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The PELGAS integrated survey conducted since 2000 in spring in the Bay of Biscay is presented.

PELGAS objectives have switched from the study of the anchovy stock status to ecosystem monitoring.

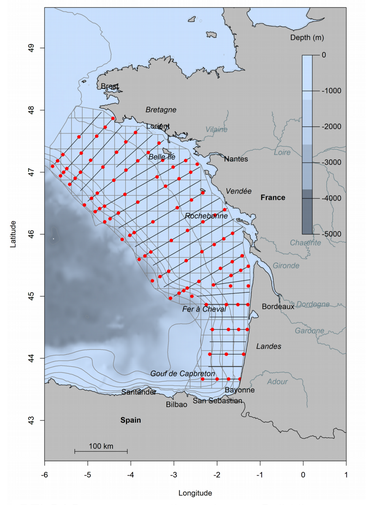
Spatially-explicit data of the main pelagic ecosystem components have been collected since 2000.

Multidisciplinary collaborative working and enough vessel space were critical success factors.

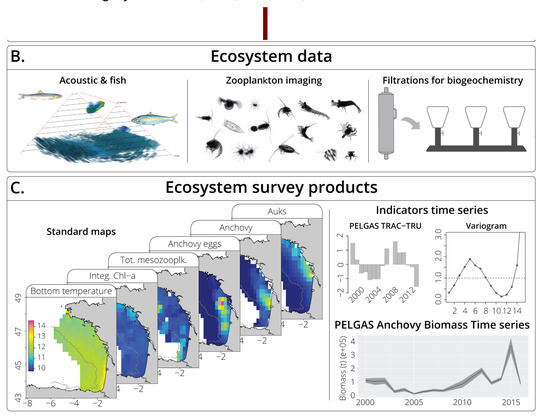
Finding relevant common scales is essential to analyse ecosystem data within or across compartments.

The PELGAS survey: ship-based integrated monitoring of the Bay of Biscay pelagic ecosystem

Doray M, Petitgas P, Romagnan JB, Huret M, Duhamel E, Dupuy C, Spitz J, Authier M, Sanchez F, Berger L, Doremus G, Bourriau P, Grellier P, Masse J.
Progress in Oceanography 2017. http://doi.org/10.1016/j.pocean.2017.09.015



PELGAS survey sampling scheme. Solid lines: systematic line transects, red dots: hydrobiology stations. Light grey grid: block averaging grid. Light grey lines: 100, 200, 300, 400, 500 m isobaths.



B. Onboard ecosystem data pre-processing:
acoustic data scrutinising, midwater trawl catch sorting, biological parameters recording, zoo and ichthyology-plankton imaging, seawater filtrations for biogeochemistry.

C. Ecosystem products:
standard raster maps of parameters in all pelagic ecosystem components, time series of indicators of the state of Biscay pelagic ecosystem, including commercial fish stocks.

Data products for fish stocks and ecosystem assessment: the PELGAS survey example

Mathieu Doray, Pierre Petitgas, Jean Baptiste Romagnan, Martin Huret, Erwan Duhamel, Christine Dupuy, Jérome Spitz, Matthieu Authier, Laurent Berger, Ghislain Dorémus, Paul Bourriau, Patrick Grellier, Jacques Massé, Florence Sanchez

Contact author: mathieu.doray@ifremer.fr

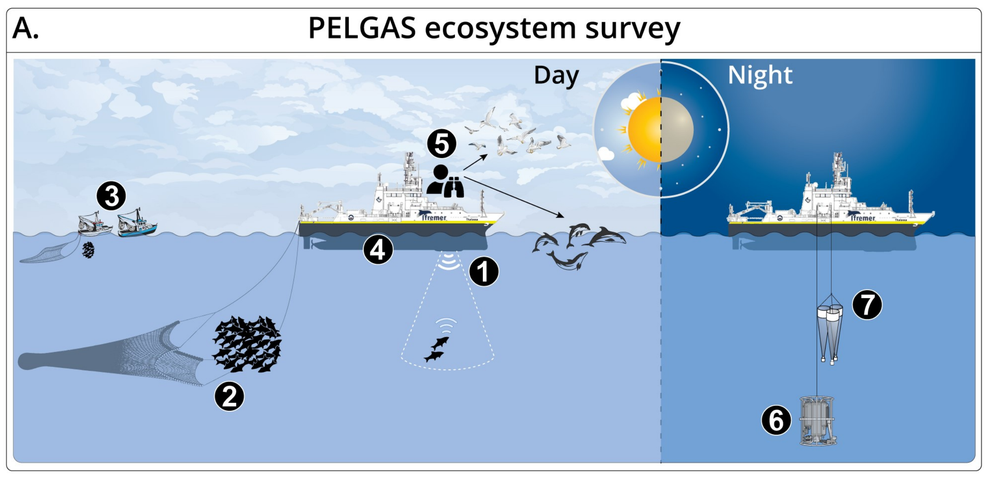
Ecosystem

Megafauna

Small pelagic fish

Zooplankton

Hydrology and phytoplankton



A. Ecosystem data collection in spring in the Bay of Biscay. During daytime, along line transects: 1. Fisheries acoustics, 2. R/V Thalassa midwater trawling, 3. Consort commercial pair trawlers fishing, 4. Hull-mounted thermosalinometer, 5. Megafauna sightings. During night-time, at fixed stations: 6. Sonde-based hydrobiological sampling, 7. Meso-zooplankton nets.

