**L4 metadata for WCO monthly time-series 1988-2022 v 2023.03.01**

|  |  |  |
| --- | --- | --- |
| **Data type**  **Column headings** | **Sampling and Analysis method** | **Data coverage**  **Availability of full data** |
| **L4: Water temperature**  L4\_Temp\_0m\_degC  L4\_Temp\_10m\_degC  L4\_Temp\_25m\_degC  L4\_Temp\_50m\_degC  Columns 3-6 | Taken weekly where conditions allow.  March 1988 to April 1993 surface temperature (0m) measured using a mercury thermometer in a stainless-steel bucket of freshly collected seawater.  May 1993 to Dec 2001 a PML CTD was also used concurrently with the bucket method.  Jan 2002 this PML CTD was replaced by a SeaBird SBE19+ CTD.  Bucket temperatures were adjusted to CTD equivalents using a regression equation for parallel determinations. For surface values, we obtained a value for each sampling week based on this adjusted bucket temperature if only this was available. If both bucket and CTD data were available, we used the CTD temperature. We then derived arithmetic mean temperatures for each month. | March 1988 to Dec 2021 monthly data derived from 1491 sampling points.  May 1993 onwards CTD was used providing 1142, 1140 and 977 weekly timepoints for 10m, 25m and 50m respectively.  <https://www.westernchannelobservatory.org.uk/data.php> |
| **L4: Nutrients**  L4\_Nitrite\_0m\_µM  L4\_Nitrite\_10m\_µM  L4\_Nitrite\_25m\_µM  L4\_Nitrite\_50m\_µM  L4\_Nitrite+Nitrate\_0m\_µM  L4\_Nitrite+Nitrate\_10m\_µM  L4\_Nitrite+Nitrate\_25m\_µM  L4\_Nitrite+Nitrate\_50m\_µM  L4\_Ammonia\_0m\_µM  L4\_Ammonia\_10m\_µM  L4\_Ammonia\_25m\_µM  L4\_Ammonia\_50m\_µM  L4\_Silicate\_0m\_µM  L4\_Silicate\_10m\_µM  L4\_Silicate\_25m\_µM  L4\_Silicate\_50m\_µM  L4\_Phosphate\_0m\_µM  L4\_Phosphate\_10m\_µM  L4\_Phosphate\_25m\_µM  L4\_Phosphate\_50m\_µM  Columns 7-26 | Taken weekly where conditions allow.  Samples returned in the cool and dark to the laboratory in Plymouth as soon as possible.  Triplicate samples are analysed using 0.2µm Millipore Fluoropore filtered and non-filtered water.  Analyser is a 5-channel Bran+Luebbe segmented flow system.  Methodology standardised according to PML protocols.  Since 2007 samples analysed as soon as possible after collection. Prior to this samples were frozen and analysed in batches.  Due to storage method concentrations of ammonia should be treated with care. More appropriate to consider trends rather than accurate concentrations.  Quality control procedures carried out using KANSO certified reference material.  Scientists participate in QUASIMEME programme.  This summary data set provides a mean value of all available determinations within any given calendar month.  In the original data set the symbol “<” refers to concentrations below detection limit. These have been assigned a value of zero before averaging | Surface (0m) Jan 2000 to Dec 2021  Profile (10m 25m 50m) Jan 2012 to Dec 2021  Full data lists individual replicate measurements from the weekly resolution sampling.  Publicly-accessible nutrient data accessed on 14 Jul 2022 from  <https://www.westernchannelobservatory.org.uk/data.php> |
| **L4: Carbonate chemistry DIC (dissolved inorganic carbon) and TA (total alkalinity)**  L4\_DIC\_0m\_µmol/kg  L4\_DIC\_10m\_µmol/kg  L4\_DIC\_25m\_µmol/kg  L4\_DIC\_50m\_µmol/kg  L4\_TA\_0m\_µmol/kg  L4\_TA\_10m\_µmol/kg  L4\_TA\_25m\_µmol/kg  L4\_TA\_50m\_µmol/kg  Columns 27-34 | Taken weekly where conditions allow.  Borosilicate glass bottles with ground glass stoppers were used to collect seawater from the Niskin bottles. Sample bottles were rinsed, filled and poisoned with mercuric chloride according to standard procedures detailed in Dickson et al. (2007).  Samples were returned to PML for analysis.  DIC was measured using a Dissolved Inorganic Carbon Analyser (Apollo SciTech, Model AS-C3). The analyser adds a strong acid (10% H3PO4 plus 10% NaCl solution) causing carbon species within the seawater to be converted to CO2 gas, which is purged from the sample by pure nitrogen (N2) carrier gas, is dried and cooled to reduce water vapour. The concentration of the dried CO2 gas is measured with a LICOR LI-7000 CO2 analyser. The total amount of CO2 is quantified as the integrated area under the concentration-time curve, and converted to DIC using a standard curve created by analysing known concentrations of the Certified Reference Materials (Dickson CO2 CRMs). A measurement volume of 0.75 mL was used, with up to 5 measurements made from each sample. Values outside a 0.1 % range were excluded from the final result.  Duplicate measurements provided an estimate of measurement error < 0.1 %. DIC was corrected for the addition of mercuric chloride.  TA was measured using the open-cell potentiometric titration method (Dickson et al. 2007) on 12 mL sample volumes using an automated titrator (Apollo SciTech Alkalinity Titrator Model AS-ALK2). Calibration was made using Certified Reference Materials (Dickson CO2 CRMs). Duplicate measurements were made for each sample, and the estimate of measurement error < 0.5 %. TA was corrected for the addition of mercuric chloride. | Surface, 0m and 50m Oct 2008 to Dec 2020  10m and 25m Sep 2017 to Dec 2020  Data are available from British Oceanographic Data Centre (BODC) and are citable via  doi:10.5285/1ec0cae5-071d-16e1-e053-6c86abc07d47/  <https://www.westernchannelobservatory.org.uk/C_chem.php> |
