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Session B4: New Insights into Schooling Behavior in Response to Flow

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Schooling behaviour in response to flow

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Outline

- Background
- Research question
- Methods
- Results
- Conclusions

Functions of grouping

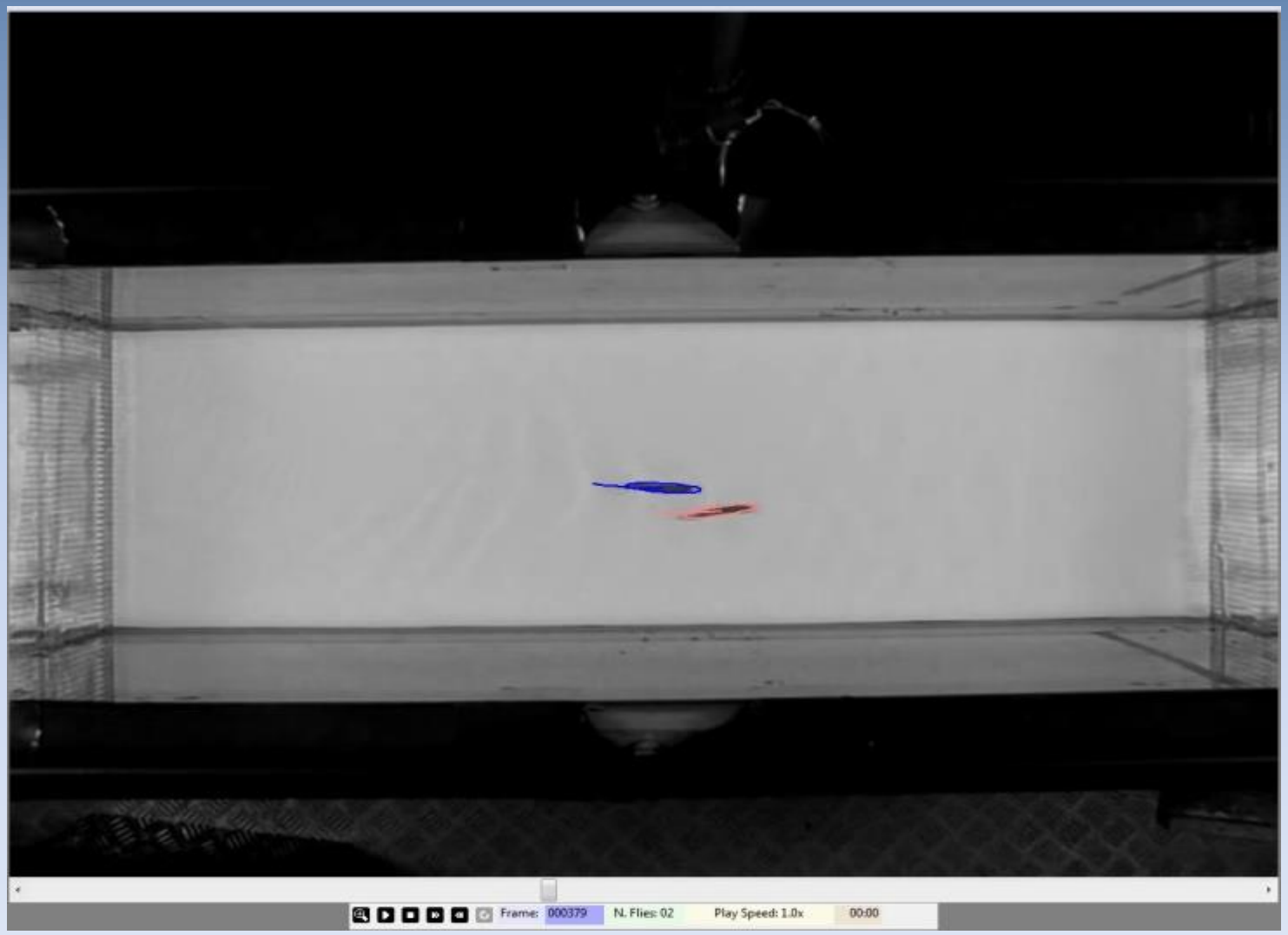
- Anti predator
- Foraging
- Hydrodynamic efficienc
- Migration
  - For upstream migrants, essential, whereas dow behavioural traits while
  - Variety of barriers along
  - Local changes in hydraulic conditions
    - Acceleration of flow / increased turbulence
    - Cause of delay

Research question

- How do hydrodynamics affect school cohesion and behaviour?
  - Focus on flow velocity and drag
  - Energy savings

- ‘Back to basics’ approach
  - Proxy for migrating fish species
  - Controlled environment

