Connectivity models in the Adriatic Sea to support the design of EFH

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Primo incontro dei portatori d'interesse del mondo della pesca
| Venice| 21 February 2019

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Connectivity models in the Adriatic Sea to support the design of EFH

Two target species
Solea solea* and *Nephrops norvegicus

Connectivity assessment
in the Adriatic Sea.

Aim of connectvity modelling tasks

Assessing biological connectivity among subpopulations is a fundamental information for sustainable fisheries management, for:

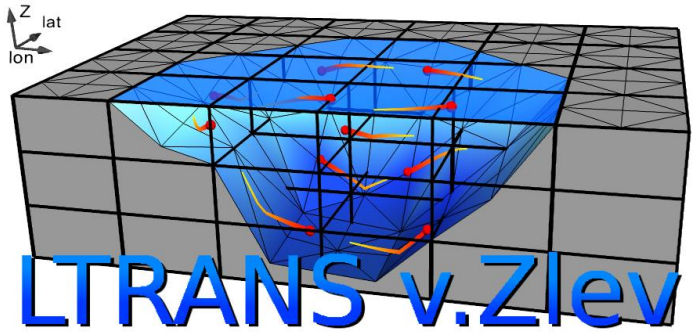
- Identification connections between larval release area and nursery area Essential Fish Habitats (EFH)
- Identify nursery areas of greater retention
- Identify release areas wich have a greater successfull settling
- Contribute to SMART spatial explicit bioeconomic model integrating connectivity and recruitment and simulate the potential effects of selective spatial fishery closures

NUMERICAL TOOLS

MITgcm

1. Hydrodynamic model

MITgcm hydrodynamic 3D current data for the 2006-2012 period, with 1/64° horizontal resolution, 60 vertical levels.



2. Lagrangian particles tracking model

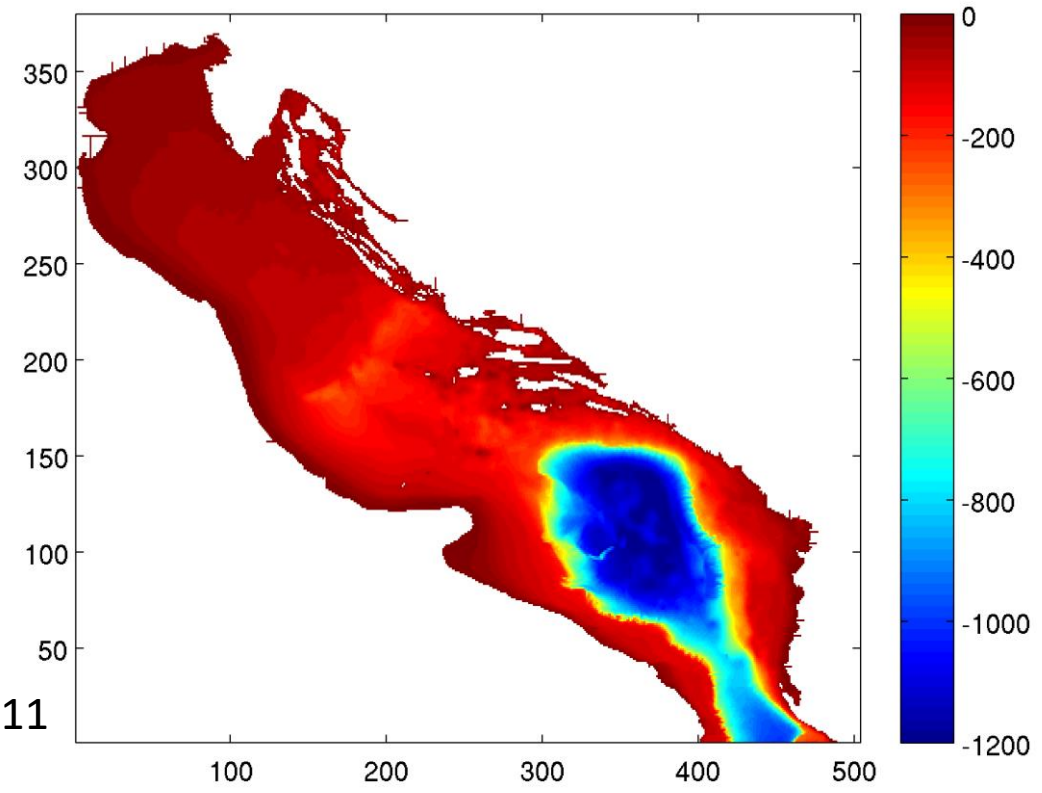
LTRANS-v.Zlev: Lagrangian particle tracking model:
used to track the trajectories of particles released from specific areas and driven by ocean currents in the GSA17 and GSA18

3. Larval behaviour model, species dependent:

- **Temporal dependeny:** temperature dependence, diel vertical migration
- **Critical survival conditions** (sediment and temperature)

MITgcm hydrodynamic model

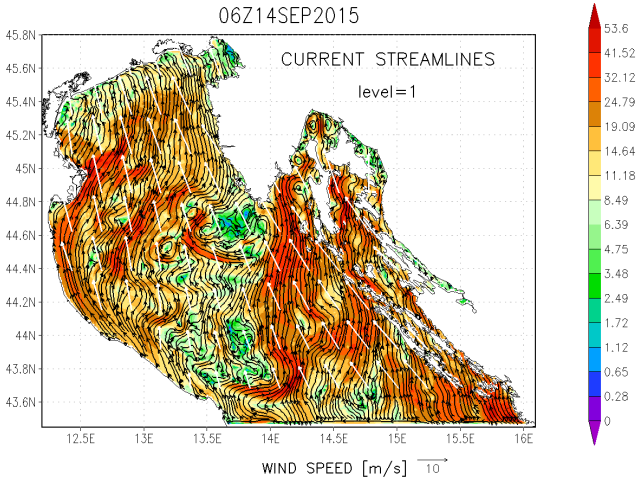
- Adriatic-Ionian system
- Spatial resolution 1/64°(~1 nm)
- 70 vertical levels
- Simulation (2006-2012)
- Time step 200 s



Querin et al., 2016, Querin et al., 2011

North Adriatic hydrodYnamic model set up

- Reanalysis **RegCM** (12 km – Adriatic-Ionian)
- Operational **ALADIN** (ARSO - SLO, 4.4 km – North Adriatic)
  - ✓ Wind (10 m)
  - ✓ Air temperature(2 m)
  - ✓ Pressure (s.m.m.)
  - ✓ Relative humidity (e/o specifica; 2 m)
  - ✓ Precipitatione
  - ✓ Long wave solar radiation
  - ✓ Short wave solar radiation
  - ✓ Rivers discharge from main rivers



Nephrops n. growth and behaviour model

Larvae released in December, January and February (*E.B. Morello, C. Froglia)*

Gr=0.02*T+0.04 larval growth TEMPERATURE limitation: death when T> 18°C

STAGE1: lenght: 6 mm where: bottom movement: passive +vertical *(Smith et al., 1987)*

STAGE2: diel vertical migration (2phases)

STAGE3: downward migration (14 mm size)

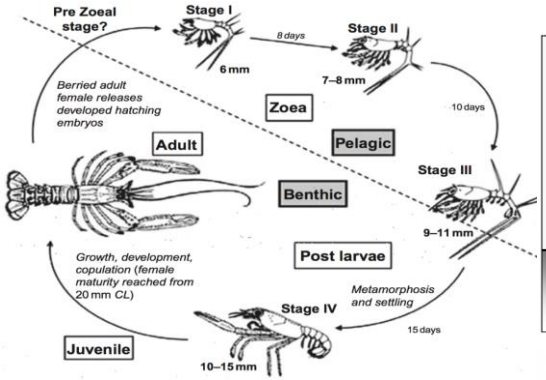
STAGE4: bottom, search of a suitable sediment site for max 5 days (OR death)

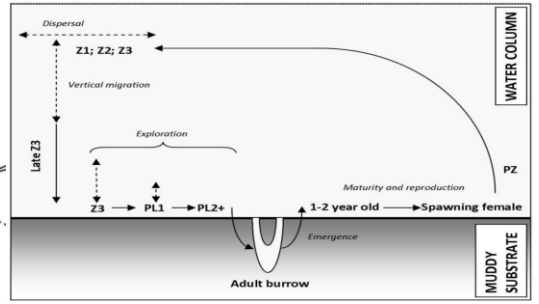
(SENSITIVITY run for temperature and searching time)