| **L4: Methane (CH4) and Nitrous Oxide (N2O) concentrations**  L4\_Ch4\_0m nmol/l  L4\_Ch4\_10m nmol/l  L4\_Ch4\_25m nmol/l  L4\_Ch4\_50m nmol/l  L4\_N2O\_0m nmol/l  L4\_N2O\_10m nmol/l  L4\_N2O\_25m nmol/l  L4\_N2O\_50m nmol/l  Columns 35-42 | Borosilicate glass bottles with ground glass stoppers were used to collect seawater from the Niskin bottles for the methane and nitrous oxide, both gasses were determined from the same bottle.  Prior to all depths being collected in 2019 samples were collected in triplicate. Sample bottles were rinsed, filled and poisoned with mercuric chloride according to standard procedures detailed in Dickson et al. (2007). Samples were returned to PML for analysis.  All samples were analysed within 3 months of collection  Samples were placed into a water bath at 25°C and temperature equilibrated for a minimum of one hour before analysis.  Samples were analysed by single-phase equilibration gas chromatography using a Flame Ionisation Detector for CH4, and electron capture detector for N2O and similar to that described by (Upstill-Goddard 1996). Samples were calibrated against three certified (±5%) reference standards (Air Products Ltd) which are traceable to NOAA WMO-N2O-X2006A. Concentrations in seawater at equilibration temperature (~25°C) and salinity were calculated from solubility tables of Weiss and Price(1980). | Surface N2O coverage is from 2011 and CH4 from 2013  All 4 depths were sampled from 2019.  https://www.westernchannelobservatory.org.uk/data.php |
| **L4: Water 16S alpha diversity**  L4\_water\_prokaryote\_diversity\_S\_0m\_16s SEQ  L4\_water\_prokaryote\_diversity\_Pielou\_0m\_16s SEQ  L4\_water\_prokaryote\_diversity\_Shannon\_0m\_16s SEQ  Columns 43-45 | Taken weekly where conditions allow.  On each sampling date, 5L of seawater was collected from the surface and filtered immediately (on board) through a 0.22mm Sterivex cartridge (Millipore).  This was then stored at -80°C at PML before further processing.  Nucleic acids were extracted using the Qiagen AllPrep DNA/RNA Mini Kit. The sterivex barrel was first filled with RLT lysis buffer and heated to 65°C for 30 mins. DNA and RNA was then extracted from the lysate following the manufacturer’s instructions. DNA samples were used for microbiome analyses by sequencing of 16S rRNA genes using the Earthmicrobiome V4 PCR primers 515F (GTGYCAGCMGCCGCGGTAA) and 806R (GGACTACNVGGGTWTCTAAT). Sequencing was performed on the MiSeq Personal Sequencer (Illumina, San Diego, CA, USA) using the V2 500 reagent kit by commercial contract (NU\_OMICS, UK). Demultiplexed paired end FASTQ files were analysed using QIIME2 and amplicon sequence variants (ASVs) generated using DADA2. For each sample, the number of ASVs (S), Pielou evenness and Shannon diversity were calculated. | Feb 2012 to Nov 2019.  Data are available from PML Karen Tait.  <https://www.westernchannelobservatory.org.uk/data.php> |
| **L4: Fluorometer-derived Chlorophyll *a* concentrations**  L4\_Chl\_0m\_Fluorom\_mgChl m-3  L4\_Chl\_10m\_Fluorom\_mgChl m-3  L4\_Chl\_25m\_Fluorom\_mgChl m-3  L4\_Chl\_50m\_Fluorom\_mgChl m-3  Columns 46-49 | Taken weekly where conditions allow  Triplicate 100 ml water samples filtered onto 25 mm GFF filters.  Extracted overnight at 4 degC and analysed on a Turner Fluorometer according to Welshmeyer 1994. | Surface (0m) and 10m Feb 1992 to 2020 with 1110 and 568 weekly resolution samples respectively.    All depths sampled from 2018    Publicly-accessible nutrient data accessed from  <https://www.westernchannelobservatory.org.uk/data.php> |
| **L4: Pigment sums generated from primary pigment data, determined by HPLC**  L4\_[TChl a]\_0m\_HPLC\_mgm-3  L4\_[TChl]\_0m\_HPLC\_mgm-3  L4\_[PPC]\_0m\_HPLC\_mgm-3  L4\_[PSC]\_0m\_HPLC\_mgm-3  L4\_[PSP]\_0m\_HPLC\_mgm-3  L4\_[TAcc]\_0m\_HPLC\_mgm-3  L4\_[TPig]\_0m\_HPLC\_mgm-3  L4\_[TChl a]\_10m\_HPLC\_mgm-3  L4\_[TChl]\_10m\_HPLC\_mgm-3  L4\_[PPC]\_10m\_HPLC\_mgm-3  L4\_[PSC]\_10m\_HPLC\_mgm-3  L4\_[PSP]\_10m\_HPLC\_mgm-3  L4\_[TAcc]\_10m\_HPLC\_mgm-3  L4\_[TPig]\_10m\_HPLC\_mgm-3  L4\_[TChl a]\_25m\_HPLC\_mgm-3  L4\_[TChl]\_25m\_HPLC\_mgm-3  L4\_[PPC]\_25m\_HPLC\_mgm-3  L4\_[PSC]\_25m\_HPLC\_mgm-3  L4\_[PSP]\_25m\_HPLC\_mgm-3  L4\_[TAcc]\_25m\_HPLC\_mgm-3  L4\_[TPig]\_25m\_HPLC\_mgm-3  L4\_[TChl a]\_50m\_HPLC\_mgm-3  L4\_[TChl]\_50m\_HPLC\_mgm-3  L4\_[PPC]\_50m\_HPLC\_mgm-3  L4\_[PSC]\_50m\_HPLC\_mgm-3  L4\_[PSP]\_50m\_HPLC\_mgm-3  L4\_[TAcc]\_50m\_HPLC\_mgm-3  L4\_[TPig]\_50m\_HPLC\_mgm-3  Columns 50-77 | Taken weekly where conditions allow  Parameter Names (if shortened versions used in column titles):  [TChl a] = Total chlorophyll a = [Chlide a] + [DVChl a] + [Chl a];  [TChl] = Total chlorophyll = [TChl a] + [TChl b] + [TChl c];  [PPC] = Photoprotective carotenoids = [Allo]+[Diad]+[Diato]+[Zea]+[Caro];  [PSC] = Photosynthetic carotenoids = [But]+[Fuco]+[Hex fuco]+Perid];  [PSP] = Photosynthetic pigments = [PSC]+[TChl];  [TAcc] = Total accessory pigments = [PPC]+[PSC]+[TChl b]+[TChl c];  [TPig] = Total pigments = [TAcc]+[TChl a].  