PML | Plymouth Marine Laboratory

Listen to the ocean

FOLLOW US ON twitter

@steve_swi

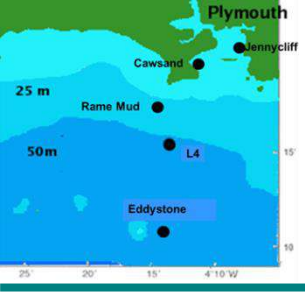
Western Channel Observatory update

Prof Steve Widdicombe

South West Marine Ecosystems 2017 meeting

Session 1: Events & Observations in 2016

21st April 2017, Sherwell Centre, Plymouth University, UK.



The Western Channel Observatory

"From Photons to Fish"

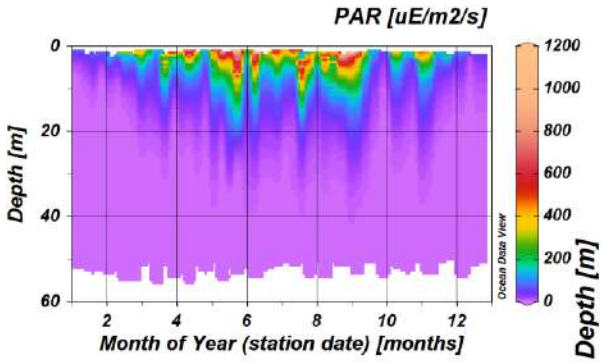
- A uniquely comprehensive, long-term marine observatory, exploring natural variability in marine systems to help predict the causes and consequences of future environmental change
- A range of coastal stations regularly measuring coupled physical, biological and chemical parameters
- First sampled in 1888, the WCO formally established by weekly plankton sampling (1998), expanded to include benthic sampling (2008), permanent data buoys (2008) & Penlee Point atmospheric observatory (2013)
- Sampling occurs across a range of temporal scales – seconds to decades
- http://www.westernchannelobservatory.org.uk/

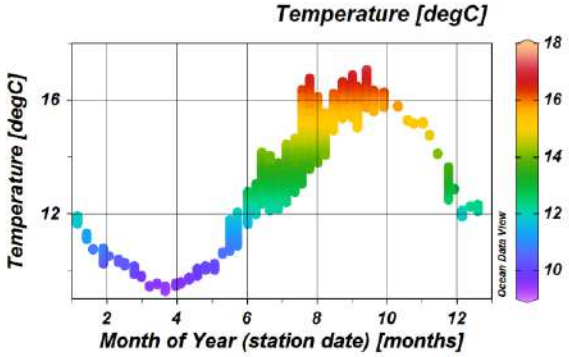
PML | Plymouth Marine Laboratory

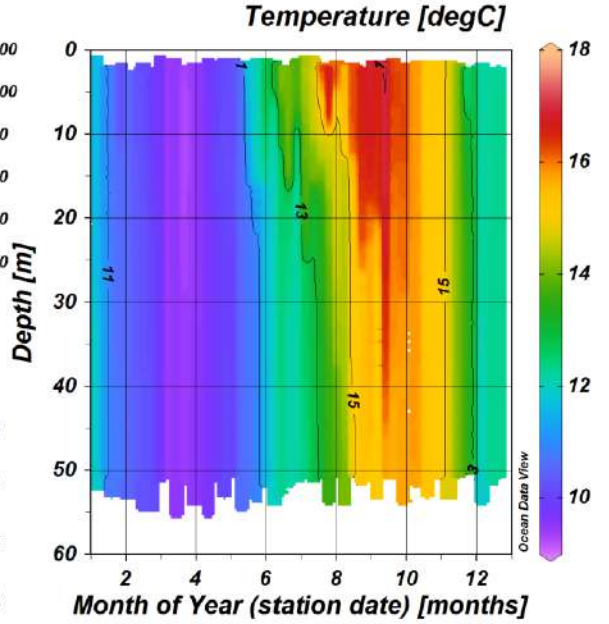
Environmental and Biological Observations at the WCO

