FINE-SCALE DISTRIBUTION OF LARVAL FISH AND ZOOPLANKTON OVER A MESOSCALE FRONT EXPLORED THROUGH HIGH FREQUENCY IMAGING

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A NEW SAMPLING TOOL : IN SITU ICHTHYOPLANKTON IMAGING SYSTEM

Current knowledge of larval fish distribution at fine-scale is limited, as even the most advanced nets integrate over tens of meters in depth and hundreds of meters horizontally. Yet, this fine-scale is the one relevant for biological interactions such as predation or gregarious behaviour. New imaging tools, like the In Situ Ichthyoplankton Imaging System (ISIIS, Cowen and Guigand 2008), gather physical data and images of biological organisms at the same high resolution. ISIIS can therefore provide distribution estimates at scales under one meter. To describe community structure and bio-physical interactions in a mesoscale feature, we towed ISIIS in the upper 100 m during a two-week cruise across a well known front in the NW Mediterranean Sea.

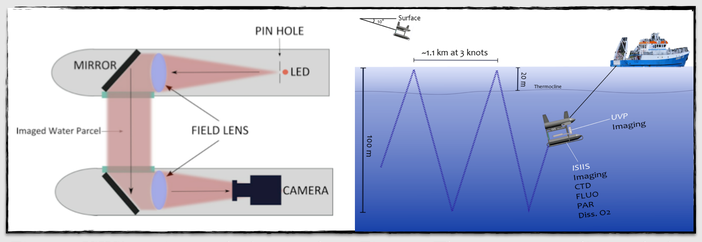


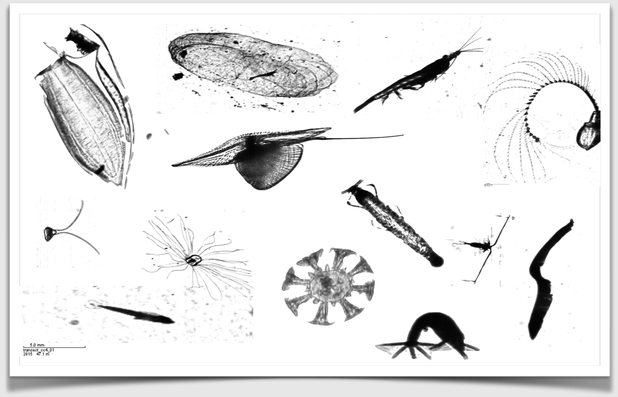
Figure 1. ISIIS' continuous shadow graph camera system. A LED emits light that passes through a pin hole before being reflected at 90° by mirrors and sent to a line-scan camera. All particles that pass between the mirrors absorb light, and the camera catches the resulting shadows.

Figure 2. The « yo-yo » sampling method with ISIIS. In this cruise, it was towed up and down from the surface down to ~100m at 4 knots of horizontal speed.

SAMPLING METHODS

Transects across the front of the Ligurian current were carried out during 10 days in July 2013. CTD and plankton nets (1m opening, 680 microns mesh) were used for 2 transects. ISIIS was used the remaining 24 transects. ISIIS collected 14 images per second (imaging 7.78L per image) and hydrological data (T, S, Chl a fluorescence, and oxygen) at 2Hz.

Fish larvae in net samples were sorted to species level. Plankton on ISIIS images was sorted in large taxonomic groups through computer-assisted identification (Zooprocess, Picheral et al 2010). Physical data was filtered and linearly interpolated after removing the anisotropy between horizontal and vertical directions.



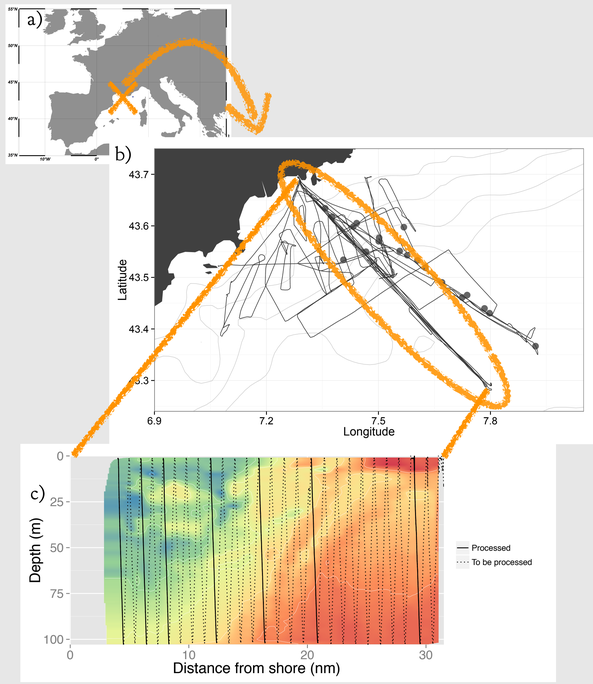


Figure 3. Sampling area
a) Localization of the sampling area;
b) Sampling path carried out during the VISUFRONT cruise. The transect presented here is in the ellipse;
c) « Yo-yo » trajectory of ISIIS along the transect. Dotted lines are data available but not yet processed.

