**Grant Agreement no. 817578 - TRIATLAS**

**Milestone Number:** 4

**Milestone Name:** Initial agreement on common protocols and best practices for data collection (physical, biochemical, acoustics and biological)

**Due Date:** 30.11.2019

**Date Delivered:** 30.11.2019

**Main Author(s):** Rainer Kiko, Henrike Andresen, Javier Aristegui, Sophie Bertrand, Peter Brandt, Peter Croot, Marcus Dengler, Tim Dudeck, Santiago Hernández León, Gerd Krahmann, Emilio Marañón, Rocio Primo, Ralf Schwamborn, Margit Wilhelm.

**Related WorkPackage(s):** 1,2,3,4,5

**Comment:** On time

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Measurement** | **Instrument/Platform** | **Related International Program** | **Protocols** | **Protocol documentation by** | **WP** |
| General entry |  |  | <https://www.oceanbestpractices.org/> |  |  |
| General entry |  |  | <https://www.go-ship.org/HydroMan.html> |  |  |
| Temperature | CTD from ship | GO-SHIP | <https://www.go-ship.org/HydroMan.html> | G. Krahmann | 1 |
| Salinity | CTD from ship | GO-SHIP | <https://www.go-ship.org/HydroMan.html> | G. Krahmann | 1 |
| Currents | sADCP and lADCP | GO-SHIP | <https://www.go-ship.org/HydroMan.html> | G. Krahmann | 1 |
| Turbulence | Microstructure | https://microstructure.ucsd.edu/  MacKinnon, et al. (2017) | Schafstall et al. 2010 | M. Dengler | 1 |
| SST | satellite |  | not relevant, used as given | n.a | 1 |
| SSS | satellite |  | not relevant, used as given | n.a | 1 |
| SLA | satellite |  | not relevant, used as given | n.a | 1 |
| multiple | ARGO buoys | Argo | not relevant, used as given | n.a | 1 |
| multiple | Moorings | PIRATA | not relevant, used as given | n.a | 1 |
| multiple | Moorings | others | See calibration procedures for relevant parameters. Sensors (e.g. T, S, oxygen) should be attached to a CTD prior and after deployment and values compared to this reference. Calibration stops at different depth are recommended. | R. Kiko | 1 |
| Oxygen | CTD SBE |  | <https://www.go-ship.org/Manual/McTaggart_et_al_CTD.pdf> | R. Kiko | 2 |
| Oxygen | Winkler on Niskin bottle samples |  | <https://www.go-ship.org/Manual/Langdon_Amperometric_oxygen.pdf> | R. Kiko | 2 |
| Nutrients | CTD Niskin bottle, profiling sensors on CTD |  | https://www.go-ship.org/Manual/Hydes\_et\_al\_Nutrients.pdf ; profiling sensors should be calibrated using niskin bottle data | P. Croot | 2 |
| Chl a from fluorometer | CTD Niskin bottle, profiling sensors on CTD |  | Protocols for the Joint Global Ocean Flux Study (JGOFS) core measurements, UNESCO (1994).  https://www.nodc.noaa.gov/archive/arc0001/9900162/2.2/data/0-data/jgofscd/Files/protocols/chap13.html | E. Marañón | 2 |
| Size fractionnated Chl a | CTD Niskin bottle |  | CALCOFI Methods Manual http://cce.lternet.edu/data/methods-manual/augmented-cruises/chlorophyll-a-size-fractionation | E. Marañón | 2 |
| Ocean colour phytoplankton | Satellite | <http://marine.copernicus.eu/services-portfolio/access-to-products/?option=com_csw&view=details&product_id=OCEANCOLOUR_GLO_CHL_L4_REP_OBSERVATIONS_009_082> |  | P. Croot | 2 |
| Primary productivity | Satellite | <http://orca.science.oregonstate.edu/1080.by.2160.monthly.hdf.vgpm.v.chl.v.sst.php> | Behrenfeld and Falkowski1997 | P. Croot | 2 |
| Flow cytometry/Bacteria | CTD Niskin bottle |  | Marie et al. 2001 | P. Croot | 2 |
| Flow cytometry/Pico&Nano | CTD Niskin bottle |  | Marie et al. 2001 | P. Croot | 2 |
| Flow cytometry / HNF | CTD Niskin bottle |  | Rose et al. 2004, Christaki et al. 2011 | P. Croot | 2 |
| Phytoplankton biovolume and biomass | CTD Niskin bottle |  | HELCOM Manual on phytoplankton biovolume http://www.helcom.fi/Lists/Publications/BSEP106.pdf | E. Marañón | 2 |
| Phytoplankton size spectra | CTD Niskin bottle |  | Huete-Ortega et al. 2010 | E. Marañón | 2 |
| Primary productivity | CTD Niskin bottle |  | Hernández-Hernández et al. 2018 | J. Aristegui | 2 |
| Particle abundance | UVP5 on CTD |  | Picheral et al. 2010 | R. Kiko | 2 |
| Plankton biomass / size spectra | UVP5 on CTD |  | Picheral et al. 2010 | R. Kiko | 2 |
| Zooplankton biomass / size spectra / composition | Nets |  | <https://www.sciencedirect.com/book/9780123276452/ices-zooplankton-methodology-manual> | R. Schwamborn | 2 |
| Acoustic backscatter (focus on zooplankton) | ADCP |  | Mullison 2017 | R. Kiko | 2 |
| Acoustic backscatter (focus on zooplankton) | Acoustic Zooplankton Fish Profiler | NA | <https://aslenv.com/azfp-processing.html> | S. Hernández León | 2 |
| Electron Transport System activity | Rate measurement on caught zooplankton | NA | Pdf available on request | Santiago Hernández León | 2 |
| Zooplankton gut fluorescence | Measurement on caught zooplankton | NA | Pdf available on request | Santiago Hernández León | 2 |
| Acoustic backscatter (focus on fish) | Echosounders other than ADCP and AZFP | NA | <http://www.mesopp.eu/wp-content/uploads/2019/01/D3.1-MESOPP_18-0003-Report-of-acoustic-processing-routines-and-quality-checking-methods.pdf> | Tim Dudeck | 3 |
| Fish biomass, size spectra and composition | Nets | NA | Fock and Ehrich 2010, https://mar-eco.no/sci/component\_projects/pelagic\_nekton/hamburg\_pelagic\_fishes\_database\_available\_to\_mar-eco\_users.html | Henrike Andresen | 3 |
| Stable isotopes | Measurement on caught fish |  | Schwamborn and Giarrizzo 2015 | Ralf Schwamborn | 3 |
| Individual movement (focus on seabirds) | Tagging with GPS/Dive sensor/3D accelerometer | NA | Nunes et al. 2018 | S. Bertrand | 3 |
| Otoliths | Measurement on caught fish |  | **Otolith chronologies:**  (1) Morrongiello and Thresher 2015  (2) Smoliński and Mirny 2017  **Otolith isotope analysis:**  (1) Grønkjær et al 2013 | M. Wilhelm | 3 |