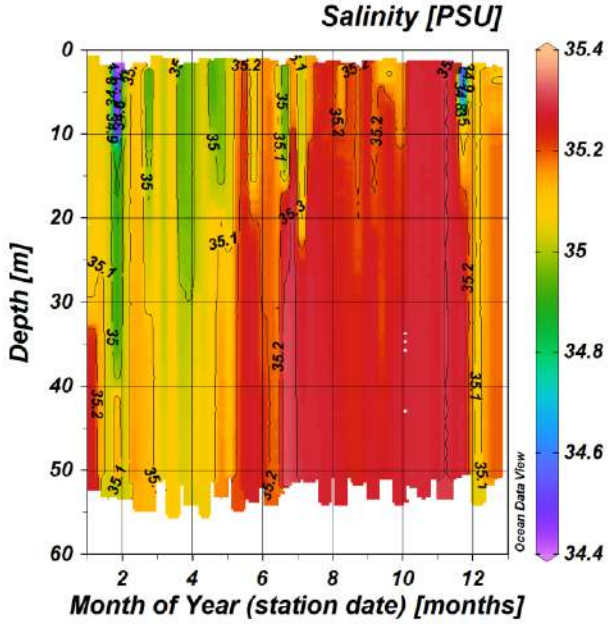
PML | Plymouth Marine Laboratory

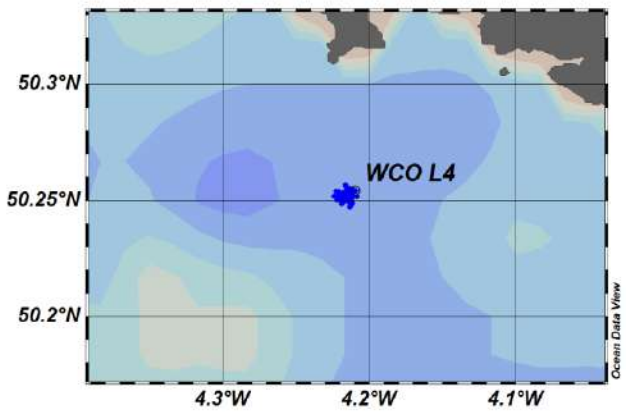
Environmental conditions during 2016

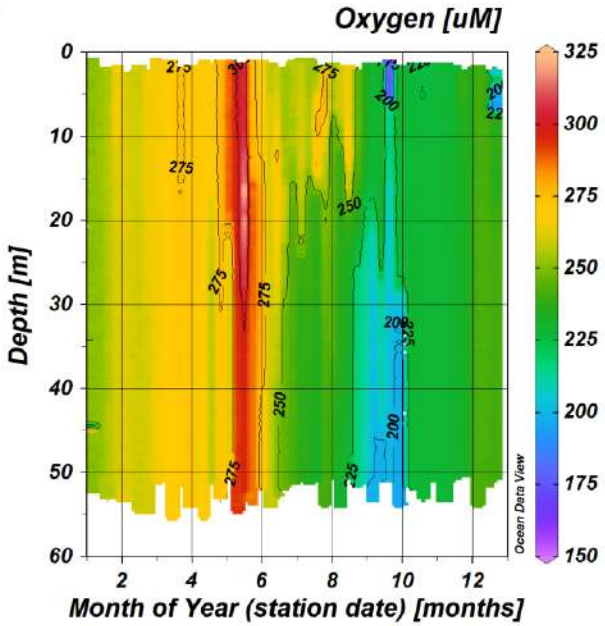


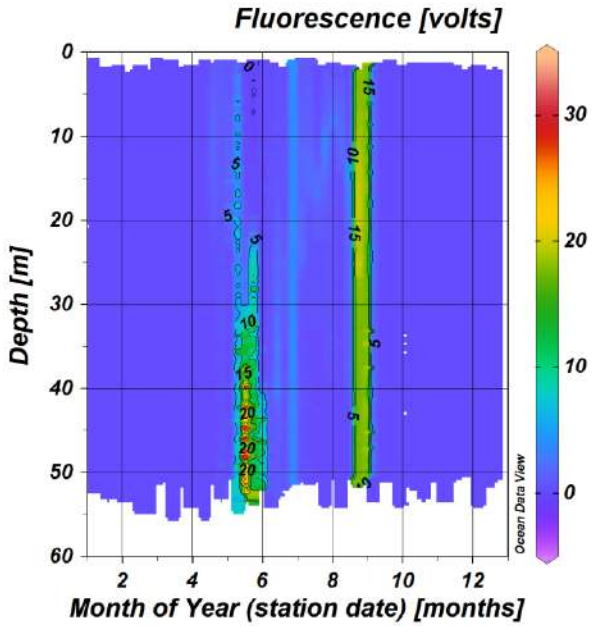




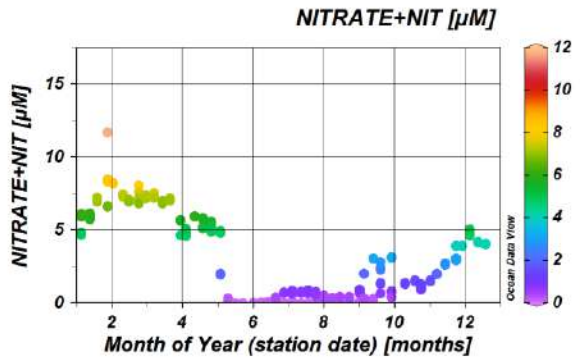


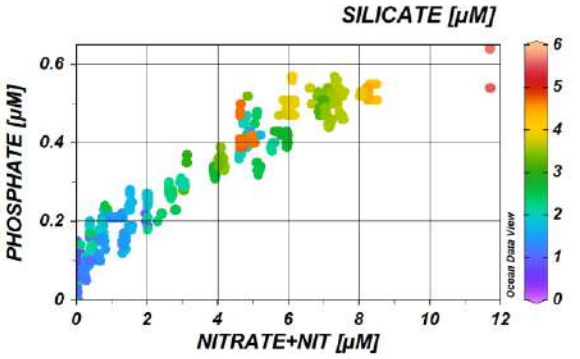


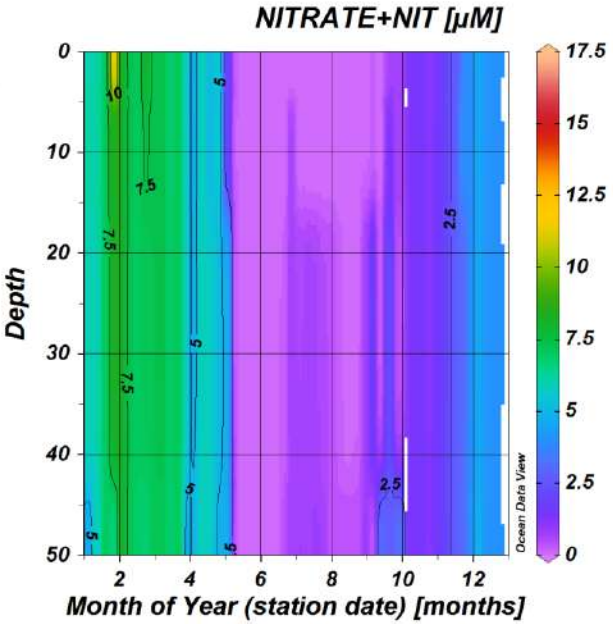


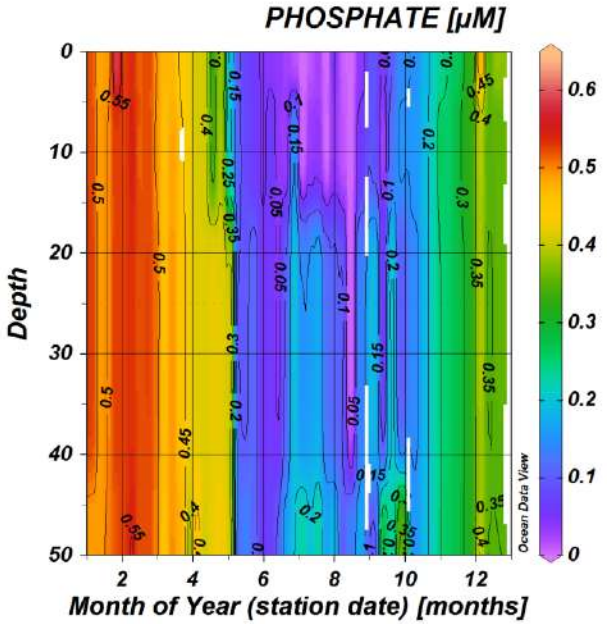


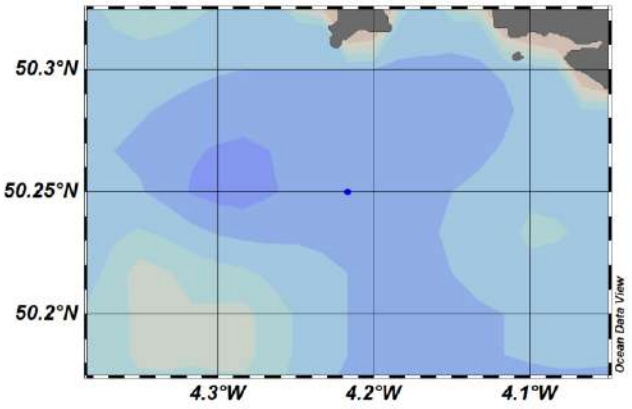
Environmental conditions during 2016

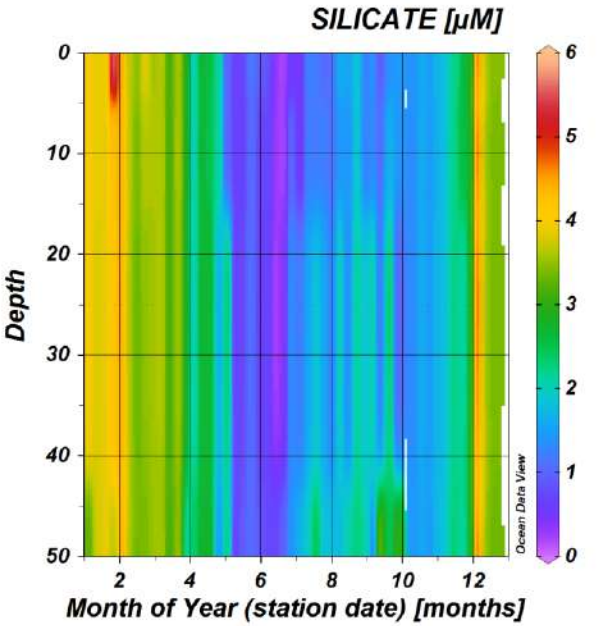


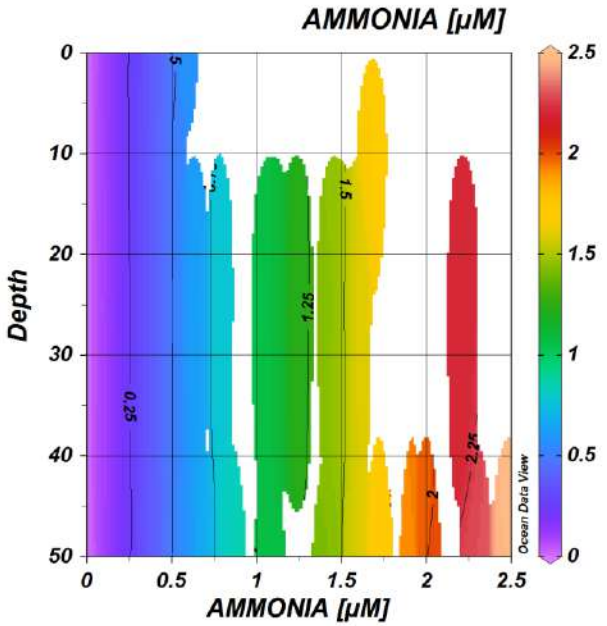




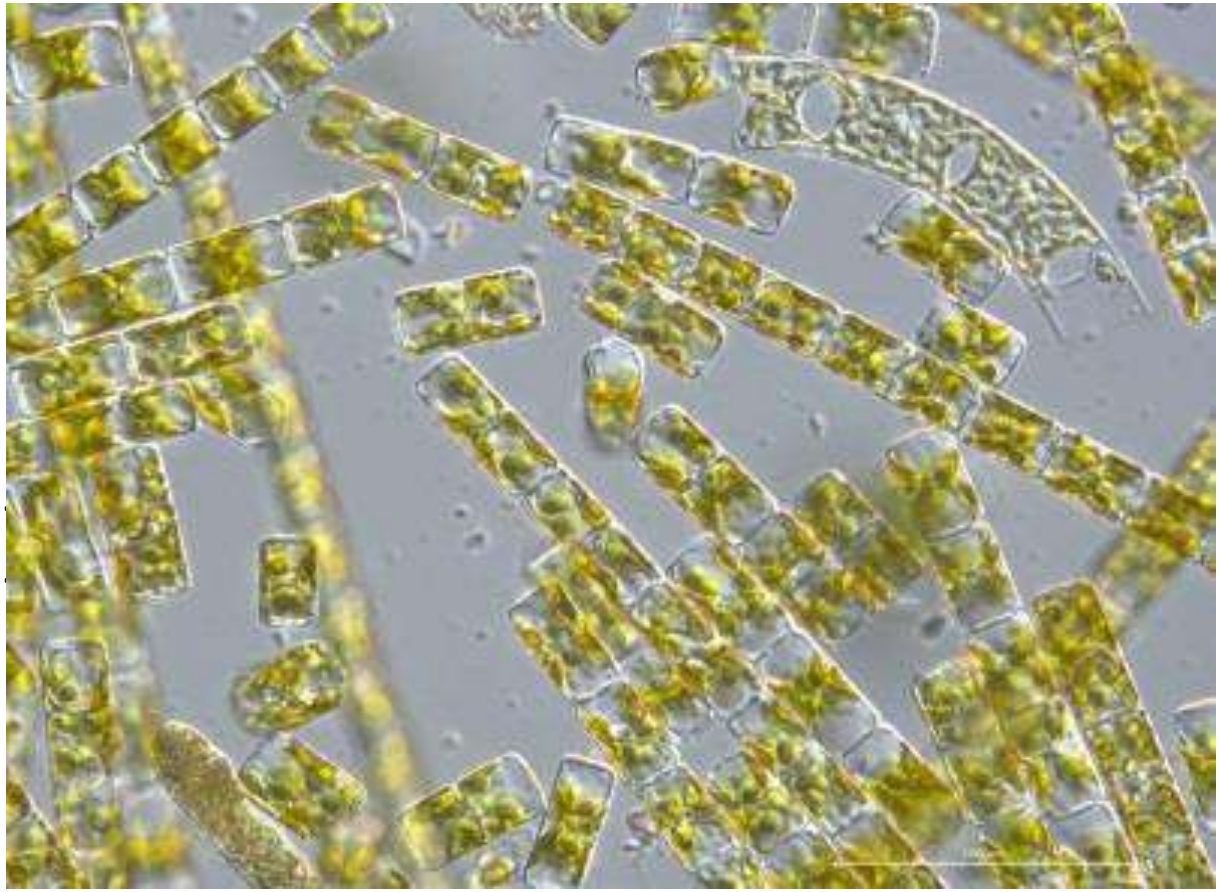








