Larval Fish Swimming Behavior Alters Dispersal Patterns From Marine Protected Areas in the NW Mediterranean Sea

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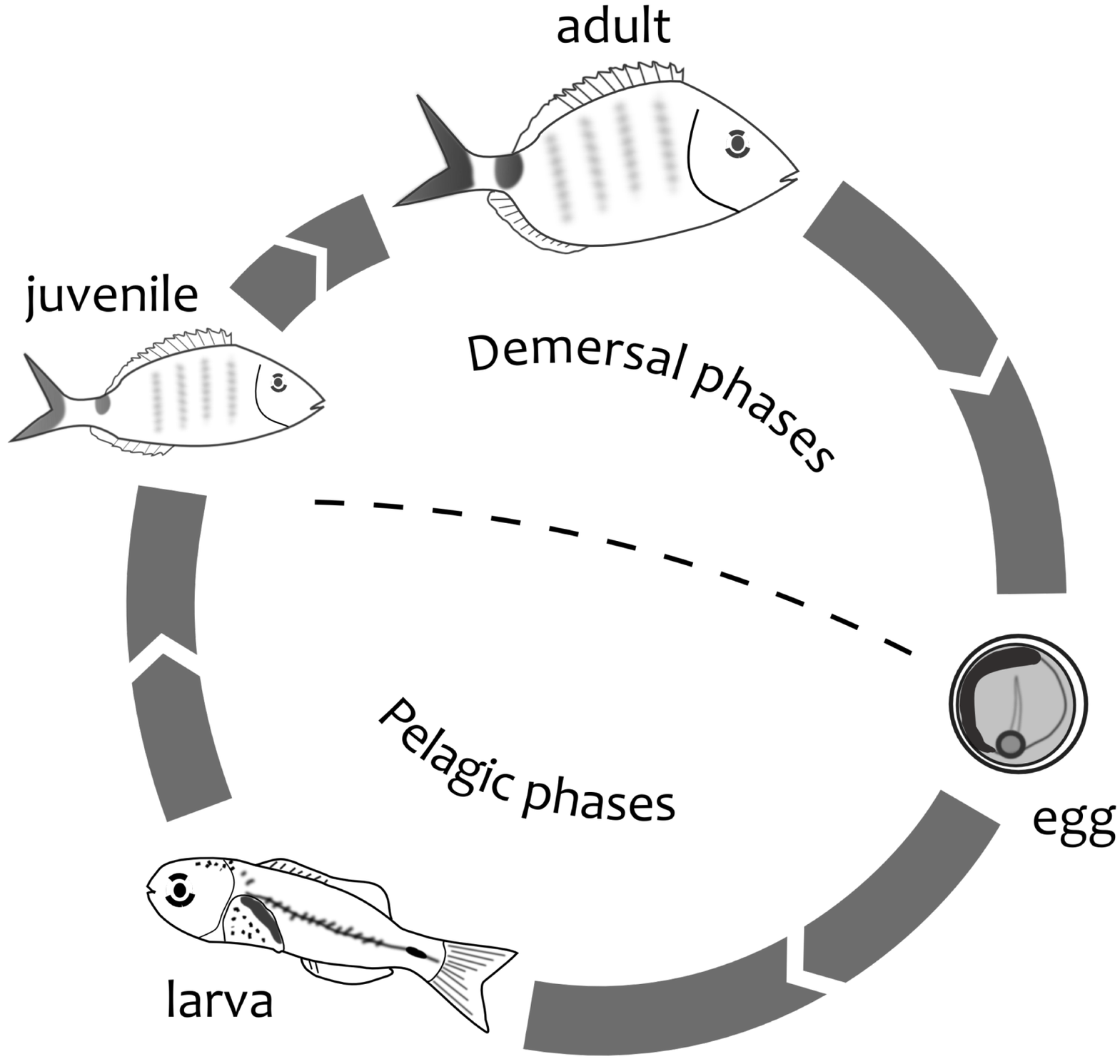
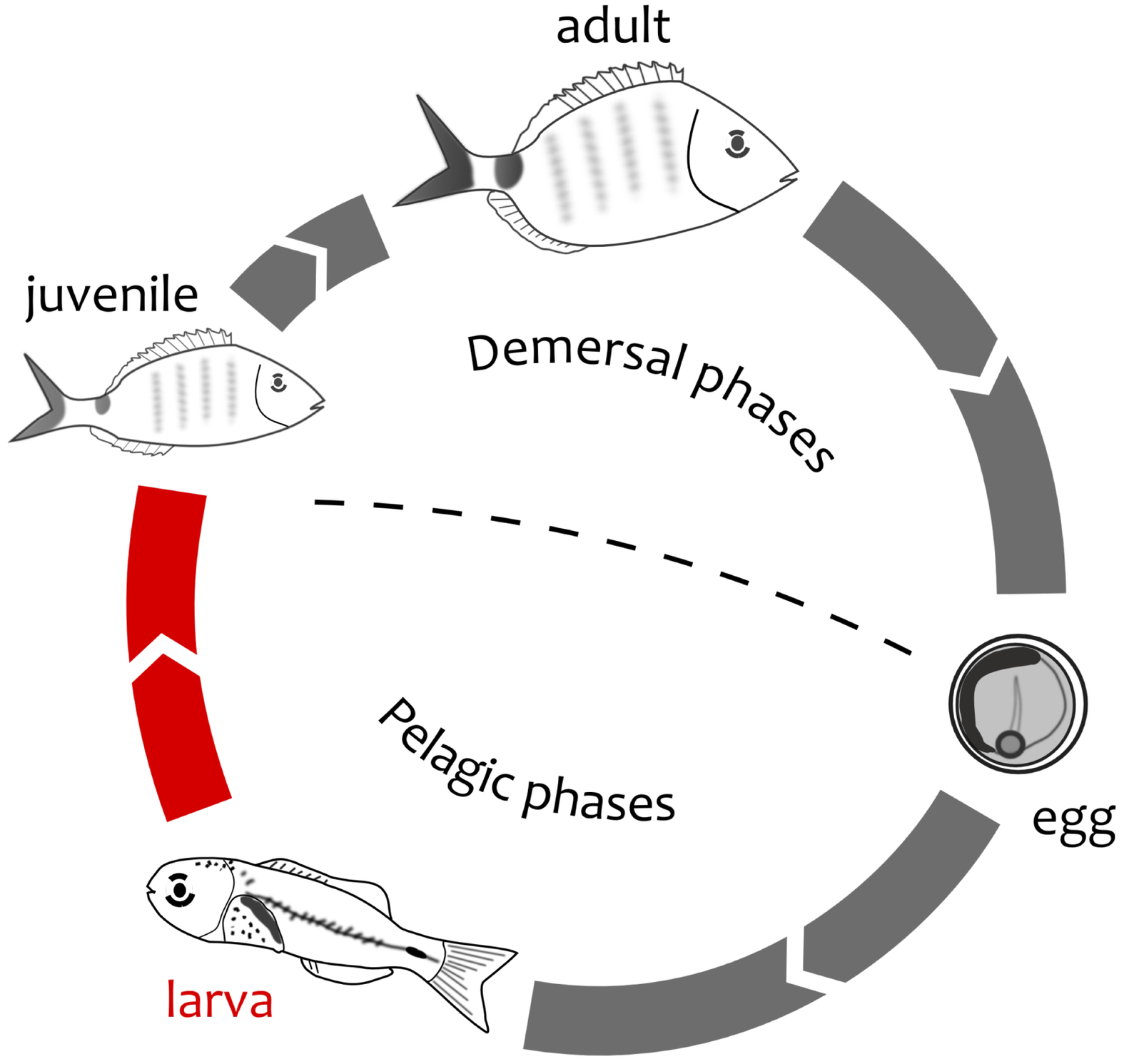
cnrs dépasser les frontières

