

Larval Fish Swimming Behavior Alters Dispersal Patterns

From Marine Protected Areas in the NW Mediterranean Sea

Robin Faillettaz, Claire B. Paris, Jean-Olivier Irisson



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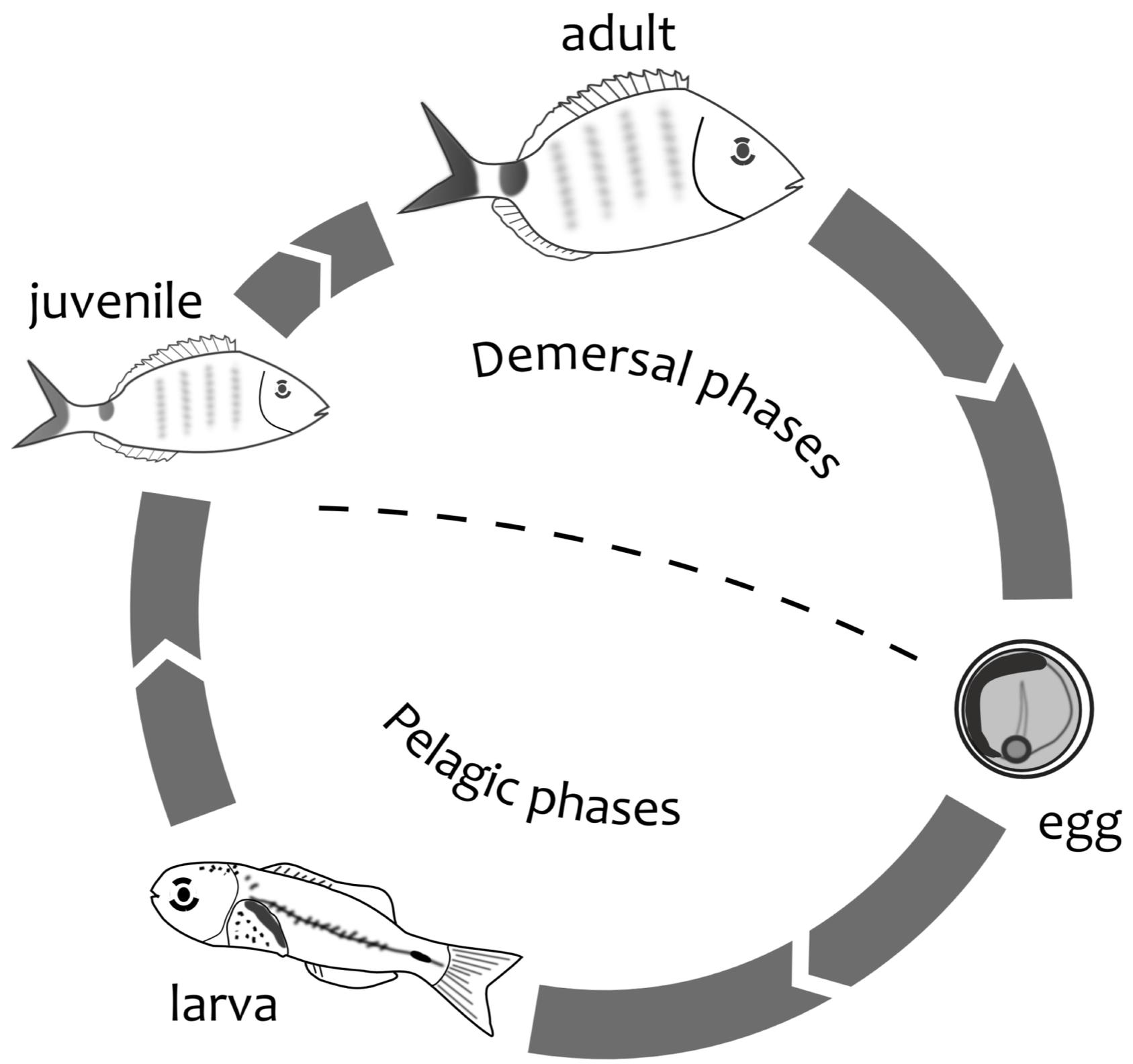
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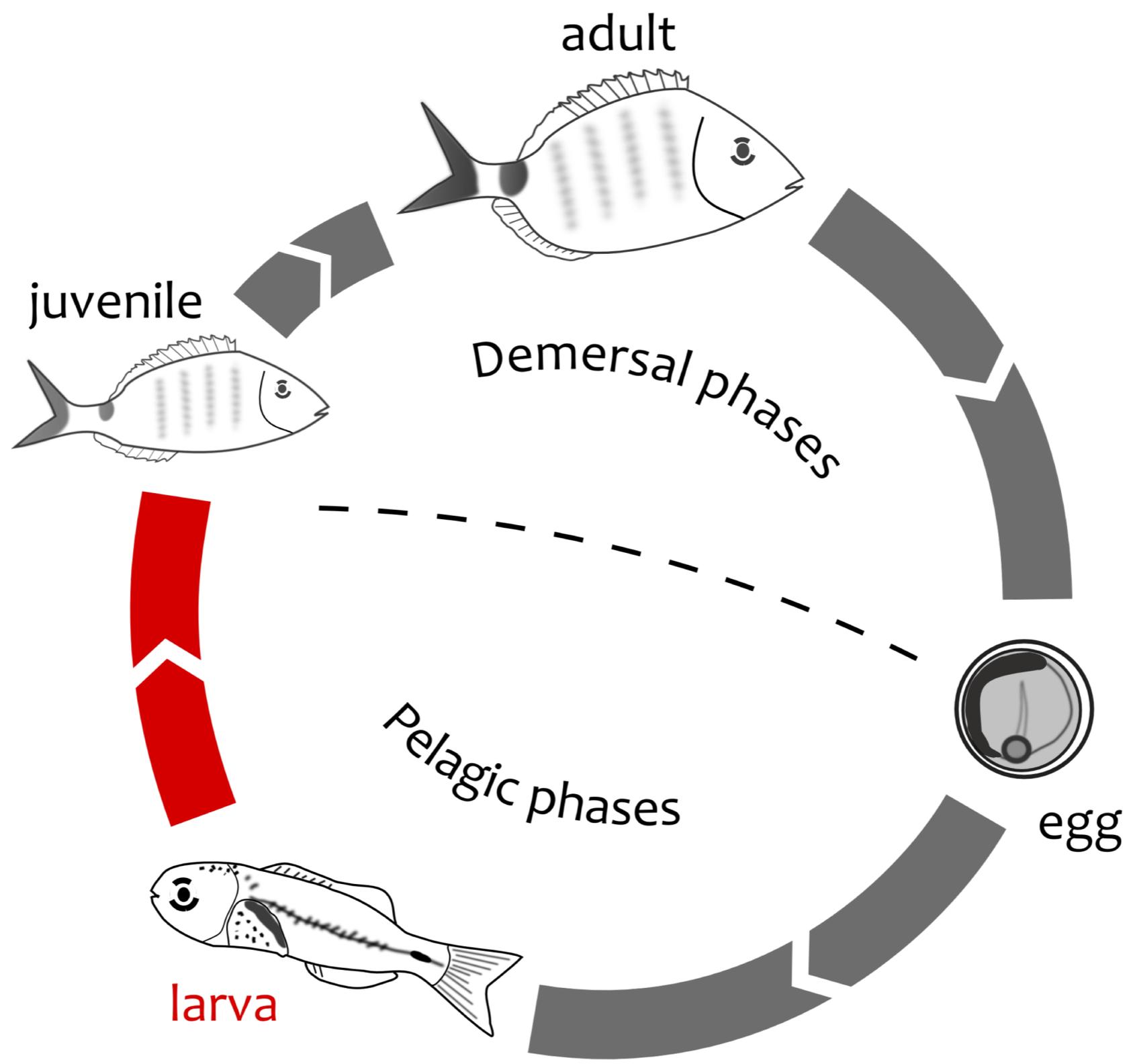
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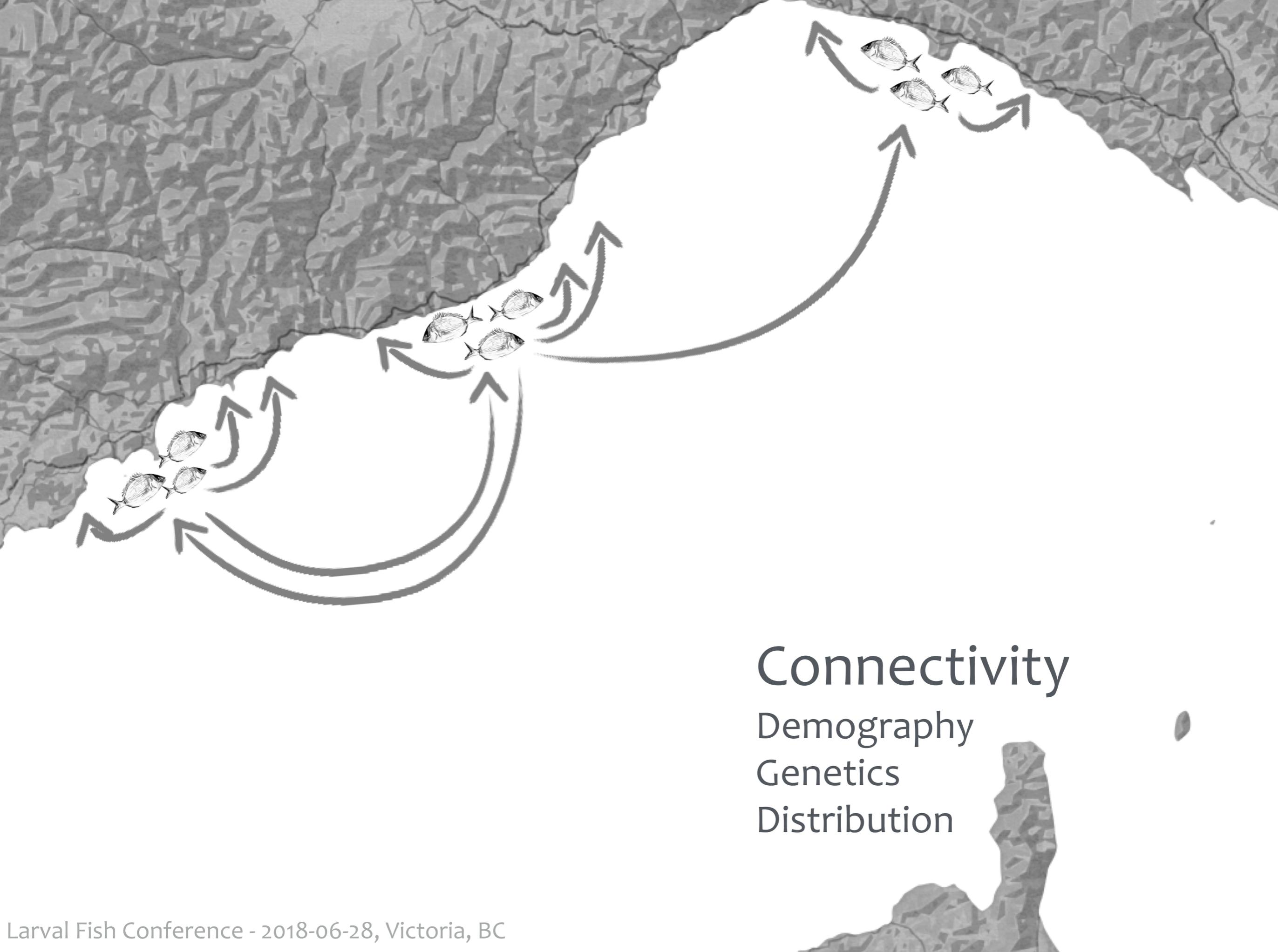
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dépasser les frontières