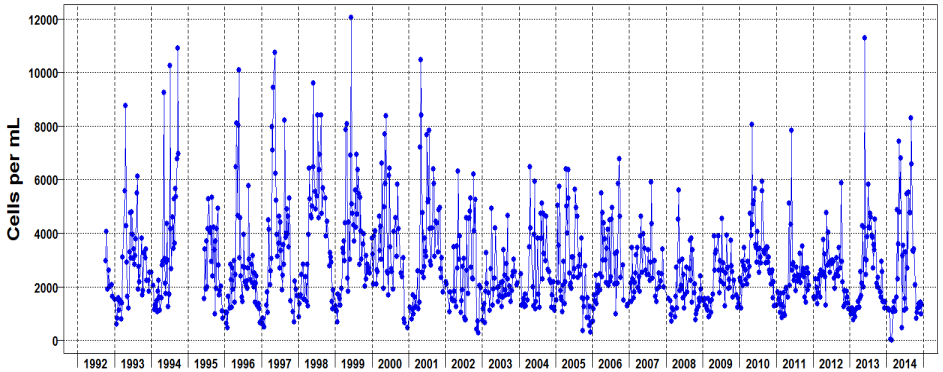
Phytoplankton blooms 2016



- Winter storms with low concentrations of phytoplankton but new and unusual species
- Spring dominated by intense *Phaeocystis* spp. bloom
- Spring diatom bloom was comparatively small with a peak in early summer
- Dinoflagellates peaked in late summer when water temperatures are highest
- *Emiliania huxleyi* dominated an autumn coccolithophore bloom
- Ciliates relatively low abundance throughout the year

Courtesy: Paul Rooks

25 years of Phytoplankton data (1992 – 2017)



Variable: Total Phytoplankton

Location: L4 station (Western Channel - UK)