Complex life cycle



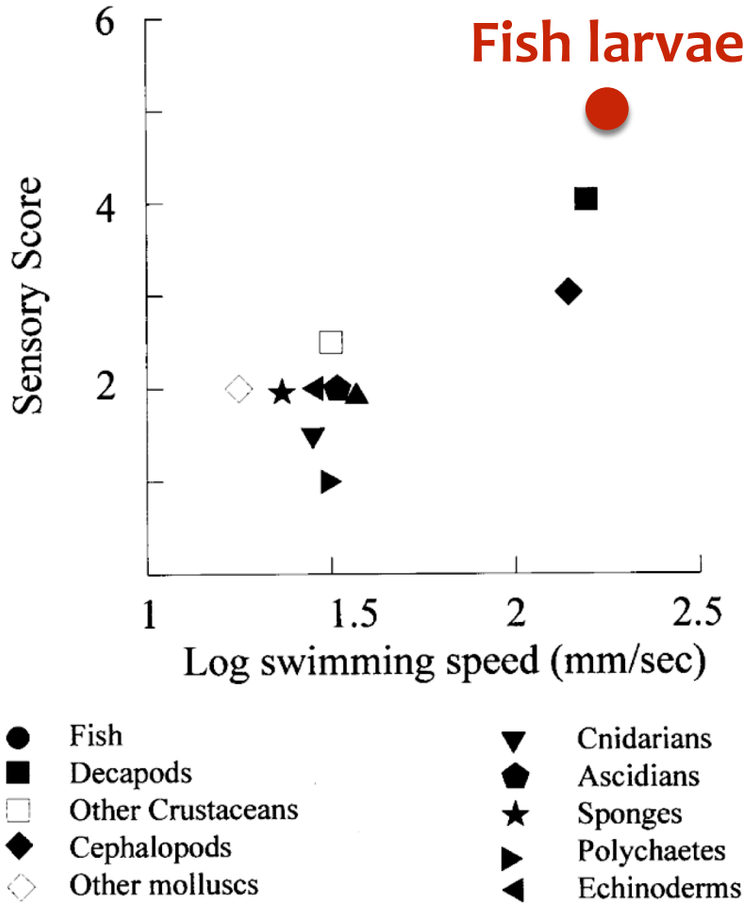
Complex life cycle



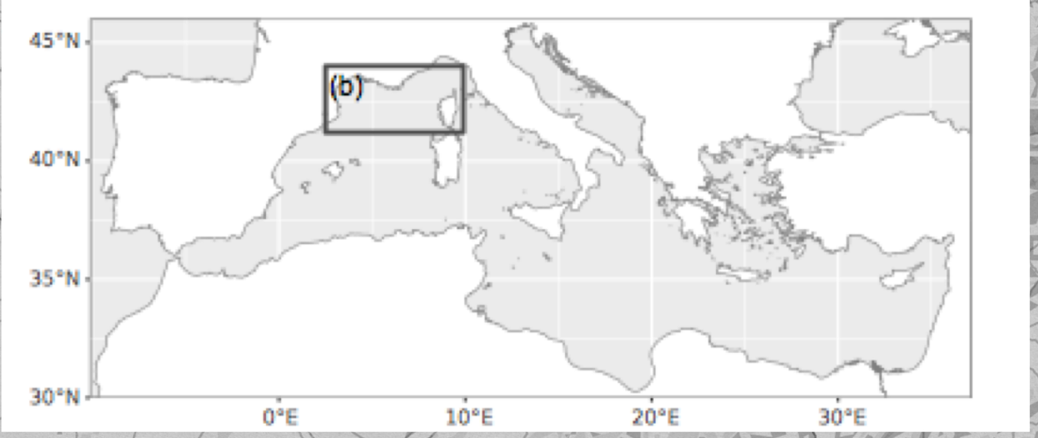
Connectivity

Demography
Genetics
Distribution

Fish larvae have strong sensory abilities and dispersal models

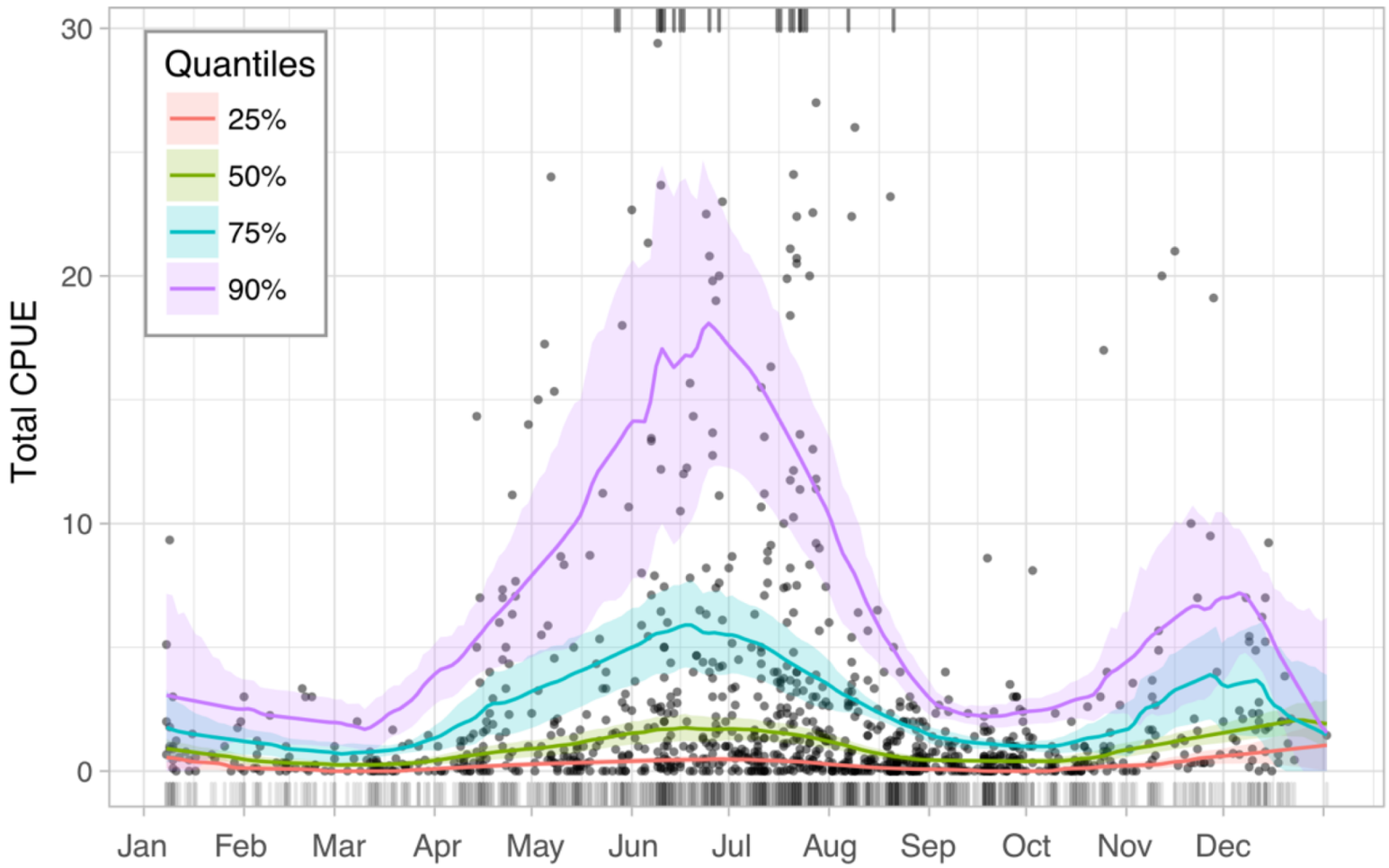


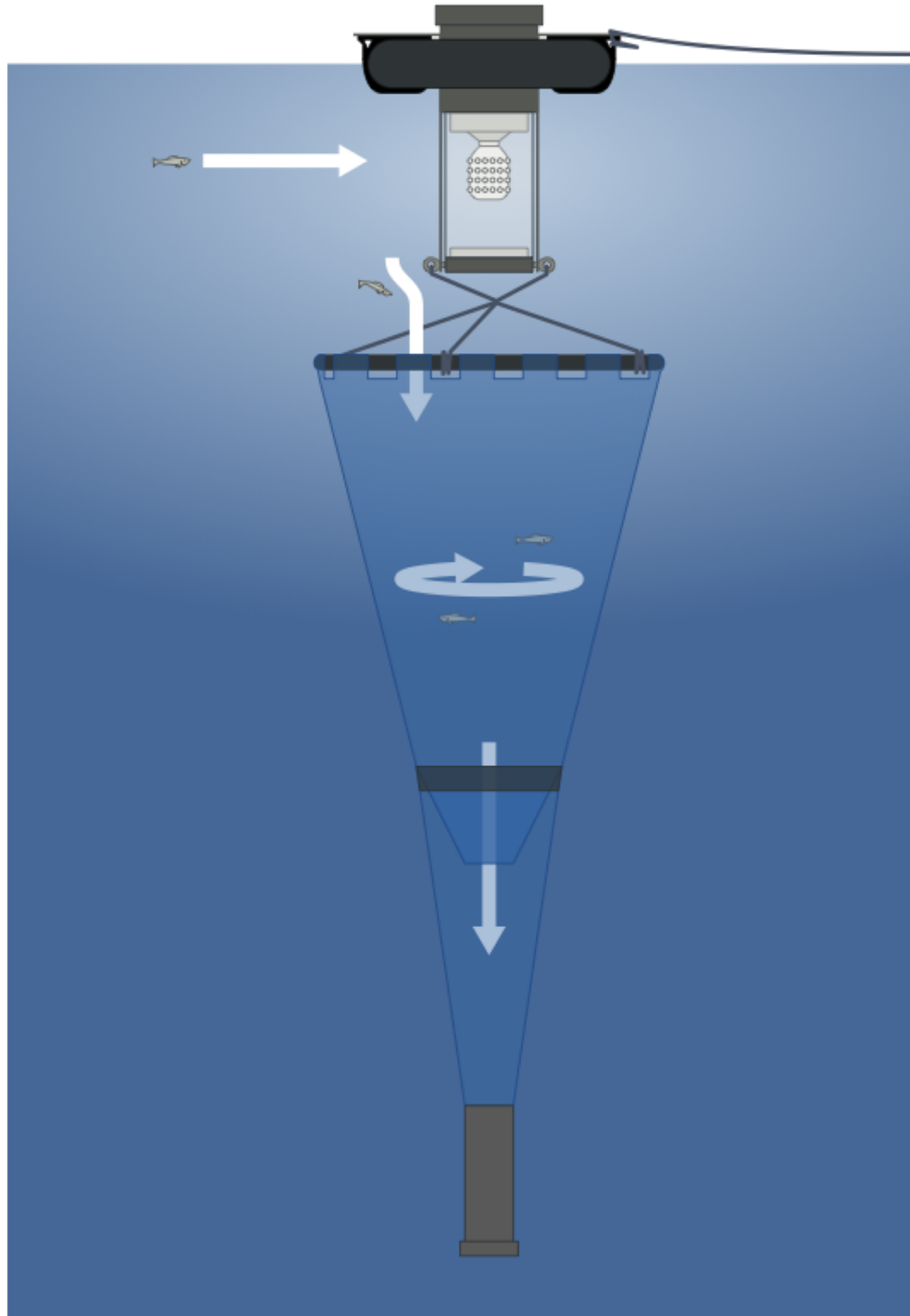
Kingsford et al., 2002


45°N
40°N
35°N
30°N
0°E
10°E
20°E
30°E
(b)

