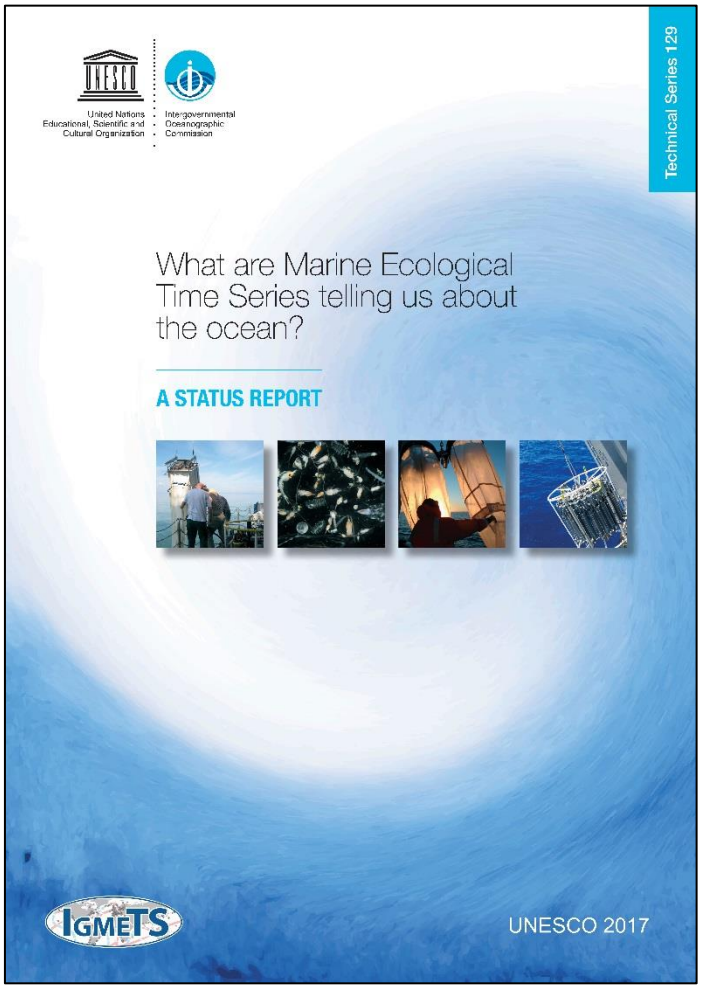
# *What are Marine Ecological Time Series telling us about the ocean? A status report*

## [ Individual Chapter (PDF) download ]

The full report (all chapters and Annex) is available online at:

http://igmets.net/report



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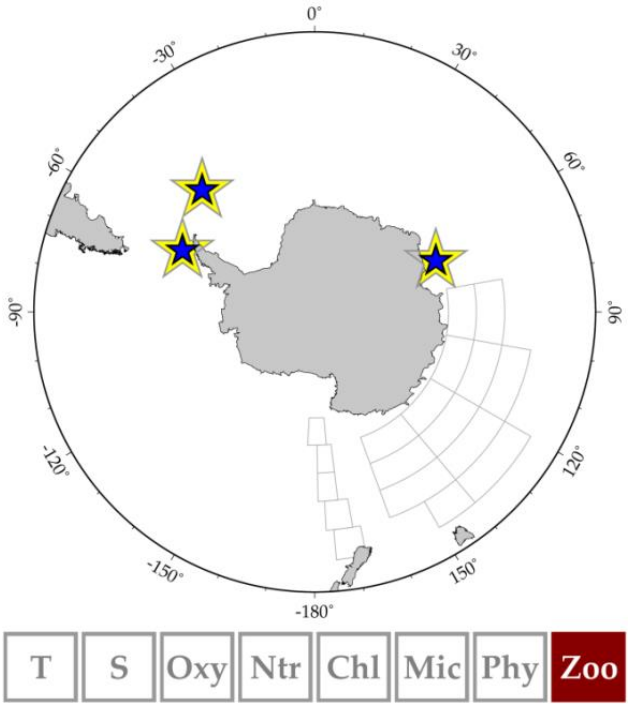
# Annex

## Description of time-series programmes

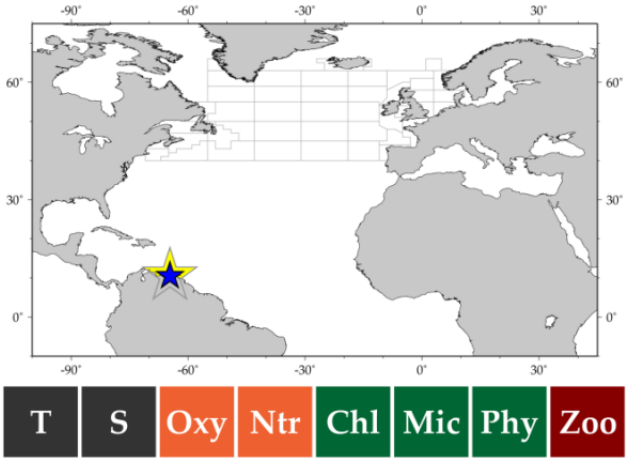
The time-series sites and programmes participating in the IGMETS analysis are individually described in the following pages. The sections of this Annex are sorted by major ocean basins, following the ocean conveyor belt starting in the Arctic Ocean (A1), North Atlantic (A2), South Atlantic (A3), Southern Ocean (A4), Indian Ocean (A5), South Pacific (A6), and finishing in the North Pacific Ocean (A7). In addition to the brief information provided within each text summary here, a unique identifier/web link is provided to access detailed information about each time-series site.

This Annex does not include every marine time series in the world. IGMETS focuses on ship-based, *in situ* time series with at least one biogeochemical and/or ecological variable (e.g. nutrients, pigments, or plankton). Some time series did not participate in this initial study because their data were proprietary or it was not possible to contact them due to changes in staffing or outdated contact information.The Annex lists only time-series sites where data were shared, highlighting the important collaborative and scientific contributions made. As IGMETS is an ongoing activity, new time series will be included and their new datasets will be added beyond this first report. Updated information is available in the online IGMETS metabase (http://igmets.net/metabase).

Two example IGMETS time-series site summary figures are shown below. These figures indicate the geographic location and available variable classes submitted to IGMETS. In some cases, additional variable types may exist, but were not provided to IGMETS for this report. The left figure is an example of a multiple-site Southern Ocean project (KRILLBASE) for which only zooplankton data were available. The right figure is a single-site programme from the North Atlantic (CARIACO) for which data from all of the IGMETS variable classes were available.




**KRILLBASE** (uk-30402)
http://igmets.net/sites/?id=**uk-30402**




**CARIACO Ocean Time Series** (ve-10101)
http://igmets.net/sites/?id=**ve-10101**

*In situ* variable icons: **T** = temperature, **S** = salinity, **Oxy** = dissolved oxygen, **Ntr** = nutrients, **Chl** = chlorophyll/pigments, **Mic** = microbial plankton, **Phy** = phytoplankton, **Zoo** = zooplankton

# A1 Arctic Ocean

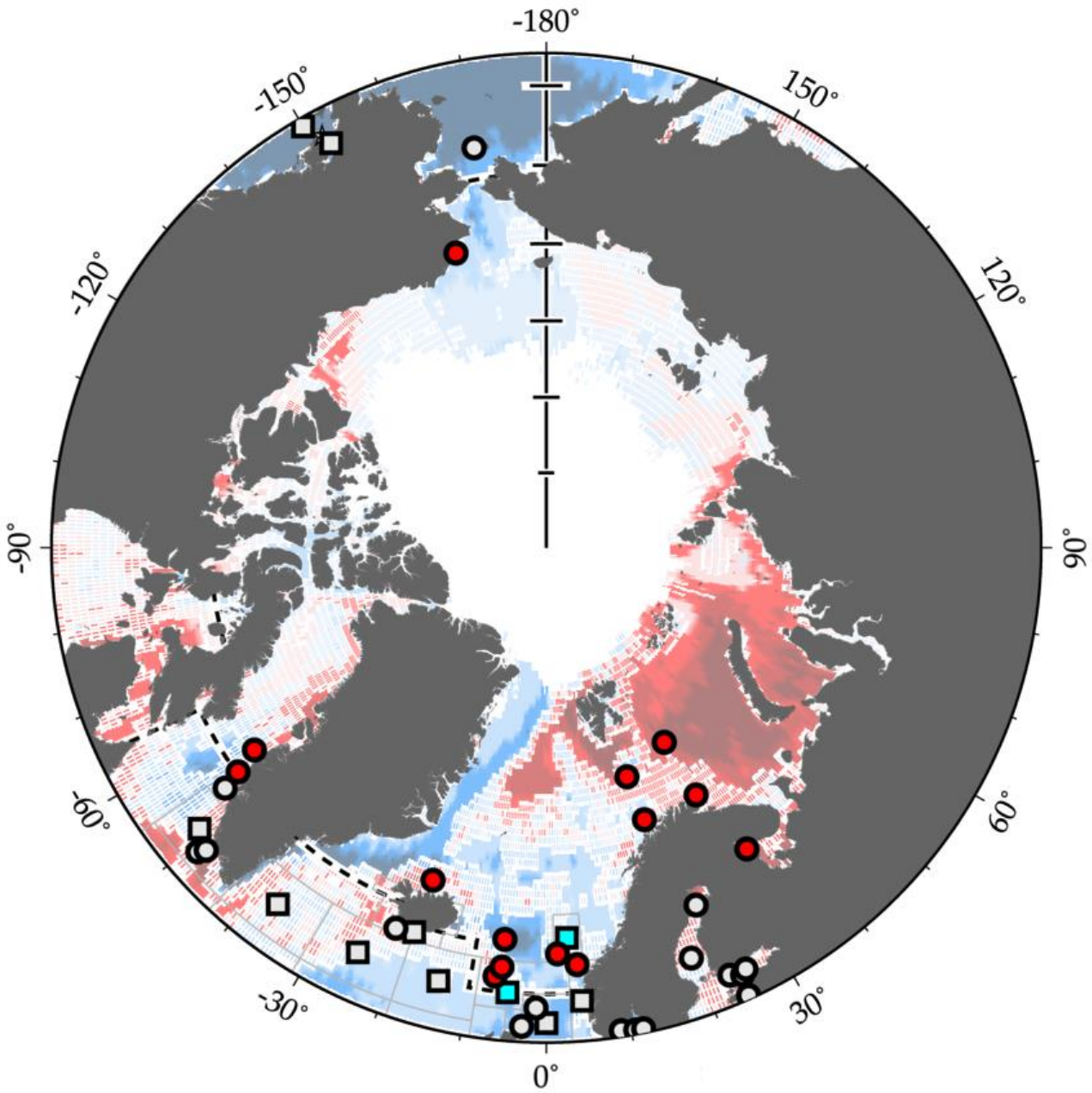



**Figure A1.** Map of IGMETS-participating Arctic Ocean time series on a background of a 10-year time-window (2003–2012) sea surface temperature trends (see also Chapter 3). At the time of this report, the Arctic Ocean collection consisted of 16 time series (coloured symbols of any type), of which two were from Continuous Plankton Recorder subareas (blue boxes). Dashed lines indicate boundaries between IGMETS regions. Uncoloured (gray) symbols indicate time series being addressed in a different regional chapter (e.g. North Atlantic, North Pacific).

**Table A1.** Time-series sites located in the IGMETS Arctic Ocean region. Participating countries: Denmark (dk), Faroe Islands (fo), Iceland (is), Norway (no), Russia (ru), United Kingdom (uk), and United States (us). Year-spans in red text indicate time series of unknown or discontinued status. IGMETS-IDs in red text indicate time series without a description entry in this Annex.

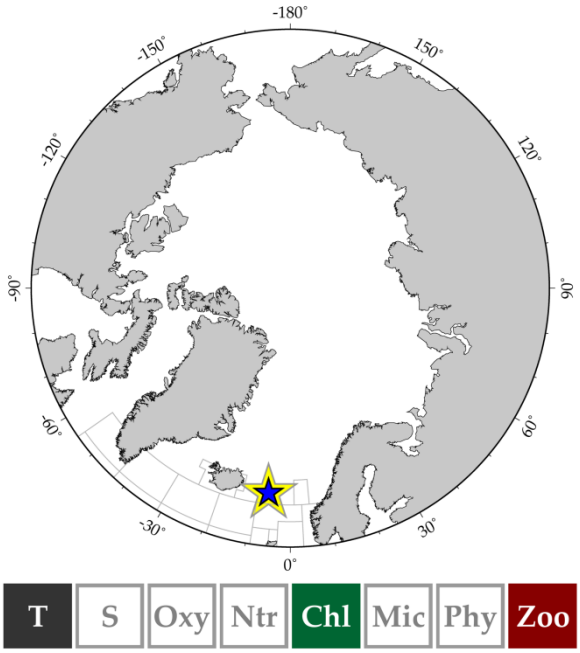
| No. | IGMETS-ID | Site or programme name | Year-span | T | S | Oxy | Ntr | Chl | Mic | Phy | Zoo |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | dk-10101 | Hellefiske Bank – S1<br>*(West Greenland)* | 1950–1984 (?) | X | - | - | - | - | - | - | X |
| 2 | dk-10102 | Sukkertop Bank – S2<br>*(West Greenland)* | 1950–1984 (?) | X | - | - | - | - | - | - | X |
| 3 | fo-30101 | Faroe Islands Shelf<br>*(Faroe Islands)*<br>*see North Atlantic Annex (A2)* | 1991–present | X | - | - | X | X | - | - | X |
| 4 | fo-30102 | Norwegian Sea Transect – North<br>*(North Faroe Islands)* | 1990–present | X | - | - | - | X | - | - | X |
| 5 | fo-30103 | Norwegian Sea Transect – South<br>*(North Faroe Islands)* | 1990–present | X | - | - | - | X | - | - | X |
| 6 | is-30101 | Siglunes Transect<br>*(North Iceland)* | 1952–present | X | X | - | - | X | - | - | X |
| 7 | no-50101 | Svinøy Transect – East<br>*(Norwegian Sea)* | 1994–present | - | - | - | - | X | - | - | X |
| 8 | no-50102 | Svinøy Transect – West<br>*(Norwegian Sea)* | 1994–present | - | - | - | - | X | - | - | X |
| 9 | no-50201 | Fugløya-Bjørnøya Transect – North<br>*(Western Barents Sea)* | 1990–present | X | X | - | - | X | - | - | X |
| 10 | no-50202 | Fugløya-Bjørnøya Transect – South<br>*(Western Barents Sea)* | 1990–present | X | X | - | - | X | - | - | X |
| 11 | no-50301 | Vardø-Nord Transect – North<br>*(Central Barents Sea)* | 1990–present | X | X | - | - | X | - | - | X |
| 12 | no-50302 | Vardø-Nord Transect – South<br>*(Central Barents Sea)* | 1990–present | X | X | - | - | X | - | - | X |
| 13 | ru-10101 | Kartesh D1<br>*(White Sea)* | 1961–present | X | X | - | - | - | - | - | X |
| 14 | uk-40101 | SAHFOS-CPR A01<br>*(Norwegian Sea)* | 1958–present | - | - | - | - | X | - | X | X |
| 15 | uk-40114 | SAHFOS-CPR B04<br>*(Southern Norwegian Sea)* | 1958–present | - | - | - | - | X | - | X | X |
| 16 | us-50604 | EMA-4: Chukchi Sea<br>*(Chukchi Sea)* | 2003–present | X | X | - | X | X | - | - | - |

## Norwegian Sea Transect

**Country:** Faroe Islands

**IGMETS-ID:** fo-30102 / fo-30103
*see also Faroe Island Shelf (North Atlantic, fo-30101)*

***Eilif Gaard, Solva Jacobsen, and Karin Margretha H. Larsen***



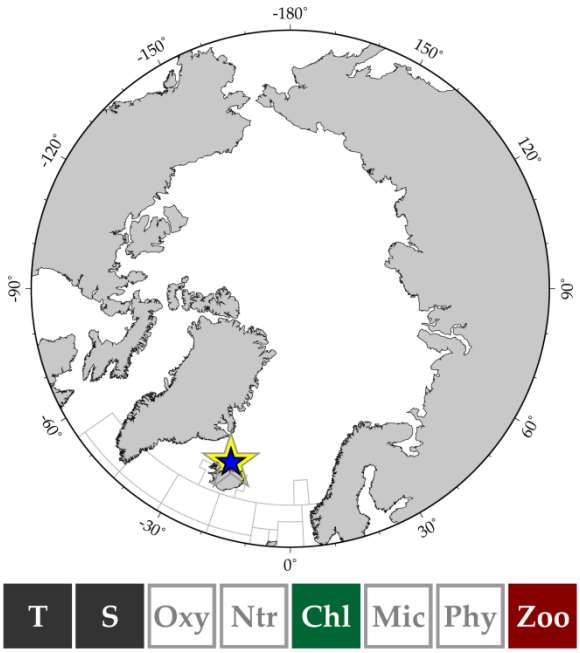

The Faroe Marine Research Institute conducts monitoring of hydrography, chlorophyll *a*, and zooplankton at a transect at 6°W extending from 62°N on the Faroe Shelf and northward to 64°30'N in the Norwegian Sea. The southern part of the transect is characterised by warm Atlantic water flowing from the southwest, while the northern part contains cold East Atlantic water, flowing from the northwest. These two water masses meet and form the Iceland–Faroe Front approximately halfway on the transect. The transect covers warm Atlantic water that is transported into the Nordic seas. Furthermore, the region is an important feeding area for pelagic planktivorous fish during spring and summer. The monitoring aims to understand temporal variability in ocean climate and linkages between environmental variables, plankton, and pelagic fish. The time series, which were established in 1990, are conducted 3–4 times annually. Profiles of temperature, salinity, chlorophyll, and PAR are measured down to ca. 1300 m. Zooplankton is collected from 50 m depth to the surface with WP-2 nets.

## Siglunes Transect (Northern Iceland)

**Country**: Iceland

**IGMETS-ID**: is-30101
*see also Selvogsbanki Transect (North Atlantic, is-30102)*

***Astthor Gislason, Hafsteinn Gudfinnsson, and Kristinn Gudmundsson***




The Icelandic monitoring programme for hydrography, nutrients, phytoplankton, and zooplankton consists of a series of standard transects around Iceland perpendicular to the coastline. In the 1960s, sampling was started at stations along transects north and east of Iceland. Additional transect lines south and west were added in the 1970s. Currently, there are approximately 90 stations, with sampling carried out at these stations every year in May and June. In this IGMETS study, we have included data from the Siglunes Transect, off northern Iceland, and the Selvogsbanki Transect, in western south Iceland. These two transects represent conditions from two very different water bodies. The Siglunes Transect contains plankton communities and hydrography primarily from subarctic, polar waters, while the Selvogsbanki Transect community and conditions predominantly represent North Atlantic water. As such, the Iceland contribution to IGMETS is found in both the Arctic Ocean (Chapter 3) and the North Atlantic (Chapter 4) sections.

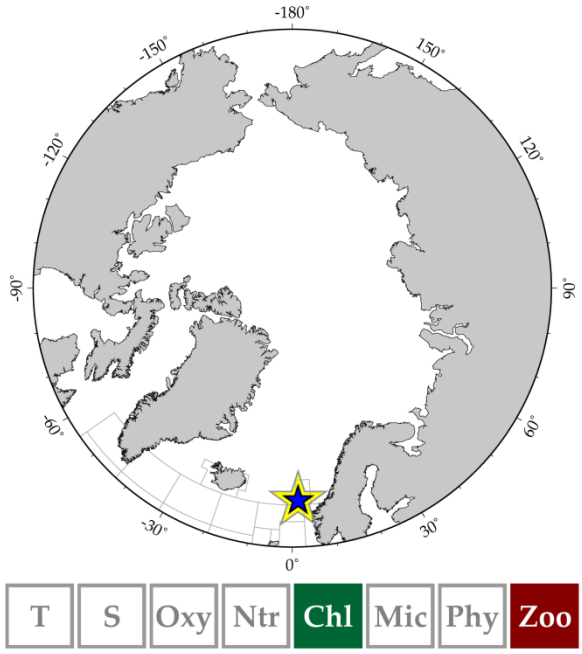
Related information: http://www.hafro.is/index_eng.php

## Svinøy Transect (Norwegian Sea)

**County:** Norway

**IGMETS-ID:** no-50101 / no-50102

***Webjørn Melle and Cecilie Broms***




The Svinøy Transect is located in the southern part of the Norwegian Sea. The Institute of Marine Research (IMR) Monitoring Programme established this transect in the mid-1990s. For mesozooplankton, the transect is, by default, sampled 4–6 times each year with a WP-2 net (56-cm diameter, 180-µm mesh) from 200 m depth to the surface. The Svinøy transect is split into two sections called Svinøy Transect East and Svinøy Transect West. Svinøy Transect East is generally located on the shallow shelf and frontal area and is influenced by Norwegian coastal water. Svinøy Transect West is generally located in and influenced by Atlantic water. A chlorophyll bloom occurs in late April and early May, with a protracted post-bloom. The dominant contributor to mesozooplankton biomass is *Calanus finmarchicus*, with a tendency for earlier production in coastal water compared to Atlantic water (Broms and Melle, 2007; Bagøien *et al*., 2012).

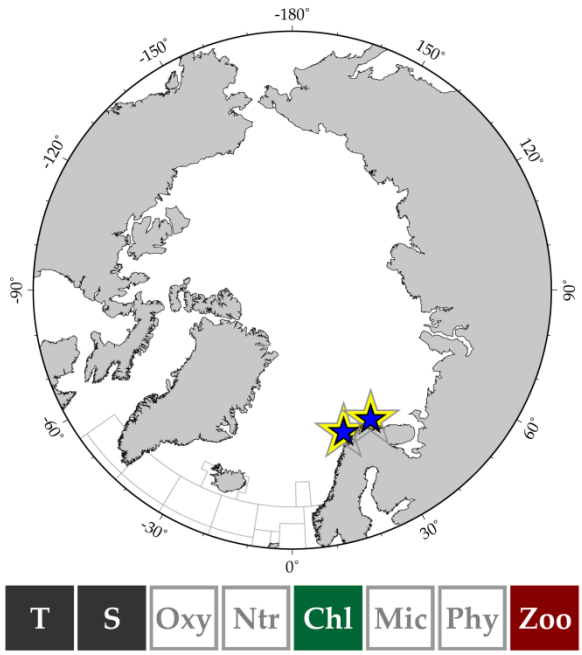
## Fugløya–Bjørnøya Transect (western Barents Sea)

## Vardø–Nord Transect (central Barents Sea)

**Country**: Norway

**IGMETS-ID**: no-50201 / no-50301

***Padmini Dalpadado***



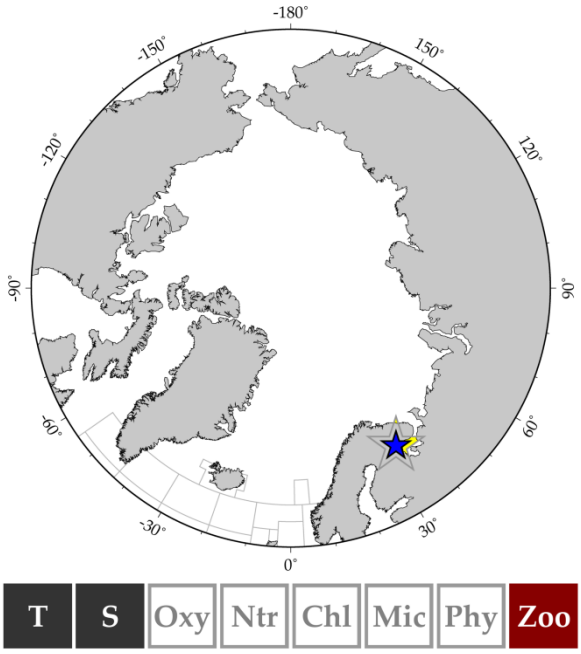

Zooplankton was collected vertically between the bottom and the surface with WP-2 plankton nets (180-mm mesh, diameter of 56 cm) along two standard sections, Fugløya–Bjørnøya (FB) and Vardø–Nord (VN). The FB and VN sections are located, respectively, in the western (Barents Sea opening) and central Barents Sea. Standard sections were sampled up to six times per year, covering most seasons. The biomass (g $m^{-2}$) data are available for three different size fractions; 2000, 2000–1000, and 1000–180 µm. The biomass for different seasons is available for both sections, allowing the exploration season dynamics of mesozooplankton. Hydrographical parameters such as temperature and salinity as well as chlorphyll, nitrate, and silicate data are also accessible for the two sections. In addition, mesozooplankton species composition (*Calanus finmarchicus*, *C. glacialis*, *C. hyperboreus*, and other species) and their abundance have been monitored since 1995 at four selected stations from the FB section.

## White Sea Hydrology and Zooplankton Time Series (Kartesh D1)

Country: Russia

**IGMETS-ID:** ru-10101

***Nikolay Usov, Daria Martynova, Inna Kutcheva, Igor Primakov, Regina Prygunkova, Vyacheslav Smirnov, and Alexey Babkov***




The zooplankton and hydrology monitoring at the D1 station was established in 1957 to understand life cycles of planktonic animals, long-term trends of zooplankton abundance, and abiotic factors influencing those biological variables. D1 is situated in Chupa Inlet (66°19.861'N 33°39.818'E), which opens to the sea, so this point is representative of the coastal zone of Kandalaksha Bay of the White Sea and similar inlets along the coast of the bay (Berger and Dahle, 2001). Zooplankton sampling and temperature, salinity, chlorophyll *a*, turbidity, and dissolved organic matter measurements are conducted every 10 days during the ice-free period of the year and monthly from the ice (Usov *et al*., 2013). Zooplankton is sampled by vertical tows at depths of 0–10, 10–25, and 25–60 m. Other parameters are measured along vertical profiles with 1 Hz frequency. Until 2005, only temperature and salinity were measured at 0, 5, 10, 15, 25, 50 m, and the bottom.

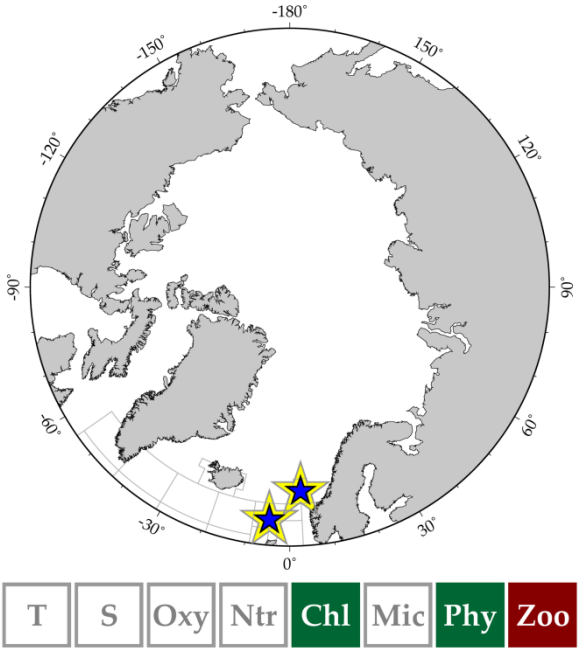
Related information: http://www.zin.ru/kartesh

## North Atlantic Continuous Plankton Recorder (CPR) survey

**Country:** United Kingdom

**IGMETS-ID:** uk-40101 / uk-40114
*see also entry in the North Atlantic chapter*

***Martin Edwards, Priscilla Licandro, Claudia Castellani, and Rowena Stern***



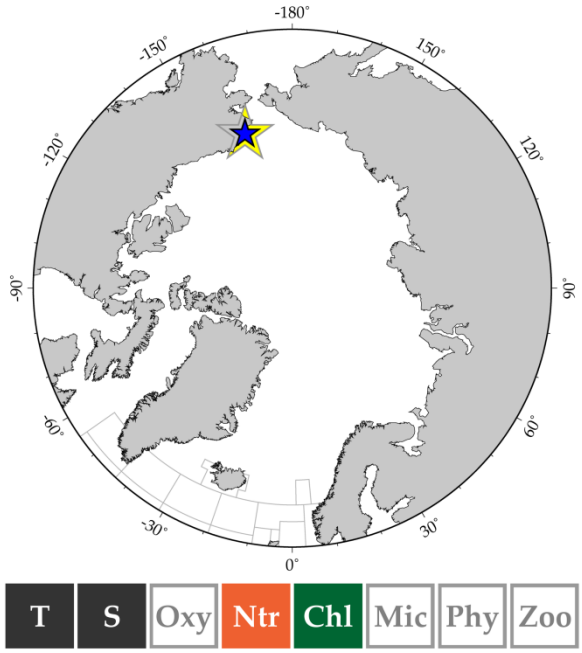

The Continuous Plankton Recorder (CPR) survey is a long-term, subsurface, marine plankton monitoring programme consisting of a network of CPR transects towed monthly across the major geographical regions of the North Atlantic. It has been operating in the North Sea since 1931, with some standard routes existing with virtually unbroken monthly coverage back to 1946. After each tow, the CPR samples are returned to the laboratory for routine analysis, including the estimation of phytoplankton biomass (Phytoplankton Colour Index, PCI) and the identification of up to 500 different phytoplankton and zooplankton taxa (Warner and Hays, 1994). Direct comparisons between the Phytoplankton Colour Index and other chlorophyll *a* estimates, including SeaWiFS satellite estimates, indicate strong positive correlations (Batten *et al*., 2003; Raitsos *et al*., 2005).

## Ecosystem Monitoring and Assessment Program (EMA) – Chukchi Sea

**Country:** United States

**IGMETS-ID:** us-50604
*see also EMA Eastern and Northern Bering Sea (North Pacific, us-50601/us-50602/us-50603)*

***Lisa Eisnor, Ed Farley, and Jeffrey Napp***




The NOAA Alaska Fisheries Science Center (AFSC) Ecosystem Monitoring and Assessment (EMA) Program's overall goal is to improve and reduce uncertainty in stock assessment models of commercially important fish species through concurrent collection of fish and oceanography data. Surface trawl and midwater acoustics are used to measure fish abundance, size, distribution, diet, and energetic status. CTDs with auxiliary sensors for chlorophyll *a* fluorescence, light attenuation, photosynthetic available radiation (PAR), and dissolved oxygen, and attached Niskin water bottles are used to collect vertical profiles of hydrography, nutrients, and chlorophyll a (total and size-fractionated). Oblique and vertical tows over the water column (150- and 505-µm nets) are used to collect zooplankton taxa. These fisheries oceanographic observations are used to connect climate change and spatial variability in large marine ecosystems to early marine survival of commercially important fish species in the Gulf of Alaska, Eastern Bering Sea, and Chukchi Sea.

# A2 North Atlantic Ocean
## North Atlantic Proper

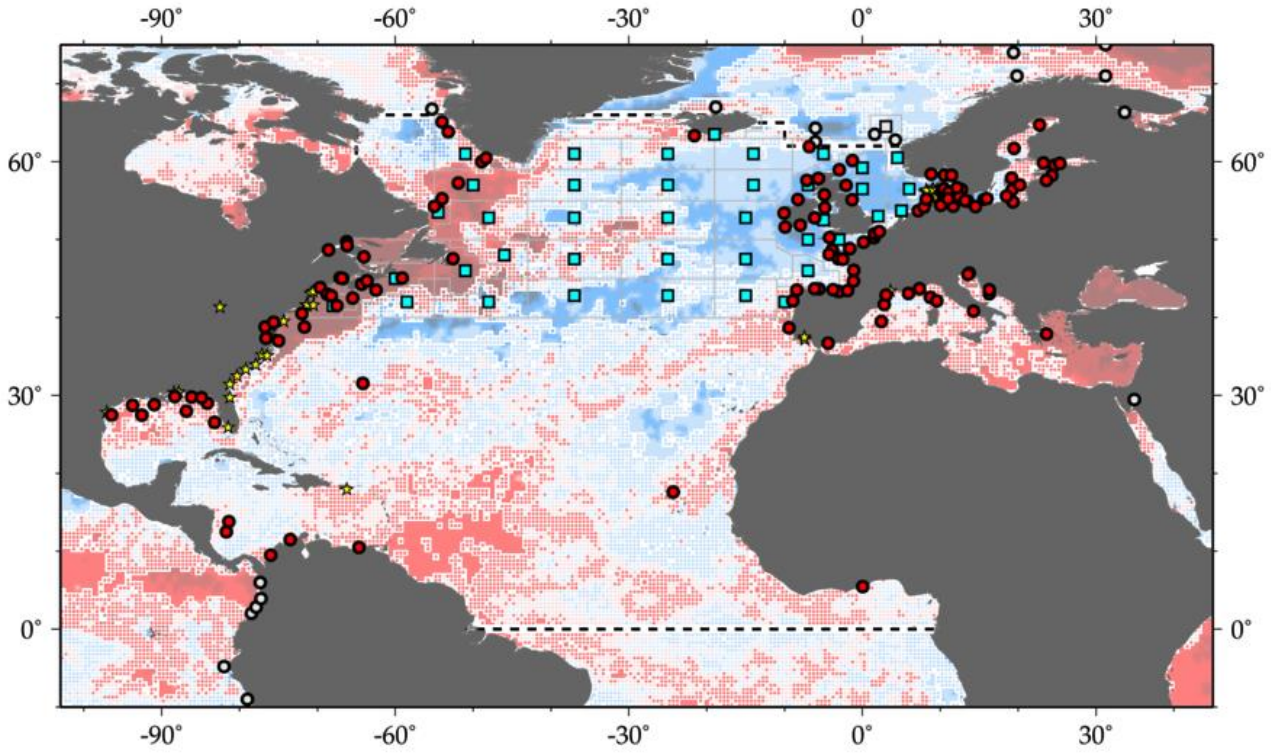



**Figure A2.1.** Map of IGMETS-participating North Atlantic time series on a background of a 10-year time-window (2003–2012) sea surface temperature trends (see also Chapter 4). At the time of this report, the North Atlantic collection consisted of 211 time series (coloured symbols of any type), of which 39 were from Continuous Plankton Recorder subareas (blue boxes) and 37 were from estuarine areas (yellow stars). Dashed lines indicate boundaries between IGMETS regions. Uncoloured (gray) symbols indicate time series being addressed in a different regional chapter (e.g. Arctic Ocean, South Pacific). Due to the number of sites in the North Atlantic proper (154), the Baltic Sea and Mediterranean Sea have their own Annex subsections.

**Table A2.1.** Time-series sites located in the IGMETS North Atlantic (not including the Baltic Sea and Mediterranean Sea) region. Participating countries: Canada (ca), Colombia (co), Germany (de), Denmark (dk), Spain (es), Faroe Islands (fo), France (fr), Ghana (gh), Ireland (ie), Isle of Man (im), Iceland (is), Portugal (pt), United Kingdom (uk), United States (us), and Venezuela (ve). Year-spans in red text indicate time series of unknown or discontinued status. IGMETS-IDs in red text indicate time series without a description entry in this Annex.

| No. | IGMETS-ID | Site or programme name | Year-span | T | S | Oxy | Ntr | Chl | Mic | Phy | Zoo |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ca-50101 | AZMP Halifax Line 2 *(Scotian Shelf)* | 1997–present | X | - | - | - | X | - | - | X |
| 2 | ca-50102 | AZMP Prince 5 *(Bay of Fundy)* | 1999–present | X | - | - | - | X | - | - | X |
| 3 | ca-50201 | AR7W Zone 1 *(Labrador Shelf)* | 1996–present | X | X | - | - | X | - | - | X |
| 4 | ca-50202 | AR7W Zone 2 *(Labrador Slope)* | 1996–present | X | X | - | - | X | - | - | X |
| 5 | ca-50203 | AR7W Zone 3 *(Central Labrador Sea)* | 1996–present | X | X | - | - | X | - | - | X |
| 6 | ca-50204 | AR7W Zone 4 *(Eastern Labrador Sea)* | 1996–present | X | X | - | - | X | - | - | X |
| 7 | ca-50205 | AR7W Zone 5 *(Greenland Shelf)* | 1996–present | X | X | - | - | X | - | - | X |
| 8 | ca-50401 | Bedford Basin *(Northwestern North Atlantic)* | 1967–present | X | X | - | X | X | X | - | - |
| 9 | ca-50501 | Bay of Fundy *(Northwestern Atlantic shelf)* | 1988–2012 discontinued | X | X | - | - | X | - | X | - |
| 10 | ca-50601 | AZMP Station 27 *(Newfoundland Shelf)* | 1960–present | X | - | - | - | X | - | - | X |
| 11 | ca-50701 | AZMP Anticosti Gyre *(Gulf of St Lawrence)* | 1999–present | X | - | - | - | X | - | - | X |
| 12 | ca-50702 | AZMP Gaspe Current *(Gulf of St Lawrence)* | 1999–present | X | - | - | - | X | - | - | X |
| 13 | ca-50703 | AZMP Rimouski *(Gulf of St Lawrence)* | 2005–present | X | X | - | X | X | - | - | X |
| 14 | ca-50704 | AZMP Shediac *(Gulf of St Lawrence)* | 1999–present | X | X | - | X | X | - | - | X |
| 15 | ca-50801 | Central Scotian Shelf *(Northwestern Atlantic shelf)* | 1996–present | X | X | - | X | X | X | - | - |
| 16 | ca-50802 | Eastern Scotian Shelf *(Northwestern Atlantic)* | 1997–present | X | X | - | X | X | X | - | - |
| 17 | ca-50803 | Western Scotian Shelf *(Northwestern Atlantic)* | 1997–present | X | X | - | X | X | X | - | - |
| 18 | co-30101 | REDCAM Isla de San Andres *(Southwestern Caribbean)* | 2002–present | X | X | X | - | - | - | - | - |
| 19 | co-30102 | REDCAM Isla de Provencia *(Southwestern Caribbean)* | 2002–present | X | X | X | - | - | - | - | - |

| No. | IGMETS-ID | Site or programme name | Year-span | T | S | Oxy | Ntr | Chl | Mic | Phy | Zoo |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | co-30103 | REDCAM Western Colombia–Caribbean Shelf *(Southwestern Caribbean)* | 2002–present | X | X | X | - | - | - | - | - |
| 21 | co-30104 | REDCAM Eastern Colombia–Caribbean Shelf *(Southwestern Caribbean)* | 2002–present | X | X | X | - | - | - | - | - |
| 22 | de-10101 | Nordeney WQ-W2 *(Southern North Sea)* | 1999–2008 (?) | X | X | - | X | - | - | X | - |
| 23 | de-30201 | Helgoland Roads *(Southeastern North Sea)* | 1962–present | X | X | - | X | - | X | X | X |
| 24 | de-30301 | Cape Verde Ocean Observatory *(Tropical Eastern North Atlantic)* | 2006–present | X | X | X | X | - | - | - | - |
| 27 | dk-30101 | North Sea: DNAMAP-1510007 *(Baltic Sea)* *see Baltic Sea Annex (A2)* | 1989–present | X | X | X | X | X | - | X | - |
| 28 | dk-30105 | Ringkobing Fjord: DNAMAP-1 *(Baltic Sea)* *see Baltic Sea Annex (A2)* | 1980–present | X | X | X | X | X | - | X | - |
| 29 | dk-30106 | Nissum Fjord: DNAMAP-22 *(Baltic Sea)* *see Baltic Sea Annex (A2)* | 1983–present | X | X | X | X | X | - | X | - |
| 30 | dk-30107 | Nissum Bredning: DNAMAP-3702-1 *(Baltic Sea)* *see Baltic Sea Annex (A2)* | 1982–present | X | X | X | X | X | - | X | - |
| 31 | dk-30110 | Lister Dyb: DNAMAP-3 *(Baltic Sea)* *see Baltic Sea Annex (A2)* | 1993–present | X | X | X | X | X | - | X | - |
| 32 | es-30101 | BILBAO 35 Time Series *(Inner Bay of Biscay)* | 1998–present | X | X | X | - | X | - | - | X |
| 33 | es-30102 | URDAIBAI 35 Time Series *(Inner Bay of Biscay)* | 1997–present | X | Xs | X | - | X | - | - | X |
| 34 | es-30201 | AZTI Station D2 *(Southeastern Bay of Biscay)* | 1986–present | X | X | X | X | X | - | X | - |
| 35 | es-30401 | Nervion River Estuary E1 *(Southern Bay of Biscay)* | 2000–present | X | X | - | - | - | - | X | - |
| 36 | es-50101 | RADIALES Santander Station 4 *(Southern Bay of Biscay)* | 1991–present | X | X | * | X | * | * | - | X |
| 37 | es-50102 | RADIALES A Coruna Station 2 *(Northwestern Iberian coast)* | 1988–present | X | X | X | X | X | X | X | X |
| 38 | es-50103 | RADIALES Gijon/Xixon Station 2 *(Southern Bay of Biscay)* | 2001–present | X | X | * | X | X | X | X | X |
| 39 | es-50104 | RADIALES Vigo Station 3 *(Northwest Iberian coast)* | 1994–present | X | X | - | X | X | - | - | X |
| 40 | es-50105 | RADIALES Cudillero Station 2 *(Southern Bay of Biscay)* | 1992–present | X | X | X | X | X | * | - | X |

| No. | IGMETS-ID | Site or programme name | Year-span | T | S | Oxy | Ntr | Chl | Mic | Phy | Zoo |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 41 | fo-30101 | Faroe Islands Shelf *(Faroe Islands)* | 1991–present | X | - | - | X | X | - | - | X |
| 42 | fr-50101 | REPHY Antifer Ponton Petrolier *(English Channel)* | 1989–present | X | X | X | X | X | - | X | - |
| 43 | fr-50102 | REPHY At So *(English Channel)* | 1987–present | X | X | - | X | X | - | X | - |
| 44 | fr-50103 | REPHY Donville *(English Channel)* | 2002–present | X | X | X | X | X | - | X | - |
| 45 | fr-50104 | REPHY Pen al Lann *(English Channel)* | 1987–present | X | X | X | - | X | - | X | - |
| 46 | fr-50105 | REPHY Point 1 SRN Boulogne *(English Channel)* | 1992–present | X | X | - | X | X | - | X | - |
| 47 | fr-50106 | REPHY Kervel *(Bay of Biscay)* | 1987–present | X | X | - | - | X | - | X | - |
| 48 | fr-50107 | REPHY Le Cornard *(Bay of Biscay)* | 1987–present | X | X | X | - | X | - | X | - |
| 49 | fr-50108 | REPHY Men er Roue *(Bay of Biscay)* | 1987–present | X | X | - | X | X | - | X | - |
| 50 | fr-50109 | REPHY Ouest Loscolo *(Bay of Biscay)* | 1987–present | X | X | - | X | X | - | X | - |
| 51 | fr-50110 | REPHY Teychan Bis *(Bay of Biscay)* | 1999–present | X | X | - | X | X | - | X | - |
| 52 | fr-50201 | Gravelines Station *(English Channel)* | 1993–present | - | - | - | - | - | - | - | X |
| 53 | ie-30101 | East Coast Ireland *(Ireland)* | 1990–present | - | - | - | - | - | - | X | - |
| 54 | ie-30102 | Northwest Coast Ireland *(Ireland)* | 1990–present | - | - | - | - | - | - | X | - |
| 55 | ie-30103 | South Coast Ireland *(Ireland)* | 1990–present | - | - | - | - | - | - | X | - |
| 56 | ie-30104 | Southwest Coast Ireland *(Ireland)* | 1990–present | - | - | - | - | - | - | X | - |
| 57 | ie-30105 | West Coast Ireland (*Ireland*) | 1990–present | - | - | - | - | - | - | X | - |
| 58 | im-10101 | Cypris Station – Isle of Man *(Irish Sea)* | 1954–2009 (?) | X | X | X | X | X | - | X | - |
| 59 | is-30102 | Selvogsbanki Transect *(South Iceland)* | 1971–present | X | X | - | - | X | - | - | X |
| 60 | no-50401 | Arendal Station 2 *(North Sea)* | 1994 – present | X | X | X | X | X | - | - | X |
| 61 | pt-30101 | Cascais Bay *(Portuguese Coast)* | 2005–present | X | X | - | - | - | - | - | X |

| No. | IGMETS-ID | Site or programme name | Year-span | T | S | Oxy | Ntr | Chl | Mic | Phy | Zoo |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 62 | pt-30201 | Guadiana Lower Estuary *(Southwest Iberian Peninsula)* | 1996–present | X | X | - | - | X | - | - | X |
| 63 | pt-30301 | Guadiana Upper Estuary *(Southwest Iberian Peninsula)* | 1996–present | X | X | - | X | X | X | X | - |
| 64 | uk-30101 | Stonehaven *(Northwest North Sea)* | 1997–present | X | X | - | X | X | - | X | X |
| 65 | uk-30102 | Loch Ewe *(Northwest North Sea)* | 2002–present | X | X | - | X | X | - | X | X |
| 66 | uk-30103 | Loch Maddy *(Northwest North Sea)* | 2003– 2011 (?) | X | X | - | X | - | - | X | - |
| 67 | uk-30104 | Mill Port *(Northwest North Sea)* | 2005– 2013 (?) | X | - | - | - | - | - | X | - |
| 68 | uk-30105 | Scalloway – Shetland Isles *(Northwest North Sea)* | 2001–present | X | X | - | X | - | - | X | - |
| 69 | uk-30106 | Scapa Bay – Orkney *(Northwest North Sea)* | 2001–present | X | X | - | X | - | - | X | - |
| 70 | uk-30201 | Plymouth L4 *(Western English Channel)* | 1988–present | X | X | X | X | X | X | X | X |
| 71 | uk-30301 | Dove *(North Sea)* | 1971–2002 discontinued | - | - | - | - | - | - | - | X |
| 72 | uk-30601 | Atlantic Meridional Transect (AMT) | 1995-present | X | X | X | X | X |  | X | X |
| 73 | uk-40106 | SAHFOS–CPR A06 *(South Iceland)* | 1958–present | - | - | - | - | X | - | X | X |
| 74 | uk-40111 | SAHFOS–CPR B01 *(Northeastern North Sea)* | 1958–present | - | - | - | - | X | - | X | X |
| 75 | uk-40112 | SAHFOS–CPR B02 *(Northwestern North Sea)* | 1958–present | - | - | - | - | X | - | X | X |
| 76 | uk-40114 | SAHFOS–CPR B04 *(Southern Norwegian Sea)* | 1958–present | - | - | - | - | X | - | X | X |
| 77 | uk-40115 | SAHFOS–CPR B05 *(Southeast Iceland)* | 1958–present | - | - | - | - | X | - | X | X |
| 78 | uk-40116 | SAHFOS–CPR B06 *(Southwest Iceland)* | 1958–present | - | - | - | - | X | - | X | X |
| 79 | uk-40117 | SAHFOS–CPR B07 *(Southeast Greenland)* | 1958–present | - | - | - | - | X | - | X | X |
| 80 | uk-40118 | SAHFOS–CPR B08 *(Southwest Greenland)* | 1962–present | - | - | - | - | X | - | X | X |
| 81 | uk-40121 | SAHFOS–CPR C01 *(Eastern Central North Sea)* | 1958–present | - | - | - | - | X | - | X | X |
| 82 | uk-40122 | SAHFOS–CPR C02 *(Western Central North Sea)* | 1958–present | - | - | - | - | X | - | X | X |

