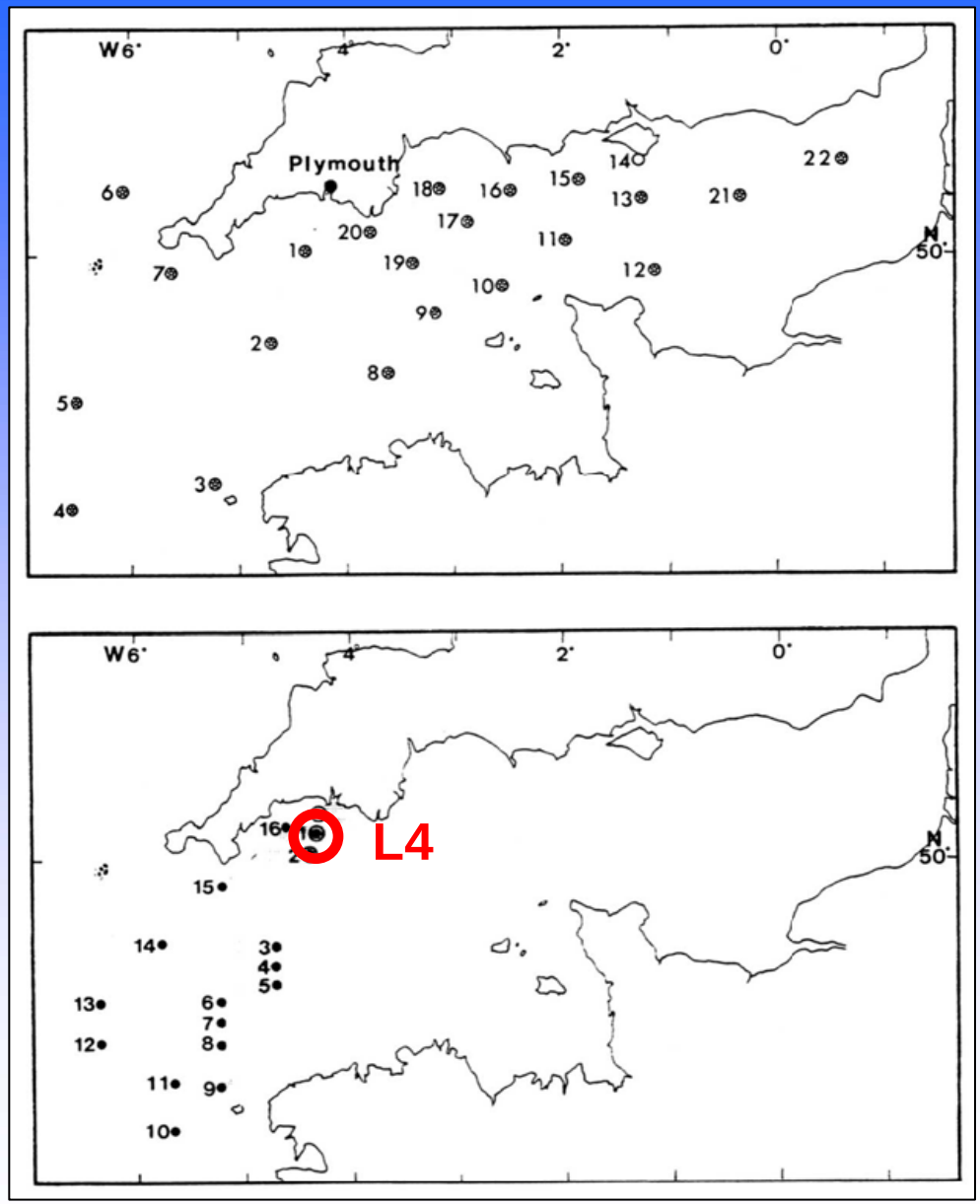
The L4 time series station

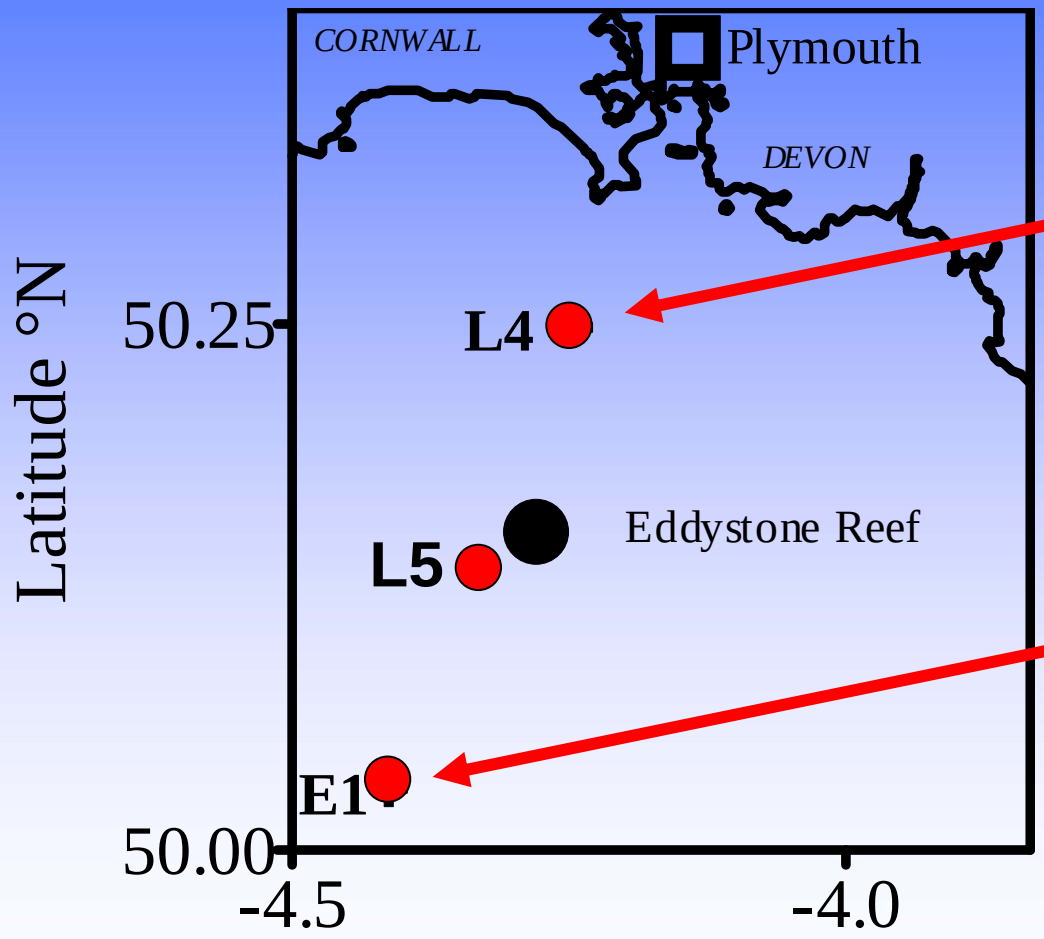
"Plankton research at L4: 1988-2008"

Early MBA and ICES hydrographic surveys

MBA “Channel Grid”



Origins and location of the L4 coastal time series station



Weekly sampling by PML

1988 - present

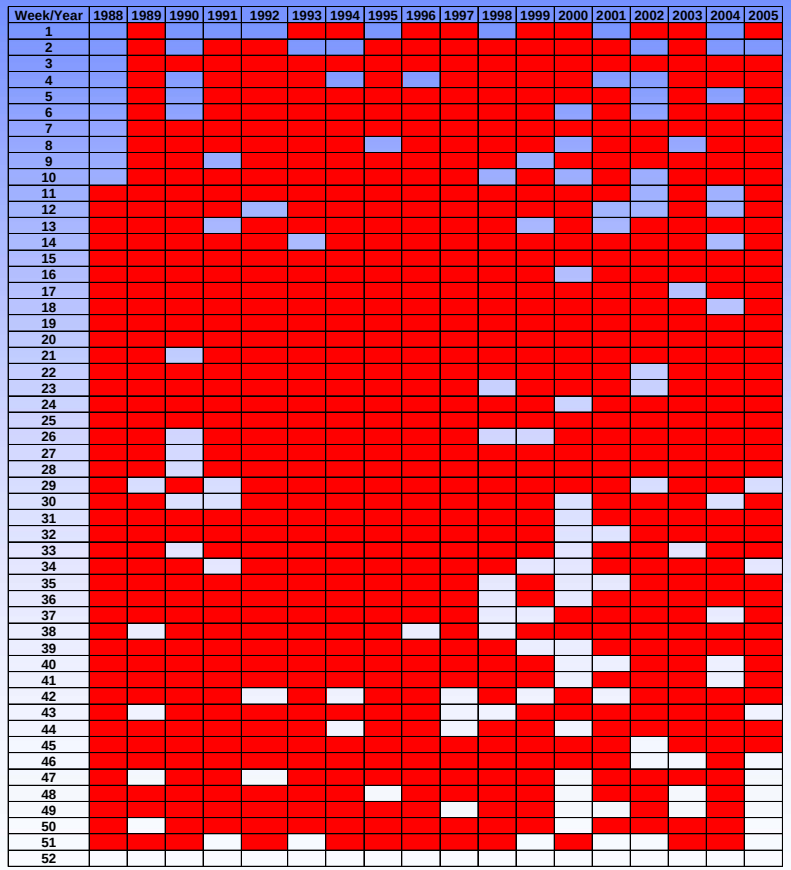
Historical MBA station

Restarted in 2002 as part of MECN

Monthly

Original Objectives: Parameters measured since 1988

Data coverage



Parameters generally measured on a weekly basis include:

- Zooplankton species abundance (128+ taxonomic categories)
- Phytoplankton species and biomass (249+ taxonomic categories)
- Vertical temperature and salinity profile
- Total, and size-fractionated, chlorophyll
- Total, and size-fractionated, particulate CHN
- Mesozooplankton size-fractionated biomass
- Copepod egg production, particularly *Calanus helgolandicus*