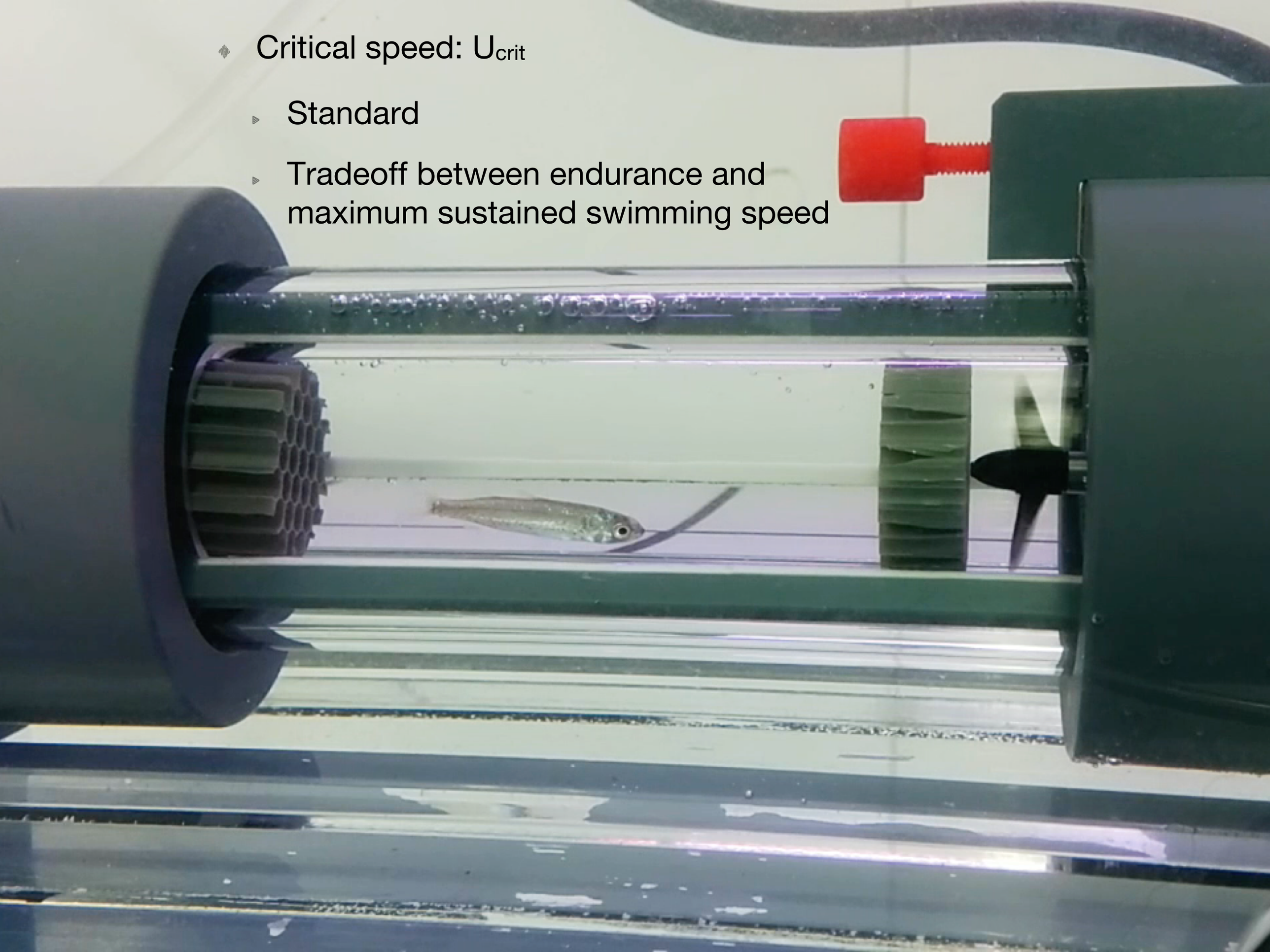
Larval supply in the Ligurian Sea

- Marked seasonality
- Strong influence of the moon

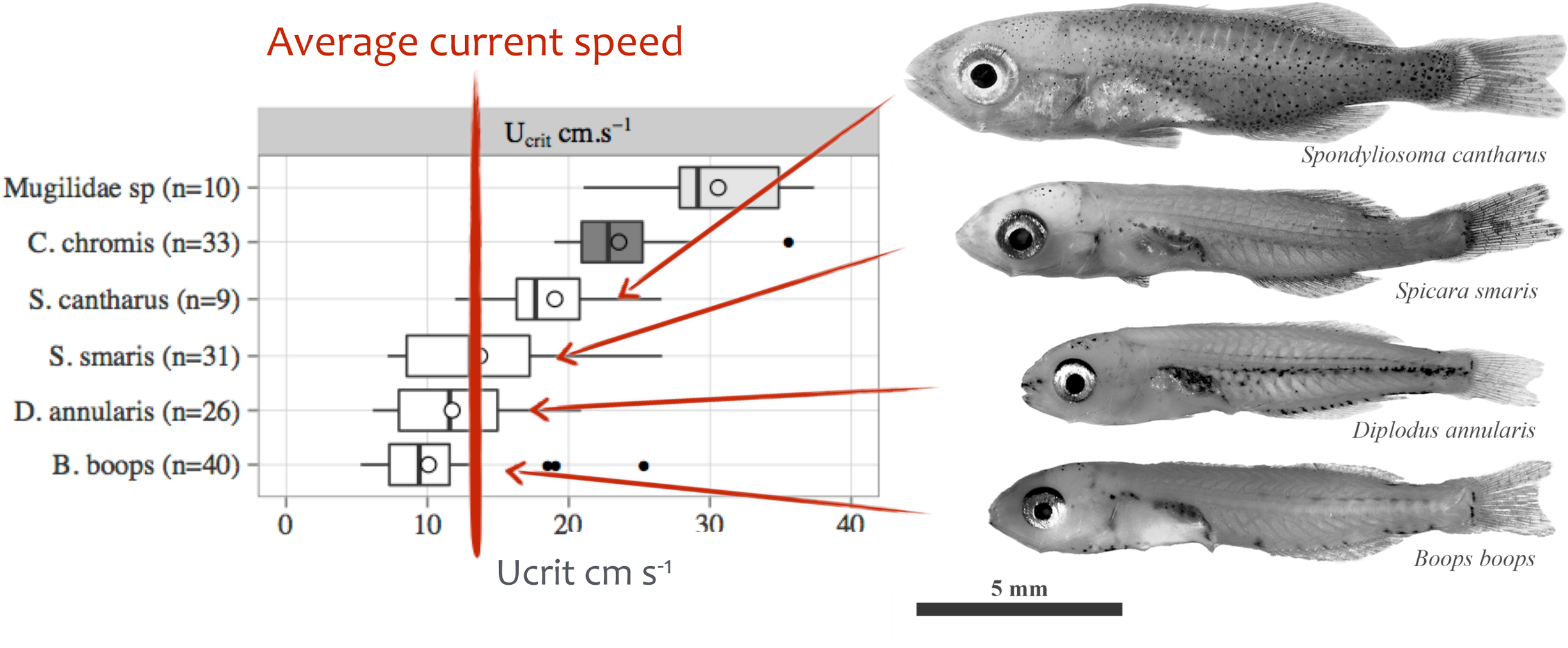




- Critical speed: U_{crit}
  - Standard
  - Tradeoff between endurance and maximum sustained swimming speed



Critical swimming speed of some Mediterranean fish larvae



"Small sparids" group
- *Oblada melanura*