Complex life cycle



Complex life cycle





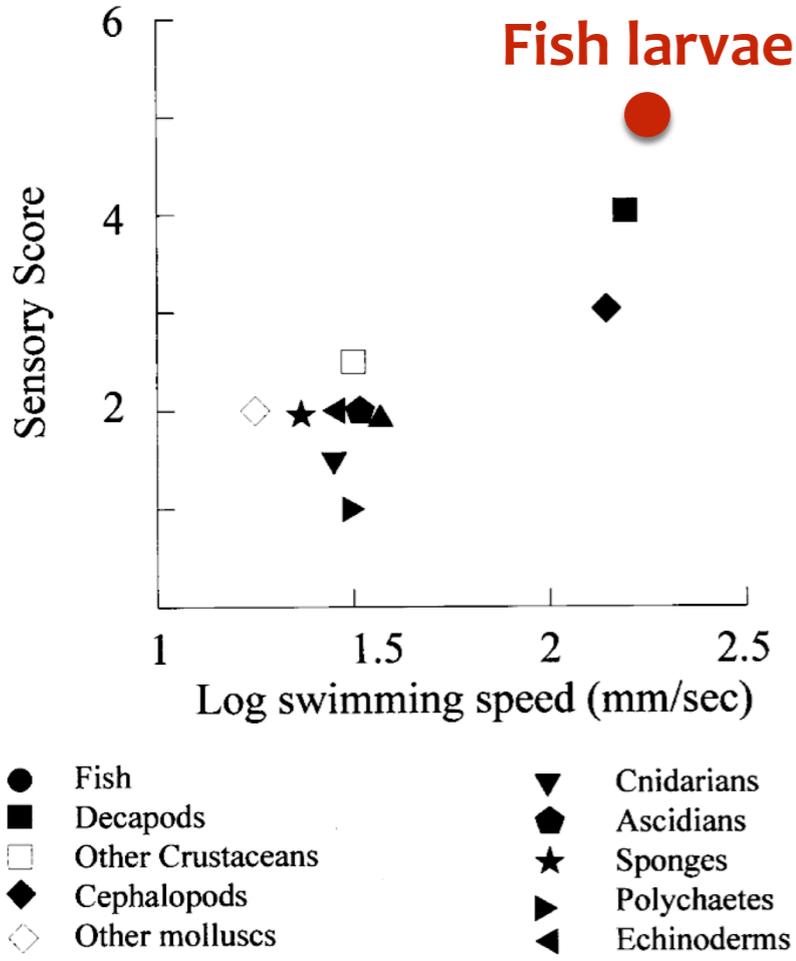
Connectivity

Demography

Genetics

Distribution

Fish larvae have strong sensory abilities and dispersal models



Kingsford et al., 2002

Low Connectivity between Mediterranean Marine Protected Areas: A Biophysical Modeling Approach for the Dusky Grouper *Epinephelus marginatus*
 Marco Andrello^{1,2,*}, David Mouillot^{3,4}, Jonathan Beuvier^{5,6}, Camille Albouy⁷, Wilfried Thuiller², Stéphane Mouillot^{1,8}

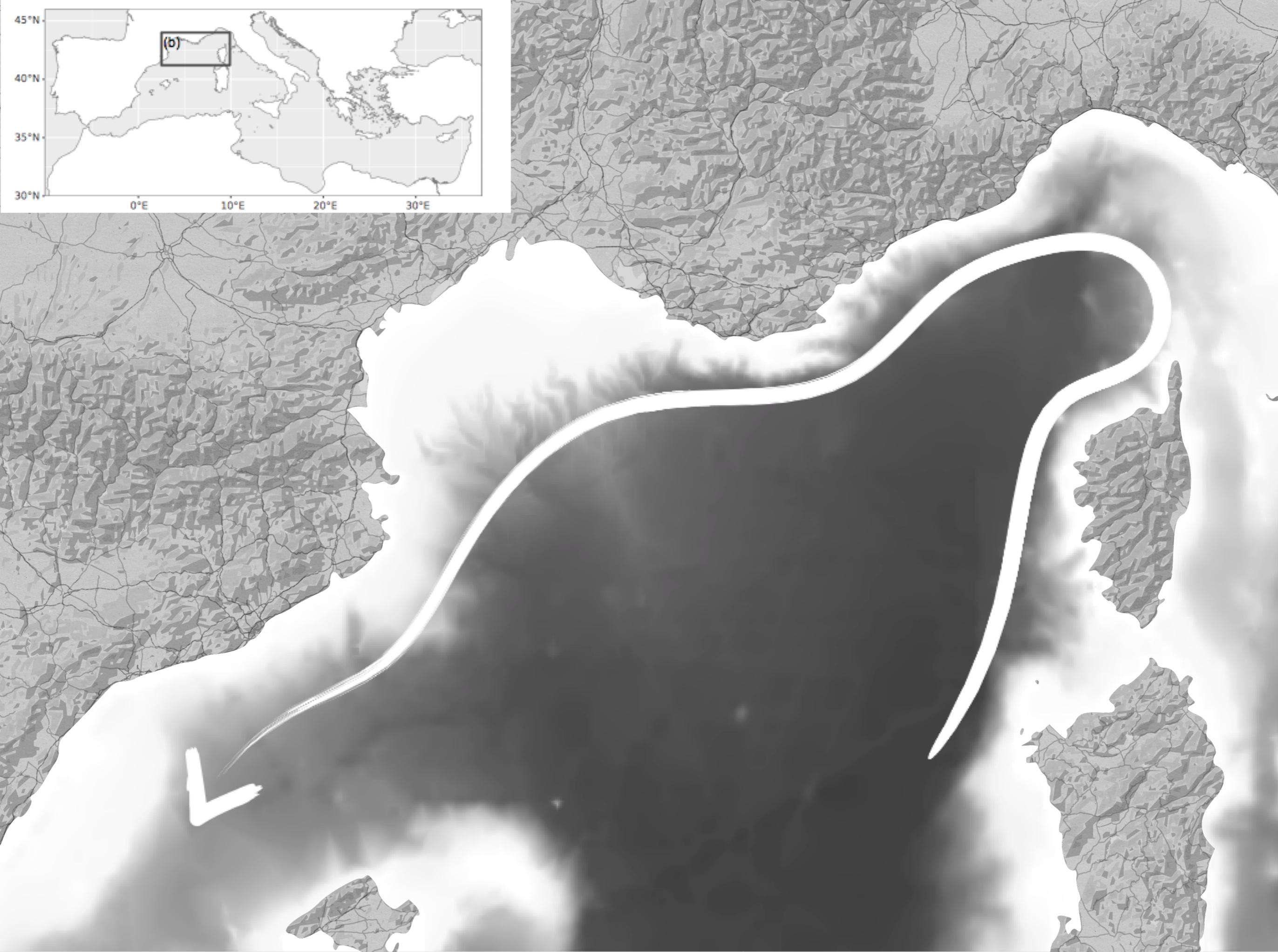
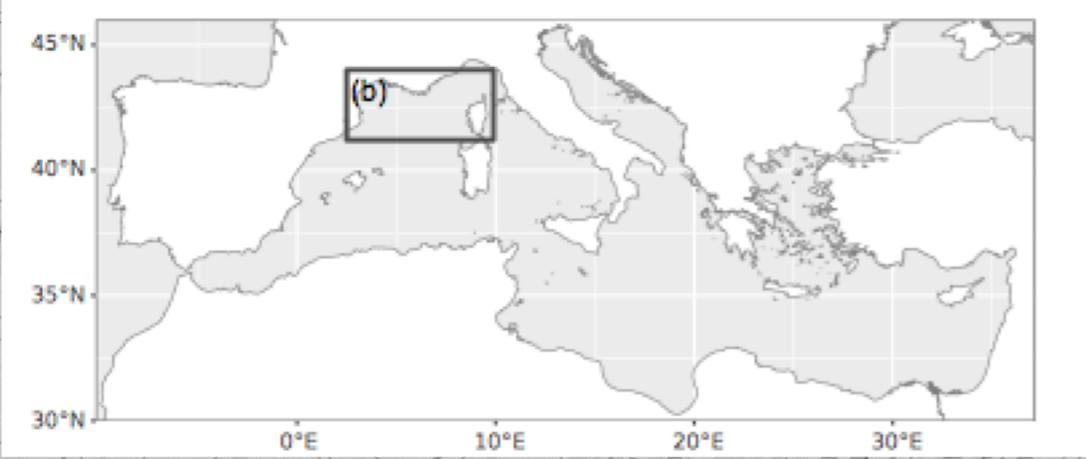
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 Fish. Oceanogr. 21:4, 291–306, 2012

Model-based assessment of local-scale fish larval connectivity in a network of marine protected areas
 GOTZON BASTERRETxea,^{1,*} ANTONI JORDI,¹ IGNACIO A. CATALÁN¹ AND ANA SABATÉS²