Setup of larval dispersal scenario

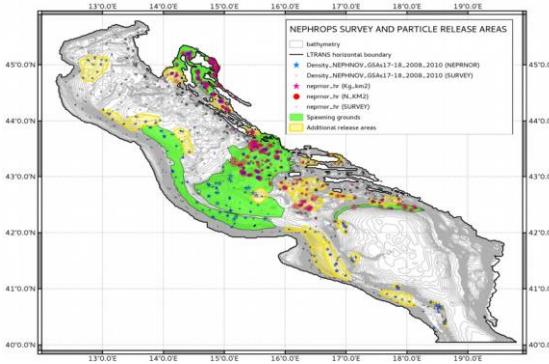
Nephrops scenarios

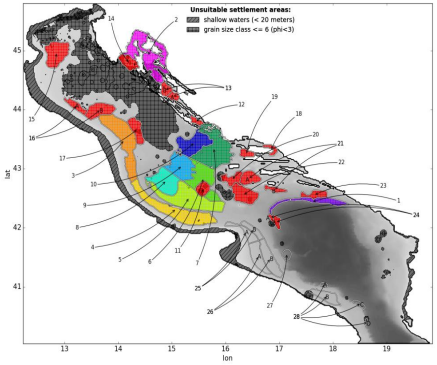
Larval dispersal
Larval growth
Temperature limitation
Sediment type

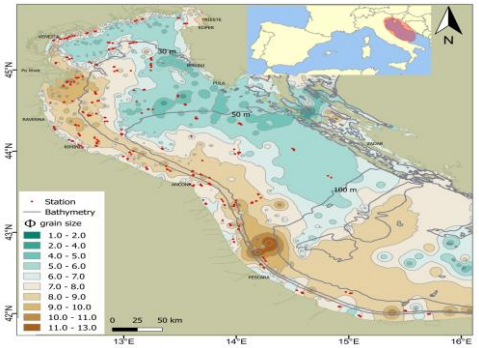




630 simulations one for each day between the 1st of December to the 28th of February, for each year between 2006 and 2012, releasing one particle from each cells of the domain, corresponding to the area shown below

