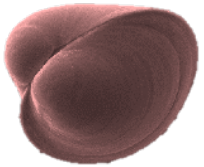
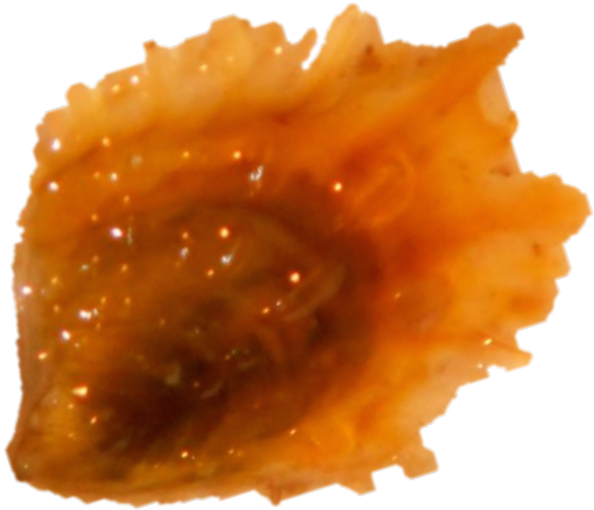
Session 2: Impacts on socio-ecosystems and biological resources

Franck Lagarde*[1]*, *Emmanuelle Roque d'orbcastel[1], Martin Ubertini[1], Serge Mortreux[1], Ismaël Bernard[2], Annie Fiandrino[1], Claude Chiantella[1], Béatrice Bec[3], Cécile Roques[3], Delphine Bonnet[3], Gilles Miron[4], Marion Richard[1], Stéphane Pouvreau[5], Christophe Lett[6]

Temporal recruitment windows of *Crassostrea gigas* in Mediterranean lagoon under oligotrophication





[1] *Ifremer/UMR MARBEC, Ifremer, 34200 Sète, France*
[2] *Eureka Modélisation, 22740 Lézardrieux, France*
[3] *Université de Montpellier/UMR MARBEC, 34095 Montpellier, France*
[4] *Université de Moncton, Nouveau-Brunswick E1A 3E9, Canada*
[5] *Ifremer/UMR LEMAR, 29280 Plouzané, France*
[6] *IRD/UMI ummisco, 34200 Sète, France*

photos: Cuif@orsay
Lagarde@ifremer

10th November 2017

French Japanese Oceanographic Symposium

The study included a global analysis of environmental effects on reproduction and recruitment from 2012 to 2014

Environnement

Meteorology

Hydrodynamic

Hydrology

Plankton

Biological cycle of pacific oysters

Adults

1. Adults gametogenesis*

2. Spawning *

Aquaculture 473 (2017) 51–61

Contents lists available at ScienceDirect

Aquaculture

journal homepage: www.elsevier.com/locate/aquaculture

Gametogenesis, spawning behavior and larval abundance of the Pacific oyster *Crassostrea gigas* in the Thau lagoon: Evidence of an environment-dependent strategy

Martin Ubertini [a,*], Franck Lagarde [a], Serge Mortreux [a], Patrik Le Gall [a], Claude Chiantella [a], Annie Fiandrino [a], Ismaël Bernard [b], Stéphane Pouvreau [c], Emmanuelle Roque d'Orbcastel [a]

[a] Ifremer/UMR MARBEC, 34200 Sète, France
[b] Eureka Modélisation, 22740 Lézardrieux, France
[c] Ifremer/UMR LEMAR, 29280 Plouzané, France