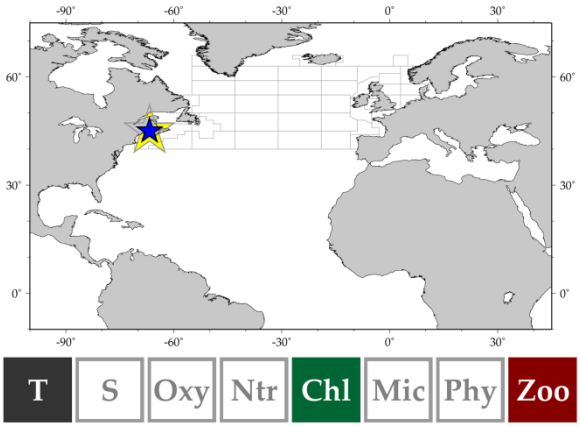
| No. | IGMETS-ID | Site or programme name | Year-span | T | S | Oxy | Ntr | Chl | Mic | Phy | Zoo |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 83 | uk-40123 | SAHFOS–CPR C03 *(Irish Sea)* | 1958–present | - | - | - | - | X | - | X | X |
| 84 | uk-40124 | SAHFOS–CPR C04 *(Northwest Scotland and Ireland)* | 1958–present | - | - | - | - | X | - | X | X |
| 85 | uk-40125 | SAHFOS–CPR C05 *(Northeast Central North Atlantic)* | 1958–present | - | - | - | - | X | - | X | X |
| 86 | uk-40126 | SAHFOS–CPR C06 *(Central North Atlantic)* | 1958–present | - | - | - | - | X | - | X | X |
| 87 | uk-40127 | SAHFOS–CPR C07 *(Northwest Central North Atlantic)* | 1959–present | - | - | - | - | X | - | X | X |
| 88 | uk-40128 | SAHFOS–CPR C08 *(Labrador)* | 1959–present | - | - | - | - | X | - | X | X |
| 89 | uk-40131 | SAHFOS–CPR D01 *(Southeast North Sea)* | 1958–present | - | - | - | - | X | - | X | X |
| 90 | uk-40132 | SAHFOS–CPR D02 *(Southwest North Sea)* | 1958–present | - | - | - | - | X | - | X | X |
| 91 | uk-40133 | SAHFOS–CPR D03 *(English Channel)* | 1958–present | - | - | - | - | X | - | X | X |
| 92 | uk-40134 | SAHFOS–CPR D04 *(South Ireland)* | 1958–present | - | - | - | - | X | - | X | X |
| 93 | uk-40135 | SAHFOS–CPR D05 *(Eastern Central North Atlantic)* | 1958–present | - | - | - | - | X | - | X | X |
| 94 | uk-40136 | SAHFOS–CPR D06 *(Central North Atlantic)* | 1958–present | - | - | - | - | X | - | X | X |
| 95 | uk-40137 | SAHFOS–CPR D07 *(Western Central North Atlantic)* | 1959–present | - | - | - | - | X | - | X | X |
| 96 | uk-40138 | SAHFOS–CPR D08 *(Western Central North Atlantic)* | 1959–present | - | - | - | - | X | - | X | X |
| 97 | uk-40139 | SAHFOS–CPR D09 *(Labrador Shelf)* | 1959–present | - | - | - | - | X | - | X | X |
| 98 | uk-40144 | SAHFOS–CPR E04 *(Bay of Biscay)* | 1958–present | - | - | - | - | X | - | X | X |
| 99 | uk-40145 | SAHFOS–CPR E05 (*Eastern Southern North Atlantic*) | 1958–present | - | - | - | - | X | - | X | X |
| 100 | uk-40146 | SAHFOS–CPR E06 (*Southern North Atlantic*) | 1961–present | - | - | - | - | X | - | X | X |
| 101 | uk-40147 | SAHFOS–CPR E07 (*Southern North Atlantic*) | 1961–present | - | - | - | - | X | - | X | X |
| 102 | uk-40148 | SAHFOS–CPR E08 (*Western Southern North Atlantic*) | 1960–present | - | - | - | - | X | - | X | X |
| 103 | uk-40149 | SAHFOS–CPR E09 (*Off Newfoundland Shelf*) | 1960–present | - | - | - | - | X | - | X | X |

| No. | IGMETS-ID | Site or programme name | Year-span | T | S | Oxy | Ntr | Chl | Mic | Phy | Zoo |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 104 | uk-40150 | SAHFOS–CPR E10 (*Off Scotian Shelf*) | 1961–present | - | - | - | - | X | - | X | X |
| 105 | uk-40154 | SAHFOS–CPR F04 (*Off Iberian Shelf*) | 1958–present | - | - | - | - | X | - | X | X |
| 106 | uk-40155 | SAHFOS–CPR F05 (*Eastern Southern North Atlantic*) | 1963–present | - | - | - | - | X | - | X | X |
| 107 | uk-40156 | SAHFOS–CPR F06 (*Central Southern North Atlantic*) | 1967–present | - | - | - | - | X | - | X | X |
| 108 | uk-40157 | SAHFOS–CPR F07 (*Central Southern North Atlantic*) | 1963–present | - | - | - | - | X | - | X | X |
| 109 | uk-40158 | SAHFOS–CPR F08 (*Central Southern North Atlantic*) | 1963–present | - | - | - | - | X | - | X | X |
| 110 | uk-40159 | SAHFOS–CPR F09 (*Western Southern North Atlantic*) | 1962–present | - | - | - | - | X | - | X | X |
| 111 | uk-40160 | SAHFOS–CPR F10 (*Off Gulf of Maine*) | 1961–present | - | - | - | - | X | - | X | X |
| 112 | us-10101 | Bermuda Atlantic Time Series (*BATS*) | 1982–present | X | X | X | X | X | X | - | X |
| 113 | us-10401 | Boothbay (*Northwestern Atlantic shelf*) | 2000–present | X | X | - | - | X | X | - | - |
| 114 | us-30101 | Upper Chesapeake – Maryland (*Chesapeake Bay*) | 1984–2002 (?) | - | - | - | - | - | - | - | X |
| 115 | us-30102 | Lower Chesapeake – Virginia (*Chesapeake Bay*) | 1985–2002 (?) | - | - | - | - | - | - | - | X |
| 116 | us-30201 | Narragansett Bay (*Northwestern Atlantic*) | 1959–present | X | X | - | X | X | - | - | - |
| 117 | us-30301 | Neuse River Estuary NR000 (*Outer Banks – North Carolina*) | 1994–present | X | X | X | X | X | - | - | - |
| 118 | us-30302 | Pamlico Sound PS1 (*Outer Banks – North Carolina*) | 2000–present | X | X | X | X | X | - | - | - |
| 119 | us-50101 | EcoMon Gulf of Maine – GOM (*Gulf of Maine*) | 1977–present | - | - | - | - | - | - | - | X |
| 120 | us-50102 | EcoMon Georges Bank – GBK (*Georges Bank*) | 1977–present | - | - | - | - | - | - | - | X |
| 121 | us-50103 | EcoMon Southern New England – SNE (*Southern New England*) | 1977–present | - | - | - | - | - | - | - | X |
| 122 | us-50104 | EcoMon Mid-Atlantic Bight – MAB (*Mid-Atlantic Bight*) | 1977–present | - | - | - | - | - | - | - | X |
| 123 | us-50105 | EcoMon Gulf of Maine CPR line (*Gulf of Maine*) | 1961–2012 discontinued | - | - | - | - | - | - | - | - |
| 124 | us-50106 | EcoMon Mid-Atlantic Bight CPR line (*Mid-Atlantic Bight*) | 1975–2012 discontinued | - | - | - | - | - | - | - | - |

| No. | IGMETS-ID | Site or programme name | Year-span | T | S | Oxy | Ntr | Chl | Mic | Phy | Zoo |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 125 | us-50201 | SEAMAP: Texas/Lousiana Shelf WEST (*Gulf of Mexico*) | 1982–present | - | - | - | - | - | - | - | X |
| 126 | us-50202 | SEAMAP: Texas/Louisiana Shelf CENTRAL (*Gulf of Mexico*) | 1982–present | - | - | - | - | - | - | - | X |
| 127 | us-50203 | SEAMAP: Texas/Lousiana Shelf EAST (*Gulf of Mexico*) | 1982–present | - | - | - | - | - | - | - | X |
| 128 | us-50204 | SEAMAP: Mississippi/Alabama Shelf (*Gulf of Mexico*) | 1982–present | - | - | - | - | - | - | - | X |
| 129 | us-50205 | SEAMAP: Florida Shelf NORTH-WEST (*Gulf of Mexico*) | 1986–present | - | - | - | - | - | - | - | X |
| 130 | us-50206 | SEAMAP: Florida Shelf NORTH-EAST (*Gulf of Mexico*) | 1986–present | - | - | - | - | - | - | - | X |
| 131 | us-50207 | SEAMAP: Florida Shelf SOUTH (*Gulf of Mexico*) | 1982–present | - | - | - | - | - | - | - | X |
| 132 | us-50208 | Northeast Off-shelf Region – SEAMAP (*Gulf of Mexico*) | 1982–present | - | - | - | - | - | - | - | X |
| 133 | us-50209 | Northwest Off-Shelf Region – SEAMAP (*Gulf of Mexico*) | 1982–present | - | - | - | - | - | - | - | X |
| 134 | us-60101 | NERRS ACE Basin | 2001–present | X | X | X | X | X | - | - | - |
| 135 | us-60102 | NERRS Apalachicola | 2002–present | X | X | X | X | X | - | - | - |
| 136 | us-60103 | NERRS Chesapeake Bay MD | 2003–present | X | X | X | X | X | - | - | - |
| 137 | us-60104 | NERRS Chesapeake Bay VA | 2002–present | X | X | X | X | X | - | - | - |
| 138 | us-60105 | NERRS Delaware | 2001–present | X | X | X | X | X | - | - | - |
| 139 | us-60107 | NERRS Grand Bay | 2004–present | X | X | X | X | X | - | - | - |
| 140 | us-60108 | NERRS Great Bay | 2001–present | X | X | X | X | X | - | - | - |
| 141 | us-60109 | NERRS Guana Tolomato Matanzas | 2002–present | X | X | X | X | X | - | - | - |
| 142 | us-60111 | NERRS Jacques Cousteau | 2002–present | X | X | X | X | X | - | - | - |
| 143 | us-60112 | NERRS Jobos Bay – Puerto Rico | 2001–present | X | X | X | X | X | - | - | - |
| 144 | us-60115 | NERRS Mission-Aransas | 2007–present | X | X | X | X | X | - | - | - |

| No. | IGMETS-ID | Site or programme name | Year-span | T | S | Oxy | Ntr | Chl | Mic | Phy | Zoo |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 145 | us-60116 | NERRS Narragansett Bay | 2002–present | X | X | X | X | X | - | - | - |
| 146 | us-60117 | NERRS North Inlet – Winyah Bay | 2001–present | X | X | X | X | X | - | - | - |
| 147 | us-60118 | NERRS North Carolina | 2001–present | X | X | X | X | X | - | - | - |
| 148 | us-60119 | NERRS Old Woman Creek | 2002–present | X | X | X | X | X | - | - | - |
| 149 | us-60121 | NERRS Rookery Bay | 2002–present | X | X | X | X | X | - | - | - |
| 150 | us-60122 | NERRS Sapelo Island | 2004–present | X | X | X | X | X | - | - | - |
| 151 | us-60126 | NERRS Wells | 2004–present | X | X | X | X | X | - | - | - |
| 152 | us-60127 | NERRS Weeks Bay | 2001–present | X | X | X | X | X | - | - | - |
| 153 | us-60128 | NERRS Waquoit Bay | 2002–present | X | X | X | X | X | - | - | - |
| 154 | ve-10101 | CARIACO Ocean Time Series (*Cariaco Basin off Venezuela*) | 1995–present | X | X | X | X | X | X | X | X |

## Atlantic Zone Monitoring Program (AZMP) Halifax Line 2, Prince 5




**Country:** Canada

**IGMETS-ID:** ca-50101, ca-50102

***Catherine Johnson, Erica Head, Emmanuel Devred, Marc Ringuette, and Dave Hebert***

The Halifax Line 2 (HL2) station has been sampled semi-monthly since 1999 by the Atlantic Zone Monitoring Program (AZMP). AZMP was implemented by Fisheries and Oceans Canada in 1998 to (i) characterize and understand the causes of ocean variability at seasonal, interannual, and decadal scales, (ii) establish relationships among biological, chemical, and physical variability, and (iii) provide adequate data to support sound development of ocean activities. HL2 is located on the central Scotian Shelf, 11 km from the Nova Scotia coast, and has a bottom depth of 149 m. It exhibits strong annual-scale temperature variation, and its water properties are influenced both by cold, low salinity waters of the equatorward flowing Nova Scotia Current and by onshelf transport of warmer, saltier waters.

The Prince-5 time-series station has been sampled semi-monthly since 1999 by the Atlantic Zone Monitoring Program (AZMP), and a temperature and salinity time series extends back to the 1920s at the station. The Prince-5 station is located in the coastal outer Bay of Fundy and has a bottom depth of 95 m. It is strongly influenced by tidal mixing, and its water properties and plankton community reflect mixing of nearshore waters and waters of the outer Bay of Fundy, which are similar to the central Gulf of Maine.

AZMP performs a core set of observations including hydrography, oxygen, nutrients, chlorophyll, and zooplankton at the stations.

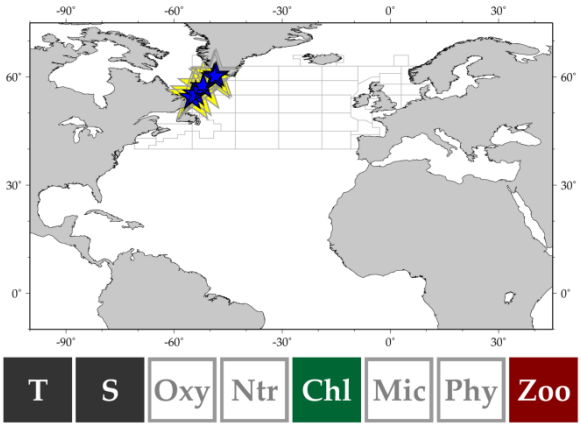
Related information: http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/azmp-pmza/index-eng.html

## AR7W Greenland Shelf, Canada

**Country:** Canada

**Site name (IGMETS-ID):**

AR7W Zone 1 – Labrador Shelf (ca-50201)
AR7W Zone 2 – Labrador Slope (ca-50202),
AR7W Zone 3 – Central Labrador Sea (ca-50203)
AR7W Zone 4 – Eastern Labrador Sea (ca-50204)
AR7W Zone 5 – Greenland Shelf (ca-50205)



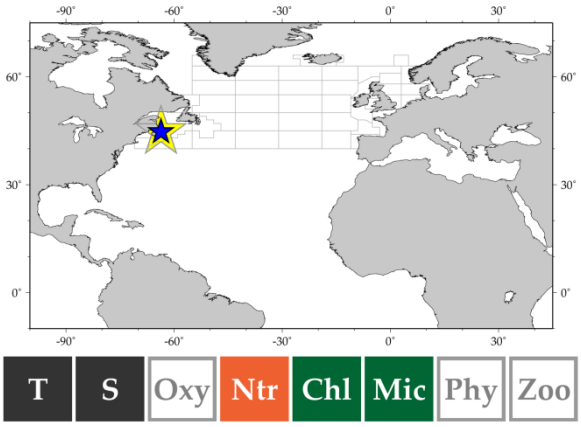

***Erica Head, Marc Ringuette Igor Yashayaev, and Kumiko Azetsu-Scott***

The Labrador Sea Monitoring Program collects physical, chemical, and biological oceanographic observations at fixed stations on the Atlantic Repeat Hydrography Line 7 West (AR7W) between southern Labrador and southwest Greenland. AR7W has been occupied annually (typically in May) since 1990, with biological measurements since 1994. The Labrador Sea is an area where intermediate-depth water masses are formed through winter convective sinking of dense surface water, transporting carbon dioxide and other important ocean properties to the lower limb of the ocean's Meridional Overturning Circulation. The Labrador Sea is also a key region for modification of the Labrador Current system, which influences oceanographic and ecosystem conditions downstream on the Atlantic Canadian shelf. As an important reservoir for the ecologically significant zooplankter *Calanus finmarchicus*, the Labrador Sea deep convection area meets the criteria for Ecologically or Biologically Significant Area adopted by the Conference of the Parties to the UNEP Convention on Biological Diversity.

## Bedford Basin Monitoring Program (BBMP)

**Country:** Canada

**IGMETS-ID:** ca-50401




***Andrew Cogswell and William Li***

Bedford Basin is a small embayment that forms the inner portion of Halifax Harbour, Nova Scotia, Canada. It is encircled by the largest urban population centre in eastern Canada. For 30 years after the establishment of the Bedford Institute of Oceanography in 1962, the Basin served as an easily accessible body of water for marine research, as opportunity permitted. In 1992, regular oceanographic observation was initiated to record the state of the plankton ecosystem on a sustained basis. Weekly measurements are made of selected properties that characterize the physical, chemical, biological, and optical environments of the water column. This programme of research and monitoring delineates normal conditions in the Basin and discerns ecological change over long periods of time. The Compass Buoy station in Bedford Basin may be considered the inshore terminus of the Scotian Shelf Halifax Line of the Atlantic Zone Monitoring Program conducted by Fisheries and Oceans Canada.

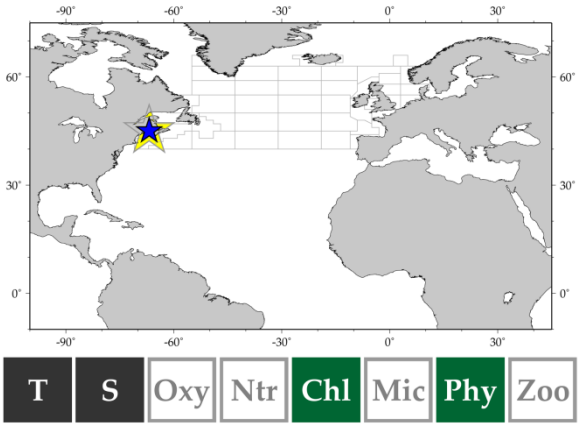
Related information: http://www.bio.gc.ca/science/monitoring-monitorage/bbmp-pobb/bbmp-pobb-eng.php

## St. Andrews Biological Station Phytoplankton Time Series – Bay of Fundy

**Country:** Canada

**IGMETS-ID:** ca-50501

***Jennifer Martin***



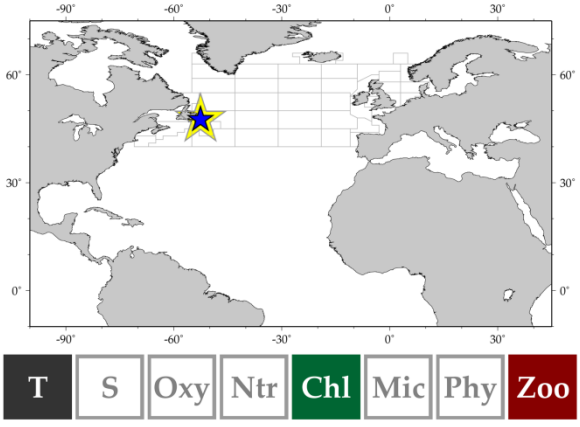

The St. Andrews Biological Station Phytoplankton Time Series was established in the Quoddy Region of the Bay of Fundy, eastern Canada in 1987. Purposes of the phytoplankton study were to (i) establish baseline data on phytoplankton populations since little detailed work had been published since earlier studies by Gran and Braarud (1935); (ii) identify harmful algal species that could potentially cause harm to the salmon aquaculture industry; (iii) provide an early warning to shellfish and finfish industries; (iv) observe new species to the region; and (v) determine patterns and trends in phytoplankton populations. The Bay of Fundy, has the largest tides in the world (exceeding 16 m), with a tidal range of 8.3 m in the Quoddy Region. Oscillation time is 13 h, and currents can be up to 2 m $s^{-1}$, resulting in vigorous mixing in some areas. Samples are collected weekly for phytoplankton, temperature, nutrients, salinity, and fluorescence from late April to late May and monthly during all other months.

## AZMP Station 27

**Country:** Canada

**IGMETS-ID:** ca-50601

***Pierre Pepin and Eugene Colbourne***




Station 27 has been sampled semi-monthly since 1999 under the Atlantic Zone Monitoring Program (AZMP), building on systematic oceanographic observations at the station extending back to 1947. AZMP was implemented by Fisheries and Oceans Canada in 1998 to (i) characterize and understand the causes of ocean variability at seasonal, interannual, and decadal scales, (ii) establish relationships among biological, chemical, and physical variability, and (iii) provide adequate data to support sound development of ocean activities. Station 27 is about 7 km off St. John's Harbour, Newfoundland in a water depth of 176 m. It is located in the Avalon Channel in the inshore branch of equatorward-flowing Labrador Current and exhibits strong annual-scale variations in temperature and salinity. AZMP performs a core set of observations including hydrography, oxygen, nutrients, chlorophyll, and zooplankton at the station.

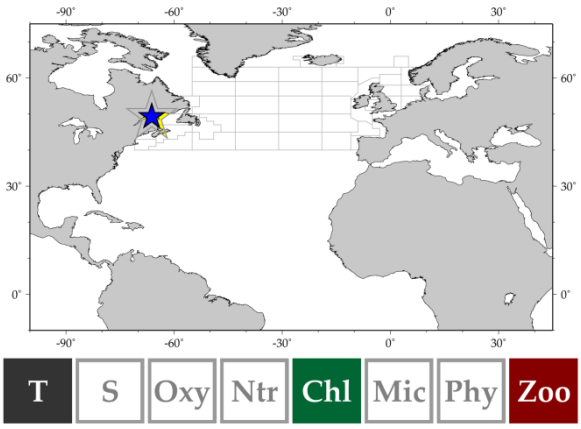
Related information: http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/azmp-pmza/index-eng.html

## Atlantic Zone Monitoring Program (AZMP): Rimouski and Shediac Valley stations

**Country:** Canada

**Station name (IGMETS-ID):**

AZMP Anticosti Gyre (ca-50701)
AZMP Gaspé Current (ca-50702)
AZMP Rimouski (ca-50703)
AR7W Shediac Valley (ca-50704)




***Stéphane Plourde, Michael Scarratt, Michel Starr, Peter Galbraith, and Laure Devine***

The Atlantic Zone Monitoring Program (AZMP) was implemented by Fisheries and Oceans Canada to detect, track, and predict changes in the state and productivity of the Northwest Atlantic. AZMP is essential in order to tackle major issues such as the impact of climate change or to support the ecosystem approach to ensure conserving resources and protecting the marine environment. The Rimouski (depth: 335 m) and Shediac Valley (depth: 84 m) stations are two high-frequency sampling sites located in the western Gulf of St. Lawrence that are sampled on a weekly (Rimouski) or monthly (Shediac) basis from early spring to late autumn. On each visit to these stations, a CTD profile is performed and samples for phytoplankton, nutrients, and extracted chlorophyll are collected using Niskin bottles at fixed depths. Finally, zooplankton is vertically sampled from the bottom to the surface with a ring net (75-cm diameter, 200-µm mesh).

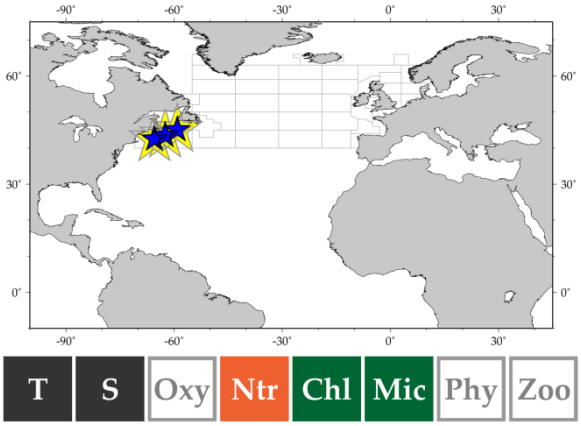
Related information: http://www.bio.gc.ca/science/monitoring-monitorage/azmp-pmza-eng.php
http://ogsl.ca/en/azmp/context.html

## Atlantic Zone Monitoring Program (AZMP): Scotian Shelf

**Country:** Canada

**Site name (IGMETS-ID):**

AZMP Central Scotian Shelf (ca-50801)
AZMP Eastern Scotian Shelf (ca-50802)
AZMP Western Scotian Shelf (ca-50803)

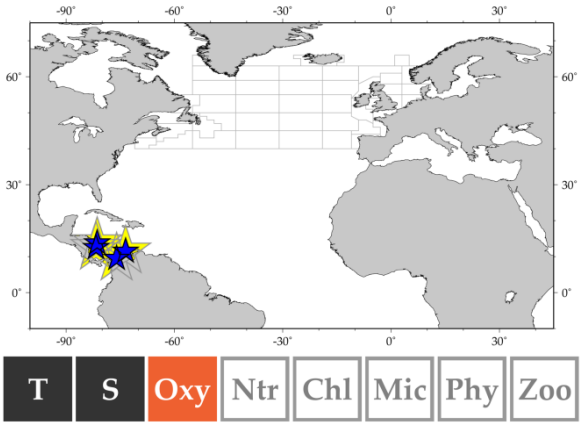



***Andrew Cogswell, Catherine Johnson, David Hebert, and William Li***

AZMP was implemented by Fisheries and Oceans Canada in 1997 for monitoring the Northwest Atlantic to understand, describe, and forecast the state of the ocean environment and marine ecosystem and to relate those changes to the predator–prey relationships of marine resources. AZMP works to protect the marine environment by providing data to support the sound development of ocean activities. The sampling regime consists of (i) seasonal and/or opportunistic sampling along 11 sections for information on the variability of the physical environment in the whole Northwest Atlantic region; (ii) higher-frequency temporal sampling (biological, chemical, and physical variables) at six accessible fixed sites for smaller time-scale dynamics in representative areas; (iii) satellite remote sensing of sea surface temperature and chlorophyll for broad synoptic spatial coverage of ocean data fields; and complemented by (iv) data from other sources (e.g. Continuous Plankton Recorder) and of other types (e.g. meteorological data, groundfish surveys).

Related information: http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/azmp-pmza/index-eng.html

## REDCAM



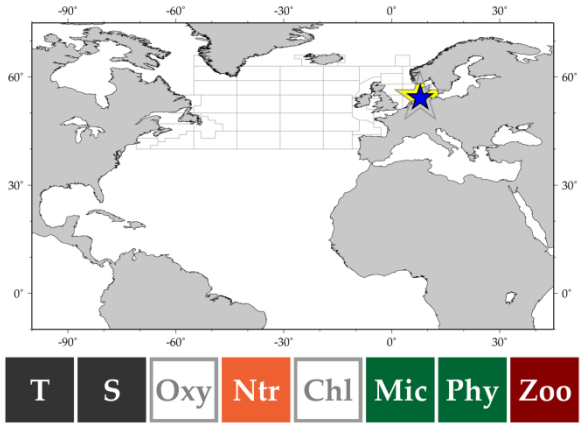

**Country:** Colombia

**Site names (IGMETS-ID):**

REDCAM Isla de San Andres (co-30101)
REDCAM Isla de Provencia (co-30102)
REDCAM Western Colombia-Caribbean Shelf (co-30103)
REDCAM Eastern Colombia-Caribbean Shelf (co-30104)

The Colombian Marine Environment Monitoring Network (REDCAM) was initiated in 2001 for the purpose of grouping multiple institutions and their efforts necessary to evaluate the chemical and sanitary quality of the marine and estuarine waters of Colombia. It is composed of 16 nodes and a main server located at INVEMAR (Santa Marta). Each node includes hardware and software for input and retrieval tables and cartographic information about the quality of marine and coastal waters of Colombia. It was established as a network of field stations that cover most of the Colombian coast. Since 2001 and twice a year at each node, it has been registering the values of the main physicochemical and bacteriological variables that characterize the quality of the marine and estuarine waters. Based on this information, the following zones have been identified as critical for its marine and coastal pollution: Santa Marta, Cartagena, Barranquilla, Morrosquillo, Uraba, and San Andres at the Caribbean coast and Buenaventura, Guapi, and La Tola at the Pacific coast.

## Helgoland Roads




**Country:** Germany

**IGMETS-ID:** de-30201

***Karen H. Wilshire, Alexandra Kraberg, Maarten Boersma, and Jasmin Renz***

The Helgoland Roads time series, located at the island of Helgoland in the German Bight, ca. 60 km off the German mainland (54°11'N 7°54'E), is one of the richest temporal marine datasets available. The dataset comprises a phytoplankton time series (started in 1962 and sampled daily) and a zooplankton time series (started in 1975 and sampled three times a week) along with time series for inorganic nutrients, salinity, and temperature and several shorter time series (e.g. chlorophyll and other data from ferrybox systems).

The high sampling frequency of the Helgoland Roads time series has provided a unique opportunity to study long-term trends in abiotic and biotic parameters, but also ecological phenomena, such as seasonal interactions between different foodweb components, niche properties, and the dynamics and timing of the spring bloom. It has also facilitated close examination of the dynamics of new species appearing in the local ecosystem.

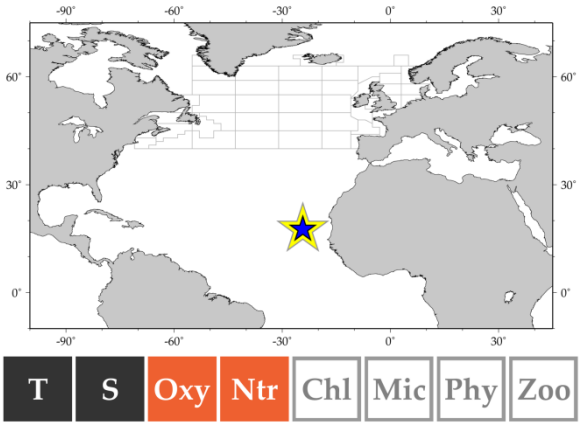
Related information: http://www.awi.de/en/research/research_divisions/biosciences/shelf_sea_ecology/long_term_studies/helgoland_roads_long_term_data_series/

## Cape Verde Ocean Observatory – CVOO

**Country:** Germany

**IGMETS-ID:** de-30301

***Björn Fiedler, Arne Körtzinger, Pericles Silva, and Johannes Karstensen***




CVOO (17°35′N 24°17′W), established in 2006, is located in the open eastern tropical North Atlantic (ETNA), 100 km northeast of the Cape Verde archipelago and downwind of the Mauritanian upwelling region (Fiedler, 2013). The Cape Verde Atmospheric Observatory (CVAO) is colocated 100 km downwind of CVOO and measures the marine boundary layer without terrestrial contaminations. CVOO represents open-ocean oligotrophic conditions; it is at the rim of an oxygen minimum zone (OMZ) in the ETNA. Observations are based on ship-based monthly sampling (0–500 m) with the local research vessel "Islândia" and an interdisciplinary full-depth mooring (3600 m) equipped with a variety of physical and biogeochemical sensors. Ship-based sampling frequency varies due to weather conditions and logistical constraints. RV "Islândia" is equipped with state-of-the-art instruments to collect temperature, salinity, biological parameters, nutrients, dissolved carbon, and oxygen. Novel observational platforms (gliders and profiling floats) are used within the framework of CVOO.

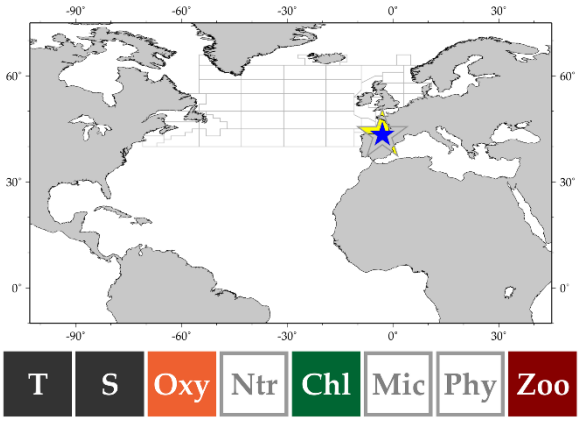
Related information: http://cvoo.geomar.de

## BILBAO 35 Time Series

**Country:** Spain

**IGMETS-ID:** es-30101

***Fernando Villate, Ibon Uriarte, and Arantza Iriarte***



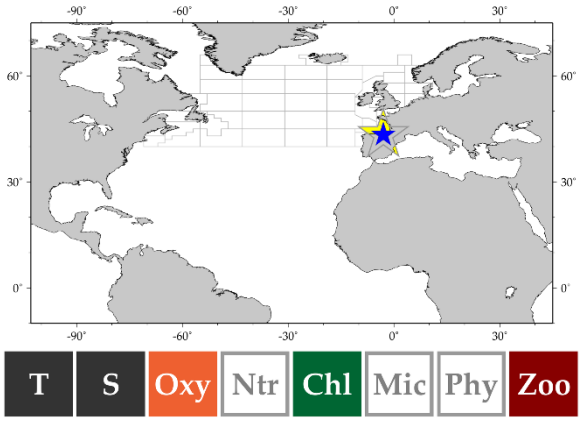

The BILBAO 35 Time-Series, established in the outer part of the Estuary of Bilbao in Abra Harbour (Basque coast, inner Bay of Biscay), constitutes the outermost sampling site of an environmental and plankton-monitoring programme carried out in five salinity sites (35, 34, 33, 30, and <30) along the estuary. The series was initiated in 1997 to report mesozooplankton changes in relation to water conditions and hydroclimatologic forces in the most perturbed estuary of the Basque coast. It also aims to contribute to understanding the combined effect of climate change and local human perturbations on plankton ecosystems of temperate coastal areas. The Bilbao 35 site (43°20′N 3°01′W) shows an annual chlorophyll maximum in summer (Iriarte *et al*., 2010), and it is sampled nearly every month to obtain profiles of temperature, salinity, and dissolved oxygen, collect zooplankton samples, and gather water samples for chlorophyll determination at mid-depth below the halocline.

## URDAIBAI 35 Time Series

**Country:** Spain

**IGMETS-ID:** es-30102

***Fernando Villate, Ibon Uriarte, and Arantza Iriarte***



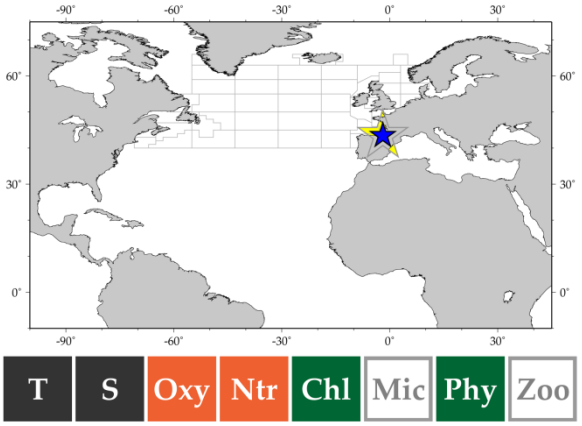

The URDAIBAI 35 Time-Series is established in the mouth of the Estuary of Urdaibai (Basque coast, inner Bay of Biscay) and constitutes the outermost sampling site of an environmental- and plankton-monitoring programme carried out in four salinity sites (35, 33, 30, and 26) along the estuary. The series was initiated in 1997 to report mesozooplankton changes in relation to water conditions and hydroclimatologic forces in this well-conserved estuary located within a biosphere reserve. The aim was also to contribute to understanding the combined effect of climate change and local human perturbations on plankton ecosystems of temperate coastal areas. The Urdaibai 35 site (43°24´N 2°41´W) shows a bimodal chlorophyll cycle with a maximum in early spring (Iriarte *et al*., 2010), and it is sampled nearly every month to obtain profiles of temperature, salinity, and dissolved oxygen, collect zooplankton samples, and gather water samples for chlorophyll determination at mid-depth below the halocline.

## AZTI Station D2

**Country:** Spain

**IGMETS-ID:** es-30201

***Marta Revilla, Almudena Fonán, Ángel Borja, and Victoriano Valencia***




D2 station (43°27'N 01°55'W) was established in 1986 in the southeastern part of the Bay of Biscay (North Atlantic region). This station is located 13.1 km offshore at a depth of 110 m. Due to its distance from the main pollution sources on land, it is considered to be unaffected by anthropogenic influences. Freshwater content is low (2.3‰ at the surface). The longest time series involves temperature, salinity, and phytoplankton biomass (chlorophyll *a*) data collected by means of CTD continuous vertical profiles. Although irregularly sampled, eight surveys per year have been conducted on average (Revilla *et al*., 2010). In addition, phytoplankton abundance and composition together with environmental variables (e.g. nutrients) have been monitored since 2002. The time series aims to understand oceanometeorological processes and how they can affect fisheries. Since 2002, this station has also been used as a reference site for the assessment of environmental/ecological quality in the context of the European Directives.