Estuarine, Coastal and Shelf Science
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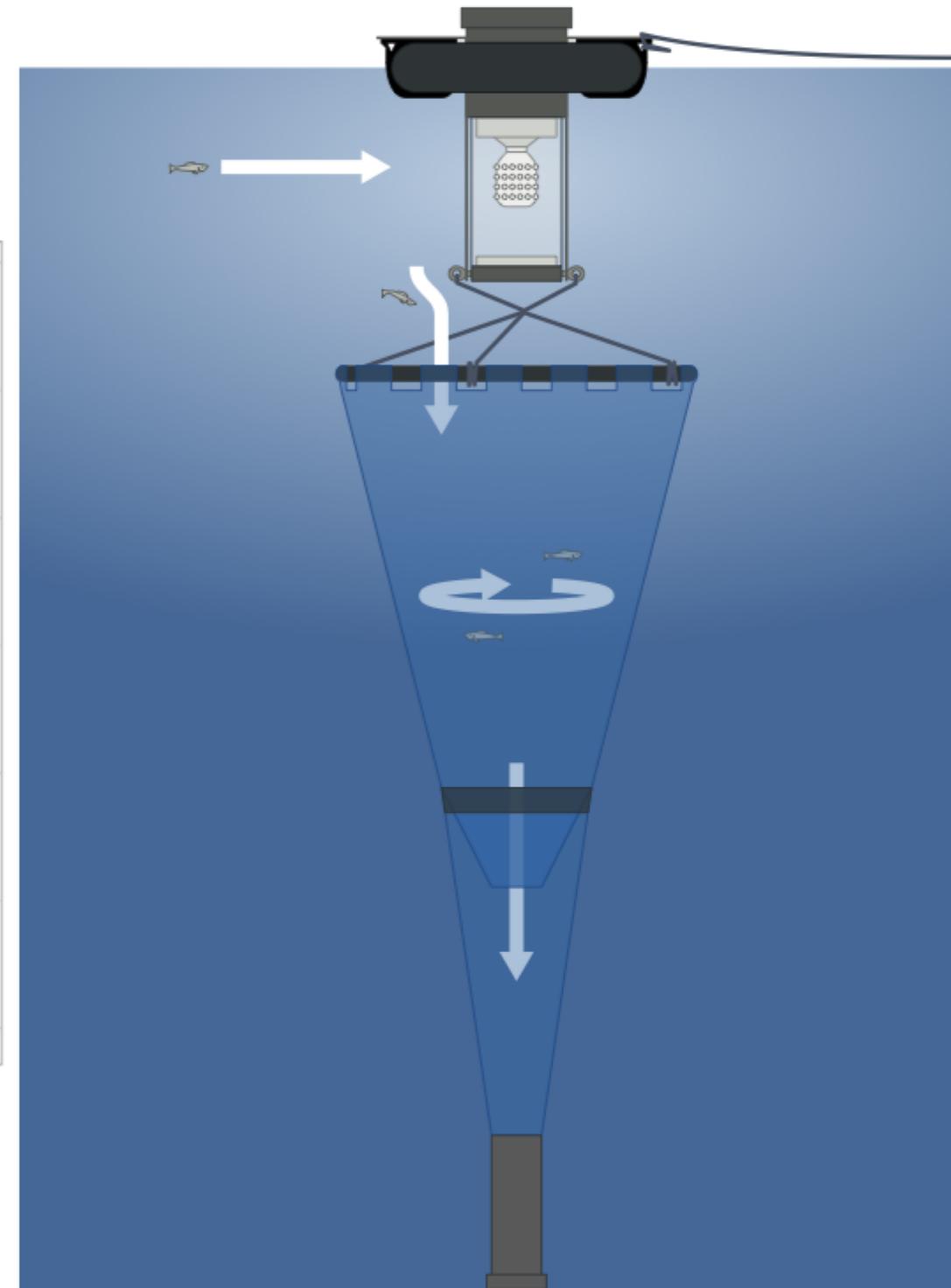
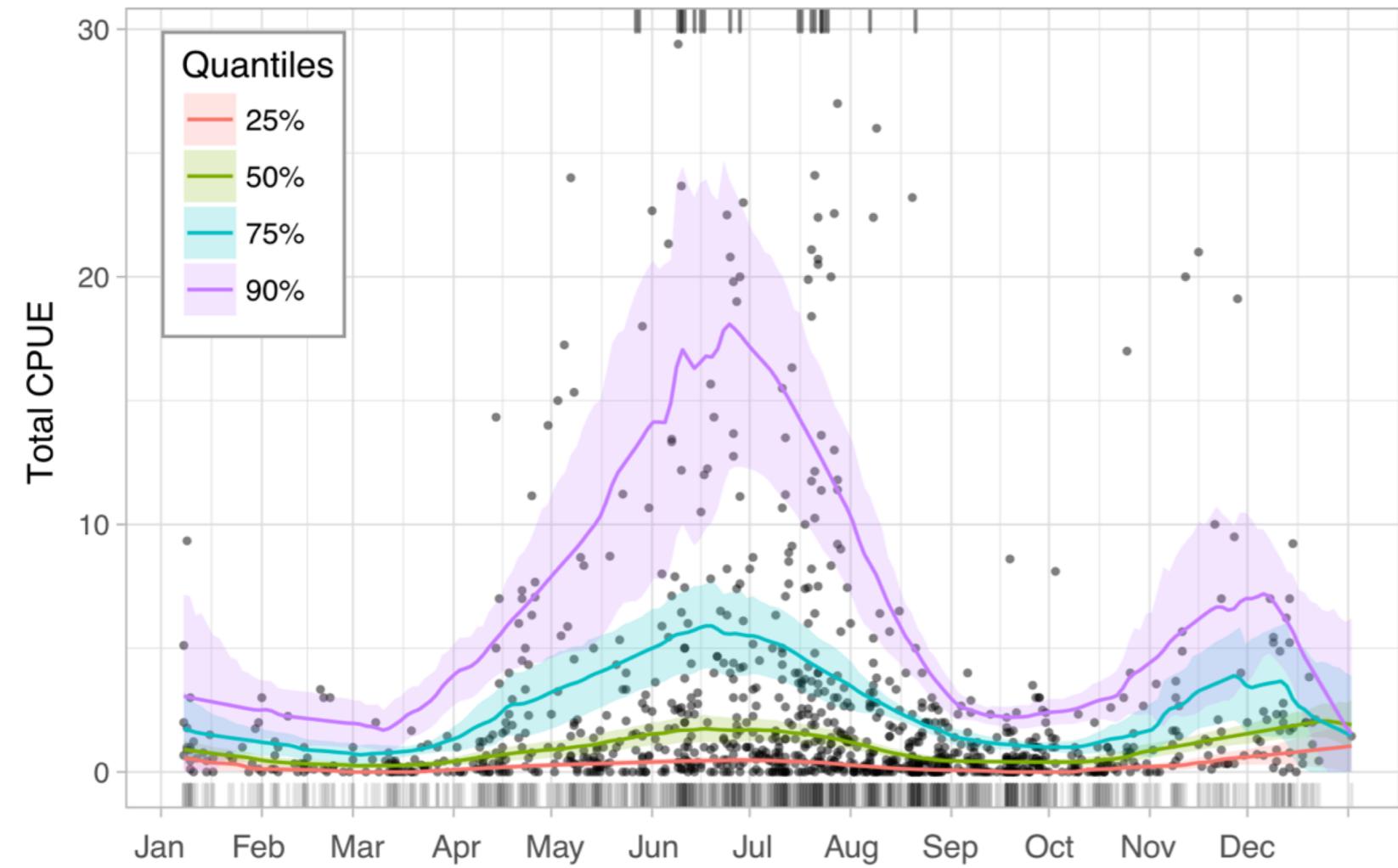
Connectivity patterns of coastal fishes following different dispersal scenarios across a transboundary marine protected area (Bonifacio strait, NW Mediterranean)
 Barbara Koeck^{a,b,*}, Olivia G rigny^{a,b,1}, Eric Dominique Henri Durieux^{a,b}, Sylvain Coudray^c, Laure-H l ne Garsi^a, Paul-Antoine Bisgambiglia^{a,b}, Fran ois Galgani^d, Sylvia Agostini^{a,b}

Jeffrey M. Leis^{1,2,*}, Claire B. Paris³, Jean-Olivier Irisson^{3,5,6}, Michelle N. Yerman^{1,7}, Ulrike E. Siebeck⁴