8. Fa

Spa

7. Spat recruitment

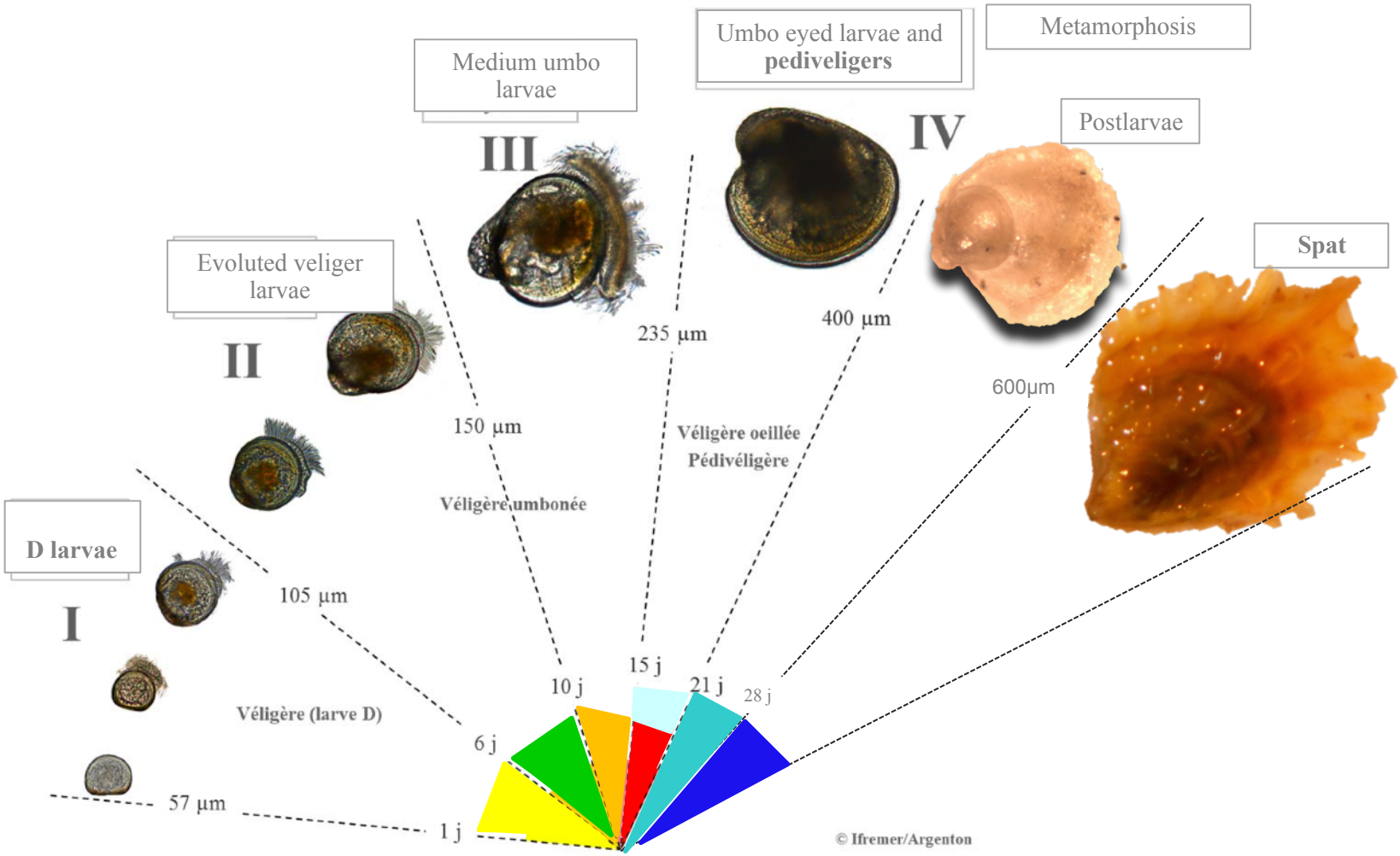
6. Settlement

rval
ply

arval

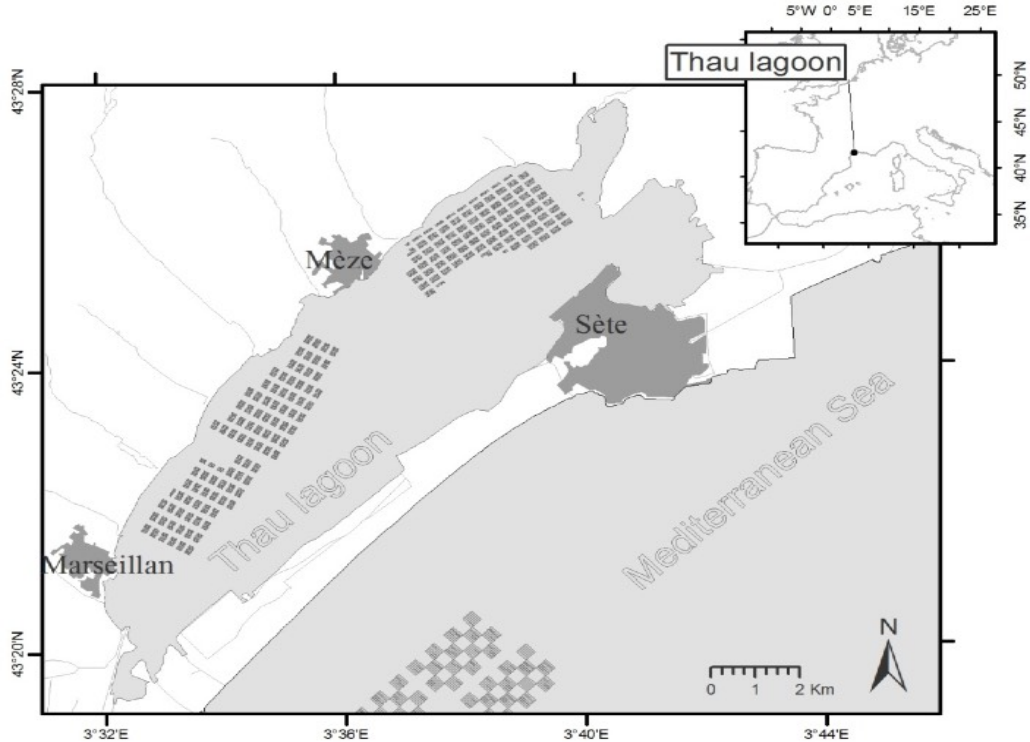
Larvae

Determination of larval stages of the Japanese oyster, *Crassostrea gigas*



From **Le Pennec (1978) et His (1991),** ***Source*** **Velyger,** ***modified*****.**

We study this species in a highly heterogeneous ecosystem



2016 :
449 incorporations

7000 to 11 000 t of oysters
2000 to 3000 t of mussels

75 M €uros/year

More than 1000 direct employments

Source : Cepralmar

We study this species in a highly heterogeneous ecosystem in space and time

POSTER OF SESSION 4: Valérie DEROLEZ *et al.*

Restoration trends of the Thau lagoon's water ecological status and phytoplankton communities in response to changes in anthropogenic nutrient inputs

Valérie Derolez[1]*, D. Soudant[2], B. Bec[3], M. Richard[1], F. Lagarde[1], C. Chiantella[1], N. Malet[4], C. Aliaume[2]

1) Ifremer LERLR, UMR MARBEC (IRD, Ifremer, Université de Montpellier, CNRS). Avenue Jean Monnet. CS30171 34203 Sète cedex. France
2) Ifremer VIGIES. Rue de l'Ile d'Yeu BP 21105. 44311 Nantes Cedex 03. France
3) Université de Montpellier, UMR MARBEC (IRD, Ifremer, Université de Montpellier, CNRS). Place Eugène Bataillon, 34095 Montpellier. France
4) Ifremer LERPAC/CO. Zoning Industriel Furiani, 20600 Bastia. France

*email: valerie.derolez@ifremer.fr

Coast Bordeaux 2017

We hypothesize the 'no-recruitment' paradigm in Mediterranean lagoon is false

Environnement

Biological cycle of pacific oysters

Meteorology

Hydrodynamic

Hydrology

Plankton

1. Adu

econdity

Vol. 578: 1–17, 2017
https://doi.org/10.3354/meps12265

MARINE ECOLOGY PROGRESS SERIES
Mar Ecol Prog Ser

Published August 31

FEATURE ARTICLE

Recruitment of the Pacific oyster *Crassostrea gigas* in a shellfish-exploited Mediterranean lagoon: discovery, driving factors and a favorable environmental window

Franck Lagarde[1,*], Emmanuelle Roque d'orbcastel[1], Martin Ubertini[1], Serge Mortreux[1], Ismaël Bernard[2], Annie Fiandrino[1], Claude Chiantella[1], Béatrice Bec[3], Cécile Roques[3], Delphine Bonnet[3], Gilles Miron[4], Marion Richard[1], Stéphane Pouvreau[5], Christophe Lett[6]

[1]Ifremer/UMR MARBEC, Ifremer, 34200 Sète, France
[2]Eureka Modélisation, 22740 Lézardrieux, France
[3]Université de Montpellier/UMR MARBEC, 34095 Montpellier, France
[4]Université de Moncton, New Brunswick E1A 3E9, Canada
[5]Ifremer/UMR LEMAR, Technopole de Brest-Iroise, 29280 Plouzané, France
[6]IRD/UMI ummisco, 34200 Sète, France

ABSTRACT: In the context of increasing demand for environmental recovery, aquatic systems may face the challenge of evolving under oligotrophication. This is the case in Mediterranean lagoons, in particular the shellfish-farmed Thau lagoon in France, where we studied recruitment of the Pacific oyster *Crassostrea gigas*. Oyster spat and environmental parameters were monitored at several sampling sites for 3 yr (2012 to 2014) using an original method with a temporal overlap deployment of collectors to study pre- and post-settlement processes and to identify the best conditions for recruitment. Contrary to the 'no Pacific oyster reproduction' paradigm in Mediterranean lagoons, our study showed that recruitment of this introduced species is possible in the Thau lagoon at levels comparable to those in other traditional French breeding basins. We identified a favorable environmental window for recruitment characterized by high water

Discovery of oyster spat recruitment in the French Mediterranean Thau lagoon.