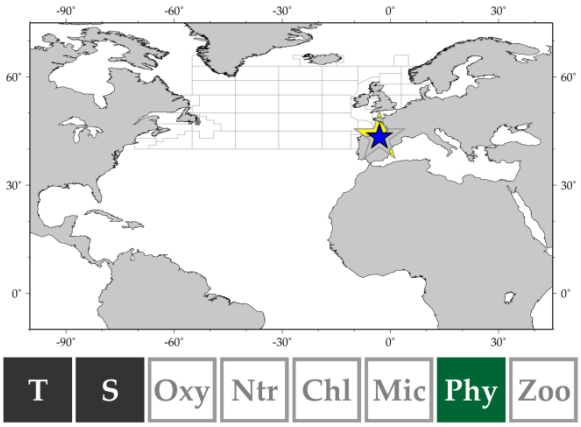
Related information: http://www.azti.es/marine-research/

## Nervión River Estuary

**Country:** Spain

**IGMETS-ID:** es-30401

***Emma Orive, Javier Franco, Aitor Laza-Martinez, Sergio Seoane, Alejando de la Sota, and Marta Revilla***



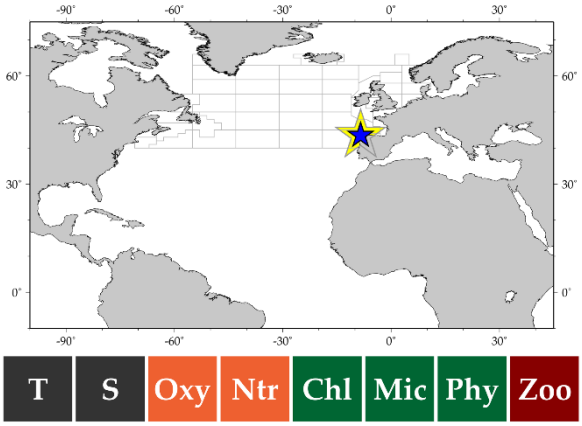

The River Nervión Estuary, also known as Bilbao Estuary and Nervión–Ibaizabal Estuary, is a small mesotidal estuary located in the northeast part of the Bay of Biscay (Atlantic Ocean, northern Spain). It is channeled for most its length (about 25 km) and consist of two well-differentiated parts: the inner and middle segments, which are narrow (about 100 m in width) and shallow (about 10 m in depth), whereas the outer segment is a semi-enclosed bay of about 2 km in width and about 25 m maximum depth. In recent years, and particularly after the implementation of the European Water Framework Directive of 2000, it has been the subject of several monitoring programmes dealing with the study of the abundance and composition of plankton populations, among other bioindicators. The outer estuary contains a very active harbour and two beaches that have been recovered for bathing following the construction of a wastewater treatment plant serving most populated areas and industries.

## RADIALES

**Country:** Spain

**Site name (IGMETS-ID):**

RADIALES Santander (es-50101)
RADIALES A Coruña (es-50102)
RADIALES Gijón/Xixón (es-50103)
RADIALES Vigo (es-50104)
RADIALES Cudillero (es-50105)




***Antonio Bode, Jorge Luis Valdés, Jose Luis Acuña, Marta Álvarez, Maria Teresa Álvarez-Ossorio, Ricardo Anadón, José Manuel Cabanas, Gerardo Casas, Xose-Anxelu Guitiérrez-Morán, Nicolás González, César González-Pola, Rafael González-Quirós, Mikel Latasa, Alicia Lavín, Ángel López-Urrutia, Ana Miranda, Enrique Nogueira, Beatriz Reguera, José-María Rodríguez, M. Carmen Rodriguez, Francisco Rodriguez-Hernández, Manuel Ruiz-Villarreal, Renate Scharek, Eva Teira, Manuel Varela, Marta Varela***

The RADIALES time-series programme has been monitoring shelf waters in northern Spain since 1990. Core observations include ship-based hydrographic, biogeochemical, and plankton measurements at monthly intervals in five oceanographic sections along the Iberian shelf. RADIALES aims at understanding and modelling the response of the marine ecosystem to the sources of temporal variability in oceanographic and planktonic components, particularly focusing on those factors and processes affecting biological production and potentially altering ecosystem services. Located in a key transitional biogeographic region, RADIALES allows for the analysis of variability in the coastal ecosystem in a gradient from the seasonal upwelling off Galicia to the temperate waters of the southern Bay of Biscay. This gradient encompasses changes in biological productivity, biodiversity, and biogeochemical fluxes. RADIALES is supported by base funds of the Instituto Español de Oceanografía (IEO) complemented by funds from competitive research projects. In addition, several universities collaborate with the programme.

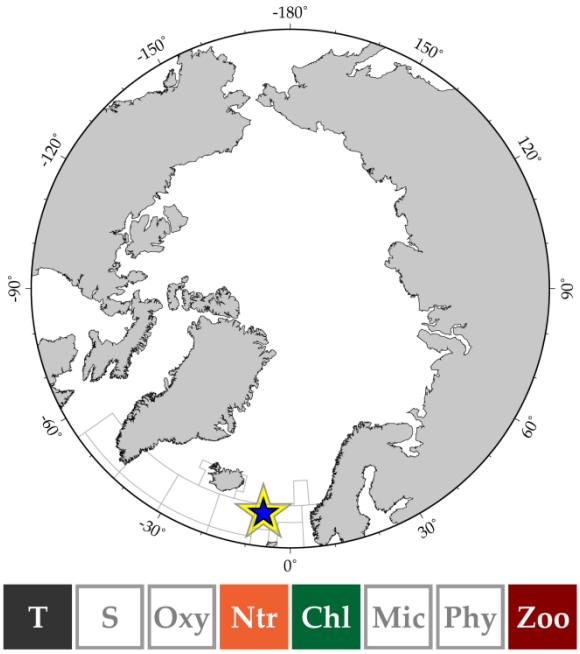
Related information: http://www.seriestemporales-ieo.com/

## Faroe Islands Shelf

**Country:** Faroe Islands

**IGMETS-ID:** fo-30101

***Eilif Gaard, Solva Jacobsen, and Karin Margretha H. Larsen***



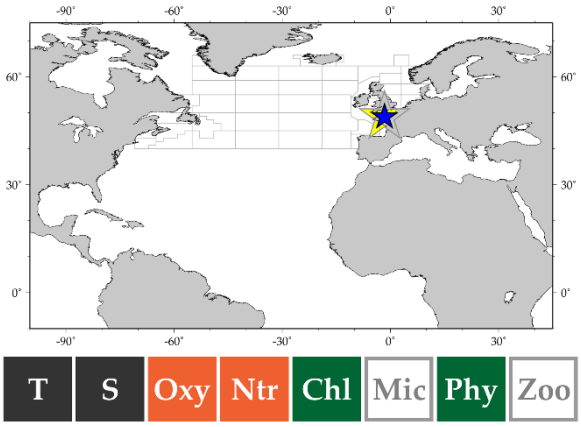

The Faroe Shelf water is relatively well separated from the surrounding ocean by a persistent front that surrounds the shelf at the 100–150 m bottom depth contour. The shelf water contains a neritic ecosystem. In order to study the influences of environmental variables on plankton and fish larvae in the ecosystem, the Faroe Marine Research Institute operates two time series: one in spring (last week of April) and one in midsummer (second half of June). The spring time series was established in 1994 and contains ca. 30 stations on the shelf and the surrounding ocean for monitoring hydrography and Chl *a* (CTD and fluorescence profiles) combined with spectrophotometric analysis of chlorophyll *a*. Zooplankton is collected with bongo net tows, using 100- and 200-µm mesh nets, respectively. *Calanus finmarchicus* egg production is monitored at selected stations. The summer time series was established in 1994 and includes profiles of temperature, salinity, Chl *a*, and nutrients at 50 stations on the shelf and the surrounding ocean. In order to study short-term variability and dynamics of the Faroe Shelf oceanography and plankton, the Faroe Marine Research Institute conducts frequent monitoring of temperature, salinity, Chl *a*, and nutrients at a coastal station on the Faroe Shelf. Seawater from 18-m depth at a tidally well-mixed location is pumped into the station. This seawater is representative of the central shelf areas. The time series was established in 1995. Temperature is measured continuously, and samples for salinity and nutrient analysis are collected twice a week throughout the year. Chlorophyll *a* is analysed on a weekly basis between April and September.

## French Phytoplankton and Phycotoxin Monitoring Network (REPHY)

**Country:** France

**Site name (IGMETS-ID):**

REPHY Antifer Ponton Petrolier (English Channel) (fr-50101),
REPHY At So (English Channel) (fr-50102)
REPHY Donville (English Channel) (fr-50103)
REPHY Pen al Lann (English Channel) (fr-50104)
REPHY Point 1 SRN Boulogne (English Channel) (fr-50105)
REPHY Kervel (Bay of Biscay) (fr-50106)
REPHY Le Cornard (Bay of Biscay) (fr-50107)
REPHY Men er Roue (Bay of Biscay) (fr-50108)
REPHY Quest Loscolo (Bay of Biscay) (fr-50109)
REPHY Teychan Bis (Bay of Biscay) (fr-50110)




***Dominique Soudant, Jacky Chauvin, Mickael Retho, Nathalie Cochennec-Laureau, and Claire Méteigner***

The French Phytoplankton and Phycotoxin Monitoring Network (REPHY) was set up in 1984 to (i) enhance knowledge of phytoplankton communities, (ii) safeguard public health, and (iii) protect the marine environment (Belin, 1998). Phytoplankton along the French coast has been sampled up to twice a month since 1987 at 12 coastal laboratories. For that purpose, the French coast is divided into a hierarchy of sites and subsites common to three regional networks: the English Channel, the Bay of Biscay, and the Mediterranean Sea.

Within the English Channel, the REPHY Point 1 SRN Boulogne and At So sites are both shallow and characterized by a macrotidal regime, especially the latter, which is also more sheltered. Sampling started in 1987 at At So and five years later at Point 1 SRN Boulogne. Ancillary measurements of temperature, salinity, chlorophyll *a*, phaeopigments, inorganic nutrient concentrations, and turbidity are also routinely measured (usually 15 samples per year). Oxygen was incorporated in 2007 at both sites.

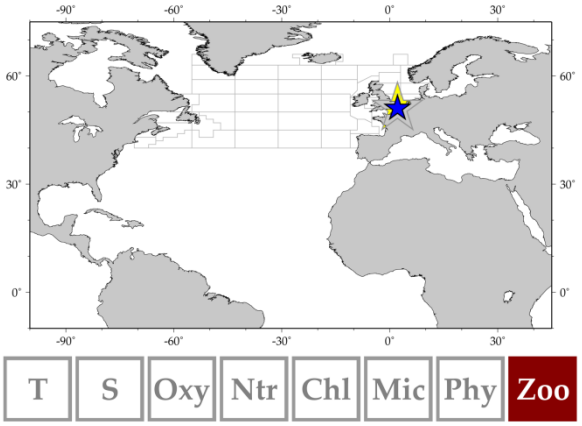
Men er Roue, Ouest Loscolo, Le Cornard, and Teychan Bis are four REPHY sites in the Bay of Biscay. These sites are all shallow, meso- to macrotidal, with differing wave exposure, from sheltered in Teychan Bis to moderately exposed at Ouest Loscolo and Le Cornard. From 1987 onwards, the basic environmental variables (salinity, temperature, and turbidity) are measured together with phytoplankton composition and abundance. Variables such as inorganic nutrient concentrations, chlorophyll *a*, phaeopigments, and oxygen were included in the time series of most of the sites later in different years.

## Gravelines Station

**Country:** France

**IGMETS-ID:** fr-50201

***Elvire Antaja, Christophe Loots, and Alain Lefebvre***




The French Research Institute for Exploitation of the Sea (Ifremer) has established a monthly time series of zooplankton species since 1978 at Gravelines, a station located in the western port of Dunkirk at the lower end of the southern bight of the North Sea. This ecological survey is done in the framework of a research programme designed to observe environmental evolution on the site of a nuclear power plant. The Gravelines Station is located in the entrance of the channel inflow to the power plant and is not impacted by the power plant water discharge. The monitoring at Gravelines Station also includes the following parameters measured on a weekly basis: temperature, ammonium, nitrate, chlorophyll *a*, phaeopigment concentrations, and phytoplankton abundance.

Related information: http://wwz.Ifremer.fr/manchemerdunord

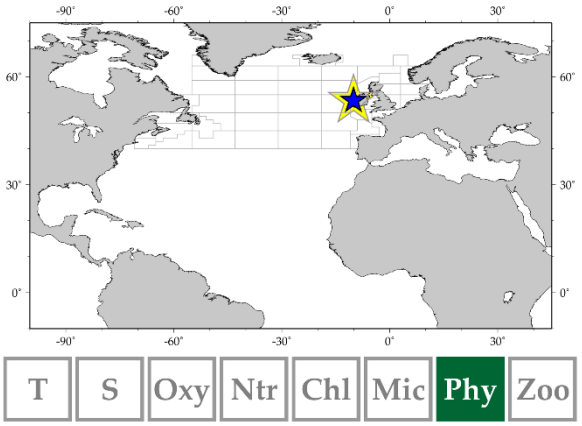
## Time Series Stations Ireland

**Country:** Ireland

**Site name (IGMETS-ID):**

East Coast Ireland (ie-30101)
Northwest Coast Ireland (ie-30102)
South Coast Ireland(ie-30103)
Southwest Coast Ireland (ie-30104)
West Coast Ireland (ie-30105)

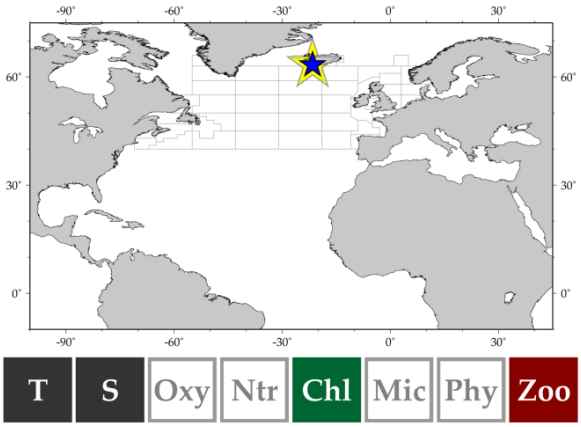
***Joe Silke and Rafael Salas***




The Marine Institute in Ireland carries out a national phytoplankton monitoring programme which extends back to the late 1980s. This includes a harmful algal blooms (HABs) monitoring service that warns producers and consumers of concentrations of toxic plankton in Irish coastal waters that could contaminate shellfish or cause fish deaths and also a series of sentinel stations that are monitored for the European Water Framework. Since 1990, data have been captured in a systematic manner and logged into an electronic database. Principal component analysis of the dataset resulted in five groups of sites. Based on the data extracted and amalgamated from these regions, it is deemed to be a good representation of the phytoplankton flora for these regions. Sites were sampled by a variety of methods, either surface samples, discrete Ruttner sampling bottles, or tube samplers. Following fixing by Lugol's iodine, they were analysed using the Utermöhl method. Species were identified and enumerated, and cell counts were expressed in cells $l^{-1}$. Average sea surface temperatures for western and southern waters of Ireland range from 8–10°C in winter to 14–17°C in summer and tend to be several degrees higher than the eastern waters. As the water column stratifies in summer, a surface-to-bottom temperature difference of up to 6°C is typical of waters along the Atlantic shelf and Celtic Sea. Along the coast, turbulent tidal currents are sufficient to prevent establishment of stratification, and the water remains mixed throughout the year. The boundary between mixed and stratified waters in summer is marked by tidal fronts that influence the composition and density of phytoplankton community in these areas.

Related information: http://www.marine.ie/habs

## Selvogsbanki Transect (southern Iceland)




**Country:** Iceland

**IGMETS-ID:** is-30102

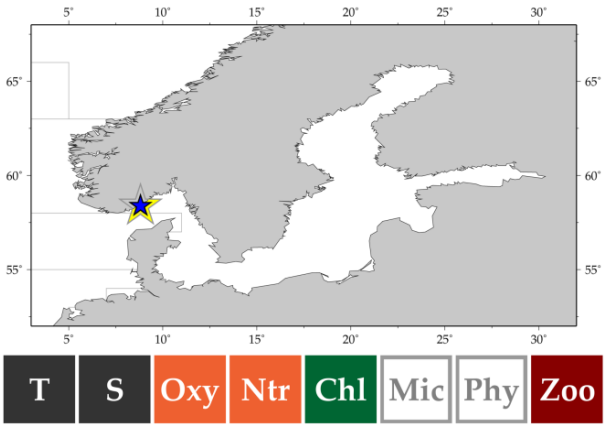
*see also Siglunes Transect (Arctic Ocean, is-30101)*

***Astthor Gislason, Hafsteinn Gudfinnsson, and Kristinn Gudmundsson***

The Icelandic monitoring programme for hydrography, nutrients, phytoplankton, and zooplankton consists of a series of standard transects around Iceland perpendicular to the coastline. In the 1960s, sampling was started at stations along transects north and east of Iceland. Additional transect lines south and west were added in the 1970s. Currently, there are ca. 90 stations, with sampling carried out at these stations every year in May and June. In this IGMETS study, we have included data from the Siglunes Transect off northern Iceland and the Selvogsbanki Transect off southwestern Iceland. These two transects represent conditions from two very different water bodies. The Siglunes Transect contains plankton communities and hydrography primarily from subarctic, polar waters, while the Selvogsbanki Transect community and conditions predominantly represent North Atlantic water. As such, the Iceland contribution to IGMETS is found in both the Arctic Ocean (Chapter 3) and the North Atlantic (Chapter 4) sections.

Related information: http://www.hafro.is/index_eng.php

## Arendal Station 2




**Country:** Norway

**IGMETS-ID:** no-50401

***Tone Falkenhaug and Lena Omli***

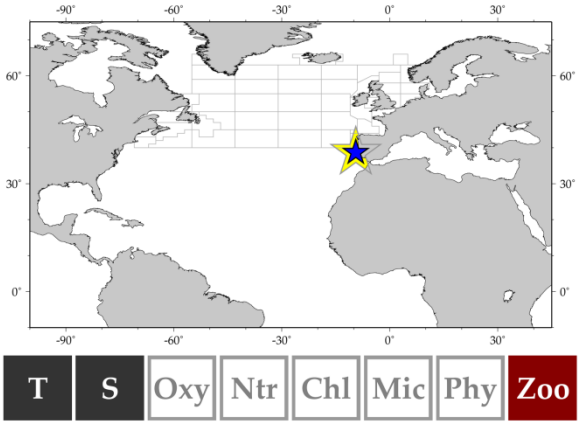
The zooplankton time series at Arendal Station 2 in northern Skagerrak was established in 1994 by the Institute of Marine Research (IMR, Norway) with the objective of monitoring the environmental status in coastal waters and documenting long-term changes in the plankton communities. The site is located at 58°23′N 08°49′E, 1 nautical mile offshore from the IMR Flødevigen Research Station in a water depth of 105 m. The Skagerrak is located downstream of the North Sea, the Baltic Sea, and the Kattegat. Water bodies of different origin enter and influence the site, which is characterized by strong seasonal variations in temperature, light, and nutrients. Sampling at Arendal Station 2 is carried out twice a month. Zooplankton is sampled from 50 m to the surface using vertical ring net tows (180-µm mesh). Data on hydrography and samples for nutrients and chlorophyll are collected using a CTD profiler fitted with a water bottle rosette.

## Cascais Watch (Cascais Bay)

**Country:** Portugal

**IGMETS-ID:** pt-30101

***Antonina dos Santos, Miguel P. Santos, João Pastor, and Alexandra Silva***



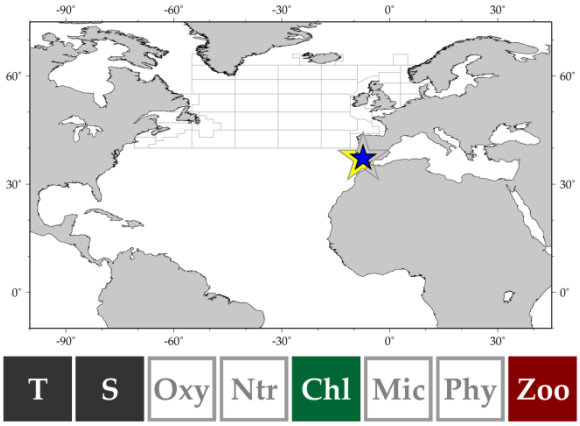

The Cascais site (since 2005) is a station of the Oceanography and Plankton Group of IPMA for providing long-term oceanographic information capable of detecting seasonal and interannual changes in plankton related to environmental conditions. The station is located off Cascais, outside the Tejo River estuary at 38°40′N 09°26′W at the west coast of Portugal. The site is considered to be under the influence of the Eastern North Atlantic Upwelling System in spring and summer. This seasonal upwelling is responsible for the high phytoplankton production which promotes stable zooplankton abundance throughout the year (Santos *et al*., 2007). Environmental parameters such as temperature, salinity, and fluorescence are collected *in situ* (CTD) and measured along with zoo- and phytoplankton sampling to obtain diversity and abundance of plankton taxa. Monthly precipitation and upwelling index values are also obtained. Plankton assemblages are very diverse and include temperate, subtropical, and tropical species.

## Guadiana Lower Estuary

**Country:** Portugal

**IGMETS-ID:** pt-30201

***Maria Alexandra Teodósio, Joana Cruz, Pedro Morais, Marco Mattos, Joao Pedro Encarnacao, Renata Goncalves, Susana Ferreira, Teja Muha, Vanessa Neves, Vania Baptista, and Luis Chicharo***



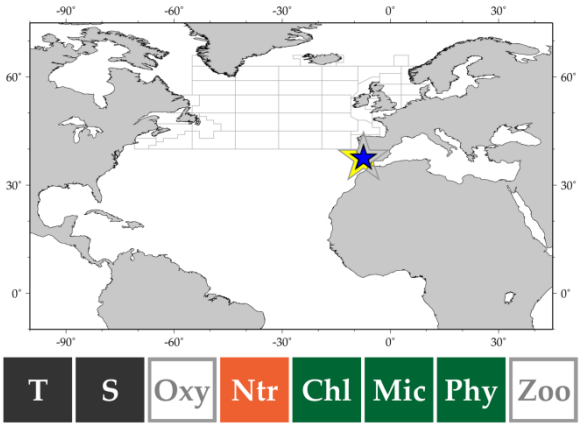

The Lower Guadiana Estuary time series, established in the south Iberia Peninsula in 1997, aims at understanding linkages between hydrological and zooplanktonic processes and how these change over time. It also aims at monitoring early phases of invasive species. The sampling conducted nearly every month includes a programme at two stations located at 37°13'N 07°24'W and 37°07'N 07°24'W, with depth ranging from 5 to 30 m and using a WP-2 net.The construction of the large Alqueva Dam, whose construction began in the upper estuary in 1999 and was completed in 2002, increased freshwater flow regulation in the area. As a consequence, the Guadiana estuary shifts between being freshwater-dominated during winter and flood periods and registering a marine influence during most of the year. In recent years, a reduction in productivity and an increase of invasive species was reported: *Blackfordia virginica* (Chícharo *et al*., 2009), *Maeotias marginata* (Muha *et al*., 2017), *Fundulus heteroclitus* (Gonçalves *et al*., 2015), *Mnemiopsis leidyi* (Cruz *et al*., subm.). The flow stability seems to facilitate introductions for different species while the natural flow regime, with low and high freshwater discharge, discourage invasions, as native biota has evolved in response to overall flow regime. An integrated management approach – i.e. freshets released from dams to control the populations– was proposed to minimize or mitigate the putative impacts of these species in the Guadiana estuary.

## Guadiana Upper Estuary

**Country:** Portugal

**IGMETS-ID:** pt-30301

***Ana B. Barbosa, Rita B. Domingues, and Helena M. Galvão***



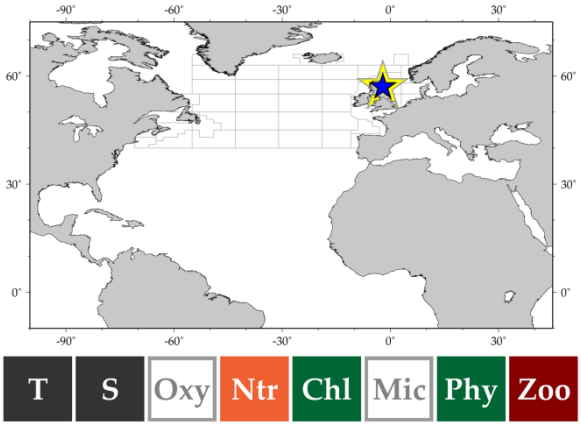

Monitoring the Guadiana Upper Estuary by the Aquatic Microbiology Laboratory at Universidade do Algarve (autumn 1996 to autumn 2010) was aimed at studying cyanobacteria bloom dynamics in the freshwater zone in the period before, during, and after construction of the Alqueva Dam. This huge dam, completed in 2003, is located 150 km upstream and has a total catchment of 55 000 km², further restricting river flow from 75 to 81%. The Guadiana River situated in an arid Mediterranean region has a torrential flow regime varying markedly both seasonally and interannually, thus exerting a strong regulating influence on chlorophyll maxima, which typically occur in the upper estuary. Potentially toxic cyanobacteria predominated in the freshwater zone from mid-summer to late autumn due to seasonal shifts in nutrients (Rocha *et al.*, 2002). The Alqueva Dam construction was hypothesized to increase intensity of cyanobacteria blooms, but contributed instead to oligotrophication and the disappearance of cyanobacteria blooms in the upper estuary (Galvão *et al.*, 2012).

## Stonehaven, East Scotland

**Country:** United Kingdom

**IGMETS-ID:** uk-30101

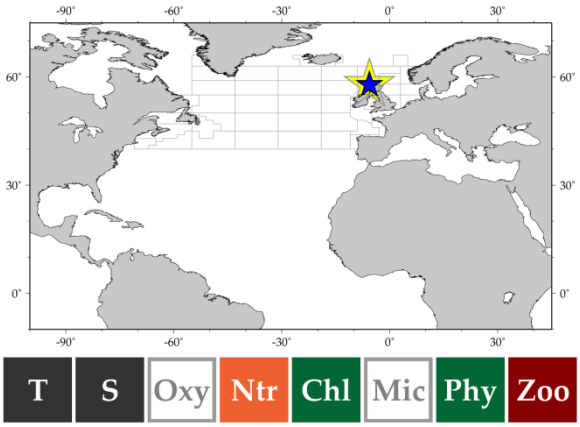
***Eileen Bresnan and Kathryn Cook***




The Marine Scotland Science (MSS) Stonehaven sampling site is located in the northern North Sea at 56°57'N 02°06'W, ca. 5 km offshore. It is part of a network of coastal ecosystem monitoring sites operated by MSS around the Scottish coast to provide information on baseline environmental conditions that act as reference sites to fulfil the requirements of the EU Water Framework Directive and to test the development of tools to identify "Good Environmental Status" for the Marine Strategy Framework Directive. The origins of water passing down the Scottish east coast lie mainly north and west of Scotland and are a variable mix of coastal and oceanic Atlantic waters. The site has a water depth of 50 m and has been sampled weekly since 1997. A wide range of parameters are measured, including surface and near-seabed temperature, salinity, nutrient concentrations, carbon chemistry, integrated (0–10 m) chlorophyll concentrations, and phytoplankton and zooplankton community composition.

Related information: http://www.gov.scot/Resource/Doc/295194/0099701.pdf

## Loch Ewe, West Scotland




**Country:** United Kingdom

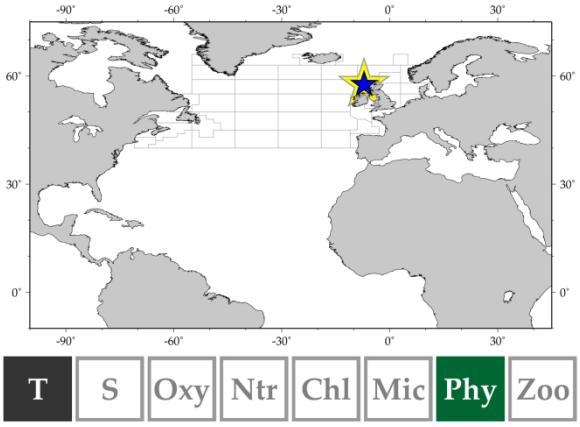
**IGMETS-ID:** uk-30102

***Eileen Bresnan and Kathryn Cook***

The Marine Scotland Science (MSS) Loch Ewe sampling site is located at 57°51'N 05°39'W ca. 0.5 km offshore in a sea loch. It is part of a network of coastal ecosystem monitoring sites operated by MSS around the Scottish coast to provide information on baseline environmental conditions that act as reference sites to fulfil the requirements of the EU Water Framework Directive and to test the development of tools to identify "Good Environmental Status" for the Marine Strategy Framework Directive. To the north, the loch opens into the North Minch and then the eastern Atlantic. Water movements in this loch are complex and strongly influenced by wind and tide. The site has a water depth of 40 m and has been sampled weekly since 2002. A wide range of parameters are measured including surface and near-seabed temperature, salinity, nutrient concentrations, integrated (0–10 m) chlorophyll concentrations, and phytoplankton and zooplankton community composition.

Related information: http://www.gov.scot/Resource/Doc/295194/0099701.pdf

## Loch Maddy




**Country:** United Kingdom

**IGMETS-ID:** uk-30103

***Eileen Bresnan***

Loch Maddy (Site 38, 57°36'N 07°08'W) is located on the Island of North Uist, part of the Western Isles. It is a unique site with a diverse saline lagoon system opening into the sea loch, which contains a mix of rocky reefs and soft-sediment habitats. This system supports a rich diversity of marine life and, as a result, has been designated a marine special area of conservation (SAC). Loch Maddy has been participating in the Marine Scotland Science Coastal Ecosystem Monitoring Programme since 2003.

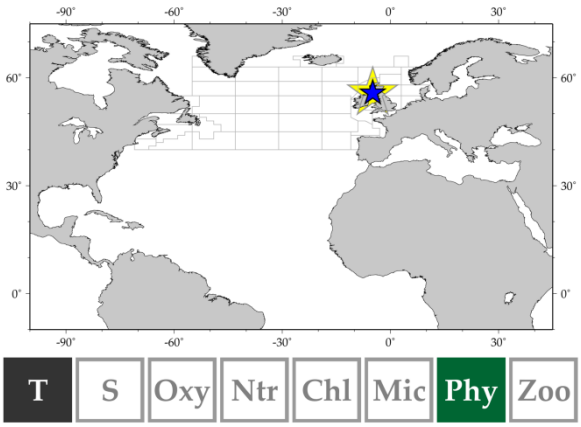
Related information: http://www.gov.scot/Resource/Doc/295194/0099701.pdf

## Millport, The Clyde

**Country:** United Kingdom

**IGMETS-ID:** uk-30104

***Eileen Bresnan***




The Marine Scotland Science (MSS) Millport sampling site is located at 55°44'N 04°54'W. It is part of a network of coastal ecosystem monitoring sites operated by MSS around the Scottish coast to provide information on baseline environmental conditions. Millport is situated on the Isle of Cumbrae in the Clyde Sea. The monitoring site is at Keppel Pier where there is one of the longest time series of temperature data in the UK. Monitoring for phytoplankton began in this site in 2005. Samples are collected by the Field Studies Centre on the Island.

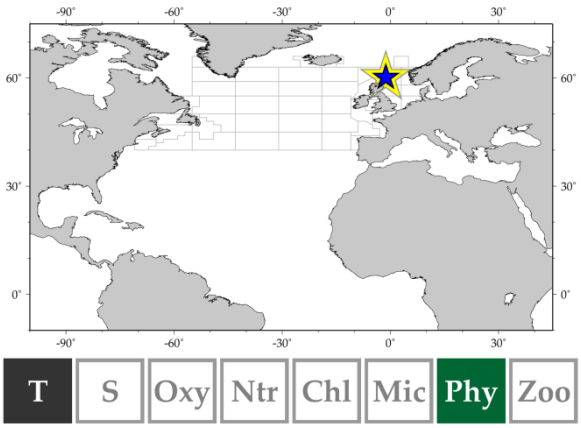
Related information: http://www.gov.scot/Resource/Doc/295194/0099701.pdf

## Scalloway, Shetland Island

**Country:** United Kingdom

**IGMETS-ID**: uk-30105

***Eileen Bresnan***




The Marine Scotland Science (MSS) Scapa Bay sampling site is located at 60°08'N 01°16'W. It is part of a network of coastal ecosystem monitoring sites operated by MSS around the Scottish coast to provide information on baseline environmental conditions that act as reference sites to fulfil the requirements of the EU Water Framework Directive and to test the development of tools to identify "Good Environmental Status" for the Marine Strategy Framework Directive. The Shetland Islands lie over 100 miles north of the UK mainland. Atlantic water from west of the UK enters the North Sea between Orkney and Shetland and also around northeast Shetland. Scalloway is located on the southwest coast of Shetland. Sampling is performed by the North Atlantic Fisheries College. The site has been sampled weekly since 2001. A range of parameters are measured including temperature, salinity, nutrient concentrations, and phytoplankton community composition.

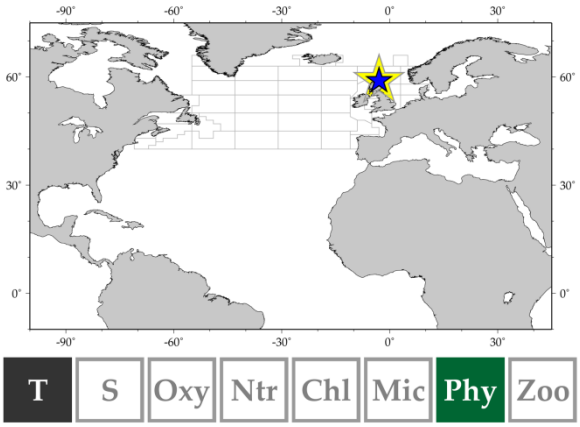
Related information: http://www.gov.scot/Resource/Doc/295194/0099701.pdf

## Scapa Bay, Orkney Islands

**Country:** United Kingdom

**IGMETS-ID:** uk-30106

***Eileen Bresnan***




The Marine Scotland Science (MSS) Scapa Bay sampling site is located at 58°57′N 02°58′W. It is part of a network of coastal ecosystem monitoring sites operated by MSS around the Scottish coast to provide information on baseline environmental conditions that act as reference sites to fulfil the requirements of the EU Water Framework Directive and to test the development of tools to identify "Good Environmental Status" for the Marine Strategy Framework Directive. The Orkney Islands are an archipelago of over 70 islands which lie 50 miles north of the UK mainland. The Scapa Bay monitoring site is located at Scapa Pier, and samples are collected by Orkney Islands Harbour Council on a voluntary basis. The site has been sampled weekly since 2001. A range of parameters are measured including temperature, salinity, nutrient concentrations, and phytoplankton community composition.

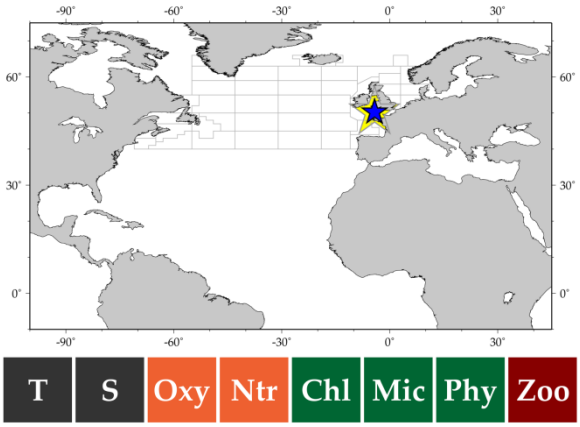
Related information: http://www.gov.scot/Resource/Doc/295194/0099701.pdf

## Plymouth L4

**Country:** United Kingdom

**IGMETS-ID:** uk-30201

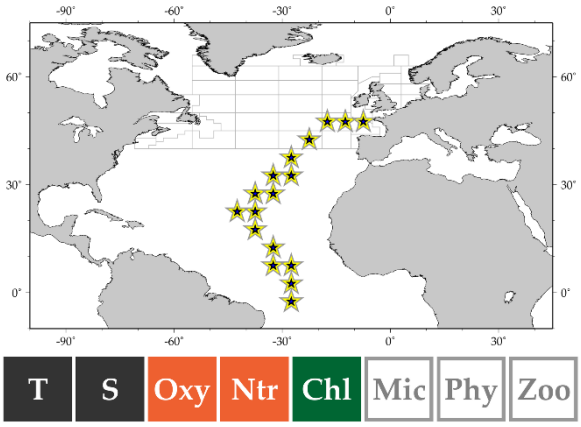
***Tim Smyth, James Fishwick, Malcolm Woodward, Glen Tarran, Ruth Airs, Claire Widdicombe, and Angus Atkinson***




L4 is one of a series of stations, now known as the Western Channel Observatory, that have been sampled periodically for over a century. Sampling of L4 (13 km from Plymouth, ca. 50 m water depth) has been on weekly basis since 1988. Another site, E1 lying further offshore, is sampled fortnightly. Buoys at both sites provide finer resolution. L4 provides both a time series and a biodiversity reference site, since a wide range of process measurements, including the benthos, augment the monitoring. Trophic levels up to fish are covered, including Plymouth Marine Laboratory's measurements on physics, optics, nutrients, flow cytometry, HPLC-pigments, and the identification of over 300 phytoplankton and zooplankton taxa. Although the L4 site is dynamic, it stratifies seasonally, and the high-resolution profiling allow insights into processes at a great range of scale from extreme weather events, through seasonality, up to decadal and longer-term changes.

Related information: http://www.westernchannelobservatory.org.uk/

## Atlantic Meridional Transect (AMT)




**Country:** United Kingdom

**IGMETS-ID:** uk-30601 – uk-30624

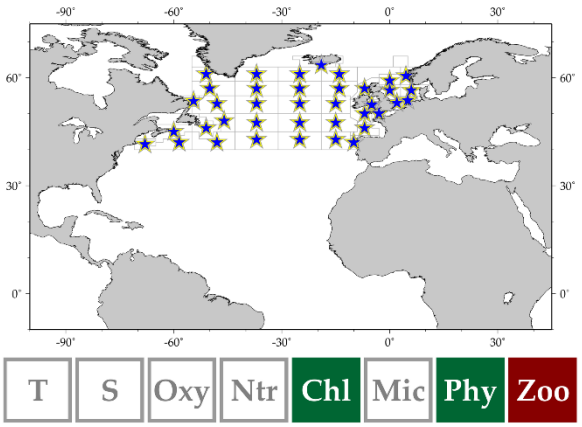
***Andy Rees***

The Atlantic Meridional Transect (AMT) is a multidisciplinary programme which undertakes biological, chemical, and physical oceanographic research during an annual voyage between the UK and destinations in the South Atlantic. AMT began in 1995, with scientific aims to assess mesoscale to basin-scale phytoplankton processes, functional interpretation of bio-optical signatures and seasonal, regional, and latitudinal variations in mesozooplankton dynamics. The programme provided a platform for international scientific collaboration, including the calibration and validation of SeaWiFS measurements and products. The measurements of hydrographic and bio-optical properties, plankton community structure, and primary production completed during the first 12 transects (1995–2000) represent the most coherent set of repeated biogeochemical observations over ocean-basin scales. This unique dataset has led to several important discoveries concerning the identification of oceanic provinces, validation of ocean-colour algorithms, distributions of picoplankton, the identification of new regional sinks of carbon dioxide, and variability in rates of primary production and respiration. In 2002, the programme restarted (2002–2006) and broadened to address a suite of cross-disciplinary questions concerning ocean plankton ecology, biogeochemistry, and their links to atmospheric processes. The programme is coordinated and led by Plymouth Marine Laboratory in collaboration with the National Oceanography Centre.

Related information: http://www.amt-uk.org/

*The spatial subsetting and analysis of the AMT time series was still being processed at the time of the preparation of this report, and data were, therefore, not included in the analysis presented in Chapter 4. Upon incorporation in the IGMETS assessment, the AMT contribution will be available online (http://igmets.net/explorer).*

## North Atlantic Continuous Plankton Recorder (CPR) survey




**Country:** United Kingdom

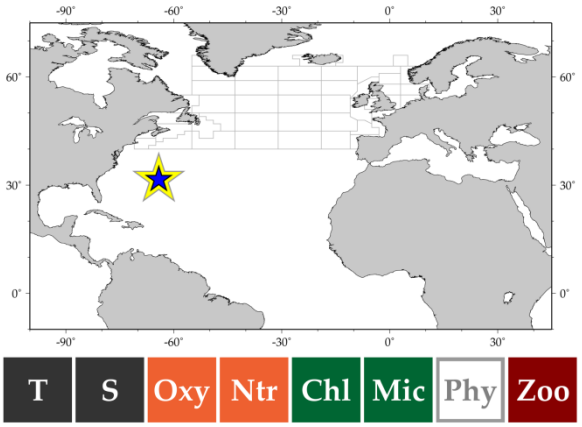
**IGMETS-ID:** uk-40106, uk-40111, uk-40112; uk-40114 through uk-40118, uk-40121 through uk-40128, uk-40131 through uk-40139, uk-40144 through uk-40150, uk-40154 through uk-40160 *see also entry in the Arctic Ocean Annex*

***Martin Edwards, Priscilla Licandro, Claudia Castellani, and Rowena Stern***

The Continuous Plankton Recorder (CPR) survey is a long-term, subsurface, marine plankton monitoring programme consisting of a network of CPR transects towed monthly across the major geographical regions of the North Atlantic. It has been operating in the North Sea since 1931, with some standard routes existing with virtually unbroken monthly coverage back to 1946. After each tow, the CPR samples are returned to the laboratory for routine analysis, including the estimation of phytoplankton biomass (Phytoplankton Colour Index, PCI) and the identification of up to 500 different phytoplankton and zooplankton taxa (Warner and Hays, 1994). Direct comparisons between the Phytoplankton Colour Index and other chlorophyll *a* estimates, including SeaWiFS satellite estimates, indicate strong positive correlations (Batten *et al*., 2003; Raitsos *et al*., 2005).