- *Spicara maris*
- *Diplodus annularis*
- *Boops boops*

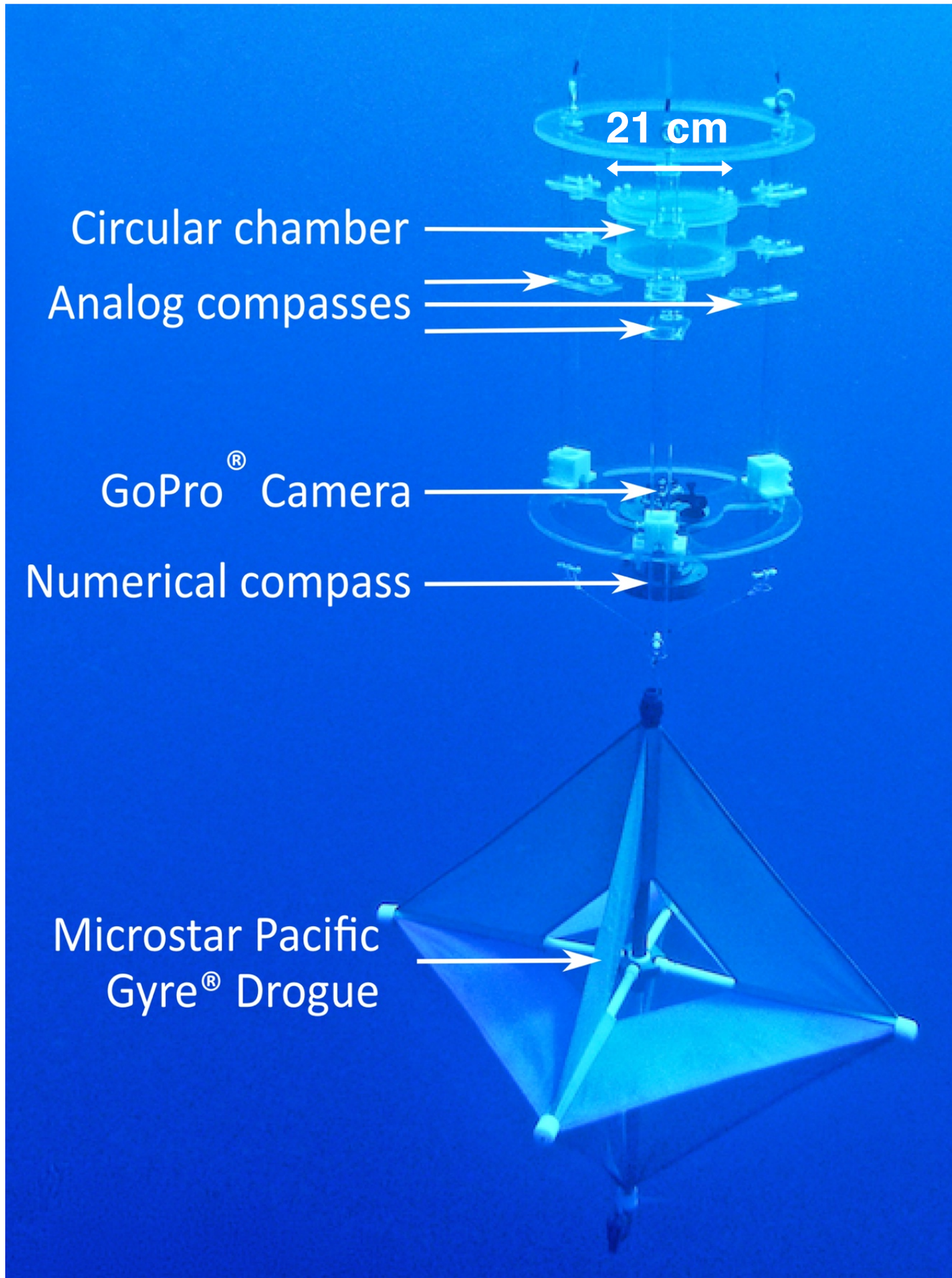
VS.

"Large sparids" group
- *Spondyliosoma cantharus*
- *Pagellus acarne*
- *Pagellus bogaraveo*

Faillettaz et al., 2017, L&O

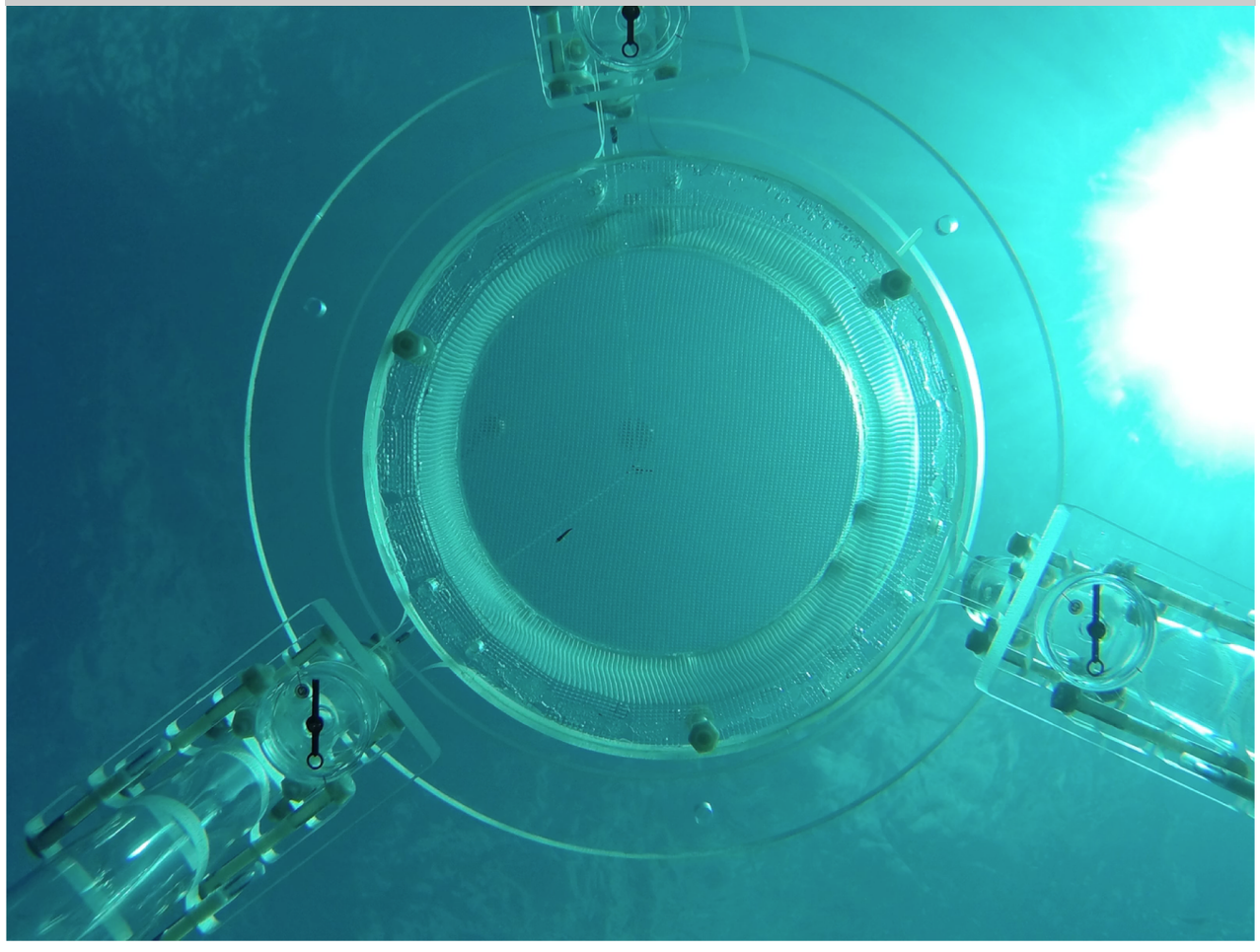
Estimating *in situ* orientation

- Drifting *In Situ* Chamber
  - Lagrangian
  - *In situ* observations
  - No human interaction