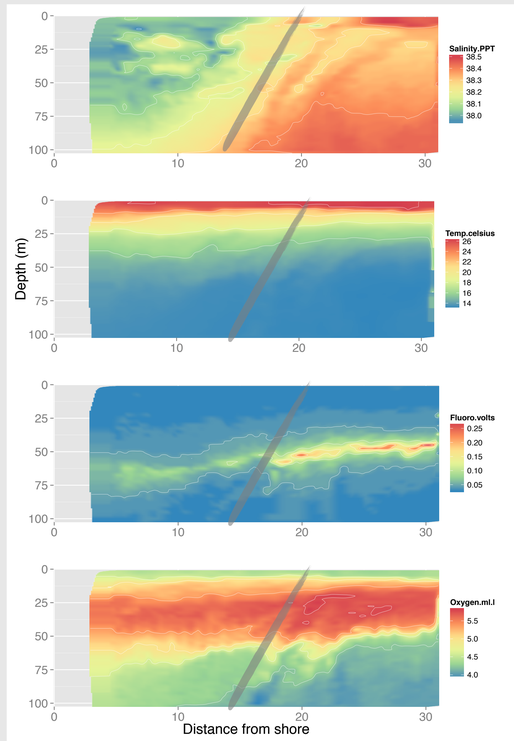
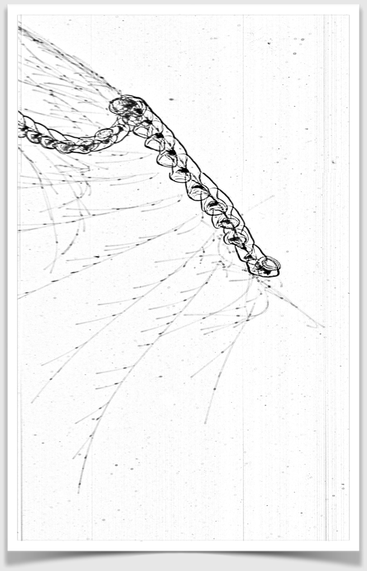


Figure 4. Salinity, temperature, fluorescence and oxygen interpolated along the transect. The gray line highlights the position of the front.

DISTRIBUTION OF ZOOPLANKTON ALONG THE TRANSECT



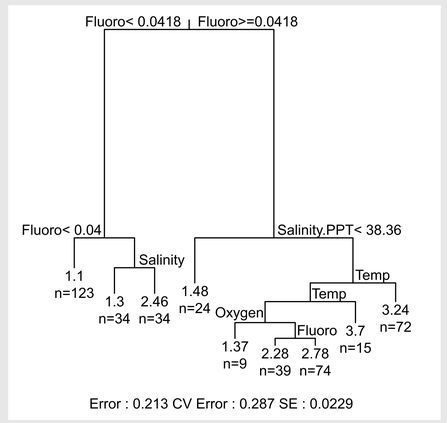


Figure 5. Regression tree of the log(n+1) transformed abundance of solitary radiolarians on environmental variables. They are mostly associated with the deep chlorophyll maximum.