Related information: http://sahfos.org/

## Bermuda Atlantic Time-series Study




**Country:** United States

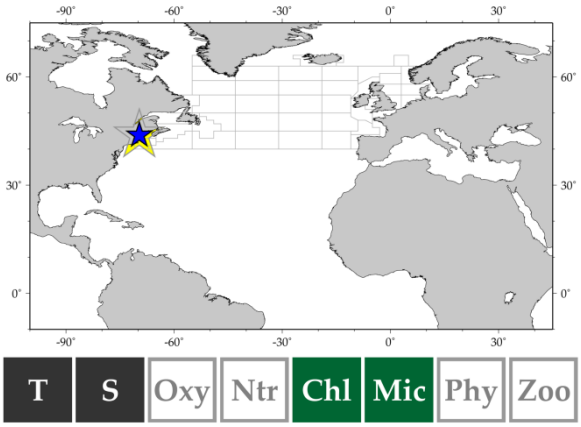
**IGMETS-ID:** us-10101

***Nicholas R. Bates, Rodney J. Johnson, Deborah K. Steinberg, and Michael W. Lomas***

The Bermuda Atlantic Time-series Study (BATS) programme has sampled the northwestern Sargasso Sea on a biweekly (January–April) to monthly basis (biweekly during January–April) since October 1988. The primary objective of the core BATS programme continues to be an improved understanding of the time-variable processes and mechanisms that control the biogeochemical cycling of carbon and related elements in the surface ocean. This study region is largely representative of other oligotrophic ocean regions, but does have a strong seasonal signal, with increased deep mixing and a seasonal peak in primary production in spring, followed by strong depletion of inorganic carbon in the surface ocean in summer (Lomas *et al*., 2013). With 25+ years of measurements for many chemical, physical, and biological variables, we are able to move beyond descriptions of seasonal and interannual variability to examination of multiyear trends (Bates *et al*., 2014) and potential climatic controls on organic matter production, export, and remineralization.

Related information: http://bats.bios.edu

## Boothbay – Maine




**Country:** United States

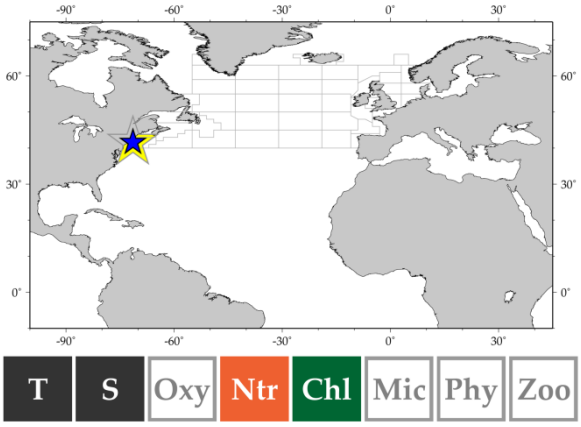
**IGMETS-ID:** us-10401

***Nicole Poulton and Mike Sieracki***

Boothbay is a small mesotidal embayment located along mid-coast Maine, USA, with no major river input. Circulation is dominated by strong semi-diurnal tidal mixing with offshore Gulf of Maine coastal waters. The monitoring site was initiated from a floating dock in 2000 located near the State of Maine's Department of Marine Resources. The purpose of the study is to monitor long-term physical and chemical changes and phytoplankton population dynamics. Weekly observations at high tide of phytoplankton, bacteria, and eukaryotic heterotrophs are made using flow cytometry. Temperature, salinity (refractometer measurements), and size-fractionated chlorophyll *a* are also determined. Flow cytometric ataxonomic groups are defined and enumerated (*Synechococcus*, cryptophytes, and total phytoplankton < 20 µm). Microplankton taxonomic distribution (15–300 µm) and abundance are collected using an imaging cytometer, FlowCAM (Sieracki *et al.*, 1998). As of 2012, nutrients and zooplankton abundance and composition (vertical net tows) have also been determined.

Related information: http://fac.bigelow.org/

## Narragansett Bay




**Country:** United States

**IGMETS-ID:** us-30201

***Tatiana Rynearson and Ted Smayda***

Narragansett Bay, Rhode Island is a highly productive estuary located on the east coast of North America. Regarded as one of the world's longest-running plankton time series, samples have been collected weekly from Narragansett Bay since the 1950s. Samples are collected once a week for temperature, salinity, turbidity, size-fractionated chlorophyll *a*, and nutrients. Microplankton community composition (species identification and abundance) is determined using a light microscope to quantify live samples. The species list for the >10-µm size fraction includes 246 different species or species complexes of protists. Samples are also collected for the determination of copepod and ctenophore concentrations. The full dataset has been available to the public since 1999.

Related information: http://www.gso.uri.edu/phytoplankton/

## Neuse River Estuary

**Country:** United States

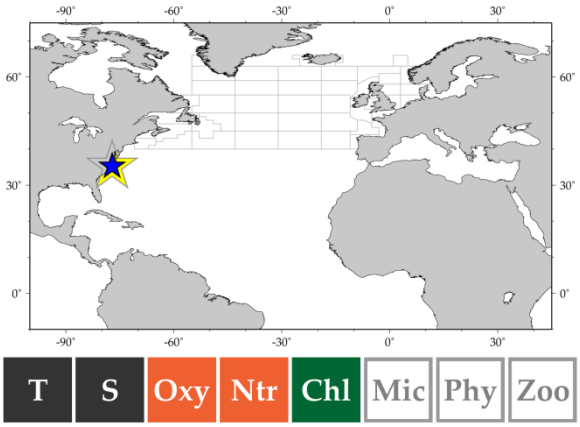
**IGMETS-ID:** us-30301

## Pamlico Sound

**Country:** United States

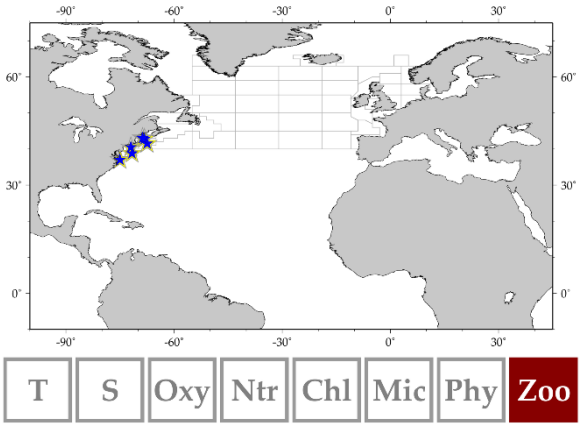
**IGMETS-ID:** us-30301

***Hans Paerl and Ben Peierls***




The Neuse River Estuary (NRE) Modeling and Monitoring Program (ModMon) is a partnership between the University of North Carolina (NC) Institute of Marine Sciences, the NC Department of Environmental and Natural Resources–Division of Water Resources, and the Neuse River Compliance Association that has been collecting and analyzing water quality data on the NRE since 1994. ModMon was created following declines in NRE water quality and in support of nutrient management actions. The NRE is a shallow (3.8 m mean depth), river- and wind-driven, intermittently mixed estuary in eastern NC that is a tributary of Pamlico Sound (4.9 m mean depth), the USA's largest lagoonal estuary. The programme consists of eleven sites in the NRE and nine sites in southwestern Pamlico Sound spanning a gradient of freshwater to seawater salinity. Profiles of *in situ* temperature, salinity, dissolved oxygen, pH, turbidity, and chlorophyll fluorescence are collected at each site, along with surface and near-bottom water samples for nutrient, organic matter, primary productivity, and phytoplankton diagnostic pigment analyses.

## EcoMon Time Series




**Country:** United States

**Site name (IGMETS-ID):**

EcoMon – Gulf of Maine (us-50101)
EcoMon – Georges Bank (us-50102)
EcoMon – Southern New England (us-50103)
EcoMon – Mid-Atlantic Bight (us-50104)
EcoMon – Gulf of Maine CPR Transects (us-50105)
EcoMon – Mid-Atlantic Bight CPR Transects (us-50106)

***Jon Hare***

The Northeast Fisheries Science Center has maintained long-term plankton observing on the Northeast US Shelf using bongo nets towed obliquely to a maximum depth of 200 m. Zooplankton are identified to the lowest taxonomic level possible, and developmental stage is determined for a subset of species. Taxonomic analyses are conducted at the Plankton Sorting and Identification Center in Szczecin, Poland. The survey area extends from Cape Hatteras, North Carolina to the western portions of the Scotian Shelf and encompasses four regions: Gulf of Maine, Georges Bank, Southern New England, and Mid-Atlantic Bight. The observations started in 1977 and surveys have occurred 6–8 times a year to resolve the large seasonality in the ecosystem. Since 2013, the seasonal coverage has been cut to four surveys per year. The effort is described more fully in McClatchie *et al*. (2014) and Kane (2007).

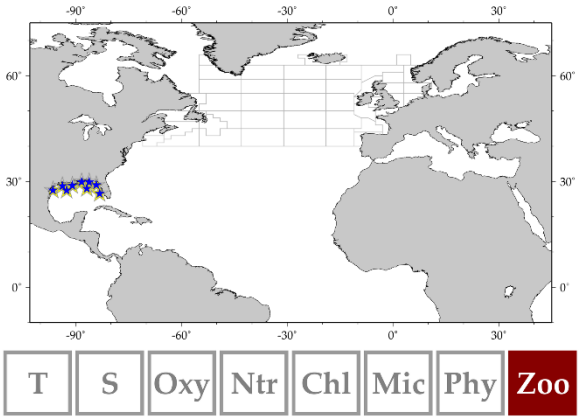
The Northeast Fisheries Science Center supported monthly Continuous Plankton Recorder (CPR) transects across the Gulf of Maine and the Mid-Atlantic Bight. Sampling began in the early 1960s in the Gulf of Maine and the mid-1970s in the Mid-Atlantic. The CPR was towed behind merchant vessels, and zooplankton and phytoplankton were identified to the lowest taxonomic level by experts at the NEFSC and the Plankton Sorting and Identification Center in Gydnia, Poland. The monthly sampling well resolved the strong seasonal cycle in the Northeast US Shelf ecosystem. The NEFSC canceled the programmes in 2013, and operations were shifted to the Sir Alister Hardy Foundation for Ocean Science. Samples are not being processed, but are being stored until funds for processing can be found. The effort is described more fully in Jossi and Kane (2013).

## SEAMAP Plankton Time Series

**Country:** United States

**Site name (IGMETS-ID):**

SEAMAP: Texas/Louisiana Shelf West (us-50201)
SEAMAP: Texas/Lousiana Shelf Central (us-50202)
SEAMAP: Texas/Louisiana Shelf East (us-50203)
SEAMAP: Mississippi/Alabama Shelf (us-50204)
SEAMAP: Florida Shelf (us-50205, us-50206, us50207)
SEAMAP: Northeast Gulf of Mexico (us-50208)
SEAMAP: Northwest Gulf of Mexico (us-50209)




***David S. Hanisko and Glenn Zapfe***

The SouthEast Area Monitoring and Assessment Program (SEAMAP) is a state/federal/university cooperative programme for collection, management, and dissemination of fishery-independent data and information in the southeastern United States. SEAMAP has been conducting plankton surveys throughout the Gulf of Mexico since 1982. The goal of these surveys has been to assemble a time series of data on the occurrence, abundance, and geographical distribution of fish eggs and larvae, as well as to collect data on selected physical properties of their pelagic habitat (McClatchie *et al.*, 2014). The SEAMAP plankton sampling domain covers the entire northern GOM from the 10-m isobath out to the US EEZ and comprises ca. 300 designated sampling sites arranged in a fixed, systematic grid. Intermittent sampling outside the SEAMAP domain has also occurred. Sampling is carried out principally during three dedicated plankton surveys, but is also piggybacked onto other fishery-independent resource surveys. Samples are primarily taken utilizing 60-cm bongo and/or 1 × 2 m neuston nets.

Related information: http://www.gsmfc.org/#:content@3:links@4
http://www.sefsc.noaa.gov/labs/mississippi/surveys/plankton.htm

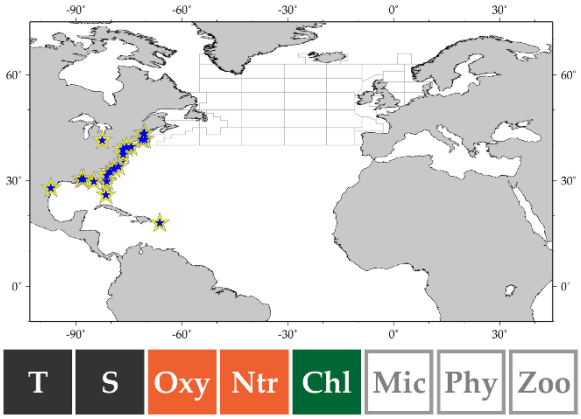
## National Estuarine Research Reserve System (NERRS)

## System-wide Monitoring Program (SWMP)

**Country:** United States

**Site name (IGMETS-ID):** us-60101 - us-60126

***Dwayne Porter (liaison)***



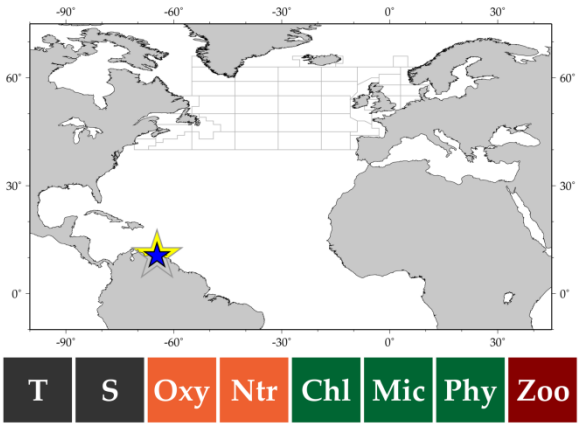

The National Estuarine Research Reserve System (NERRS) is a network of 28 coastal sites designated to protect and study estuarine systems. Established through the Coastal Zone Management Act, the reserves represent a partnership programme between the National Oceanic and Atmosphere Administration (NOAA) and the coastal states. NOAA provides funding and national guidance, and each site is managed on a daily basis by a lead state agency or university with input from local partners.

NERRS acknowledges the importance of both long-term environmental monitoring programmes and data and information dissemination through its support of the NERRS System-wide Monitoring Program (SWMP). The goal of the SWMP is to identify and track short-term variability and long-term changes in the integrity and biodiversity of representative estuarine ecosystems and coastal watersheds for the purpose of contributing to effective national, regional, and site-specific coastal zone management. This comprehensive programme consists of three phased components: estuarine water quality monitoring, biodiversity monitoring, and land-use and habitat change analysis.

The NERRS research reserves encompass 1.3 million acres of estuaries along the US coastlines.

Related information: https://coast.noaa.gov/nerrs/

## CARIACO Ocean Time Series, Venezuela




**Country:** Venezuela

**IGMETS-ID:** ve-10101

***Laura Lorenzoni and Frank Muller-Karger***

The CARIACO Ocean Time Series Project was established in the Cariaco Basin in November 1995 with support from the Venezuelan Fondo Nacional de Ciencia, Tecnología e Investigación (FONACIT) and the US National Science Foundation (NSF). The Cariaco Basin is a semi-enclosed tectonic depression located on the continental shelf off northern Venezuela in the southern Caribbean Sea. It is composed of two ca. 1400 m deep subbasins that are connected to the Caribbean Sea by two ca. 140 m deep channels. These channels allow for open exchange of near-surface water. The restricted circulation below the 140-m sill, coupled with highly productive surface waters due to seasonal wind-driven coastal upwelling (ca. 450 g C $m^{-2}$ $year^{-1}$; Muller-Karger *et al*., 2010), has led to sustained anoxia below about 250 m. The goal of the project is to understand linkages between oceanographic processes and the production, remineralization, and sinking flux of particulate matter in the Cariaco Basin and how these change over time. It also aims at understanding climatic changes in the region, as well as in the Atlantic Ocean, and how variation in the processes are preserved in sediments accumulating in this anoxic basin. CARIACO conducts near-monthly cruises to the station (10°30'N 64°40'W) to collect a core suite of biogeochemical and ecological samples. It also has a microbiology component, which carries out specific biannual cruises, and a sediment trap mooring which collects particle fluxes biweekly at five depths from ca. 150 m to ca. 1200 m.

Related information: http://imars.marine.usf.edu/cariaco

# A2 North Atlantic Ocean
## Baltic Sea

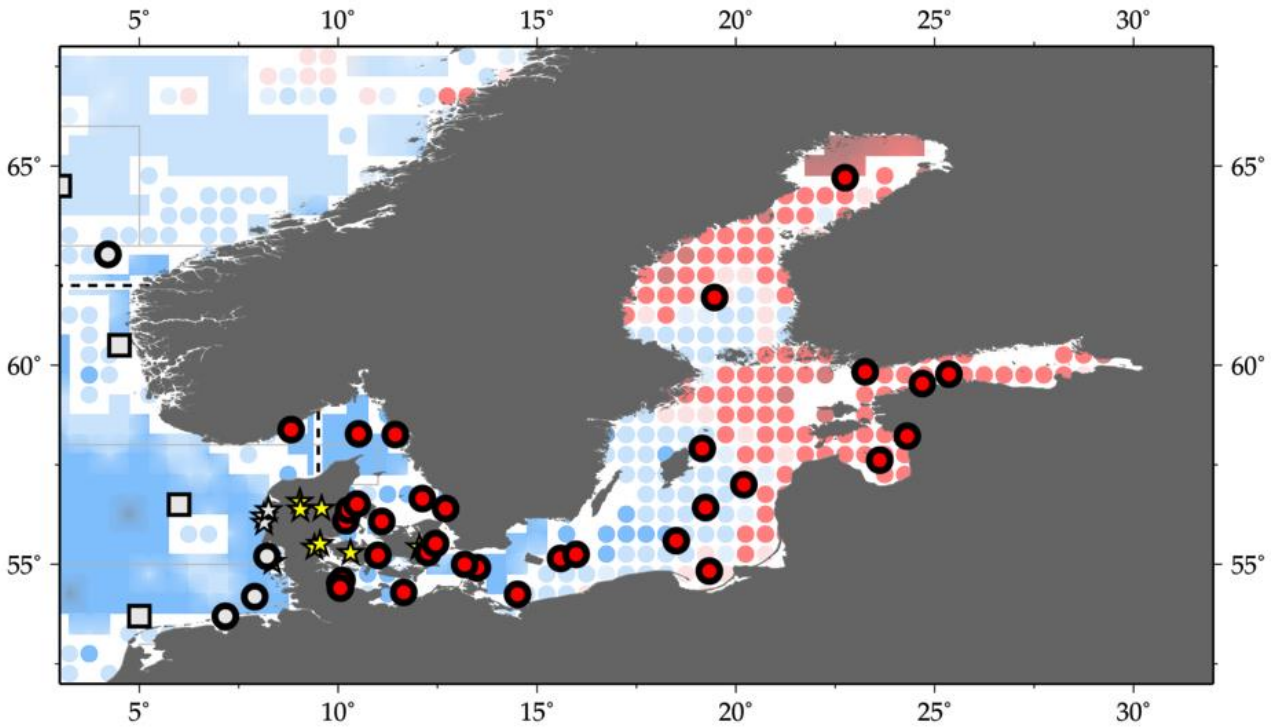


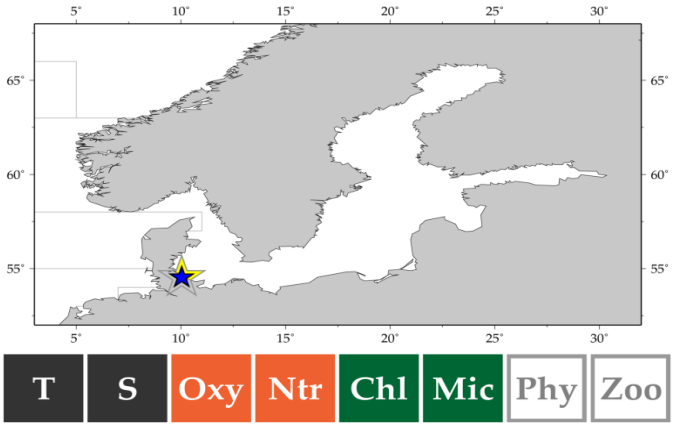

**Figure A2.2.** Map of IGMETS-participating North Atlantic – Baltic Sea time series on a background of a 10-year time-window (2003–2012) sea surface temperature trends (see also Chapter 4). At the time of this report, the North Atlantic – Baltic Sea collection consisted of 41 time series (coloured symbols of any type), of which seven were from estuarine areas (yellow stars). Uncoloured (gray) symbols indicate time series being addressed in a different regional chapter or subregion (e.g. Arctic Ocean, North Atlantic Proper).

**Table A2.2.** Time-series sites located in the IGMETS North Atlantic – Baltic Sea region. Participating countries: Germany (de), Denmark (dk), Estonia (ee), Finland (fi), Latvia (lv), Poland (pl), and Sweden (se).

| No. | IGMETS-ID | Site or programme name | Year-span | T | S | Oxy | Ntr | Chl | Mic | Phy | Zoo |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | de-10201 | Boknis Eck Time Series Station *(Eckernfoerde Bay – SW Baltic Sea)* | 1957–present | X | X | X | X | X | X | - | - |
| 2 | de-30101 | Arkona Basin (*Southern Baltic Sea*) | 1979–present | X | X | X | X | X | X | X | X |
| 3 | de-30102 | Bornholm Basin (*Southern Baltic Sea*) | 1979–present | X | X | X | X | X | X | X | - |
| 4 | de-30103 | Mecklenburg Bight (*Southern Baltic Sea*) | 1980–present | X | X | X | X | X | X | X | - |
| 5 | de-30104 | Eastern Gotland Basin (*Southern Baltic Sea*) | 1979–present | X | X | X | X | X | X | X | - |
| 6 | dk-30102 | Arhus Bugt: DNAMAP-170006 (*Baltic Sea*) | 1979–present | X | X | X | X | X | - | X | - |
| 7 | dk-30103 | Koge Bugt: DNAMAP-1727 (*Baltic Sea*) | 1985–present | X | X | X | X | X | - | X | - |
| 8 | dk-30104 | Hevring Bugt: DNAMAP-190004 (*Baltic Sea*) | 1985–present | X | X | X | X | X | - | X | - |
| 9 | dk-30108 | Logstor Bredning: DNAMAP-3708-1 (*Baltic Sea*) | 1980–present | X | X | X | X | X | - | X | - |
| 10 | dk-30109 | Skive Fjord: DNAMAP-3727-1 (*Baltic Sea*) | 1980–present | X | X | X | X | X | - | X | - |
| 11 | dk-30111 | Alborg Bugt: DNAMAP-409 (*Baltic Sea*) | 1981–present | X | X | X | X | X | - | X | - |
| 12 | dk-30112 | Anholt East: DNAMAP-413 (*Baltic Sea*) | 1981–present | X | X | X | X | X | - | X | - |
| 13 | dk-30113 | Vejle Fjord: DNAMAP-4273 (*Baltic Sea*) | 1982–present | X | X | X | X | X | - | X | - |
| 14 | dk-30114 | Ven: DNAMAP-431 (*Baltic Sea*) | 1979–present | X | X | X | X | X | - | X | - |
| 15 | dk-30115 | Arkona: DNAMAP-444 (*Baltic Sea*) | 1979–present | X | X | X | X | X | - | X | - |
| 16 | dk-30116 | Mariager Fjord: DNAMAP-5503 (*Baltic Sea*) | 1979–present | X | X | X | X | X | - | X | - |
| 17 | dk-30117 | Horsens Fjord: DNAMAP-5790 (*Baltic Sea*) | 1981–present | X | X | X | X | X | - | X | - |
| 18 | dk-30118 | Roskilde Fjord: DNAMAP-60 (*Baltic Sea*) | 1979–present | X | X | X | X | X | - | X | - |
| 19 | dk-30119 | Lillebaelt-South: DNAMAP-6300043 (*Baltic Sea*) | 1979–present | X | X | X | X | X | - | X | - |
| 20 | dk-30120 | Lillebaelt-North: DNAMAP-6870 (*Baltic Sea*) | 1979–present | X | X | X | X | X | - | X | - |

| No. | IGMETS-ID | Site or programme name | Year-span | T | S | Oxy | Ntr | Chl | Mic | Phy | Zoo |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | dk-30121 | Odense Fjord: DNAMAP-6900017 (*Baltic Sea*) | 1979–present | X | X | X | X | X | - | X | - |
| 22 | dk-30122 | Gniben: DNAMAP-925 (*Baltic Sea*) | 1979–present | X | X | X | X | X | - | X | - |
| 23 | dk-30123 | Storebaelt: DNAMAP-939 (*Baltic Sea*) | 1982–present | X | X | X | X | X | - | X | - |
| 24 | dk-30124 | Bornholm Deep: DNAMAP-bmpk2 (*Baltic Sea*) | 1980–present | X | X | X | X | X | - | X | - |
| 27 | ee-10101 | Pärnu Bay (*Gulf of Riga*) | 1957–present | X | X | - | - | X | - | - | X |
| 28 | ee-10201 | Tallinn Bay (*Gulf of Finland*) | 1959–present | X | X | - | - | X | - | - | X |
| 29 | fi-30101 | Bothnian Bay Region: Bo3+F2 (*Northern Baltic Sea*) | 1959–present | X | X | X | X | X | X | X | X |
| 30 | fi-30102 | Bothnian Sea Region: SR5+US5b+F64 (*Northern Baltic Sea*) | 1959–present | X | X | X | X | X | X | X | X |
| 31 | fi-30103 | Gulf of Finland Region: LL3A+LL7+LL12 (*Northern Baltic Sea*) | 1959–present | X | X | X | X | X | X | X | X |
| 32 | fi-30104 | Northern Baltic Proper Region: BY15+BY38+LL17+LL23 (*Northern Baltic Sea*) | 1959–present | X | X | X | X | X | X | X | X |
| 33 | lv-10101 | Station 121 (*Gulf of Riga*) | 1959–present | X | X | - | - | X | - | - | X |
| 34 | lv-10201 | Eastern Gotland Basin (*Central Baltic Sea*) | 1959–present | X | X | X | X | X | - | - | X |
| 35 | pl-30101 | Gdansk Basin (*Baltic Sea*) | 1959–present | X | X | - | X | X | X | X | X |
| 36 | pl-30102 | Bornholm Basin (*Baltic Sea*) | 1959–present | X | X | - | X | X | X | X | X |
| 37 | pl-30103 | Pomeranian Bay (*Baltic Sea*) | 1979–present | X | X | - | X | X | X | X | - |
| 38 | pl-30104 | Southern Gotland Basin (*Baltic Sea*) | 1959–present | X | X | X | - | X | - | - | X |
| 39 | se-50101 | SMHI A17 (*Sweden*) | 1982–present | X | X | X | X | X | X | X | X |
| 40 | se-50102 | SMHI Anholt East (*Kattegat*) | 1959–present | X | X | X | X | X | X | X | X |
| 41 | se-50103 | SMHI Slaggo (*Sweden*) | 1959–present | X | X | X | X | X | X | X | X |

## Boknis Eck Time series Station



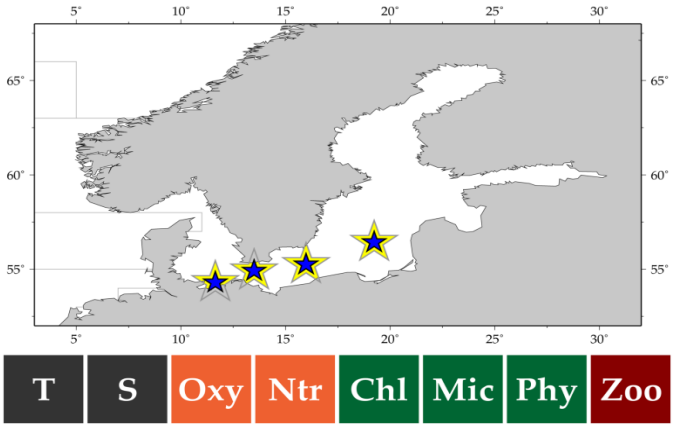

**Country:** Germany

**IGMETS-ID:** de-10201

The Boknis Eck Time series Station (BE) is located at the entrance to Eckernförde Bay (54°31'N 10°02'E; water depth 28 m, muddy sediments) in the south-western Baltic Sea. Samples are taken from six depths on a monthly basis. Salinity, temperature, phosphate, and $O_2$ data have been recorded since 1957. Chlorophyll *a* measurements started in 1960. Additional nutrients (nitrate, nitrite, ammonium, and silicate) and Secchi depths are available since 1979 and 1986, respectively. Since riverine and groundwater inputs are negligible, the overall hydrographic setting at BE is dominated by the regular inflow of North Sea water through the Kattegat and the Great Belt. Seasonal stratification usually occurs from mid-March until mid-September and causes pronounced hypoxia, which sporadically become anoxic. The location of BE is ideal to study (i) a coastal ecosystem under the influence of pronounced changes of salinity and (ii) biogeochemical processes sensitive to changes in dissolved oxygen.

Related information: http://www.bokniseck.de

## IOW Baltic Sea Time Series




**Country:** Germany

**Site name** (IGMETS-ID):

Arkona Basin (de-30101)
Bornholm Basin (de-30102)
Mecklenburg Bight (de-30103)
Eastern Gotland Basin (de-30104)

***Norbert Wasmund and Jörg Dutz***

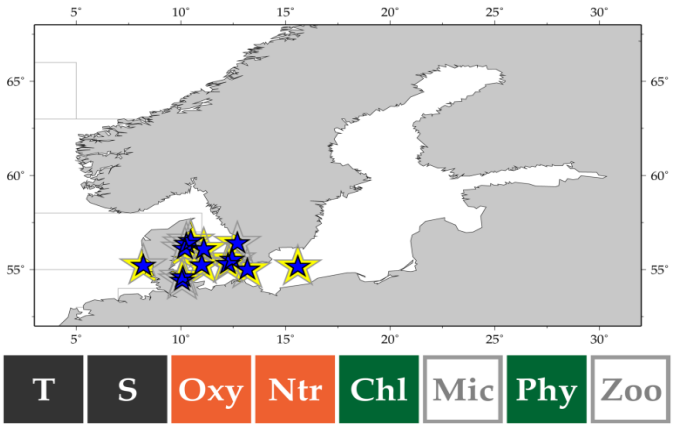
The IOW Baltic Sea Time Series, established in 1979 within the framework of the Helsinki Commission (HELCOM), records long-term changes in plankton abundance, frequency, and biodiversity in relation to climatic and anthropogenic forcing. Monitored sites extend from the western Belt Sea and the Arkona Sea to the Bornholm and eastern Gotland Basin along a pronounced salinity and depth gradient that exerts a strong influence on local plankton. A periodical inflow of seawater and an outflow of Baltic brackishwater cause particularly strong variability in the plankton composition of the western areas. IOW conducts five cruises a year collecting physical, chemical, and biological core data in February, March, May, August, and November. Integrated surface samples for phytoplankton biomass and chlorophyll *a* concentration from the upper 10 m are taken at 10 stations. Zooplankton abundance/biomass is monitored at nine stations, with the sampling depth adjusted to seasonal stratification.

## Danish National Aquatic Monitoring and Assessment Program (DNAMAP)

**Country:** Denmark

**IGMETS-ID:** dk-30101 – dk-30124 (24 sites)

***Jacob Carstensen***



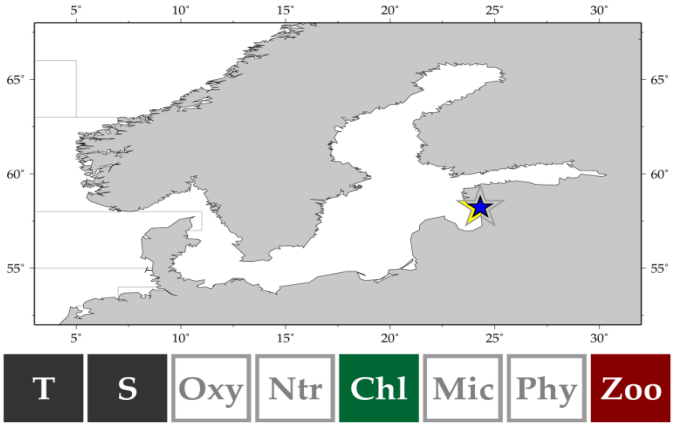

The Danish National Aquatic Monitoring and Assessment Program (DNAMAP) was established in 1989 with the aim of reporting coastal ecosystems responses to nutrient reductions (ca. 50% for N and >80% for P). DNAMAP was based on previous regional and national monitoring activities. The marine monitoring component includes hydrochemistry, phytoplankton, zooplankton, benthic vegetation, benthic macrofauna, harmful substances, and their effects on biota. Sampling and analyses were carried out according to common protocols, and data have been reported to the national database for marine data. Almost 100 stations scattered over estuaries, coastal, and open waters have been monitored for up to four decades. Estuaries and coastal waters are shallow (typically < 10 m), intermittently stratified and impacted by land-based inputs, whereas the open-water stations are permanently stratified due to the exchange of brackish Baltic Sea water with water from the North Sea. The monitoring data provide an excellent example of coastal ecosystem recovery from eutrophication.

## Pärnu Bay Time Series

**Country:** Estonia

**IGMETS-ID:** ee-10101

***Arno Põllumäe, Mart Simm and Maria Põllupüü***



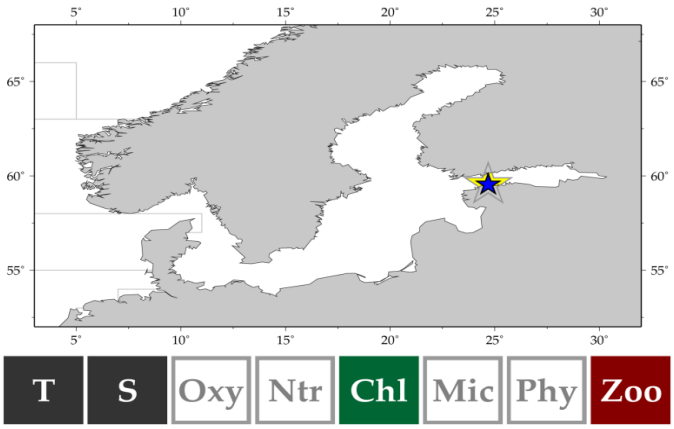

Pärnu Bay in northeastern part of the Gulf of Riga (Baltic Sea) is the site of the longest consistent marine biological sampling in Estonia. Zooplankton sample collection started in 1957 to assess feeding conditions for herring (*Clupea harengus membras*). Since 1993, three stations inside the shallow (10 m) Bay have been a part of the Estonian national marine monitoring programme, which started simultaneous sampling of zooplankton, phytoplankton, macrozoobenthos, and nutrients several times a year. In 2000, frequency of sampling was raised to 12 cruises per year. The salinity of Pärnu Bay is slightly lower than that in the Gulf of Riga, with an average salinity of 5 psu. Pärnu Bay also suffers from heavy anthropogenic eutrophication, with nitrate and phosphate coming into the Bay from the town of Pärnu and the Pärnu River. Because of the port and low biodiversity of local species, the Bay has also been an important foothold for some new invasions.

## Tallinn Bay Time Series

**Country:** Estonia

**IGMETS-ID:** ee-10201

***Arno Põllumäe***




The Tallinn Bay Time Series started in 1993 as one of many monitoring stations around Estonia within the Estonian National Monitoring Program. The main objective of this monitoring programme has been to assess the Baltic Sea ecosystem response to eutrophication. During the 1990s, the frequency of sampling was 1–4 times a year, and the parameters monitored were oceanography, phytoplankton, zooplankton, and macrozoobenthos. In 2001, the frequency of sampling of the Tallinn Bay Time Series was increased to 12 cruises a year. The depth of the monitoring station is 45 m. Tallinn Bay is an exposed water body in the central part of the Gulf of Finland (Baltic Sea) and the time series characterizes typical coastal environments of the entire Gulf that are subjected to high anthropogenic pressure.

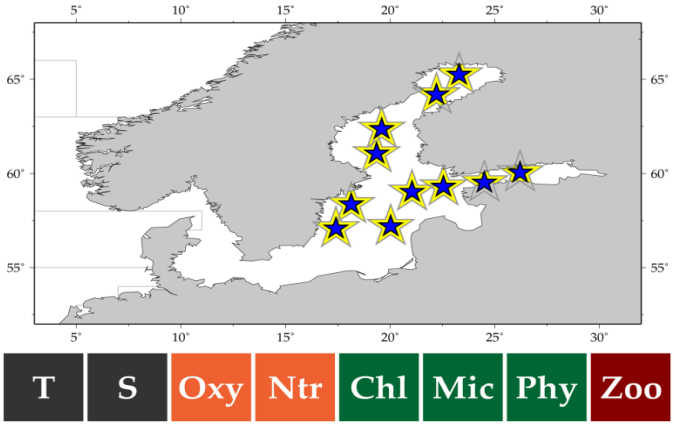
## Northern Baltic Sea Time Series

**Country:** Finland

**Site name** (IGMETS-ID):

SYKE Bothnian Bay (fi-30101)
SYKE Bothnian Sea (fi-30102)
SYKE Gulf of Finland (fi-30103)
SYKE Baltic Proper (fi-30104)

***Maiju Lehtiniemi and Sirpa Lehtinen***

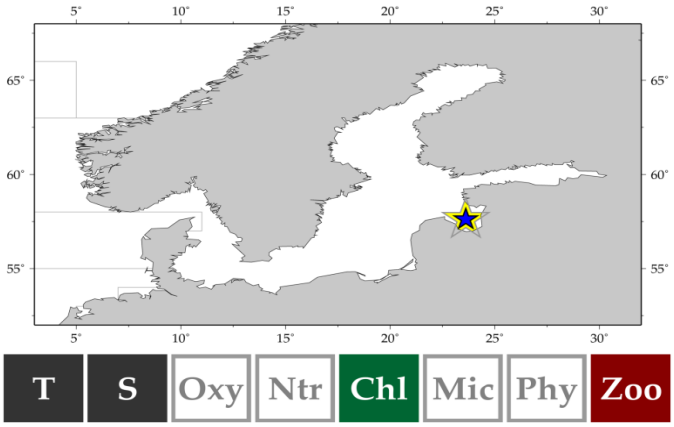



The Northern Baltic Sea Time Series, established in 1979 in the gulfs of Finland and Bothnia, northern Baltic Proper, and the Åland Sea aims at understanding the ecosystem changes in the pelagic zone and the linkages between regional climatic changes and plankton production. The semi-enclosed brackishwater Baltic Sea is connected to the North Sea via narrow straits in the west, and its salinity is regulated by irregular salt water intrusions through the straits and by river inflow of freshwater. It experiences high seasonal temperature variation and partial ice cover every winter and is characterized by strong vertical stratification of both salinity and temperature. Northern Baltic Sea sampling is conducted by the Finnish Environment Institute (SYKE) once a year in August for phyto- and zooplankton and three times a year for hydrographical parameters on board RV "Aranda".

## Central Gulf of Riga Time Series (Station 121)

**Country:** Latvia

**IGMETS-ID:** lv-10101



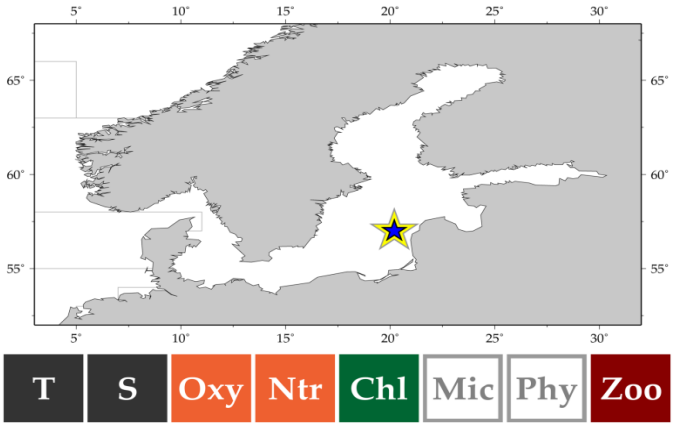

The Central Gulf of Riga Time Series were started in 1974 for physical-chemical parameters and in 1993 for biological parameters as part of a marine monitoring programme to assess the status of the marine environment and to follow trends in ecosystem components. The Gulf of Riga is the third largest gulf in the Baltic Sea, receiving substantial freshwater and nutrient loads, while at the same time being seasonally stratified and having a salinity of 2–6 psu. Time series are represented by one measurement and sampling point at 57°37′N 23°37′E visited three times a year and located out of the impact zone of inflowing freshwater to characterize the deeper and more stable part of the Gulf. Therefore, effects of long-term atmospheric processes and related oceanographic and biological changes can be detected (Jurgensone *et al*., 2011).

## Eastern Gotland Basin (Station 37)

**Country:** Latvia

**IGMETS-ID:** lv-10201

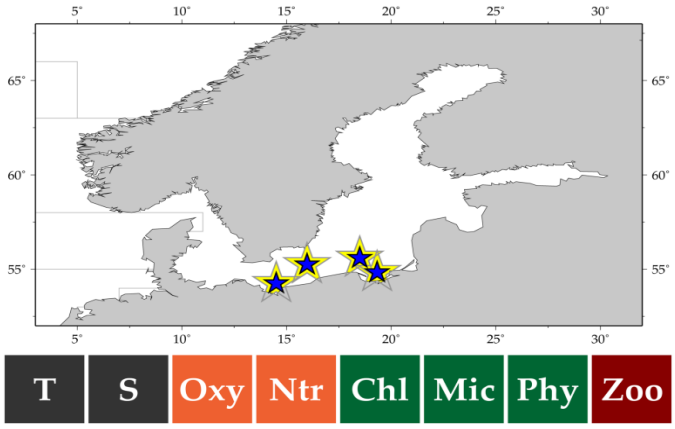
***Gunta Rubene and Solvita Strāķe***




The Eastern Gotland Basin Station 37 (57°02′N 19°06′E) is located in the central Baltic Sea, ICES Subdivision 28. The deeper part of this site could be characterized by an anoxic zone formed at a depth of 249 m. Two different time-series periods have been visible here for sea surface water temperature and salinity, with a regime of lower temperature and higher salinity until the 1990s and the opposite trends afterwards. The time series of the eastern Gotland Basin (zooplankton, temperature, and salinity) has been collected since 1959 to investigate fish resources, regulation of utilization, and reproduction. Zooplankton has been sampled using a Juday net (upper ring diameter – 36 cm, mesh size 160 μm) covering the water column to a maximum depth of 100 m. Hydrological variables were collected using a bathometer until 2005, but subsequently with a CTD probe in the upper water layer (0–10m). All the variables have been sampled once a season (May, August, and October).