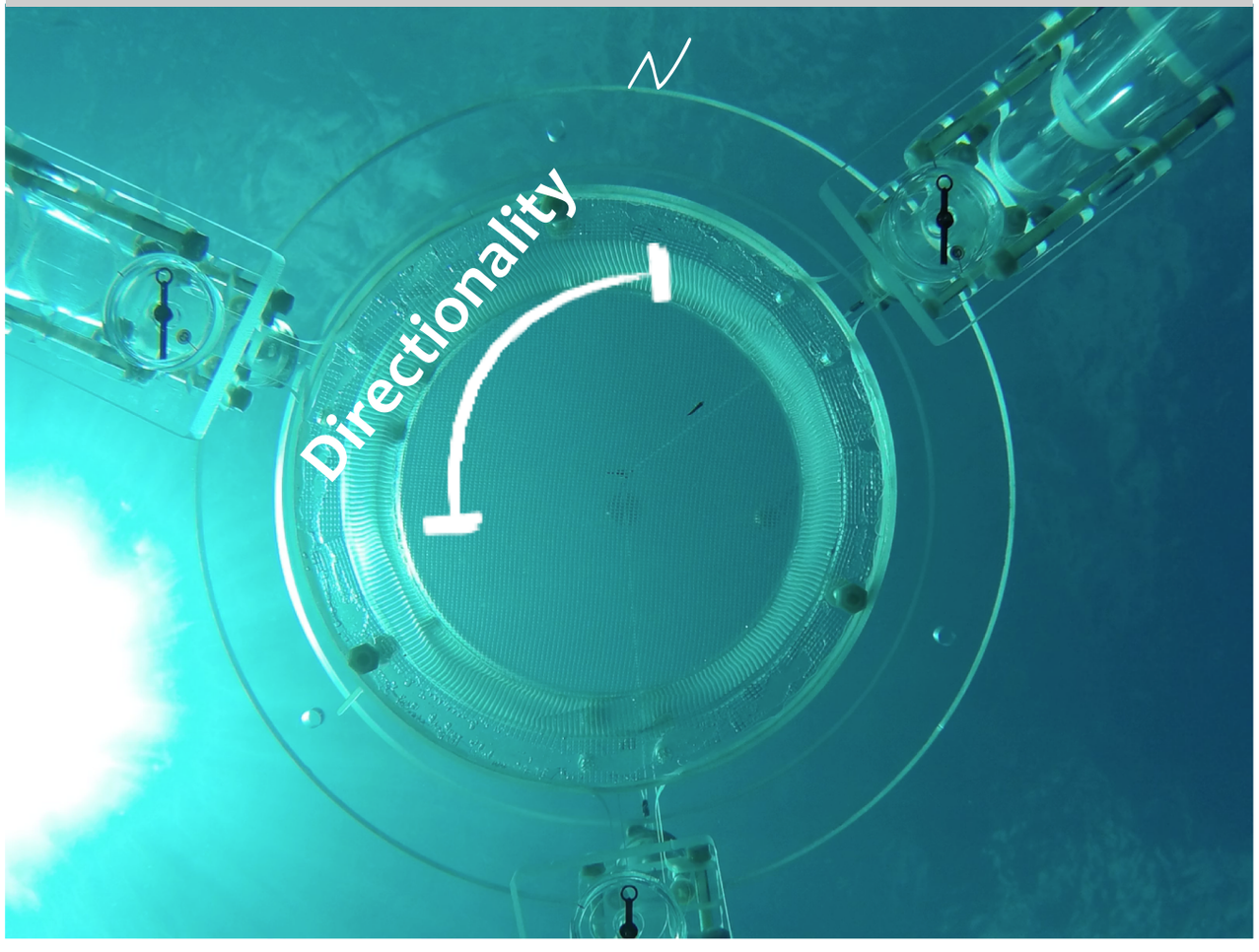


Directionality = the ability to follow a fixed direction

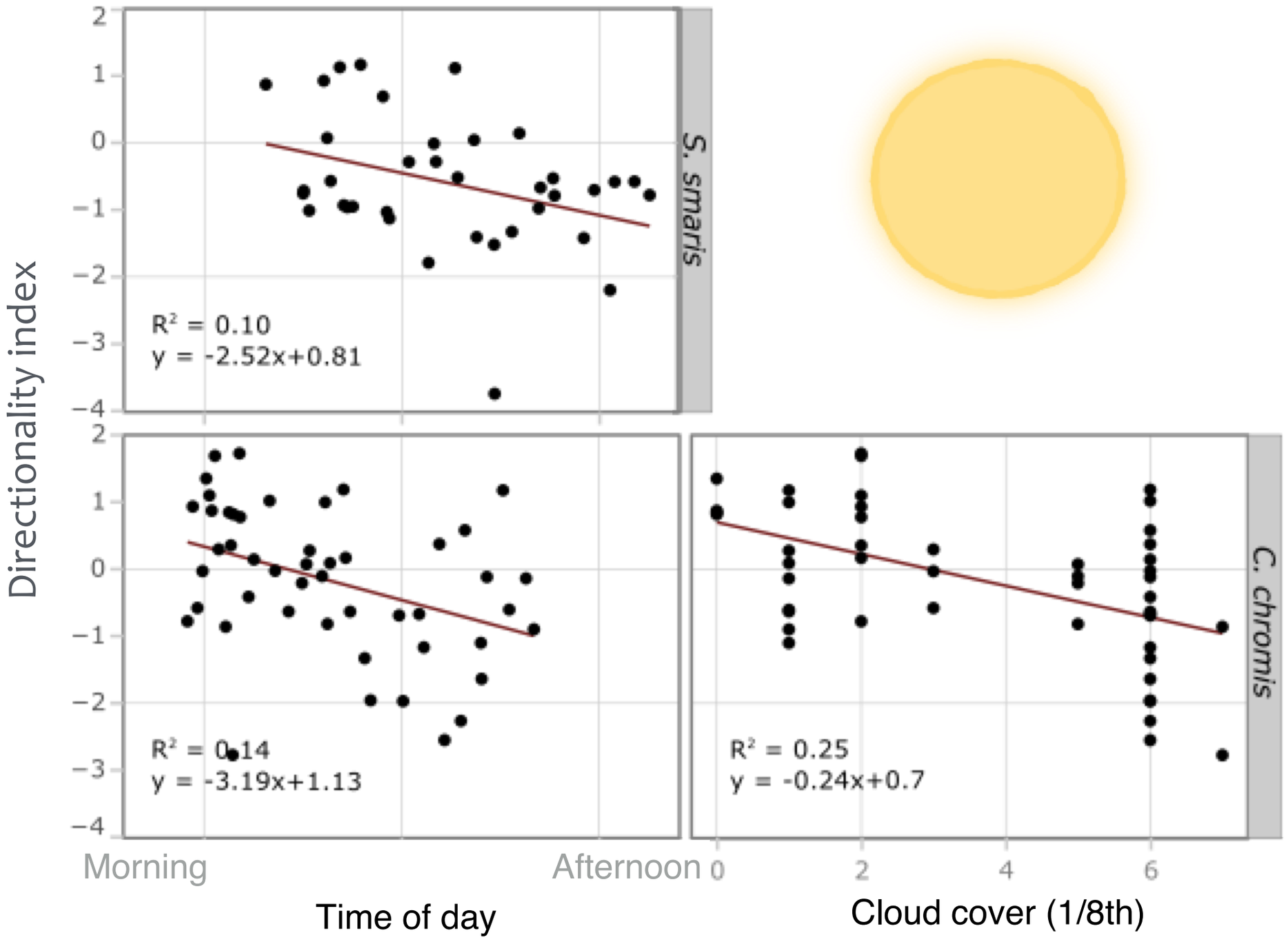
RAW



CORRECTED



Sun-related cues influence directionality



Faillettaz et al., 2015, PLoS ONE

Testing the aberrant drift hypothesis (Hjort, 1914)