Total chlorophyll a = chlorophyllide a + divinyl chlorophyll a + chlorophyll a. May be underestimated if chlorophyllide a is not quantified.  Total chlorophyll b = chlorophyll b + divinyl chlorophyll b. Divinyl chlorophyll b coelutes with chlorophyll b under HPLC conditions used to generate these data, so were not quantified separately. Divinyl chlorophyll b is not expected to be present in UK waters.  Total chlorophyll c = chlorophyll c1 + chlorophyll c2 + chlorophyll c3  Carotenes = βε-Carotene + ββ-Carotene  Alloxanthin: quantified by both HPLC methods used to generate L4 pigment data  19'-butanoyloxyfucoxanthin: quantified by both HPLC methods used to generate L4 pigment data  Diadinoxanthin: quantified by both HPLC methods used to generate L4 pigment data  Diatoxanthin: quantified by both HPLC methods used to generate L4 pigment data  Fucoxanthin: quantified by both HPLC methods used to generate L4 pigment data  19'-hexanoloxyfucoxanthin: quantified by both HPLC methods used to generate L4 pigment data. May include prasinoxanthin (when present) for data generated using Barlow HPLC method (1999-2011)  Peridinin: quantified by both HPLC methods used to generate L4 pigment data  Zeaxanthin: quantified by both HPLC methods used to generate L4 pigment data  Chlorophyll a: includes allomers and epimers: quantified by both HPLC methods used to generate L4 pigment data  Divinyl chlorophyll a: quantified by both HPLC methods used to generate L4 pigment data  Chlorophyllide a: quantified in 2002; 2004-5 and May 2011 onwards  Chlorophyll b and divinyl chlorophyll b: Divinyl chlorophyll b coelutes with chlorophyll b under HPLC conditions used to generate these data, so were not quantified separately. Dinvinyl chlorophyll b is not expected to be present in UK waters.  Chlorophyll c1: Quantified separately from chlorophyll c2 from May 2011 onwards.  Chlorophyll c2: Includes chlorophyll c1 for data from 1999-April 2011  Chlorophyll c3: quantified by both HPLC methods used to generate L4 pigment data  βε-carotene (alpha-carotene): quantified separately from ββ-carotene from May 2011 onwards.  ββ-carotene (beta-carotene): includes βε-carotene for data from 1999-April 2011.  Barlow HPLC Method reference: Barlow RG et al. (1997)  Column: MOS-2 Hypersil; 100x4.6mm; 3um particle size  Flow rate: 1mL/min  Mobile phase: Barlow et al. 1997  Extraction solvent and volume: 90% acetone; 2mL  Internal standard used?: Yes, Trans-B-Apo-8'-carotenal used until 2008.  Disruption method and time: Sonication (probe), 35s  Soak time: 1 hr  Clarification procedure: Centrifugation  Injection procedure and volume: Autosampler mixes sample with ammonium acetate (1 M) in 50/50 ratio by volume. Injects 50 uL  Calibration Procedure: Single point  Source of standards: DHI, Denmark  Absorption coefficients used: Those provided with standards by DHI  Expected capability of method: Not recorded  Quality assurance protocols: Up to 20 samples were analysed per day, so maximum time of samples in autosampler is 24 h. Autosampler is maintained at 4oC.  Zapata HPLC Method reference: Zapata M et al. (2000)  Column: Waters C8 Symmetry; 150x2.1 mm; 3.5um particle size  Flow rate: 200uL/min  Mobile phase: As described by Zapata et al. 2000  Extraction solvent and volume: 90% acetone; 2mL  Internal standard used?No  Disruption method and time: Sonication (probe), 35s  Soak time: 1 hr  Clarification procedure: Centrifugation and filtration (0.45 um Teflon syringe filter)  Injection procedure and volume: Autosampler mixes 200 uL sample and 80 uL water in a vial. 25 uL of this mixture is injected (actual injection volume of sample = 17.86 uL  Calibration Procedure:Multipoint; three solutions bracketing the LOQ, and three bracketing the expected sample concentration  Source of standards: DHI, Denmark  Absorption coefficients used: Those provided with standards by DHI  Expected capability of method: Average precision and accuracy for chl a (standards) was 1.44 and 2.01%, respectively  Quality assurance protocols: First run of the day was discarded. A sample of mixed pigments was run prior to any samples to check retention times and resolution of critical pairs.  Three samples of chlorophyll standard were analysed with each sample set to check response factor is within 5% of calibration value.  Up to 20 samples are analysed per day, so maximum time of samples in autosampler is 24 h. Autosampler was maintained at 4oC.  Pipette accuracy determined daily by weighing. | Surface coverage is from March 1999 to Dec 2014  10, 25 and 50 m from 2009 onwards (some gaps in data) until 2014  Source data accessed via  <https://www.westernchannelobservatory.org.uk/data.php> |