Photo: ©UMR MARBEC

4. Larval supply

Pelagic larval stage

8. Farming

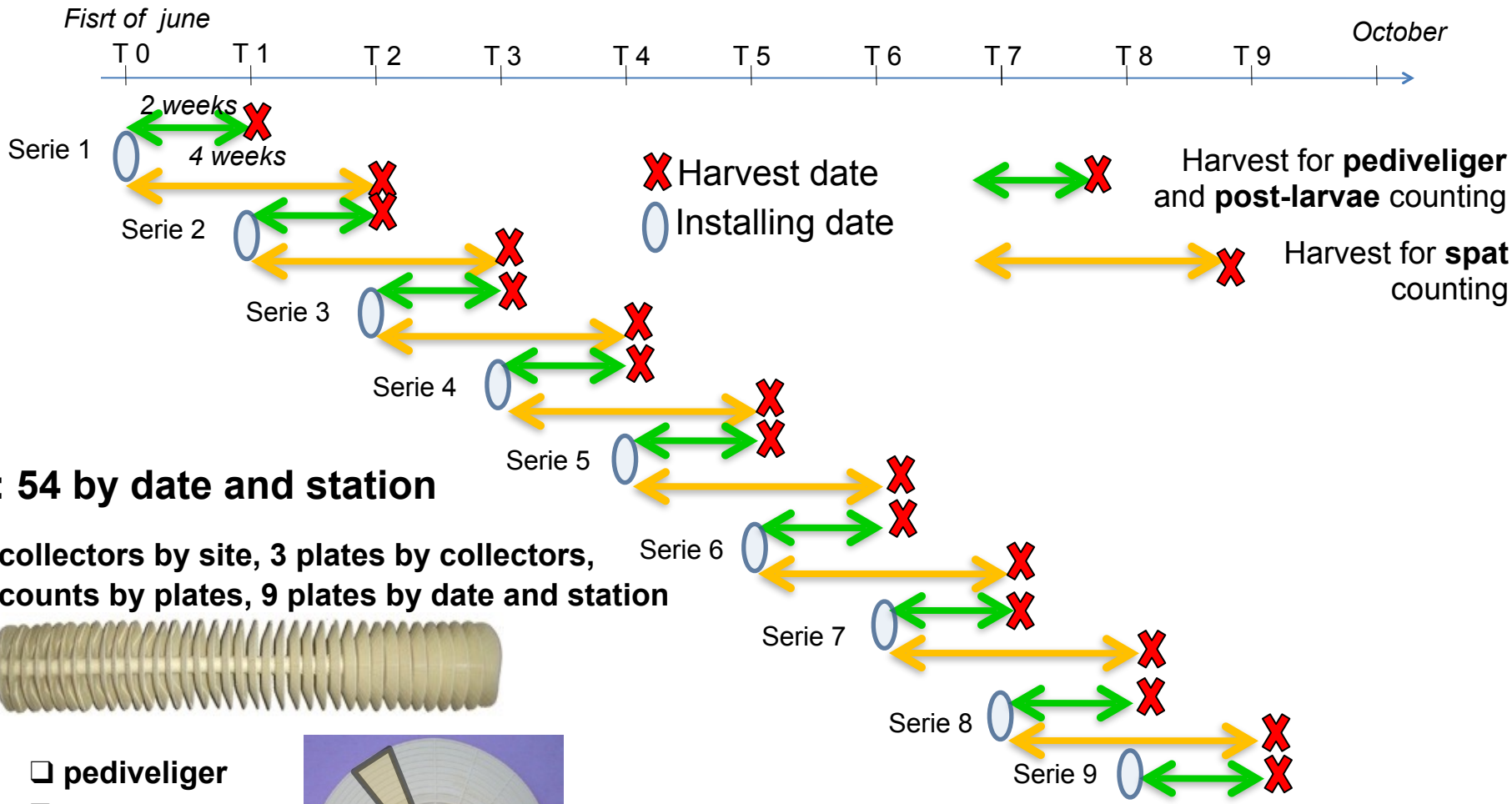
Spat

7. S

6. Settlement

Larvae

We used a temporal overlap deployment of collectors



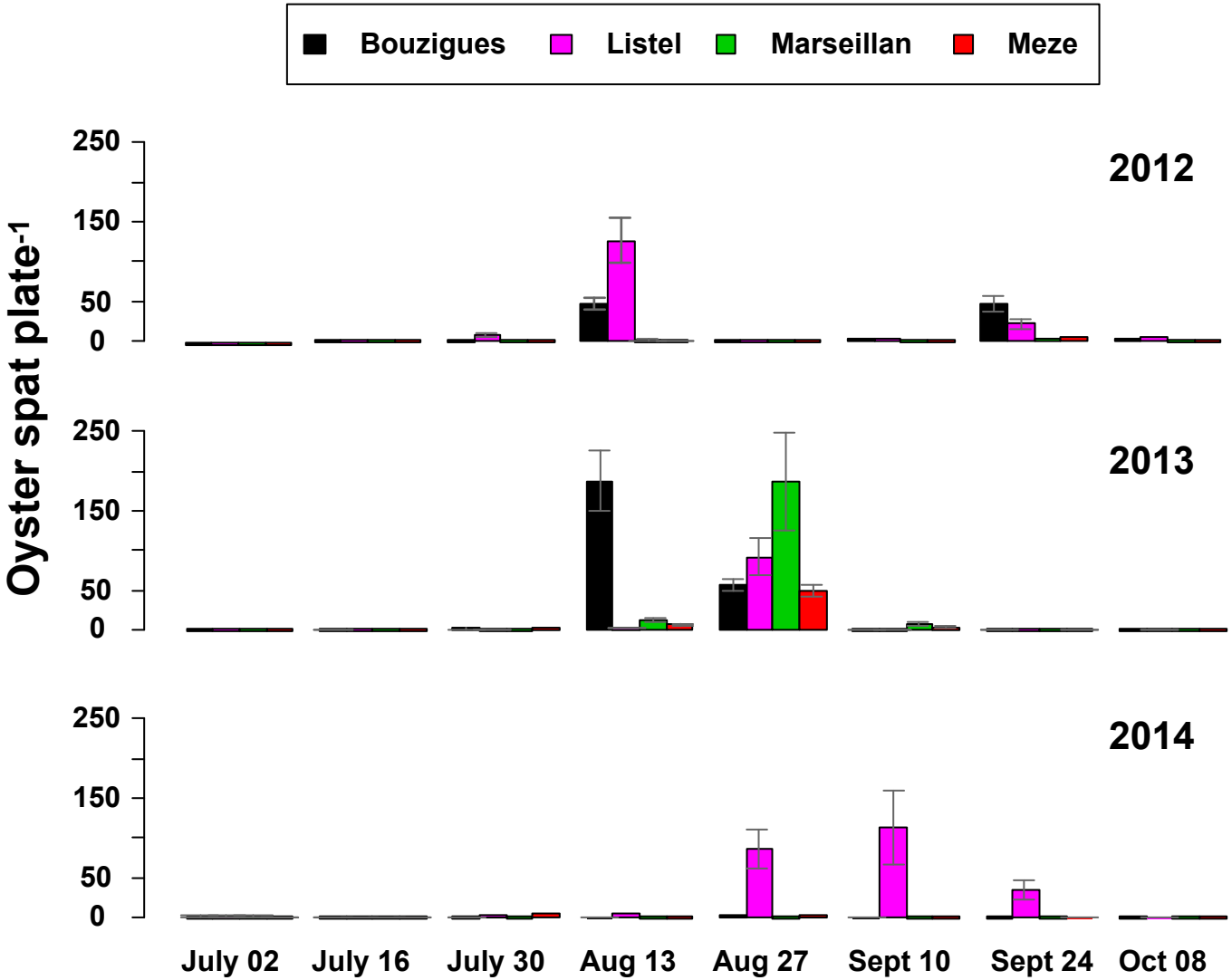
n: 54 by date and station

3 collectors by site, 3 plates by collectors,
6 counts by plates, 9 plates by date and station

