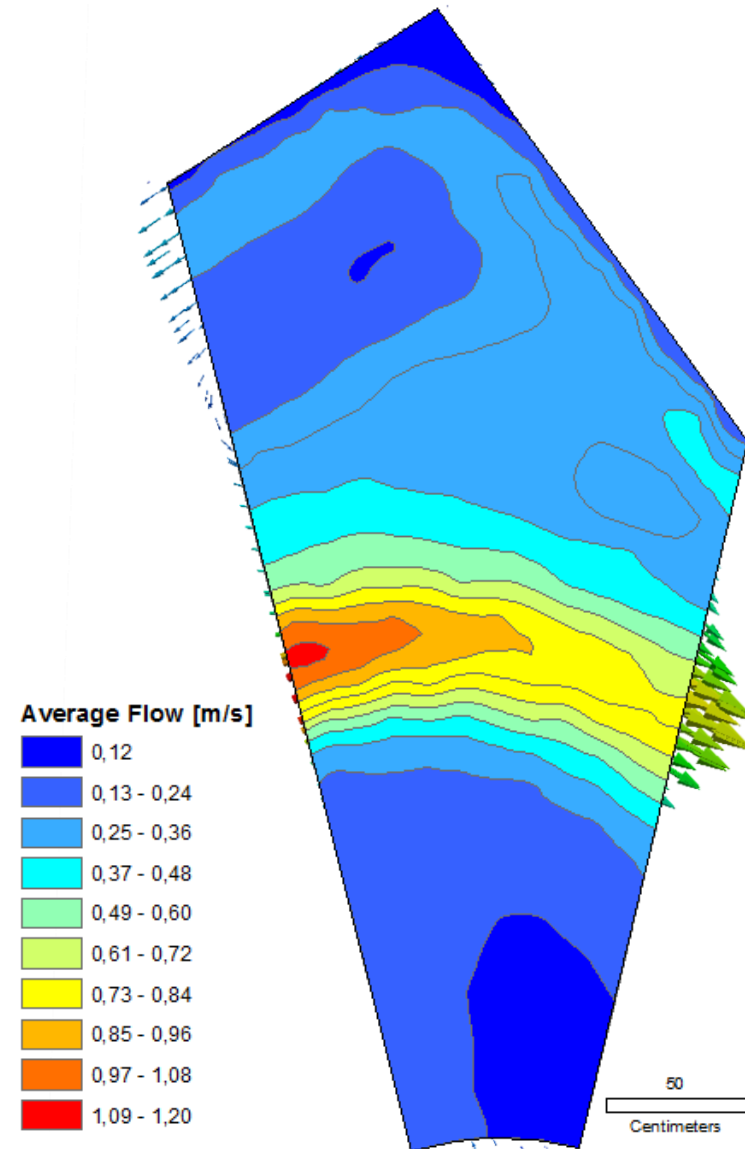
## 4. Results: do fish rest in turning basins?