| **L4: Plankton abundance profiles measured by flow cytometry**  L4\_Syn\_0m\_FCM\_cells mL-1  L4\_Picoeuk\_0m\_FCM\_cells mL-1  L4\_Nanoeuk\_0m\_FCM\_cells mL-1  L4\_Cocco\_0m\_FCM\_cells mL-1  L4\_Crypto\_0m\_FCM\_cells mL-1  L4\_HNan\_0m\_FCM\_cells mL-1  L4\_HNAbacteria\_0m\_FCM\_cells mL-1  L4\_LNAbacteria\_0m\_FCM\_cells mL-1  L4\_Syn\_10m\_FCM\_cells mL-1  L4\_Picoeuk\_10m\_FCM\_cells mL-1  L4\_Nanoeuk\_10m\_FCM\_cells mL-1  L4\_Cocco\_10m\_FCM\_cells mL-1  L4\_Crypto\_10m\_FCM\_cells mL-1  L4\_HNan\_10m\_FCM\_cells mL-1  L4\_HNAbacteria\_10m\_FCM\_cells mL-1  L4\_LNAbacteria\_10m\_FCM\_cells mL-1  L4\_Syn\_25m\_FCM\_cells mL-1  L4\_Picoeuk\_25m\_FCM\_cells mL-1  L4\_Nanoeuk\_25m\_FCM\_cells mL-1  L4\_Cocco\_25m\_FCM\_cells mL-1  L4\_Crypto\_25m\_FCM\_cells mL-1  L4\_HNan\_25m\_FCM\_cells mL-1  L4\_HNAbacteria\_25m\_FCM\_cells mL-1  L4\_LNAbacteria\_25m\_FCM\_cells mL-1  L4\_Syn\_50m\_FCM\_cells mL-1  L4\_Picoeuk\_50m\_FCM\_cells mL-1  L4\_Nanoeuk\_50m\_FCM\_cells mL-1  L4\_Cocco\_50m\_FCM\_cells mL-1  L4\_Crypto\_50m\_FCM\_cells mL-1  L4\_HNan\_50m\_FCM\_cells mL-1  L4\_HNAbacteria\_50m\_FCM\_cells mL-1  L4\_LNAbacteria\_50m\_FCM\_cells mL-1  Columns 78-109 | Taken weekly where conditions allow  Analysed in triplicate (phytoplankton and bacteria) or duplicate (heterotrophic nanoflagellates).  Vertical profiles of the mean abundance of groups of microbial plankton as cells per millilitre, measured using flow cytometry (BD Accuri C6 flow cytometer)  The groups quantified are divided into phytoplankton and heterotrophs.  Phytoplankton groups quantified are:  **Syn** Synechococcus sp. (cyanobacteria)  **Picoeuk** Picoeukaryotes (smaller than 3 μm)  **Crypto** Cryptophytes  **Cocco** Coccolithophores  **Nanoeuk** Nanoeukaryotes not already mentioned (2-20 μm).  Heterotrophs quantified are:  **HNan** heterotrophic nanoflagellates  **HNAbacteria** heterotrophic bacteria with relatively high nucleic acid content  **LNAbacteria** heterotrophic bacteria with relatively low nucleic acid content. | April 2007 to Dec 2021    Source data accessed via  <https://www.westernchannelobservatory.org.uk/data.php> |
| **L4: Microscopy analysis of lugols and formalin preserved protists**  L4\_Diatoms\_10m\_microscopy\_cells ml-1  L4\_Dinoflagellates\_10m\_microscopy\_cells ml-1  L4\_Coccolithophores\_10m\_microscopy\_cells ml-1  L4\_Flagellates\_10m\_microscopy\_cells ml-1  L4\_Phaeocystis\_10m\_microscopy\_cells ml-1  L4\_Ciliates\_10m\_microscopy\_cells ml-1  L4\_Diatoms\_10m\_microscopy\_mgC m-3  L4\_Dinoflagellates\_10m\_microscopy\_mgC m-3  L4\_Coccolithophorid\_10m\_microscopy\_mgC m-3  L4\_Flagellates\_10m\_microscopy\_mgC m-3  L4\_Phaeocystis\_10m\_microscopy\_mgC m-3  L4\_Ciliates\_10m\_microscopy\_mgC m-3  Columns 110-121 | Taken weekly where conditions allow  Paired 200mL water samples collected from 10m depth using Niskin bottle attached to the CTD are immediately fixed in 1) acid Lugol’s iodine (for all taxa except coccolithophores) and 2) neutral formaldehyde for coccolithophores.  Sub samples are analysed by light microscopy using the settlement technique (Utermohl, 1958) and identified to species level where possible. Organised into six functional groups.  Mean cell dimensions of each taxa are used to calculate species-specific biovolumes which are converted to carbon biomass using the equations of (Menden-Deuer & Lessard, 2000)  Abundance data are presented as cells per mL and biomass as mgC per m3.  **Note: In 2005 sample collection was via a deck hose. This caused damage to the fragile ciliates hence the count is much lower for that year.** | Single depth (10m) October 1992 – December 2020, except for gaps in sampling between October 1994 – May 1995 and December 2011  Data are available from British Oceanographic Data Centre (BODC) and are citable via  <https://www.bodc.ac.uk/data/published_data_library/catalogue/10.5285/c9386b5c-b459-782f-e053-6c86abc0d129/>  <https://www.westernchannelobservatory.org.uk/data.php> |
| **L4: FlowCam analysis of 63µm mesh plankton net hauls (50-0m)**  L4\_Total Diatoms\_FlowCam\_mgCm-3  L4\_Total Dinoflagellates\_FlowCam\_mgCm-3  L4\_Ciliates\_FlowCam\_mgCm-3  L4\_Colony flagellates\_FlowCam\_mgCm-3  L4\_Large Protists\_FlowCam\_mgCm-3  L4\_Total Copepod nauplii\_FlowCam\_mgCm-3  Columns 122-127 | Taken weekly where conditions allow  Water samples collected from a 0-50m vertical haul using a 63µm mesh WP2 style net (UNESCO, 1968, p. 153–157). Mesh change in July 2019 from 63µm to 50µm.  Prior to analysis samples are pre-screened using a 300µm mesh. However, net samples collected between June 2015 and May 2016 were pre-screened using a 200µm mesh.  Sample analysed live whenever possible using a FlowCam VS IV model fitted with a 300µm flowcell.  Analysis carried out using x4 magnification using auto-image mode.  Classification of acquired images carried out using Visualspreadsheet (2012-2016) and Ecotaxa (2017-2019). Taxa were then assigned to six broad functional groups.  Mean cell dimensions of each taxa were used to calculate species-specific biovolumes which were converted to carbon biomass using suitable C conversion equations. Biomass is presented as mgC per m3.  For Diatoms, Dinoflagellates (excluding Noctiluca, & Neoceratium spp) and Ciliates, morphological information and shape assignment was used to calculate biovolume (Alvarez et al 2012 Table 1.).  For Noctiluca and Neoceratium spp., mean cell volumes were taken from Widdicombe et al (2010). For all other Dinoflagellates, Diatoms and Ciliates, cell biovolumes were converted to carbon biomass using the equations of Menden- Deuer and Lessard (2000).  For large protists mostly Radiolaria, the C conversion in Michaels et al (1995) was used.  Colonial flagellates were converted to C according to Børsheim & Bratbak, (1987).  Biomass of Copepod nauplii was calculated using the equations of Uye et al (1996). | Sept 2012 to Dec 2013 are from 43 time points  June 2015 to Dec 2019 are from 163 time points    Abundance data are also available for meroplankton taxa, these have not been converted to biomass to date.  Source data accessed via  <https://www.westernchannelobservatory.org.uk/data.php> |