Monitoring small pelagic fish in the Bay of Biscay ecosystem, using indicators from an integrated survey.

Doray Mathieu, Petitgas Pierre, Huret Martin, Duhamel Erwan, Romagnan Jean-Baptiste, Authier Matthieu, Dupuy Christine, Spitz Jerome.
Progress in Oceanography 2017. http://doi.org/10.1016/j.pocean.2017.12.004

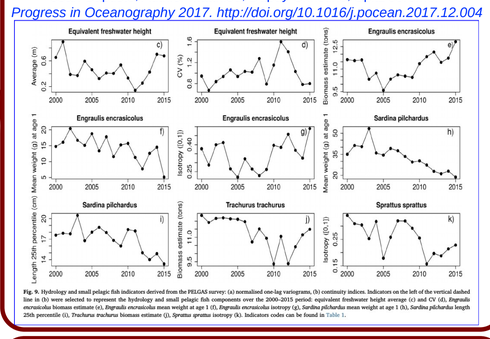


Fig. 9. Hydrology and small pelagic fish indicators derived from the PELGAS survey: (a) normalised one-lag variograms, (b) continuity indices. Indicators on the left of the vertical dashed line in (b) were selected to represent the hydrology and small pelagic fish components over the 2000-2015 period: equivalent freshwater height average (c) and CV (d), *Engraulis encrasicolus* biomass estimate (e), *Engraulis encrasicolus* isotropy (g), *Sardina pilchardus* mean weight at age 1 (h), *Sardina pilchardus* length 25th percentile (i), *Trachurus trachurus* biomass estimate (j), *Sprattus sprattus* isotropy (k). Indicators codes can be found in Table 1.

A method for selecting relevant ecosystem indicators is applied to PELGAS integrated survey.

River plume, bottom temperature, phyto & mesozooplankton selected as hydrobiology indicators.

Small pelagic fish species appear to have followed distinct trajectories over the last 15 years.

A marked decrease in mean weights of age 1 & 2 anchovy and sardine over the last 15 years is highlighted.

Low impact of fishing and no effect of climate forcing on pelagic ecosystem in spring are confirmed.

Prey consumption by cetaceans reveals the importance of energy-rich food webs in the Bay of Biscay.

Spitz J, Ridoux V, Trites AW, Laran S, Authier M.
Progress in Oceanography 2017. https://doi.org/10.1016/j.pocean.2017.09.013

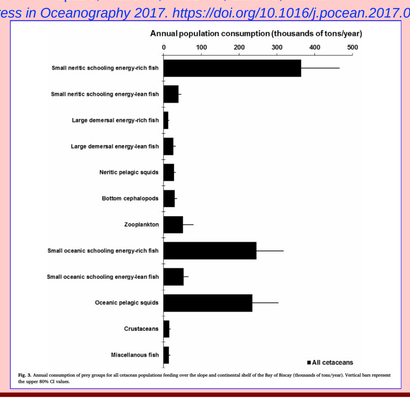


Fig. 3. Annual consumption of prey groups for all cetacean populations feeding over the slope and continental shelf of the Bay of Biscay (thousands of tons/year). Vertical bars represent the upper 80% CI values.

Annual and seasonal energy and biomass removals by cetaceans in the Bay of Biscay.

Estimates address interspecific differences in the cost of living of cetaceans.

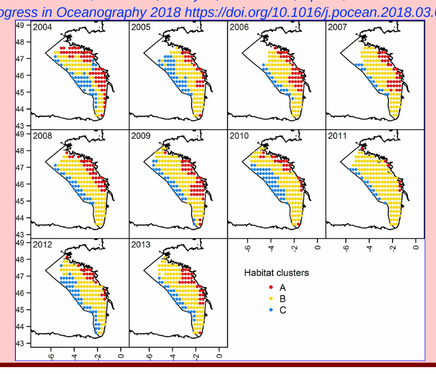
Estimates based on functional prey groups.

Small energy-rich schooling fish are the key prey group in the Bay of Biscay.