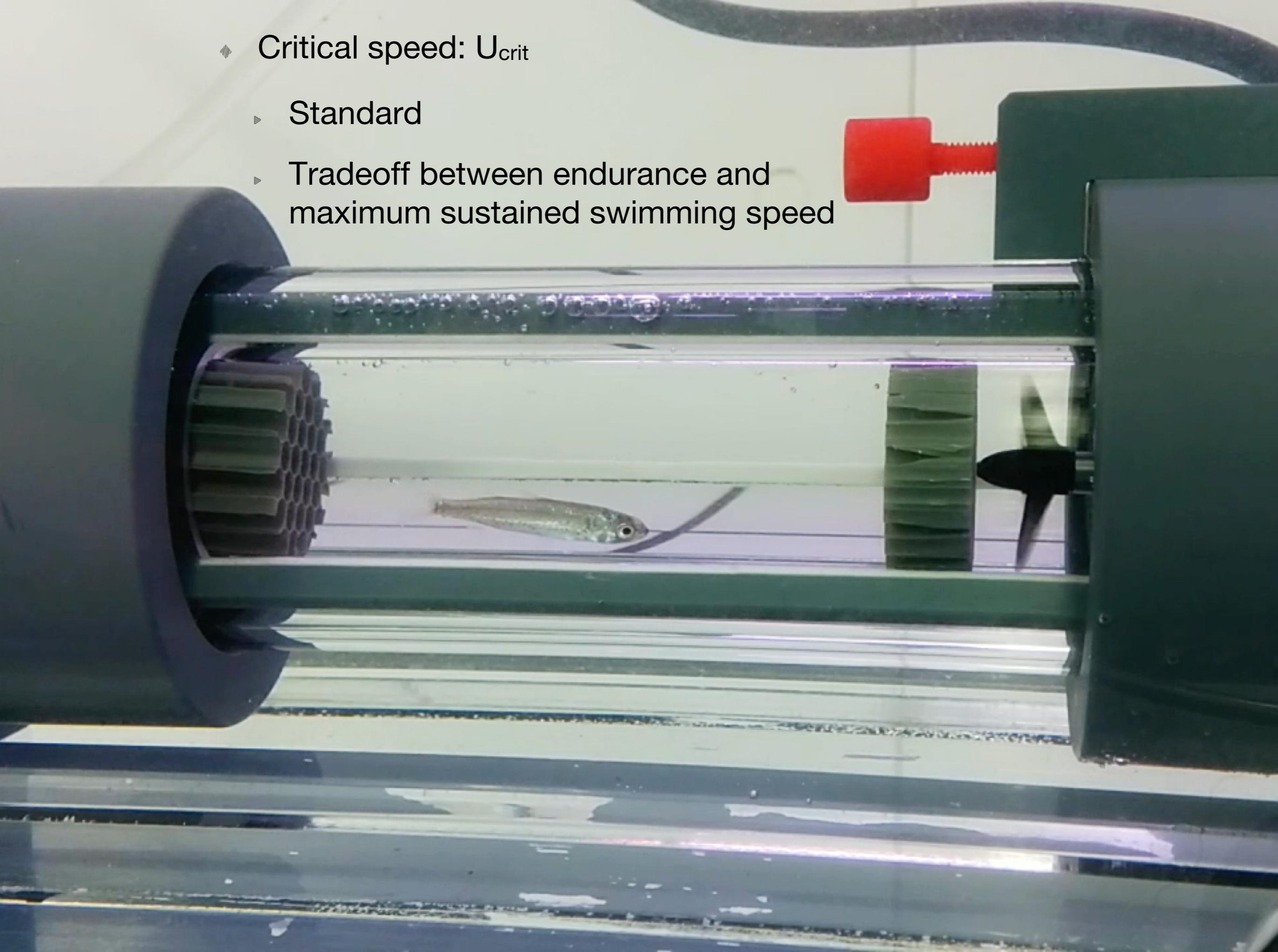


Larval supply in the Ligurian Sea

- ◆ Marked seasonality
- ◆ Strong influence of the moon

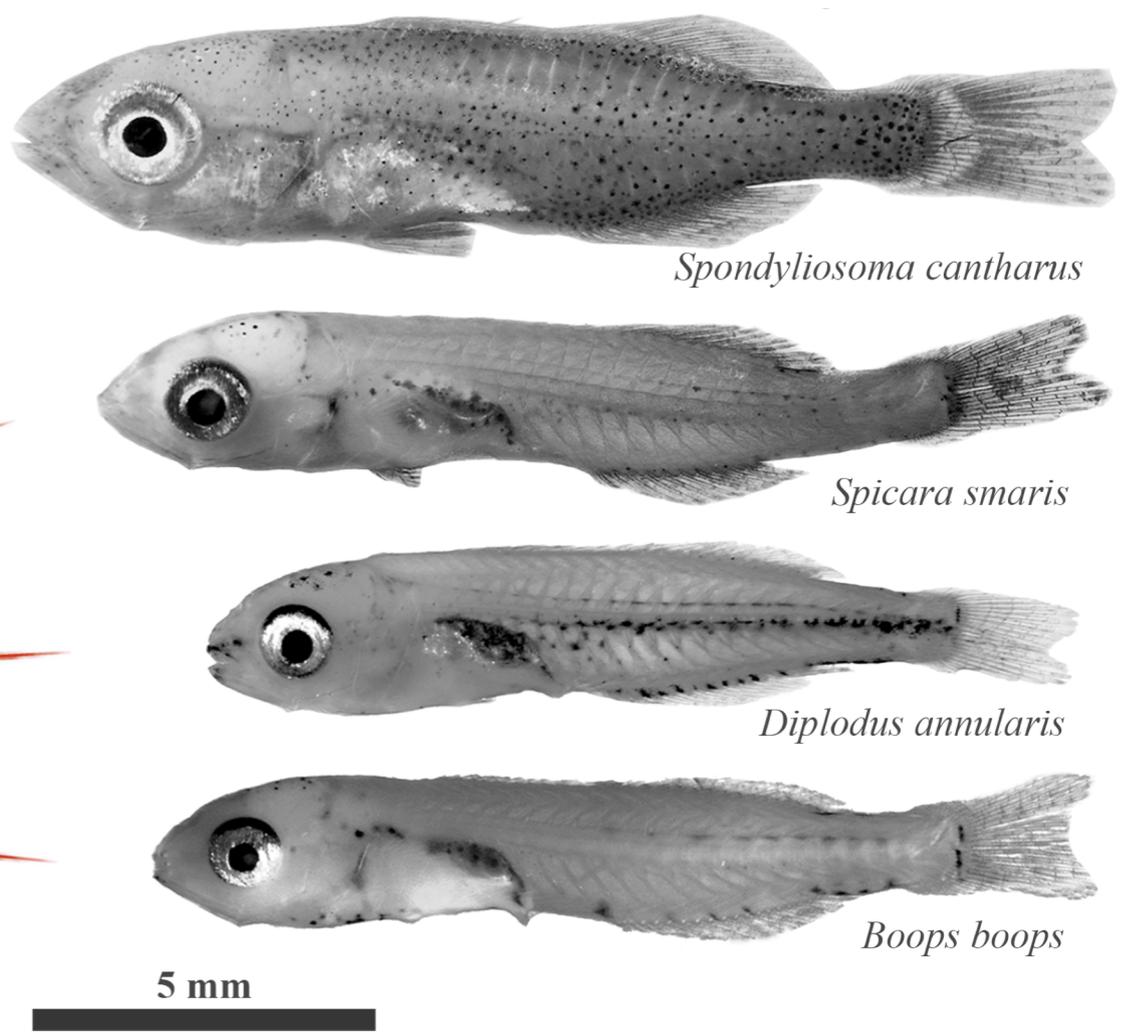
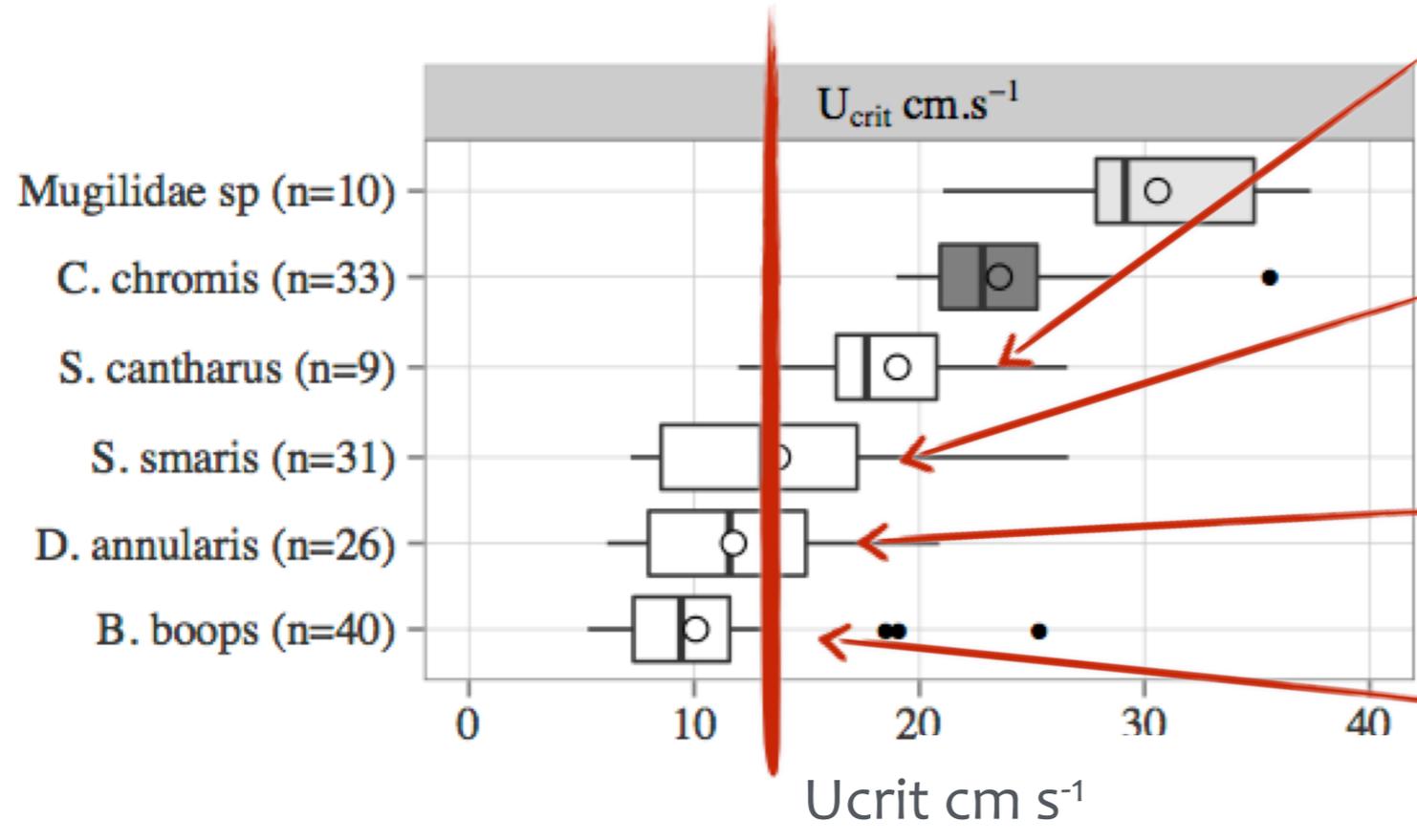


- ◆ Critical speed: U_{crit}
 - ▶ Standard
 - ▶ Tradeoff between endurance and maximum sustained swimming speed



Critical swimming speed of some Mediterranean fish larvae

Average current speed



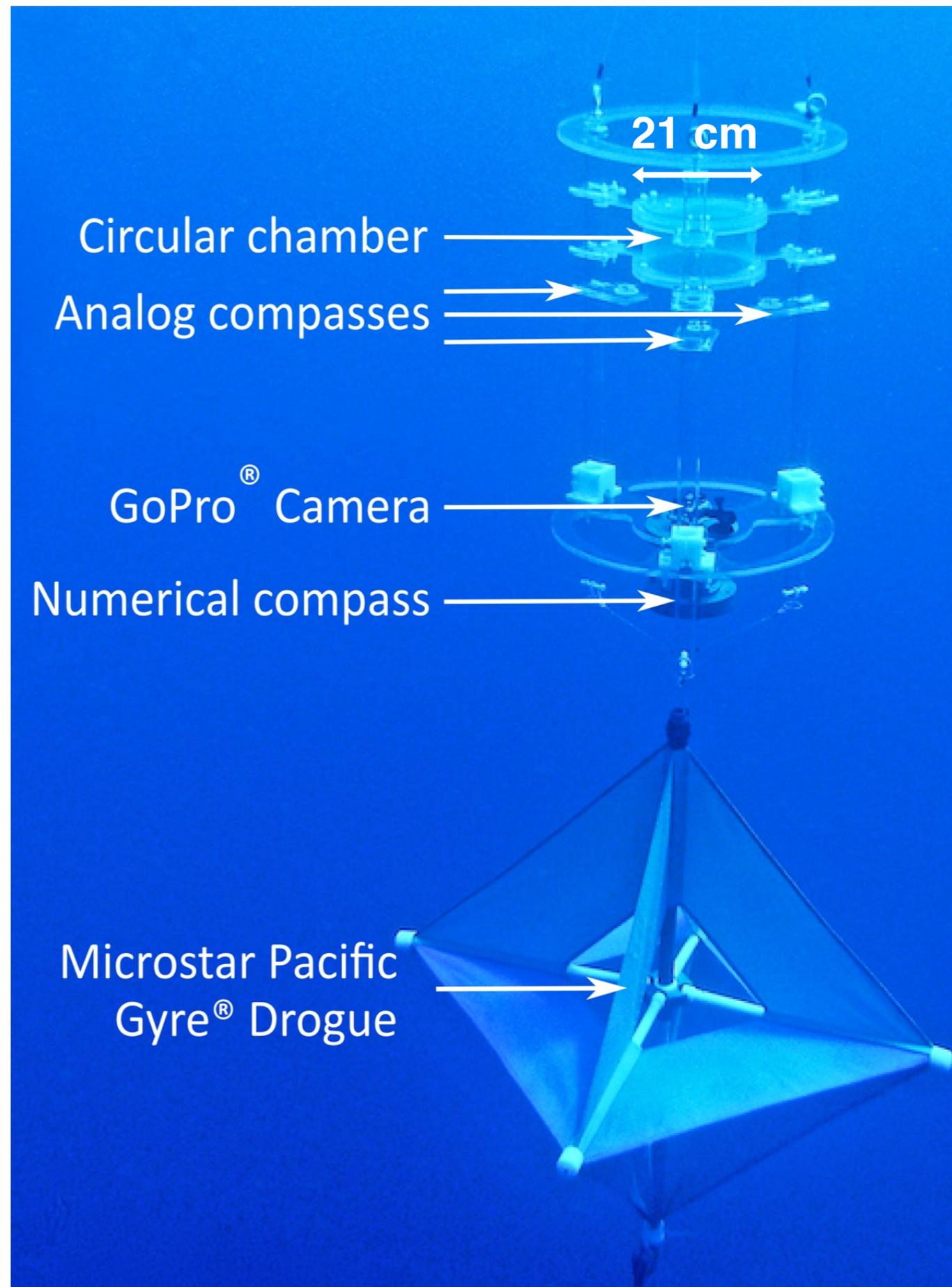
- "Small sparids" group**
- *Oblada melanura*
 - *Spicara maris*
 - *Diplodus annularis*
 - *Boops boops*

VS.