Period: 1992-2014

Number of samples: 916

Min: 9.16

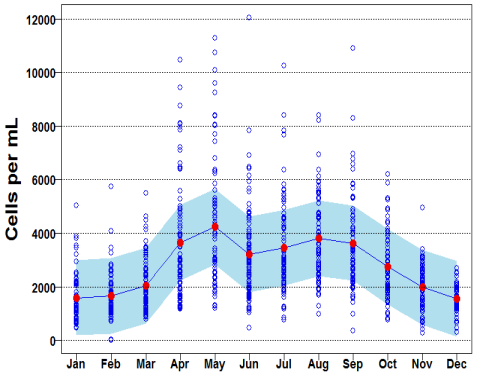
Max: 12043.58

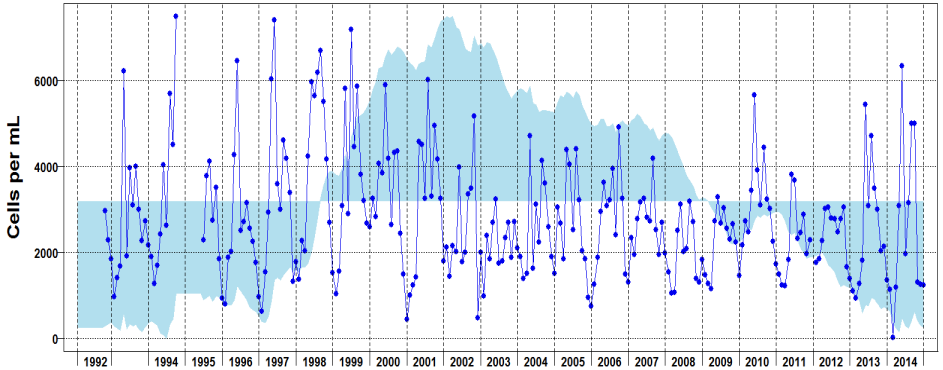
Average: 2888.16

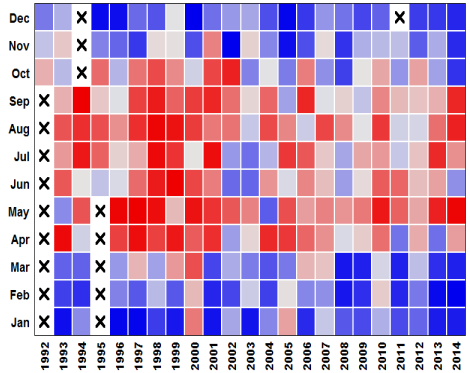
SD: 1782.09

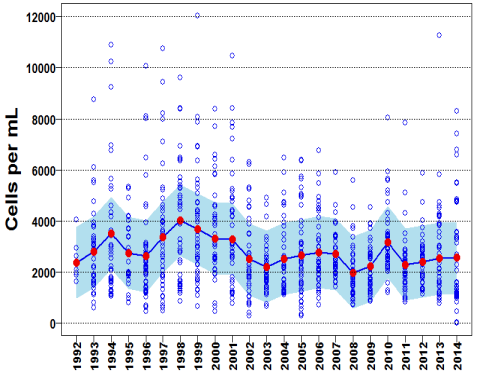
Median: 2485.63

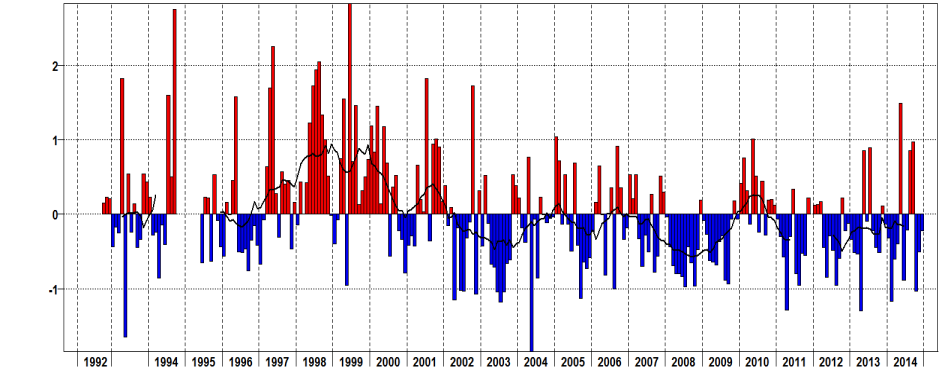
Unit: Cells per mL

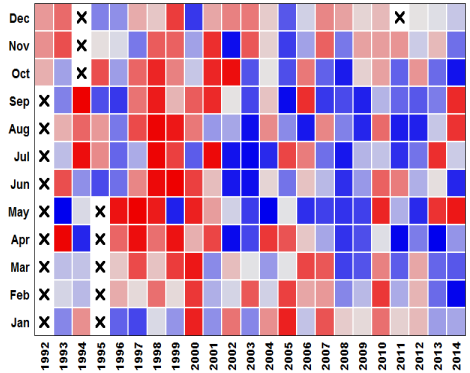


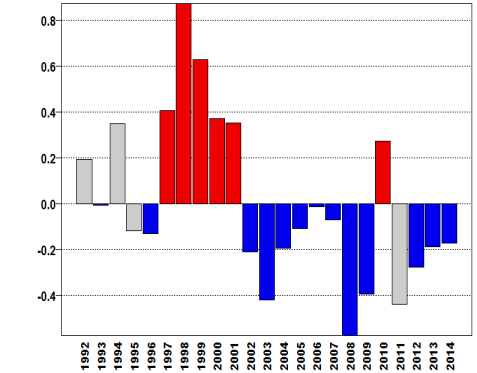






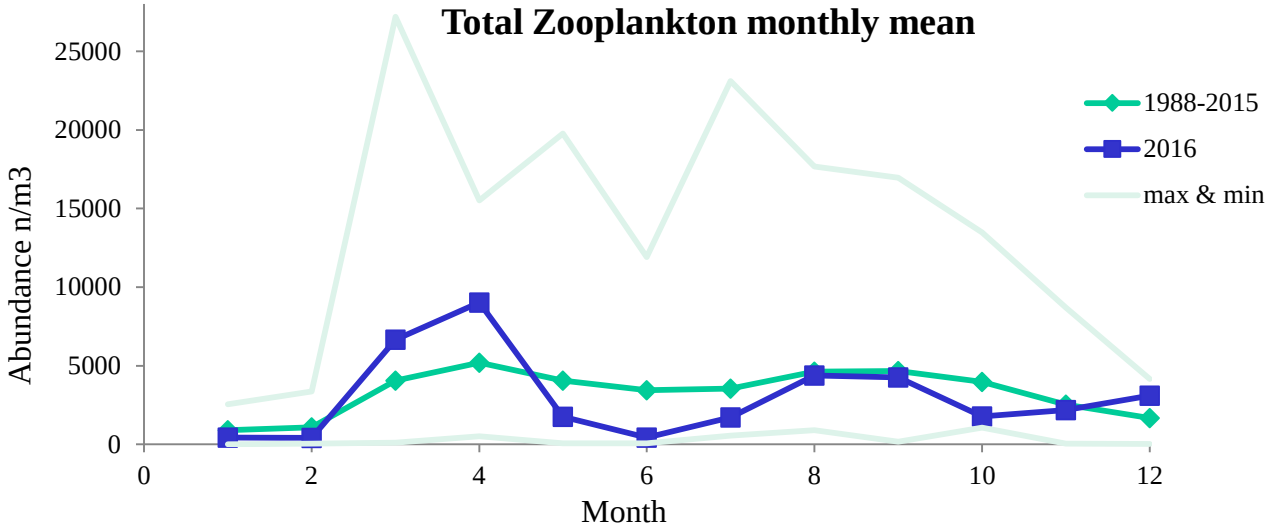


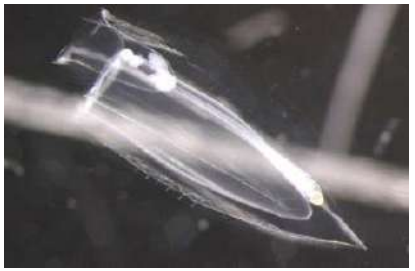




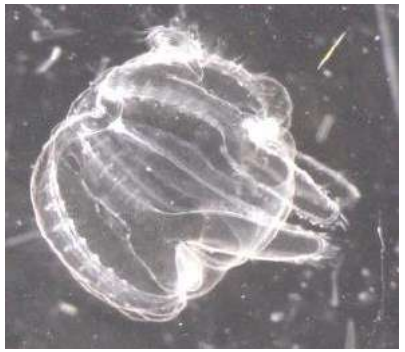
Courtesy: Claire Widdicombe

Zooplankton blooms 2016





Muggiaea atlantica (Siphonophore)

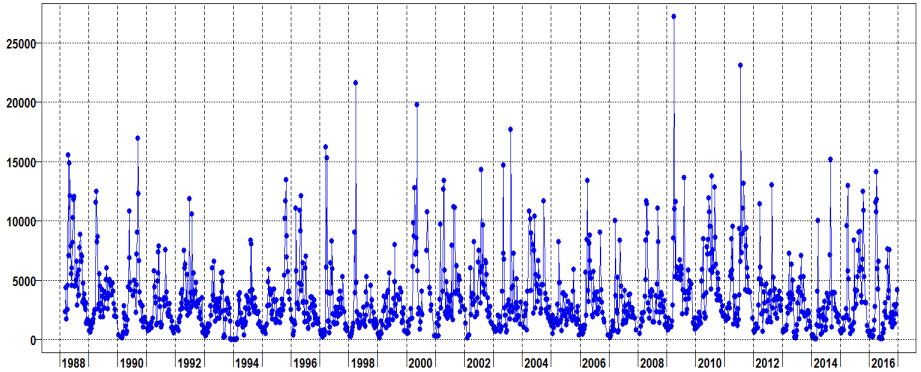


Bolinopsis sp

Copepod

- 100 zooplankton samples (2 per week) were taken and analysed
- Unusual *entoproct* larvae appeared in Dec 2015 and throughout Jan/Feb 2016. They are tiny sessile solitary or colonial organisms. They are not well studied. They have been seen previously at L4 and at Milbay Marina before but not formally recorded in the database.
- *Bolinopsis(Ctenophore)* appeared in June (very fragile and breaks up easily during sampling), this was a new record for the L4 database as was *Proboscidactyla stellate(Hydrozoa)*.
- Jan-April 2016: Clade IV *Trichodesmium* – filamentous colonial cyanobacterium recorded
- Higher number of Siphonophores than the last two years, but still within limits of the whole time series

29 years of Zooplankton data (1988 – 2017)



Variable: Total Zooplankton

Location: L4 station (Western Channel - UK)