- ❑ **pediveliger**
- ❑ **post-larvae**
- ❑ **spat**

◀ **plates: one sampling unit**

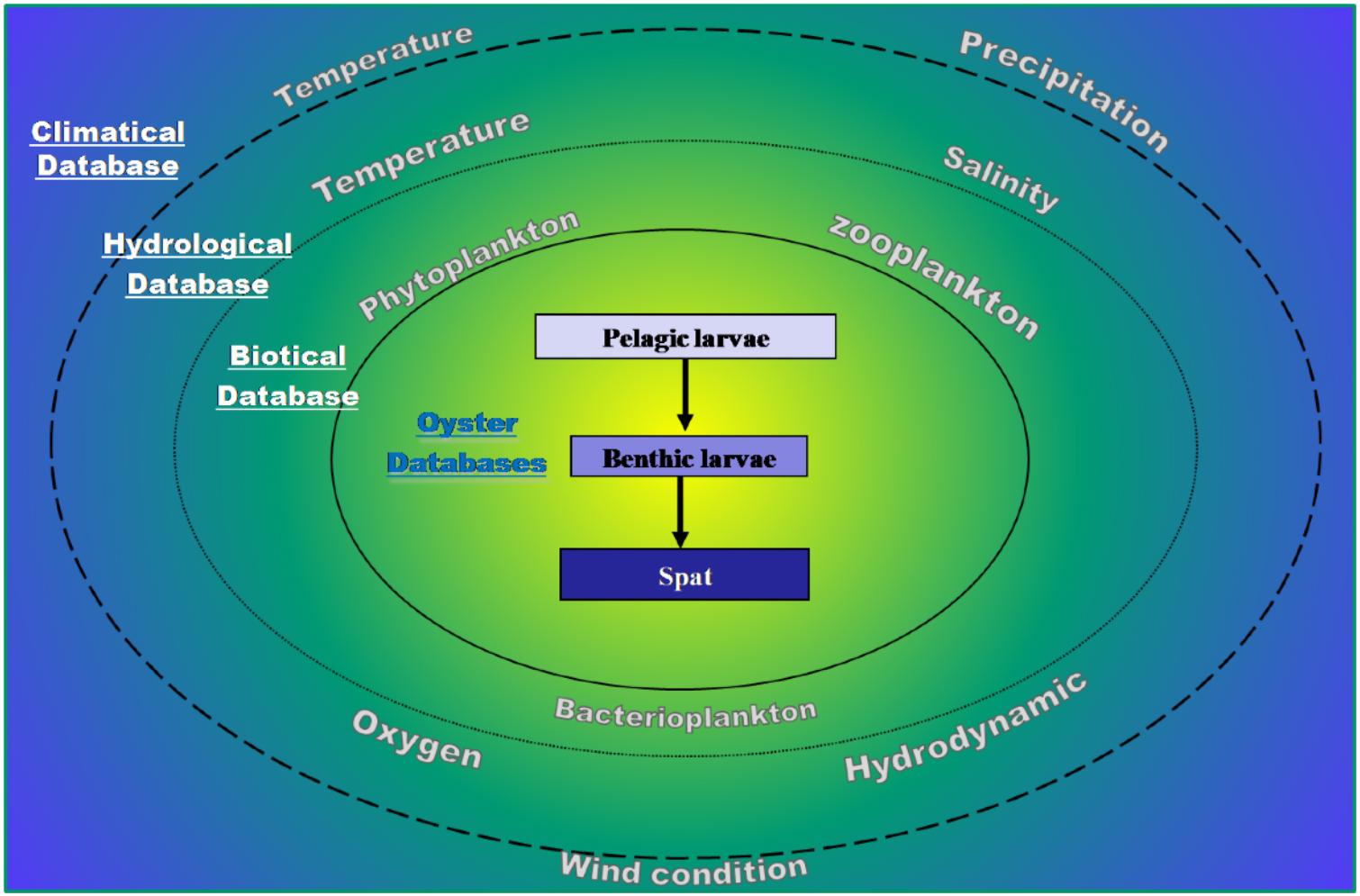
The recruitment is heterogeneous in the Mediterranean Thau lagoon.



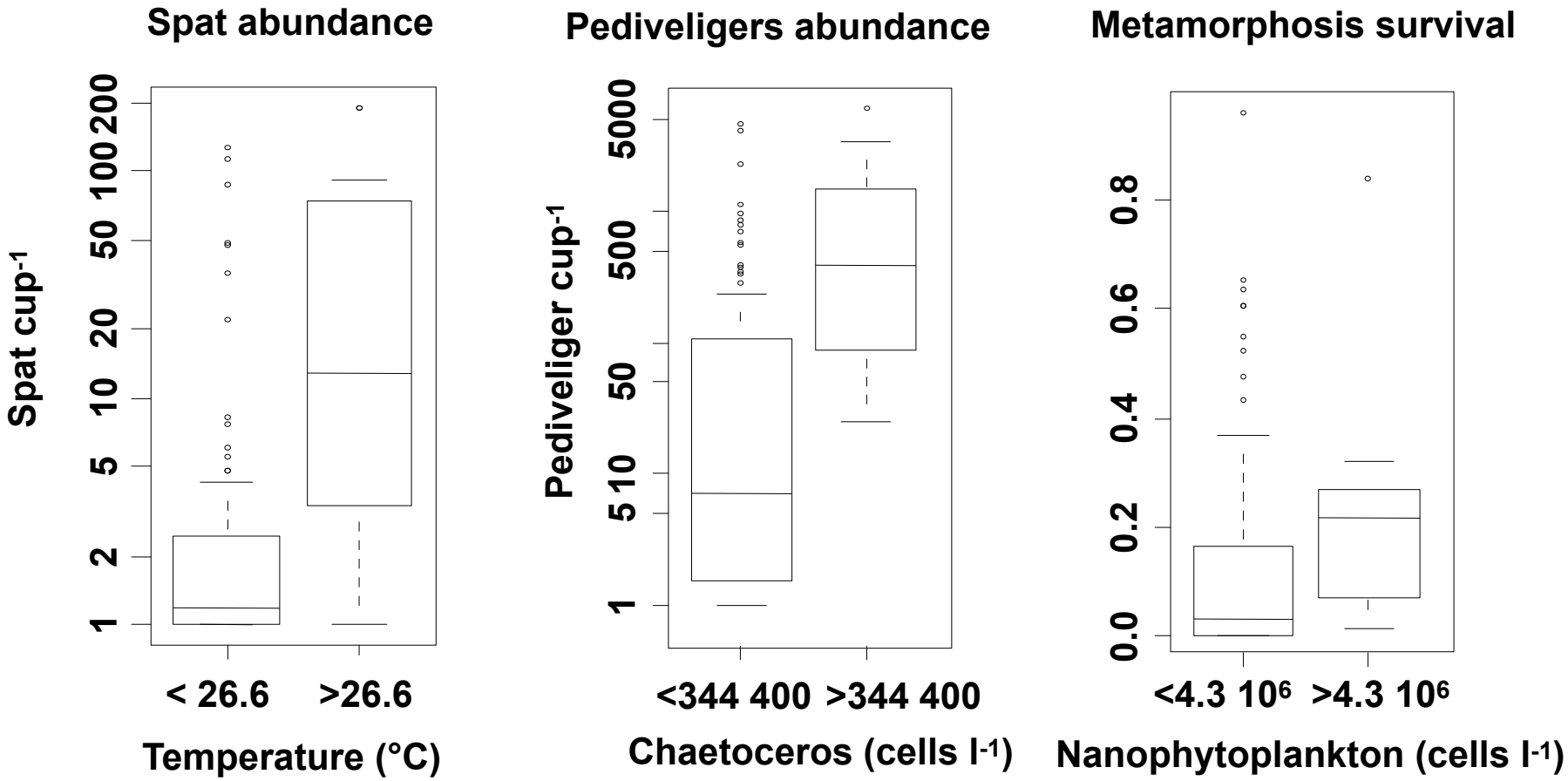
Anova, sampling site, n=96, $p < 0.05$

Lagarde et al., 2017. doi.org/10.3354/meps12265

We have 6 databases to integrate at different spatial and time scales



We identified a favorable recruitment windows with high water temperature, nanophytoplank. and *Chaetoceros* abund.