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

Estimating *in situ* orientation

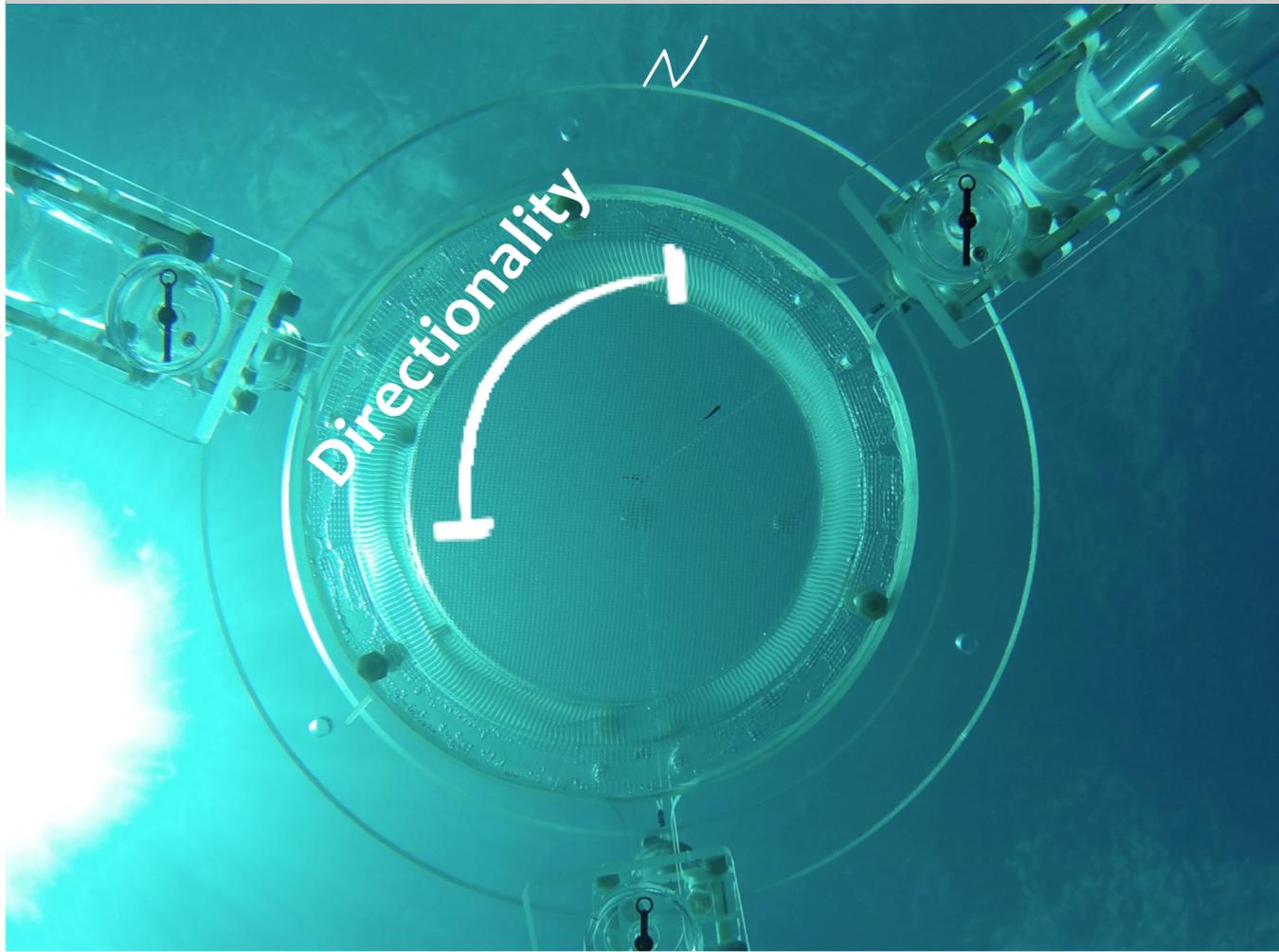
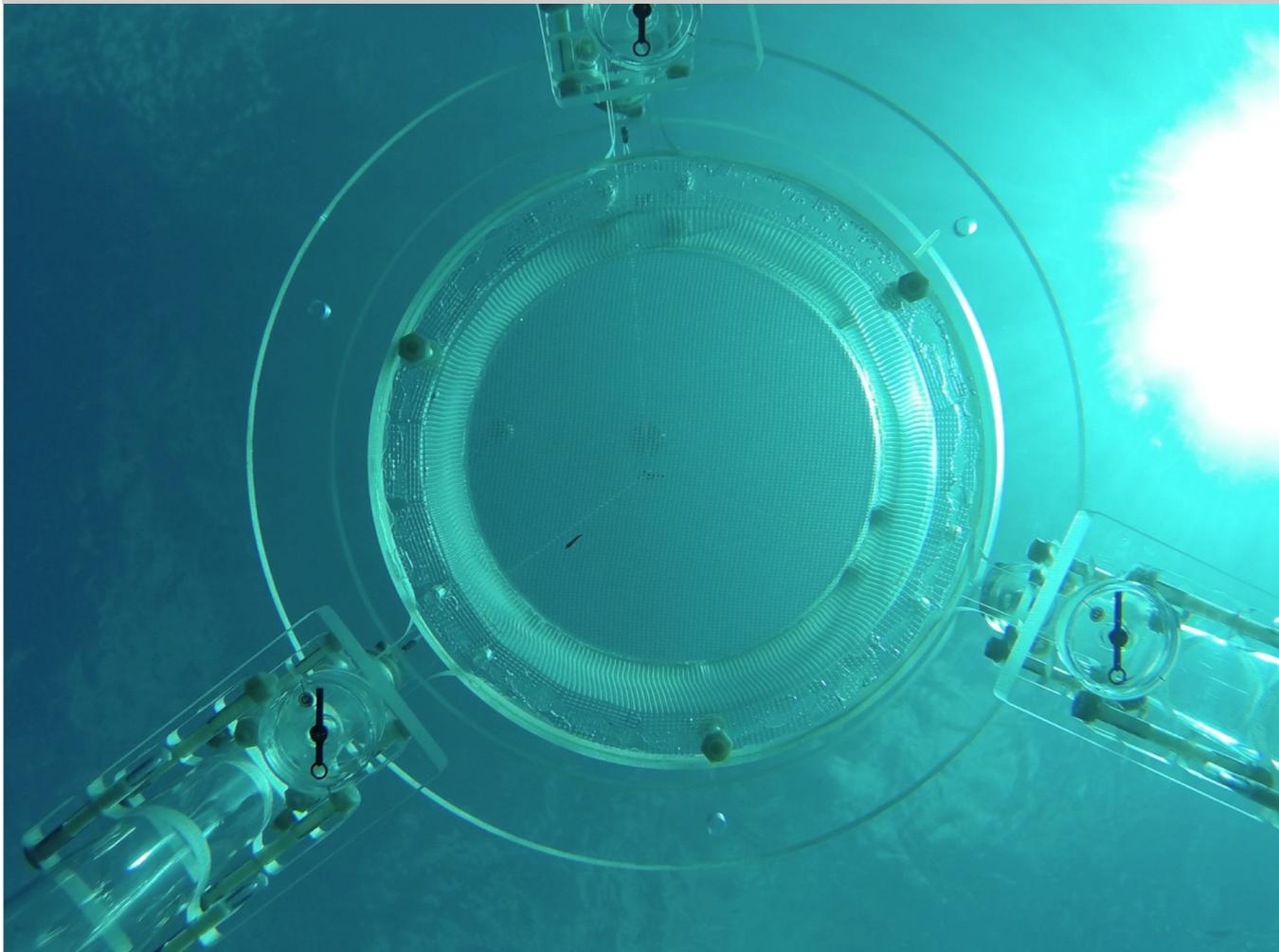
- ◆ Drifting *In Situ* Chamber
 - ▶ Lagrangian
 - ▶ *In situ* observations
 - ▶ No human interaction



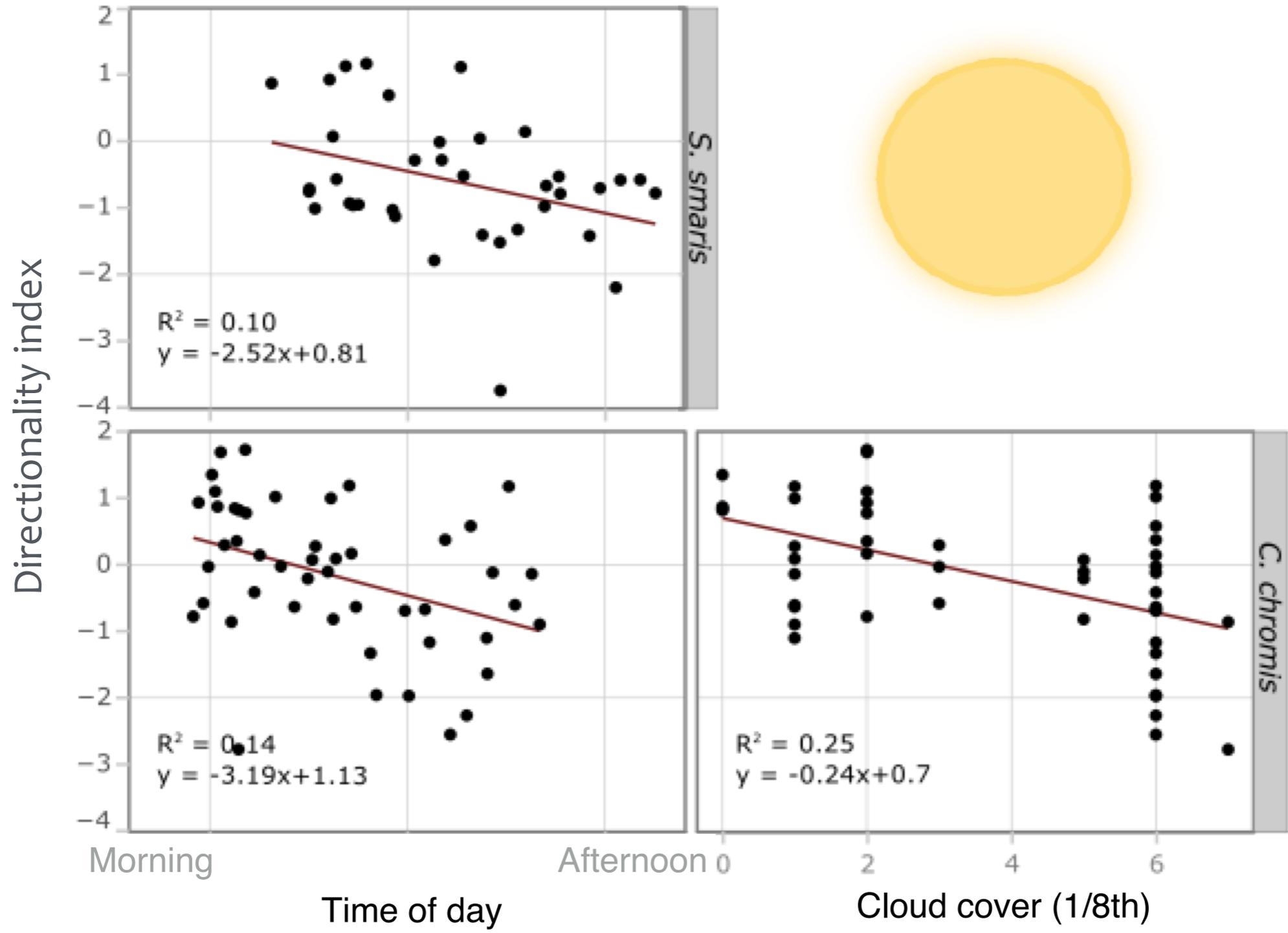
Directionality = the ability to follow a fixed direction

RAW

CORRECTED



Sun-related cues influence directionality



Testing the aberrant drift hypothesis (Hjort, 1914)

Advection + swimming (CMS)