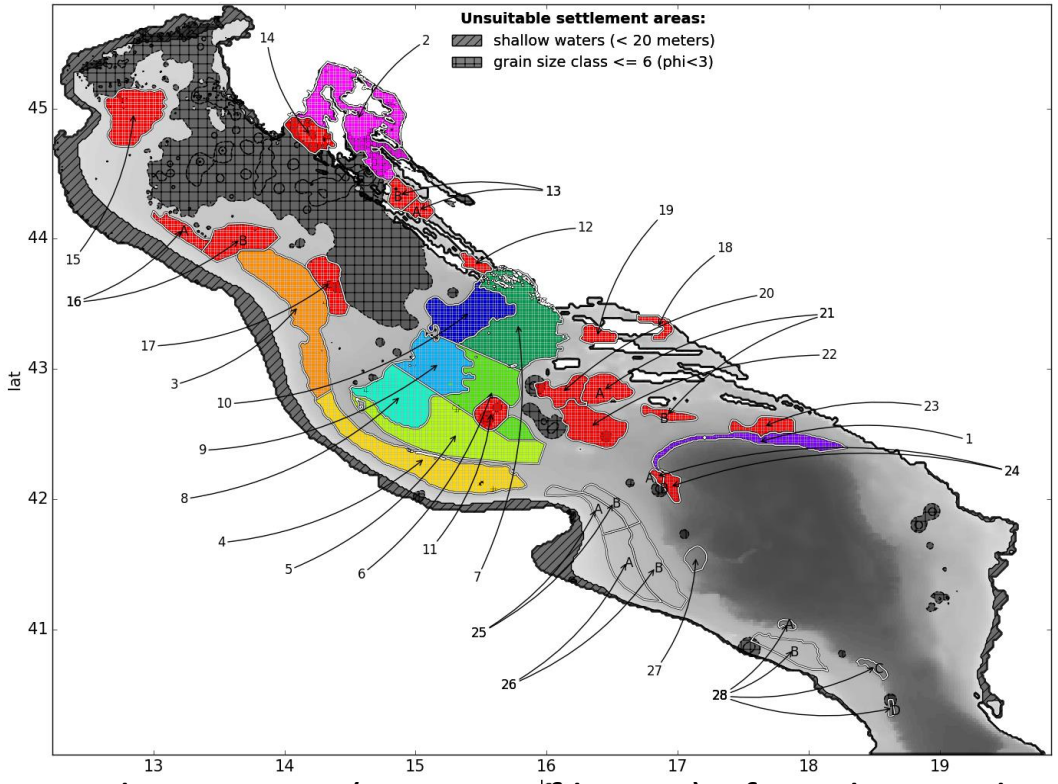


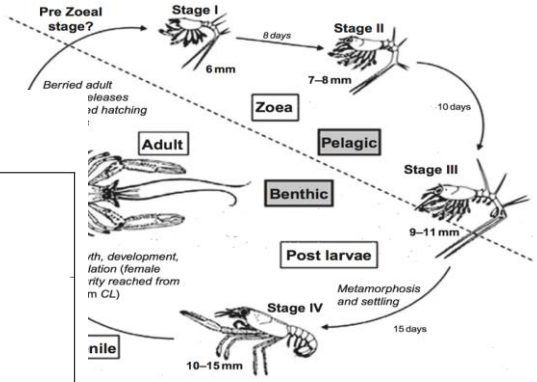


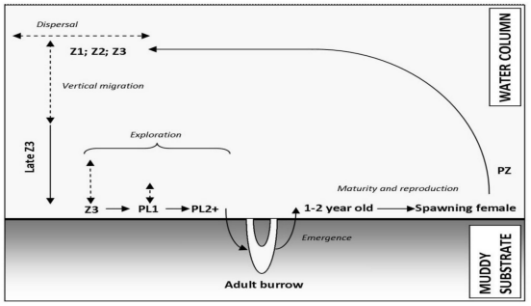


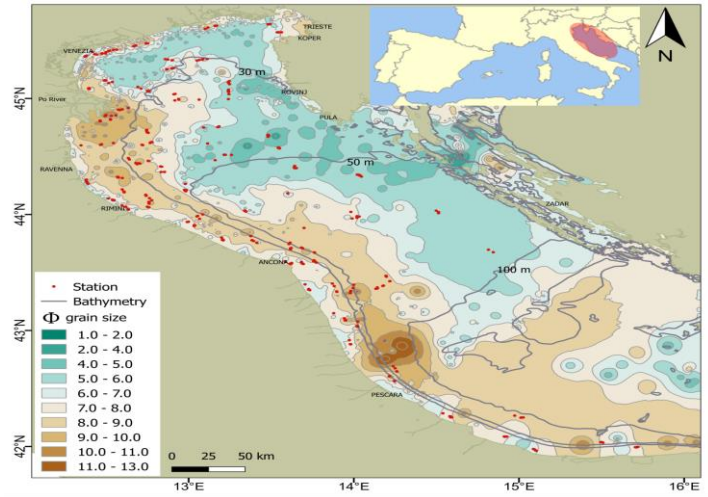
Setup of larval dispersal scenario

Nephrops scenarios







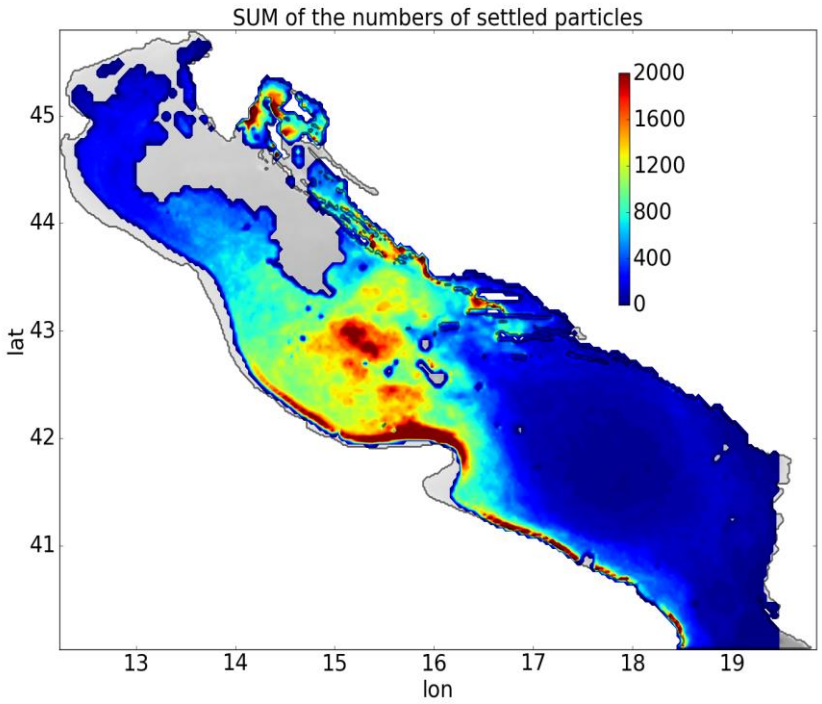


Grain size for suitability

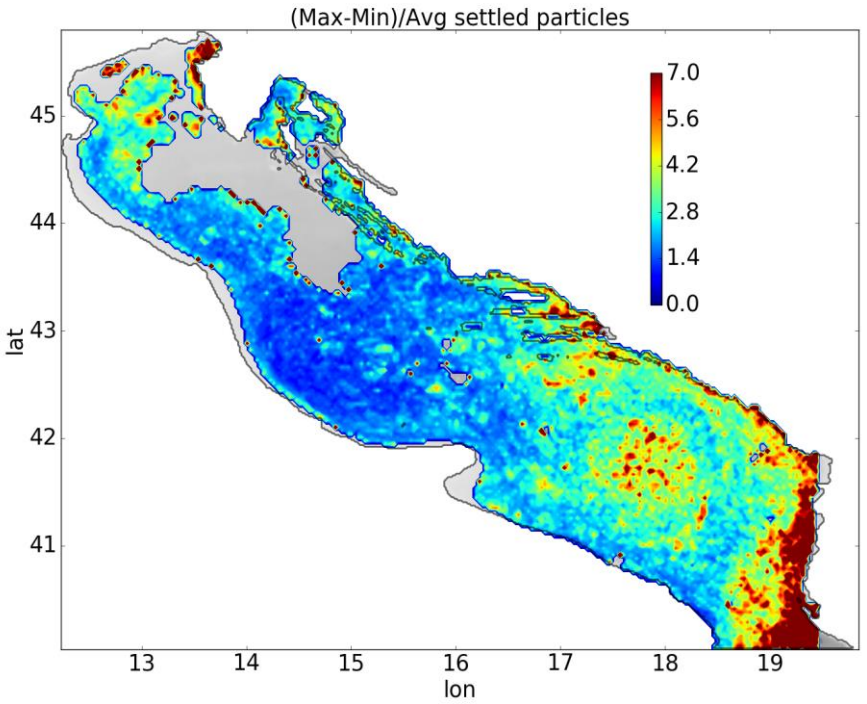
Release areas (sources of larvae) of Nephrops plotted in agreement with MEDITS data Nephrops assessment (1996-2017).

Results: nephrops connectivity

(whole suitable areas)



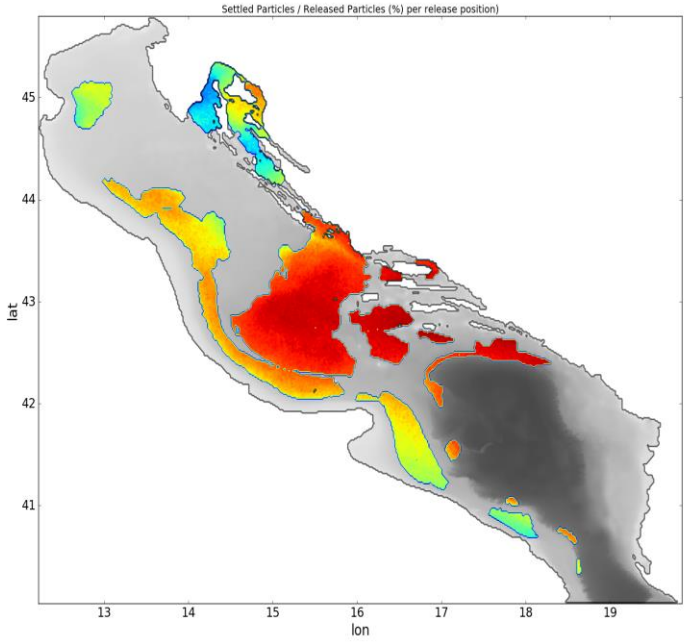
Settling density (retention rate at each grid point)



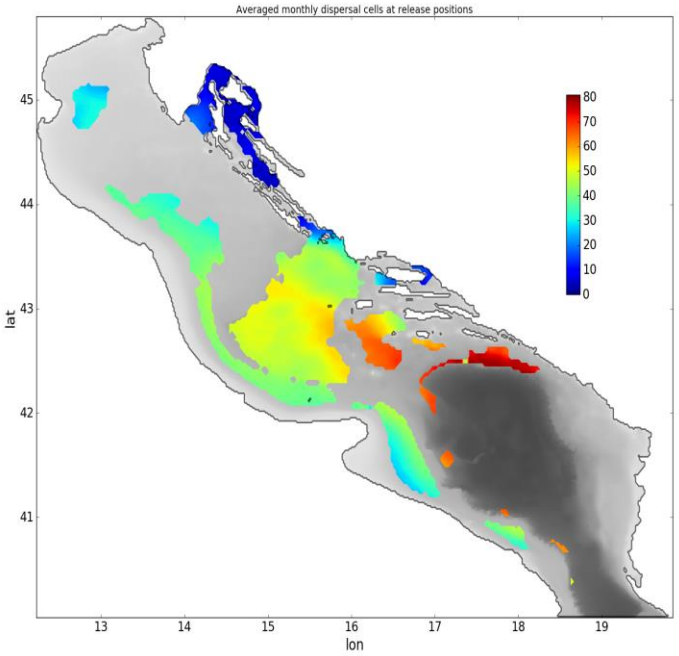
Settling density variability

Results: nephrops connectivity

(compute only for the area identified in MEDITS map)