Decision tree method and Anova, $p < 0.05$

Lagarde et al., 2017. doi.org/10.3354/meps12265

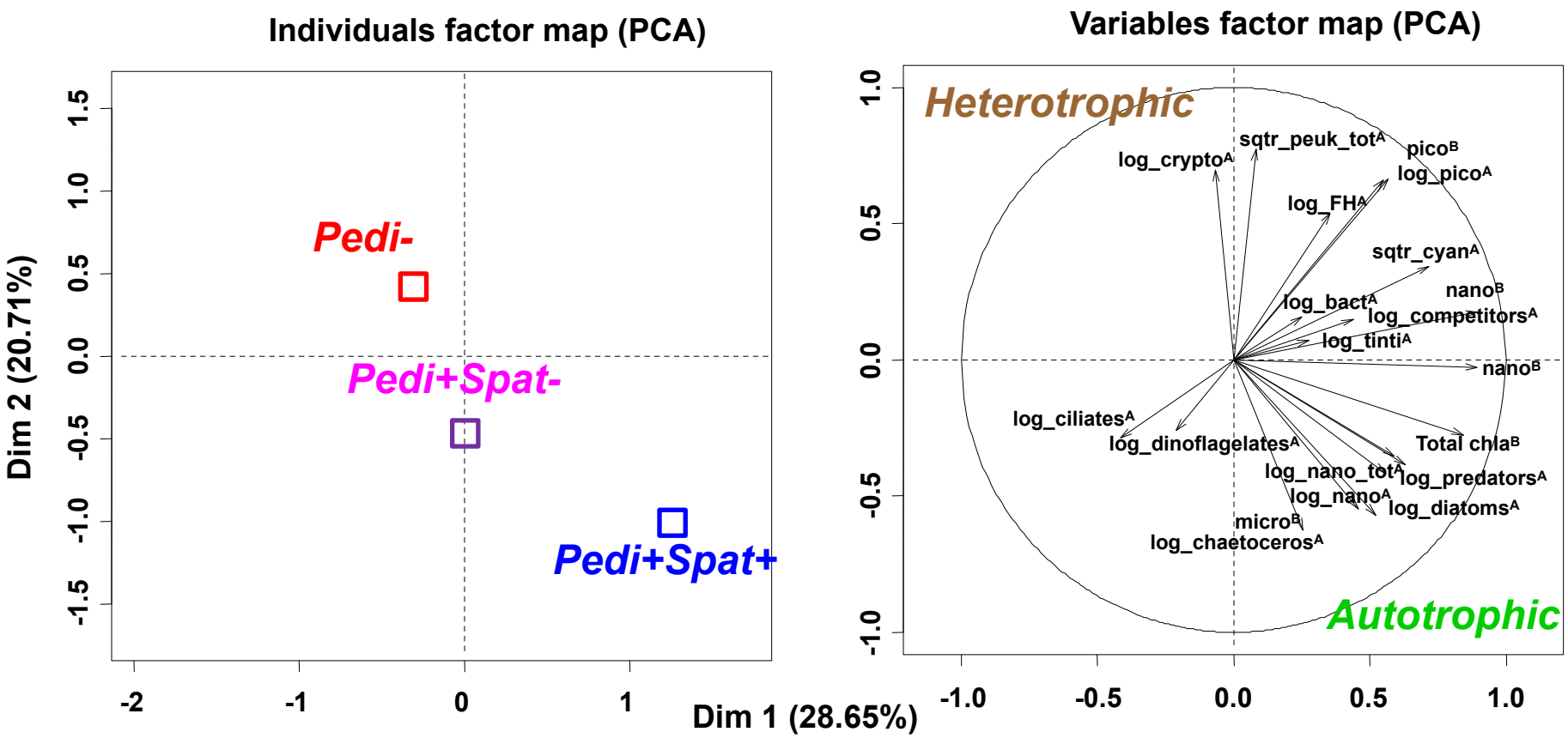
Larval recruitment variability is related to autotrophic or heterotrophic functioning of ecosystem