Related information: http://www.bior.lv

## Southern Baltic Proper (NMFRI Monitoring)




**Country:** Poland

**Site name (IGMETS-ID):**

Gdansk Basin (pl-30101)
Bornholm Basin (pl-30102)
Pomeranian Bay (pl-30103)
Southern Gotland Basin (pl-30104)

***Anetta Ameryk, Sławomira Gromisz, Janina Kownacka, Marianna Pastuszak, Mariusz Zalewski, and Piotr Margonski***

A phytoplankton database was created by the National Marine Fisheries Research Institute (NMFRI), and samples have been collected and analyzed by experts from NMFRI. Nutrients and chlorophyll *a* have been monitored since 1977, while phytoplankton taxa since 1987. Each study area is a rectangle containing several sampling stations. Monitoring of the Gdańsk Basin and Pomeranian Bay is important as both areas are significantly influenced by the Vistula and Oder rivers, respectively. Samples are collected using 2- to 5-l Nansen or Niskin bottles at five fixed depth strata between 0 and 10 m. Frequent cruises, 6–10 times a year, were organized in the 1980s and only twice a year, in spring and summer, over the last ten years. The database has many gaps, especially in the region of Pomeranian Bay.

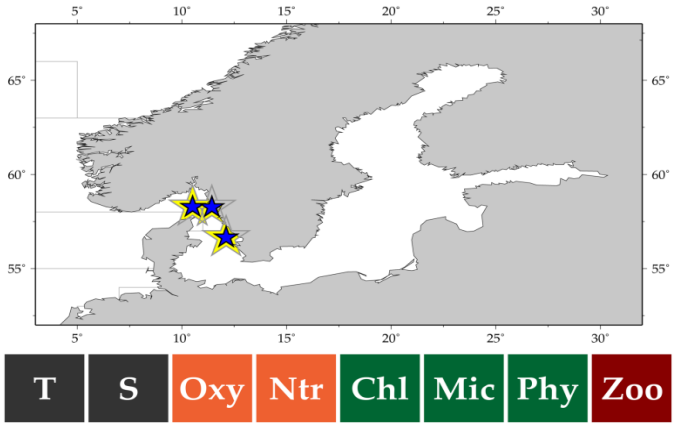
Zooplankton samples are collected within the Baltic Sea HELCOM COMBINE Monitoring Programme. The Maritime Branch of the Institute of Meteorology and Water Management is responsible for collecting the samples along the southern coast of the Baltic Sea (in the Polish EEZ). Over the 30 years of monitoring, zooplankton have been analyzed by several experts working in various institutions. The dataset starts in 1979, with two stations located in the Bornholm and southern Gotland basins. Since 1986, a third sampling location in the Gdansk Basin was added. Vertical hauls of the WP-2 net with 100-µm mesh size were used. Stratified samples are presented here as an average of the whole water column) were collected in the layers from the bottom to the halocline (included), from the top of the halocline to the thermocline (included), and from the top of the thermocline to the surface. The frequency of sampling varied in time (3–6 times a year), but spring and summer conditions can be described for each year.

## Swedish Meteorological and Hydrological Institute Time Series

**Country:** Sweden

**Site name (IGMETS-ID):**

SMHI Å17 (se-50101)
SMHI Anholt East (se-50102)
SMHI Släggö (se-50103)




***Patrik Strömberg and Marie Johansen***

The Swedish National Oceanographic Data Centre is financed by the Swedish Agency for Marine and Water Management (SWAM) and part of SMHI (Swedish Meteorological and Hydrological Institute) and hosts Swedish marine environmental monitoring data comprising biogeochemistry, physics, and zooplankton. Data are publicly available and downloadable from sharkweb.smhi.se, and there is a machine–machine interface at this website making it possible to harvest data. The earliest record dates to June 1979 (two records in total); more data are added every year. Time series are more complete after 2007; for 2013, there are 174 records. As of 19 March 2015, there were 1519 zooplankton records. Since 2007, SMHI samples monthly in the Baltic Sea and along the Swedish west coast in accordance with the HELCOM manual. For zooplankton, a WP-2 net (90-µm mesh) is used. SMHI released an updated version of the website in 2015 that enabled many improvements, including the possibility to download physical and chemical data. Time-series data availability increased from 1971–2014 (44 years) to 1893–2014 (122 years).

# A2 North Atlantic Ocean
## Mediterranean Sea

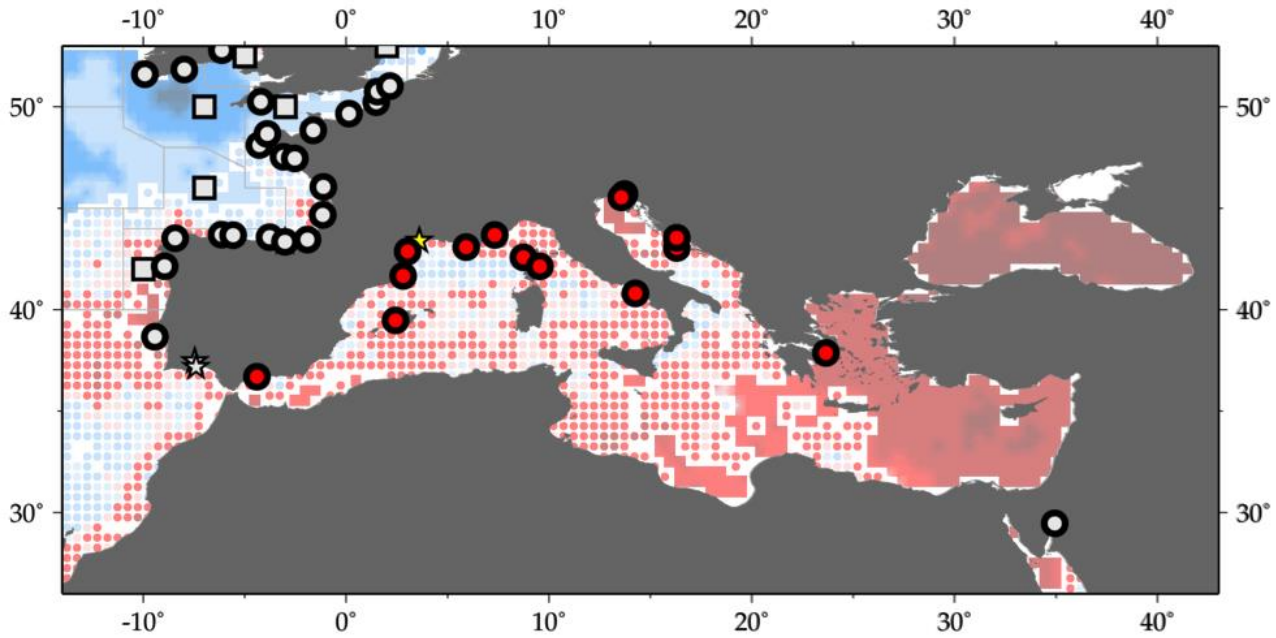
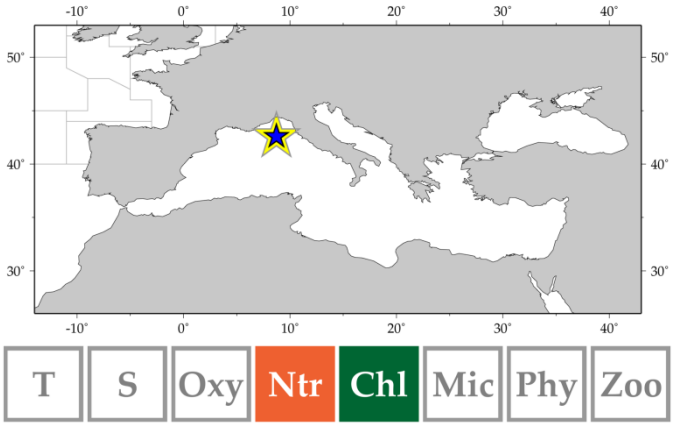



**Figure A2.3.** Map of IGMETS-participating North Atlantic – Mediterranean Sea time series on a background of a 10-year time-window (2003–2012) sea surface temperature trends (see also Chapter 4). At the time of this report, the North Atlantic – Mediterranean Sea collection consisted of 16 time series (coloured symbols of any type), of which one was from estuarine areas (yellow star). Uncoloured (gray) symbols indicate time series being addressed in a different subregion (e.g. North Atlantic Proper).

**Table A2.3.** Time-series sites located in the IGMETS North Atlantic – Mediterranean Sea region. Participating countries: Belgium (be), Spain (es), France (fr), Greece (gr), Croatia (hr), Italy (it), and Slovenia (si).

| No. | IGMETS-ID | Site or programme name | Year-span | T | S | Oxy | Ntr | Chl | Mic | Phy | Zoo |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | be-10101 | PHYTOCLY Time Series *(Bay of Calvi)* | 1988–present | - | - | - | X | X | - | - | - |
| 2 | es-30301 | Blanes Bay *(Northwest Mediterranean)* | 1992–present | X | X | - | X | X | X | - | - |
| 3 | es-50201 | IEO Mallorca Baleares Station *(Mallorca Channel)* | 1994–present | X | X | - | - | X | - | - | X |
| 4 | es-50301 | IEO ECOMÁLAGA *(Alboran Sea)* | 1992–present | X | X | - | X | X | - | - | X |
| 5 | fr-10101 | Villefranche Point B *(Cote d'Azur)* | 1995–present | - | - | - | - | - | - | - | X |
| 6 | fr-10201 | Thau Lagoon *(Mediterranean Sea)* | 1965–present | X | X | - | X | X | X | X | - |
| 7 | fr-50111 | REPHY Diana Centre *(Mediterranean Sea)* | 1987–present | X | X | X | X | X | - | X | - |
| 8 | fr-50112 | REPHY Lazaret A *(Western Mediterranean)* | 1987–present | X | X | X | - | X | - | X | - |
| 9 | fr-50113 | REPHY Parc Leucate 2 *(Mediterranean Sea)* | 1987–present | X | X | - | - | X | - | X | - |
| 10 | fr-50114 | REPHY Villefranche *(Mediterranean Sea)* | 1995–present | X | X | - | - | - | - | X | - |
| 11 | gr-10101 | Saronikos Gulf S11 *(Aegean Sea)* | 1987–present | - | - | - | - | X | - | - | X |
| 12 | hr-10101 | Stoncica *(Central Adriatic Sea)* | 1959–present | - | - | - | - | - | X | - | X |
| 13 | hr-10102 | Kastela Bay *(Central Adriatic Sea)* | 1994–present | - | - | - | - | - | X | - | - |
| 14 | it-30101 | Gulf of Naples LTER-MC *(Tyrrhenian Sea)* | 1984–present | X | X | - | X | X | - | X | X |
| 15 | it-30201 | C1-LTER Gulf of Trieste *(Northern Adriatic Sea)* | 1970–present | - | - | - | - | - | - | - | X |
| 16 | si-10101 | Gulf of Trieste – MBS Buoy *(Northern Adriatic Sea)* | 1990–present | X | X | X | X | X | - | X | - |

## PHYTOCLY Time Series



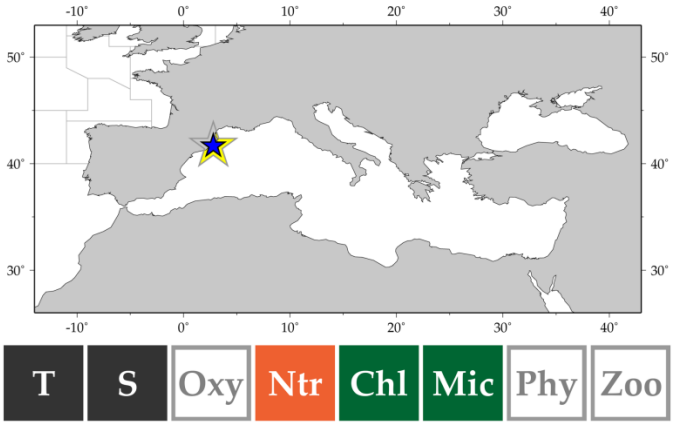

**Country:** Belgium

**IGMETS-ID:** be-10101

***Anne Goffart, Amandine Collignon, and Jean-Henri Hecq***

The PHYTOCLY Time Series, established in 1979 in the Bay of Calvi (Corsica, northwestern Mediterranean), aims to investigate the effects of climate forcing on surface nutrient replenishment as well on phyto- and zooplankton dynamics. The Bay of Calvi is a well-preserved and low-runoff system, with high water quality. It opens to the north to the Ligurian Sea and is characterized by a narrow continental shelf (mean width  ca. 3 km) and the presence of a deep canyon (mean depth  ca. 600 m), which enhances shelf–slope exchanges. The trophic character of the Bay of Calvi changes yearly and ranges from very oligotrophic (low seasonal variability) to mesotrophic (well-marked increases in nutrient concentrations, chlorophyll *a*, and zooplankton during the winter–spring period). A third regime occurs during severe winters and is characterized by specific wind conditions when Mediterranean "high nutrient – low chlorophyll" conditions occurred. Sampling and analysis were supported by the University of Liège (Belgium), Stareso SA (Calvi, France), Ifremer (France), the French Water Agency (PACA-Corsica) and the Territorial Collectivity of Corsica.

## Blanes Bay




**Country:** Spain

**IGMETS-ID:** es-30301

***Josep M Gasol, Ramon Massana, Rafel Simó, Celia Marrasé, Silvia G. Acinas, Carlos Pedrós-Alió, Carles Pelejero, M. Montserrat Sala, Eva Calvo, Dolors Vaqué, and Francesc Peters***

The Blanes Bay Microbial Observatory is placed in an open east-facing bay in the northwestern Mediterranean Catalan coast about 70 km north of Barcelona. It is a good example of an oligotrophic (relatively nutrient-poor) coastal ecosystem relatively unaffected by human influences. It is also one of the sites for which more information exists on the ecology of the Mediterranean planktonic environment dating back to the 1940s. Current monitoring, which started in 2000, is focused on biogeochemistry and microbial diversity.

The site is at about 0.5 miles offshore over 20 m depth. An oceanographic fully-operated buoy is operative nearby. The station is at the limit between the rocky coast of the "Costa Brava" and the sandy coast southward, with very limited riverine influence. Dominant southwestern water circulation drives away the Tordera River outflow south of the site. A nearby submarine canyon sporadically introduces offshore seawater to the site.

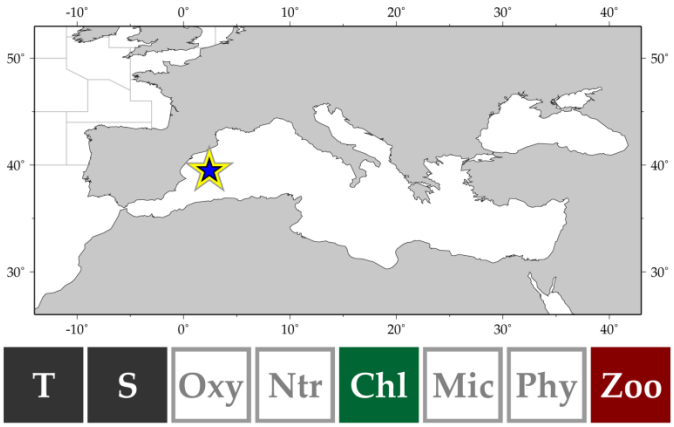
Related information: http://www.icm.csic.es/bio/projects/icmicrobis/bbmo

## IEO Mallorca Baleares Station

**Country:** Spain

**IGMETS-ID:** es-50201

***Maria Luz Fernandez de Puelles***




Mallorca Station (75 m depth) is located southwest of Mallorca Island (39°29′N 02°26′E) and has been sampled every 10 days between January 1994 and December 2005. Sampling since 2007 has only been seasonally. CTD data were also recorded. Zooplankton was sampled by bottom–surface oblique hauls with bongo net with 250- and 100-µm mesh. A General Oceanic flowmeter was fitted to estimate the volume of filtered water. Samples are split into subsamples for biomass and taxonomic analysis, with the latter preserved with 4% neutralized formaldehyde. All groups are identified, with the main focus on copepods and cladocerans to the species level. Subsamples for biomass are frozen (–20°C) for subsequent estimation as dry weight.

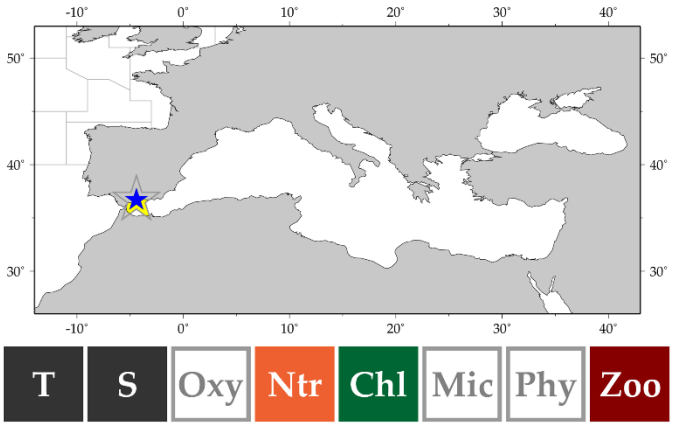
This area experiences regular influxes of northern Mediterranean and Atlantic waters and their broad range of temperatures and salinities. A seasonal cycle of temperature includes a mixing period during winter followed by a stratified period of more than six months (May–October), which coincides with the lowest zooplankton biomass. Phytoplankton blooms generally occur in January, but sometimes in late spring. Zooplankton biomass peaks in winter (March), spring (May), and at the end of summer (September), during which copepods are the dominant zooplankton group.

## IEO ECOMÁLAGA

**Country:** Spain

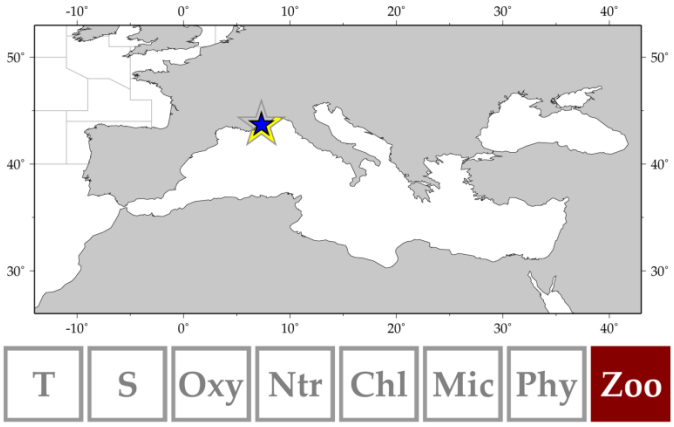
**IGMETS-ID:** es-50301

***Lidia Yebra, Jesús M. Mercado, and Dolores Cortés***




The ECOMÁLAGA time series operated by the Instituto Español de Oceanografía (IEO) sampled Málaga Bay during 1992–2007. In 2010, quarterly sampling of hydrochemical and biological variables restarted with the aim of assessing the environmental status of marine pelagic communities as well as the impact of human-induced activities on the plankton community structure. Station MA2 is located in northwestern Alboran Sea (36°42′N 04°24′E), with a bottom depth of 28 m. The region presents high variability in hydrochemical conditions. This is due to the presence of an anticyclonic gyre originated by the jet of Atlantic water than enters the Mediterranean through the Strait of Gibraltar. Also, within the shelf, frontal areas appear associated with westerly wind-induced upwelling events. Plankton production along the coast is significantly higher than in offshore waters (Mercado *et al*., 2014) and is among the highest in the entire Mediterranean Sea.

## Northwestern Mediterranean Sea Zooplankton Time Series (Point B)




**Country:** France

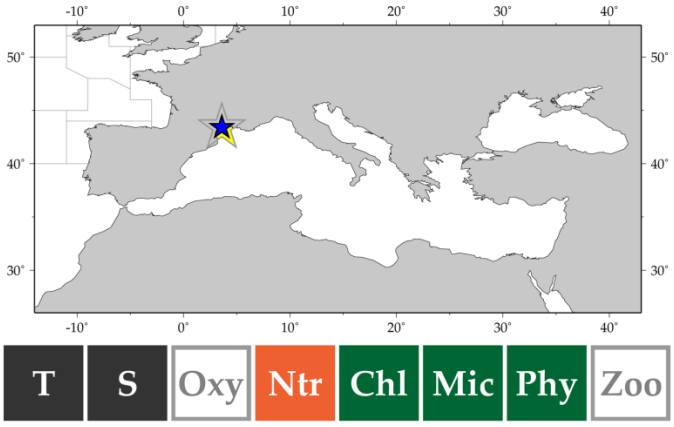
**IGMETS ID:** fr-10101

***Fabien Lombard, Lars Stemmann, Gabriel Gorsky, Amanda Elineau, and Corinne Desnos***

The Villefranche Point B dataset consists of more than 30 years of samples collected off Villefranche at 43°41′N 07°19′E. Samples were collected by a vertical tow from bottom to surface (75–0 m) using a Juday-Bogorov net (1996–2003, 330-µm mesh) and WP-2 net (1995–2012, 200-µm mesh). The sampling site is located at the mouth of the bay over a bathymetry of 80 m and is thus open to the Ligurian Sea. Zooplankton abundance was counted from ongoing and historical samples using the wet-bed image scanning technique of ZooScan (Gorsky *et al.*, 2010).

Zooplankton abundance was highest during years with well-mixed winter periods (in the 1980s), followed by a general decline, with rising water temperatures and increasing stratification in the 1990s (Garcia-Comas *et al.*, 2011). After 2000, the mesozooplankton abundance again reached the levels seen in the 1980s (Vandrome *et al.*, 2012).

## Thau Lagoon Time-Series




**Country:** France

**IGMETS-ID:** fr-10201

***Yves Collos, Béatrice Bec and Eric Abadie***

The Thau Lagoon Time-Series, established in Thau Lagoon in 1971, aims at understanding linkages between physical and chemical variables, phytoplankton species, and oyster production and how these change over time. It also aims at understanding regional climatic changes and how variations in these processes affect oyster production. The Thau Lagoon is a semi-enclosed lagoon located in southern France that is connected to the Mediterranean Sea by three narrow channels. Systematic observations of physical (temperature, salinity) and chemical (nutrient concentrations) properties have been made since 1971, and biological (phytoplankton > 5 µm) properties have been monitored since 1987. Picophytoplankton (picoeukaryotes and picocyanobacteria) has been counted by flow cytometry since 1991. The lagoon harbors *Ostreococcus tauri*, the smallest eukaryote in the world (Courties *et al.*, 1994). Sampling frequency is twice monthly, but can increase to weekly or more during periods favorable to harmful algae.

## French Phytoplankton and Phycotoxin Monitoring Network (REPHY)

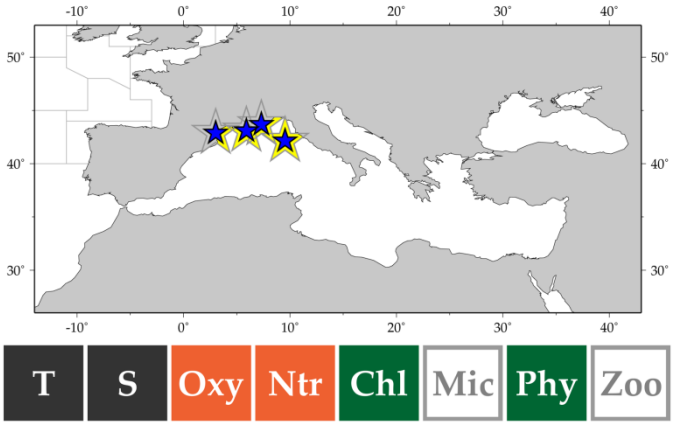
**Country:** France

**Site name (IGMETS-ID):**

REPHY Diana Centre (fr-50111)
REPHY Lazaret A (fr-50112)
REPHY Parc Leucate 2 (fr-50113)
REPHY Villefranche (fr-50114)

*see also REPHY in the North Atlantic Annex*

***Dominique Soudant and Eric Abadie***




The French Phytoplankton and Phycotoxin Monitoring Network (REPHY) was set up in 1984 with three objectives: (i) enhance knowledge of phytoplankton communities, (ii) safeguard public health, and (iii) protect the marine environment (Belin, 1998). Phytoplankton along the French coast has been sampled up to twice a month since 1987 at 12 coastal laboratories. For that purpose, the French coast is divided into a hierarchy of sites and subsites common to three regional networks: the English Channel, the Bay of Biscay, and the Mediterranean Sea.

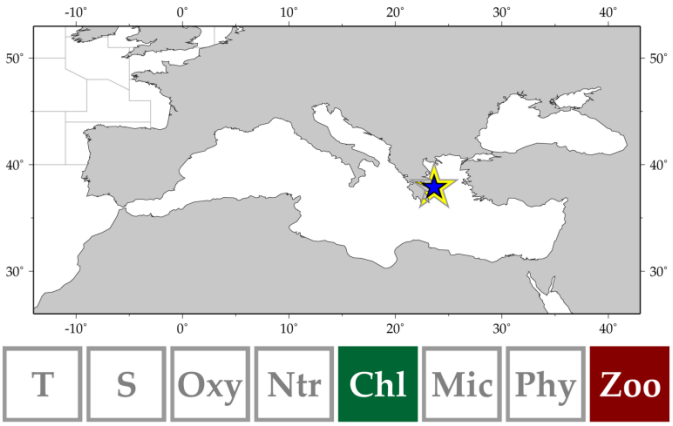
Lazaret A and Diana Centre are two Mediterranean REPHY sites. Lazaret A is located in well-mixed waters, with a medium-depth, sandy bottom within Toulon Bay. Diana Center is located in shallow, less-mixed waters of a coastal lagoon in Corse and features a muddy bottom. As with the Bay of Biscay and English Channel REPHY sites, sampling started in 1987, with salinity, temperature, turbidity, and oxygen measured concomitantly from the beginning or one year thereafter. Chlorophyll *a* and pheopigments started at Diana Centre in 1988 and at Lazaret A in 1999. This latter site is sampled twice a month on average, whereas fewer samples (17 on average from 10 months) are taken annually at Diana Centre.

## Saronikos S11, Aegean Sea

**Country:** Greece

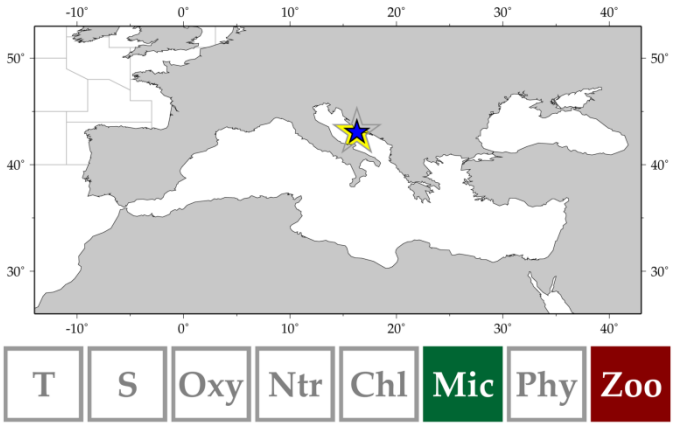
**IGMETS-ID:** gr-10101

***Soultana Zervoudaki, Epaminondas Christou, and Assimakopoulou Georgia***




Saronikos S11 (37°52′N 23°38′E) time series is located in the Saronikos Gulf in the Aegean Sea (eastern Mediterranean) with a bottom depth of 78 m. This area receives treated sewage effluents from the Athens metropolitan area through a deep underwater outlet situated near Psitallia Islet on the northeast side of the Gulf. Since 1987, the marine environment has been seasonally and interannually monitored in order to assess *inter alia* any short- and long-term effects on plankton. Average temperature in this station has seasonal cycles, with minima in March (14°C) and maxima in September (23°C). Salinity ranges between 38 and 39, depending on the variability of the inflow of Aegean water (Kontoyiannis *et al*., 2005; Kontoyiannis, 2010). Chlorophyll *a* shows clear annual cycles, with sharp peaks around 2 mg $m^{-3}$ in spring. The area has been classified as mesotrophic, having good water quality (Simboura *et al*., 2014).

## Station Stončica



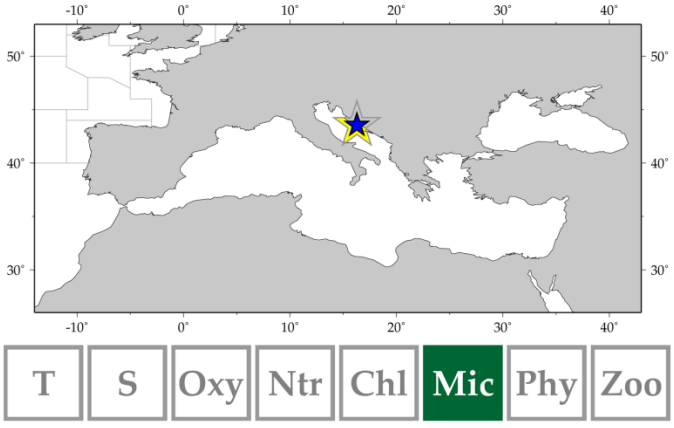

**Country:** Croatia

**IGMETS-ID:** hr-10101

***Mladen Solic, Olja Vidjak, Nada Krstulovic, Danijela Santic, and Stefanija Sestanovic***

Station Stončica is located in the central part of the Adriatic Sea (43°02′N 16°17′E), with a maximum depth of 107 m. The area is strongly influenced by the incoming Mediterranean water (Levantine Intermediate Water). The Stončica site is considered as a reference for the oligotrophic open waters of the central Adriatic and has been under regular monitoring from as early as the 1950s, resulting in several multidecadal datasets of bacterial, phyto-, and mesozooplankton abundance and/or their respective production and biomass measured on a near-monthly basis. Plankton data are accompanied by concurrent temperature, salinity, nutrient, and oxygen concentration measurements in the water column. Stončica dataseries were analyzed in several publications, aiming at understanding natural plankton cycles and fluctuation patterns and identifying climate–population connections in the water column (Baranović *et al.*, 1993; Šolić *et al.*, 1997; Berline *et al.*, 2012; Grbec *et al.*, 2009).

## Station Kaštela Bay




**Country:** Croatia

**IGMETS-ID:** hr-10102

***Mladen Solic, Nada Krstulovic, Danijela Santic, and Stefanija Sestanovic***

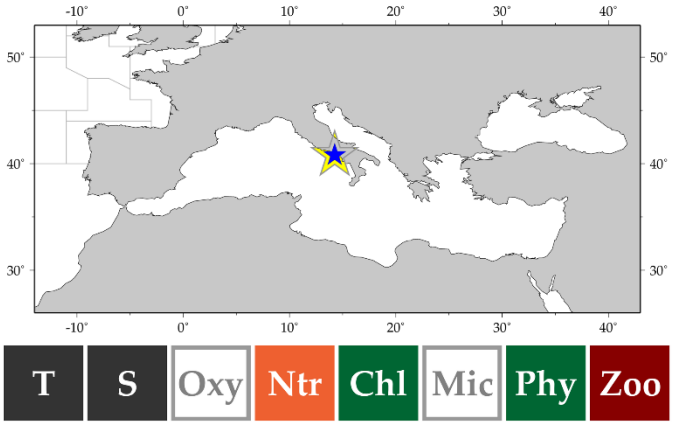
Station Kaštela Bay (38-m depth) is located in one of the largest bays on the eastern Adriatic coast (43°32′N 16°23′E). The River Jadro discharges into the eastern part, with an average annual inflow of 10 $m^{-3}$ $s^{-1}$. The Bay encompasses a total area of 61 $km^2$ and a volume of 1.4 $km^3$, with a densely populated narrow coastal strip and some industrial activities along the coast. For decades, the Bay was severely eutrophicated; however, recent investigations point to considerable improvement in water quality (Kušpilić *et al.*, 2009). Long-term monitoring of the ecological status of the Bay conducted at this site produced long sets of bacterial, phyto-, and zooplankton data (abundance, production, and biomass) measured near-monthly, accompanied by temperature, salinity, nutrient, and oxygen measurements. Available data were tested in the context of anthropogenic impacts, water quality, biodiversity, and climate change (Šolić *et al.*, 2010; Ninčević-Gladan *et al.*, 2015).

## Gulf of Naples LTER-MC

**Country:** Italy

**IGMETS-ID:** it-30101

***Adriana Zingone, Maria Grazia Mazzocchi, Diana Sarno, Iole Di Capua, Francesca Margiotta, and Maurizio Ribera d'Alcalà***




The MareChiara Time-Series was established in 1984 in the Gulf of Naples (Tyrrhenian Sea, western Mediterranean) with the aim of understanding plankton variability and its relationships with external forcing, including anthropogenic disturbance and climate change. The sampling site LTER-MC (40°49'N 14°15'E) is located over the 75-m isobath, 2 nautical miles off the coast of the densely populated city of Naples at the boundary between the eutrophic coastal zone and the offshore oligotrophic waters. The site has been part of the European and international LTER networks since 2006. Sampling was fortnightly until July 1991 and has been weekly since February 1995, with an interruption between the two periods. Numerous physical, chemical, and biological variables are regularly recorded, and metagenomic analyses have been conducted in recent years. Presently, first results are available on the website weekly in real-time. Laboratory experiments are conducted to test hypotheses stemming from field studies.

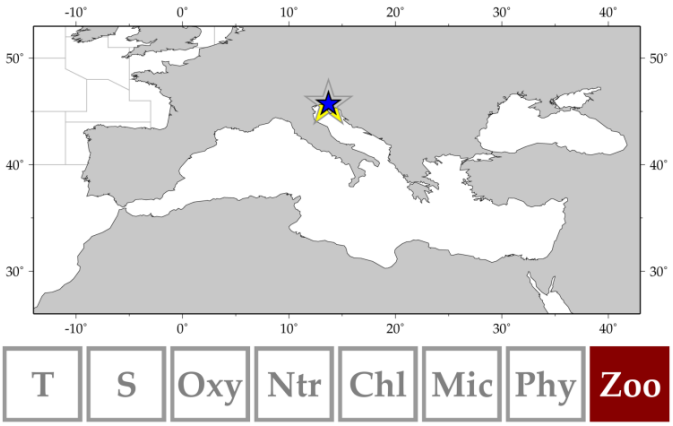
Related information: http://szn.macisteweb.com/

## C1-LTER (Gulf of Trieste)

**Country:** Italy

**IGMETS-ID:** it-30201

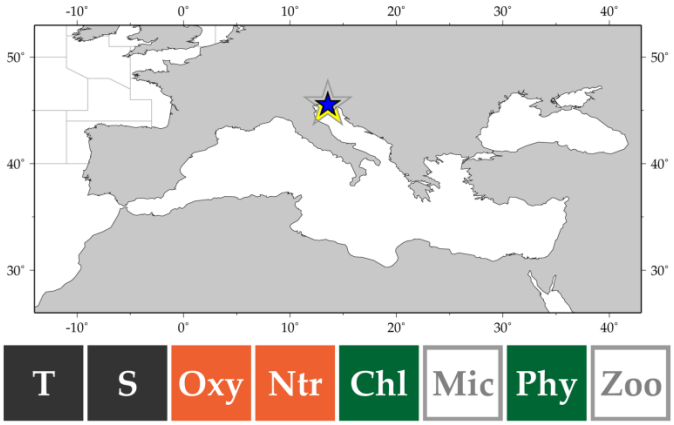
***Valentina Tirelli, Serena Fonda Umani, and Alessandra de Olazabal***




The station C1 is located in the Gulf of Trieste in the northernmost part of the Adriatic Sea. In 2006, it was formally included in the Italian network of long-term ecological research sites (LTER-Italy). Zooplankton are collected by vertical hauls from 15 m to the surface using a WP-2 net (200-µm mesh). Sampling has been ongoing since April 1970, with a major interruption from January 1981 to February 1986, inclusive. The sampling frequency is monthly and was fortnightly during a few months in the 1980s and in 2002–2004. The time-series station C1, established by the University of Trieste, was later taken over by the Laboratory of Marine Biology of Trieste after its formal institution in December 1979 and, since October 2005, has been handled by the Division of Oceanography (OCE) of the OGS (Istituto Nazionale di Oceanografia e Geofisica Sperimentale) of Trieste.

Related information: http://nettuno.ogs.trieste.it/ilter/BIO

## Gulf of Trieste - MBS Buoy




**Country:** Slovenia

**IGMETS-ID**: si-10101

***Patricija Mozetič, Janja Francé, Neli Glavaš, Vlado Malačič, and Milijan Šiško***

This time series in the southeastern part of the Gulf of Trieste (northern Adriatic Sea) was established in 1990 when the national monitoring programme became operational. The time series aims at understanding the variability in phytoplankton community structure in relation to physical and chemical properties of coastal waters (Mozetič *et al*., 2012) and distinguishing between natural fluctuations and those induced by anthropogenic activities. The Gulf of Trieste (surface area 600 km$^2$, volume 9.5 km$^3$, maximum depth 25 m) is affected by water-mass exchange with the northern Adriatic, local meteorological conditions, and freshwater inputs (Malačič *et al*., 2006). Events of hypoxia/anoxia and accumulation of mucous aggregates have characterized the area in the recent past. Sampling of physical, chemical, and biological parameters of the water column is carried out monthly at a relatively non-impacted station located in the vicinity of the oceanographic MBS buoy (45°54'N 13°55'E).

Related information: http://www.nib.si/mbp/

# A3 South Atlantic Ocean

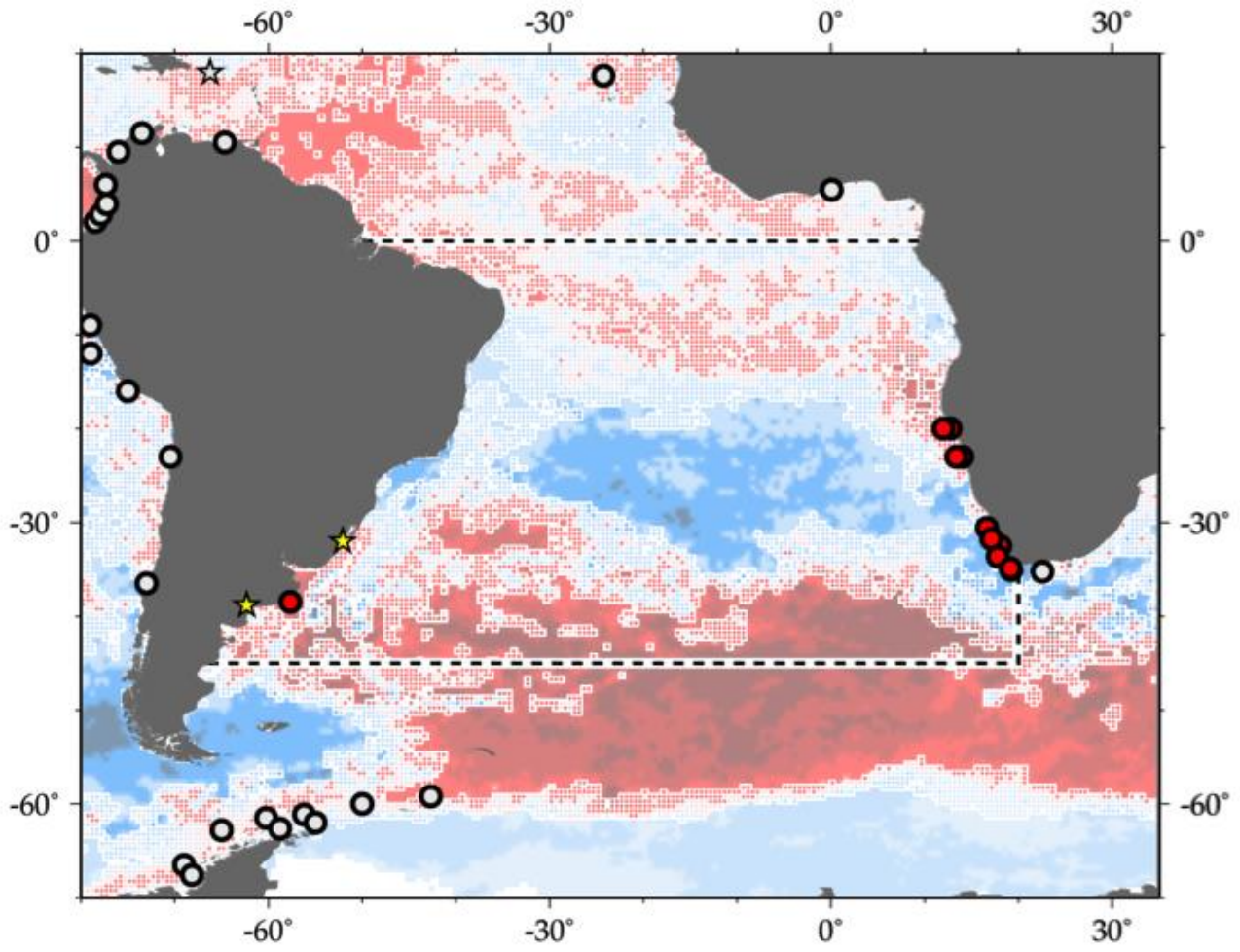
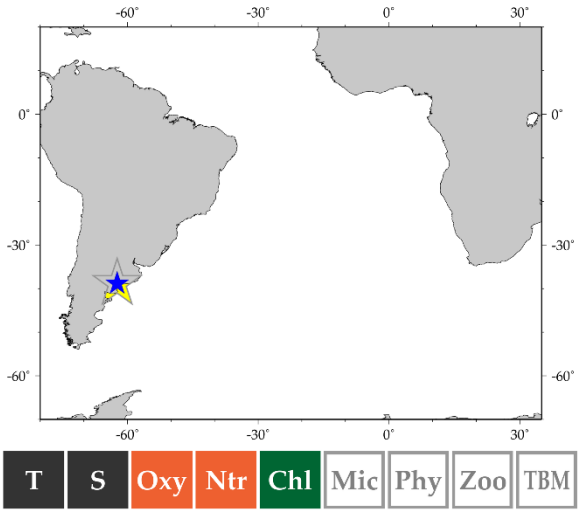



**Figure A3.** Map of IGMETS-participating South Atlantic time series on a background of a 10-year time-window (2003–2012) sea surface temperature trends (see also Chapter 5). At the time of this report, the South Atlantic collection consisted of 13 time series (coloured symbols of any type), of which two were from estuarine areas (yellow stars). Dashed lines indicate boundaries between IGMETS regions. Uncoloured (gray) symbols indicate time series being addressed in a different regional chapter (e.g. Southern Ocean, North Atlantic, and South Pacific).