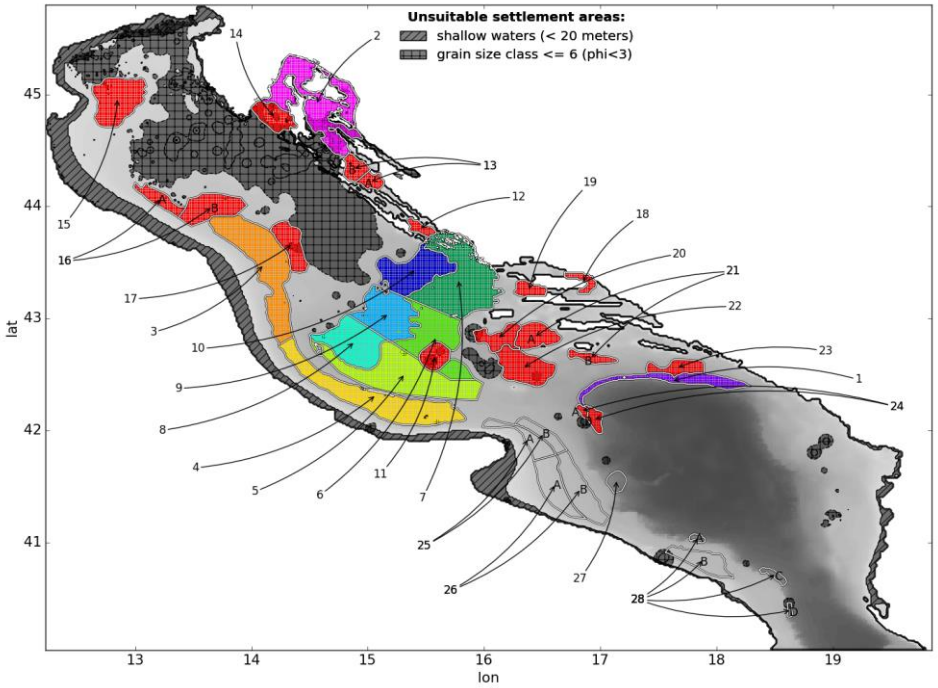


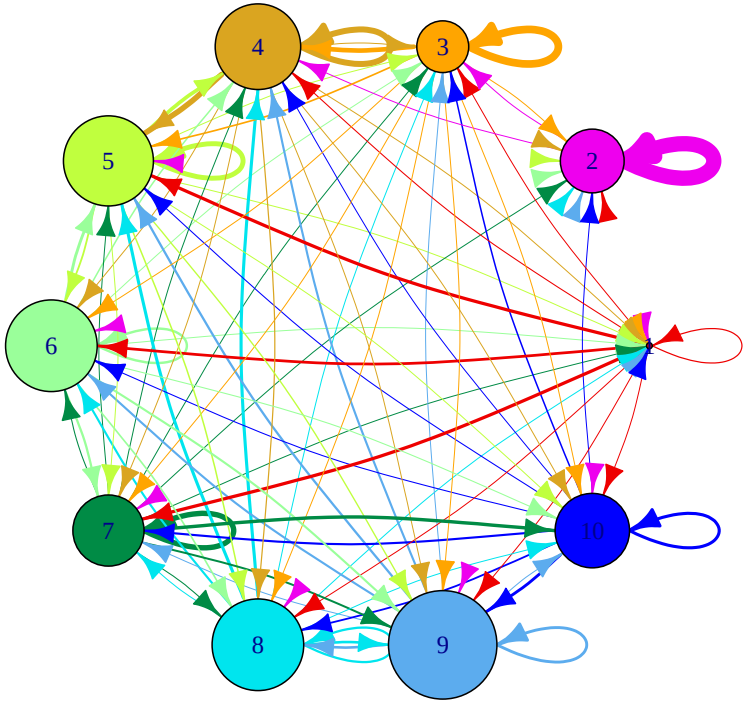
Success rate per grid point
(how much)



Dispersion rate
(how large is the spreading area)

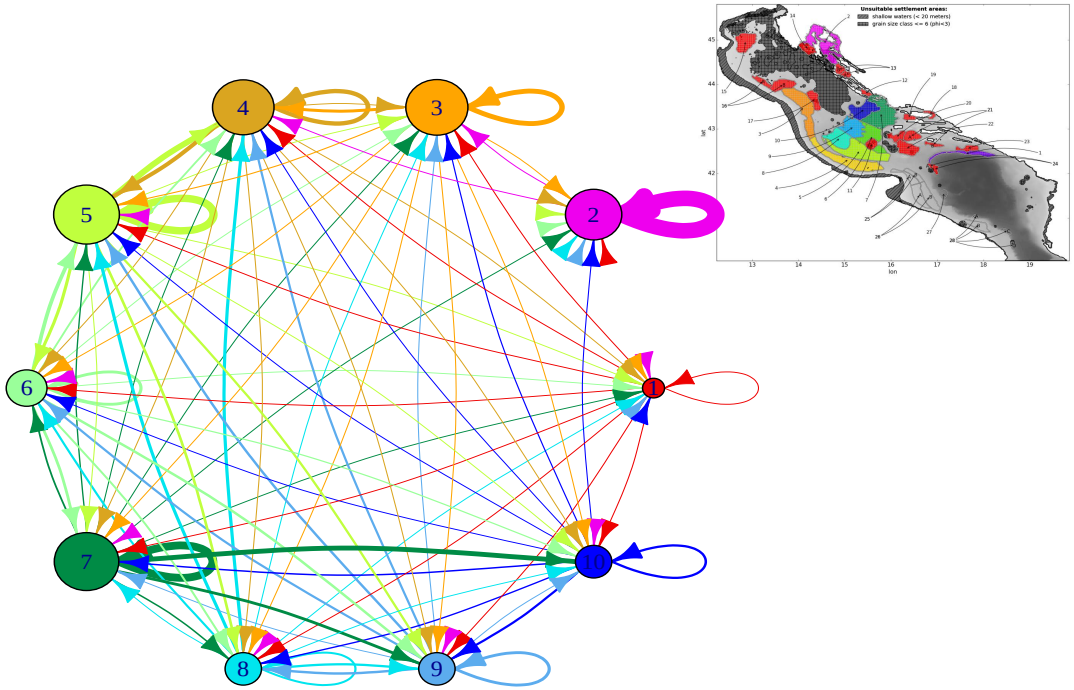
Results: nephrops connectivity

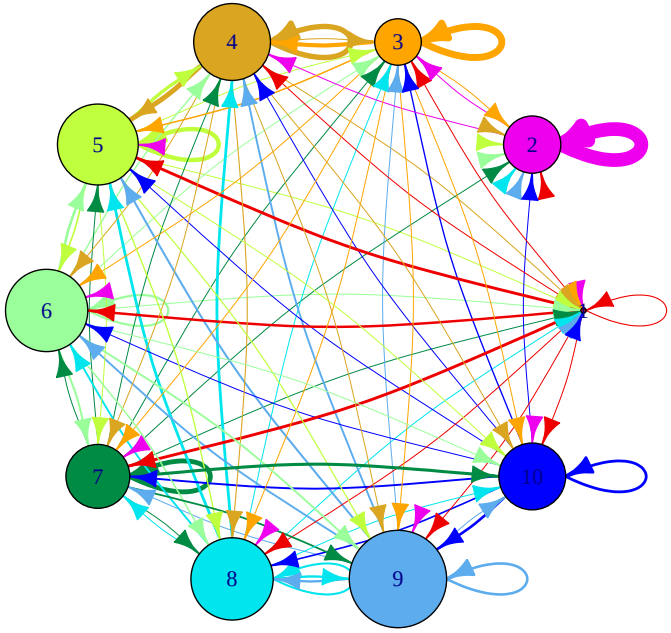




Connectivity between **Release area** 1-10
Dimension proportional to **Retention rate**
Lines → fluxes between two areas
Line thickness → flux intensity

Results: nephrops connectivity





Connectivity between **Release area** 1-10
Dimension proportional to **SURFACE**
Lines → fluxes between two areas
Line thickness → flux intensity

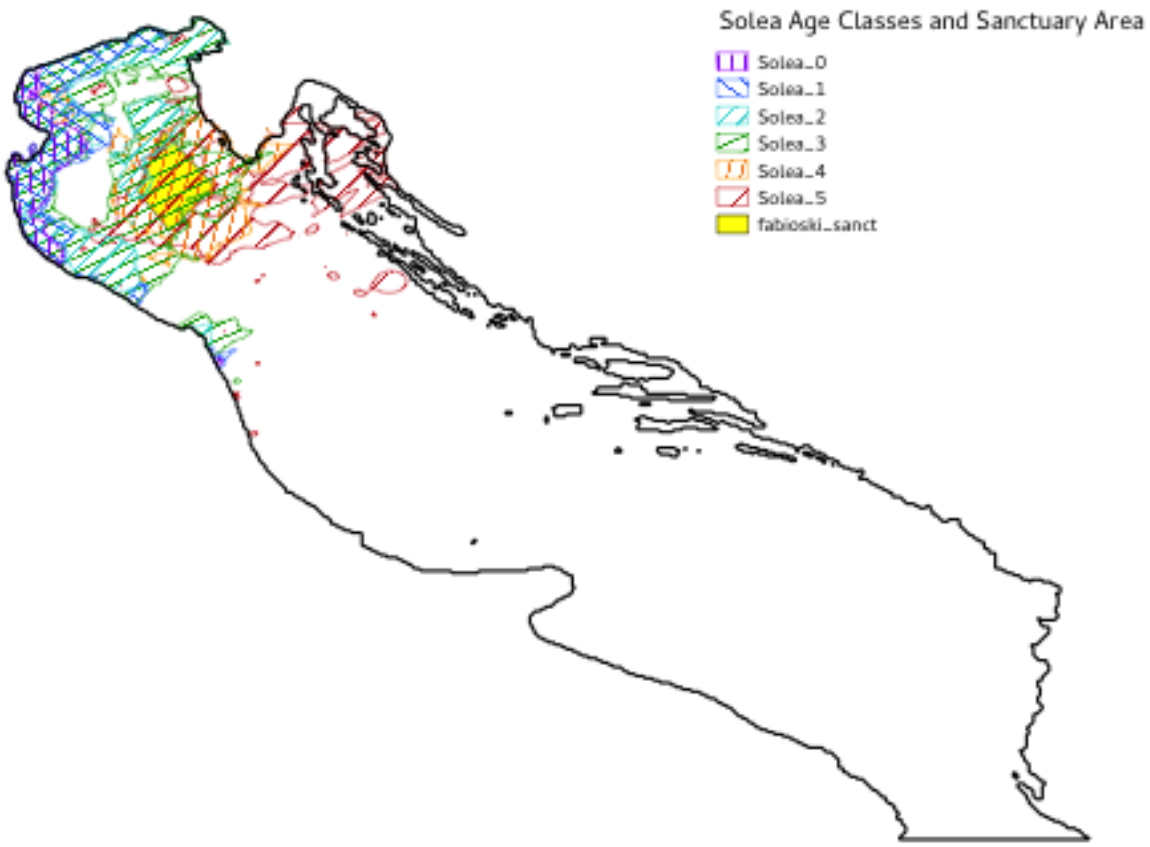
Connectivity between **Release area** 1-10
Dimension proportional to **Retention rate**
Lines → fluxes between two areas
Line thickness → flux intensity