1.2 km grid, 3 h

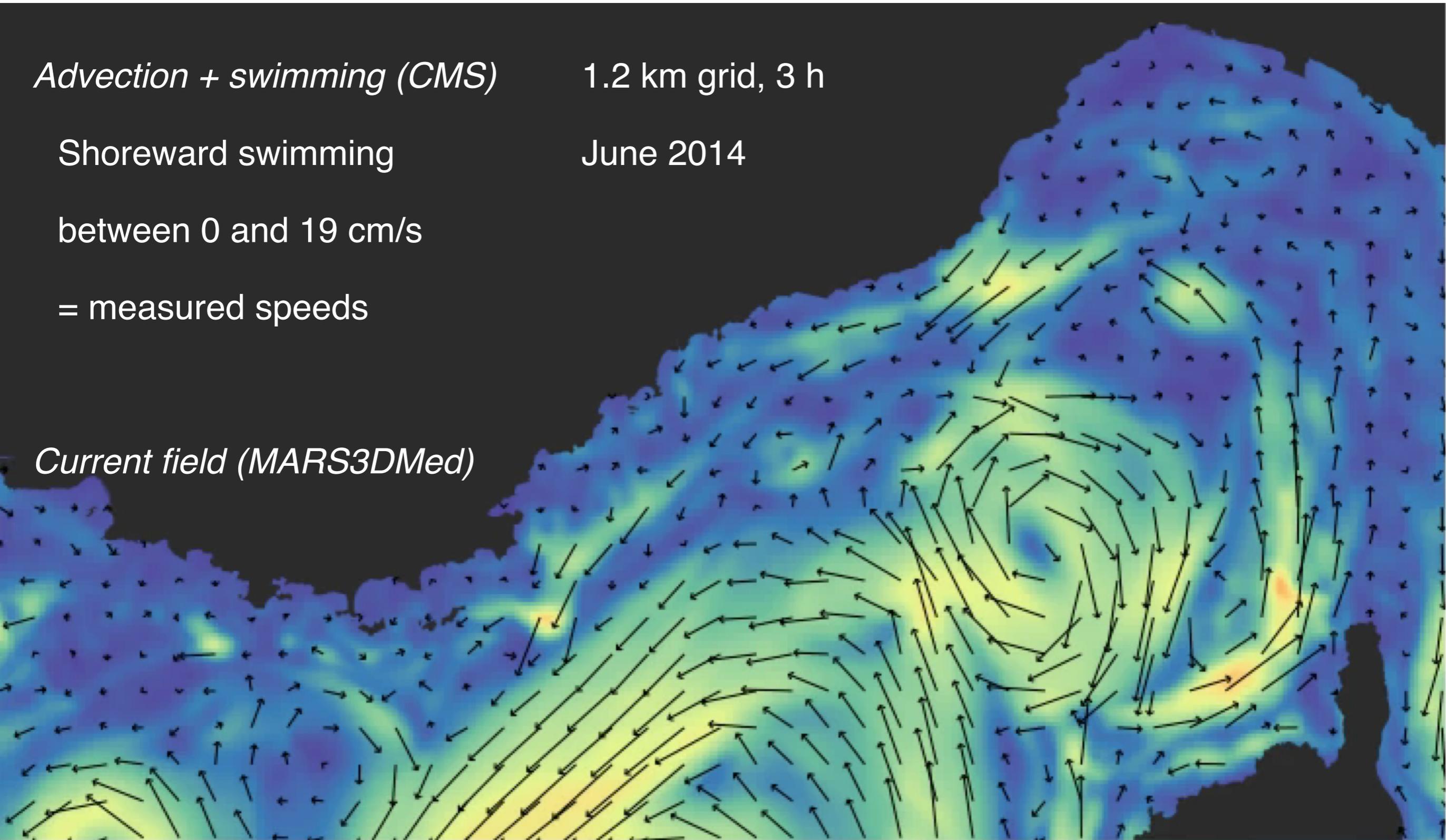
Shoreward swimming

June 2014

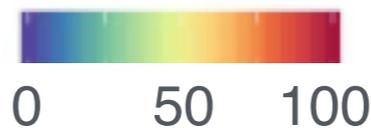
between 0 and 19 cm/s

= measured speeds

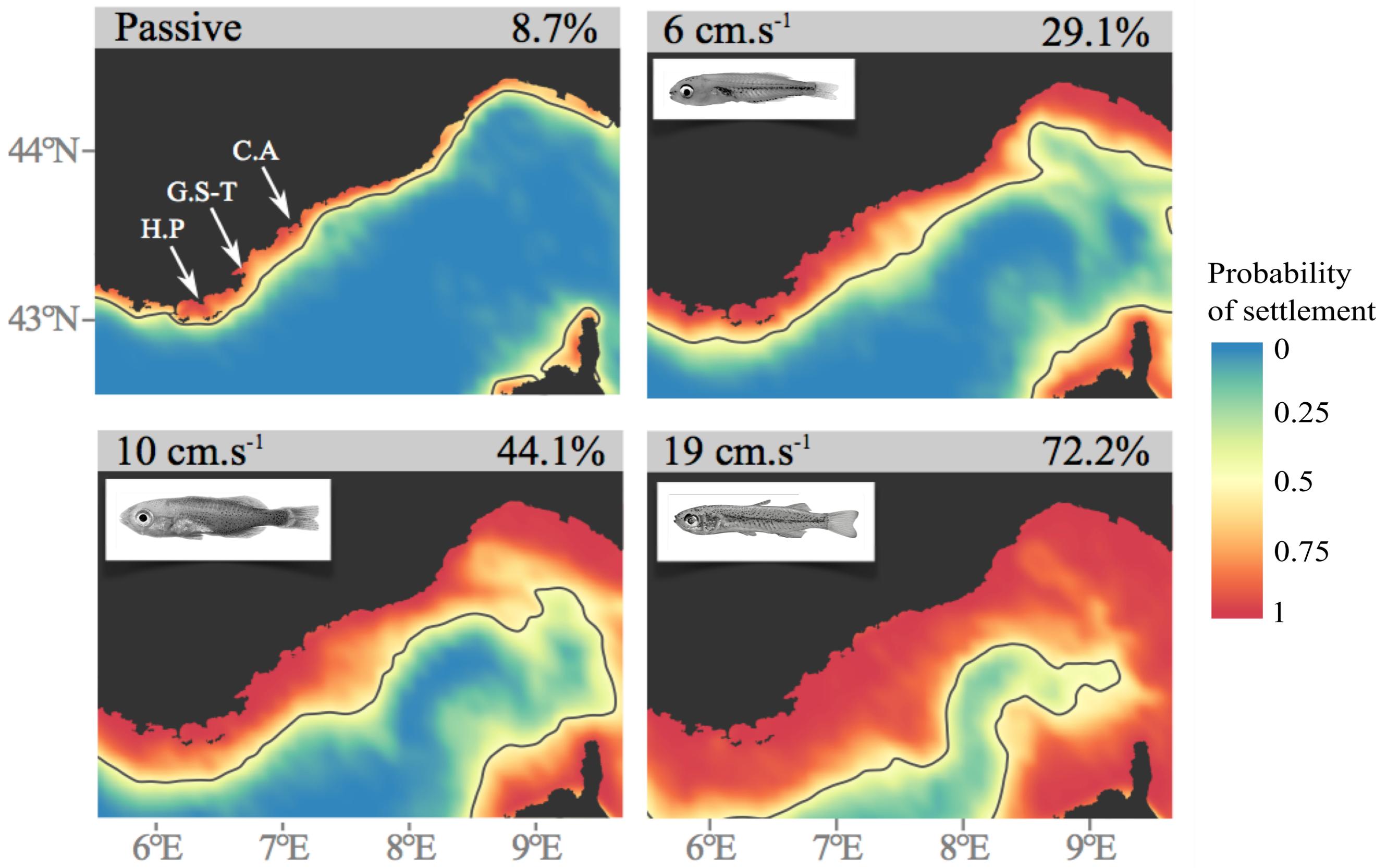
Current field (MARS3DMed)



Intensity ($\text{cm}\cdot\text{s}^{-1}$)



Fast swimming larvae may settle from anywhere



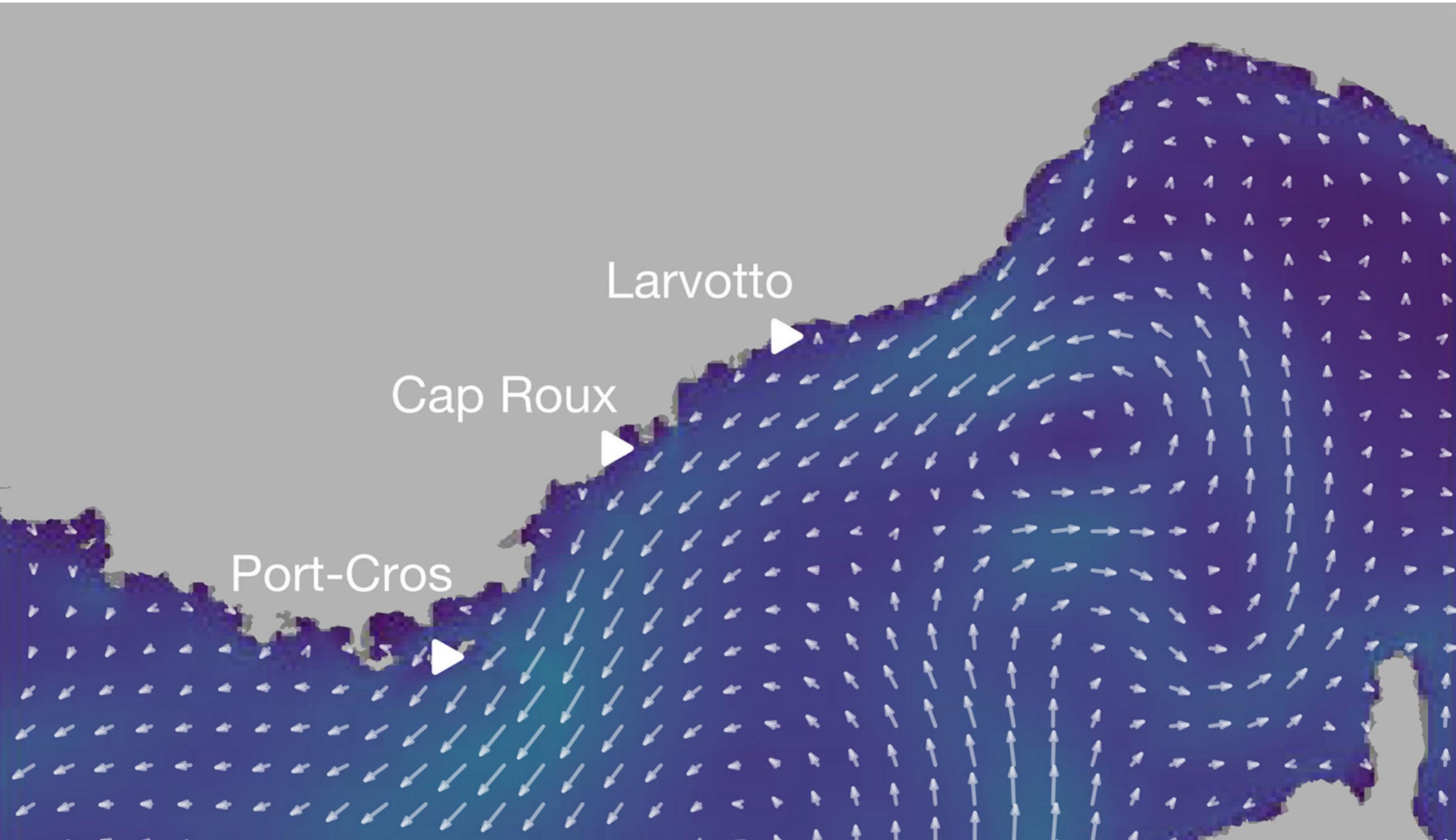
Behaviour in connectivity models: an example