Now part of the “Western Channel Observatory”

Current Objectives:

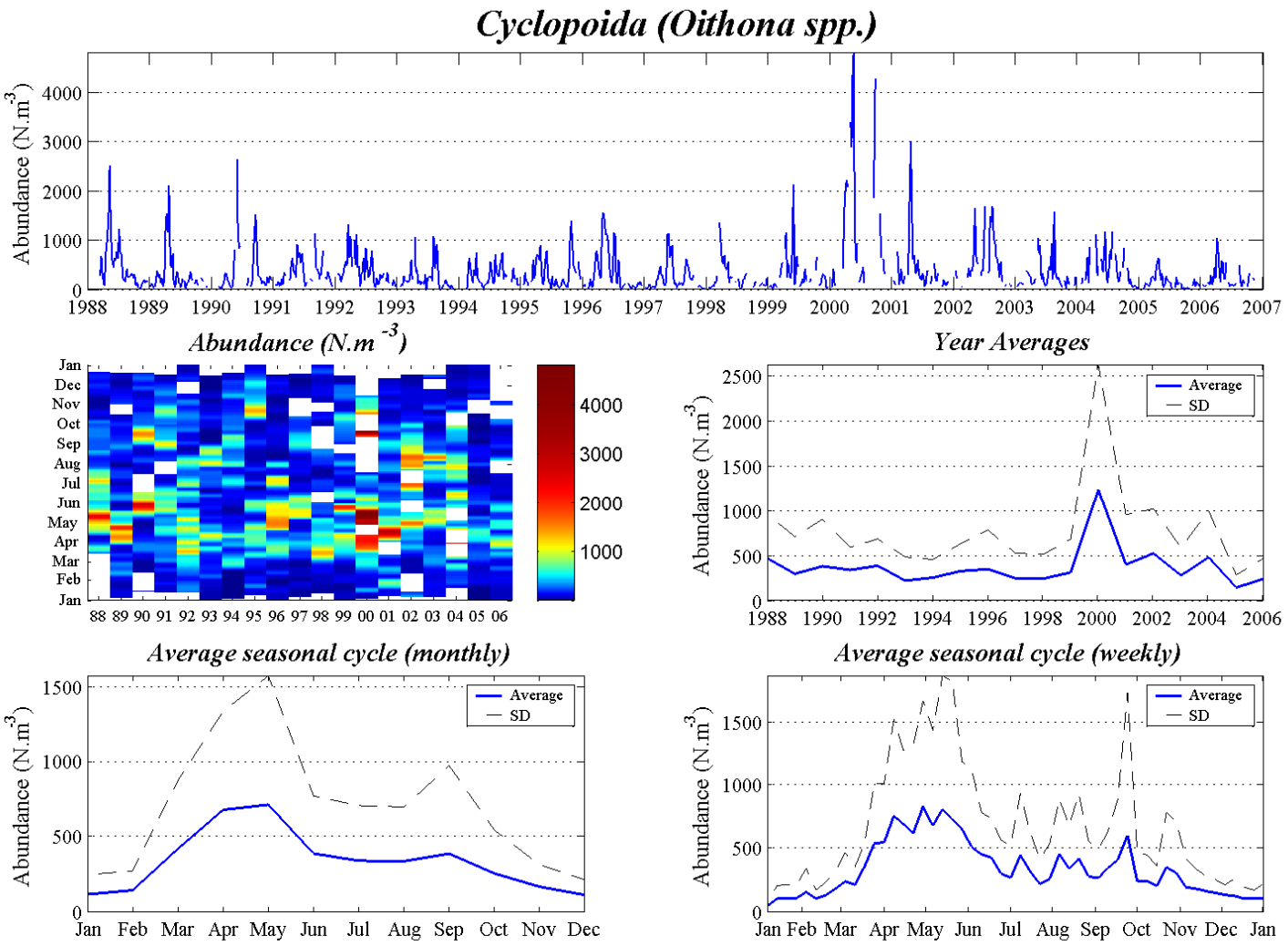
Additional parameters as part of the PML Research Programme

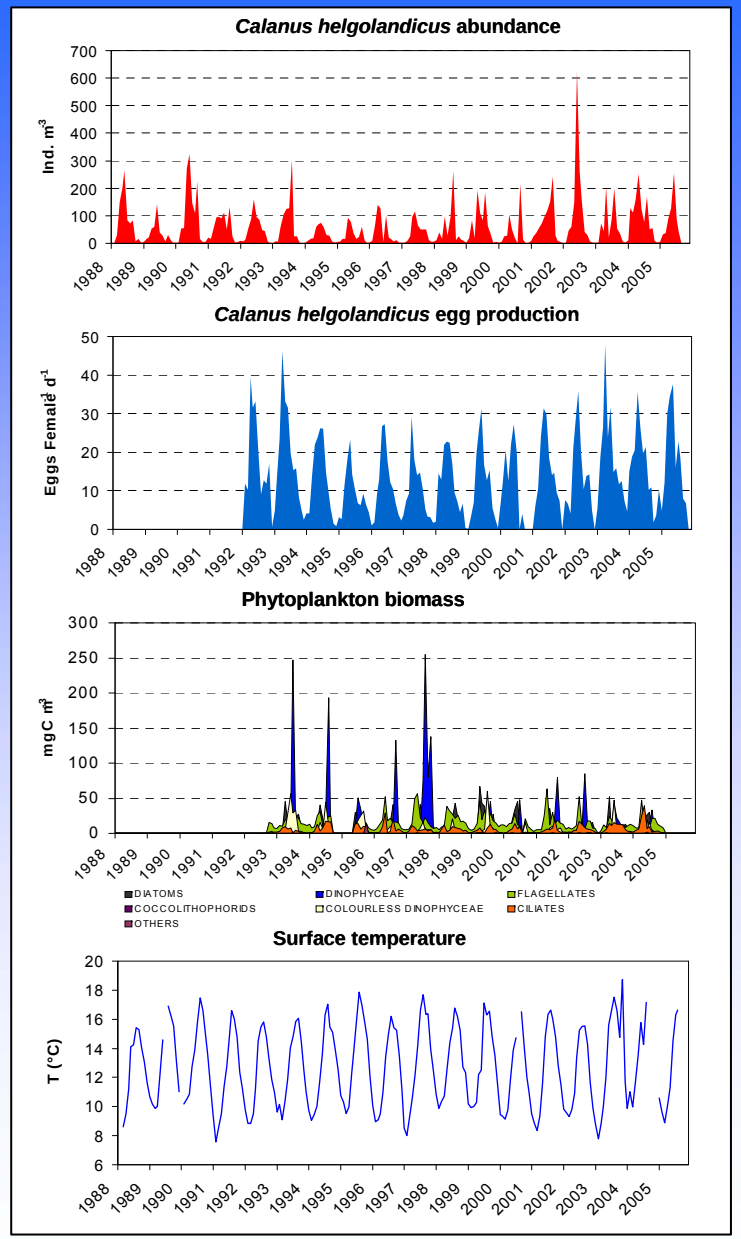
- Optics
- Nutrients
- Pigments
- Virus, pico and nanoplankton
- Bacteria
- Plankton respiration and production
- Biogases
- Mycosporine-like Amino Acids (MAA’s)
- Microzooplankton
- Molecular studies of zooplankton

L4 Time Series characteristics

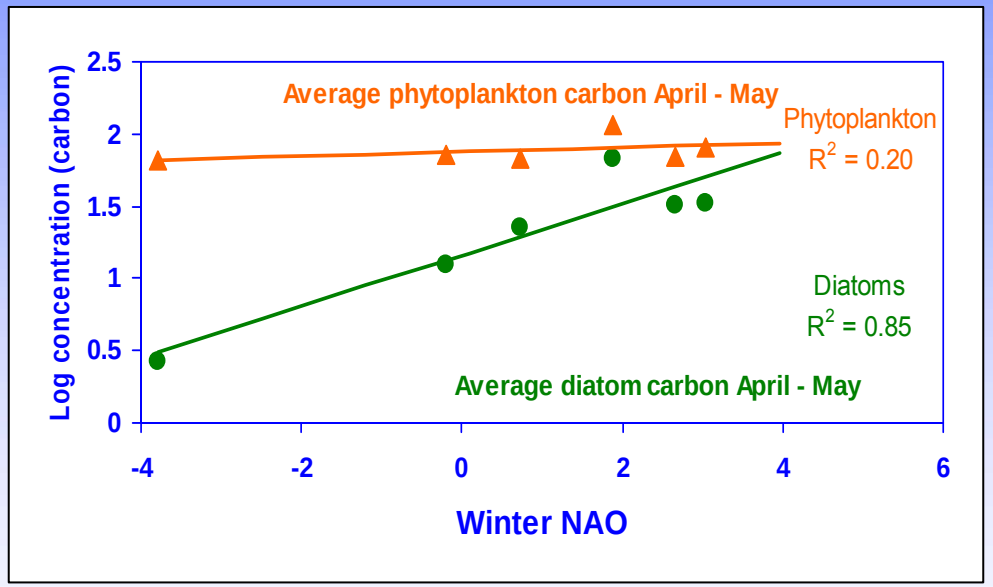
- High temporal frequency – weekly
- High taxonomic resolution – biodiversity (350+ plankton species)
- All major components of the lower food-web (virus to zooplankton) – ecosystem models
- Emphasis on processes – zooplankton production – longest global time-series of copepod egg production
- Good integration with other European time series – WGZE, EUR-OCEANS

Individual species time-series information available over the web





The time series data and its use



Irigoien, X., Harris, R.P., Head, R.N. and Harbour, D. 2000. North Atlantic Oscillation and spring bloom phytoplankton composition in the English Channel. *J. Plankton Res.*. 22: 2367-2371.