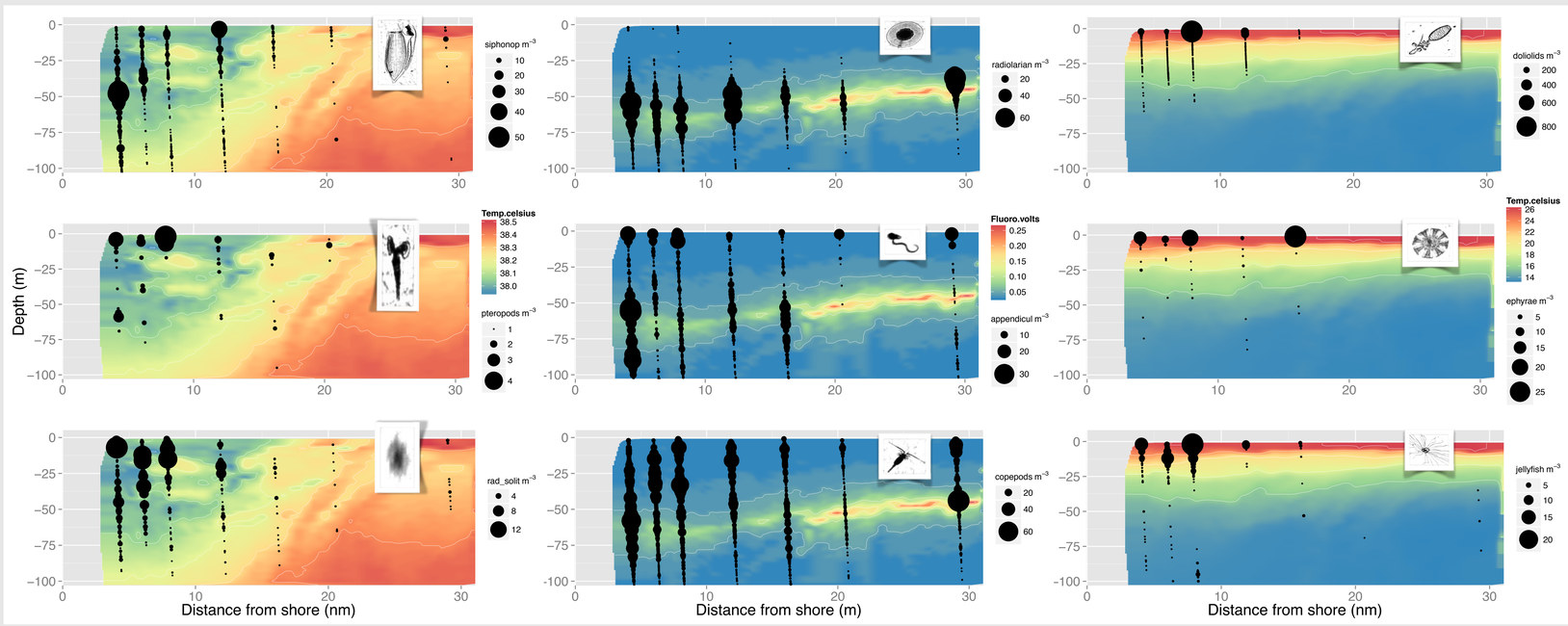


Figure 6. Abundance per cubic meter of siphonophores, pteropods and solitary radiolarians plotted on top of interpolated salinity.

Figure 7. Abundance per cubic meter of radiolarian, appendicularians and copepods plotted on top of interpolated fluorescence.

Figure 8. Abundance per cubic meter of gelatinous zooplankton (doliolids, Pelagia noctiluca ephyrae and other jellyfishes) plotted on top of interpolated temperature.

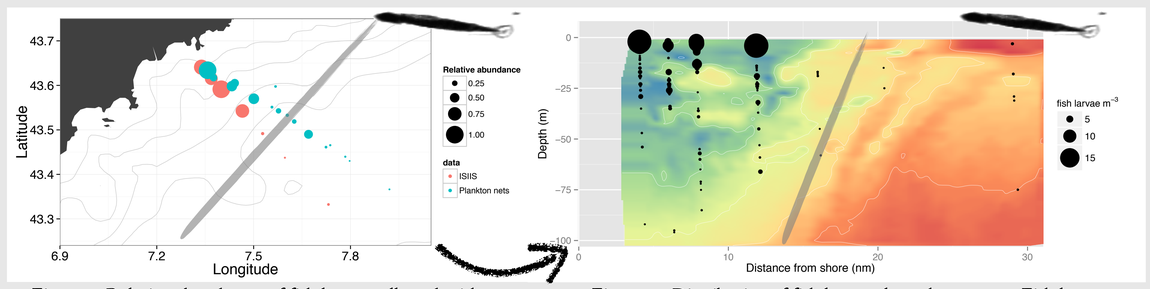


Figure 9. Relative abundances of fish larvae collected with plankton nets (blue) and ISIIS (red). Raw abundances in plankton nets were 10-fold lower than those in ISIIS data.

Figure 10. Distribution of fish larvae along the transect. Fish larvae are very abundant near the surface, on the coastal side of the front.

TAKE HOME MESSAGES

Well-marked hydrological front

Strong influence of front on plankton distribution

Unexpectedly strong concentration of larval fish in the first 5m of the water column

REFERENCES

Cowen, RK and Guigand, CM, 2008. Limnology and Oceanography: Methods, 6, 126-132

Picheral, M et al 2010. Limnology and Oceanography: Methods, 8, 462-473

All analyses made in R 2.15.1, with packages plyr and reshape2 for data management and ggplot2 for graphics.