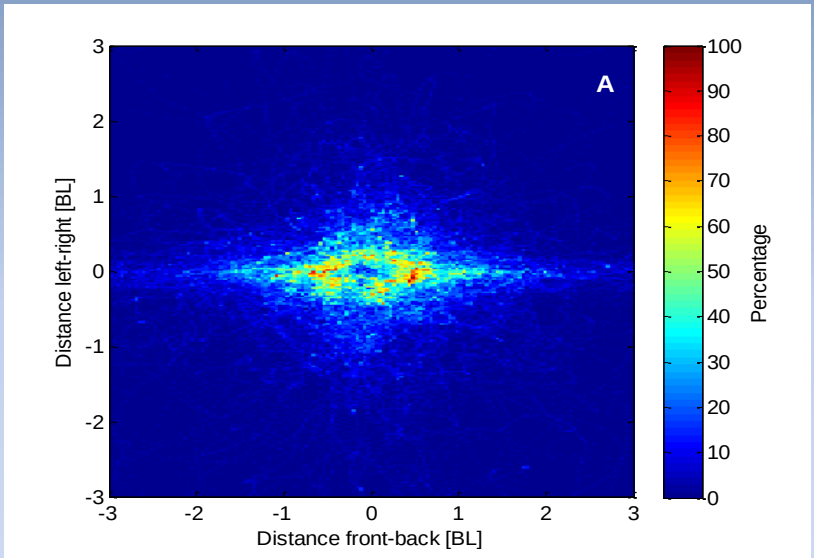
Methodology

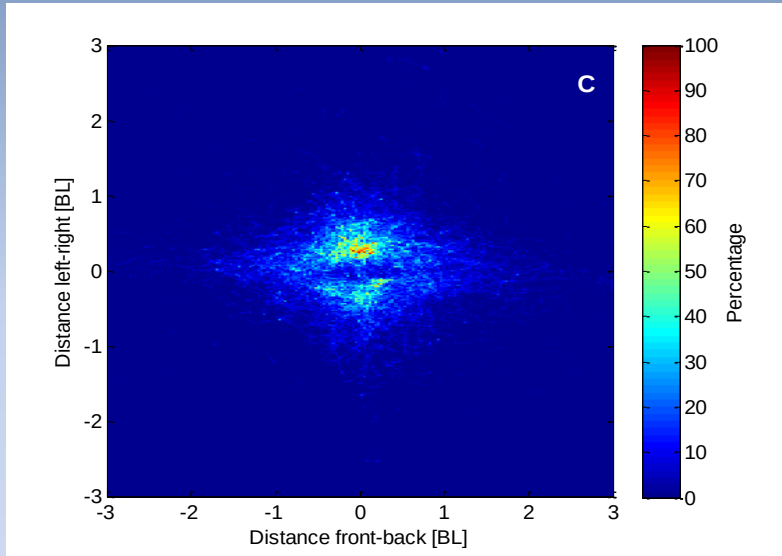


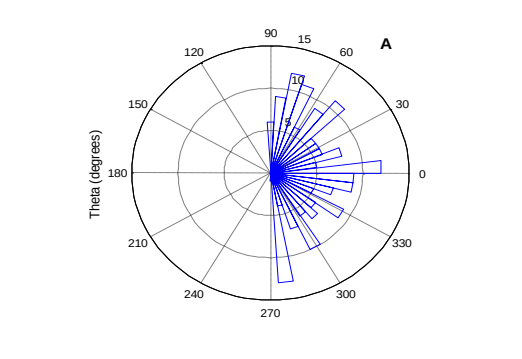
Results

- Increase in schooling time

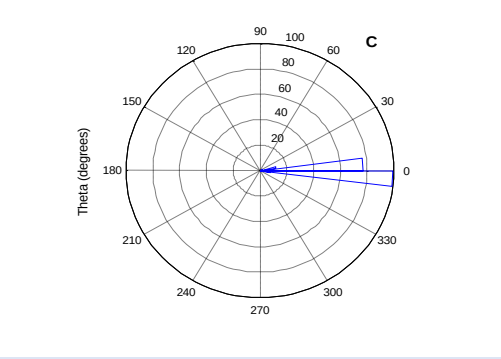
  Kruskal-Wallis: $H = 8.689$, $p = 0.013$; Jonckheere-Terpstra: $z = 2.890$, $p = 0.004$







Standing water



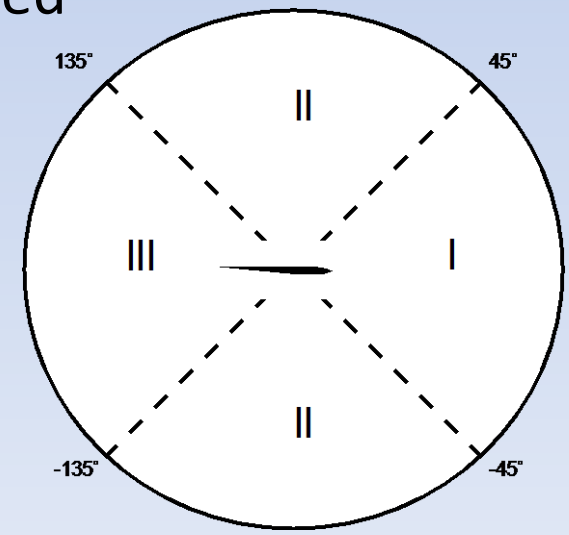
High flow

Conclusions (1)

- Flow drives fish together in a school
- Side-by-side configuration facing the flow
  - No wake exploiting
  - Novel finding that persists in bigger schools
- Why:
  - Saving energy possible?[1]
  - Disturbance of lateral line limiting information transfer?[2]

Results

1. Model drag coefficients in ANSYS Fluent®
   - As distance between fish decreases, drag increases and is higher than that of single fish
2. Investigate speeding (V_x) and turning (V_y) velocity correlations
   - Faster response time to change in speed
   - Higher turning correlation



Conclusions (2)

- Fish aim to maximise information transfer in flowing environment
  - Role of lateral line/vision changes in noisy environment
  - Neighbour along side preferred
  - Optimal navigation

- Fish sacrifice possible energy savings in the process

Thank you

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KATZ, Y., TUNSTROM, K., IOANNOU, C. C., HUEPE, C. & COUZIN, I. D. 2011. Inferring the structure and dynamics of interactions in schooling fish. *Proceedings of the National Academy of Sciences of the United States of America,* 108**,** 18720-18725.

CHICOLI, A., BUTAIL, S., LUN, Y., BAK-COLEMAN, J., COOMBS, S. & PALEY, D. A. 2014. The effects of flow on schooling Devario aequipinnatus: school structure, startle response and information transmission. *Journal of Fish Biology,* 84**,** 1401-1421.