Pedi- *: bad pedivelyger supply*

Pedi+ Spat- *: metamorphosis failure*

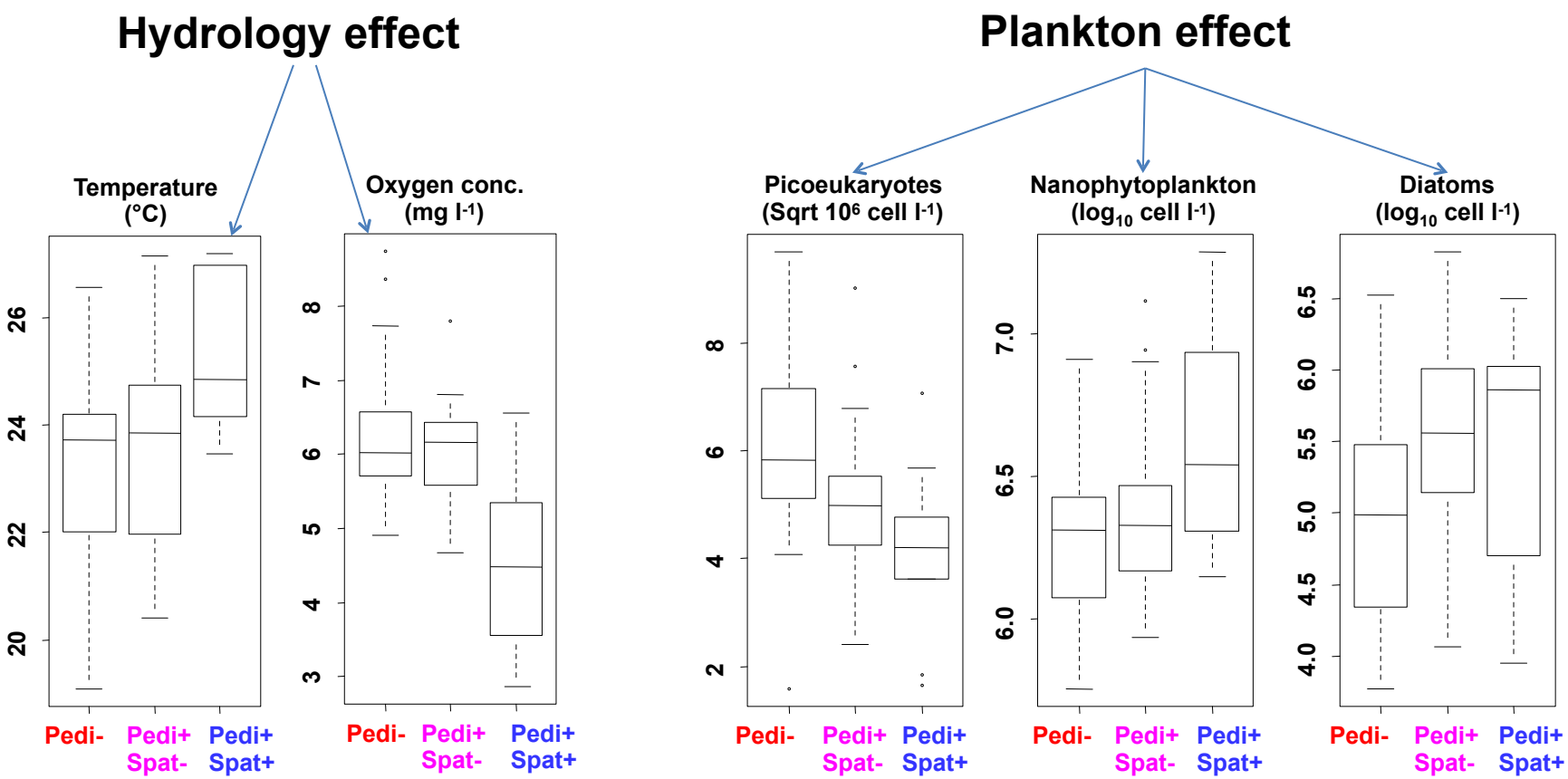
Pedi+ Spat+ *: recruitment success*

- to + *: threshold at 20 ind. plate^{-1}*



Lagarde et al., 2017. doi.org/10.3354/meps12265

Temperature and oxygen drive the autotrophic plankton abundances favorising recruitment success



Pedi- *: bad pedivelyger supply*

Pedi+ Spat- *: metamorphosis failure*

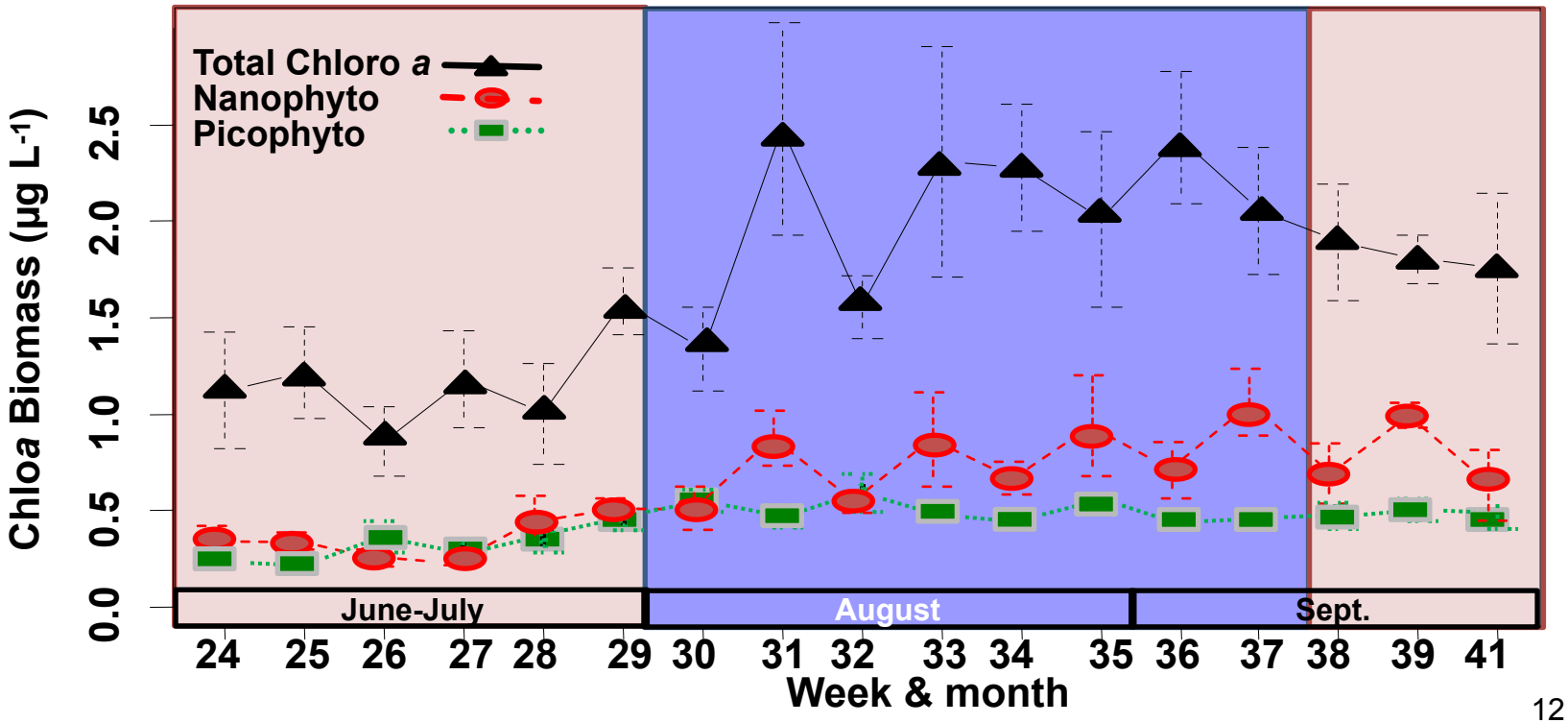
Pedi+ Spat+ *: recruitment success*

Kruskall Wallis test, $p < 0.05$

Lagarde et al., 2017. doi.org/10.3354/meps12265

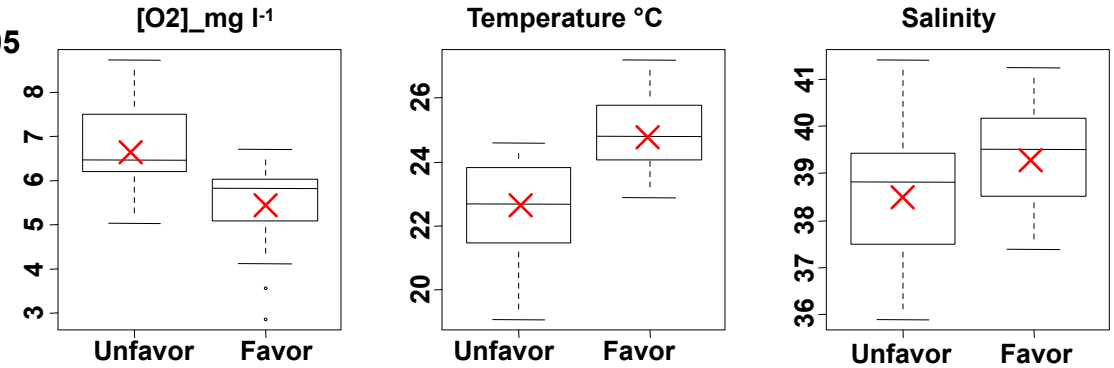
There is a temporal structure defining favorable and unfavorable recruitment window during 2012, 2013 and 2014

	Time line															
Month	June		July				August					September				October
Week	24	26	27	28	29	30	31	32	33	34	35	36	37	38	39	41
bad pedivelyger supply	4	4	0	4	0	3	2	2	3	5	3	7	0	5	1	3
metamorphosis failure	4	4	4	4	4	4	0	1	1	2	1	0	2	3	3	1
recruitment success	0	0	0	0	0	1	2	5	0	1	0	1	2	0	0	0
Recruitment window	Unfavorable					Favorable								Unfavorable		