- ◆ 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

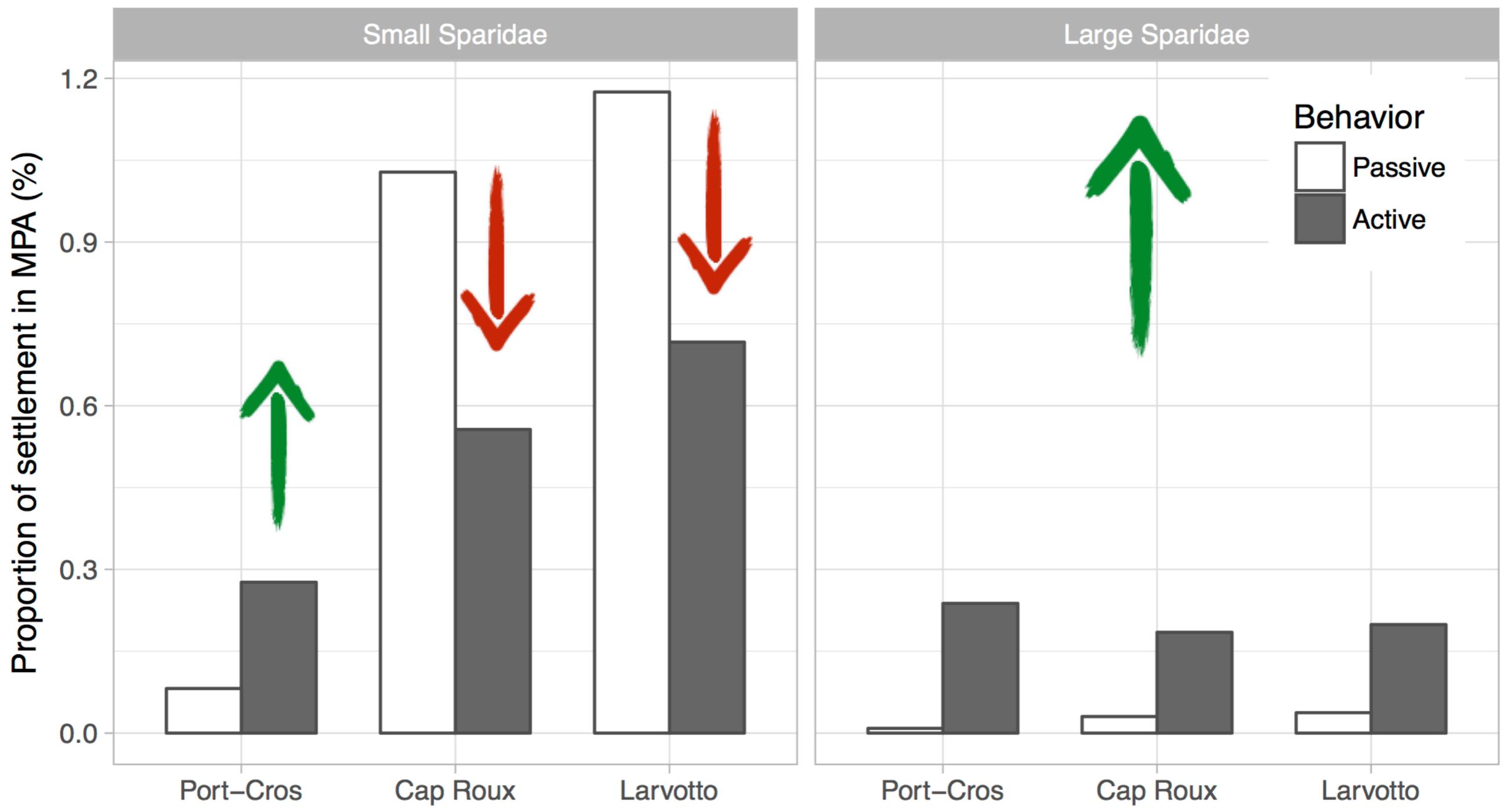


Small sparids	Large Sparids
1+13/19 d	1+28/38 d
1-10 m	1-10 m
6 cm/s at 12dph	10 cm/s at 28dph
After 8 dph	After 8 dph
Spawning around full moon	One lunar cycle from catch

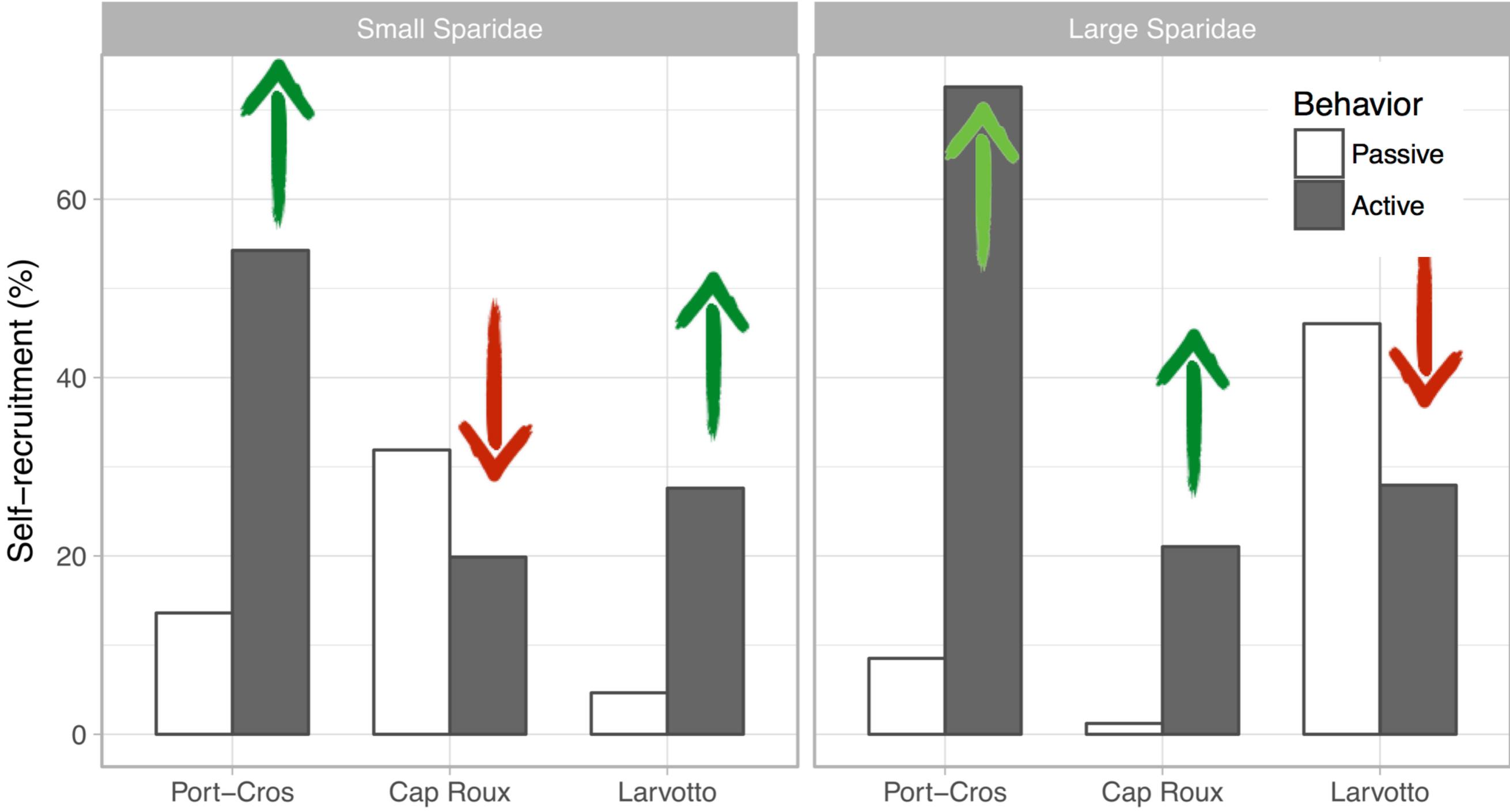
Behaviour in connectivity models: an example



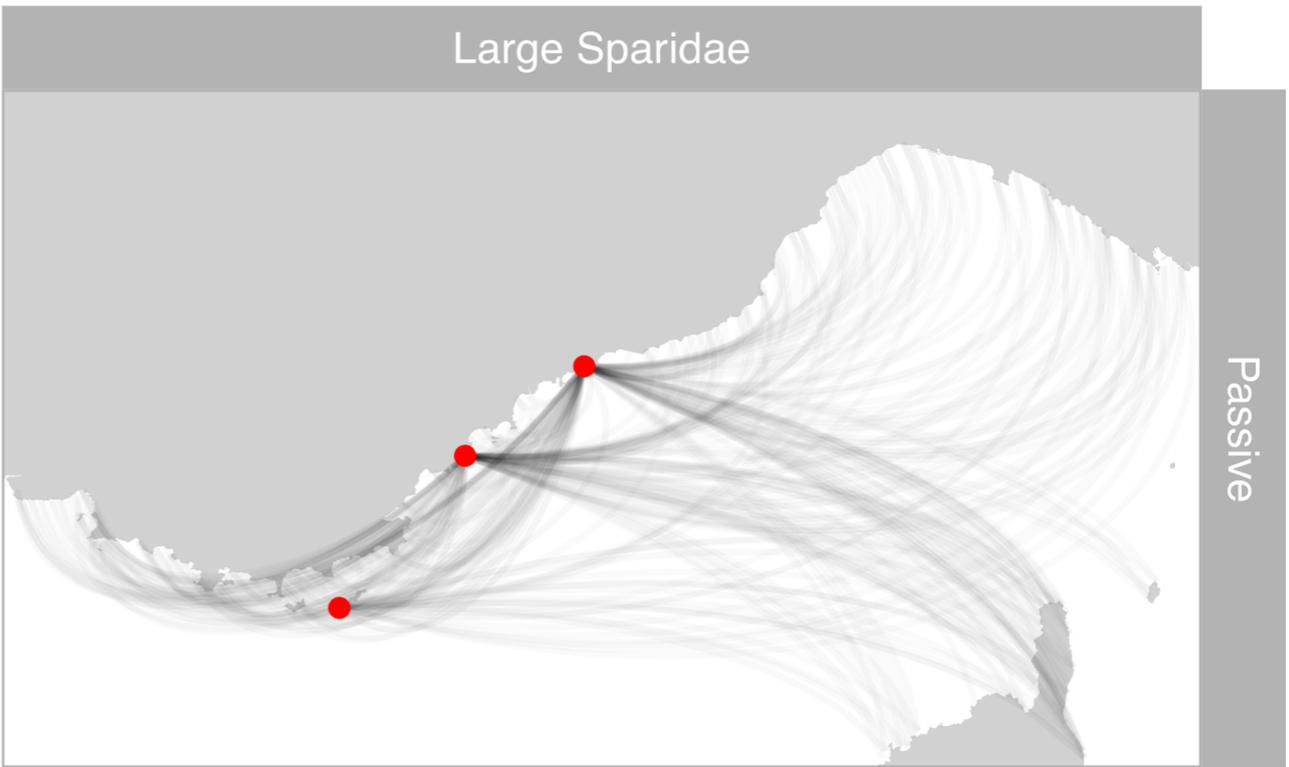
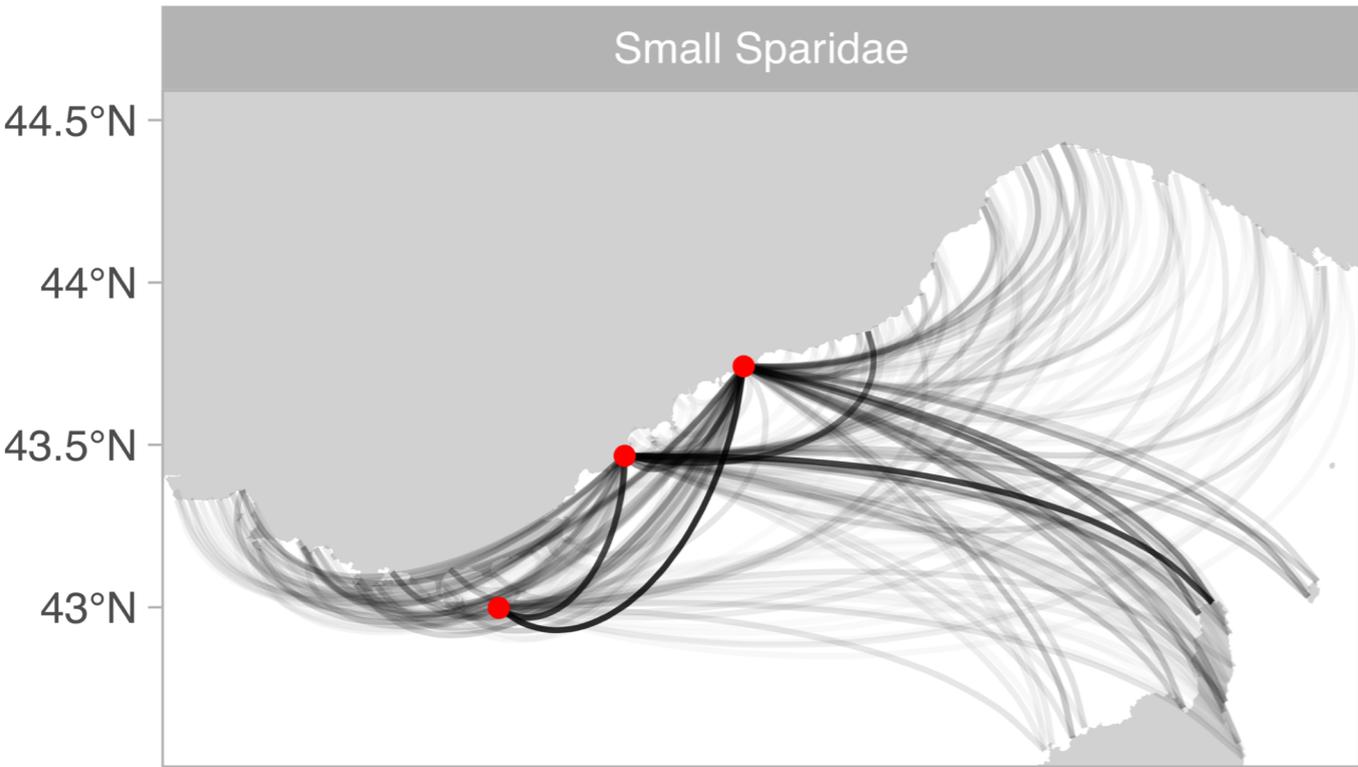
Settlement in MPAs