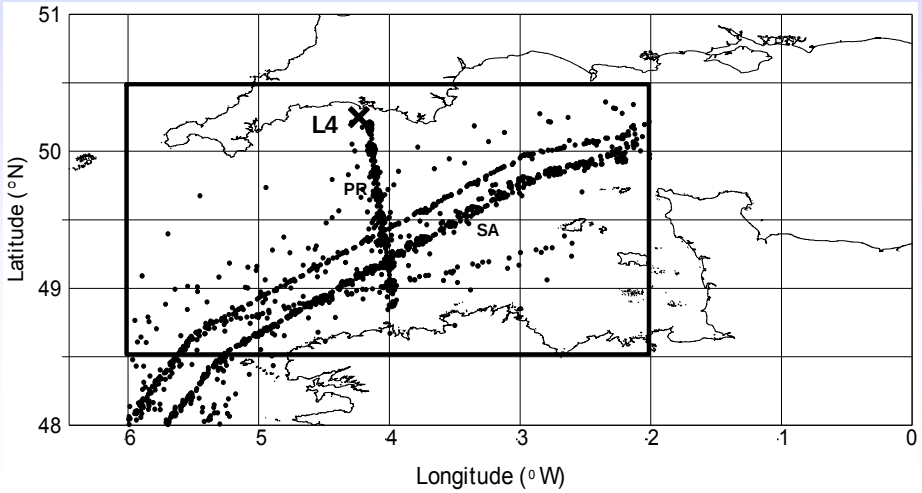
Inter-annual variability

Effects of climate on the pelagic system

Inter- comparison with other time series :

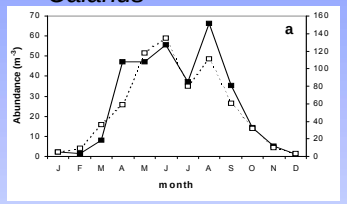
L4 compared with the CPR

Copepod taxa	Abundance Ratio L4:CPR
Acartia (1.1mm)	2.3
Calanus (3-3.5mm)	2.1
Oithona (0.8mm)	43.3
Pseudocalanus (1.4mm)	31.2
Total Copepods	14.5

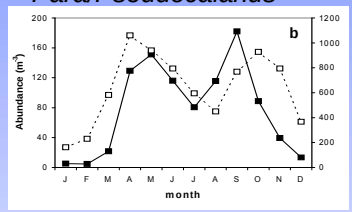


Seasonal cycles of copepod abundance: comparing CPR with L4

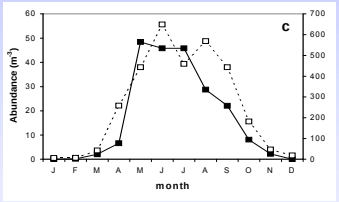
Calanus



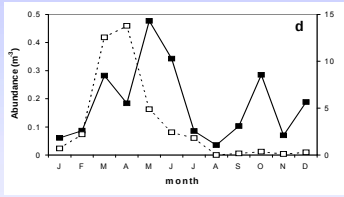
Para/Pseudocalanus



Temora



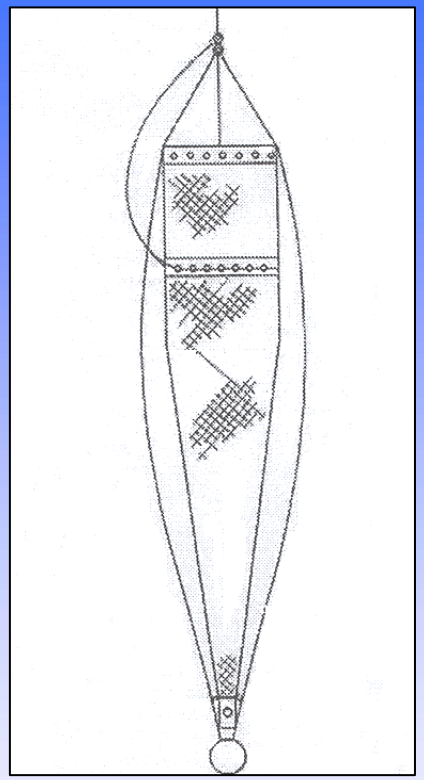
Metrida



John, E.H., Batten, S.D., Harris, R.P. and Hays, G.C. 2001.Comparison between zooplankton data collected by the Continuous Plankton Recorder survey in the English Channel and by WP-2 nets at station L4, Plymouth (UK). *Journal of Sea Research,* 46, 223-232.

Net comparison:

L4 (WP-2) with historical MBA series (YFT)



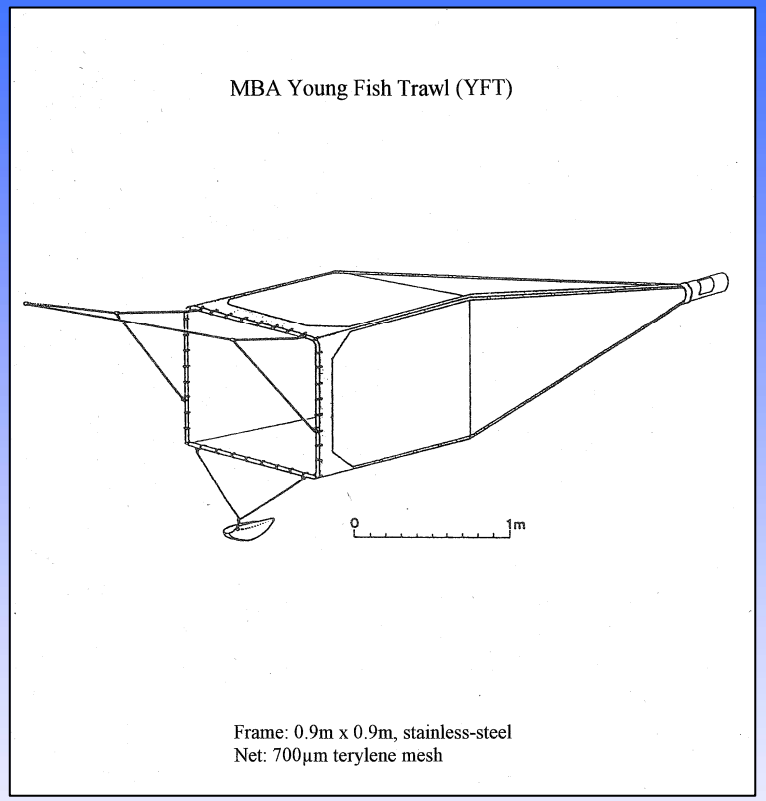
WP2 net

-200µm mesh

-57cm aperture

-Vertical tow (bottom surface)