**Table A3.** Time-series sites located in the IGMETS South Atlantic region. Participating countries: Argentina (ar), Brazil (br), Namibia (na), United Kingdom, (uk), and South Africa (za). Year-spans in red text indicate time series of unknown or discontinued status. IGMETS-IDs in red text indicate time series without a description entry in this Annex.

| No. | IGMETS-ID | Site or programme name | Year-span | T | S | Oxy | Ntr | Chl | Mic | Phy | Zoo |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ar-10101 | Puerto Cuatreros *(Bahia Blanca Estuary)* | 1975–present | X | X | X | X | X | - | - | - |
| 2 | ar-10201 | EPEA – Estacion Permanente de Estudios Ambientales *(Argentine Coastal Waters)* | 2000–present | X | X | - | X | X | X | - | - |
| 3 | br-10101 | Patos Lagoon Estuary – Phyto-plankton Time Series *(Southeastern Brazil)* | 1993–present | X | X | - | X | X | X | X | - |
| 4 | na-10101 | Walvis Bay 23S shelf *(Northern Benguela Current)* | 1978–present | X | X | X | - | - | - | - | X |
| 5 | na-10102 | Namibia 20S shelf *(Northern Benguela Current)* | 2002–present | - | - | - | - | - | - | - | X |
| 6 | na-10103 | Walvis Bay 23S offshore *(Northern Benguela Current)* | 1978–present | X | X | X | - | - | - | - | X |
| 7 | na-10104 | Namibia 20S offshore *(Northern Benguela Current)* | 2002–present | - | - | - | - | - | - | - | X |
| 8 | uk-30601 | Atlantic Meridional Transect (AMT) | 1995–present | X | X | X | X | X |  | X | X |
| 9 | za-10101 | St Helena Bay *(Southern Benguela Current)* | 1951–present | X | X | - | - | - | - | - | X |
| 10 | za-30101 | SBCTS-A: North West Coast *(Southern Benguela Current)* | 1988–present | - | - | - | - | - | - | - | X |
| 11 | za-30102 | SBCTS-B: Central West Coast *(Southern Benguela Current)* | 1988–present | - | - | - | - | - | - | - | X |
| 11 | za-30103 | SBCTS-C: South West Coast *(Southern Benguela Current)* | 1988–present | - | - | - | - | - | - | - | X |
| 12 | za-30104 | SBCTS-D: Western Agulhas Bank *(Southern Benguela Current)* | 1988–present | - | - | - | - | - | - | - | X |
| 13 | za-30201 | ABCTS Danger Point Monitoring Line *(Agulhas Bank)* | 1988–present | - | - | - | - | - | - | - | X |

## Puerto Cuatreros, Bahia Blanca Estuary




**Country:** Argentina

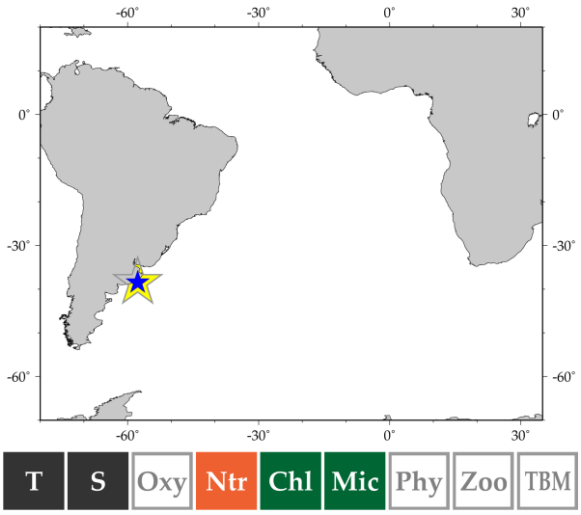
**IGMETS-ID:** ar-10101

***Jorge Marcovecchio, Valeria Guinder, and Carla Spetter***

The Bahia Blanca Estuary, located in the southwest part of the Buenos Aires Province, Argentina, is a mesotidal estuary (Perillo *et al*., 2001). The mean tidal amplitude ranges from 2.2 to 3.5 m, the spring tidal amplitude ranges from 3 to 4 m, and the highest tidal amplitudes occur near the head of the estuary (Perillo *et al*., 2001). The estuary is formed by a series of northwest- to southeast-oriented tidal channels separated by extensive tidal flats, salt marsh patches, and islands (Perillo, 1995).

The sampling site is located at the inner zone of this estuary in Cuatreros Port, which is considered a chemically representative site of this zone (Freije and Marcovecchio, 2004).

## EPEA (Estación Permanente de Estudios Ambientales)



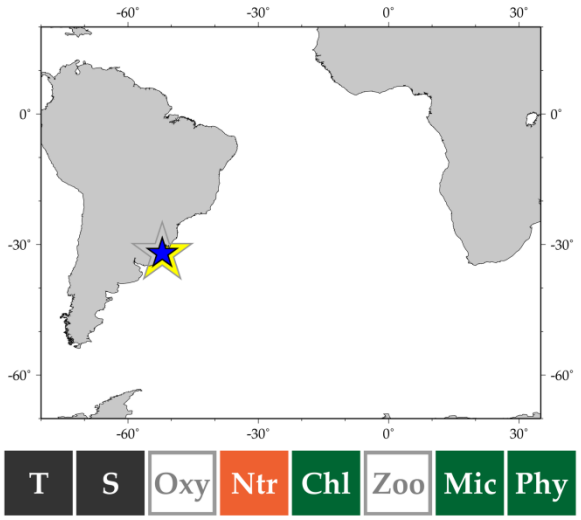

**Country:** Argentina

**IGMETS-ID:** ar-10201

***Ruben Negri, Vivian A. Lutz, Carla F. Berghoff, Mario O. Carignan, Georgina Cepeda, Daniel Cucchi Colleoni, Marina Vera Diaz, María Constanza Hozbor, Ezequiel Leonarduzzi, Graciela N. Molinari, Nora Montoya, Luciano Padovani, Marcelo Pájaro, M. Guillermina Ruiz, Valeria Segura, Ricardo I. Silva, and María Delia Viñas***

The main objective of the EPEA time series (38°28′S 57°41′E) is to understand the annual and interannual dynamics of environmental variables and all components of plankton and follow possible long-term changes. It has been sampled monthly (with unfortunate gaps) since 2000. Variables measured include temperature, salinity, oxygen, nutrients, light penetration, absorption by particulate matter (phytoplankton and non-algal particles) and coloured dissolved organic material, chlorophyll *a*, pigment composition, bacterio-, phyto- (pico, nano, and micro), zoo-, and ichtyoplankton. The station is characterized by a temperate regime; annual range of SST: 10–21°C and salinity: 33.5–34.1. The hydrographic system is a transition between high-salinity coastal waters and mid-shelf waters. Under exceptional conditions, salinity can drop due to the influence of the Río de la Plata. Several unusual phytoplankton events, linked to large spatial and temporal scales, were detected during these years. EPEA forms part of the Latin American network Antares.

## Patos Lagoon Estuary (PLE) Phytoplankton Time Series




**Country:** Brazil

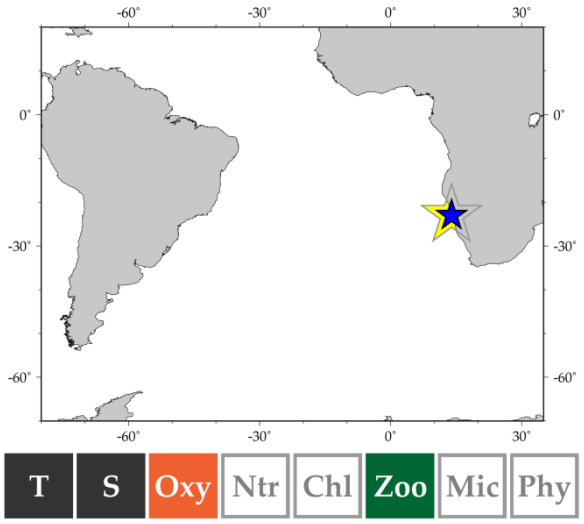
**IGMETS-ID:** br-10101

***Clarisse Odebrecht and Paulo Cesar Abreu***

Large interannual phytoplankton variations observed in the 1980s instigated the establishment of the Patos Lagoon Estuary (PLE) Phytoplankton Time Series carried out in the framework of the Brazilian Long-Term Ecological Research (BR-LTER). The main objective is to identify the natural and anthropic impacts on the PLE and adjacent coast. PLE (ca. 1000 km²) is a warm-temperate shallow and choked (only one long and narrow entrance) estuary where water exchanges with the Atlantic Ocean occur through a stabilized inlet, mainly controlled by winds and freshwater discharge, whereas tides are not significant. Peaks of river discharge are associated with El Niño episodes and turn the system riverine. Environmental (water temperature, salinity, Secchi disk depth, and concentrations of dissolved inorganic nutrients) and biotic properties (chlorophyll *a*, phytoplankton) have been measured monthly since 1993, providing the longest phytoplankton time series in Brazil.

Related information: http://www.peld.furg.br

## Walvis Bay (23°S) Time Series




**Country:** Namibia

**IGMETS-ID:** na-10101 / na-10103

***Anja Kreiner, Richard Horaeb, Hans Verheye, Fabienne Cazassus, Rudi Cloete, and Sakhile Tsotsobe***

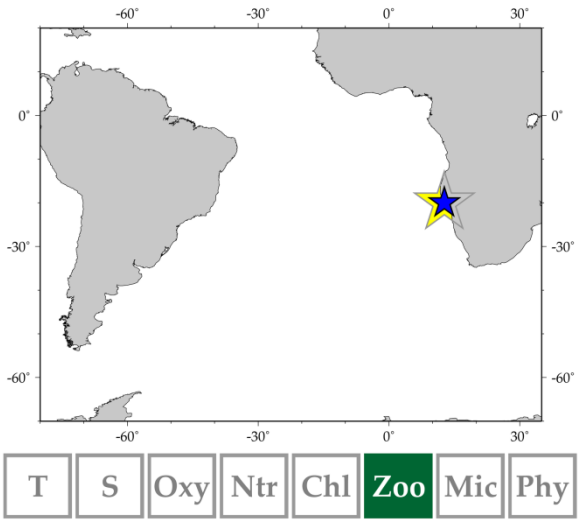
The National Marine Information and Research Centre (NatMIRC) in Swakopmund, Namibia started zooplankton monitoring in 2000 within an intense routine monitoring (Monthly Oceanographic Monitoring - MOM) programme on the 23°S line just outside Walvis Bay in an important fisheries nursing area. Sampling was done ca. monthly for the first five years, but since 2005, sampling has been done about eight times a year. Stations are positioned 2, 5, 10, 20, 30, 40, 50, 60, and 70 nautical miles from the coast. Sampling is done using a UNESCO WP-2 net equipped with a 200-µm mesh and in the upper 200 m of the water column (or 10 m from the bottom, if shallower). Apart from zooplankton, environmental parameters (temperature, salinity, and dissolved oxygen) are measured at every station. Zooplankton time series can reveal changes in environmental regimes, including turning points or regime shifts, which are important to understand for successful fisheries management.

## Namibia (20°S) Time Series

**Country:** Namibia

**IGMETS-ID:** na-10102 / na-10104

***Richard Horaeb and Rudi Cloete***



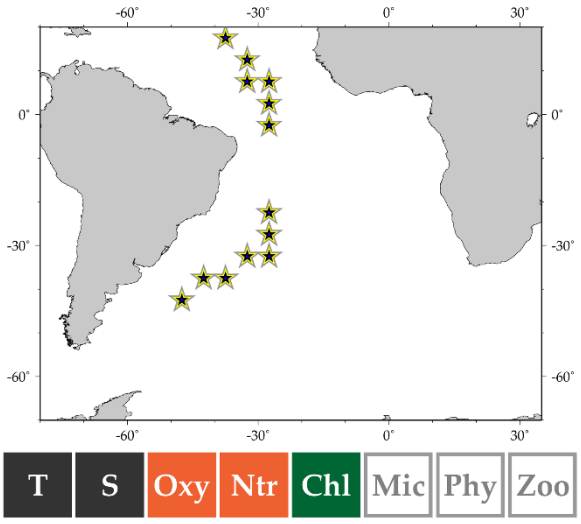

Within the Monthly Oceanographic Monitoring (MOM) Programme of the National Marine Information and Research Centre (NatMIRC) in Swakopmund, Namibia, zooplankton samples along with oceanographic data, such as SST, salinity, oxygen, and chlorophyll *a*, have been collected regularly since March 2005 along the transect at 20°S. Sampling stations are located at 2, 5, 10, 20, 30, 40, 50, 60, and 70 nautical miles from the coast. Sampling is done using a UNESCO WP-2 net equipped with a 200-µm mesh and in the upper 200 m of the water column (or 10 m from the bottom, if shallower). Changes in zooplankton species composition can be indicators of changes in environmental regimes and thus give important information for sustainable fisheries management.

## Atlantic Meridional Transect (AMT) - South

**Country:** United Kingdom

**IGMETS-ID:** uk- 30601 to uk-30624

***Andy Rees***




The Atlantic Meridional Transect (AMT) is a multidisciplinary programme which undertakes biological, chemical, and physical oceanographic research during an annual voyage between the UK and destinations in the South Atlantic. AMT began in 1995, with scientific aims to assess mesoscale to basin-scale phytoplankton processes, the functional interpretation of bio-optical signatures, and the seasonal, regional, and latitudinal variations in mesozooplankton dynamics. The programme provided a platform for international scientific collaboration, including the calibration and validation of SeaWiFS measurements and products. The measurements of hydrographic and bio-optical properties, plankton community structure, and primary production completed during the first 12 transects (1995–2000) represent the most coherent set of repeated biogeochemical observations over ocean basin-scales. This unique dataset has led to several important discoveries concerning the identification of oceanic provinces, validation of ocean colour algorithms, distributions of picoplankton, the identification of new regional sinks of carbon dioxide, and variability in rates of primary production and respiration. In 2002, the programme restarted (2002–2006) and broadened to address a suite of cross-disciplinary questions concerning ocean plankton ecology, biogeochemistry, and their links to atmospheric processes. The programme is coordinated and led by the Plymouth Marine Laboratory in collaboration with the National Oceanography Centre.

Related information: http://www.amt-uk.org/

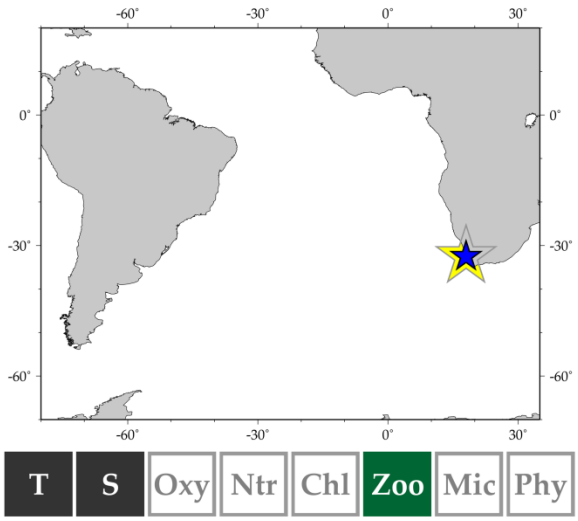
*The spatial subsetting and analysis of the AMT time series was still being processed at the time of the preparation of this report, and data were, therefore, not included in the analysis presented in Chapter 5. Upon incorporation in the IGMETS assessment, the AMT contribution will be available online (http://igmets.net/explorer).*

## St Helena Bay Copepod Time Series

**Country:** South Africa

**IGMETS-ID:** za-10101

***Hans Verheye and Jenny Huggett***




St Helena Bay (32°50'S), on the west coast of South Africa, is one of the most productive regions of the Benguela Current Large Marine Ecosystem (BCLME), one of the world's four productive upwelling regions of the eastern boundary current systems. It is the centre of pelagic fish recruitment and has been the focus of environmental, plankton, and fisheries research and monitoring since the early 1950s when the pelagic fishery developed in South Africa. The copepod time series (1951–2010) was constructed based on retrospective analysis of abundance and species composition of copepods in samples collected within 60 nautical miles from the coast in the bay during several fisheries-oriented, plankton dynamics and environmental sampling programmes since 1951. The analysis focused on austral autumn (April–June), the time when recruitment of anchovy (*Engraulis encrasicolus*) and sardine (*Sardinops sagax*) is at its peak. Details on sampling time, strategy, gear, and sample analysis are described in Verheye *et al*. (1998).

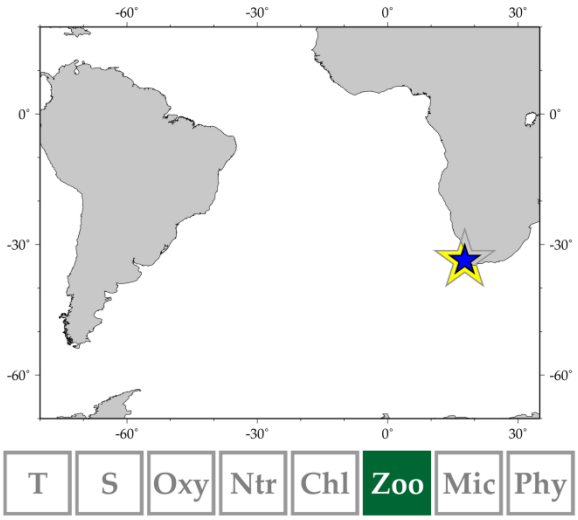
## Southern Benguela Copepod Time Series

**Country:** South Africa

**Site Name (IGMETS-ID):**

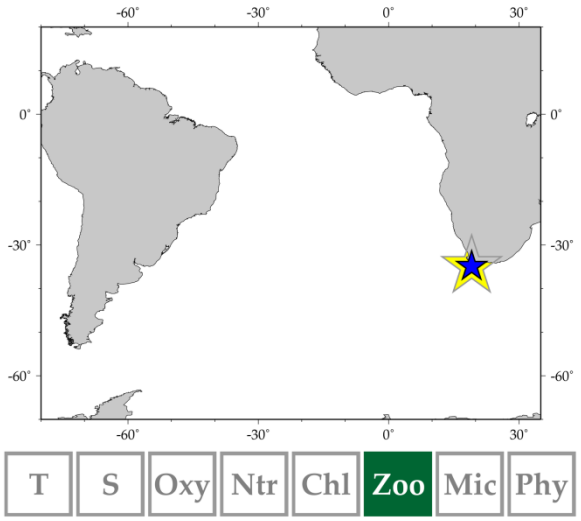
North West Coast (IGMETS-ID: za-30101)
Central West Coast (IGMETS-ID: za-30102)
South West Coast (IGMETS-ID: za-30103)
Western Agulhas Bank (IGMETS-ID: za-30104)

***Jenny Huggett and Hans Verheye***




The Benguela system is one of the four major eastern boundary upwelling systems of the world, characterized by high productivity and large pelagic fish populations. The Southern Benguela extends from the Orange River in the north (the boundary between South Africa and Namibia) to Cape Agulhas on the south coast of South Africa, the approximate longitude of the (warm) Agulhas Current retroflection. Upwelling-favourable, southeasterly winds reach a maximum during austral spring and summer, with the upwelling season extending from September to March. The system has been subdivided into four areas for spatial analysis (Huggett *et al*., 2009). Three regions on the west coast correspond to upwelling cells, as defined by Shannon and Nelson (1996): (i) the Namaqua (Hondeklipbaai) cell in the extreme north, designated the North West Coast (NWC), extending from the mouth of the Orange River to 31°S; (ii) the Columbine cell, designated the Central West Coast (CWC), extending from 31°S to Cape Columbine; and (iii) the Cape Peninsula cell in the south, called the South West Coast (SWC), extending from Cape Columbine to Cape Point. The fourth area, the Western Agulhas Bank (WAB), extends eastward from Cape Point to Cape Agulhas on the south coast. The west coast is an important nursery area for pelagic fish in winter, whereas the adult fish spawn mainly in summer on the south coast. Biannual monitoring of zooplankton, with a focus on copepods as important prey items for pelagic fish, was initiated in 1988. Vertical bongo net (200-µm mesh) hauls to a depth of 200 m were used to collect zooplankton along stratified random transects crossing the continental shelf, perpendicular to the coast, during hydroacoustic pelagic surveys in late spring/early summer (November/December) and late autumn/early winter (May/June). All copepods were counted and identified to stage, species, or category, as described in Huggett *et al*. (2009).

## Agulhas Bank Copepod Time Series – Danger Point




**Country:** South Africa

**IGMETS-ID:** za-30201

*see also Mossel Bay (za-30202) in the Indian Ocean section*

***Jenny Huggett***

The Agulhas Bank is a wide continental shelf that forms the southern tip of the African continent. The eastern shelf is bounded by the warm, fast-flowing Agulhas Current, which retroflects at ca. 20°S, south of Cape Agulhas. The Agulhas Bank serves as a spawning ground for many commercially important fish, including sardine, round herring (*Etrumeus whiteheadi*), and anchovy. Copepods, which comprise 90% of the zooplankton carbon on the Agulhas Bank, provide an important food source for these pelagic fish as well as for juvenile squid. A single large (ca. 3 mm) species of copepod (*Calanus agulhensis*) dominates the copepod community in terms of biomass and has a centre of distribution associated with a semi-permanent ridge of cool, upwelled water south of Mossel Bay (Huggett and Richardson, 2000). Annual monitoring of copepod abundance and species composition on the Agulhas Bank was initiated in 1988 during austral spring (November/December). This time of year coincides with peak spawning by anchovy. Sampling was conducted along transects crossing the continental shelf, perpendicular to the coast, at two locations: one on the western Agulhas Bank near Danger Point (19°30′E) and one on the eastern Agulhas Bank near Mossel Bay (22°E). Zooplankton were collected using vertical bongo net (200-µm mesh) hauls to a maximum depth of 200 m during routine hydroacoustic surveys of pelagic fish. All copepods were counted and identified to stage, species, or category, as described in Huggett *et al*. (2009).

# A4 Southern Ocean

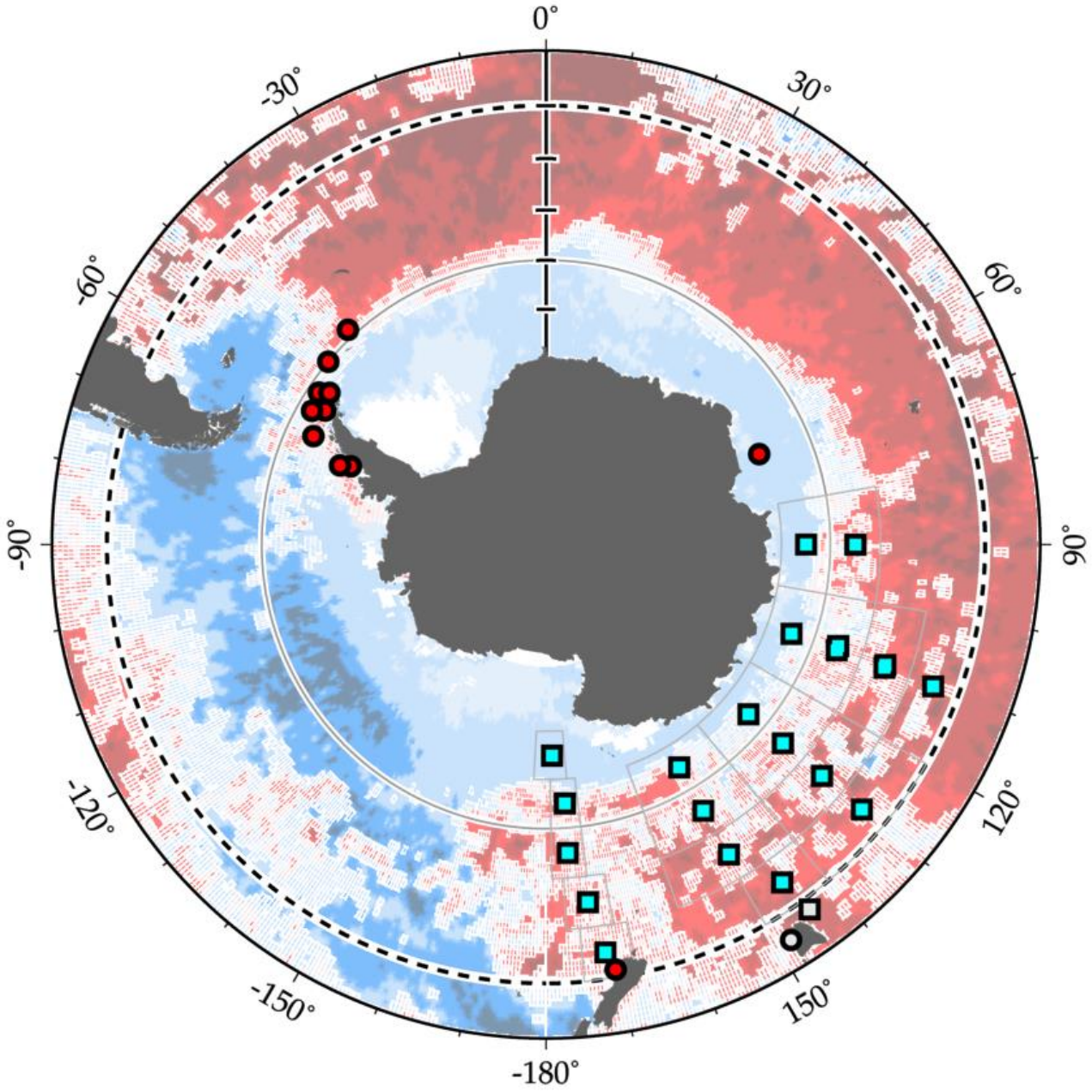


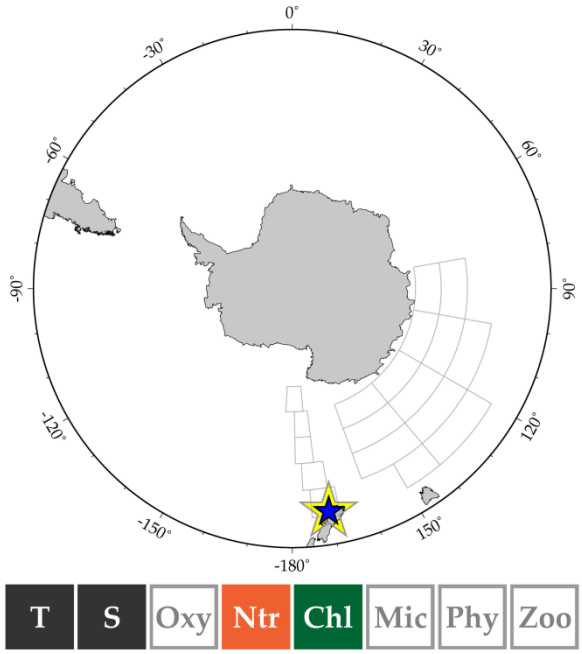

**Figure A4.** Map of IGMETS-participating Southern Ocean time series on a background of a 10-year time-window (2003–2012) sea surface temperature trends (see also Chapter 6). At the time of this report, the Southern Ocean collection consisted of 32 time series (coloured symbols of any type), of which 21 were from Continuous Plankton Recorder subareas (blue boxes). The dashed line at 45°S indicates the boundary between the IGMETS Southern Ocean region and other IGMETS regions in this report (e.g. South Pacific, South Atlantic, Indian Ocean), while the gray line at 60°S indicates the Antarctic Treaty boundary. Uncoloured (gray) symbols indicate time series being addressed in a different regional chapter.

**Table A4.** Time-series sites located in the IGMETS Southern Ocean region. Participating countries: New Zealand (nz), United Kingdom (uk), United States (us), and multiple countries (zz). Year-spans in red text indicate time series of unknown or discontinued status. IGMETS-IDs in red text indicate time series without a description entry in this Annex.

| No. | IGMETS-ID | Site or programme name | Year-span | T | S | Oxy | Ntr | Chl | Mic | Phy | Zoo |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | nz-10101 | Munida Time Series (*Western South Pacific*) | 1998–present | X | X | - | X | X | - | - | - |
| 2 | uk-30401 | KRILLBASE: Atkinson Krill Study (*Southern Ocean*) | 1976–2003 (?) | - | - | - | - | - | - | - | X |
| 3 | uk-30402 | KRILLBASE: Antarctic Peninsula and western Scotia Sea (*Southern Ocean*) | 1975–present | - | - | - | - | - | - | - | X |
| 4 | uk-30403 | KRILLBASE: Eastern Scotia Sea and South Georgia (*Southern Ocean*) | 1975–present | - | - | - | - | - | - | - | X |
| 5 | uk-30404 | KRILLBASE: Indian Ocean Sector (*Southern Ocean*) | 1981–2006 (?) | - | - | - | - | - | - | - | X |
| 6 | uk-30501 | Rothera Time Series (RaTS) (*Southern Ocean*) | 1998–present | X | X | - | - | X | - | - | - |
| 7 | us-30501 | Palmer Station Antarctica LTER (*Antarctic*) | 1989–present | X | X | X | X | X | - | - | X |
| 8 | us-50701 | AMLR Elephant Island – EI (*Southern Ocean*) | 1995–present | X | X | - | - | X | - | - | - |
| 9 | us-50702 | AMLR South – SA (*Southern Ocean*) | 1995–present | X | X | - | - | X | - | - | - |
| 10 | us-50703 | AMLR West – WA (*Southern Ocean*) | 1995–present | X | X | - | - | X | - | - | - |
| 11 | us-50704 | AMLR Joinville Island – JI (*Southern Ocean*) | 1997–present | X | X | - | - | X | - | - | - |
| 12 | zz-40101 | SCAR SO-CPR Aurora 080-100-B5560 (*Southern Ocean*) | 1991–present | X | X | - | - | X | - | - | X |
| 13 | zz-40102 | SCAR SO-CPR Aurora 080-100-B6065 (*Southern Ocean*) | 1991–present | X | X | - | - | X | - | - | X |
| 14 | zz-40103 | SCAR SO-CPR Aurora 100-120-B5055 (*Southern Ocean*) | 1998–present | X | X | - | - | X | - | - | X |
| 15 | zz-40104 | SCAR SO-CPR Aurora 100-120-B5560 (*Southern Ocean*) | 1991–present | X | X | - | - | X | - | - | X |
| 16 | zz-40105 | SCAR SO-CPR Aurora 100-120-B6065 (*Southern Ocean*) | 1997–present | X | X | - | - | X | - | - | X |
| 17 | zz-40106 | SCAR SO-CPR Aurora 120-140-B4550 (*Southern Ocean*) | 1998–present | X | X | - | - | X | - | - | X |
| 18 | zz-40107 | SCAR SO-CPR Aurora 120-140-B5055 (*Southern Ocean*) | 1997–present | X | X | - | - | X | - | - | X |
| 19 | zz-40108 | SCAR SO-CPR Aurora 120-140-B5560 (*Southern Ocean*) | 1995–present | X | X | - | - | X | - | - | X |

| No. | IGMETS-ID | Site or programme name | Year-span | T | S | Oxy | Ntr | Chl | Mic | Phy | Zoo |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | zz-40109 | SCAR SO-CPR Aurora 120-140-B6065 (*Southern Ocean*) | 1995–present | X | X | - | - | X | - | - | X |
| 21 | zz-40110 | SCAR SO-CPR Aurora 140-160-B4550 (*Southern Ocean*) | 1999–present | X | X | - | - | X | - | - | X |
| 22 | zz-40111 | SCAR SO-CPR Aurora 140-160-B5055 (*Southern Ocean*) | 1995–present | X | X | - | - | X | - | - | X |
| 23 | zz-40112 | SCAR SO-CPR Aurora 140-160-B5560 (*Southern Ocean*) | 1995–present | X | X | - | - | X | - | - | X |
| 24 | zz-40113 | SCAR SO-CPR Aurora 140-160-B6065 (*Southern Ocean*) | 1997–present | X | X | - | - | X | - | - | X |
| 25 | zz-40131 | SCAR SO-CPR Shirase E108111-S4550 (*Southern Ocean*) | 2000–present | X | X | - | - | X | - | - | X |
| 26 | zz-40132 | SCAR SO-CPR Shirase E108111-S5055 (*Southern Ocean*) | 1999–present | X | X | - | - | X | - | - | X |
| 27 | zz-40133 | SCAR SO-CPR Shirase E108111-S5560 (*Southern Ocean*) | 1999–present | X | X | - | - | X | - | - | X |
| 28 | zz-40151 | SCAR SO-CPR Aotea B4550 (*Southern Ocean*) | 2008–present | - | - | - | - | - | - | - | X |
| 29 | zz-40152 | SCAR SO-CPR Aotea B5055 (*Southern Ocean*) | 2008–present | - | - | - | - | - | - | - | X |
| 30 | zz-40153 | SCAR SO-CPR Aotea B5560 (*Southern Ocean*) | 2008–present | - | - | - | - | - | - | - | X |
| 31 | zz-40154 | SCAR SO-CPR Aotea B6065 (*Southern Ocean*) | 2008–present | - | - | - | - | - | - | - | X |
| 32 | zz-40155 | SCAR SO-CPR Aotea B6570 (*Southern Ocean*) | 2008–present | - | - | - | - | - | - | - | X |

## Munida Time Series



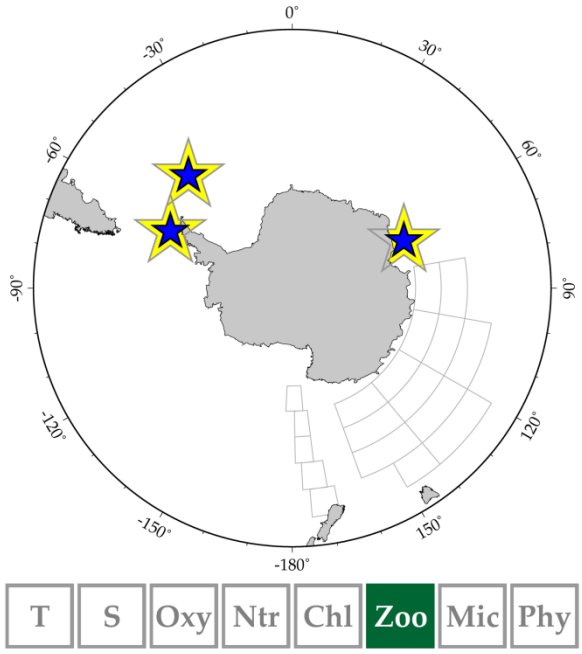

**Country**: New Zealand

**IGMETS-ID**: nz-10101

***Kim Currie, Keith Hunter and Malcolm Reid***

The Munida Time Series is a surface transect extending 65 km off the southeast coast of New Zealand and including neritic, modified subtropical, and subantarctic surface waters (SASW). The time series was established in 1998 to study the role of these waters in the uptake of atmospheric carbon dioxide and the seasonal, interannual, and long-term changes of the carbonate chemistry. Cruises are bimonthly and consist of surface measurements plus a depth station in SASW. All water masses are a sink for atmospheric carbon dioxide (Currie *et al*., 2011), and the seasonal cycles of dissolved inorganic carbon are primarily driven by net community production (Brix *et al*., 2013; Jones *et al*., 2013), with modification by the annual cycle of sea surface temperature. Aspects of trace metal chemistry, nitrogen cycling, and bacterial production have been studied on a shorter-term basis, embedded within the main programme.

## KRILLBASE: a circumpolar database of Antarctic krill and salps




**Countries:** United Kingdom, Germany, Canada, United States, and Australia

**Site Name (IGMETS-ID):**

Atkinson Krill Study (uk-30401)
Antarctic Peninsula and Western Scotia Sea (uk-30402)
Eastern Scotia Sea and South Georgia (uk-30403)
Indian Ocean Sector (uk-30404)

***Angus Atkinson, Volker Siegel, Evgeny Pakhomov, Simeon Hill, Christian Reiss, Debbie Steinberg, and So Kawaguchi***

Standardized monitoring of *Euphausia superba* and salps only dates from the 1990s and in a few sites. However, a wealth of historical data exists from various countries all focusing on a narrow "slice" of Antarctica. KRILLBASE has mined and compiled all available scientific net-haul data into a single searchable database. This active project so far contains about 15 000 net hauls for abundance of salps and postlarval krill, with many individual krill length measurements. The best coverage is December–March in the Atlantic and Indian sectors (1926–1939, post-1976). This composite dataset needs careful analysis because the methods were not standardized. However, it is more than the sum of its parts and allows a diversity of analyses, e.g. meso- and circumpolar-scale dynamics, changes with time and krill demographics. KRILLBASE includes state-funded programmes (see above) which require direct prior communication for access to their parts of the dataset.

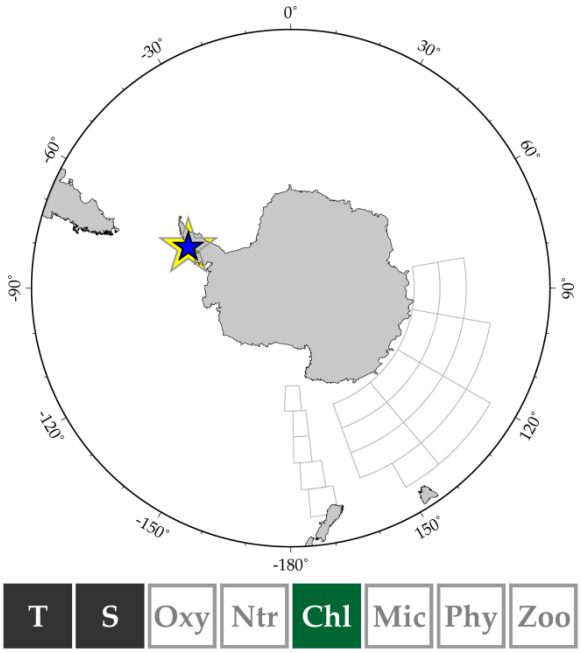
Related information: http://www.iced.ac.uk/science/krillbase.htm

## Rothera Time Series (RaTS)

**Country:** United Kingdom

**IGMETS-ID:** uk-30501

***Hugh Venables, Alexander Brearley, Andrew Clarke, and Michael Meredith***




The western Antarctic Peninsula (WAP) warmed more rapidly than any other region in the southern hemisphere during the second half of the 20th century. To understand the impacts of this change on the interdisciplinary marine environment, the Rothera Time Series (RaTS) was instigated in 1997 to make the high-quality, sustained ocean measurements required. RaTS involves quasi-weekly profiling of the physical properties (temperature, salinity, density) of the water column at the WAP from rigid inflatable boats plus sampling for a range of biogeochemical and biological parameters. The suite of measurements includes chlorophyll concentration, nutrients, isotopic tracers of ice melt, carbonate system parameters, and so on. Uniquely, RaTS includes full ocean measurements in winter, including sampling though holes cut in sea ice when the ocean surface is completely frozen. These winter measurements have resulted in the attainment of some of the most important new insights into the functioning of the oceanographic and biological systems.

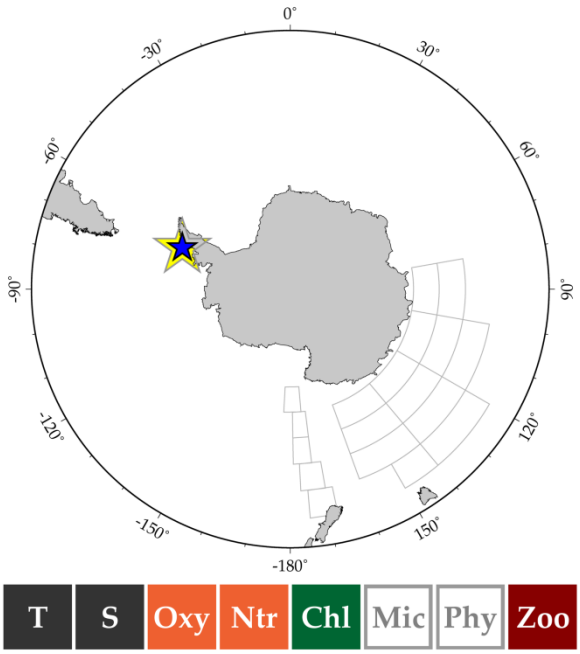
Related information: https://www.bas.ac.uk/project/rats/

## Palmer Station Antarctica-LTER

**Country:** United States

**IGMETS-ID:** us-30501

***Hugh Ducklow, Debbie Steinberg, Oscar Schofield, Michael Meredith, and Douglas Martinson***




Palmer Station Antarctica (LTER) is an interdisciplinary polar marine research programme established in 1990 as part of a national network of long-term ecological research sites created by the US National Science Foundation (NSF). The western Antarctic Peninsula (WAP) is distinctive among the Antarctic regions with its north–south orientation, direct exposure to prevailing westerly atmospheric winds and complex ocean circulation patterns. The extent, duration, and seasonality of sea ice and inputs from glacial meltwater are strong influences on the ecological and biogeochemical processes in the coastal marine ecosystem. Sea ice is the principal physical determination of variability in the coastal marine ecosystem. In fact, the life cycles of most organisms are influenced by the seasonal changes.

To study these changes on a global-scale, Palmer LTER examines the region, which is a series of dynamic, interconnected systems encompassing an immediate coastal region (0 300 m deep), a continental shelf region (300–1000 m deep), and a continental slope region (>1000 m deep). Yearly between the months of October and April, semi-weekly observations of nearshore process studies are made from Palmer Station. These are complemented in January (austral summer in the Antarctic) by a regional-scaled LTER cruise.