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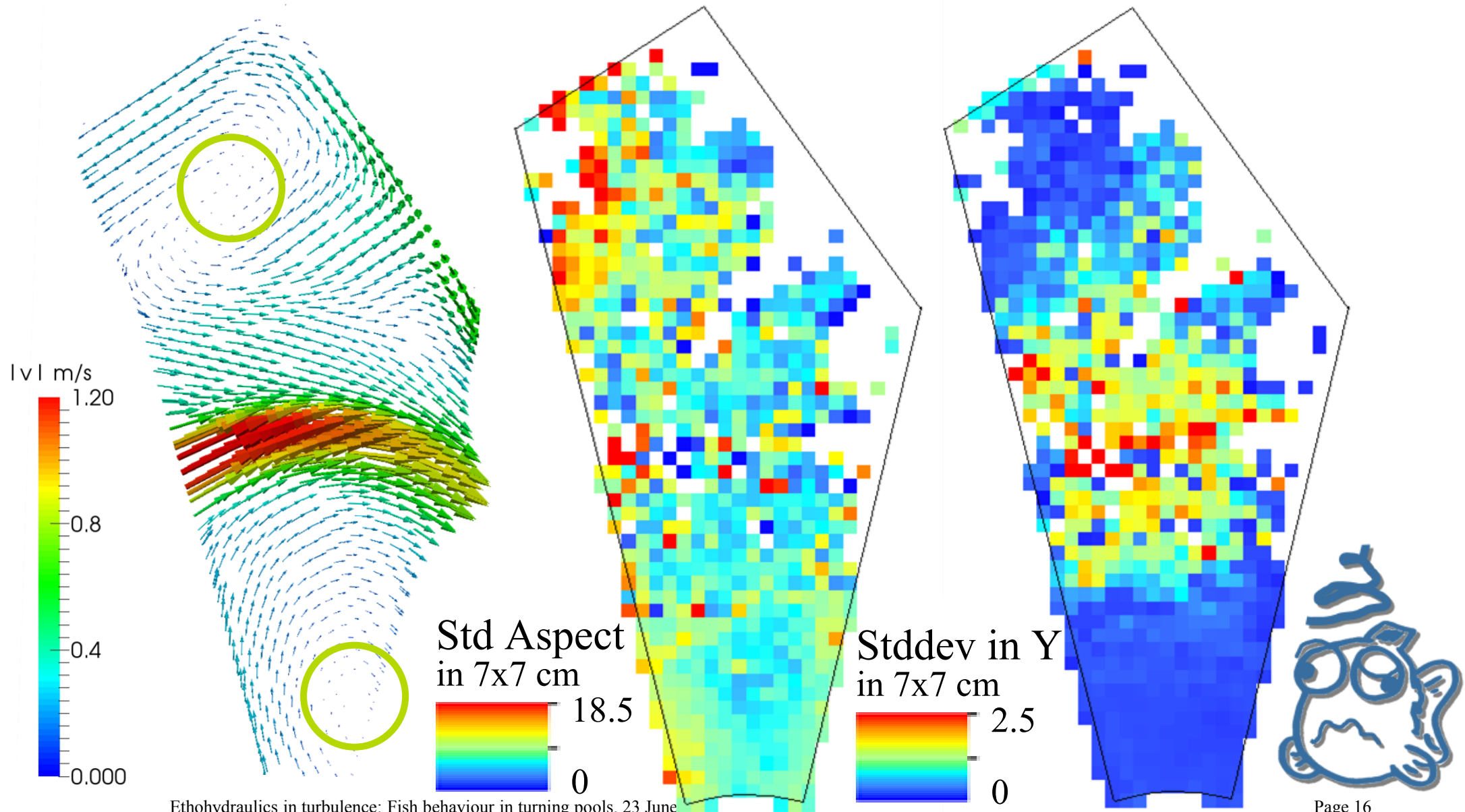