-Slowly towed



Young Fish Trawl

-700µm mesh

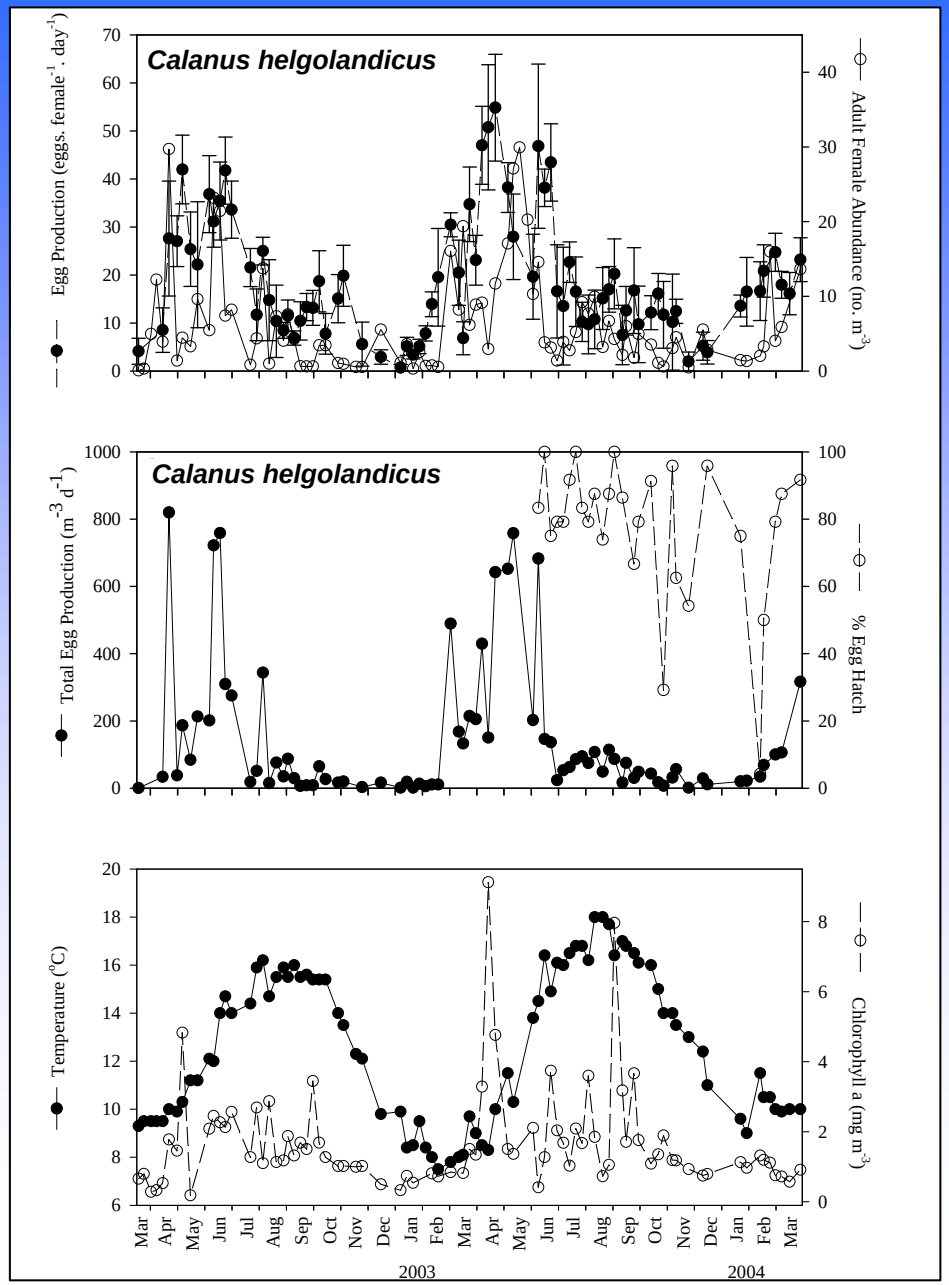
-0.9m aperture

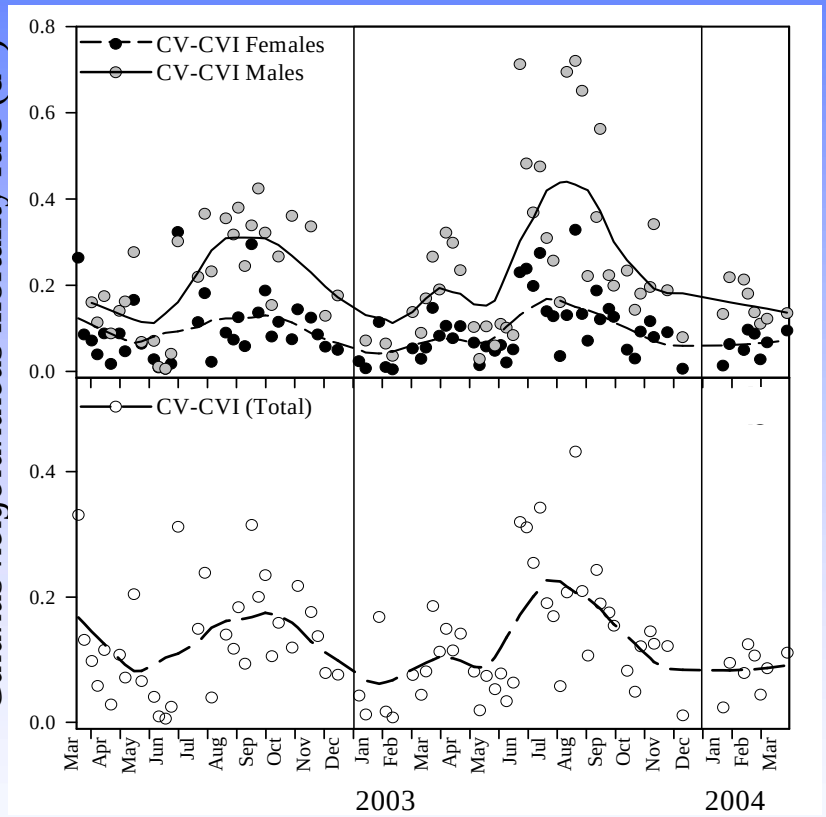
-Double oblique tow

-Towed at 2 knots

With N Halliday, MBA

Population dynamics, egg production, mortality





(Hirst, Bonnet & Harris (2007) *Marine Ecology Progress Series, 340, 189 : 205.)*

Isolation of viruses responsible for the demise of an *Emiliania huxleyi* bloom in the English Channel

William H. Wilson*§, Glen A. Tarran†, Declan Schroeder*, Michael Cox‡, Joanne Oke* and Gillian Malin∫

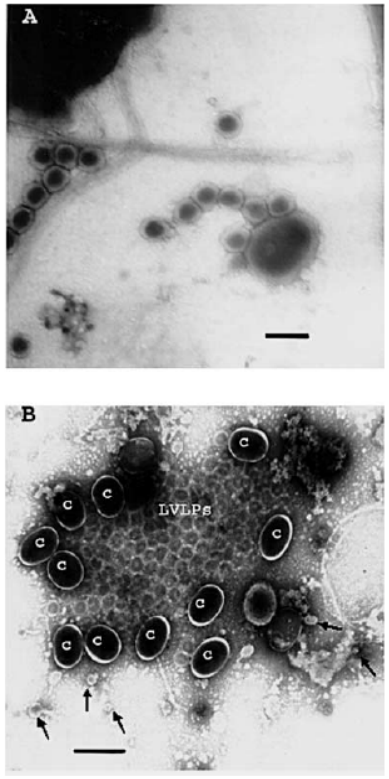


Figure 5. Transmission electron microscope analysis of fixed seawater samples collected from Station 4 (50°13.79′N 4°9.59′W) of the cruise transect. (A) Numerous large virus-like particles (LVLP) approx 150 nm–200 nm in size were observed. (B) Large VLPs bursting from what we assumed was an *Emiliania huxleyi* cell surrounded by coccoliths (c). Small arrows indicate smaller VLPs that were also abundant in all water samples. Scale bars: A, ~250 nm; B, ~500 nm.

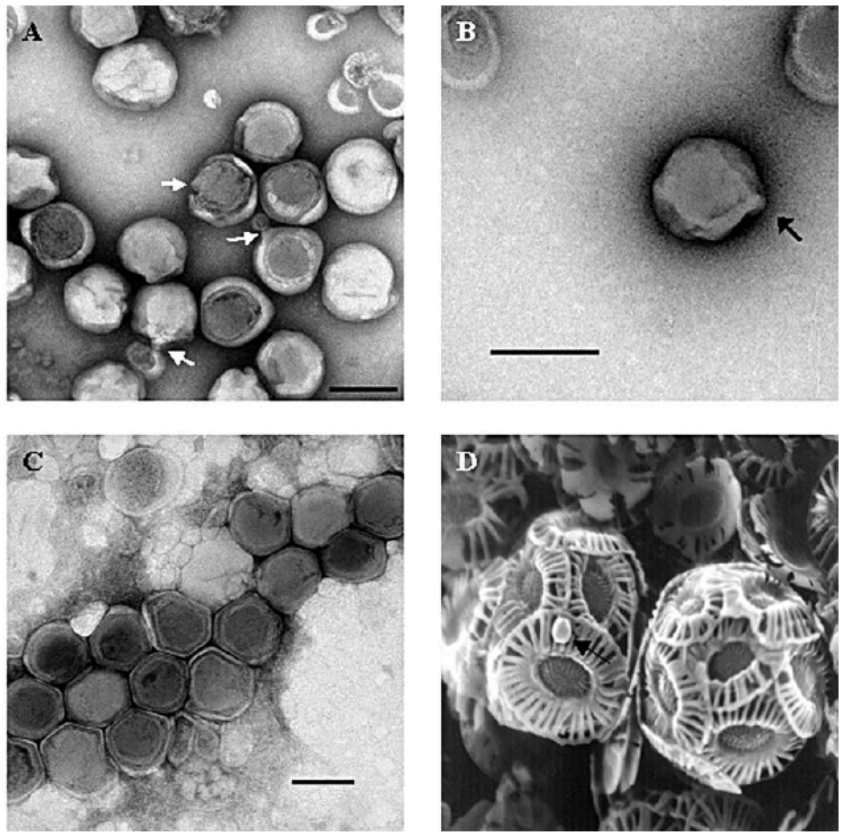


Figure 7. Transmission electron microscope (TEM) and scanning electron microscope (SEM) analysis of *Emiliania huxleyi*-specific virus isolates. (A) and (B) TEMs of *Ehv*84, the arrows indicate possible tail stubs that may be involved in attachment. (C) TEM of *Ehv*86. (D) SEM of *Ehv*86 (arrowed) attached to an *E. huxleyi* cell. Scale bars: A–C, ~190 nm; D, no scale information available.

J. Mar. Biol. Ass. U.K. (2002), **82**, 369–377

The annual cycle of phytoplankton photosynthetic quantum efficiency, pigment composition and optical properties in the western English Channel

Jim Aiken*, James Fishwick, Gerald Moore and Katharine Pemberton

Plymouth Marine Laboratory, Prospect Place, Plymouth, PL1 3DH, UK.
*Corresponding author, e-mail: ja@pml.ac.uk

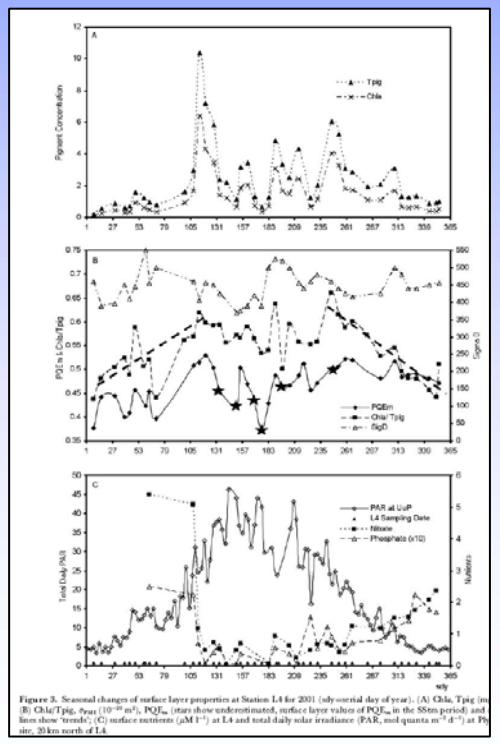


Figure 3. Seasonal changes of surface layer properties at Station L4 for 2001 (sdy=serial day of year). (A) Chla, Tpig (m
(B) Chla/Tpig, σ_{PSII} (10^{-20} m^2), PQE_m (stars show underestimated, surface layer values of PQE_m in the SSm period) and
lines show 'trends'; (C) surface nutrients (μM l^{-1}) at L4 and total daily solar irradiance (PAR, mol quanta m^{-2} d^{-1}) at Ply
ore, 20 km north of L4.