Related information: http://pal.lternet.edu

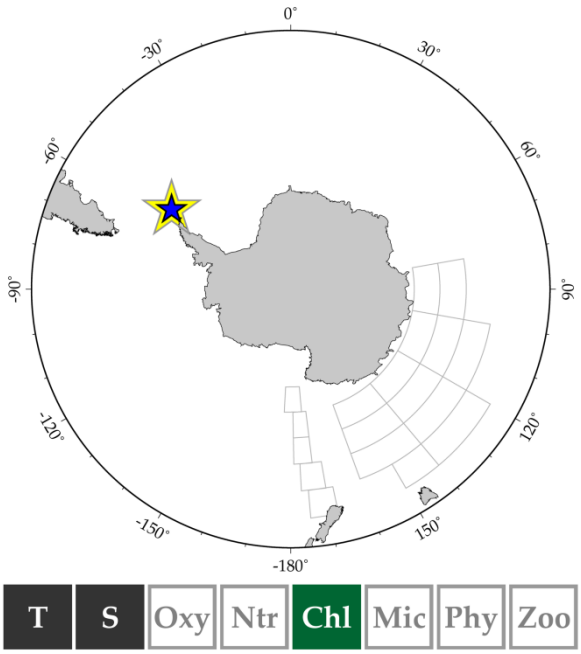
## AMLR

**Country:** United States

**Site name (IGMETS-ID):**

AMLR Elephant Island – EI (us-50701)
AMLR South – SA (us-50702)
AMLR West – WA (us-50703)
AMLR Joinville Island – JI (us-50704)

***Christian Reiss***

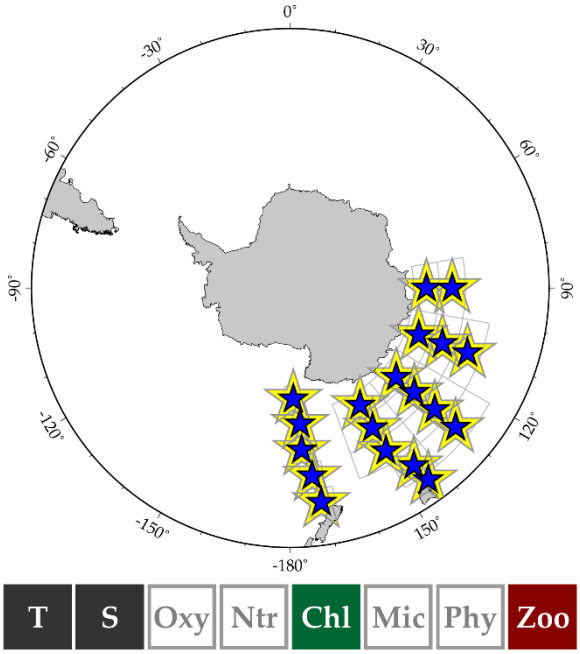



The Antarctic Ecosystem Research Division (AERD) conducts research to fulfill NOAA's mandate of providing scientific advice that supports US interests related to resource management by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), of which the US is a member country. NOAA Fisheries' Antarctic research is mandated by the US Antarctic Marine Living Resources (AMLR) Convention Act of 1984; thus, the programme of work undertaken and managed by the AERD is widely known as the US AMLR Program. The US AMLR Program is internationally recognized for its ongoing contributions to ecosystem-based management of fisheries that impact krill, finfishes, krill-dependent predators, and other components of the Antarctic ecosystem. Since 1986, the AERD has managed the US AMLR Program's field studies in Antarctic waters to investigate the effects of commercial fisheries on the marine ecosystem, including effects on local seal and seabird populations. Studies conducted by US AMLR/AERD researchers include (i) an annual research vessel survey to map prey distribution and abundance and to measure environmental variables in a study area off the Antarctic Peninsula; (ii) research at land stations to determine effects of fishing on pinniped and seabird populations during their reproductive cycles; and (iii) accounting for the status and role of mesopelagic species such as myctophids, *Pleurogramma*, and so on.

Related information: http://swfsc.noaa.gov/aerd/

## SCAR SO-CPR - Southern Ocean Continuous Plankton Recorder

**IGMETS ID:** zz-40101 – zz-40131 – zz-40151




The SCAR SO-CPR Survey was established in 1991 to map the spatial-temporal patterns of zooplankton biodiversity and then to use the sensitivity of plankton to environmental change as early warning indicators of the health of the Southern Ocean. CPRs are towed from research, supply, and fishing vessels which usually also collect environmental data such as SST, salinity, fluorometry, light, and other meteorological parameters while underway. Sixteen ships from ten countries have participated to date providing a near circum-Antarctic survey. Most tows are conducted in the region south of Africa eastward to the Ross Sea. All zooplankton in 5-nautical-mile-equivalent sections are identified to the lowest possible taxa, usually species, and counted. Antarctic krill (*Euphausia superba*) and other euphausiids are identified to the developmental stage. Counts are combined with averaged environmental data for each 5 nautical miles. Approximately 250 000 nautical miles have been sampled representing ca. 50 000 samples for about 250 zooplankton taxa. The dataset is a SCAR business product.

For the purposes of the IGMETS analysis, the SCAR SO-CPR data set was divided into twenty sub-areas (indicated by the gray box outlines in the map above), similar to the sub-areas and methods used for the North Atlantic and North Pacific CPR programs.

# A5 Indian Ocean

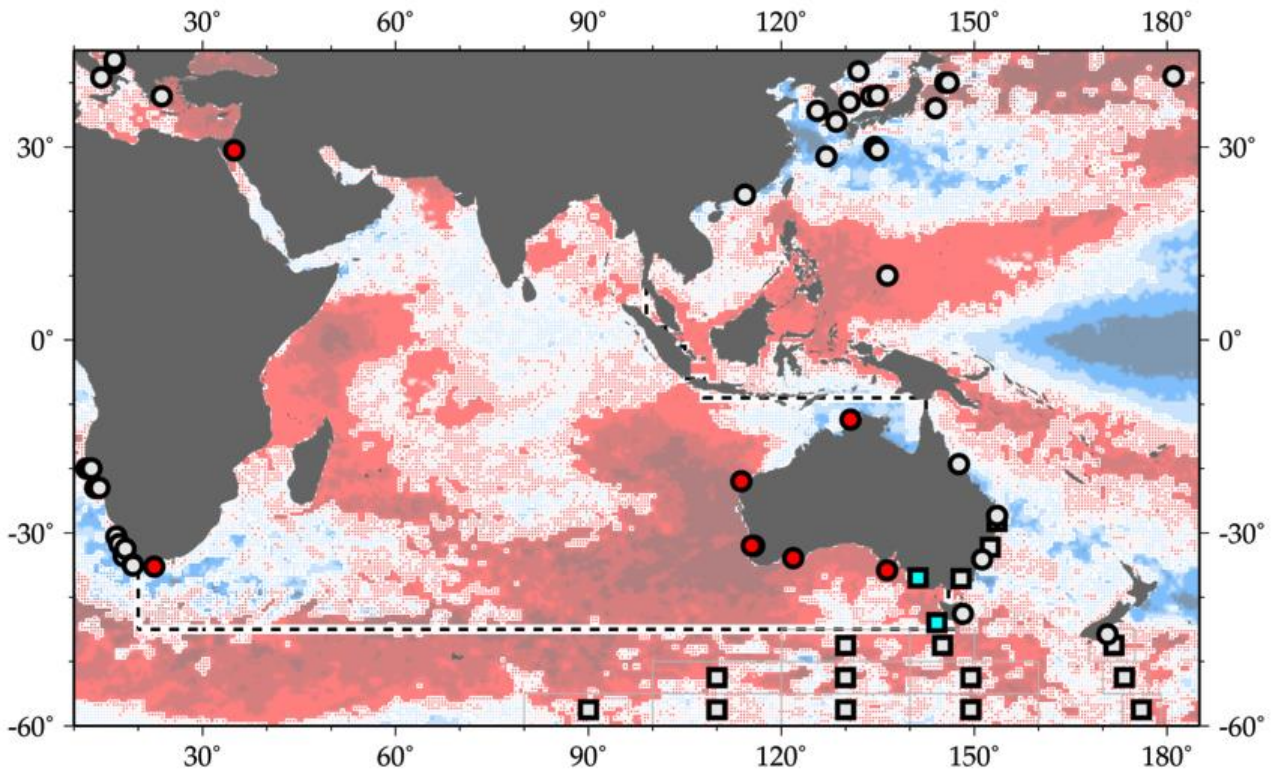



**Figure A5.** Map of IGMETS-participating Indian Ocean time series on a background of a 10-year time-window (2003–2012) sea surface temperature trends (see also Chapter 7). At the time of this report, the Indian Ocean collection consisted of 10 time series (coloured symbols of any type), of which two were Continuous Plankton Recorder subareas (blue boxes) and one was estuarine (yellow star). Dashed lines indicate boundaries between IGMETS regions. Uncoloured (gray) symbols indicate time series being addressed in a different regional chapter (e.g. Southern Ocean, North/South Pacific, South Atlantic).

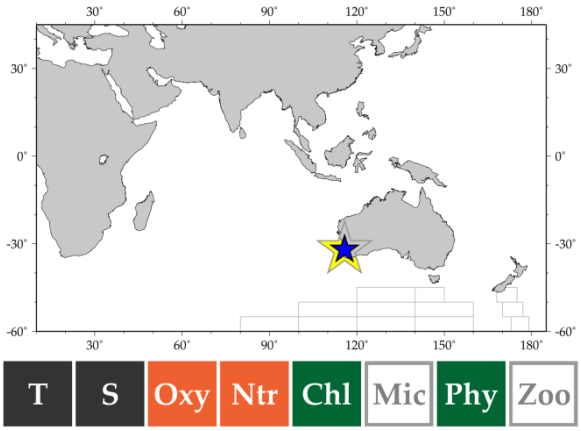
**Table A5.** Time-series sites located in the IGMETS Indian Ocean subarea. Participating countries: Australia (au), Israel (il), and South Africa (za).

| No. | IGMETS-ID | Site or programme name | Year-span | T | S | Oxy | Ntr | Chl | Mic | Phy | Zoo |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | au-10101 | Swan River Estuary: S01 Blackwall Reach *(Southwestern Australia)* | 1994–present | X | X | X | X | X | - | X | - |
| 2 | au-40114 | SO-CPR Aurora 140-160-B4245 *(Southern Ocean)* *see Southern Ocean Annex A4)* | 2008–present | X | X | - | - | X | - | - | X |
| 3 | au-40205 | AusCPR MEAD Line *(Australian Coastline)* *see Southern Ocean Annex A4)* | 2010–present | - | - | - | - | X | - | X | X |
| 4 | au-50102 | IMOS National Reference Station Darwin *(Northern Australia)* | 2011–present | X | X | - | X | X | X | X | X |
| 5 | au-50103 | IMOS National Reference Station Esperance *(Southern Australia)* | 2009–present | X | X | X | X | X | X | X | X |
| 6 | au-50104 | IMOS National Reference Station Kangaroo Island *(Southern Australia)* | 2008–present | X | X | - | X | X | X | X | X |
| 7 | au-50106 | IMOS National Reference Station Ningaloo *(Western Australia)* | 2010–present | X | X | - | X | X | X | X | X |
| 8 | au-50108 | IMOS National Reference Station Rottnest Island *(Southwestern Australia)* | 2009–present | X | X | - | X | X | X | X | X |
| 9 | il-10101 | Gulf of Eilat Aqaba NMP Station A *(Gulf of Eilat – Gulf of Aqaba)* | 2003–present | X | X | X | X | X | - | - | - |
| 10 | za-30202 | ABCTS Mossel Bay Monitoring Line *(Agulhas Bank)* | 1988–present | - | - | - | - | - | - | - | X |

## Swan River Estuary

**Country:** Australia

**IGMETS-ID:** au-10101



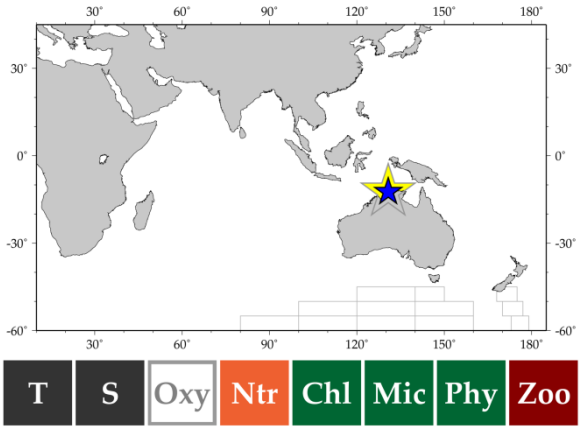

The Swan and Canning rivers flow through the heart of metropolitan Perth, a city of more than 1.5 million people and the capital of Western Australia. The Swan (Derbal Yerrigan) and Canning (Djarlgarra or Dyarlgarro) rivers are 72 and 110 km long, respectively. Together, these two rivers and their tributaries drain a catchment area of 2090 km$^2$. The Swan–Canning river system is typified by a large urban and agricultural catchment and relatively shallow and slow-moving river conditions. These factors as well as sandy soils and a climate of diminishing rainfall and long hot summers make the system vulnerable to a suite of environmental issues. The Swan River Trust has a series of initiatives and monitoring programmes in place aimed at improving water quality in the Swan and Canning rivers and their tributaries.

## Integrated Marine Observing System's (IMOS) - IMOS National Reference Station – Darwin

**Country:** Australia

**IGMETS-ID:** au-50102

***Anthony J. Richardson, Frank Coman, Claire Davies, Ruth Eriksen, Felicity McEnnulty, Anita Slotwinski, Mark Tonks, and Julian Uribe-Palomino***




Darwin (12°40′S 130°77′E) is one of seven National Reference Stations that comprise IMOS. The NRSs are designed to provide regular baseline information to understand how large-scale, long-term change and variability in the global ocean are affecting Australia's coastal ecosystems. The goal is to develop multidecadal time series of the physical and biogeochemical properties of Australia's coastal seas, informing research into ocean change, climate variability, ocean circulation, and ecosystem responses. The Darwin NRS is situated close to the largest town in Northern Australia, and its population has a considerable impact on the ecosystem. This dataset contains seasonal data on zooplankton biomass and species composition collected since June 2011 using a 100-µm mesh dropnet deployed to 18 m. The corresponding biogeochemical datasets including temperature, salinity, nutrients, chlorophyll, and phytoplankton abundance are available through the AODN portal https://portal.aodn.org.au/.

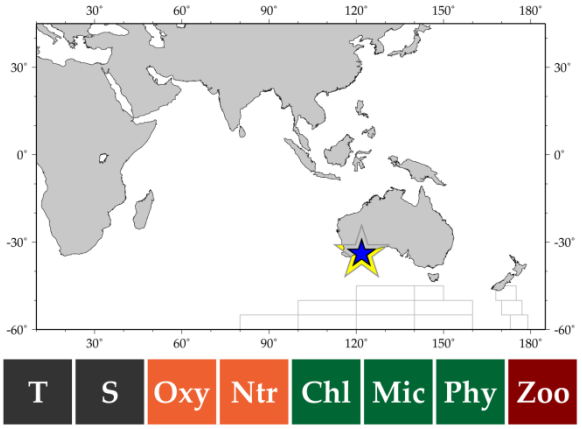
Related information: http://imos.org.au/anmnnrs.html

## Integrated Marine Observing System's (IMOS) - IMOS National Reference Station – Esperance

**Country:** Australia

**IGMETS-ID:** au-50103

***Anthony J. Richardson, Frank Coman, Claire Davies, Ruth Eriksen, Felicity McEnnulty, Anita Slotwinski, Mark Tonks, and Julian Uribe-Palomino***




Esperance (33°93'S 121°85'E) is one of two National Reference Stations that was dropped from the original set of nine moorings that comprise IMOS. The NRSs are designed to provide regular baseline information to understand how large-scale, long-term change and variability in the global ocean are affecting Australia's coastal ecosystems. The goal is to develop multidecadal time series of the physical and biogeochemical properties of Australia's coastal seas, informing research into ocean change, climate variability, ocean circulation, and ecosystem responses. The Esperance NRS was isolated and logistically challenging to sample monthly; it operated between May 2009 and July 2013. This dataset contains seasonal data on zooplankton biomass and species composition collected using a 100-µm mesh dropnet deployed to 45 m. The corresponding biogeochemical datasets including temperature, salinity, nutrients, chlorophyll, and phytoplankton abundance are available through the AODN portal https://portal.aodn.org.au/.

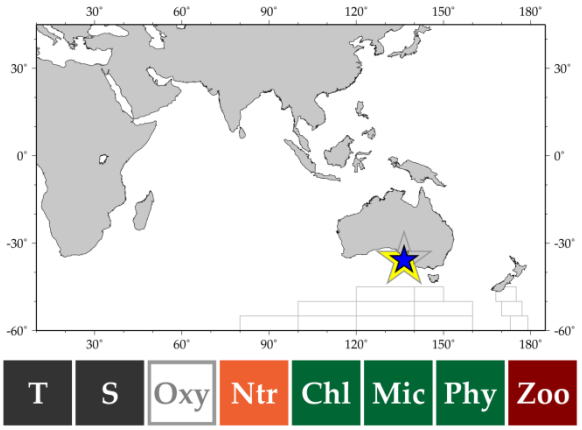
Related information: http://imos.org.au/anmnnrs.html

## Integrated Marine Observing System's (IMOS) - IMOS National Reference Station – Kangaroo Island

**Country:** Australia

**IGMETS-ID:** au-50104

***Anthony J. Richardson, Frank Coman, Claire Davies, Ruth Eriksen, Felicity McEnnulty, Anita Slotwinski, Mark Tonks, and Julian Uribe-Palomino***




Kangaroo Island (35°83'S 136°44'E) is one of seven National Reference Stations that comprise IMOS. The NRSs are designed to provide regular baseline information to understand how large-scale, long-term change and variability in the global ocean are affecting Australia's coastal ecosystems. The goal is to develop multidecadal time series of the physical and biogeochemical properties of Australia's coastal seas, informing research into ocean change, climate variability, ocean circulation, and ecosystem responses. The Kangaroo Island NRS is part of a mooring array that monitors the large seasonal coastal upwelling of water that occurs along the region's continental shelf during summer. This dataset contains seasonal data on zooplankton biomass and species composition collected since November 2009 using a 100-µm mesh dropnet deployed to 100 m. The corresponding biogeochemical datasets including temperature, salinity, nutrients, chlorophyll, and phytoplankton abundance are available through the AODN portal https://portal.aodn.org.au/.

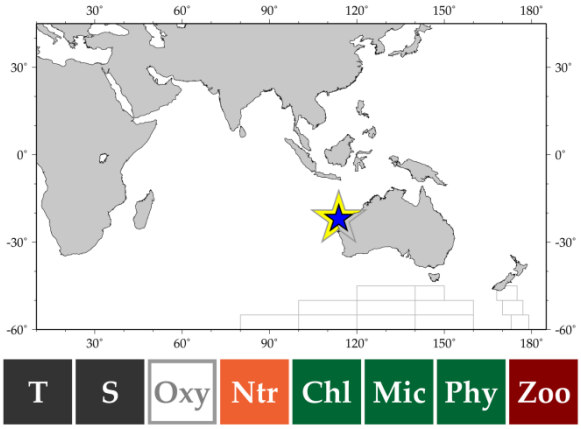
Related information: http://imos.org.au/anmnnrs.html

## Integrated Marine Observing System's (IMOS) - IMOS National Reference Station – Ningaloo

**Country**: Australia

**IGMETS-ID:** au-50106

***Anthony J. Richardson, Frank Coman, Claire Davies, Ruth Eriksen, Felicity McEnnulty, Anita Slotwinski, Mark Tonks, and Julian Uribe-Palomino***




Ningaloo (21°99′S 113°78′E) is one of two National Reference Stations that was dropped from the original set of nine moorings that comprise IMOS. The NRSs are designed to provide regular baseline information to understand how large-scale, long-term change and variability in the global ocean are affecting Australia's coastal ecosystems. The goal is to develop multidecadal time series of the physical and biogeochemical properties of Australia's coastal seas, informing research into ocean change, climate variability, ocean circulation, and ecosystem responses. The Ningaloo NRS was isolated and logistically challenging to sample monthly; it operated between November 2010 and August 2013. This dataset contains seasonal data on zooplankton biomass and species composition collected using a 100-µm mesh dropnet deployed to 25 m. The corresponding biogeochemical datasets including temperature, salinity, nutrients, chlorophyll, and phytoplankton abundance are available through the AODN portal https://portal.aodn.org.au/.

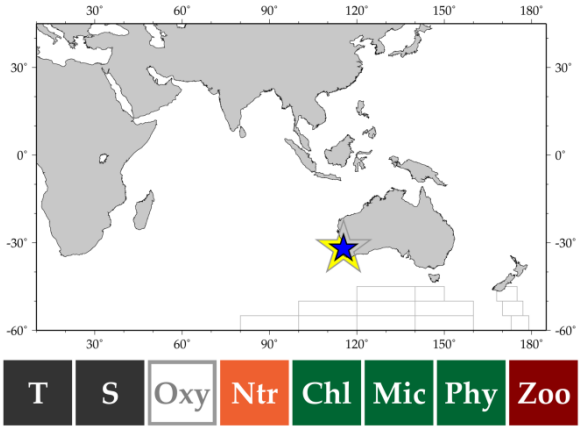
Related information: http://imos.org.au/anmnnrs.html

## Integrated Marine Observing System's (IMOS) - IMOS National Reference Station – Rottnest Island

**Country**: Australia

**IGMETS-ID:** au-50108

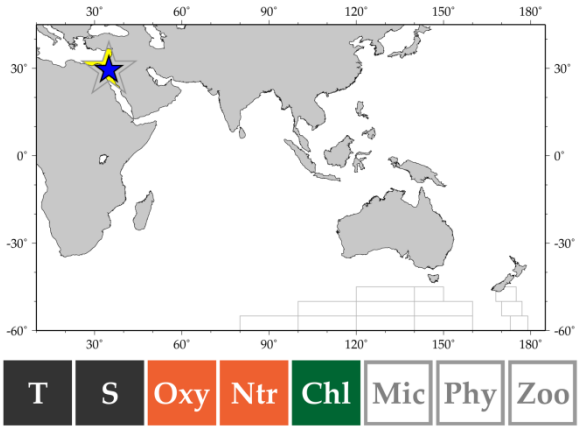
***Anthony J. Richardson, Frank Coman, Claire Davies, Ruth Eriksen, Felicity McEnnulty, Anita Slotwinski, Mark Tonks, and Julian Uribe-Palomino***




Rottnest Island (32°S 115°42′E) is one of seven National Reference Stations that comprise IMOS. The NRSs are designed to provide regular baseline information to understand how large-scale, long-term change and variability in the global ocean are affecting Australia's coastal ecosystems. The goal is to develop multidecadal time series of the physical and biogeochemical properties of Australia's coastal seas, informing research into ocean change, climate variability, ocean circulation, and ecosystem responses. The Rottnest Island NRS is sited at an historical mooring, operating since 1951 to monitor variability in the Leeuwin Current. This dataset contains seasonal data on zooplankton biomass and species composition collected since December 2009 using a 100-µm mesh dropnet deployed to 45 m. The corresponding biogeochemical datasets include temperature, salinity, nutrients, chlorophyll, and phytoplankton abundance are available through the AODN portal https://portal.aodn.org.au/.

Related information: http://imos.org.au/anmnnrs.html

## Gulf of Eilat/Aqaba NMP Station A




**Country**: Israel

**IGMETS-ID:** il-10101

***Yonathan Shaked and Amatzia Genin***

Israel's national monitoring programme (NMP) monitors habitats at the northern end of the Gulf of Eilat/Aqaba (Red Sea) within Israel's borders. The programme was initiated in 2003 by Israel's Ministry of Environmental Protection to provide administrators with scientific data.

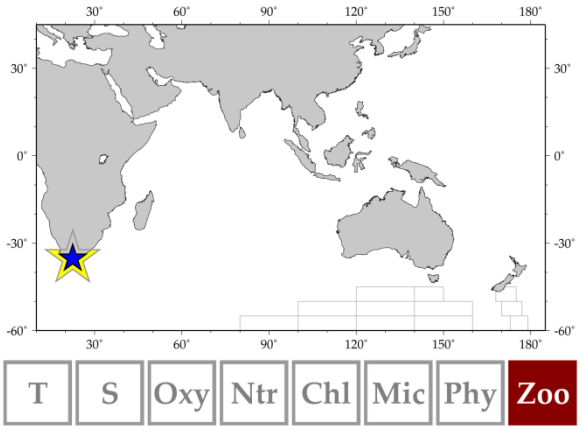
The Gulf is a deep narrow basin surrounded by an arid landmass. SST reaches ca. 28°C in summer, but, the deep waters are uniquely always about 21°C, forcing a low SST limit that accommodates some of the world's northernmost coral reefs. Winter cooling promotes water column mixing, sometimes deeper than 800 m, that supply scarce nutrients to the upper waters.

The NMP's scope includes both deep and shallow habitats. Monthly cruises sample the water column (to > 700 m depth) and shallow waters along the Israeli coast. Reefs and other shallow habitats are surveyed annually, and various supplementary measurements aid data analyses.

An annual report (Hebrew, English abstract and figure legends) and all data are available online.

Related information: http://www.iui-eilat.ac.il/Research/NMPmeteodata.aspx

## Agulhas Bank Copepod Time Series – Mossel Bay




**Country:** South Africa

**IGMETS-ID**: za-30202

***Jenny Huggett***

The Agulhas Bank is a wide continental shelf that forms the southern tip of the African continent. The eastern shelf is bounded by the warm, fast-flowing Agulhas Current which retroflects at ca. 20°S, south of Cape Agulhas. The Agulhas Bank serves as a spawning ground for many commercially important fish including sardine, round herring, and anchovy. Copepods, which comprise 90% of the zooplankton carbon on the Bank, provide an important food source for these pelagic fish as well as for juvenile squid. A single large (ca. 3 mm) species of copepod (*Calanus agulhensis*) dominates the copepod community in terms of biomass and has a centre of distribution associated with a semi-permanent ridge of cool, upwelled water south of Mossel Bay (Huggett and Richardson, 2000). Annual monitoring of copepod abundance and species composition on the Agulhas Bank was initiated in 1988 during austral spring (November/December). This time of year coincides with peak spawning by anchovy. Sampling was conducted along transects crossing the continental shelf, perpendicular to the coast, at two locations: one on the western Agulhas Bank near Danger Point (19°30'E) and one on the eastern Agulhas Bank near Mossel Bay (22°E). Zooplankton were collected using vertical bongo net (200-µm mesh) hauls to a maximum depth of 200 m during routine hydroacoustic surveys of pelagic fish. All copepods were counted and identified to stage, species, or category, as described in Huggett *et al*. (2009).

# A6 South Pacific Ocean

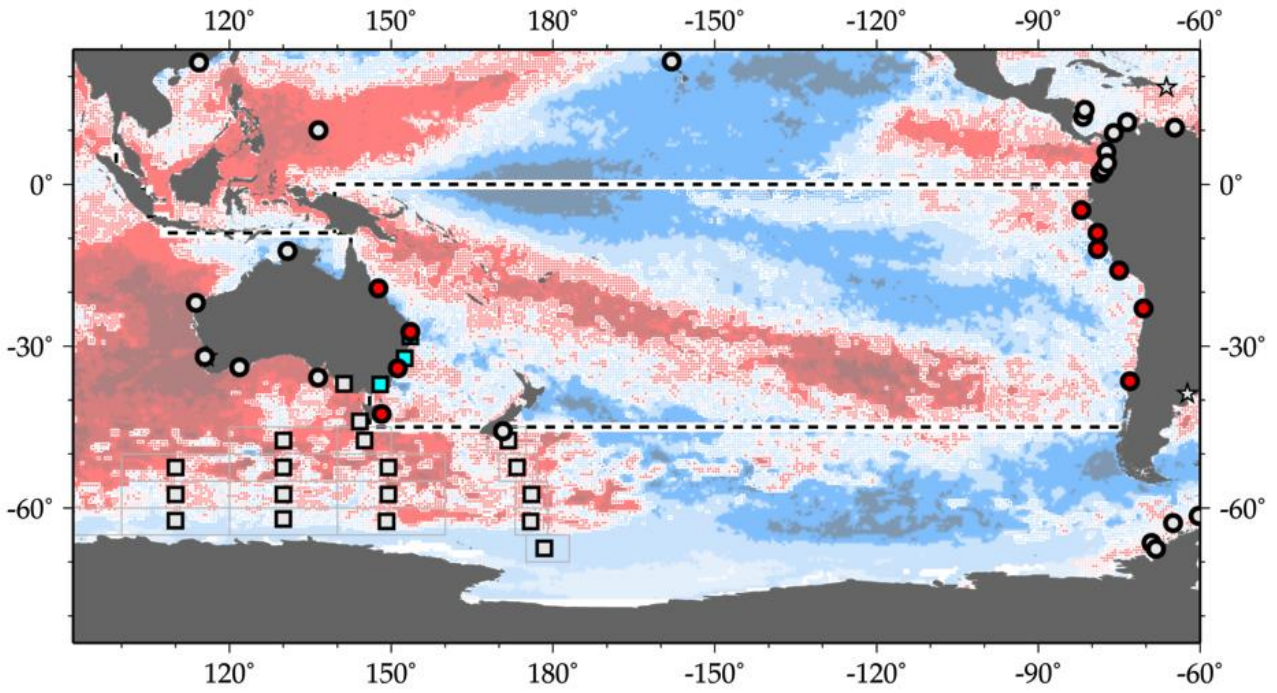



**Figure A6.** Map of IGMETS-participating South Pacific time series on a background of a 10-year time-window (2003–2012) sea surface temperature trends (see also Chapter 7). At the time of this report, the South Pacific collection consisted of 13 time series (coloured symbols of any type), of which three were from Continuous Plankton Recorder subareas (blue boxes) and none were from estuarine areas (yellow stars). Dashed lines indicate boundaries between IGMETS regions. Uncoloured (gray) symbols indicate time series being addressed in a different regional chapter (e.g. Southern Ocean, North Pacific, Indian Ocean).

**Table A6.** Time-series sites located in the IGMETS South Pacific region. Participating countries: Australia (au), Chile (il), and Peru (pe). Year-spans indicated in red belong to time series which were terminated. Year-spans in red text indicate time series of unknown or discontinued status. IGMETS-IDs in red text indicate time series without a description entry in this Annex.

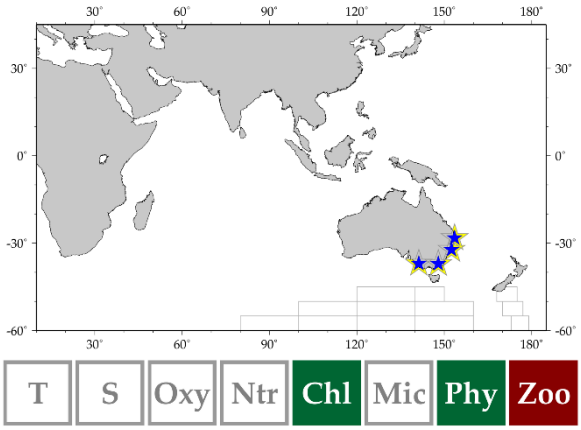
| No. | IGMETS-ID | Site or programme name | Year-span | T | S | Oxy | Ntr | Chl | Mic | Phy | Zoo |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | au-40201 | AusCPR BRSY Line – North (*Australian Coastline*) | 2009–present | - | - | - | - | X | - | X | X |
| 2 | au-40202 | AusCPR BRSY Line – South (*Australian Coastline*) | 2009–present | - | - | - | - | X | - | X | X |
| 3 | au-40204 | AusCPR SYME Line – South (*Australian Coastline*) | 2009–present | - | - | - | - | X | - | X | X |
| 4 | au-50101 | IMOS National Reference Station – Port Hacking (*Southeastern Australia*) | 2002–present | X | X | - | X | X | X | X | X |
| 5 | au-50105 | IMOS National Reference Station – Maria Island (*Tasmania*) | 2009–present | X | X | X | X | X | X | X | X |
| 6 | au-50107 | IMOS National Reference Station – North Stradbroke Island (*Eastern Australia*) | 2008–present | - | X | - | X | X | X | X | X |
| 7 | au-50109 | IMOS National Reference Station – Yongala (*Northeastern Australia*) | 2009–present | X | X | - | X | X | X | X | X |
| 8 | cl-30101 | Concepcion Station 18 (*Chilean Coast*) | 2002–present | - | - | - | - | - | - | - | X |
| 9 | cl-30102 | Bay of Mejillones (*Chilean Coast*) | 1988–present | - | - | - | - | - | - | - | X |
| 10 | pe-30101 | IMARPE Region A *(Eastern South Pacific)* | 1962–2005 (?) | - | - | - | - | - | - | - | X |
| 11 | pe-30102 | IMARPE Region B *(Eastern South Pacific)* | 1962–2005 (?) | - | - | - | - | - | - | - | X |
| 12 | pe-30103 | IMARPE Region C *(Eastern South Pacific)* | 1964–2005 (?) | - | - | - | - | - | - | - | X |
| 13 | pe-30104 | IMARPE Callao *(Eastern South Pacific)* | 2001–present | - | - | X | X | X | - | - | - |

## Australian Continuous Plankton Recorder Sites

**Country**: Australia

**Site name (IGMETS-ID)**:

AusCPR BRSY Line - North (au-40201)
AusCPR BRSY Line – South (au-40202)
AusCPR SYME Line – South (au-40204)
AusCPR MEAD Line (au-40205)




***Anthony Richardson, Claire Davies, Frank Coman, Ruth Eriksen, Felicity McEnnulty, Anita Slotwinski, Mark Tonks, and Julian Uribe-Palomino***

The AusCPR Survey is a joint project of CSIRO Oceans and Atmosphere and the Australian Antarctic Division (AAD) to measure plankton communities as a guide to the health of Australia's oceans. The survey is part of the Integrated Marine Observing System (IMOS), a national collaborative programme to observe Australia's marine environments. The aims of the survey are to:

- map plankton biodiversity and distribution
- develop the first long-term plankton baseline for Australian waters
- document plankton changes in response to climate change
- provide indices for fisheries management
- detect harmful algal blooms
- validate satellite remote sensing
- initialize and test ecosystem models

The survey has sampled throughout Australia, but concentrates on the East Australian Current, the Great Australian Bite, and the Great Barrier Reef. The dataset is freely available through the AODN (https://portal.aodn.org.au/) and provides researchers and policy makers with environmental and climatic indicators on harmful algal blooms, eutrophication, pollution, climate change, and fisheries.

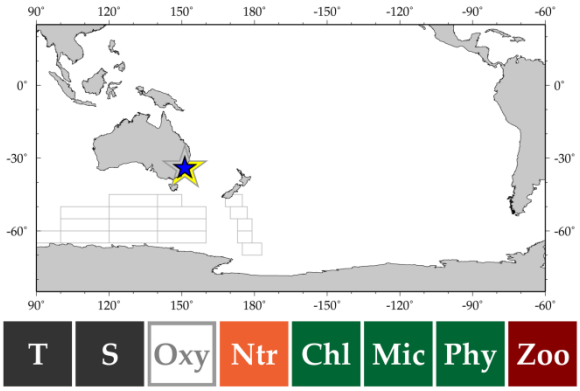
Related information: http://imos.org.au/auscontinuousplanktonrecorder.html
https://portal.aodn.org.au

## Integrated Marine Observing System's (IMOS): IMOS National Reference Station – Port Hacking

**Country:** Australia

**IGMETS-ID:** au-50101

***Anthony J. Richardson, Frank Coman, Claire Davies, Ruth Eriksen, Felicity McEnnulty, Anita Slotwinski, Mark Tonks, and Julian Uribe-Palomino***




Port Hacking (34°12'S 151°23'E) is one of seven National Reference Stations that comprise IMOS. The NRSs are designed to provide regular baseline information to understand how large-scale, long-term change and variability in the global ocean are affecting Australia's coastal ecosystems. The goal is to develop multidecadal time series of the physical and biogeochemical properties of Australia's coastal seas, informing research into ocean change, climate variability, ocean circulation, and ecosystem responses. The Port Hacking NRS is sited on an historical mooring operating since 1953 looking at the East Australian Current and its movement away from the coast. This dataset contains seasonal data on zooplankton biomass and species composition collected since 2002 using a 100-µm mesh dropnet deployed to 100 m. The corresponding biogeochemical datasets from February 2009 including temperature, salinity, nutrients, chlorophyll, and phytoplankton abundance are available through the AODN portal https://portal.aodn.org.au/.

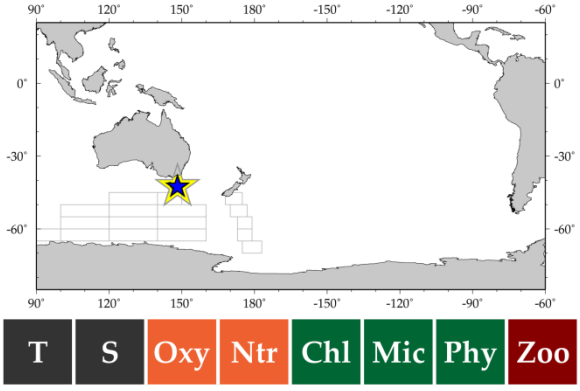
Related information: http://imos.org.au/anmnnrs.html

## Integrated Marine Observing System's (IMOS): IMOS National Reference Station – Maria Island

**Country:** Australia

**IGMETS-ID:** au-50105

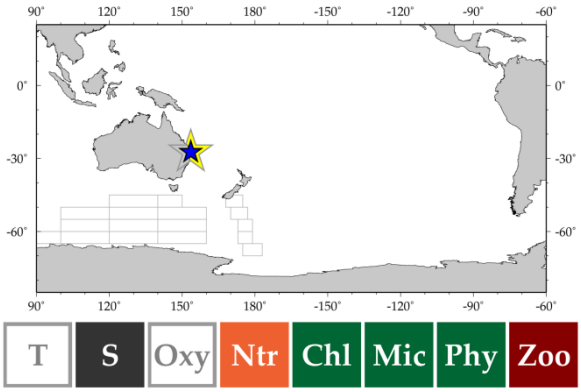
***Anthony J. Richardson, Frank Coman, Claire Davies, Ruth Eriksen, Felicity McEnnulty, Anita Slotwinski, Mark Tonks, and Julian Uribe-Palomino***




Maria Island (42°60'S 148°23'E) is one of seven National Reference Stations that comprise IMOS. The NRSs are designed to provide regular baseline information to understand how large-scale, long-term change and variability in the global ocean are affecting Australia's coastal ecosystems. The goal is to develop multidecadal time series of the physical and biogeochemical properties of Australia's coastal seas, informing research into ocean change, climate variability, ocean circulation, and ecosystem responses. The Maria Island NRS is sited at an historical mooring operating since 1944 where ocean temperatures are rising faster than anywhere else in Australia due to the increasing incursion of the East Australian Current. This dataset contains seasonal data on zooplankton biomass and species composition collected since April 2009 using a 100-µm mesh dropnet deployed to 80 m. The corresponding biogeochemical datasets including temperature, salinity, nutrients, chlorophyll, and phytoplankton abundance are available through the AODN portal https://portal.aodn.org.au/.

Related information: http://imos.org.au/anmnnrs.html

## Integrated Marine Observing System's (IMOS): IMOS National Reference Station – North Stradbroke Island




**Country:** Australia

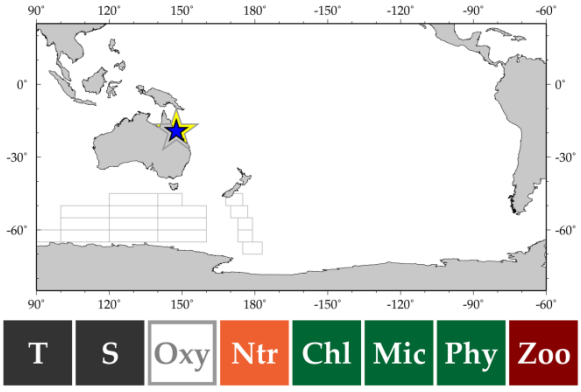
**IGMETS-ID:** au-50107

***Anthony J. Richardson, Frank Coman, Claire Davies, Ruth Eriksen, Felicity McEnnulty, Anita Slotwinski, Mark Tonks, and Julian Uribe-Palomino***

North Stradbroke Island (27°35'S 153°56'E) is one of seven National Reference Stations that comprise IMOS. The NRSs are designed to provide regular baseline information to understand how large-scale, long-term change and variability in the global ocean are affecting Australia's coastal ecosystems. The goal is to develop multidecadal time series of the physical and biogeochemical properties of Australia's coastal seas, informing research into ocean change, climate variability, ocean circulation, and ecosystem responses. The North Stradbroke Island NRS is well placed for measuring the effects of the East Australian Current as it is located where the Current is strongest and most coherent. This dataset contains seasonal data on zooplankton biomass and species composition collected since September 2008 using a 100-µm mesh dropnet deployed to 60 m. The corresponding biogeochemical datasets including temperature, salinity, nutrients, chlorophyll, and phytoplankton abundance are available through the AODN portal https://portal.aodn.org.au/.

Related information: http://imos.org.au/anmnnrs.html

## Integrated Marine Observing System's (IMOS): IMOS National Reference Station – Yongala




**Country:** Australia

**IGMETS-ID:** au-50109

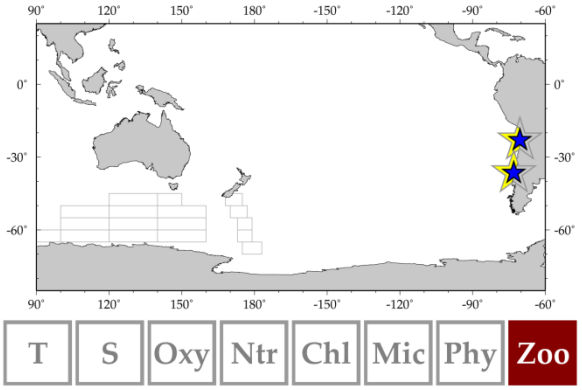
***Anthony J. Richardson, Frank Coman, Claire Davies, Ruth Eriksen, Felicity McEnnulty, Anita Slotwinski, Mark Tonks, and Julian Uribe-Palomino***

Yongala (19°31'S 147°62'E) is one of seven National Reference Stations that comprise the Australian Integrated Marine Observing System's (IMOS). The NRSs are designed to provide regular baseline information to understand how large-scale, long-term change and variability in the global ocean are affecting Australia's coastal ecosystems. The goal is to develop multidecadal time series of the physical and biogeochemical properties of Australia's coastal seas, informing research into ocean change, climate variability, ocean circulation, and ecosystem responses. The Yongala NRS is situated in the lagoon of the central Great Barrier Reef, where there are concerns about the impacts of eutrophication. This dataset contains seasonal data on zooplankton biomass and species composition collected since September 2009 using a 100-µm mesh dropnet deployed to 26 m. The corresponding biogeochemical datasets including temperature, salinity, nutrients, chlorophyll, and phytoplankton abundance are available through the AODN portal https://portal.aodn.org.au/.