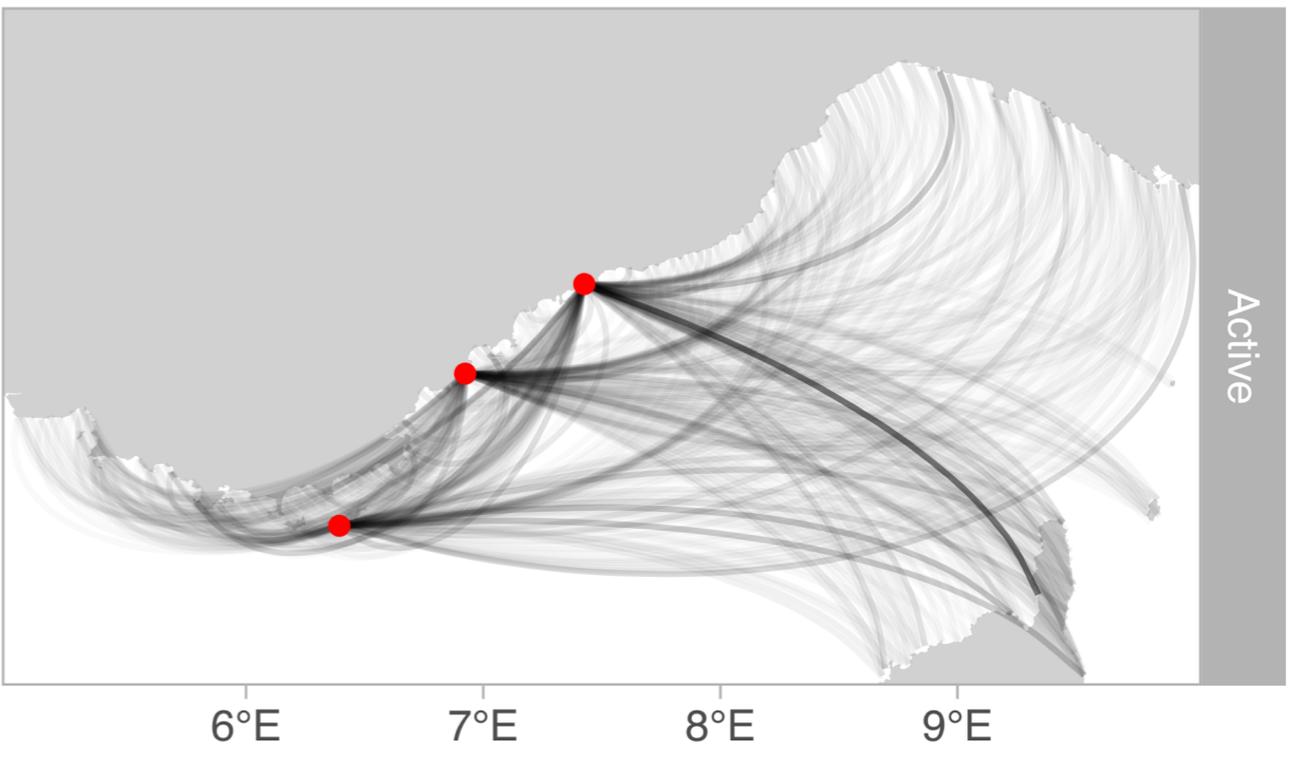
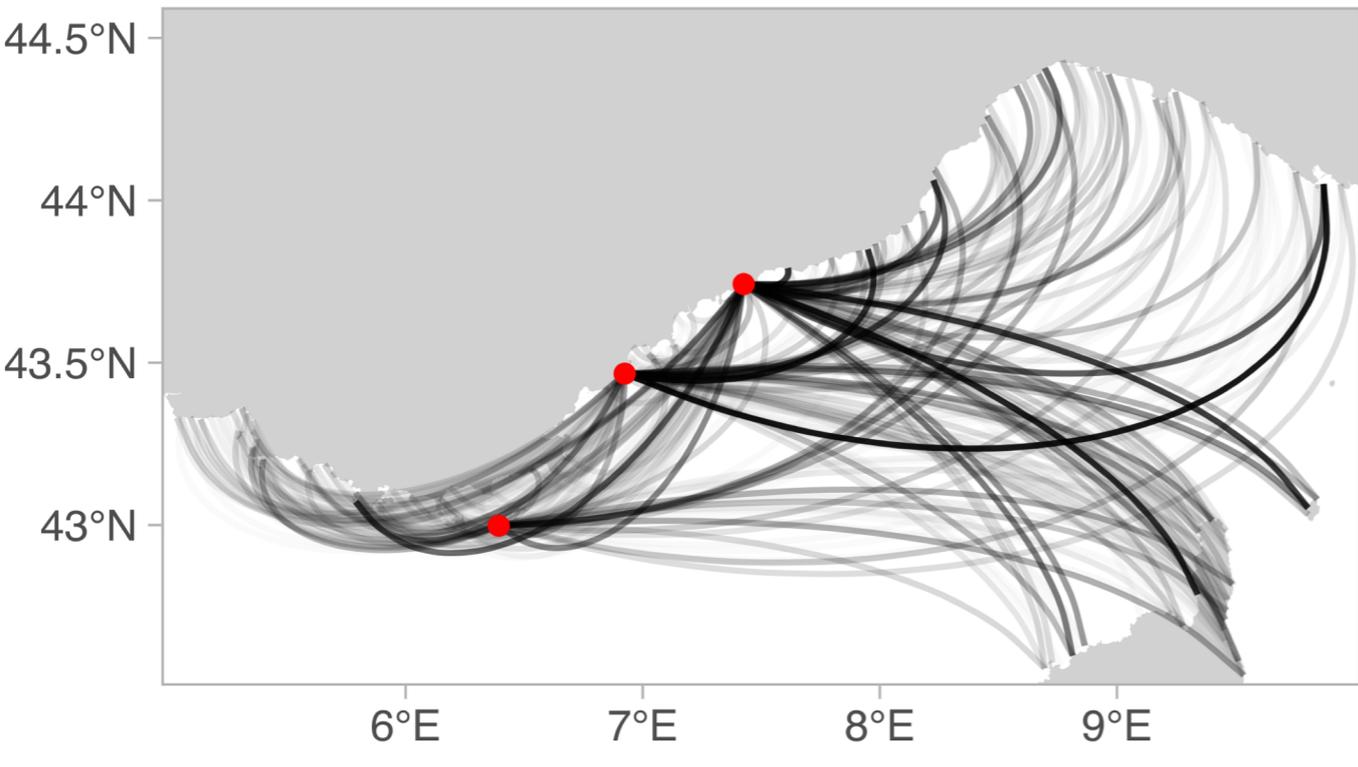
Self-recruitment (% originated from the MPA that settled in the MPA / larval supply)



Enhanced connectivity!



Passive



Active

Conclusion and perspectives



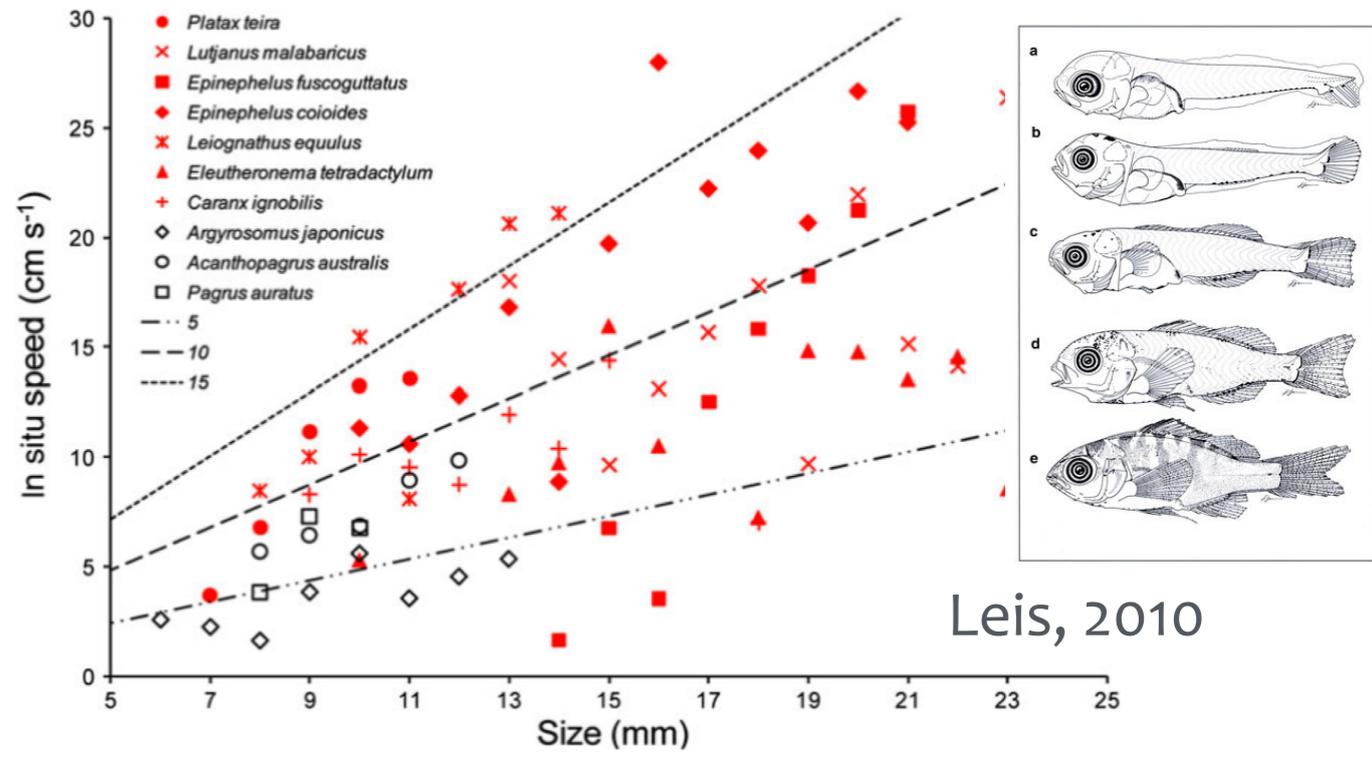
◆ Behaviour and connectivity models

- ▶ 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



Interns:

Agathe Blandin

Elysanne Durand

THANK YOU ! QUESTIONS?



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