| **L4: *Noctiluca scintillans* microscopy analysis of WP2 net hauls (50-0m)**  L4\_*Noctiluca scintillans*\_WP2net\_no.m-3  L4\_*Noctiluca scintillans*\_WP2net\_mcgC.m-3  Columns 128-129 | Taken weekly where conditions allow.  Two vertical hauls (50-0m) are taken using 200 micron WP2 nets (UNESCO, 1968, p. 153–157)  Both replicates samples are analysed by subsampling, enumerated and identified, currently using a Olympus SZX16 stereo microscope fitted with a SZX2-ILLT LED transmitted light illuminator stand.  Source data represents weekly average abundance across the two replicates and converted to numbers in a m3.  Monthly abundance represent an arithmetic mean value from between 1 and 5 visits in any given month and on a weekly basis.  Biomass calculations derived from abundance data using a conversion factor of 0.020375mcgC per cell using the equations of (Menden-Deuer & Lessard, 2000).  Be aware that zeros are present from 2009 onwards where there is confidence in the data. A zero represents looked for but not present in the sample analysed. Data prior to this is less certain so zeros have been omitted. | July 1997-2021.  Source data available via  McEvoy A.; Atkinson A.; Beesley A.(2022). Zooplankton abundance time series from net hauls at site L4 off Plymouth, UK between 1988-2021.  <https://www.bodc.ac.uk/data/published_data_library/catalogue/10.5285/e785f2f7-05d5-2f47-e053-6c86abc08bee/>  <https://www.westernchannelobservatory.org.uk/data.php> |
| **L4: Zooplankton microscopy analysis of WP2 net hauls (50-0m)**  L4\_meroplankton\_WP2net\_no.m-3  L4\_small\_copepods\_WP2net\_no.m-3  L4\_large\_copepods\_WP2net\_no.m-3  L4\_fish\_larvae\_WP2net\_no.m-3  L4\_gelatinous\_predators\_WP2net\_no.m-3  L4\_semi-gelatinous\_predators\_WP2net\_no.m-3  L4\_other\_crustacean\_holoplankton\_WP2net\_no.m-3  L4\_other\_non-crustacean\_holoplankton\_WP2net\_ no.m-3  L4\_meroplankton\_WP2net\_mgCm-3  L4\_small\_copepods\_WP2net\_mgCm-3  L4\_large\_copepods\_WP2net\_mgCm-3  L4\_fish\_larvae\_WP2net\_mgCm-3  L4\_gelatinous\_predators\_WP2net\_mgCm-3  L4\_semi-gelatinous\_predators\_WP2net\_mgCm-3  L4\_other\_crustacean\_holoplankton\_WP2net\_mgCm-3  L4\_other\_non\_crustacean\_holoplankton\_WP2net\_mgCm-3  Columns 130-145 | Taken weekly where conditions allow.  Two vertical hauls (50-0m) are taken using 200-micron WP2 nets (UNESCO, 1968, p.153-157))  Both replicates' samples are analysed by subsampling, enumerated and identified currently using an Olympus SZX16 stereo microscope fitted with a SZX2-ILLT LED transmitted light illuminator stand. More details are provided in Atkinson et al (2015).  Source data comprises average abundance of the taxa that have been consistently identified since 1988. These source data are weekly averages across the two replicates, converted to numbers per m3 and biomass estimated.  Data presented here have been aggregated into functional groups broadly based on the lifeforms for policy reporting in Ostle et al (2021). There has, however, been a few further subdivisions to better reflect trophic mode. These functional group allocations are coded, and numbers-to-biomass conversion factors are provided within the “trait” header bar data from the source dataset.  Therefore there are 8 functional groups based partly on size, taxonomy and trophic mode, and with separate columns for abundance and estimated biomass. Because biomass is a derived property, often with different conversion factors between the four seasons (see data source doi), it is best to use numerical abundance data for population dynamics studies and biomass data for models, carbon budgets etc.  As previously stated the groups comprise the whole of the consistently identified zooplankton so adding them will give a good estimate of total metazoan zooplankton with the exception of Ctenophores (see below).  **MEROPLANKTON**: All 14 taxa with code no. 38. They are numerically dominated by Cirripedia larvae. The biomass is strongly dominated by the larvae of Cirripedia, Decapoda and Polychaeta plus Gammaridea amphipods. Fish and Cnidarians are excluded, some of whom are meroplanktonic, but which are all pooled within the fish larvae and gelatinous predator lifeforms instead.  **SMALL COPEPODS**: Excluding nauplii, code no. 36 with the addition of the uncoded harpacticoid copepods. They are species with total adult body length under 2mm. They comprise 20 taxa dominated numerically by the genera *Oithona, Oncaea, Paracalanus* and *Pseudocalanus* and in biomass by *Pseudocalanus, Temora* and *Paracalanus.*  **LARGE COPEPODS**: They comprise 8 taxa with code no. 36 and are species with total body length 2mm or over. Their numbers and biomass are strongly dominated by *Calanus helgolandicus*.  **FISH LARVAE**: Note the lifeforms group for plankton reporting in Ostle et al. (2021) includes eggs and larvae pooled, but here the fish eggs have been omitted to better describe the abundance of actively carnivorous groups.  **GELATINOUS PREDATORS**: Cnidarians only, dominated in terms of numbers and biomass by Siphonophores. A notable taxon not included is Ctenophores, due to potential inconsistency in counting in early years and due to preservation issues, which we are in the process of resolving.  **SEMI-GELATINOUS PREDATORS**: Chaetognaths and *Tomopteris* spp., with numbers and biomass strongly dominated by the former.  **OTHER CRUSTACEAN HOLOPLANKTON**: These are the remaining groups of crustacean holoplankton not covered above, namely *Evadne* spp. *Podon* spp., Hyperiidae amphipods, mysids, and the various nauplii to adult stages of Euphausiids. They are strongly dominated numerically and in terms of biomass by the Cladocerans (miscoded as non-crustaceans in the source file).  **OTHER NON-CRUSTACEAN HOLOPLANKTON**: These are the remaining groups of crustacean holoplankton not covered above, namely Appendicularians, *Limacina* spp., Doliolids and *Clione* spp. They are strongly dominated numerically and in terms of biomass by Appendicularians. | March 1988 to Dec 2020. Derived from 1452 sampling timepoints with a weekly resolution.  Monthly mean data are available for each intervening month except August 2000 and typically represent an arithmetic mean value across between 1 and 5 weekly visits in any given month.  McEvoy, A., Beesley, A., & Atkinson, A. (2022). Subset of zooplankton abundance and biomass time series from net hauls at site L4 off Plymouth, UK between 1988-2020. (Version 1) [Data set]. NERC EDS British Oceanographic Data Centre NOC. <https://doi.org/10.5285/D7FB6CE3-7BC9-307B-E053-6C86ABC0671B>  <https://www.westernchannelobservatory.org.uk/l4_zooplankton.php> |
| **L4: Calanus helgolandicus weekly egg production using females from the Western English Channel site L4**  L4\_Calanus eggs\_watercolumn\_expt\_eggs per female per day  Column 146 | Taken weekly where conditions allow  A live sample is collected and returned in the cool and dark to the laboratory in Plymouth as soon as possible. Sample is gently poured through a 200-micron mesh sieve  *Calanus sp* females in healthy condition are picked out gently using stork-billed forceps under a microscope as quickly as possible.  Five replicates each containing 5 female *Calanus* spare incubated in the dark in filtered seawater for 24 hours. Each beaker contains an egg collector. Temperature follows ambient conditions at L4 surface. The eggs produced are collected and counted. Females are identified for species. Eggs retained for hatching success. | Feb 1992 to Nov 2021 where availability of *Calanus* females allow.  Data represents Mean No eggs per female per day.  McEvoy A.; Beesley A.; Atkinson A.(2022). Calanus helgolandicus weekly egg production time series between 1992-2021, using females from the Western English Channel site L4.  <https://www.westernchannelobservatory.org.uk/calanus_egg_production.php> |
| **L4: Sediment 16S alpha diversity**  L4\_sediment\_prokayote\_diversity\_S\_0m\_16S SEQ  L4\_sediment\_prokayote\_diversity\_Pielou\_0m\_16s SEQ  L4\_sediment\_prokayote\_diversity\_Shannon\_0m\_16s SEQ  Columns 147-149 | Sediments are collected using a box corer and the uppermost 0 - 1cm carefully sampled by scraping into a sterile 2mL tube.  Eight replicate samples are taken for each sampling time, and four of these are used for DNA extraction using 0.5g sediment and Qiagen’s DNeasy PowerSoil Kit according to the manufacturer’s instructions. 16S rRNA genes were sequenced using the Earthmicrobiome V4 PCR primers 515F (GTGYCAGCMGCCGCGGTAA) and 806R (GGACTACNVGGGTWTCTAAT). Sequencing was performed on the MiSeq Personal Sequencer (Illumina, San Diego, CA, USA) using the V2 500 reagent kit by commercial contract (NU\_OMICS, UK). Demultiplexed paired end FASTQ files were analysed using QIIME2 and amplicon sequence variants (ASVs) generated using DADA2. For each sampling occasion, the mean number of ASVs for the four replicates is calculated (S), along with Pielou evenness and Shannon diversity. | Feb 2012 to 2019.  In 2012 and from 2014 to 2019, the aim was to sample monthly when possible.  In 2013 samples were collected in February and September only.  Data are available from PML Karen Tait.  <https://www.westernchannelobservatory.org.uk/data.php> |