Related information: http://imos.org.au/anmnnrs.html

## Concepción Station 18

### Bay of Mejillones




**Country:** Chile

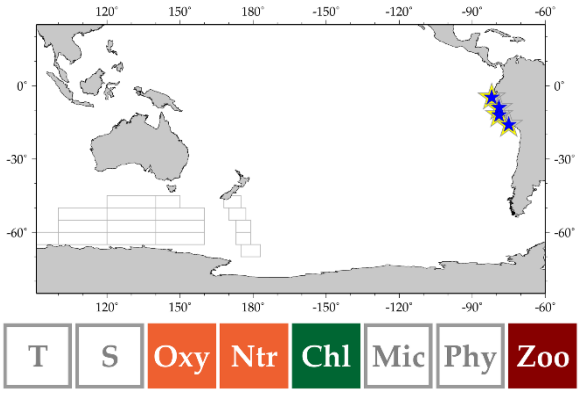
**IGMETS-ID:** cl-30101, cl-30102

***Ruben Escribano***

In August 2002 in the central/southern region of Chile, the COPAS oceanographic centre initiated a time-series study at Station 18 on the continental shelf (ca. 90 m depth) of Concepción. Zooplankton are sampled on a nearly monthly basis using a 1-m² Tucker trawl equipped with 200-µm mesh nets. The net has a calibrated flowmeter to estimate the volume sampled. Oblique tows are made from 80 m to the surface between 12 pm and 4 pm (daylight hours). The net collects integrated samples from 0 to 80 m and also stratified samples from 80 to 50 m and 50 to 0 m. In 1988, a time series of zooplankton was initiated at Antofagasta in the Bay of Mejillones. Prior to 2010, this site was only sampled twice a year (summer and winter). Since 2010, nearly monthly sampling has been done at the site. Samples were obtained with a 200-µm WP-2 net towed from between 50 m and 20 m to the surface. Water volume filtered was estimated from the depth of deployment. All sampling was performed during daylight hours.

Related information: http://copas.udec.cl/eng/research/serie/
http://copas.udec.cl/eng/

## Instituto del Mar del Perú (IMARPE) Time Series




**Country:** Peru

**Site name (IGMETS-ID):**

IMARPE Region A (pe-30101),
IMARPE Region B (pe-30102)
IMARPE Region C (pe-30103)

***Patricia Ayon***

IMARPE has always focused on fisheries. Zooplankton samples were a byproduct of ichthyoplankton sampling, which was conducted on all pelagic, demersal, or hydrographic surveys. Between 1961 and 2006, 150 surveys were carried out, with > 10 000 samples collected. Surveys covered up to 500 km from the coast between 3°30′ and 18°20′S, although over 95% of the samples were collected within 100 km of the coastline. Two types of standard surveys for zooplankton sampling have evolved with time. The first type is the Hensen Net Program in which zooplankton data have been collected since 1964 on pelagic fish, demersal fish, and oceanographic surveys, where a Hensen net (330-µm mesh, 60 cm diameter) has been towed vertically from 50 m to the surface. The stations are located on a predefined meander-shaped cruise track covering the whole coastal area of Peru, although the cruise track was sometimes modified. Zooplankton samples were only taken at stations where echograms indicated fish were present and fish trawling should also be conducted. Since 1996, additional zooplankton sampling has been conducted where distance between trawl positions was >20 nautical miles. The second type is the Fixed Coastal Stations Program on transects perpendicular to the coast near Paita, San José, and Callao, with horizontal surface tows taken since 1994 with a WP2 net. Additionally, since 2004, oblique bongo net tows (60-cm diameter, 300-µm mesh size) have been included.

# A7 North Pacific Ocean

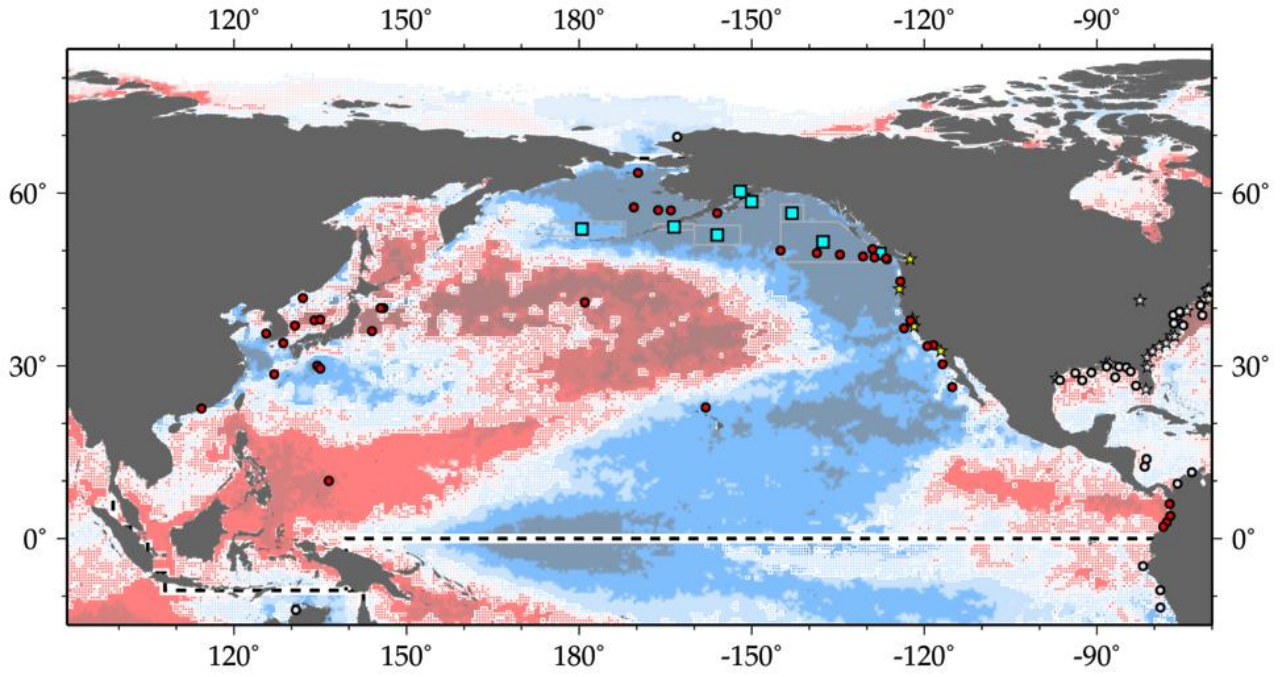



**Figure A7.** Map of IGMETS-participating North Pacific time series on a background of a 10-year time-window (2003–2012) sea surface temperature trends (see also Chapter 8). At the time of this report, the North Pacific collection consisted of 54 time series (coloured symbols of any type), of which eight were from Continuous Plankton Recorder subareas (blue boxes), and six were from estuarine areas (yellow stars). Dashed lines indicate boundaries between IGMETS regions. Uncoloured (gray) symbols indicate time series being addressed in a different regional chapter (e.g. Arctic Ocean, South Pacific).

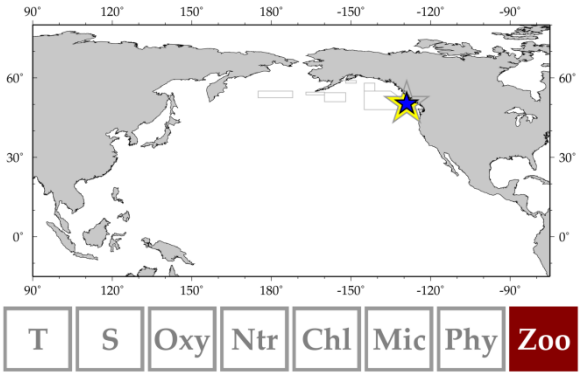
**Table A7.** Time-series sites located in the IGMETS North Pacific region. Participating countries: Canada (ca), Colombia (co), China – Hong Kong (hk), Japan, (jp), Republic of Korea (kr), Mexico (mx), United Kingdom (uk), and United States (us). Year-spans in red text indicate time series of unknown or discontinued status. IGMETS-IDs in red text indicate time series without a description entry in this Annex.

| No. | IGMETS-ID | Site or programme name | Year-span | T | S | Oxy | Ntr | Chl | Mic | Phy | Zoo |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ca-50301 | Northern Vancouver Island – Offshore *(Canadian Pacific Coast)* | 1983–present | - | - | - | - | - | - | - | X |
| 2 | ca-50302 | Southern Vancouver Island – Offshore *(Canadian Pacific Coast)* | 1979–present | - | - | - | - | - | - | - | X |
| 3 | ca-50901 | Line P – P26 – OWS Papa *(Northeast North Pacific)* | 1956–present | X | X | X | X | X | - | - | X |
| 4 | ca-50902 | Line P – P20 *(Northeast North Pacific)* | 1968–present | X | X | X | X | X | - | - | X |
| 5 | ca-50903 | Line P – P16 *(Northeast North Pacific)* | 1968–present | X | X | X | X | X | - | - | X |
| 6 | ca-50904 | Line P – P12 *(Northeast North Pacific)* | 1968–present | X | X | X | X | X | - | - | X |
| 7 | ca-50905 | Line P – P08 *(Northeast North Pacific)* | 1968–present | X | X | X | X | X | - | - | X |
| 8 | ca-50906 | Line P – P04 *(Northeast North Pacific)* | 1968–present | X | X | X | X | X | - | - | X |
| 9 | co-30110 | REDCAM Department of Cauca *(Colombia Coastline)* | 2002–present | X | X | X | - | - | - | - | - |
| 10 | co-30111 | REDCAM Department of Choco *(Colombia Coastline)* | 2002–present | X | X | X | - | - | - | - | - |
| 11 | co-30112 | REDCAM Department of Narino *(Colombia Coastline)* | 2002–present | X | X | X | - | - | - | - | - |
| 12 | co-30113 | REDCAM Department of Valle del Cauca *(Colombia Coastline)* | 2002–present | X | X | X | - | - | - | - | - |
| 13 | hk-30101 | Hong Kong EPD Marine Water Quality Monitoring *(Hong Kong)* | 1991–present | X | X | X | X | X | - | X | - |
| 14 | jp-30104 | PM Line *(Japan Sea)* | 1972–2002 (?) | - | - | - | - | - | - | - | X |
| 15 | jp-30101 | Kuroshio Current *(Western North Pacific)* | 1951–2002 (?) | X | - | - | - | - | - | - | X |
| 16 | jp-30102 | Oyashio Current *(Western North Pacific)* | 1951–2004 (?) | X | - | - | - | - | - | - | X |
| 17 | jp-30103 | Oyashio–Kuroshio Transition *(Western North Pacific)* | 1951–2004 (?) | X | - | - | - | - | - | - | X |
| 18 | jp-30201 | Bering Sea – HUFO *(Bering Sea)* | 1955–2006 (?) | - | - | - | - | - | - | - | X |
| 19 | jp-30202 | Central North Pacific – HUFO *(North Pacific)* | 1979–2000 (?) | - | - | - | - | - | - | - | X |

| No. | IGMETS-ID | Site or programme name | Year-span | T | S | Oxy | Ntr | Chl | Mic | Phy | Zoo |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | jp-30401 | JMA East China Sea *(East China Sea)* | 1965–present | X | X | X | X | - | - | - | - |
| 21 | jp-30402 | JMA Japan Sea *(Japan Sea)* | 1964–present | X | X | X | X | X | - | - | - |
| 22 | jp-30403 | JMA Philippine Sea *(Philippine Sea)* | 1965–present | X | X | X | X | X | - | - | - |
| 23 | jp-30404 | JMA Southeast Hokkaido *(Northwest North Pacific)* | 1965–present | X | X | X | X | X | - | - | - |
| 24 | jp-30405 | JMA 137E Transect *(Lower Philippine Sea)* | 1970–present | X | X | X | X | - | - | - | - |
| 25 | kr-30103 | Korea East *(Japan Sea)* | 1965–2006 (?) | - | - | - | - | - | - | - | X |
| 26 | kr-30104 | Northeast Korea – Russian Sampling *(Japan Sea)* | 1988–2007 (?) | - | - | - | - | - | - | - | X |
| 27 | kr-30102 | Korea South *(East China Sea)* | 1965–2006 (?) | - | - | - | - | - | - | - | X |
| 28 | kr-30101 | Korea West *(Yellow Sea)* | 1965–2006 (?) | - | - | - | - | - | - | - | X |
| 29 | mx-30101 | IMECOCAL Northern Baja – NB *(Southeastern North Pacific)* | 1998–present | - | - | - | - | - | - | - | X |
| 30 | mx-30102 | IMECOCAL Southern Baja – SB *(Southeastern North Pacific)* | 1998–present | - | - | - | - | - | - | - | X |
| 31 | uk-40201 | Pacific CPR – Southern Bering Sea *(Northeastern North Pacific)* | 2000–present | - | - | - | - | X | - | X | X |
| 32 | uk-40202 | Pacific CPR – Aleutian Shelf *(Northeastern North Pacific)* | 2000–present | - | - | - | - | X | - | X | X |
| 33 | uk-40203 | Pacific CPR – Western Gulf of Alaska *(Northeastern North Pacific)* | 2000–present | - | - | - | - | X | - | X | X |
| 34 | uk-40204 | Pacific CPR – Alaskan Shelf *(Northeastern North Pacific)* | 2004–present | - | - | - | - | X | - | X | X |
| 35 | uk-40205 | Pacific CPR – Cook Inlet *(Northeastern North Pacific)* | 2004–present | - | - | - | - | X | - | X | X |
| 36 | uk-40206 | Pacific CPR – Northern Gulf of Alaska *(Northeastern North Pacific)* | 1997–present | - | - | - | - | X | - | X | X |
| 37 | uk-40207 | Pacific CPR – Offshore BC *(Northeastern North Pacific)* | 1997–present | - | - | - | - | X | - | X | X |
| 38 | uk-40208 | Pacific CPR – BC Shelf *(Northeastern North Pacific)* | 2000–present | - | - | - | - | X | - | X | X |
| 39 | us-10201 | Hawaii Ocean Time series – HOT *(Central North Pacific)* | 1988–present | X | X | X | X | X | X | - | X |

| No. | IGMETS-ID | Site or programme name | Year-span | T | S | Oxy | Ntr | Chl | Mic | Phy | Zoo |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | us-10301 | USC WIES San Pedro Ocean Time series – SPOT *(Eastern North Pacific)* | 2000–present | X | X | X | X | X | - | - | - |
| 41 | us-30401 | Central Bay *(San Francisco Bay)* | 1978–present | X | X | X | X | X | X | X | - |
| 42 | us-50301 | CalCOFI California Current region – CC *(California Current)* | 1951–present | - | - | - | - | - | - | - | X |
| 43 | us-50302 | CalCOFI Southern California region – SC *(Southern California Current)* | 1951–present | - | - | - | - | - | - | - | X |
| 44 | us-50401 | Western Kodiak Island – EcoFOCI *(Gulf of Alaska)* | 1981–present | - | - | - | - | - | - | - | X |
| 45 | us-50501 | Newport Line NH-5 *(Newport-Oregon)* | 1969–present | X | X | - | X | X | - | - | X |
| 46 | us-50601 | EMA-1: Eastern Bering Sea – East *(Southeastern Bering Shelf)* | 1999–present | X | X | X | X | X | - | - | X |
| 47 | us-50602 | EMA-2: Eastern Bering Sea – West *(Southwestern Bering Shelf)* | 2002–present | X | X | X | X | X | - | - | X |
| 48 | us-50603 | EMA-3: Northern Bering Sea *(Northern Bering Sea)* | 2002–present | X | X | X | X | X | - | - | X |
| 49 | us-60106 | NERRS Elkhorn Slough *(Northeastern North Pacific)* | 2001–present | X | X | X | X | X | - | - | - |
| 50 | us-60113 | NERRS Kachemak Bay *(Northeastern North Pacific)* | 2003–present | X | X | X | X | X | - | - | - |
| 51 | us-60120 | NERRS Padilla Bay *(Northeastern North Pacific)* | 2009–present | X | X | X | X | X | - | - | - |
| 52 | us-60123 | NERRS San Francisco Bay *(Northeastern North Pacific)* | 2008–present | X | X | X | X | X | - | - | - |
| 53 | us-60124 | NERRS South Slough *(Northeastern North Pacific)* | 2002–present | X | X | X | X | X | - | - | - |
| 54 | us-60125 | NERRS Tijuana River *(Northeastern North Pacific)* | 2004–present | X | X | X | X | X | - | - | - |

## Vancouver Island Time Series




**Country:** Canada

**Site name (IGMETS-ID):**

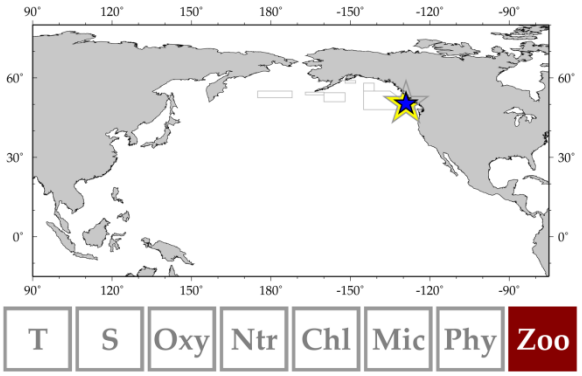
Northern Vancouver Island (ca-50301)
Southern Vancouver Island (ca-50302)

***Ian Perry, Moira Galbraith, Dave Mackas, and Doug Yelland***

The La Perouse Zooplankton Monitoring Program started in 1979 by sampling the southern continental shelf and shelf break west of Vancouver Island, British Columbia, Canada (Mackas *et al*., 2001, 2006, 2007). In 1990, this survey was expanded to include off northern Vancouver Island, but with low sampling intensity and taxonomic resolution in 1991–1995 (Mackas *et al*., 2004, 2006). This programme began with four surveys a year (spring, summer, autumn, winter) to understand regional seasonality, but recently has decreased to two surveys a year (May and September). Sampling gear and methods have remained consistent: a dual-net (bongo) sampler with black 236-µm mesh and TSK flowmeter hauled vertically 10 m off the bottom on the shelf or a maximum of 250 m on the slope and offshore areas. One side is used for size fractionated biomass and the other for taxonomic identifications, including life stage. A CTD and/or Rosette profile is also done at each station where a zooplankton tow is taken. The areas being covered under the La Perouse Program have expanded to include survey lines along the entire west coast of Vancouver Island and into the Strait of Georgia. Additional sampling is undertaken by other DFO surveys to this region to survey other seasons. Zooplankton and ichthyoplankton data are archived in the IOS Zooplankton Database.

Data from each sampling period are spatially averaged within each region (geometric mean), and sample-number-weighted averages of the survey means are used to calculate average seasonal cycles = climatologies (to 2005) for each region. Within-region and within-time-period anomalies are calculated as log(observation/climatology), and these are then averaged within year (and sometimes across groups of taxa and across adjoining spatial regions) to give the time series of annual anomalies. For information or access to these data, contact Ian Perry (general enquiries), Moira Galbraith (plankton data), or Doug Yelland (hydrographic data).

## Ocean Station Papa and Line P




**Country:** Canada

**IGMETS-ID:** ca-50901 – ca-50906

***Marie Robert, Moira Galbraith, Andrew Ross, Ian Perry, and Dave Mackas***

Line P is a long standing programme which surveys a 1400-km long section west of Vancouver Island, Canada, three times a year. It is composed of 27 stations spread from the mouth of Juan de Fuca Strait (P1 at 48°35'N 125°30'W) to Ocean Station Papa (50°N 145°W). Of these 27 stations, seven are major stations (P2, P4, P8, P12, P16, P20, and P26) where a whole suite of properties are measured, including biogeochemical and ecological samples. At the other stations, CTD profiles collect physical and some chemical data via sensors. Ocean Station Papa is the site of a large array of moorings. Past years have seen moored sediment traps and the Canadian SOLAS moorings. Present moorings are serviced by various US agencies and universities. Data have been collected along this line since 1956 and show evidence of the impact of climate variability on ocean productivity. Although the main focus of the Line P Program is ocean monitoring, is it a fantastic basis for various research projects. Line P data can be accessed at www.waterproperties.ca/linep.

Zooplankton records collected on these surveys are archived in the IOS Zooplankton Database. Data start in 1956 and go to 1980 on a monthly basis for Station Papa: P26. Samples were taken using a NorPac or SCOR vertical net haul using 350-µm mesh from a depth of 150 m. Early samples (1956–1964) consisted of total biomass measurements. In 1965–1967, major taxonomic groups were enumerated: copepods, amphipods, euphausiids, chaetognaths, and medusae. During 1968–1980, more detailed identification of zooplankton began, but only for selected species. In 1987, bongo nets were introduced using black Nitex 236-µm mesh. This apparatus has paired 2.5-m socks with 0.5-$m^2$ mouth opening. One side was used for taxonomic identification of zooplankton and the other for size-fractionated biomass. Zooplankton sampling on the Line P Monitoring Program started in 1995; samples were taken from 150 m to the surface using the same methods described for 1987. In 2003, the maximum sampling depth was changed to 250 m so as to sample below the diel migrators of the open ocean.

Related information: http://www.waterproperties.ca/linep

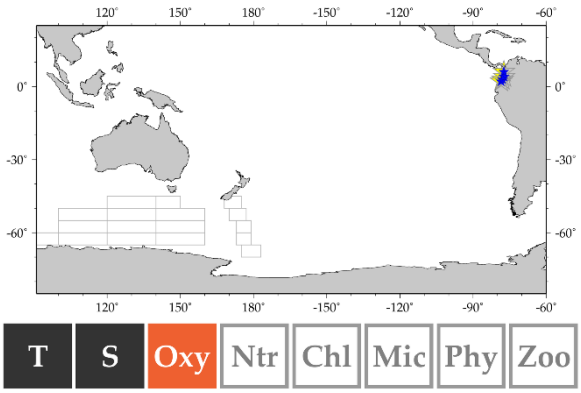
## REDCAM – Pacific Sites

**Country:** Colombia

**Site name (IGMETS-ID):**

REDCAM Department of Cauca (co-30110)
REDCAM Department of Choco (co-30111)
REDCAM Department of Narino (co-30112)
REDCAM Department of Valle del Cauca (co-30113)

*see also REDCAM in North Atlantic (co-30101 to co-30104)*

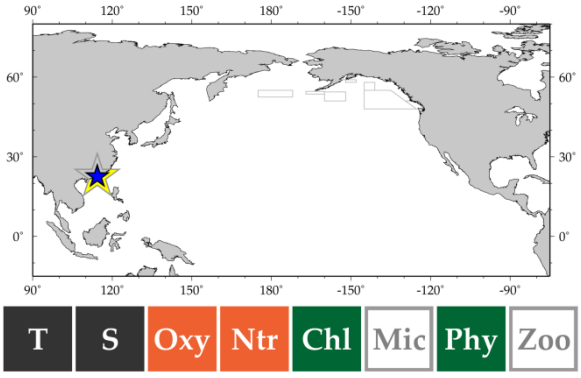



The Colombian Marine Environment Monitoring Network (REDCAM) was initiated in 2001 to group the institutions and the efforts necessary to evaluate the chemical and sanitary quality of the marine and estuarine waters of Colombia. It is composed of 16 nodes and a main server located at INVEMAR (Santa Marta). Each node includes hardware and software for input and retrieval tables and cartographic information about the quality of marine and coastal waters of Colombia. It was established as a network of field stations that covers most of the Colombian coasts. Since 2001 and twice a year at each node, it has been registering the values of the main physicochemical and bacteriological variables that characterize the quality of the marine and estuarine waters. Based on this information, the following zones have been identified as critical for its marine and coastal pollution: Santa Marta, Cartagena, Barranquilla, Morrosquillo, Uraba, and San Andres at the Caribbean coast and Buenaventura, Guapi, and La Tola at the Pacific coast.

## Hong Kong EPD Marine Water Quality Monitoring - Pearl River (Hong Kong)

**Country:** China (Hong Kong)

**IGMETS-ID:** hk-30101




The Environmental Protection Department (EPD) of the Hong Kong SAR Government monitors the water quality of some 1700 km² of the territory's marine waters. The purpose of this programme is to (i) indicate the state of health of marine waters; (ii) assess compliance with the statutory Water Quality Objectives (WQOs); (iii) reveal long-term changes in water quality; and (iv) provide a basis for the planning of pollution control strategies.

The Hong Kong waters are divided into ten Water Control Zones (WCZs). A range of physical and chemical parameters, including temperature, pH, salinity, turbidity, and dissolved oxygen, are measured *in situ* by a CTD. In addition, water and sediment samples are collected and sent to the laboratories for the analysis of some 40 parameters, such as nutrients, metals, organics, and coliform bacteria. Water-quality monitoring is generally conducted once a month, whereas sediment quality monitoring is done twice a year.

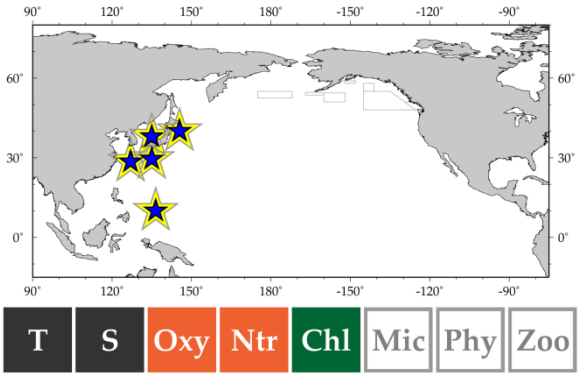
Related information: http://wqrc.epd.gov.hk/en/overview/index.aspx

## Japanese Meteorological Agency oceanographic monitoring

**Country:** Japan

**Site name (IGMETS-ID):**

JMA East China Sea (jp-30401)
JMA Japan Sea (jp-30402)
JMA Philippine Sea (jp-30403)
JMA Southeast Hokkaido (jp-30404)
JMA 137E Transect (jp-30405)




***Toshiya Nakano and Masao Ishii***

Section 137 E in the western North Pacific was established in 1967 by J. Masuzawa and his colleagues at the Japan Meteorological Agency. This section encompasses the coastal zone of Japan, Kuroshio Recirculation Gyre and North Equatorial Current zone in the subtropics, North Equatorial Countercurrent, and the tropical warm pool near Indonesia. The longest time series involves temperature, salinity, oxygen, nutrients, and DIC (1994–) in the water column and underway, and $pCO_2$ in surface seawater (1983–) and in the atmosphere. Recently, they have been sampled seasonally or biannually at station intervals of 1° latitude for CTDO2 and 1–5° for biogeochemical variables. This high-frequency section aims to understand the trend of ocean warming, salinity change (freshening), ocean circulation change, deoxygenation, anthropogenic $CO_2$ storage and acidification, air–sea $CO_2$ flux, and so on that are associated with climate variability/change and anthropogenic $CO_2$ emission.

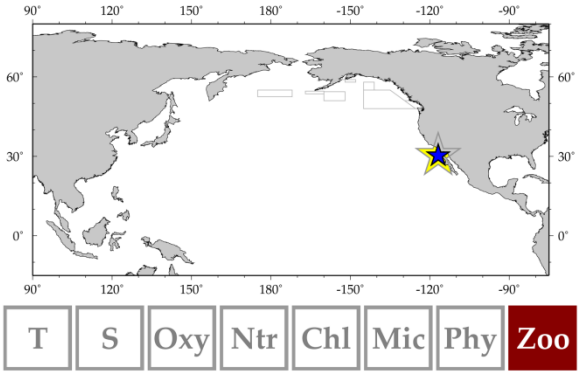
Related information: http://www.data.jma.go.jp/gmd/kaiyou/db/vessel_obs/data-report/html/ship/ship_e.php

## Baja California Zooplankton Time Series

**Country:** Mexico

**Site name (IGMETS-ID):**

Northern Baja California Zooplankton Time Series (mx-30101)
Southern Baja California Zooplankton Time Series (mx-30102)



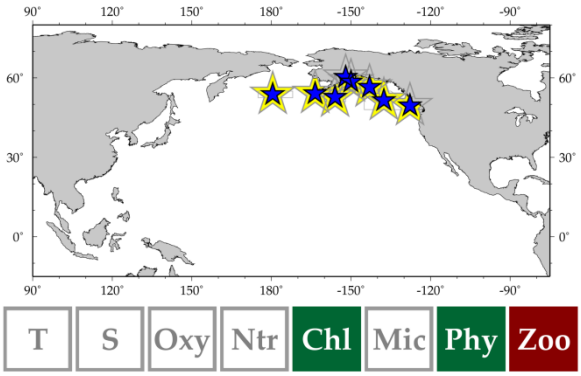

***Bertha E. Lavaniegos***

The Baja California Zooplankton Time Series are derived from biological material collected by IMECOCAL cruises since September 1997 in the subtropical sector of the California Current. The aim is to provide data of biomass and abundance by functional groups and species in order to understand the composition of and changes in the zooplankton component at different temporal scales. The California Current is an eastern boundary upwelling ecosystem. Subarctic water upstream presents low temperature and salinity, with both increasing downstream. From late summer to early winter, a major influence of subtropical oceanic water is observed associated with branching of the California Current off northern Baja California, with a return flow (poleward) along the coast, weakening the rest of the current that continues equatorward. During the spring transition, the California Current is renewed, and strong winds enhance coastal upwelling. The coastal shelf is narrow, except for Vizcaino Bay and the Gulf of Ulloa. The topography, winds, and circulation determine strong onshore–offshore differences in zooplankton communities and, to a lesser extent, from north to south.

A summary of the zooplankton time series for the period 1997-2013 is offered by Lavaniegos et al. (2015).

Related information: http://imecocal.cicese.mx/

## Pacific Continuous Plankton Recorder survey




**Country:** Multiple countries

**Site name (IGMETS-ID):**

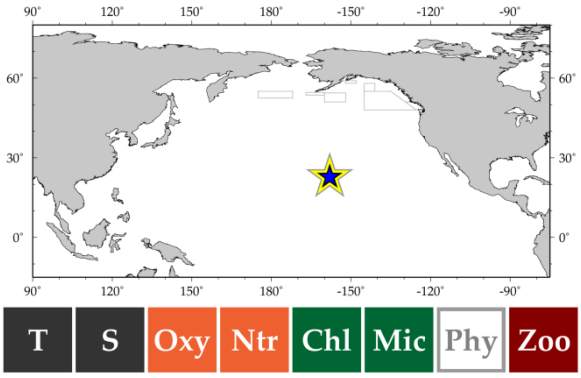
Southern Bering Sea (uk-40201)
Aleutian Shelf (uk-40202)
Western Gulf of Alaska (uk-40203)
Alaskan Shelf (uk-40204)
Cook Inlet (uk-40205)
Northern Gulf of Alaska (uk-40206)
Offshore BC (Oceanic Northeast Pacific between 48 and 55°N) (uk-40207)
BC Shelf (uk-40208)

***Sonia Batten***

Continuous Plankton Recorders (CPR) were first deployed in the North Pacific in 2000. The purpose of the programme is to provide taxonomically resolved data on lower-trophic-level abundance and distribution. Seasonal resolution is also possible since transects are sampled multiple times a year between spring and autumn. This enables interannual variability to be determined and the influence of ocean climate on marine productivity to be assessed. The CPR is towed behind merchant ships at about 7 m depth on their regular routes. It samples continuously, although the transect is divided into discrete 10-nautical-mile samples during processing. Samples are examined microscopically to identify and enumerate plankton. While all data are available on request, data here have been binned into distinct oceanographically meaningful regions (such as shelf distinct from offshore), which incorporate the extent and variability of the ships' transect positions between tows.

Related information: http://www.pices.int/projects/tcprsotnp/main.aspx

## Hawaii Ocean Time Series (HOT)




**Country:** United States

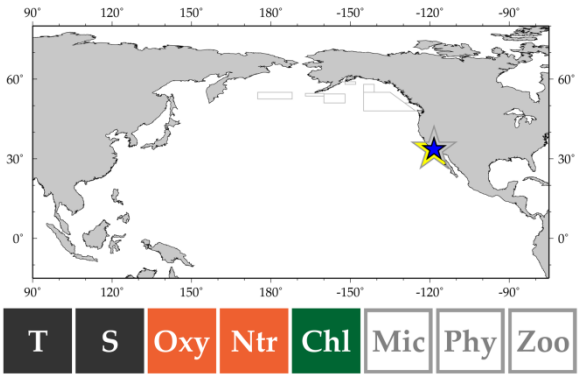
**IGMETS-ID:** us-10201

***Matthew J. Church, David M. Karl, Roger Lukas, Robert Bidigare, John E. Dore, Ricardo M. Letelier, Michael Landry, Robert Weller, and Al Pleudemann***

Since 1988, the Hawaii Ocean Time Series (HOT) programme has conducted near-monthly research cruises to the open-ocean field site Station ALOHA (22°75′N 158°W) to examine time variability in biogeochemical and physical processes in the North Pacific Subtropical Gyre (NPSG). The resulting measurements provide information on interactions between ocean climate and ecosystem variability in the NPSG and quantify time-variability in reservoirs and fluxes of carbon (C) and associated bioelements (nitrogen, oxygen, phosphorus, and silicon). HOT programme measurements are enabling quantification of long-term trends in upper-ocean carbonate system properties (including pH and dissolved inorganic carbon) and highlighting key biological and physical processes mediating air–sea carbon exchange in this ecosystem (Karl and Church, 2014). Despite a persistently oligotrophic upper ocean, HOT programme measurements indicate net community productivity ranges between ca. 1.5 and 4 mol C $m^{-2}$ $year^{-1}$. Moreover, the carbon cycle appears sensitive to variability in ocean climate, including regional-scale changes in evaporation and precipitation.

Related information: http://hahana.soest.hawaii.edu/hot/

## USC WIES San Pedro Ocean Time Series (SPOT)




**Country:** United States

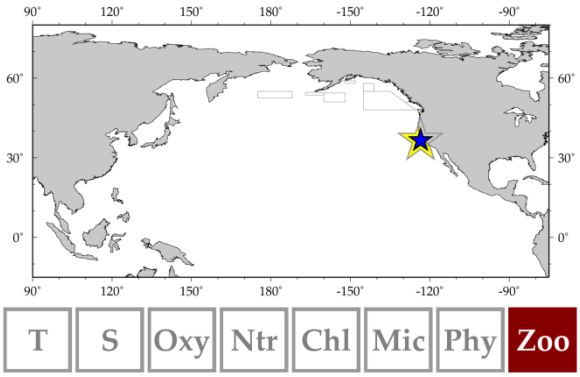
**IGMETS-ID:** us-10301

***Roberta Marinelli, David Caron, Jed Fuhrman, Troy Gunderson, and Diane Kim***

The San Pedro Ocean Time Series (SPOT) was established in 1998 by the USC Wrigley Institute for Environmental Studies to study basic oceanographic processes at a near-coastal site in the Southern California Bight. Near Los Angeles, CA, the SPOT station (33°33′N 118°24′W) provides a unique vantage point to study human impacts on the ocean environment. Biogeochemical and physical water-column properties measured monthly by ship demonstrate low surface chlorophyll *a* concentrations (< 2 μg $L^{-1}$) year-round. Relatively shallow mixing in winter (mixed layer depth maximum of ca. 50 m) stimulates slight increases in chlorophyll *a* concentrations in spring. Depth of the deep chlorophyll *a* maximum varies seasonally (< 20–60 m), and the site is persistently hypoxic (< 1 ml $L^{-1}$) below ca. 300 m to the bottom of the San Pedro Basin (ca. 890 m). In September 2000, the NSF USC Microbial Observatory (now Dimensions of Biodiversity) began complementing SPOT collections with microbiological (archaea, bacteria, microbial eukaryotes) and virus data.

Related information: http://dornsife.usc.edu/spot/

## California Cooperative Oceanic Fisheries Investigations (CalCOFI)




**Country:** United States

**Site name (IGMETS-ID):**

CalCOFI California Current region (us-50301)
CalCOFI Southern California region (us-50302)

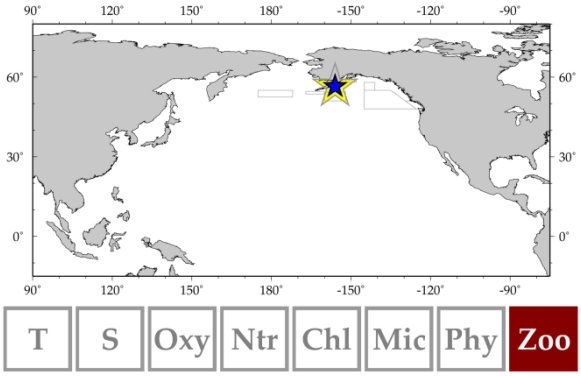
***Sam McClatchi, Edward Weber, Ralf Goericke, and Mark Ohman***

The California Cooperative Oceanic Fisheries Investigations (CalCOFI) programme is a joint research effort by the US National Oceanic and Atmospheric Administration Southwest Fisheries Science Center, University of California Scripps Institution of Oceanography, and California Department of Fish and Wildlife. Joint fisheries and oceanography surveys have been conducted regularly by the CalCOFI programme since 1951 and are currently conducted quarterly.

Vertical, oblique, and surface tows are collected routinely on CalCOFI cruises. Several important changes have occurred in sampling methods for collecting icthyoplankton. In 1969, tow depths were extended from 140 to 210 m, and nets were changed from 0.55-mm mesh silk to 0.505-mm mesh nylon. In 1977, oblique tows were changed from using 1-m bridled ringnets (denoted C1 in the data) to 0.71-m bridleless bongo nets (denoted CB). See Hewitt (1980), Brinton and Townsend (1981), and Ohman and Smith (1995) for details.

Related information: http://www.calcofi.org/
http://coastwatch.pfeg.noaa.gov/erddap/search/index.html?page=1&itemsPerPage=1000&searchFor=calcofi

## Western Kodiak Island (Western Gulf of Alaska) - EcoFOCI




**Country:** United States

**IGMETS-ID:** us-50401

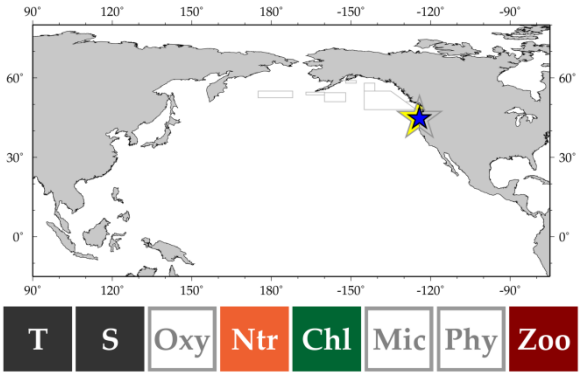
***Janet Duffy-Anderson***

Ecosystems and Fisheries Oceanography Coordinated Investigations (EcoFOCI) is a joint research programme between the Alaska Fisheries Science Center (NOAA/NMFS/AFSC) and the Pacific Marine Environmental Laboratory (NOAA/OAR/PMEL). FOCI was established by NOAA in 1984 to study the variability in recruitment success of commercially valuable finfish and shellfish in Alaskan waters. The project initially studied walleye pollock (*Gadus chalcogrammus*) in the western Gulf of Alaska. From FOCI to EcoFOCI, the programme has broadened to ecosystems research in the North Pacific and Alaskan waters, drawing on multiple scientific disciplines, and matching NOAA scientists with academia as part of NOAA's Cooperative Institute partnership.

The goal of our ecosystems research is to determine the influence of physical and biological environments on marine populations and their subsequent impact on fisheries. We work towards understanding ecosystem dynamics, applying that understanding to fisheries resource management, and analyzing observations in the context of climate and ocean changes. EcoFOCI scientists integrate field, laboratory, and modeling studies and work on many time-scales (seasonal, annual, decadal, and longer). Our research regions include the Gulf of Alaska, the Aleutian Passes, the Bering Sea, and the Chukchi Sea.

Related information: http://www.ecofoci.noaa.gov/

## Newport Hydrographic (NH) and Zooplankton Time Series




**Country:** United States

**IGMETS-ID:** us-50501

***William T. Peterson, Jennifer L. Fisher, Cheryl A. Morgan, and Jay O. Peterson***

The Newport Hydrographic (NH) and Zooplankton Time Series characterizes ocean conditions in the Northern California Current, which is a region of high productivity driven by seasonal coastal upwelling and large-scale ocean gyre circulation (Peterson *et al*., 2014). Hydrographic and zooplankton data are collected at seven stations across the shelf 2–46 km from shore off Newport, Oregon (44°65'N). Biophysical data have been (and continue to be) collected biweekly–monthly since 1996. Zooplankton are sampled vertically from just above the bottom to the surface with a 0.5-m plankton net using a 202-µm mesh. Organisms are enumerated and expressed as carbon biomass (mg C $m^{-3}$) after appropriate conversions. Full water-column profiles of temperature, salinity, chlorophyll fluorescence, and oxygen are collected with a Seabird CTD. Surface water is analyzed for chlorophyll *a* concentration and nutrients.

Related information: www.nwfsc.noaa.gov/oceanconditions

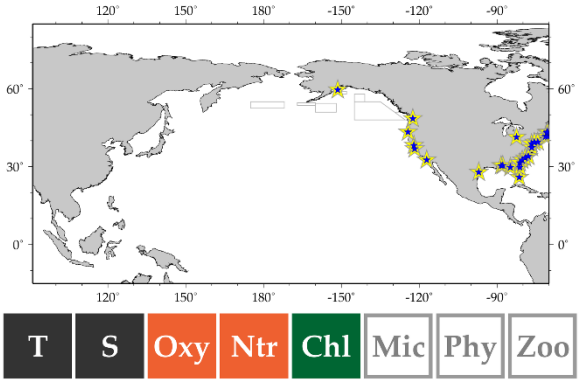
## National Estuarine Research Reserve System (NERRS)

## System-wide Monitoring Program (SWMP)

**Country:** United States

**Site name (IGMETS-ID):** us-60101 - us-60126

***Dwayne Porter (liason)***




The National Estuarine Research Reserve System (NERRS) is a network of 28 coastal sites designated to protect and study estuarine systems. Established through the Coastal Zone Management Act, the reserves represent a partnership programme between the National Oceanic and Atmosphere Administration (NOAA) and the coastal states. NOAA provides funding and national guidance, and each site is managed on a daily basis by a lead state agency or university with input from local partners.

NERRS acknowledges the importance of both long-term environmental monitoring programmes and data and information dissemination through its support of the NERRS System-wide Monitoring Program (SWMP). The goal of SWMP is to identify and track short-term variability and long-term changes in the integrity and biodiversity of representative estuarine ecosystems and coastal watersheds for the purpose of contributing to effective national, regional, and site-specific coastal zone management. This comprehensive programme consists of three phased components: estuarine water quality monitoring, biodiversity monitoring, and land-use and habitat-change analysis.

The NERRS research reserves encompass 1.3 million acres of estuaries along the US coastlines.

Related information: https://coast.noaa.gov/nerrs/

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