Energy-rich food webs are crucial to maintaining ecosystem functions and services

Decadal stability in top predator habitat preferences in the Bay of Biscay

Lambert C, Authier M, Doray M, Dorémus G, Spitz J, Ridoux V.
Progress in Oceanography 2018 https://doi.org/10.1016/j.pocean.2018.03.007



Concurrent sampling of predators and habitat unveiled their relationships in time.

PCA on environmental variables identified 3 main habitats used by predators.

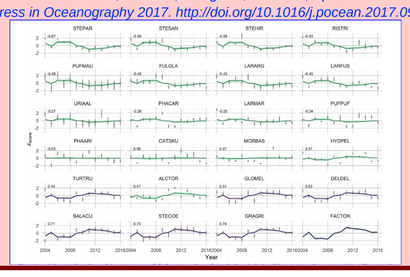
Predators exhibited various habitat preferences specificity and stability in time.

Narrower habitat preferences paired with stronger stability among years.

Wider habitat preferences paired with higher variability among years.

Exploring Change in the Relative Abundance of Marine Megafauna in the Bay of Biscay, 2004-2016.

Authier M, Doremus G, Van Canneyt O, Boubert JJ, Gautier G, Doray M, Duhamel E, Massé J, Petitgas P, Ridoux V, Spitz J.
Progress in Oceanography 2017. http://doi.org/10.1016/j.pocean.2017.09.014



Monitoring biodiversity is essential to marine conservation in Europe.

Marine megafauna (cetaceans and seabirds) are important nodes in foodwebs.

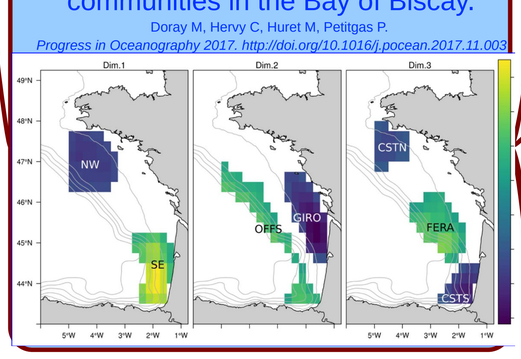
Trajectories of megafauna relative abundance in the Bay of Biscay were contrasted.

Offshore species tended to increase in relative abundance over the study period.

One third of the studied species tended to decrease between 2004 and 2016.

Spring habitats of small pelagic fish communities in the Bay of Biscay.

Doray M, Hervy C, Huret M, Petitgas P.
Progress in Oceanography 2017. http://doi.org/10.1016/j.pocean.2017.11.003



A spatio-temporal approach of the diversity of small pelagic fish in their environment is proposed.

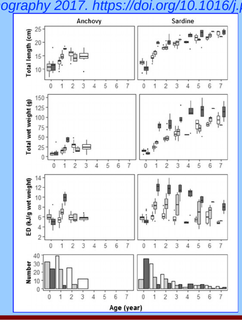
Latitudinal and coastal-offshore spatial gradients identified in pelagic fish and hydrology.

Anchovy-chub mackerel community consistently found in warmer southern spring habitat in Biscay.

Small clupeiforms community found in coastal spring spawning habitats with low salinity in Biscay.

Bioenergetic condition of anchovy and sardine in the Bay of Biscay and English Channel.

Gatti P, Cominassi L, Duhamel E, Grellier P, Le Delliou H, Le Mestre S, Petitgas P, Rabiller M, Spitz J, Huret M.
Progress in Oceanography 2017. https://doi.org/10.1016/j.pocean.2017.12.006



Exploration of energy density sources of variability: species, season, region, size.

Relationships between dry mass content and ED are strong but species specific.

Larger length, mass and ED at age in the English Channel than in the Bay of Biscay.

Sardine display larger energy reserves than anchovy.

Larger reserves are likely in link with larger spawning or maintenance costs.

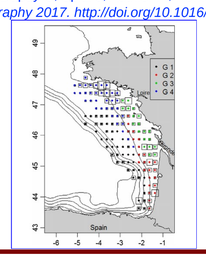
A strong scaling of ED with size with a dome shape pattern for sardine.

Decrease of ED with size is discussed in link with feeding and spawning behaviours.

Demonstrate how integrated survey data series can serve ecosystem description.

Ecosystem spatial structure revealed by integrated survey data.

Petitgas P, Huret M, Dupuy C, Spitz J, Authier M, Romagnan JB, Doray M.
Progress in Oceanography 2017. http://doi.org/10.1016/j.pocean.2017.09.012



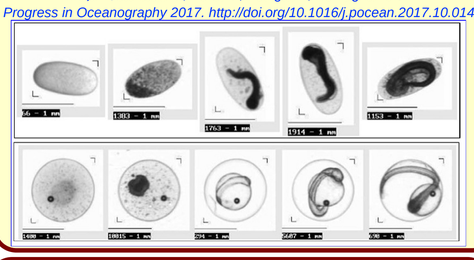
How ecosystem spatial structure can be revealed by Multiple Factor Analysis (MFA).