Period: 1988-2016

Number of samples: 1272

Min: 7.48

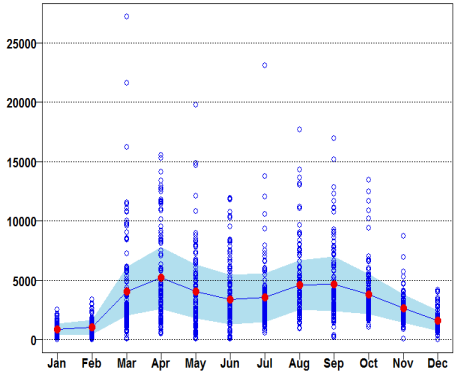
Max: 27185.18

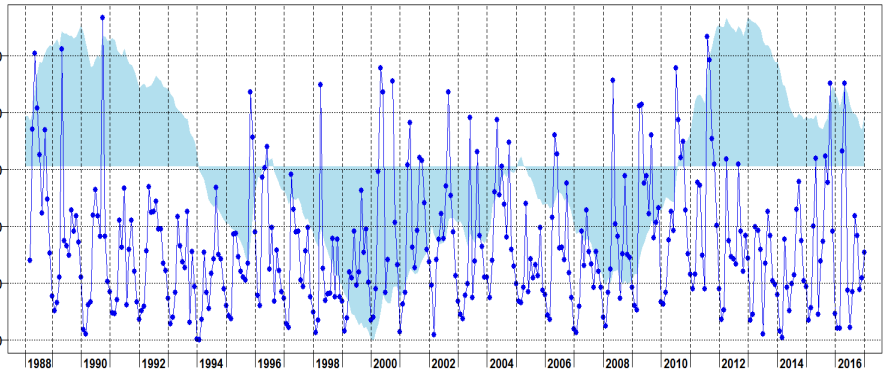
Average: 3419.94

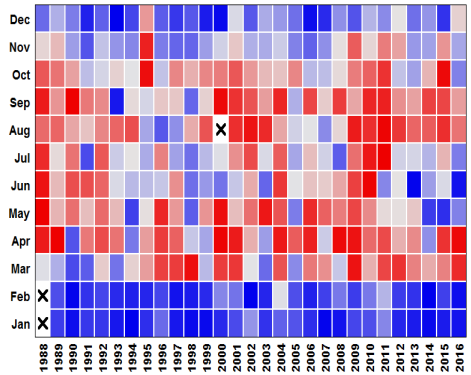
SD: 3050.16

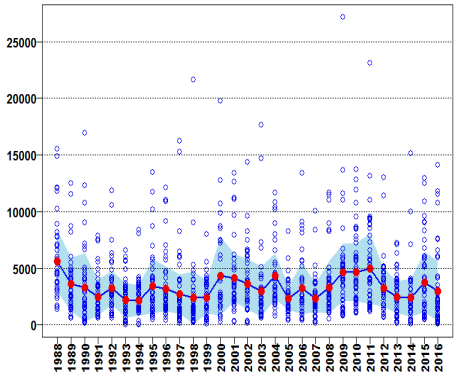
Median: 2566.7

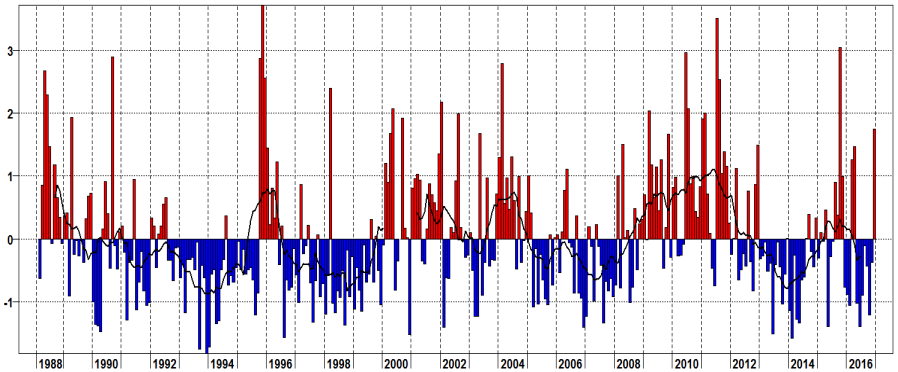
Unit:

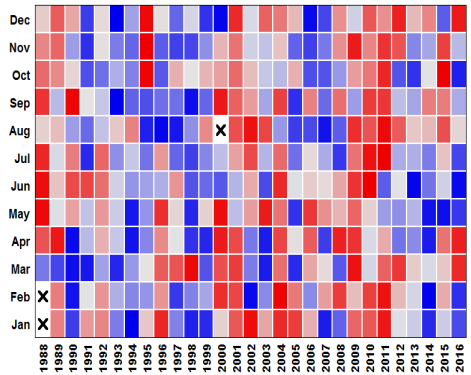


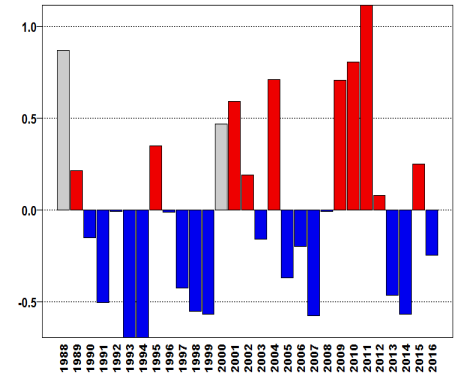








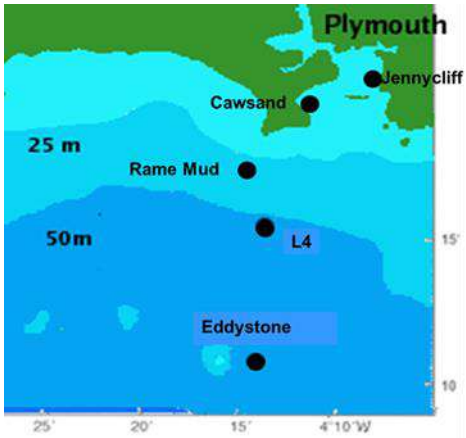


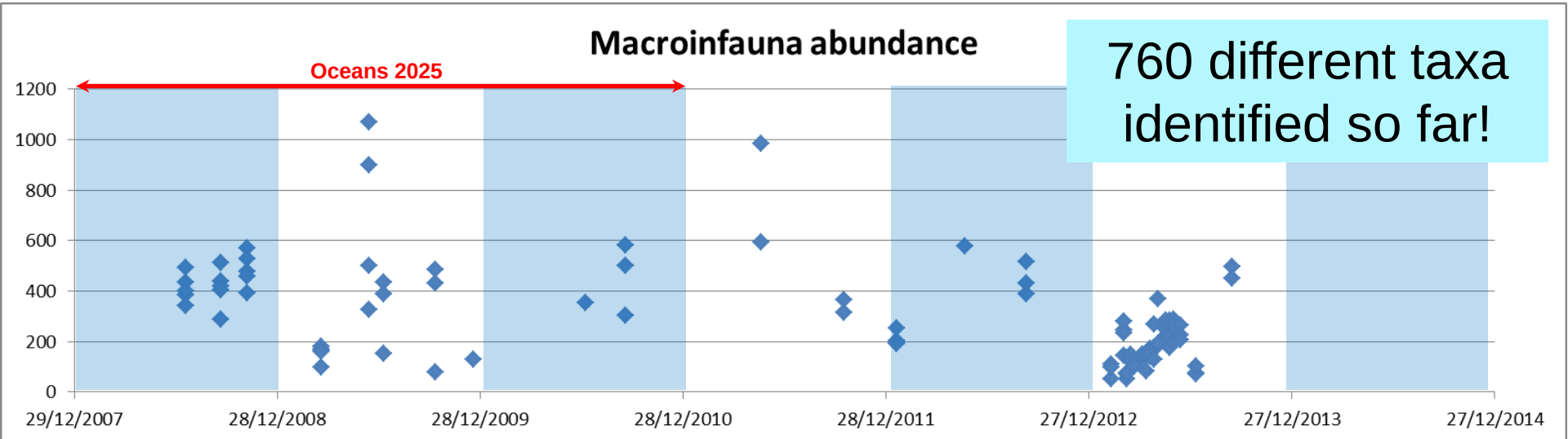


Courtesy: Andrea McEvoy

Benthic infaunal time series

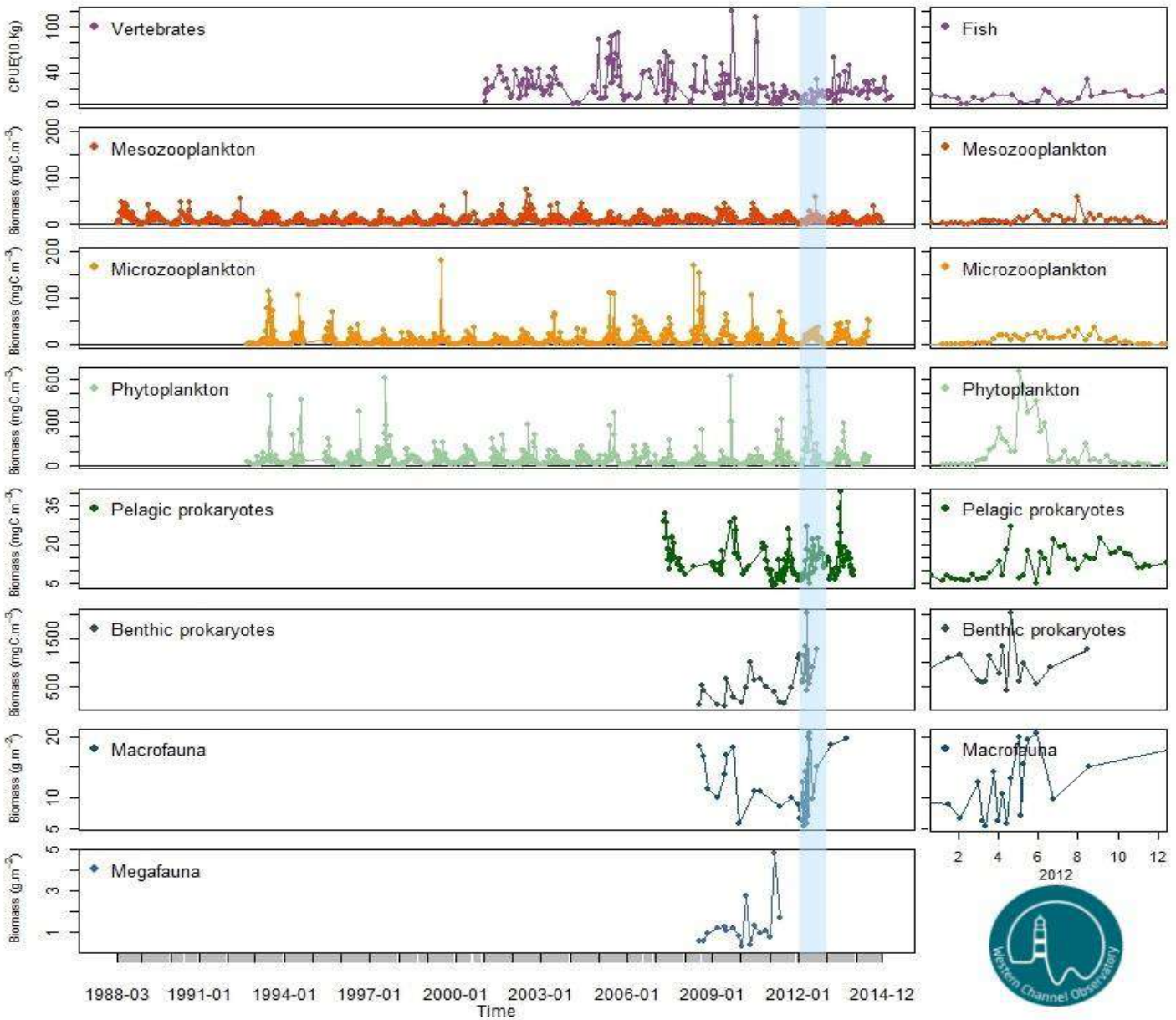
- Intermittent benthic sampling has occurred off Plymouth since 1895.
- Benthic survey started as part of WCO in July 2008 with regular (every 2 months) visits to 4 contrasting soft sediment sites:
- L4, Rame Mud, Cawsand & Jennycliff
- Sites represent a variety of sediment types and water depths.
- Benthic sampling now concentrated at L4 and conducted monthly.
- Mega & meiofauna have also been collected