J. Mar. Biol. Ass. U.K. (2004), 84, 301–313

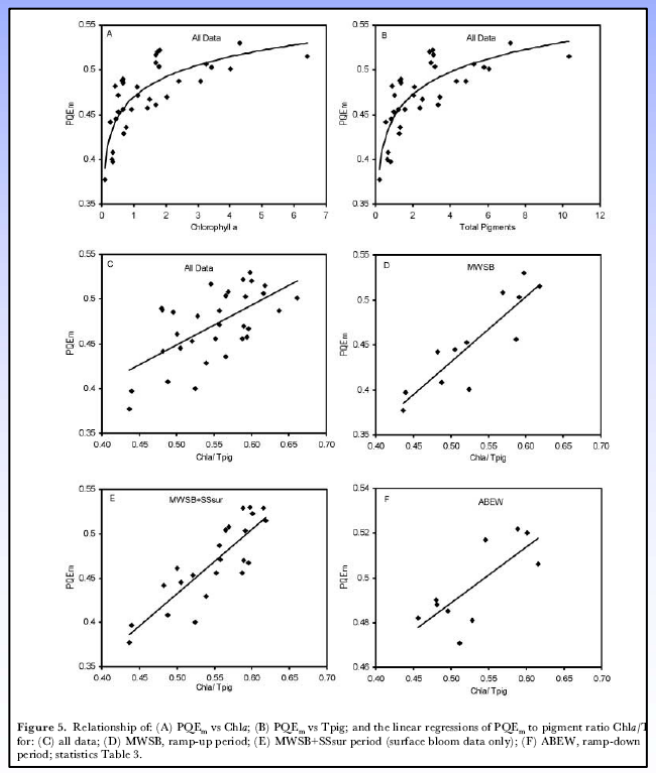


Figure 5. Relationship of: (A) PQE_m vs Chla; (B) PQE_m vs Tpig; and the linear regressions of PQE_m to pigment ratio Chla/T
for: (C) all data; (D) MWSB, ramp-up period; (E) MWSB+SSsur period (surface bloom data only); (F) ABEW, ramp-down
period; statistics Table 3.

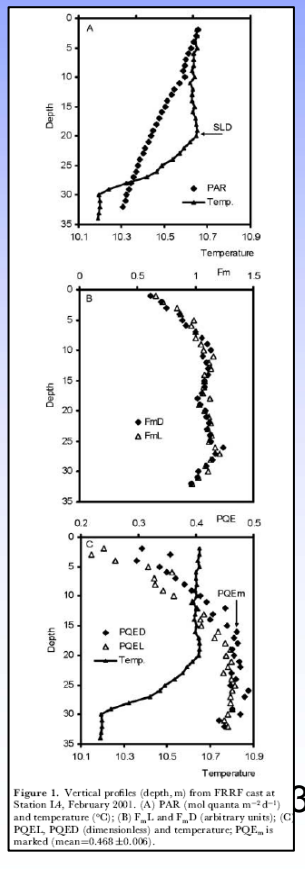
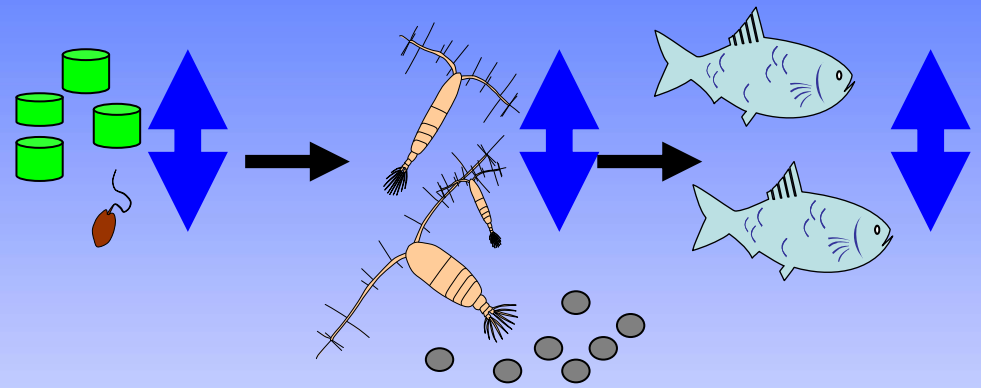
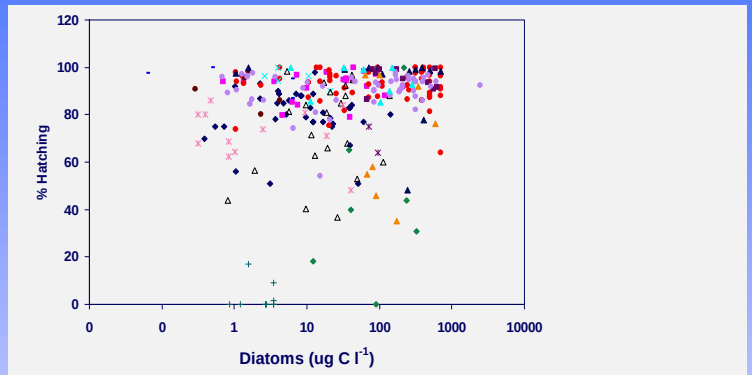


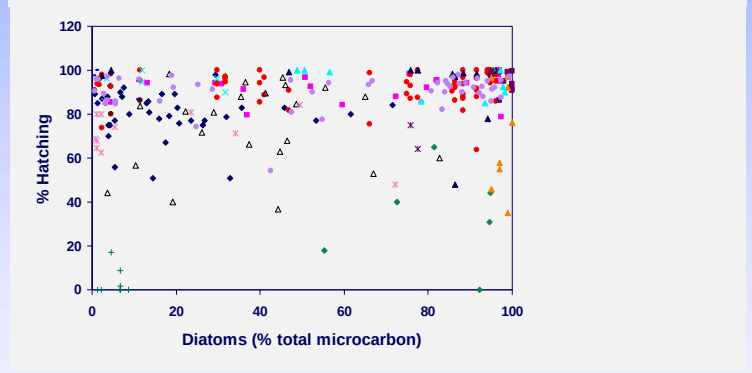
Figure 1. Vertical profiles (depth, m) from FRRF cast at
Station L4, February 2001. (A) PAR (mol quanta m^{-2} d^{-1})
and temperature (°C); (B) F_mL and F_mD (arbitrary units); (C
PQEL, PQED (dimensionless) and temperature; PQE_m is
marked (mean=0.468 ±0.006).

Combining observation and experimentation : diatoms and copepod egg viability



- **11 environments (upwelling, sub-polar, temperate, oceanic, coastal)**
- **13 Copepod species**
- **Diatoms 0.05 - 2449 mg C m-3 (0.1 to 99 %)**
- **No relation between diatoms and egg hatching rates**



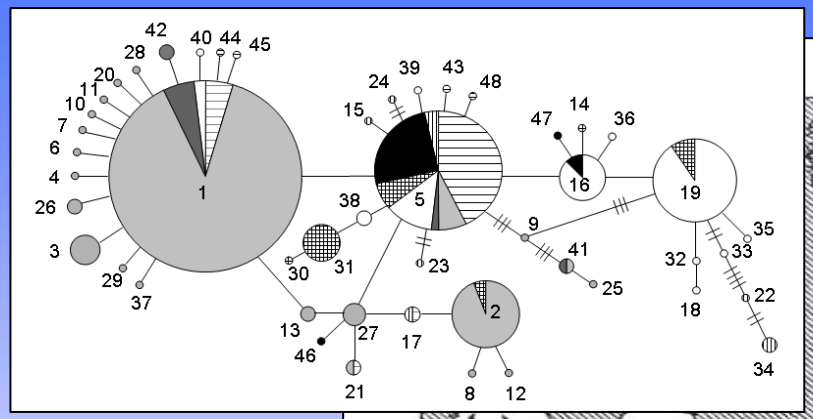


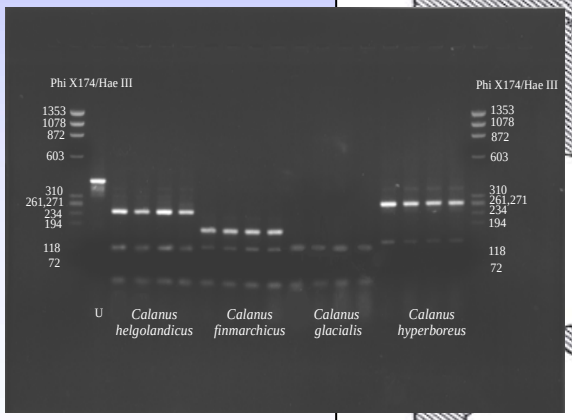
Does phytoplankton diet affect reproduction?

Copepod Hatching Success in Marine Ecosystems with High Diatom Concentrations. Nature, 419: 387- 389.