Solea solea larval dispersal scenario

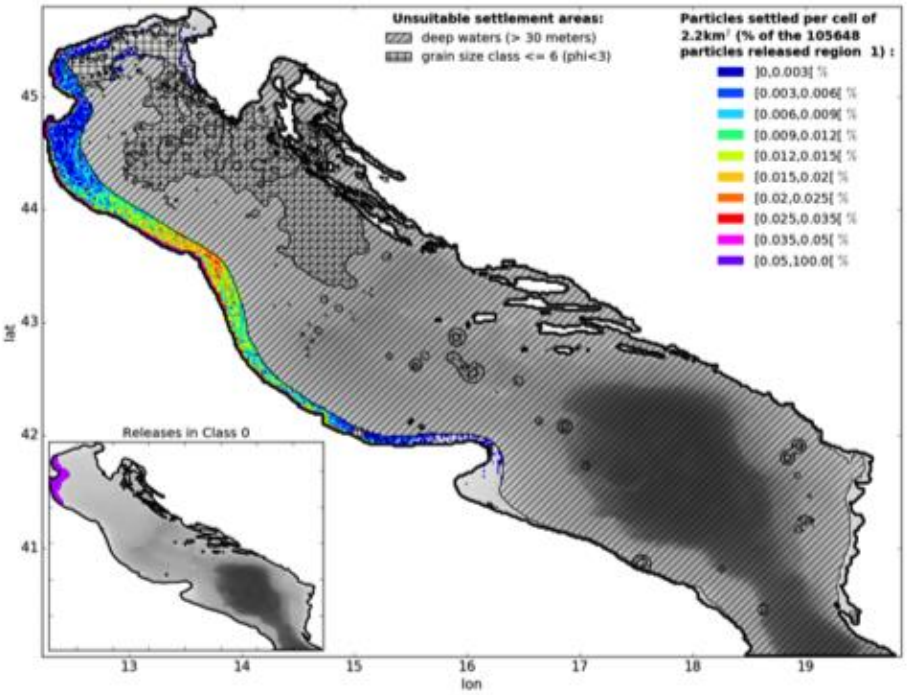
Solea solea scenarios

Growth temperature dependent
Diel vertical migration

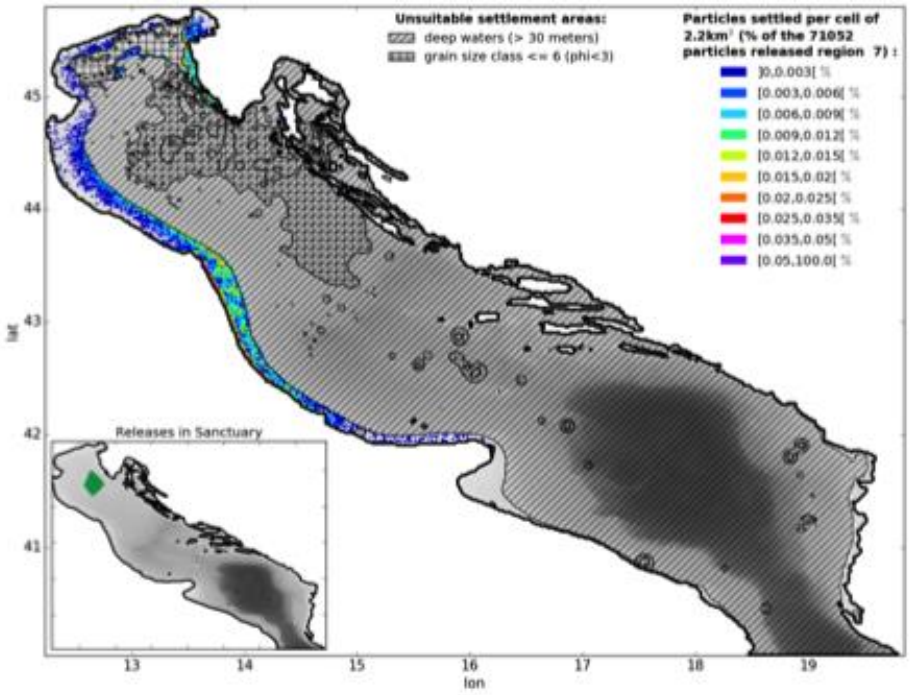
6 years of simulations,
420 simulations (one for each day between the 1st of December to the 31 of January)
releasing one particle from each cells of the domain
(Scarcella et al., 2014, Grati et al., 2013)



Results Solea solea larval connectivity

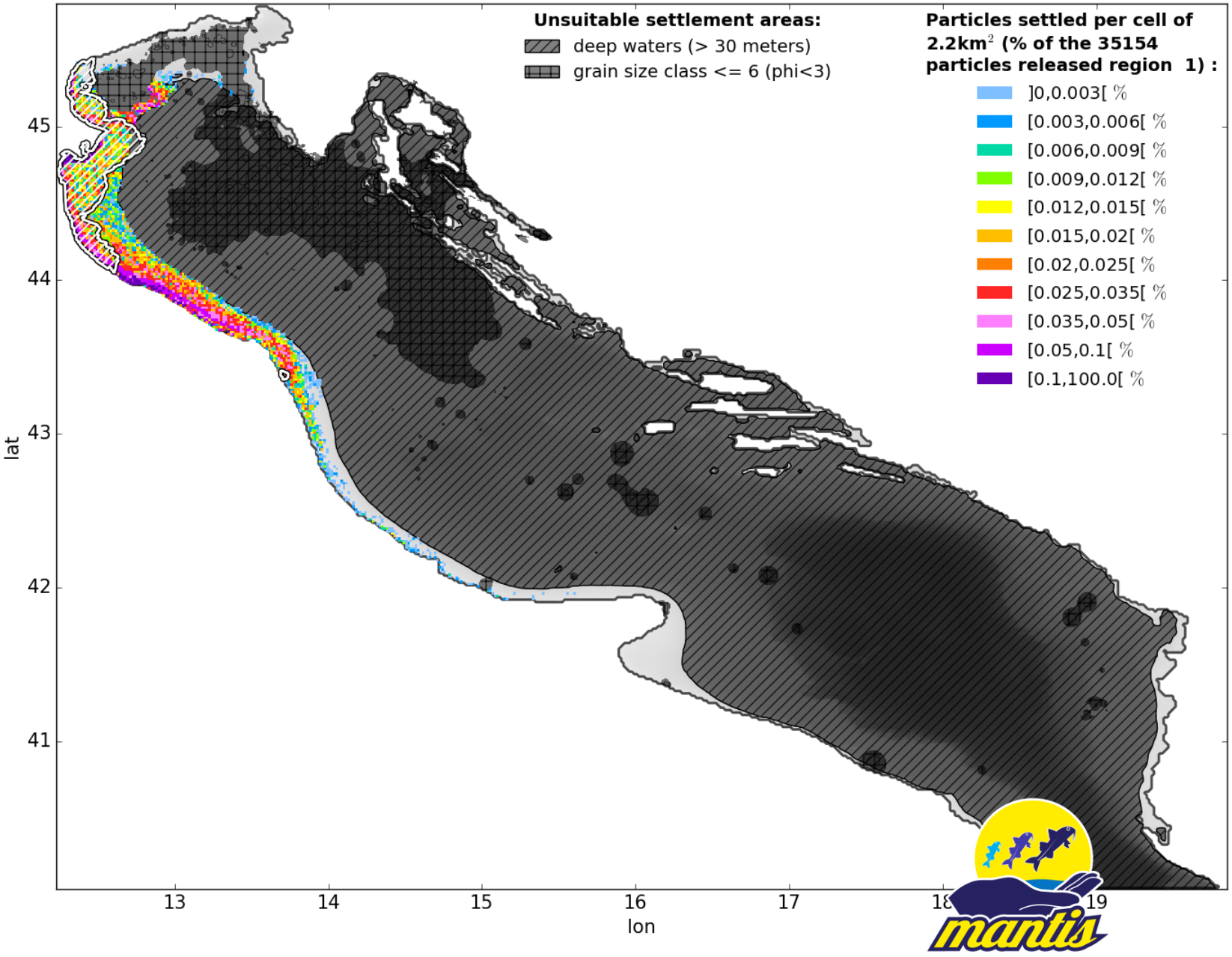


Averaged arrival density of *S. solea* released from the area shown in the small map in the down/left panel.