| **L4: Benthic fauna from box cores**  L4\_Macrofaunal Deposit Feeders\_50m\_0.1m3 Box Core\_Average abundance of individual taxa per month  L4\_Macrofaunal Suspension Feeders\_50m\_0.1m3 Box Core\_Average abundance of individual taxa per month  L4\_Macrofaunal Predators\_50m\_0.1m3 Box Core\_Average abundance of individual taxa per month  L4\_Macrofaunal Scavengers\_50m\_0.1m3 Box Core\_Average abundance of individual taxa per month  L4\_Macrofaunal Deposit Feeders\_50m\_0.1m3 Box Core\_Average biomass of individual taxa per month  L4\_Macrofaunal Suspension Feeders\_50m\_0.1m3 Box Core\_Average biomass of individual taxa per month  L4\_Macrofaunal Predators\_50m\_0.1m3 Box Core\_Average biomass of individual taxa per month  L4\_Macrofaunal Scavengers\_50m\_0.1m3 Box Core\_Average biomass of individual taxa per month    Columns 150-157 | Taken monthly where conditions allow.  4 or 5 replicate 0.1m3 box cores of sediment collected from 50m depth.  All sediment collected is sieved over a 0.5mm mesh and retained fauna preserved in 10% formaldehyde solution.  Source taxa are identified and counted using stereo and compound microscopy to species level or lowest possible taxonomic resolution.  Abundance and blotted wet weight (0.00000g) per taxa is recorded per 0.1m3 box core sample.  From 4 principle feeding traits, based on information primarily gathered from the BIOTIC database, 1 unique principle trait was assigned per taxa; calculated using algorithms based upon body composition, maximum length and body mass. (MarLIN 2006) | July 2008 to July 2019. Abundance and biomass data from 65 time points is presented as monthly averages per corresponding feeding trait; suspension feeders, deposit feeders, scavengers, carnivores.  Mesher T., McNeill C.L. (2022). Benthic Survey Macrofauna Abundance and Biomass Data, as part of the Western Channel Observatory, UK, between 2008 and 2019.  <https://www.bodc.ac.uk/data/published_data_library/catalogue/10.5285/d9f44202-b0d4-646c-e053-6c86abc018c6/>  <https://www.westernchannelobservatory.org.uk/data.php> |
| **L4: Cephalopoda and Demersal fish families by trawling**  L4\_Cephalopoda abundance\_50-60m\_Standard Haul\_individuals.trawl-1  L4\_Bothidae abundance\_50-60m\_Standard Haul\_individuals.trawl-1  L4\_Soleidae abundance\_50-60m\_Standard Haul\_individuals.trawl-1  L4\_Callionymidae abundance\_50-60m\_Standard Haul\_individuals.trawl-1  L4\_Caproidae abundance\_50-60m\_Standard Haul\_individuals.trawl-1  L4\_Cepolidae abundance\_50-60m\_Standard Haul\_individuals.trawl-1  L4\_Triglidae abundance\_50-60m\_Standard Haul\_individuals.trawl-1  L4\_Clupeidae abundance\_50-60m\_Standard Haul\_individuals.trawl-1  L4\_Engraulidae abundance\_50-60m\_Standard Haul\_individuals.trawl-1  L4\_Pleuronectidae abundance\_50-60m\_Standard Haul\_individuals.trawl-1  L4\_Gadidae abundance\_50-60m\_Standard Haul\_individuals.trawl-1  L4\_Merlucciidae abundance\_50-60m\_Standard Haul\_individuals.trawl-1  L4\_Mullidae abundance\_50-60m\_Standard Haul\_individuals.trawl-1  L4\_Carangidae abundance\_50-60m\_Standard Haul\_individuals.trawl-1  L4\_Zeidae abundance\_50-60m\_Standard Haul\_individuals.trawl-1  L4\_Gobiidae abundance\_50-60m\_Standard Haul\_individuals.trawl-1  L4\_Scombridae abundance\_50-60m\_Standard Haul\_individuals.trawl-1  L4\_Scyliorhinidae abundance\_50-60m\_Standard Haul\_individuals.trawl-1  L4\_Scophthalmidae abundance\_50-60m\_Standard Haul\_individuals.trawl-1  L4\_Cephalopoda biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Bothidae biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Soleidae biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Callionymidae biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Cepolidae biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Triglidae biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Clupeidae biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Engraulidae biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Pleuronectidae biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Gadidae biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Merlucciidae biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Mullidae biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Carangidae biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Zeidae biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Scombridae biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Scyliorhinidae biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Lophiidae biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Triakidae biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Scophthalmidae biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Rajidae biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Lotidae biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Moronidae biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Congridae biomass\_50-60m\_Standard Haul\_g.trawl-1  L4\_Squalidae biomass\_50-60m\_Standard Haul\_g.trawl-1  Columns 158-200 | Standard hauls were collected using a large otter trawl (2008-June 2014), a Channel Hunter box trawl (July 2014-March 2015) deployed from Plymouth Quest, then a modified Channel Hunter box trawl (April 2015-September 2018) deployed from MBA Sepia.  Trawl duration was approximately 40 minutes.  Only trawls from 50-60m are included.  Individuals were identified to species, measured (mm) and weighed (g) on-board.  Where a species was abundant a subsample was weighed and total biomass extrapolated.  Abundances and biomass are reported at the family level, and only families comprising at least 1% contribution in at least one month are included. | April 2008 to Sept 2018.  Between 1 and 7 trawls were collected per month sampled (total 282, average 2.88)  Source data for 2015-2018 via  https://portal.medin.org.uk/portal/start.php#details?tpc=010\_0370af22f970a98e2a5fcc79d5dd05b1 |