Population structuring of *Calanus helgolandicus* and *C. euxinus* in European waters: morphology, genetics and hydrography

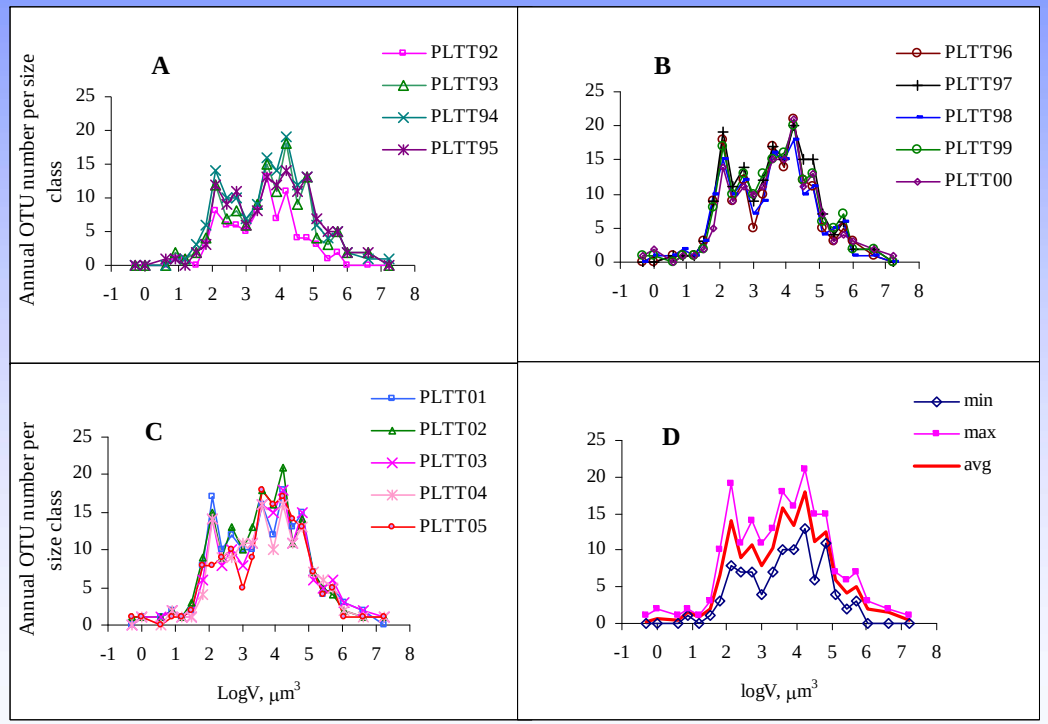
Population genetics

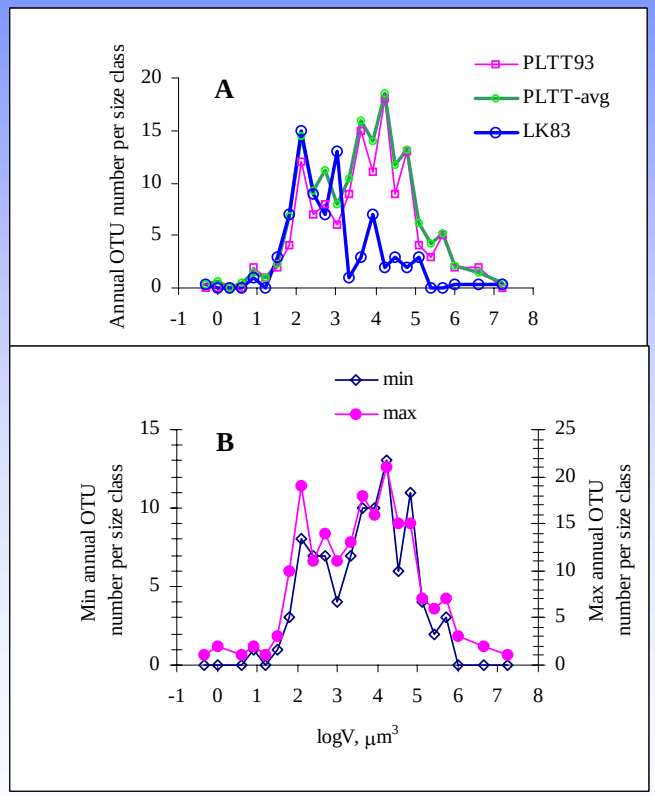




Lidia Yebra, Delphine Bonnet, Roger P. Harris,Katja Peijnenburg, Pennie Lindeque : Molecular Ecology (Submitted)

Taxonomic size structure of phytoplankton: The English Channel vs. Lake Kinneret





Kamenir, Yury , Zvy Dubinsky and Roger Harris, Limnology and Oceanography (submitted)

L4 Team-Work

Aiken's Law of the SQUILLA

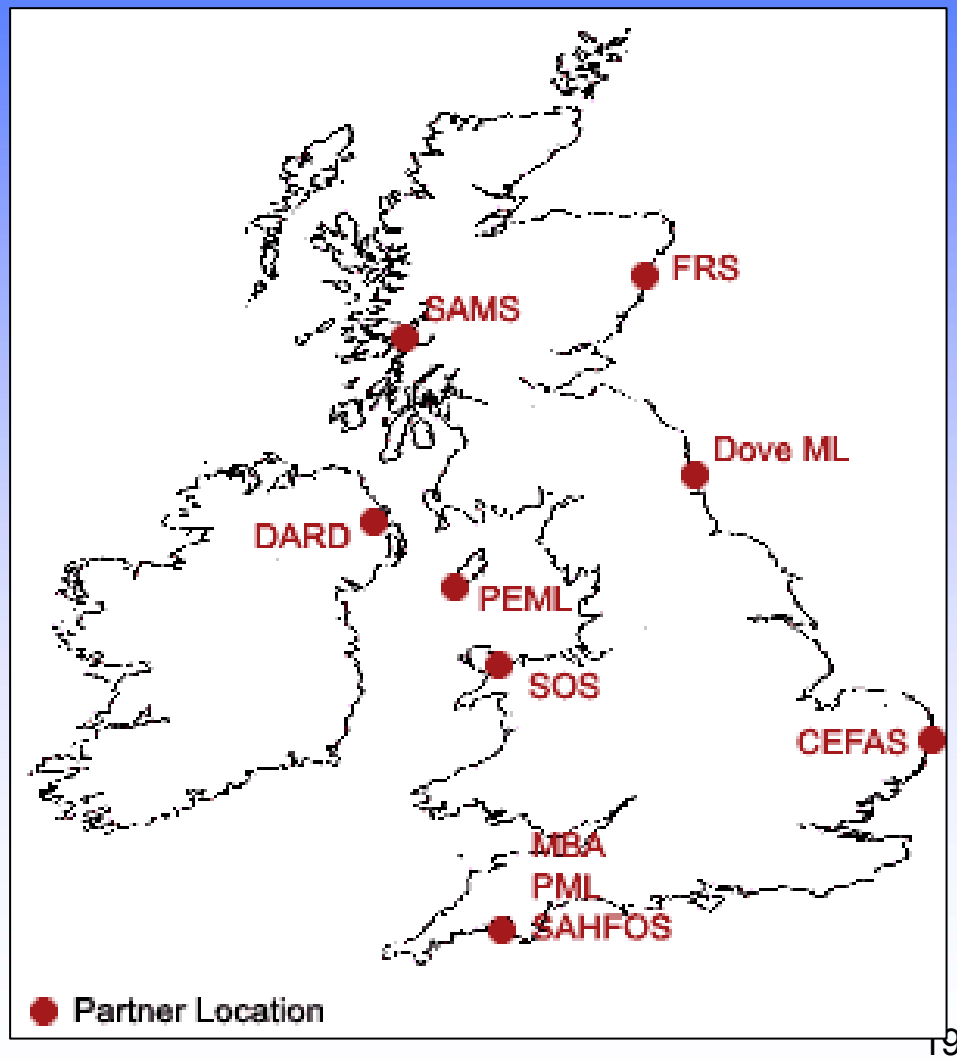
- "Funny ship the Squilla"

"One year I went on her 13 times and was sick once"

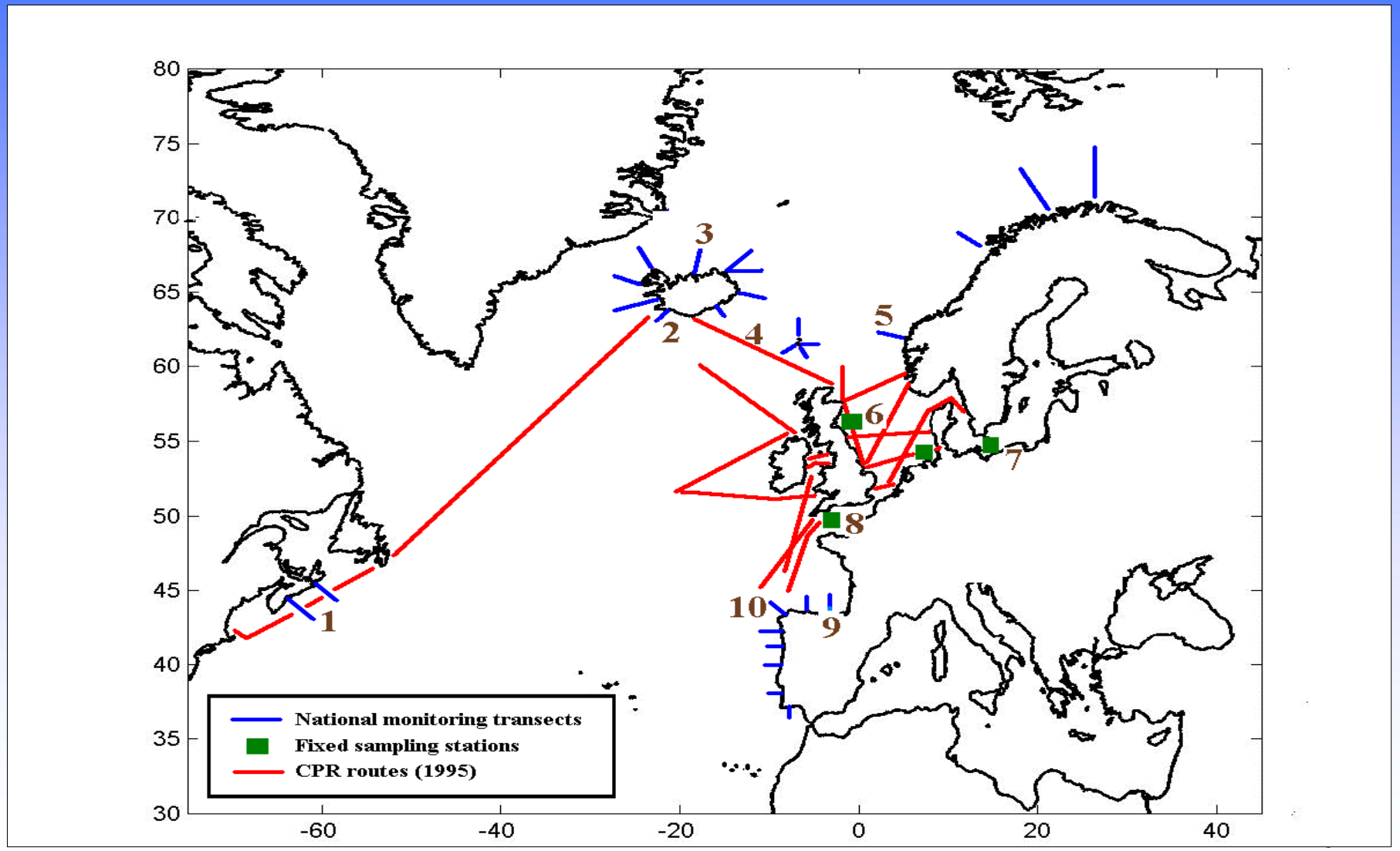
"The next year year I went out once and was sick 13 times"