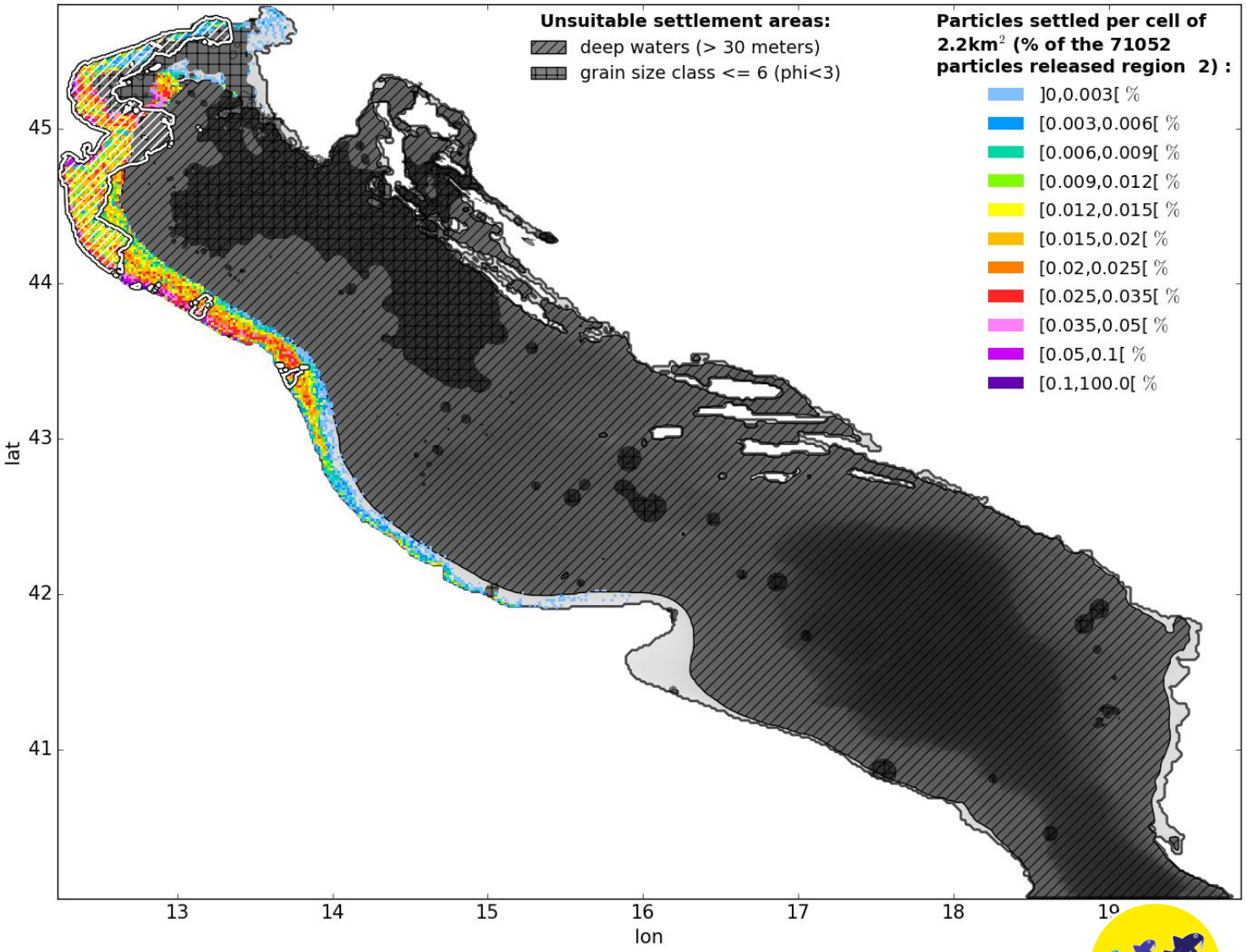


Averaged arrival density of *S. solea* released from the area shown in the small map in the down/left panel (Fabionsky sanctuary)