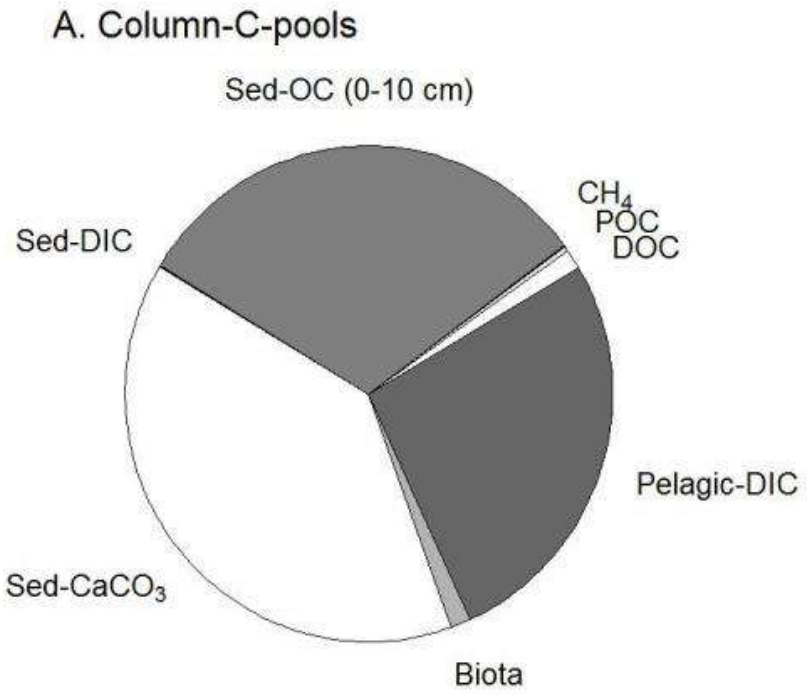


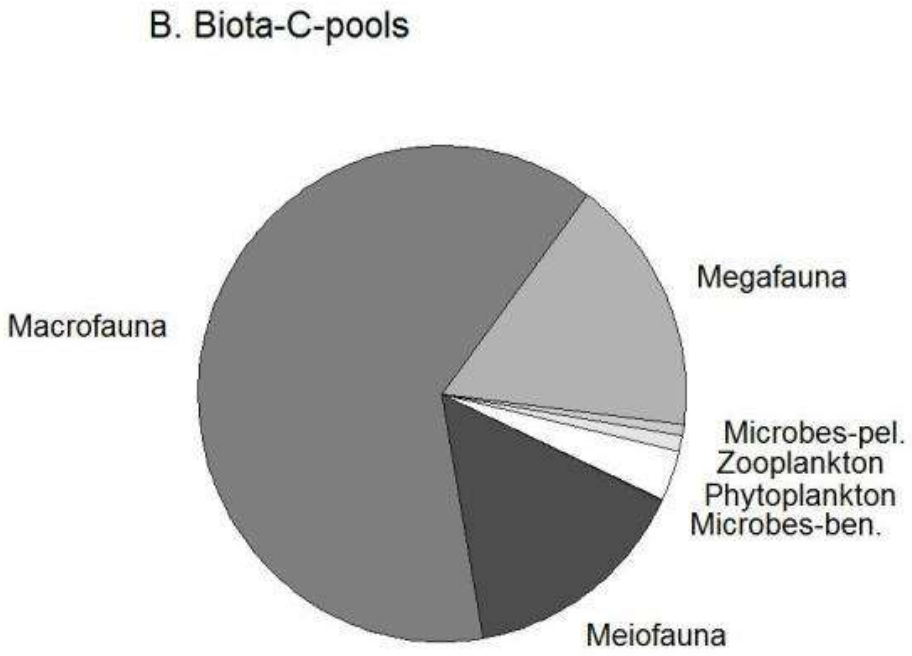
760 different taxa identified so far!

Putting the pieces together



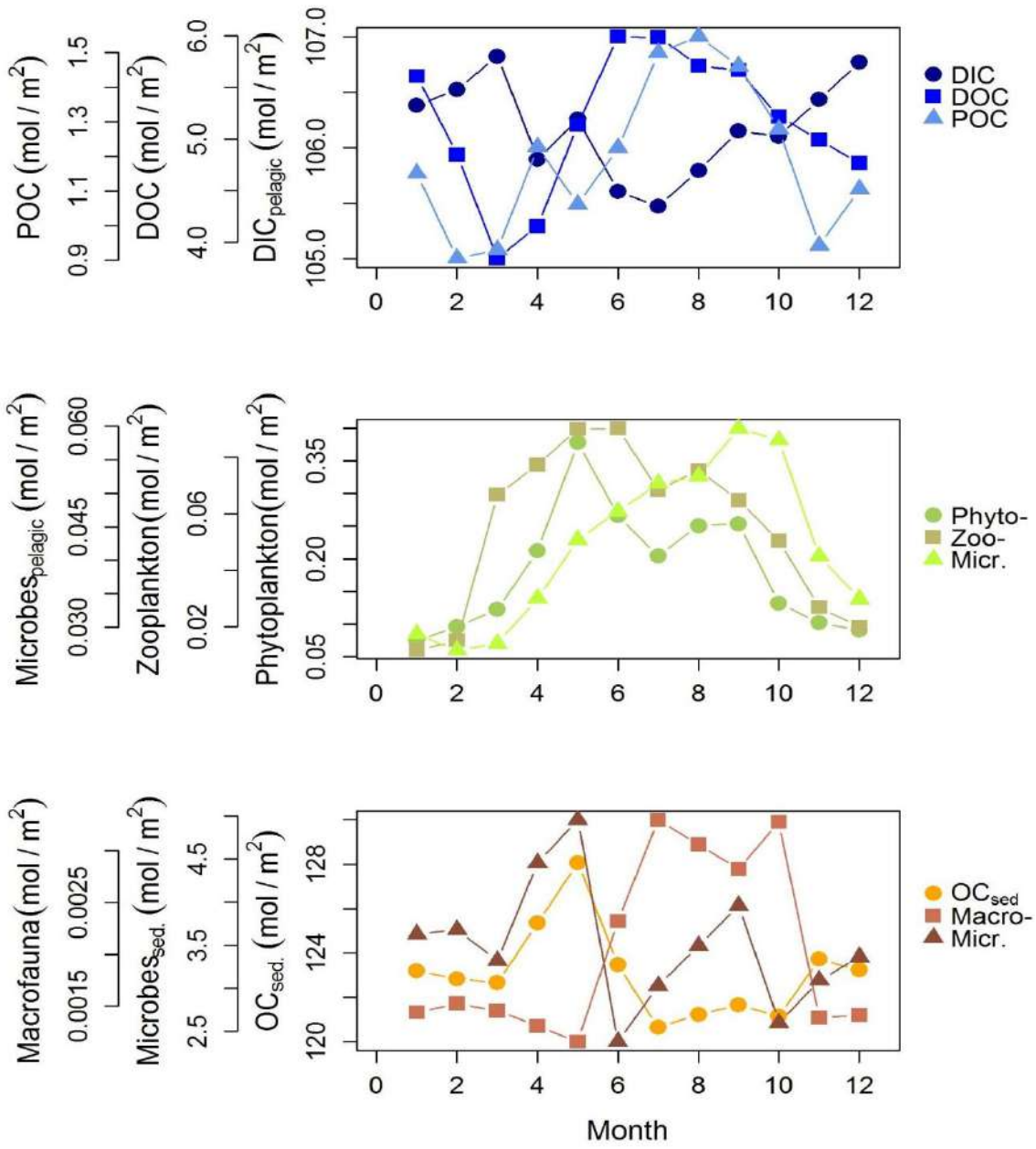
Coastal Carbon Stocks





- Average annual carbon pools at Station L4
- Biological biomass pool is small but extremely active (stock vs flow)
- Benthic pool is larger than pelagic