THE WIDER CONTEXT

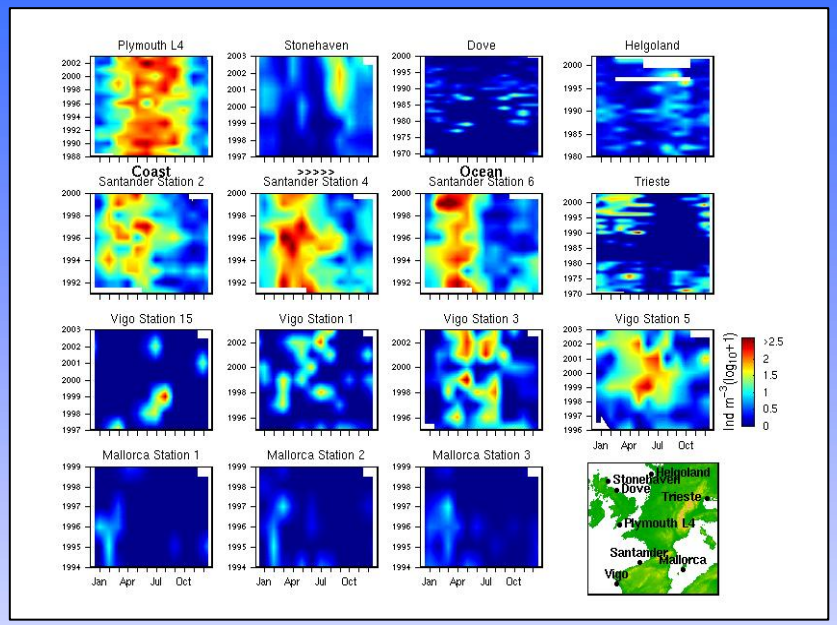
UK Marine Environmental Change Network (MECN) - DEFRA

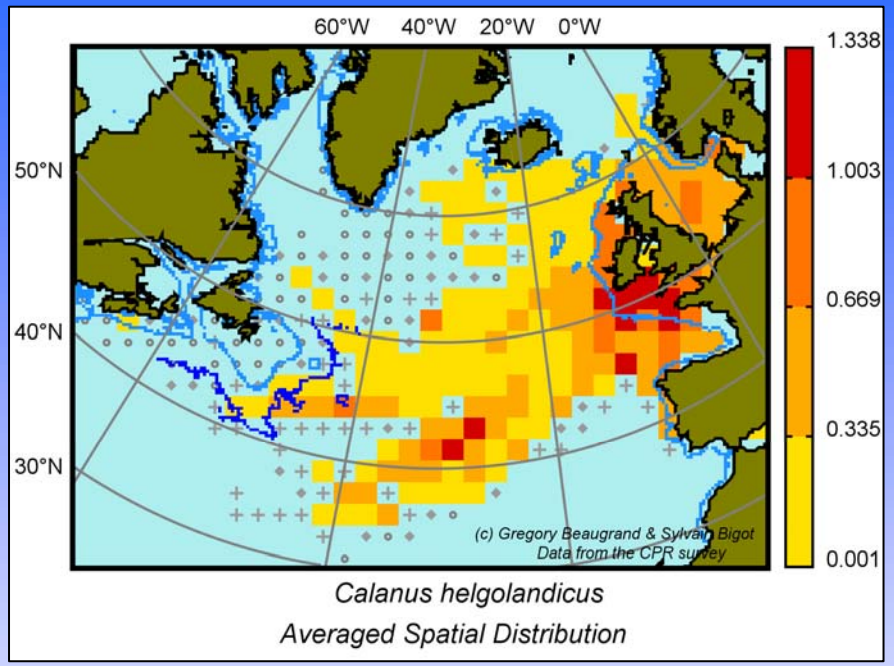


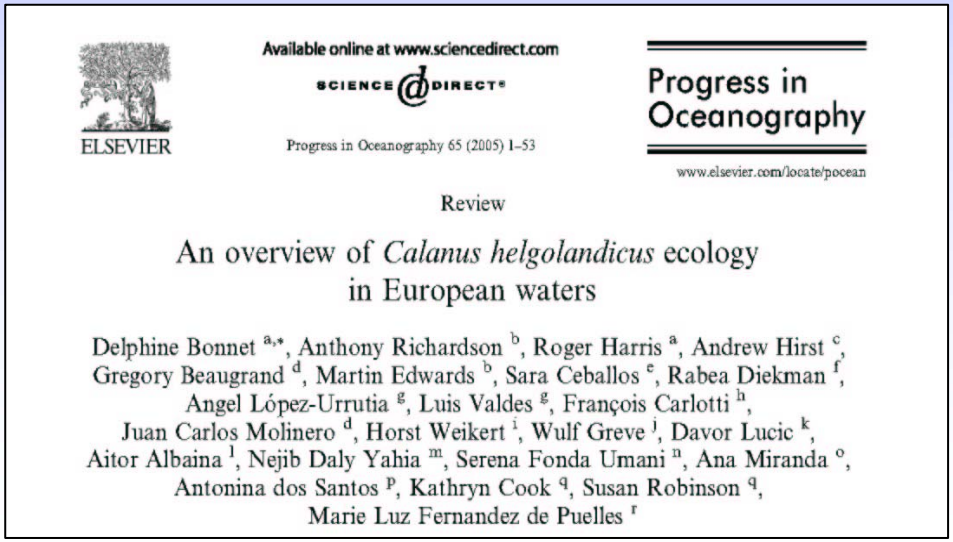
ICES CRR No 276: Zooplankton monitoring results in the ICES area, Summary Status Report 2003/2004, ICES Working Group on Zooplankton Ecology



The wider spatial scale: climate and the autecology of *Calanus helgolandicus*







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Progress in Oceanography

Progress in Oceanography 65 (2005) 1–53

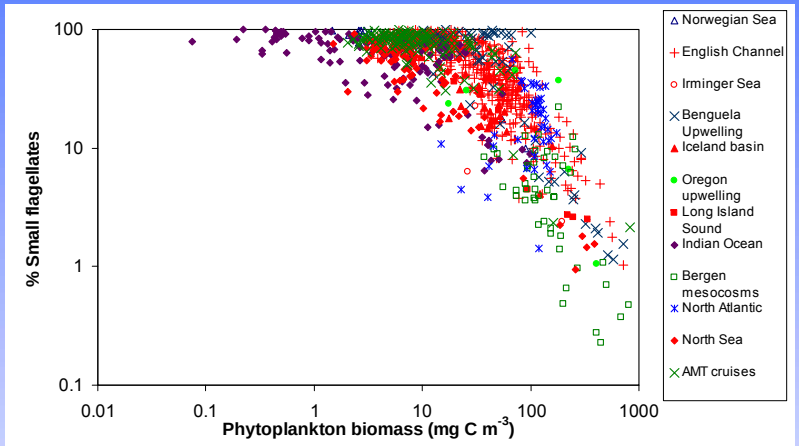
www.elsevier.com/locate/pocean

Review

An overview of *Calanus helgolandicus* ecology in European waters

Delphine Bonnet [a,*], Anthony Richardson [b], Roger Harris [a], Andrew Hirst [c], Gregory Beaugrand [d], Martin Edwards [b], Sara Ceballos [e], Rabea Diekman [f], Angel López-Urrutia [g], Luis Valdes [g], François Carlotti [h], Juan Carlos Molinero [d], Horst Weikert [i], Wulf Greve [j], Davor Lucic [k], Aitor Albaina [l], Nejib Daly Yahia [m], Serena Fonda Umani [n], Ana Miranda [o], Antonina dos Santos [p], Kathryn Cook [q], Susan Robinson [q], Marie Luz Fernandez de Puelles [r]

Exploiting the value of large data-sets: global biodiversity patterns of marine phytoplankton and zooplankton



Small cells dominate at low biomass

news and views

Diversity in the deep blue sea

Peter J. Morin and Jeremy W. Fox

A large-scale survey of the diversity and abundance of plankton in different marine environments around the world has produced some thought-provoking similarities and contrasts with other ecosystems.