## 4. Results: do fish swim against the flow?

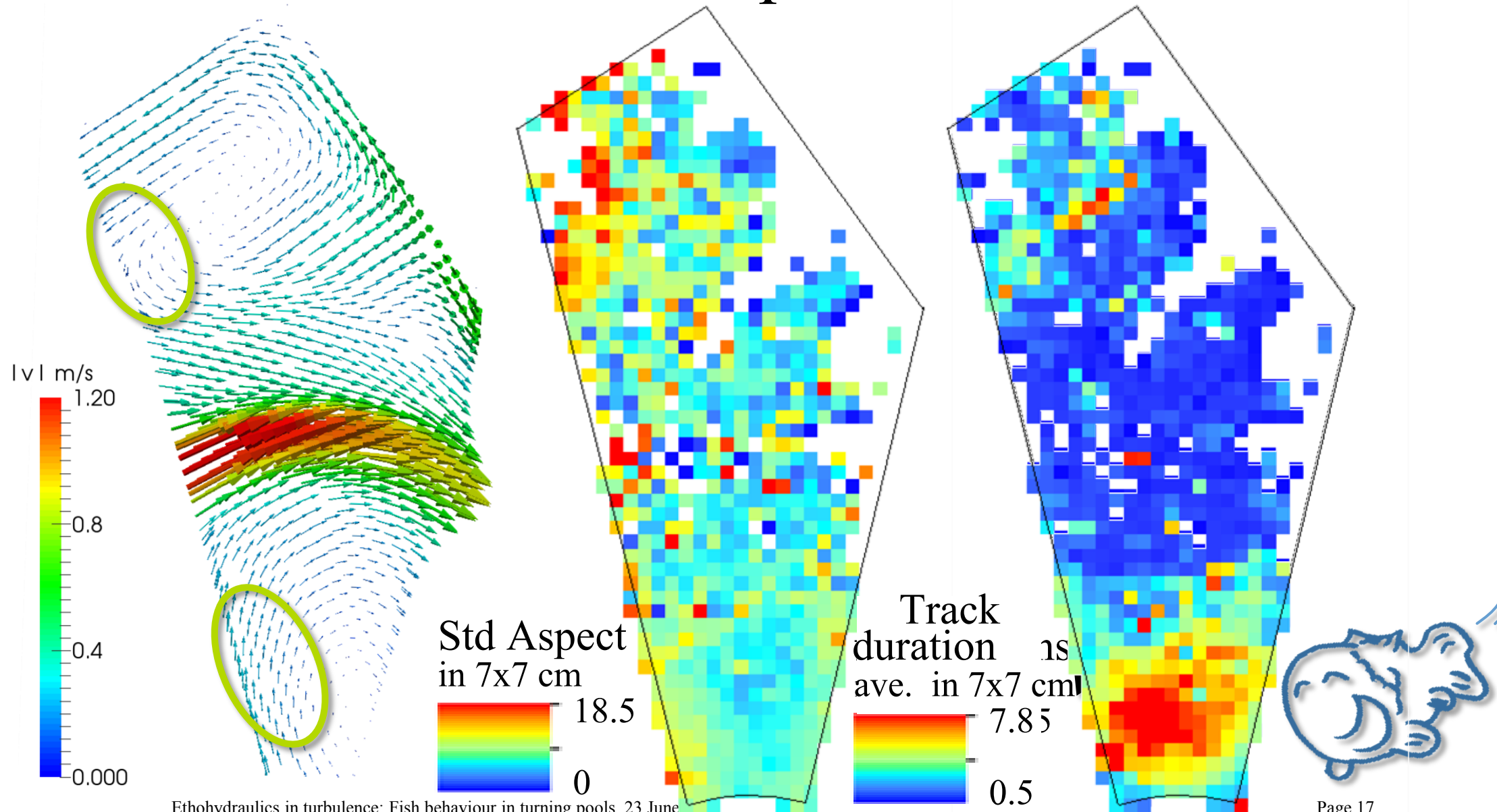




## 4. Results: vortex causes disorientation?



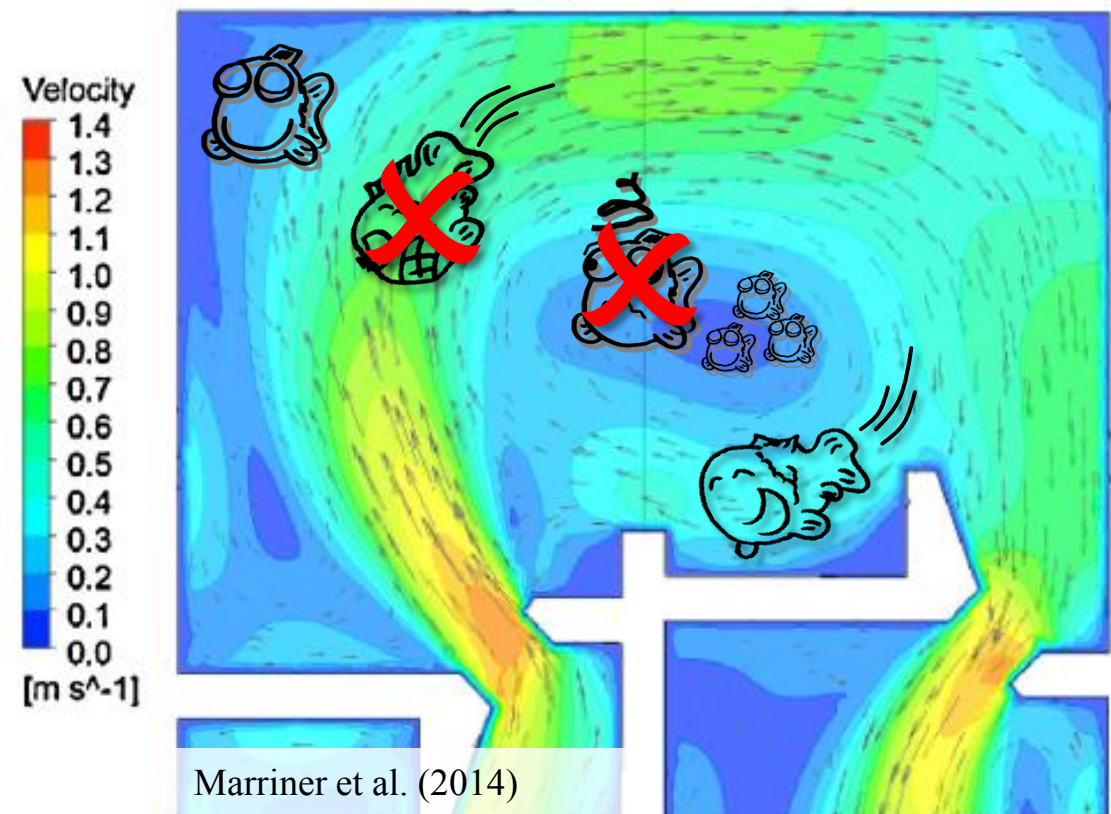
## 4. Results: vortex capture?