Advection + swimming (CMS)

Shoreward swimming

between 0 and 19 cm/s

= measured speeds

1.2 km grid, 3 h

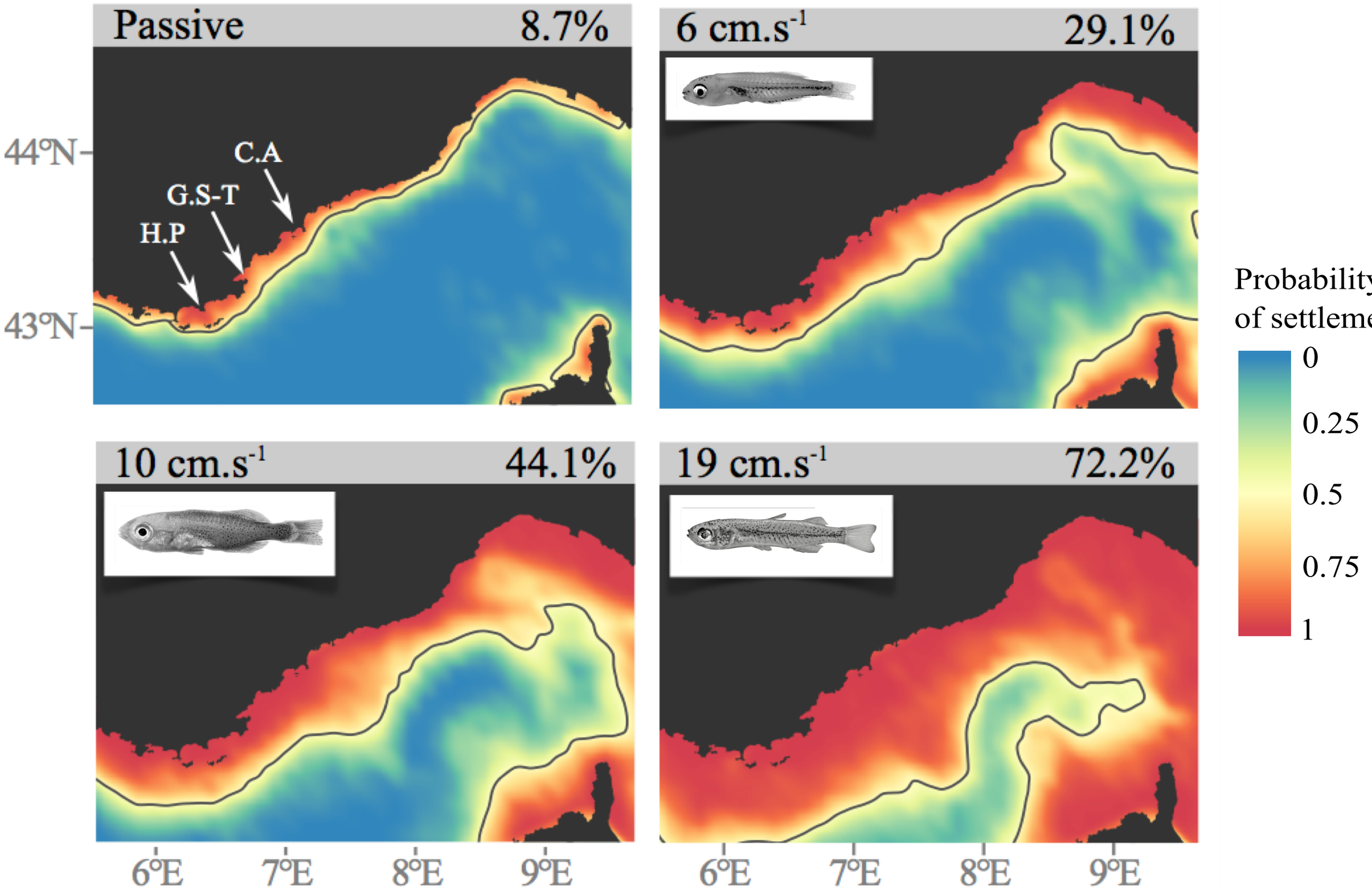
June 2014

Current field (MARS3DMed)

Intensity ($cm.s^{-1}$)