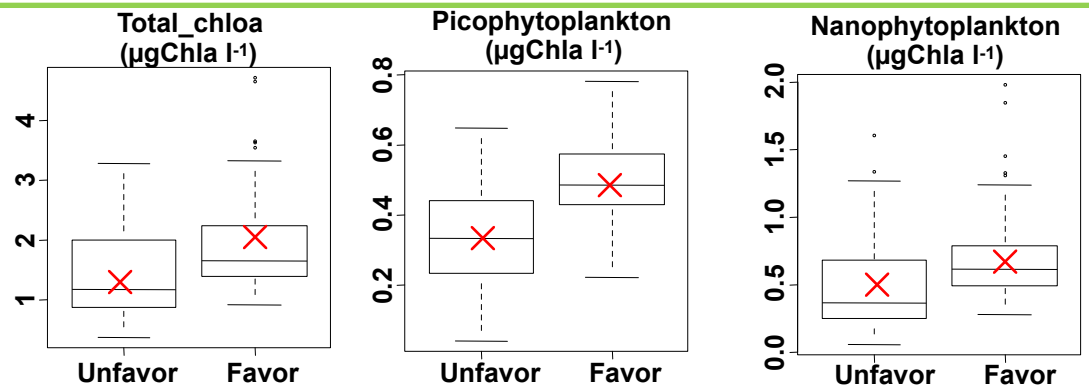


Favorable recruitment windows are driven by hydrology cues inducing trophic functions of the ecosystem

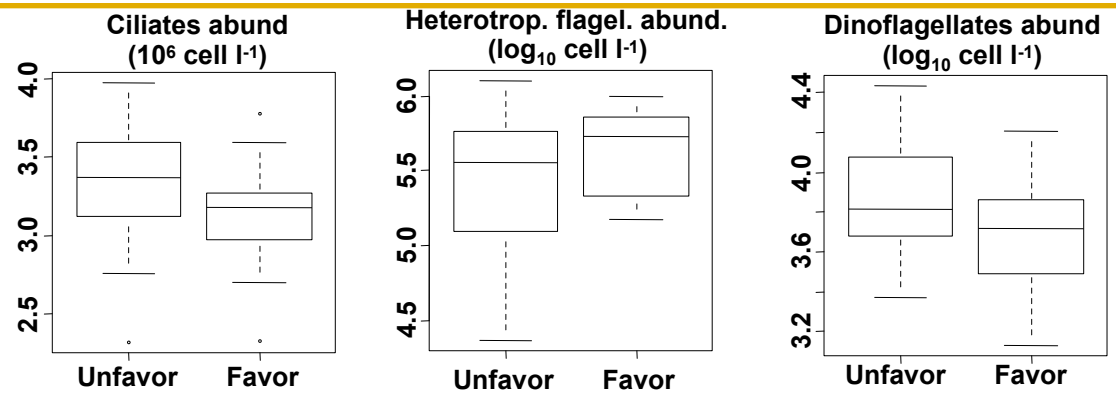
Kruskall Wallis test, p < 0.05



Autotrophic indicator



Heterotrophic indicator



Lagarde et al., 2017. doi.org/10.3354/meps12265

Temporal recruitment windows of *Crassostrea gigas* is controlled by trophic ecological function

Unfavorable period

Heterotrophic food sources

Temperature		+
Oxygen conc.		+
Plankton	picophyto	-
	nanophyto	-
Mismatch	chaetoceros	-
	diatoms	-
	total chlo	-
	ciliates	+
	dinoflagellates	+

Recruitment failure

Trophic interaction: Top Down controlled by filter-feeders

Favorable period

Autotrophic food sources

Temperature		++	
Oxygen conc.		-	
Plankton	picophyto	+	
	nanophyto	+	
Match	chaetoceros	+	Troph. Settl. Trigger ?
	diatoms	+	
	total chlo	+	
	ciliates	-	
	dinoflagellates	-	

Recruitment success

Trophic interaction: Bottom-up controlled by temperature, hypoxic events and nutrients

Cushing 1990, doi.org/10.1016/S0065-2881(08)60202-3, Toupoint et al. 2012, doi.org/10.1890/11-1292.1


Coast Bordeaux 2017
Société franco-japonaise d'Océanographie
Thank you very much
for your attention
Ifremer
Crédit photo
marbec
marine biodiversity
exploitation & conservation

Temporal recruitment windows of *Crassostrea gigas* is controlled by trophic ecological function

Unfavorable period

Heterotrophic food sources

Temperature		+
Oxygen conc.		+
Plankton	picophyto	-
	nanophyto	-
Mismatch	chaetoceros	-
	diatoms	-
	total chlo	-
	ciliates	+
	dinoflagellates	+

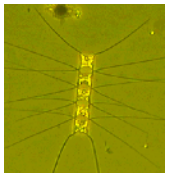
Recruitment failure

Trophic interaction: Top Down controlled by filter-feeders

Favorable period

Autotrophic food sources

Temperature		++
Oxygen conc.		-
Plankton	picophyto	+
	nanophyto	+
Match	chaetoceros	+
	diatoms	+
	total chlo	+
	ciliates	-
	dinoflagellates	-



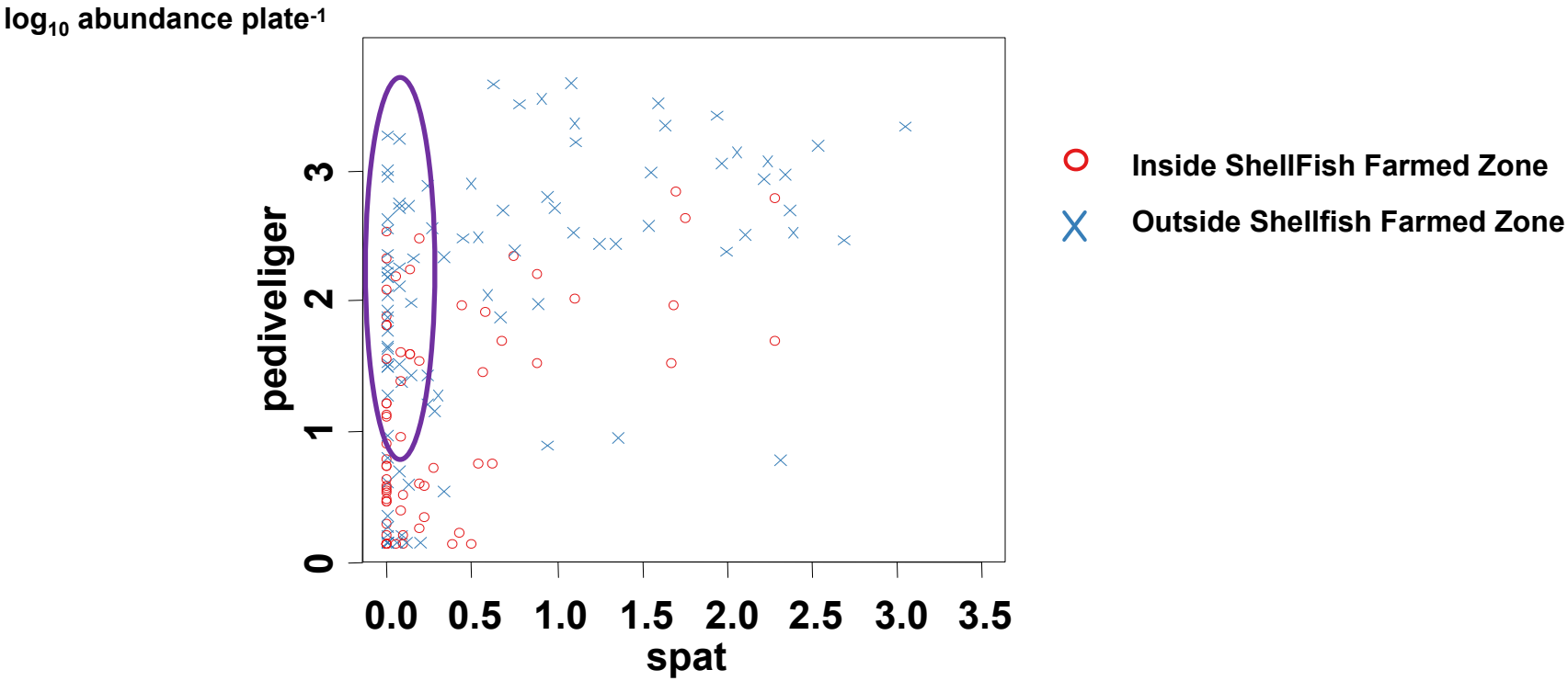
Troph. Settl. Trigger ?