## 5. Conclusions

### Causes of fish passage delays in turning basins

- ✓ fish use areas with reduced flow to rest, especially:
  - . smaller fish
  - . in the central vortex
- ✓ fish do not swim against the main current
- ✓ main current = barrier
- ✓ fish do not seem to be disoriented by vortex
- ✓ fish capture the vortex



## 5. Discussion

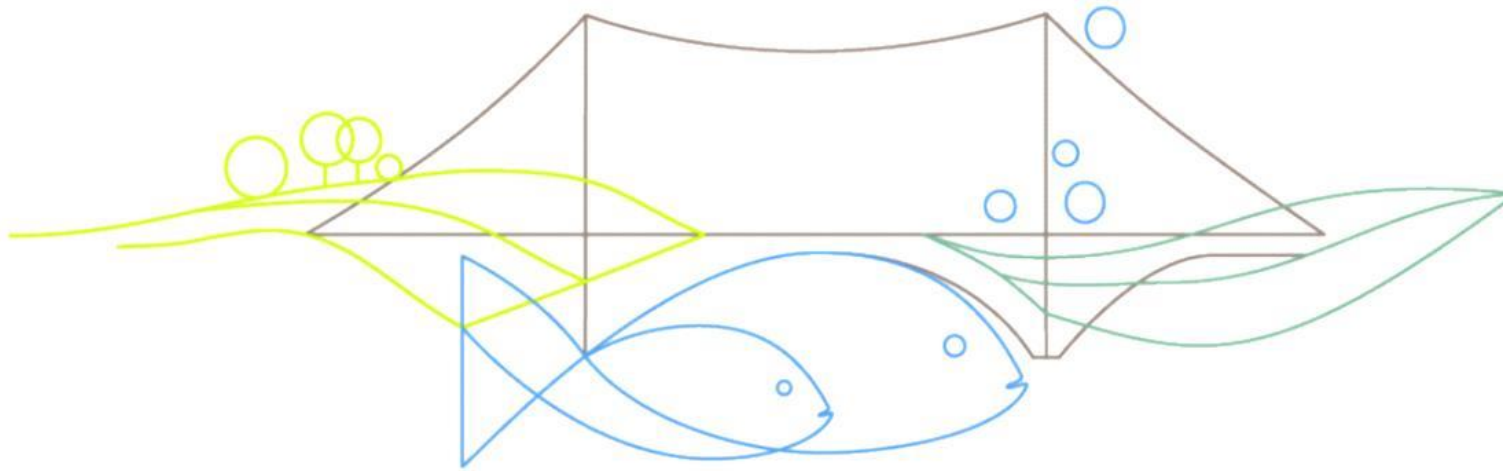
- ✓ Nov & Dec. outside classical migration period
- ✓ Not all turning basins are the same
- ✓ Preliminary results: more data still has to be evaluated
- ✓ Differences in vertical flow patterns → 3D sonar?
- ✓ More accurate hydraulic model
- ✓ Link with PIT Tags & Fish Counter



HamburgerJung (2005)



# Thank you for your attention



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