Álvarez, E., Lopez-Urrutia, A., & Nogueira, E. (2012). Improvement of plankton biovolume estimates derived from image-based automatic sampling devices: application to FlowCAM. *Journal of Plankton Research*, *34*(6), 454-469.

Atkinson, A., Harmer, R. A., Widdicombe, C. E., McEvoy, A. J., Smyth, T. J., Cummings, D. G., Somerfield, P. J., Maud, J. L., & McConville, K. (2015). Questioning the role of phenology shifts and trophic mismatching in a planktonic food web. Progress in Oceanography, 137, 498-512.

Barlow, R., Cummings, D., & Gibb, S. (1997). Improved resolution of mono-and divinyl chlorophylls a and b and zeaxanthin and lutein in phytoplankton extracts using reverse phase C-8 HPLC. Marine Ecology Progress Series, 161, 303-307.

Børsheim, K. Y., & Bratbak, G. (1987). Cell volume to cell carbon conversion factors for a bacterivorous Monas sp. enriched from seawater. Marine Ecology Progress Series, 171-175.

Dickson, A. G., Sabine, C. L., & Christian, J. R. (2007). Guide to best practices for ocean CO2 measurements. North Pacific Marine Science Organization.

MarLIN, 2006. BIOTIC - Biological Traits Information Catalogue. Marine Life Information Network. Plymouth: Marine Biological Association of the United Kingdom

Menden-Deuer, S., & Lessard, E. J. (2000). Carbon to volume relationships for dinoflagellates, diatoms, and other protist plankton. Limnology and Oceanography, 45(3), 569-579. <https://doi.org/DOI> 10.4319/lo.2000.45.3.0569

Michaels, A. F., Caron, D. A., Swanberg, N. R., Howse, F. A., & Michaels, C. M. (1995). Planktonic sarcodines (Acantharia, Radiolaria, Foraminifera) in surface waters near Bermuda: abundance, biomass and vertical flux. Journal of Plankton Research, 17(1), 131-163.

Ostle, C., Paxman, K., Graves, C. A., Arnold, M., Artigas, L. F., Atkinson, A., Aubert, A., Baptie, M., Bear, B., & Bedford, J. (2021). The Plankton Lifeform Extraction Tool: a digital tool to increase the discoverability and usability of plankton time-series data. Earth System Science Data, 13(12), 5617-5642.

UNESCO. (1968). Monographs on Oceanographic Methodology: Zooplankton Sampling. 153-157. https://unesdoc.unesco.org/ark:/48223/pf0000071517

Utermohl, H. (1958). Zur Ver vollkommung der quantitativen phytoplankton-methodik. Mitteilung Internationale Vereinigung Fuer Theoretische unde Amgewandte. Limnologie, 9, 39.

Upstill-Goddard, R. C., Rees, A. P., & Owens, N. J. P. (1996). Simultaneous high-precision measurements of methane and nitrous oxide in water and seawater by single phase equilibration gas chromatography. Deep Sea Research Part I: Oceanographic Research Papers, 43(10), 1669-1682.ye, S.-i., Nagano, N., & Tamaki, H. (1996). Geographical and seasonal variations in abundance, biomass and estimated production rates of microzooplankton in the Inland Sea of Japan. Journal of Oceanography, 52(6), 689-703.

Uye, S.-i., Nagano, N., & Tamaki, H. (1996). Geographical and seasonal variations in abundance, biomass and estimated production rates of microzooplankton in the Inland Sea of Japan. *Journal of Oceanography*, *52*(6), 689-703.

Welschmeyer, N. A. (1994). Fluorometric analysis of chlorophyll a in the presence of chlorophyll b and pheopigments. Limnology and Oceanography, 39(8), 1985-1992.

Weiss, R. F. and Price, B. A., 1980. Nitrous oxide solubility in water and seawater. Mar. Chem., 8: 347--359,

Widdicombe, C. E., Eloire, D., Harbour, D., Harris, R. P., & Somerfield, P. J. (2010). Long-term phytoplankton community dynamics in the Western English Channel. Journal of Plankton Research, 32(5), 643-655.

Zapata, M., Rodríguez, F., & Garrido, J. L. (2000). Separation of chlorophylls and carotenoids from marine phytoplankton: a new HPLC method using a reversed phase C8 column and pyridine-containing mobile phases. Marine Ecology Progress Series, 195, 29-45.