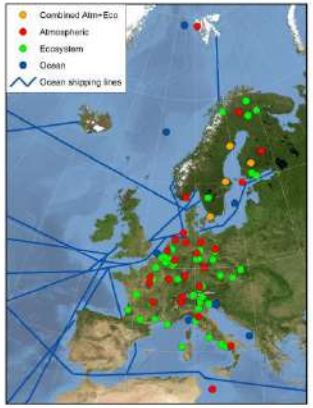
Annual Patterns in Carbon



- Strong seasonal patterns in carbon pools
- Describe a typical carbon “phenology”
- Identify key linkages and trade-offs

ICOS: Integrated Carbon Observation System

- European Research Infrastructure Consortium (ERIC) - a legal entity.
- An extensive network of standardized and integrated national atmospheric, ecosystem and marine stations (< 100 so far).
- The UK (NERC) has just applied to join ICOS, proposing five stations.
  1. The Porcupine Abyssal Plan observing station (NOC/UK Met Office)
  2. The UK-Caribbean line (U. Exeter/NOC)
  3. **The Western Channel Observatory (PML)**
  4. The Weybourne Atmospheric Observatory (NCAS/UEA)
  5. The Auchenmorth Moss ecosystem station (CEH)
- Marine stations cover the North Atlantic and European marginal seas and consist of a network of ships and fixed stations monitoring carbon exchange and acidification.
- The Ocean Thematic Centre (OTC) is one of four ICOS central facilities and is supported by Norway (Bergen) and the UK (NOC, U. Exeter and PML)



Member Countries (so far)

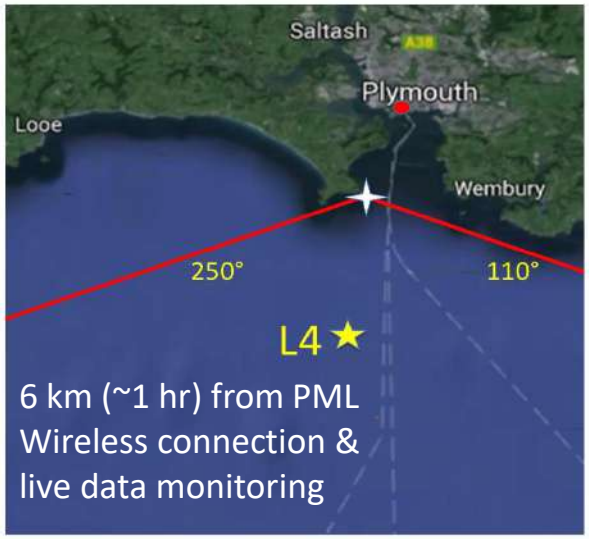
New(ish) Activities and Observations

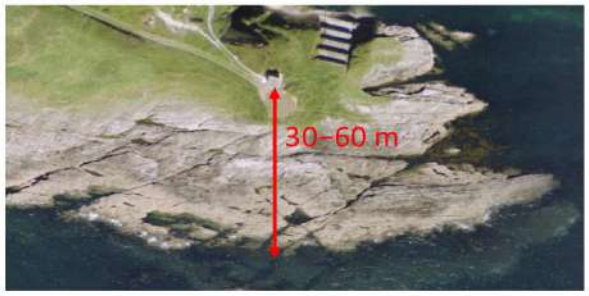
Penlee Point Atmospheric Observatory

PML | Plymouth Marine Laboratory

Established May 2014

Contact: Tom Bell (tbe@pml.ac.uk) or Mingxi Yang (miya@pml.ac.uk)



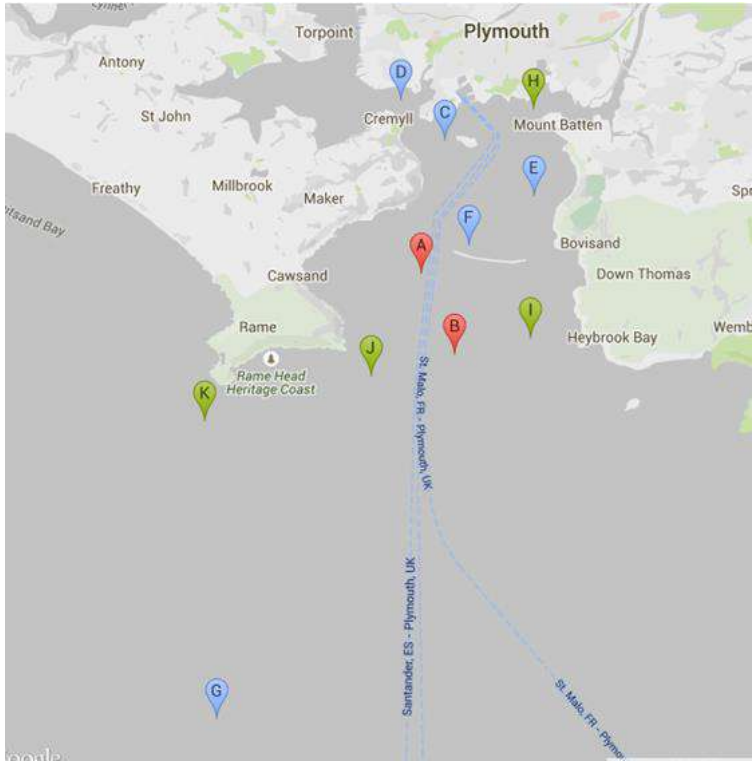


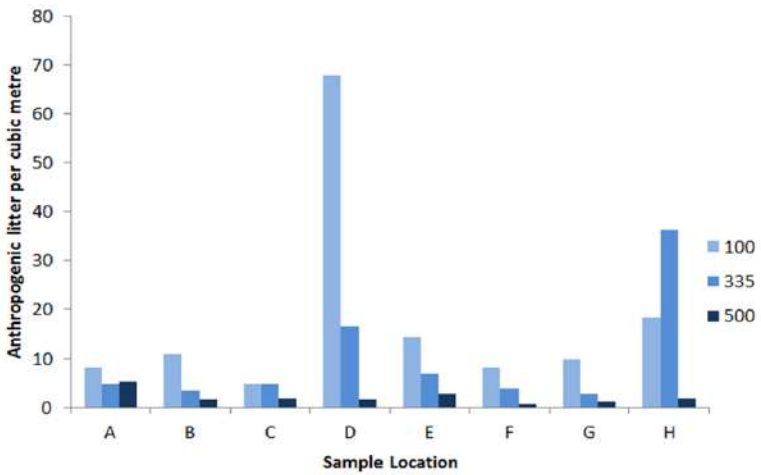
Topics of interest:

- ❖ **Ocean influence on regional air quality (particles, pollution)**
- ❖ **Greenhouse gas concentrations and air/sea fluxes**
- ❖ **Ship emissions of gases and particles**

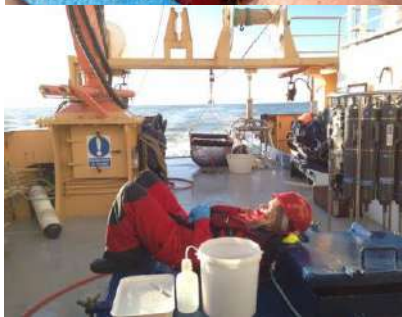
http://www.westernchannelobservatory.org.uk/penlee/

Presence of microplastics at the WCO



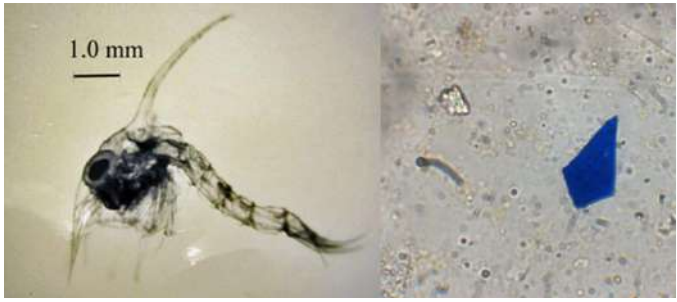


- Microplastics collected from 14 coastal sites around Plymouth
- 17,227 suspected microplastics items identified from samples, with an average concentration of 2.06 particles m^{-3}
- **BUT at the mouth of the river Plym, June, >15,000 fibres m^{-3}**
- Of these plastics, the majority were fibrous (77.1 %) or fragments (18.7%), with beads contributing 4.2%.
- Mean number of microplastics collected declines as mesh size increases, with nine times more particles collected by the 100 µm net than the 500 µm net
- This can have significant biological implications!