0 50 100

Fast swimming larvae may settle from anywhere



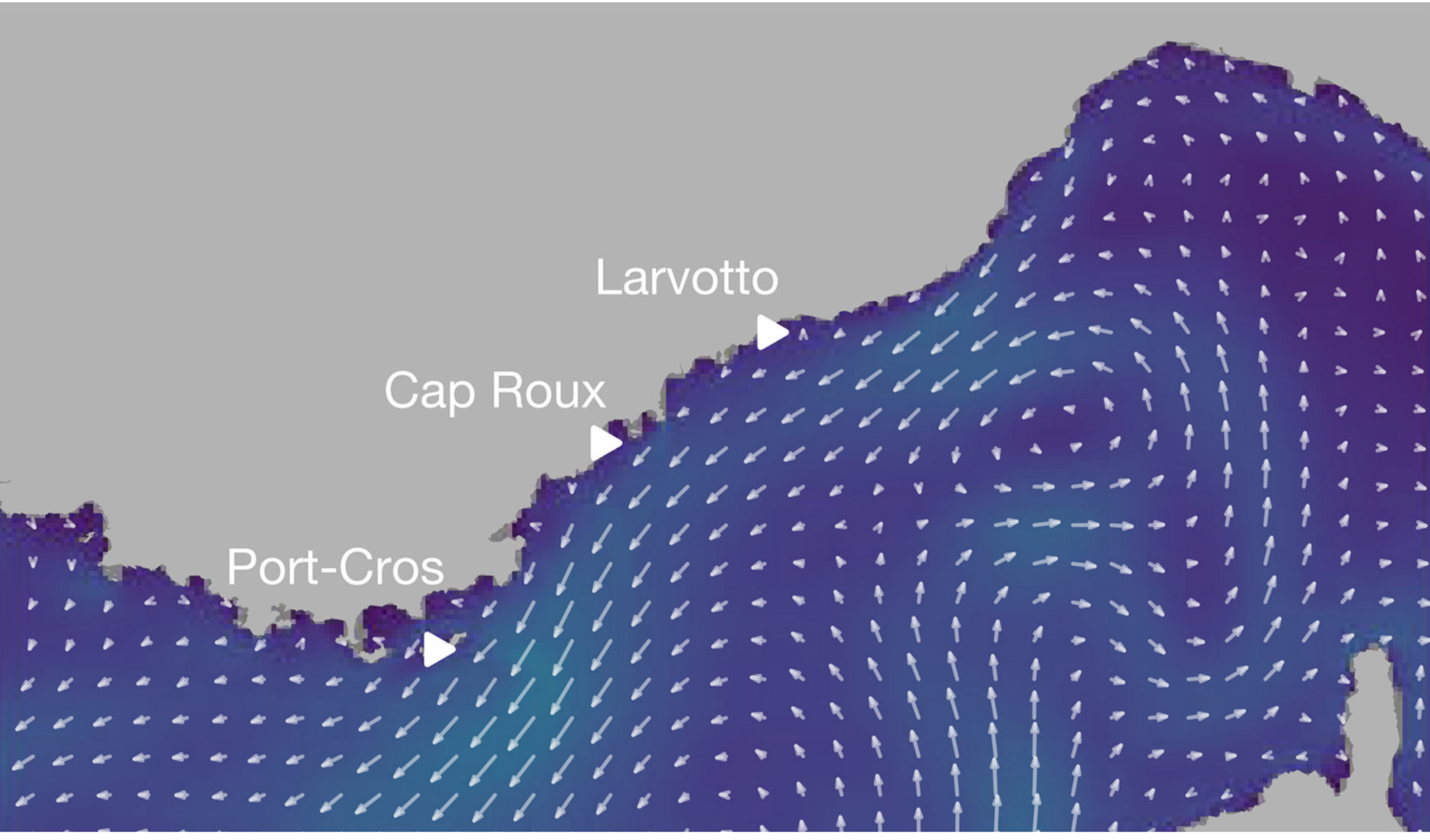
Faillettaz et al., 2017, L&O

Behaviour in connectivity models: an example

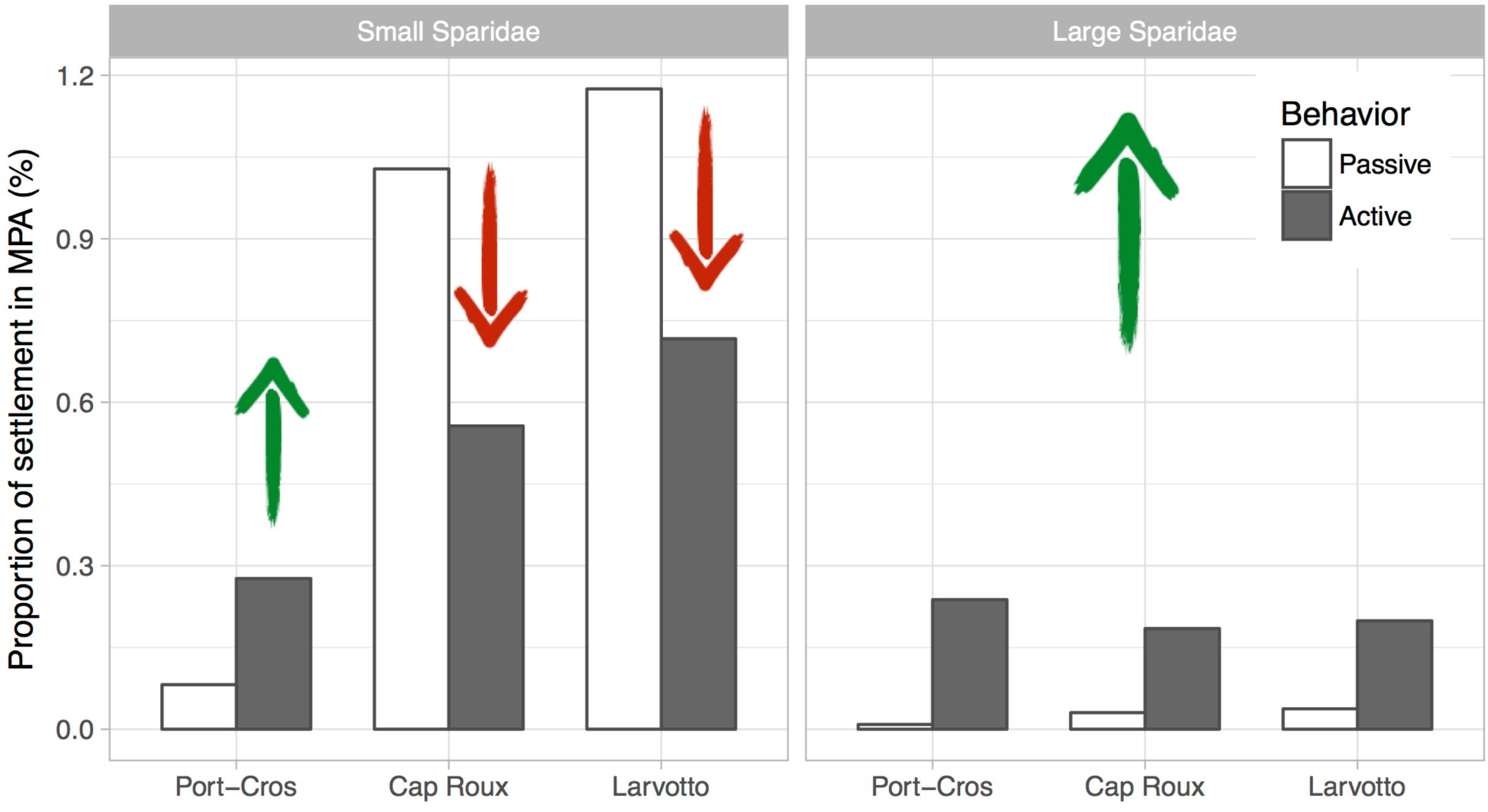
- All observations and behaviors implemented at once
  - Two groups of seabream larvae
  - Pelagic phases duration (egg + larva)
  - Diel vertical migration
  - Measured swimming speeds (50% U_{crit})
  - Orientation independent of coastal cues
  - Settlement around new moon

Small sparids	Large Sparids
1+13/19 d	1+28/38 d
1-10 m	1-10 m
6 cm/s at 12dph	10 cm/s at 28dph
After 8 dph	After 8 dph
Spawning around full moon	One lunar cycle from catch

Behaviour in connectivity models: an example

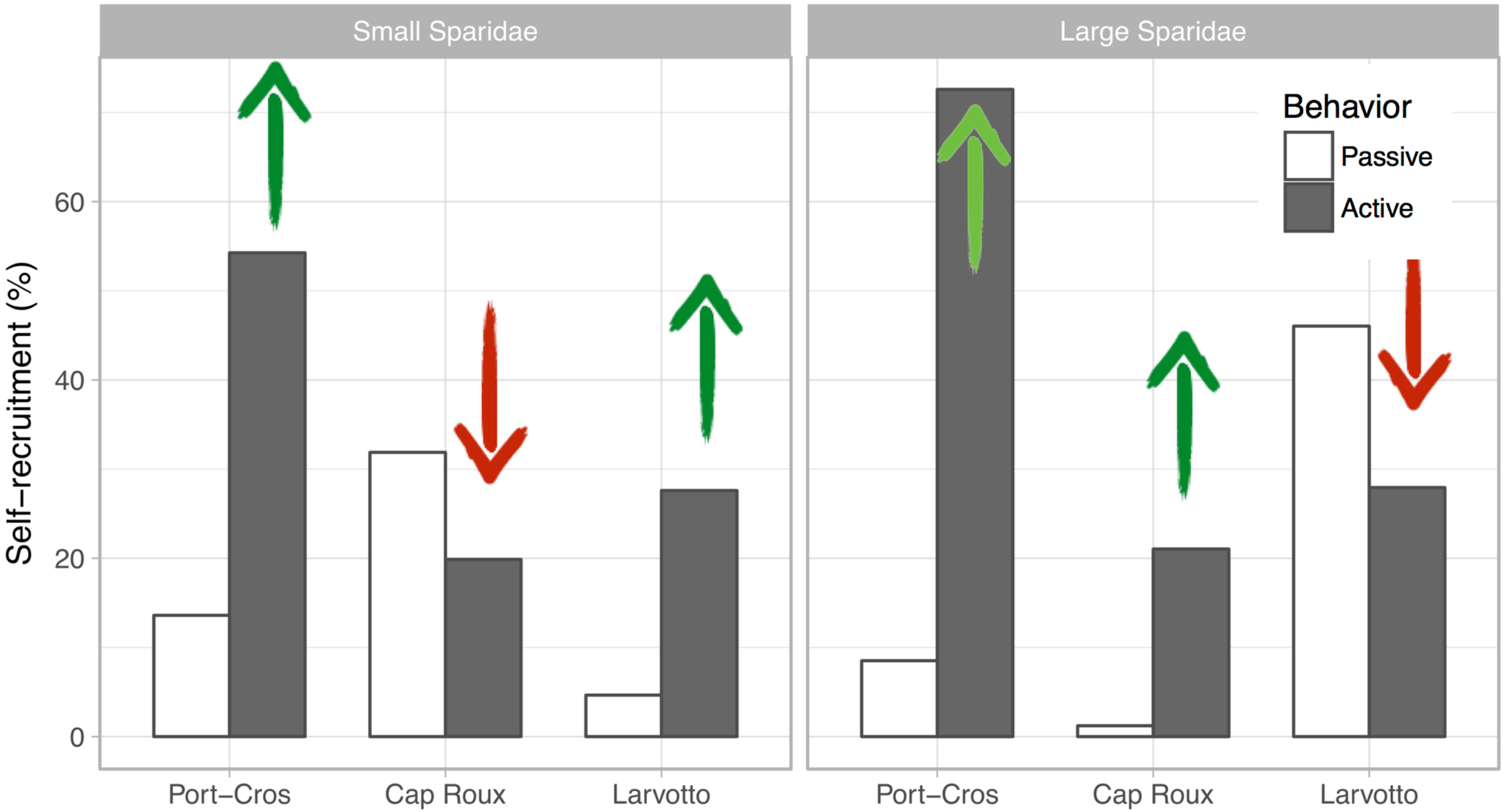


Settlement in MPAs



Faillettaz et al., 2018, Frontiers in Marine Science

Self-recruitment (% originated from the MPA that settled in the MPA / larval supply)