How time variability around the average ecosystem structure can be mapped.

The understanding of the Bay of Biscay as a meta-ecosystem made of production systems.

The ZooCAM, a new in-flow imaging system for fast onboard counting, sizing and classification of fish eggs and metazooplankton.

Colas F, Tardivel M, Perchoc J, Lunven M, Forest B, Guyader G, Danielou MM, Le Mestre S, Bourriau P, Antajan E, Sourisseau M, Huret M, Petitgas P, Romagnan JB.
Progress in Oceanography 2017. http://doi.org/10.1016/j.pocean.2017.10.014



The ZooCAM is an in-flow system for on-board imaging of fish eggs and zooplankton.

It enabled the analysis ~10,000 samples on-board in 4 years, without any failure.

It provides staged fish eggs counts equivalent to those done with microscopes.

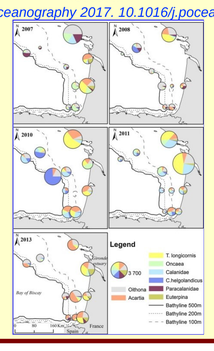
It provides results comparable to the ZooScan on complex planktonic assemblages.

The ZooCAM helps improve the spatio-temporal resolution of zooplanktonic studies.

Spring mesozooplankton was studied over a decade in the southern Bay of Biscay.

The spring mesozooplankton variability and its relationship with hydrobiological structure over year-to-year changes (2003–2013) in the southern Bay of Biscay (Northeast Atlantic).

Dessier A, Bustamante P, Chouvelon T, Huret M, Pagano M, Marquis E, Rousseaux F.
Progress in Oceanography 2017. 10.1016/j.pocean.2018.04.011



Spatial structuration of habitats was mainly driven by continental outflow.

Mesozooplankton abundance decreased from 2007 to 2009 but recovered afterward.

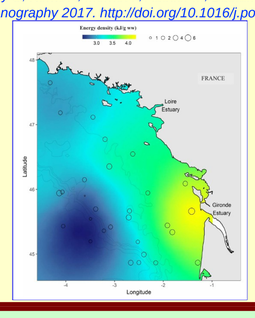
High percentage of gelatinous organisms and low percentage of copepods occurred in 2006.

In springtime, the copepod dynamics was mainly governed by resource availability

The nutritional quality is not homogeneous among the mesozooplanktonic community in the Bay of Biscay.

Variability of energy density among mesozooplankton community: new insights in functional diversity to forage fish.

Dessier A, Dupuy C, Kerric A, Mornet F, Authier M, Bustamante P, Spitz J.
Progress in Oceanography 2017. http://doi.org/10.1016/j.pocean.2017.10.009



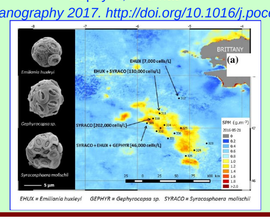
Taxonomic approach is more relevant than size-classes approach to investigate mesozooplankton profitability.

A clear spatial pattern of energy density is highlighted for Calanus helgolandicus.

Offshore turbidity in May is associated with coccolithophores in the Bay of Biscay.

Coccolith-derived turbidity and hydrological conditions in May in the Bay of Biscay.

Perrot L, Gohin F, Ruiz-Pino D, Lampert L, Huret M, Dessier A, Malestroit P, Dupuy C, Bourriau P.
Progress in Oceanography 2017. http://doi.org/10.1016/j.pocean.2017.10.014



Satellite-derived Suspended Particulate Matter and in-situ turbidity are well related.

Turbidity profiles together with satellite data result in a better 3-D conception of the blooms.

Absence of coccolithophores in May is associated with stronger stratification.

A degree-day metric from satellite Sea Surface Temperature data in the Bay of Biscay.

Survey timing vs. ecosystem scheduling: Degree-days to underpin observed interannual variability in marine ecosystems.

Huret M, Bourriau P, Doray M, Gohin F, Petitgas P.
Progress in Oceanography 2017. http://doi.org/10.1016/j.pocean.2017.07.007

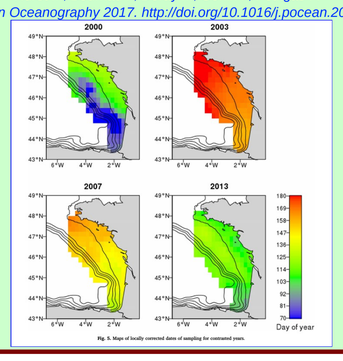


Fig. 5. Maps of locally corrected dates of sampling for contrasted years.

It is used to position annual surveys within the environment seasonal scheduling.

Anchovy and sardine spawning observations are interpreted based on this schedule.

Survey-independent data are really valuable in interpreting survey observations.