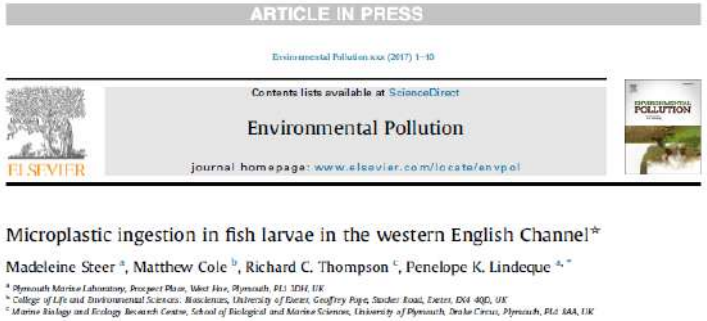


Biological impacts of Microplastics

- Sampled 6 local stations, 8 times over annual cycle
- Plastics found in a wide range of zooplankton e.g. decapod larvae on the right.



- First study to assess waterborne microplastic concentrations and ingestion in fish larvae
- 2.9 % of fish larvae sampled had ingested microplastics, of which 66% were blue fibres
- Station L4 ratio fish larvae:microplastics (m^{-3}) 1:27!!


ARTICLE IN PRESS

Environmental Pollution xxx (2017) 1–10

Contents lists available at ScienceDirect

Environmental Pollution

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

Microplastic ingestion in fish larvae in the western English Channel*

Madeleine Steer [a], Matthew Cole [b], Richard C. Thompson [c], Penelope K. Lindeque [a, *]

[a] Plymouth Marine Laboratory, Prospect Place, West Hoe, Plymouth, PL1 3DH, UK
[b] College of Life and Environmental Sciences: Biosciences, University of Exeter, Geoffrey Pope, Stocker Road, Exeter, EX4 4QD, UK
[c] Marine Biology and Ecology Research Centre, School of Biological and Marine Sciences, University of Plymouth, Drake Circus, Plymouth, PL4 8AA, UK

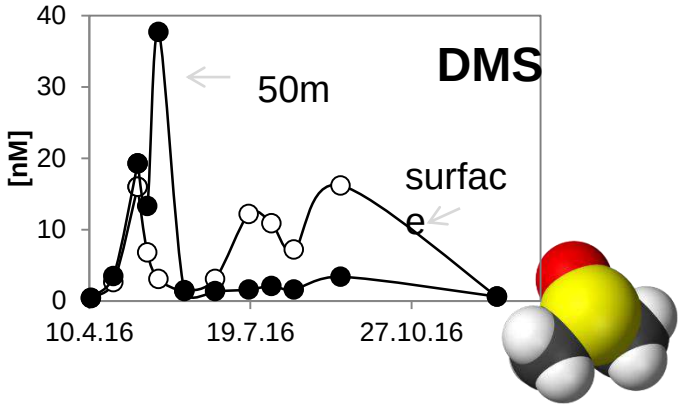
Madie Steer (MRes) undertook study with Pennie Lindeque (PML) and Richard Thompson (UoP)

Supporting NERC Research Projects

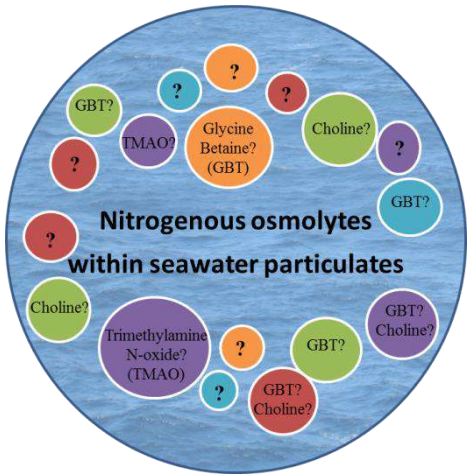
WCO: a hub for cutting edge NERC Discovery Science

Bioavailabilty and biological effects of microplastics debris in the ocean: *Lindeque et al., 2014-2017*

Microbial degradation of dimethylsulfoxide (DMSO): *Dixon et al., 2014-2017*



Biogeochemical cycling of *N-osmolytes* in the surface ocean: *Airs et al., 2014-2017*



A multidisciplinary study of DMSP production and lysis – from enzymes to organisms to process modelling: *Airs et al., 2017-2020*

Development and application of eDNA tools to assess the structure and function of coastal sea ecosystems: *Wilson et al., 2016-2018*

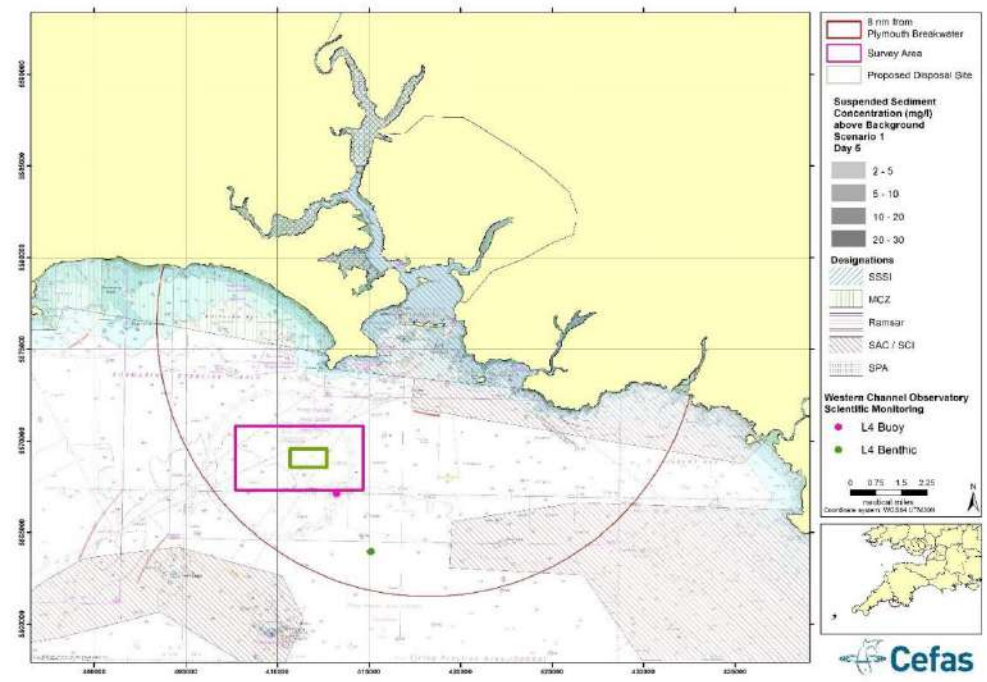
University of Exeter undergraduate field course

Undergraduate education:

- 24 UG students from University of Exeter (Penryn campus)
- Marine Ecology module
- Field sampling on Plymouth Quest using a variety of benthic sampling gear
- Beam trawling at a variety of inshore and offshore sites

Additional Points of Interest

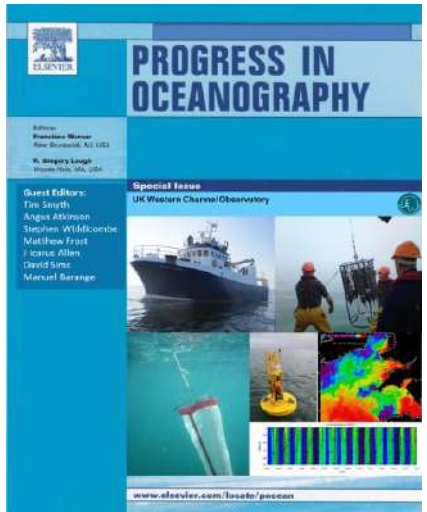
New site for disposal of dredged material



- Government decided that a new disposal site was needed for material dredged from the River Tamar as part of port operations.
- Cefas conducted an assessment of possible new locations and reported to MMO (report published 22nd Nov 2016).
- PML were not happy with original proposed new site, so representation was submitted 7th January 2017.

- As a result there is now a better quantification of what “L4” and the “WCO” are.
- Also better impact indicator quantification, for both benthic & pelagic.
- An alternative disposal site has been identified.
- Pre-disposal samples have been collected and PML will be monitoring for any impacts of dredge disposal on the WCO time series.

2018 – the WCO enters it's 30s



Thank you

www.westernchannelobservatory.org.uk/