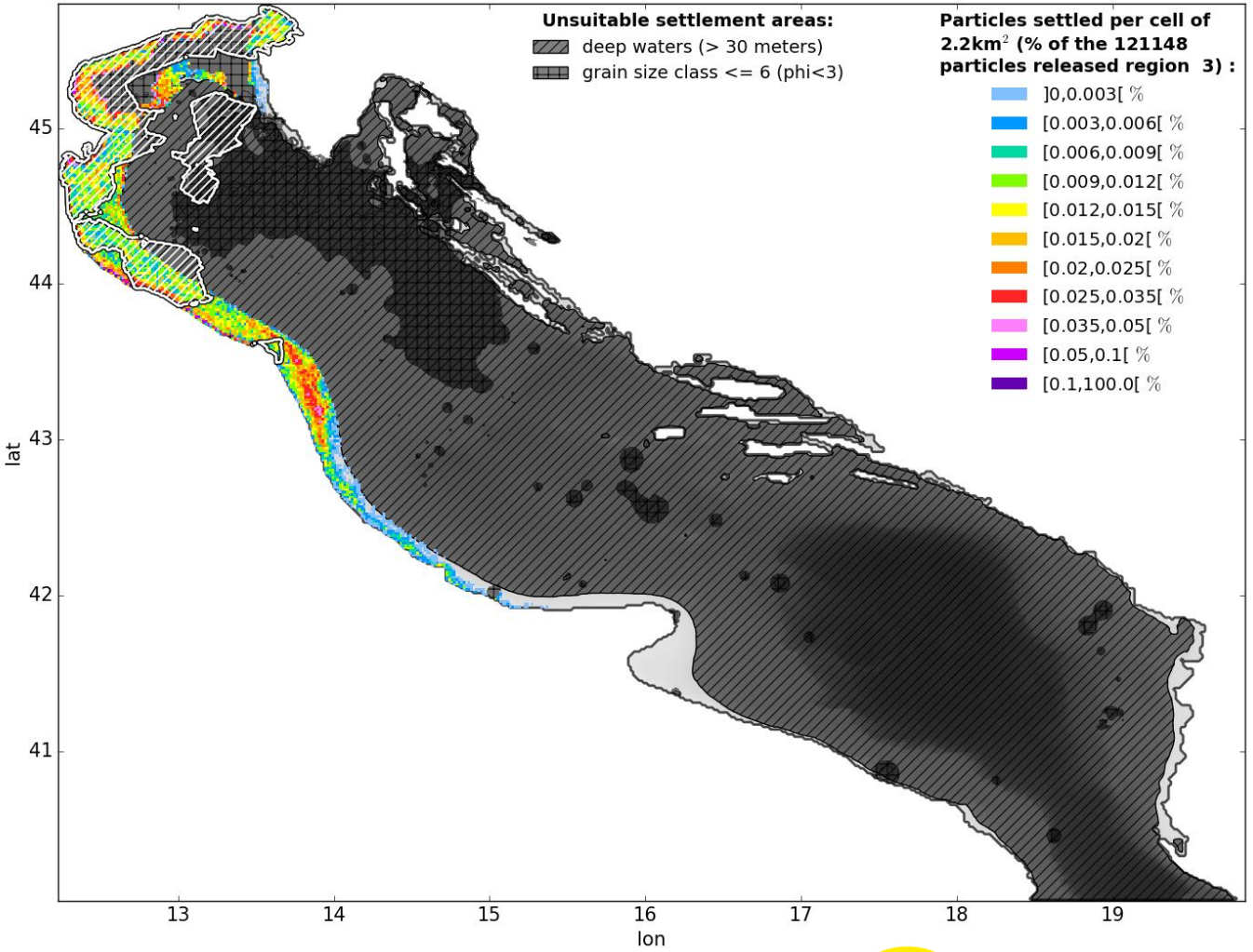
Results Solea solea larval connectivity



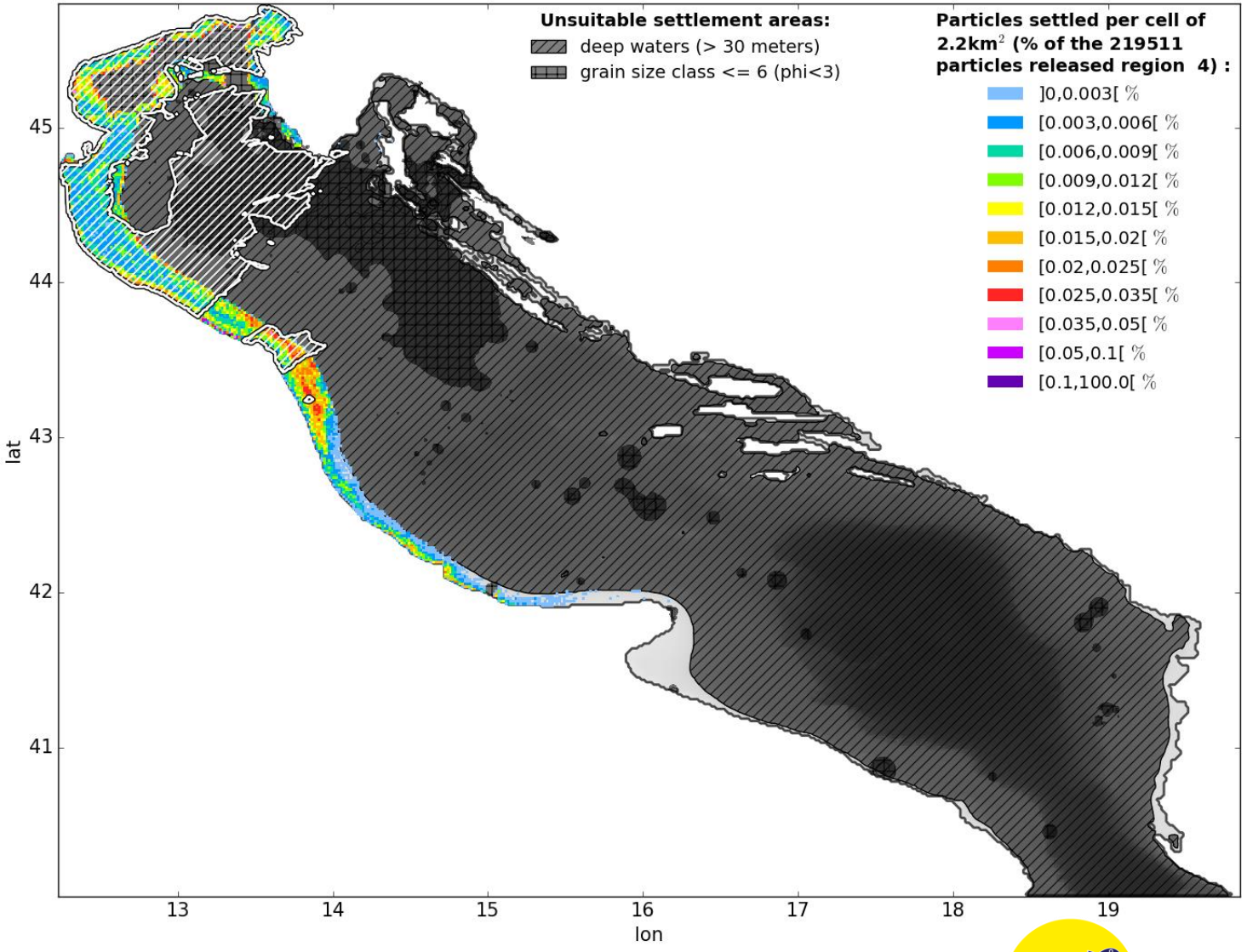
Results Solea solea larval connectivity



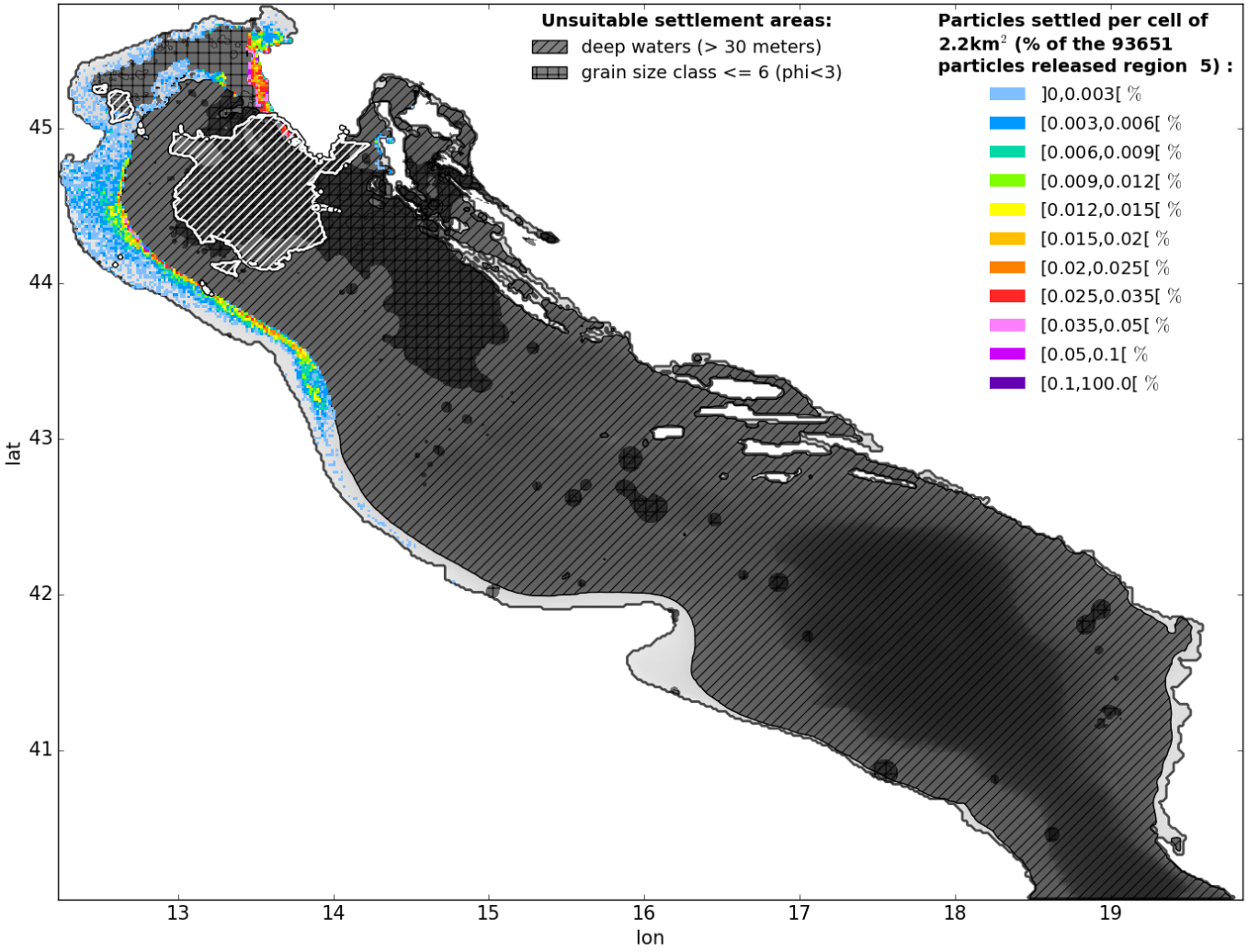
Results Solea solea larval connectivity



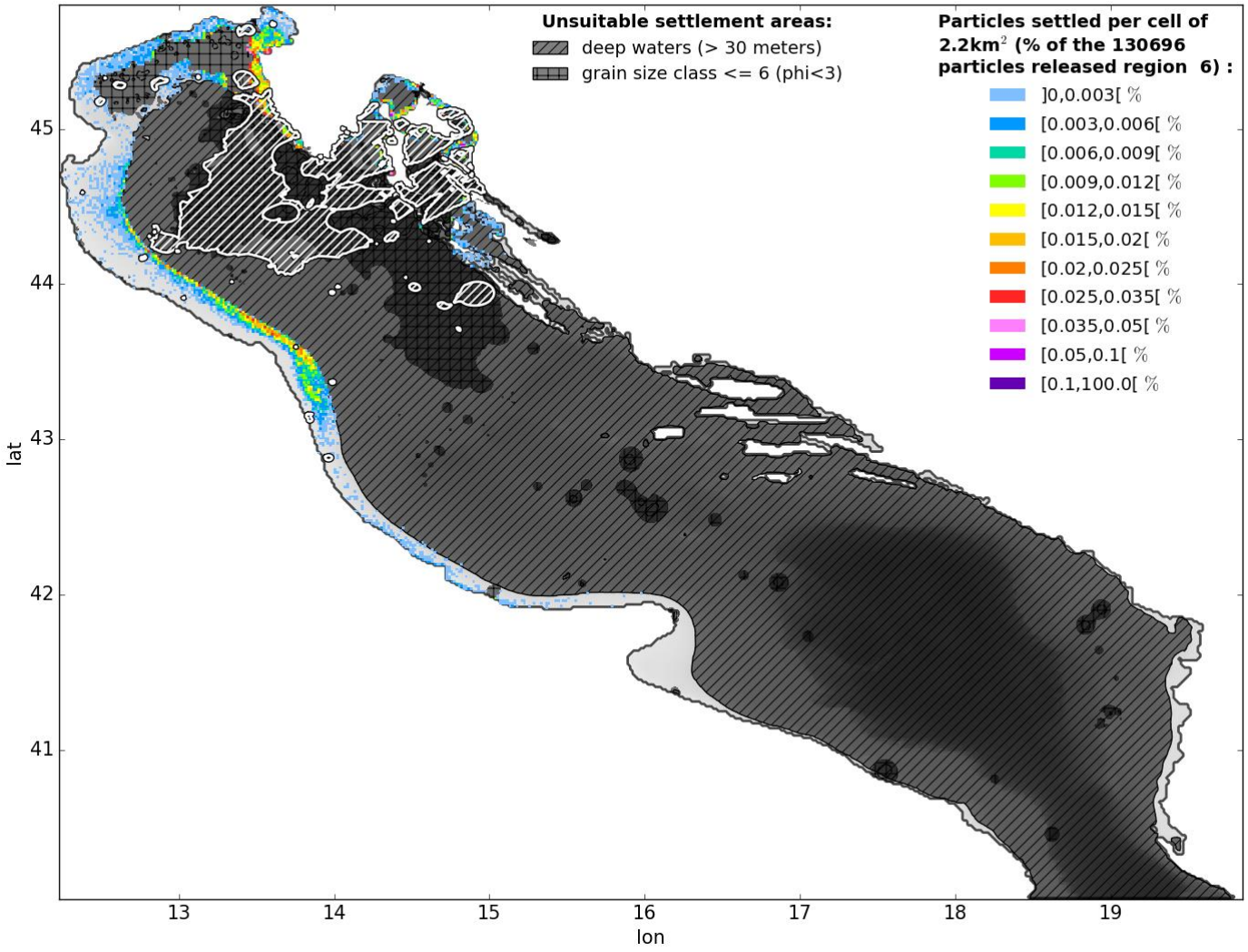
Results Solea solea larval connectivity



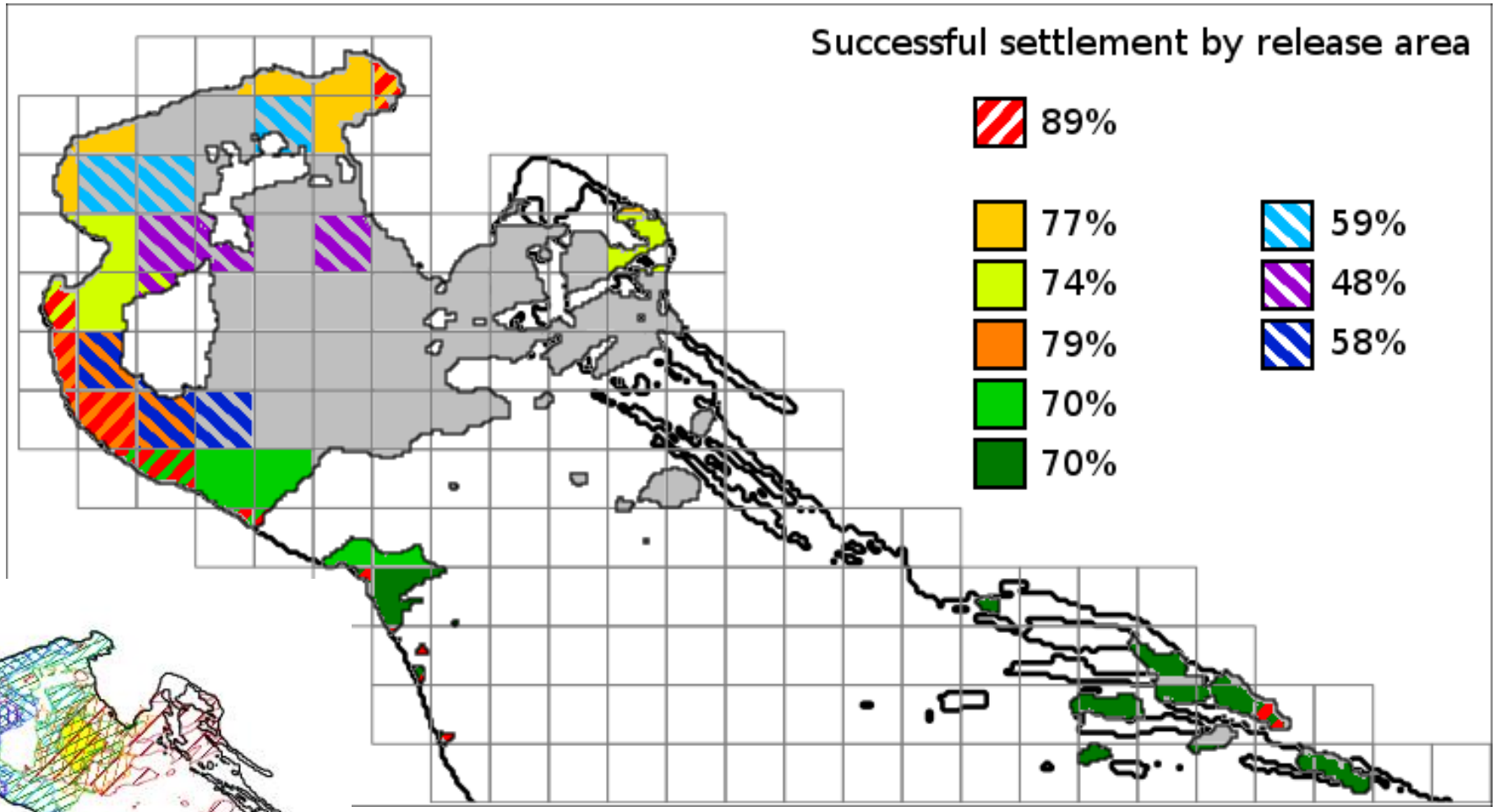
Results Solea solea larval connectivity



Results Solea solea larval connectivity



EFH design (searching recruitment sites)



Future Needs

- Discuss results with experts
- Potential abundance maps to weight larval production from different zones;
- Information on larval behaviour and growth parameters (now addressed by sensitivity analysis);

Conclusion

Nephrops norvegicus:

Results highlighted the existence of isolated subpopulations of *N. norvegicus* and the area of greater retention, and of greater dispersion. The Pomo-Jabuka Pit area hosst a subpopulation which is connected with the other Adriatic subpopulations.

Solea solea:

Results evidenced the connectivity between spawning and recruitment sites.
Assuming a uniform density of larval release, an efficient design of recruitment sites can be discussed and proposed.

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