Recruitment success

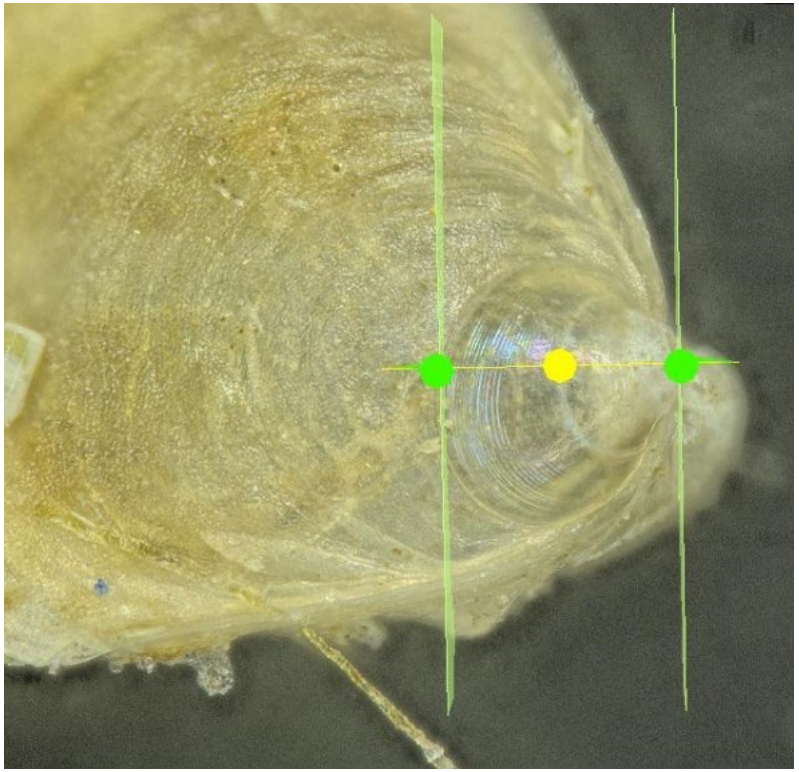
Trophic interaction: Bottom-up controlled by temperature, hypoxic events and nutrients

Cushing 1990, doi.org/10.1016/S0065-2881(08)60202-3, Toupoint et al. 2012, doi.org/10.1890/11-1292.1

We detected metamorphosis failure of Japanese oyster inside Thau lagoon.



Metamorphosis delay related to larger PII size seems to limit recruitment in Mediterranean Thau lagoon

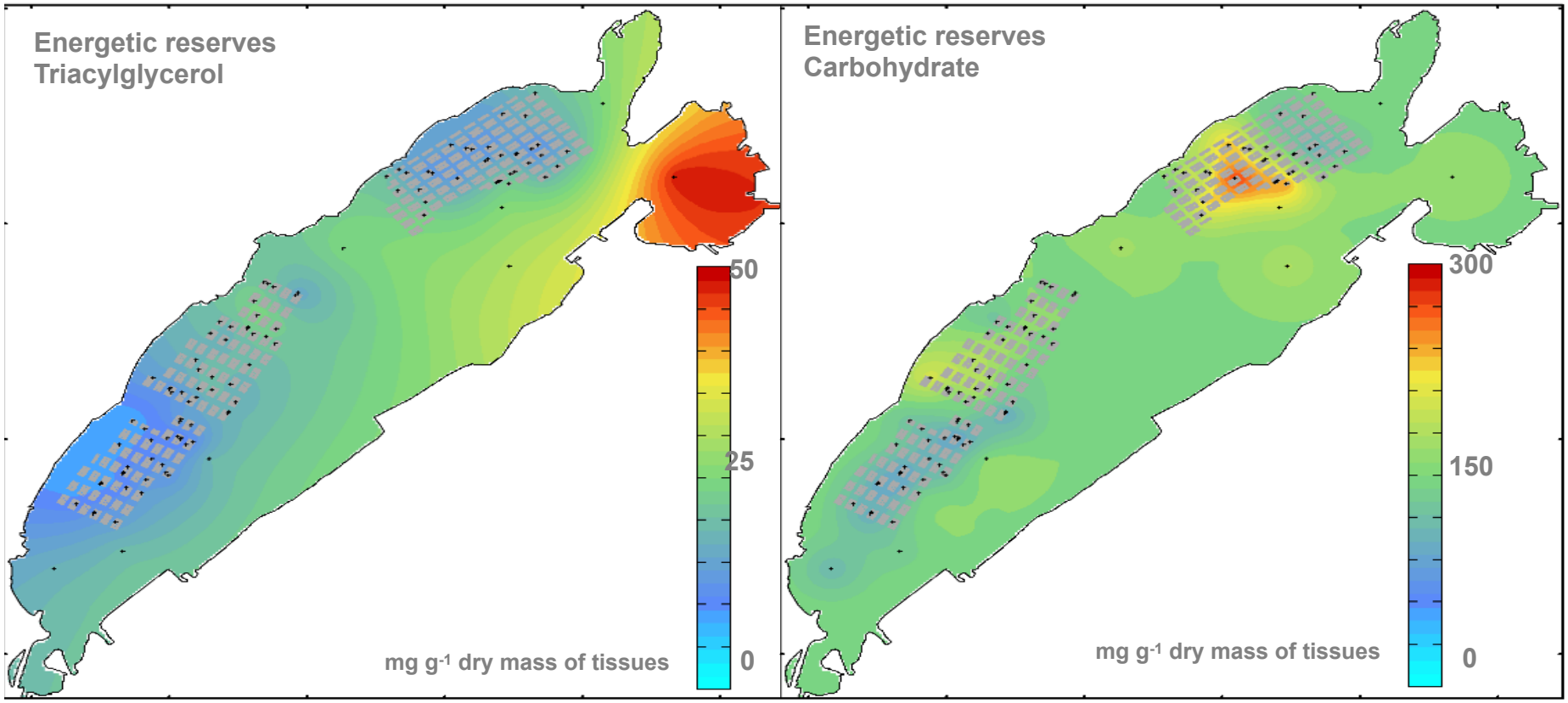


Variability of the PII size was identified showing metamorphosis delays

Metamorphosis delays were influenced by temperature and ecological status of ecosystem

Lagarde et al., 2017. Physiomar, Cambridge, UK

We study this species in a heterogeneous ecosystem in space



From Pernet et al., 2014. doi:10.1371/journal.pone.0088469

The Mediterranean Thau lagoon and its heterogeneity