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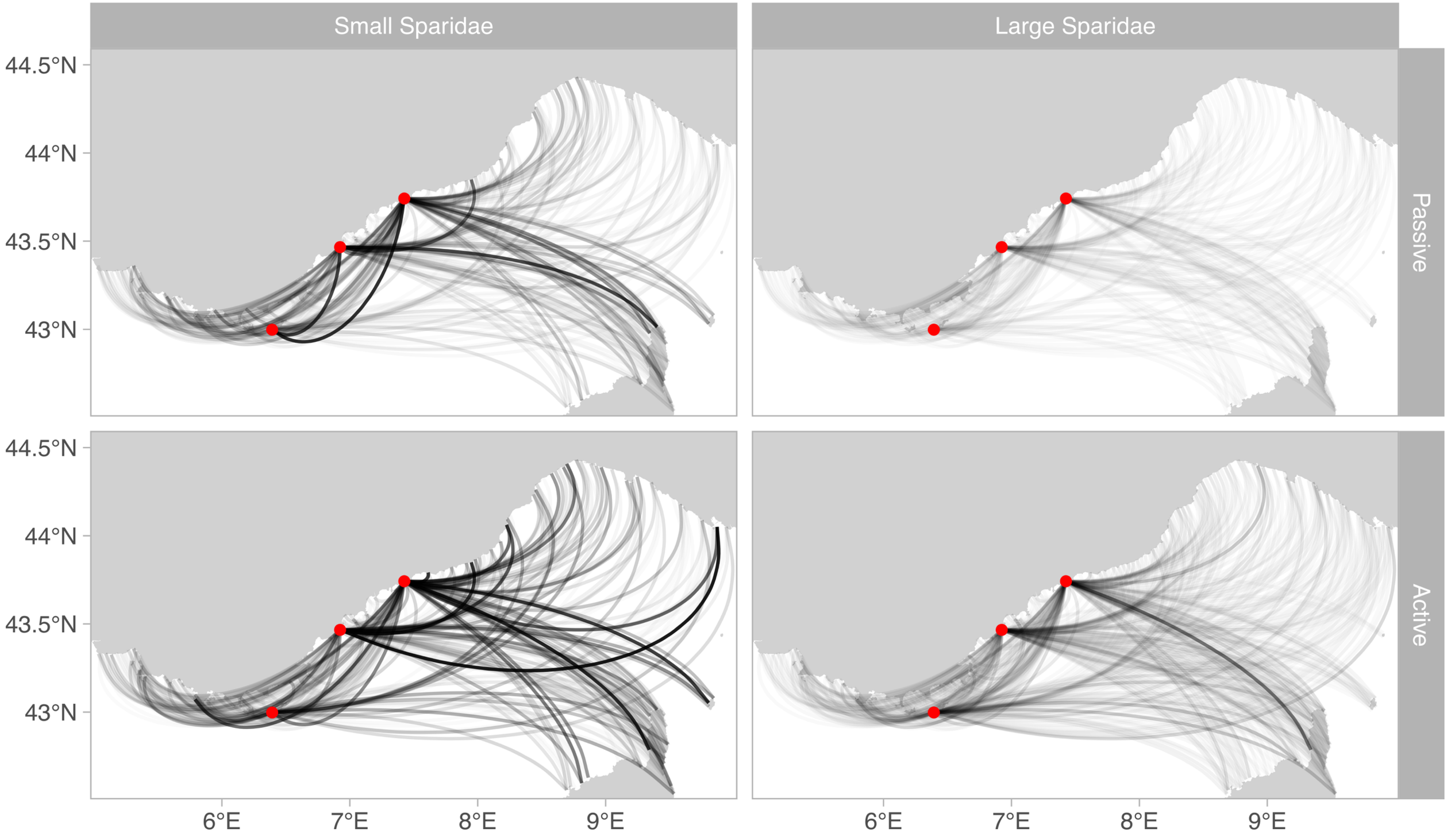
Enhanced connectivity!



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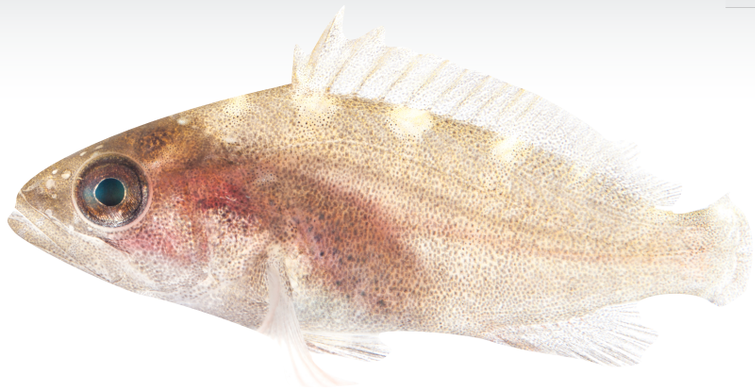
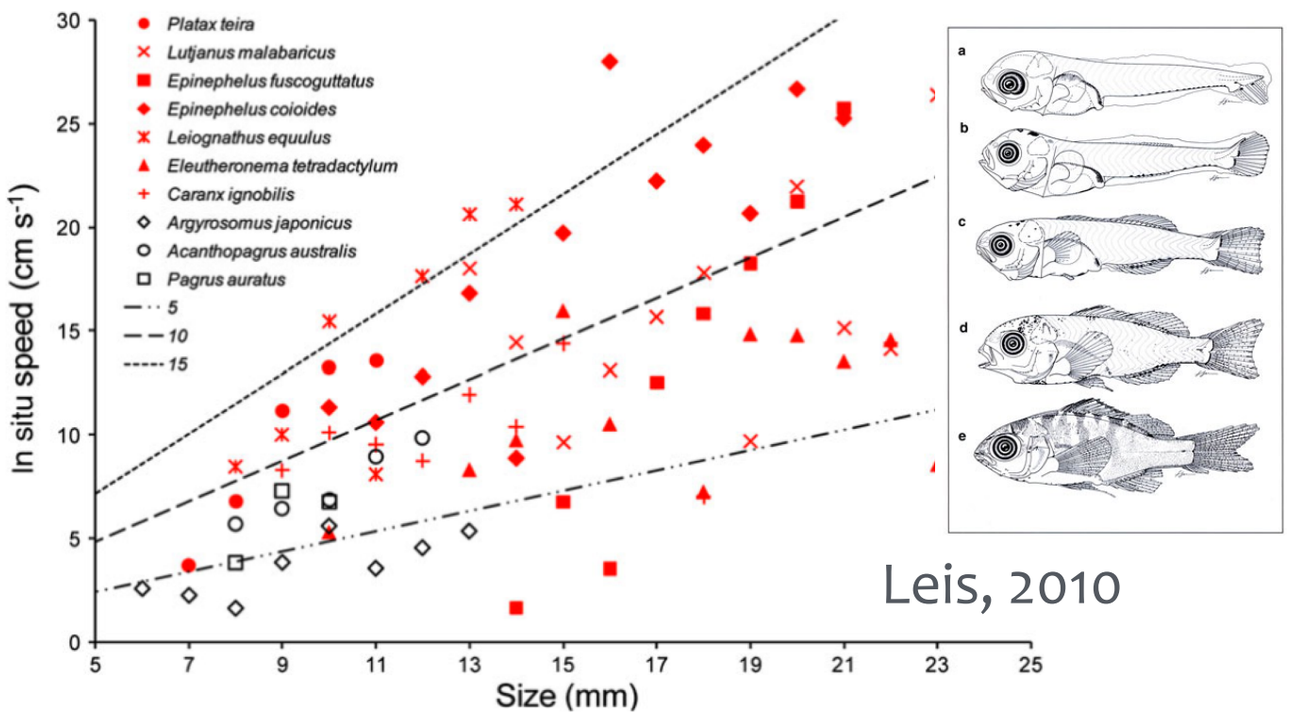
Conclusion and perpectives



- **Behaviour and connectivity models**
  - Are pre-settlement stage fish larvae passive? **Not really…**
  - Can we still ignore larval fish behaviour in dispersal models? **NO !!!**
  - Is this enough to inform managers? **It's a start!**

- **Critical lack of empirical data !!!**
  - Test more species and environments
  - What do fish larvae do at night?
  - Behaviour throughout ontogeny
  - Swimming endurance



Leis, 2010

Interns:
Agathe Blandin
Elysanne Durand

THANK YOU ! QUESTIONS?

MORE QUESTIONS? —> ROBIN.FAILLETTAZ@RSMAS.MIAMI.EDU