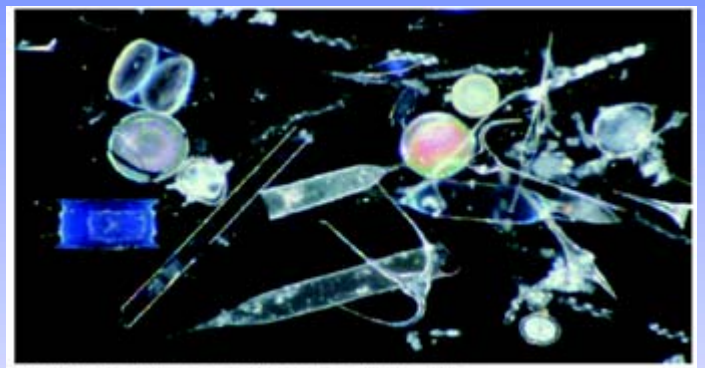
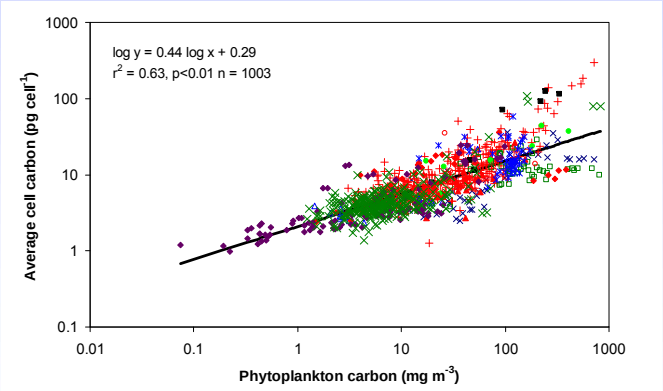
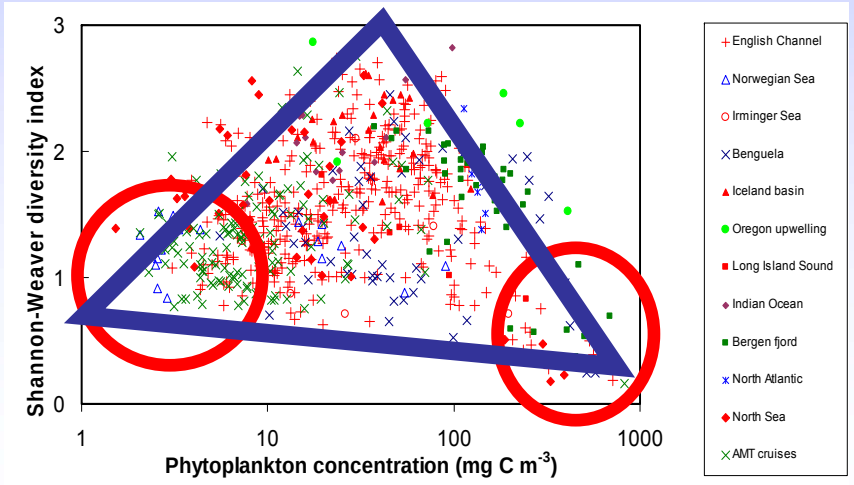


Figure 1 Plankton: little organisms that pose big ecological questions.



Blooms are dominated by large cells

Irigoien, X., Huisman, J. Harris, R.P. 2004. Global biodiversity patterns of marine phytoplankton and zooplankton. *Nature,* 429, 863-867.



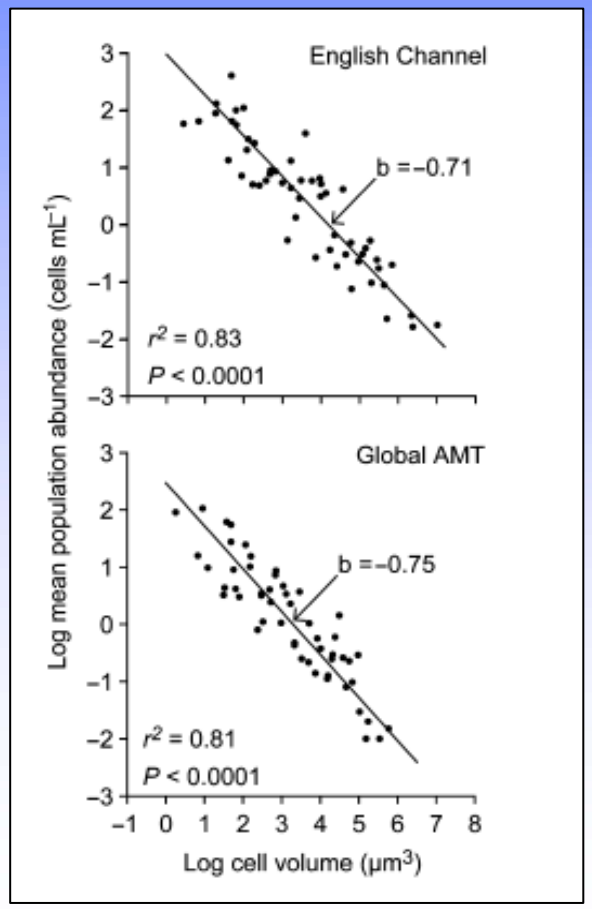
Unimodal diversity-biomass relation

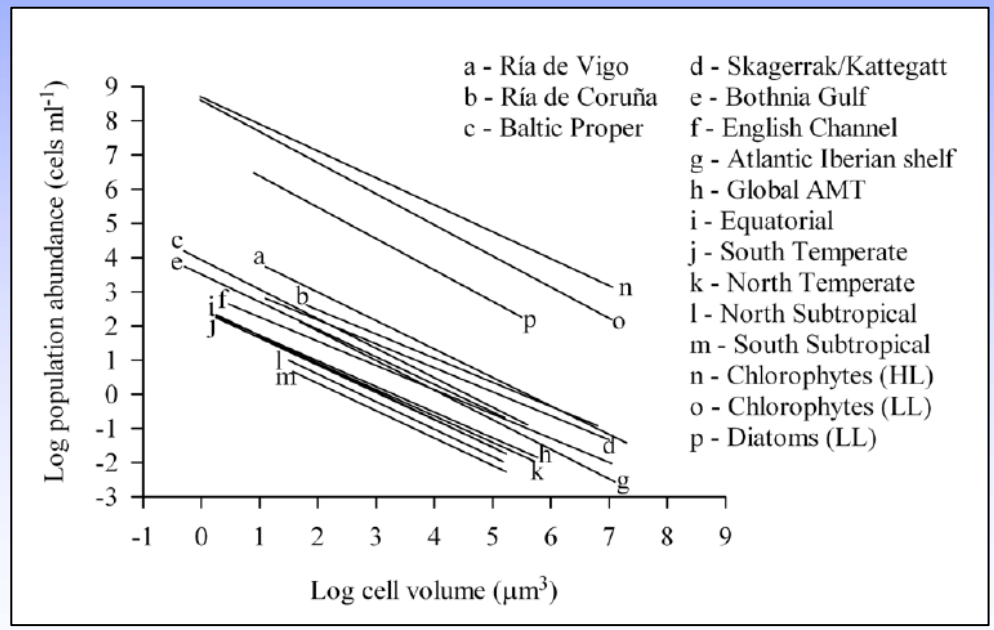
Ecology Letters, (2006) **9**: 1210–1215 doi: 10.1111/j.1461-0248.2006.00973.x

LETTER

Invariant scaling of phytoplankton abundance and cell size in contrasting marine environments

Pedro Cermeño,[1]* Emilio Marañón,[1,2] Derek Harbour[3] and Roger P. Harris[3]





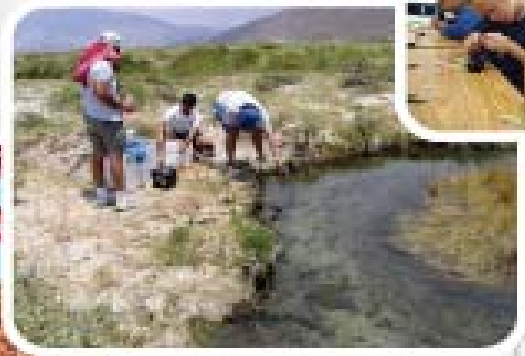
The L4 Dataset: freely available information for the scientific community

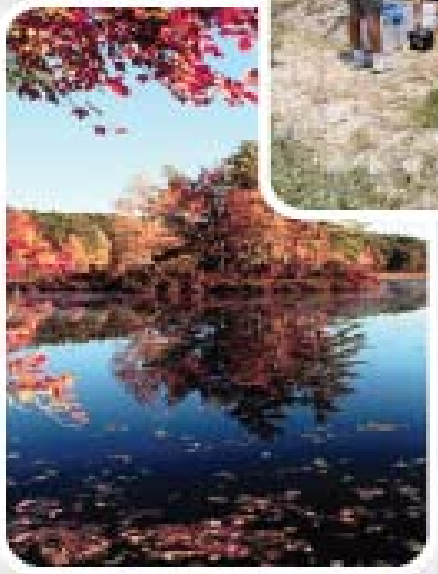
L4 website
http://www.pml.ac.uk/L4

- **Collaborative scientific publications (see L4 publication list)**
- **PhD training**
- **Student projects**
- **Wider public through the web**
- **Integrated within the Western Channel Observatory**

The Future

- Western English Channel Observatory (PML: integrating local time series, remote sensing and models)
- Improving collaboration and data sharing within MECN and other UK networks
- Setting time series within the European Seas context
- Basin-scale North Atlantic integration and synthesis (EU/NSF)
- Ecological Research role very important





Long Term Ecological Research Network

Celebrating 25 Years of Excellence in Long-Term Ecological Research

The LTER Network Goals are:

- **Understanding**: To understand a diverse array of ecosystems at multiple spatial and temporal scales.
- **Synthesis:** To create general knowledge through long-term, interdisciplinary research, synthesis of information, and development of theory.
- **Outreach:** To reach out to the broader scientific community, natural resource managers, policymakers, and the general public by providing decision support, information, recommendations, and the knowledge and capability to address complex environmental challenges.
- **Education:** To promote training, teaching, and learning about long-term ecological research and the Earth's ecosystems, and to educate a new generation of scientists.
- **Information:** To inform the LTER and broader scientific community by creating well-designed and well-documented databases.
- **Legacies:** To create a legacy of well-designed and documented long-term observations, experiments,

Aiken's channel hypothesis - "L4 is an oceanic site": is it valid?

- If you are a physicist from Ballymena, yes.
- Otherwise, no, but….
- It is an excellent site for investigating general processes occurring in the open ocean
- It is an excellent site for studying seasonality, which cannot easily be done in the open ocean
- It provides PML with unique opportunities

And lastly – the Zooplankton Group Christmas Lunch

FINALLY

Prof Aiken reflecting on his four laws