|  |  |  |
| --- | --- | --- |
| **Further info data submission** | **Further info data submission** | **Tutorial on data submission to Pangaea** |
| <https://wiki.pangaea.de/wiki/Main_Page> | <https://wiki.pangaea.de/wiki/Parameter> | <https://portal.geomar.de/documents/18749/1192630/2018-09-27_PANGAEA+Data+Submission+Tutorial.pdf/94d2da0e-256b-40ab-b7f6-313144b88823> |

**Abbreviations:**

GO-Ship: Global Ocean Ship-Based Hydrographic Investigation Program

**References:**

Behrenfeld, M.J., Falkowski, P.G. (1997) Photosynthetic rates derived from satellite-based chlorophyll concentration. Limnology and Oceanography 42:1-20.

Christaki, U., Courties, C., Massana, R., Catala, P., Lebaron, P., Gasol, J.M., Zubkov, M.V. (2011) Optimized routine flow cytometric enumeration of heterotrophic flagellates using SYBR Green I. Limnology and Oceanography-Methods 9:329-339.

Fock, H. O., Ehrich, S. (2010) Deep-sea pelagic nekton biomass estimates in the North Atlantic: horizontal and vertical resolution of revised data from 1982 and 1983. Journal of Applied Ichthyology 26:85-101.

Grønkjær, P,, Pedersen, J.B., Ankjærø, T.T., Kjeldsen, H., Heinemeier, J., Steingrund, P., Nielsen, J.M., Christensen, J.T. (2013) Stable N and C isotopes in the organic matrix of fish otoliths: validation of a new approach for studying spatial and temporal changes in the trophic structure of aquatic ecosystems. Can J Fish Aquat Sci 70:143−146.

Hernández-Hernández, N., Bach, L.T., Montero, M.F., Taucher, J., Baños, I., Guan, W., Espósito, M., Ludwig, A., Achterberg, E. P., Riebesell, U., Arístegui, J. (2018) High CO2 Under Nutrient Fertilization Increases Primary Production and Biomass in Subtropical Phytoplankton Communities: A Mesocosm Approach. Frontiers in Marine Science 5:213. doi: 10.3389/fmars.2018.00213

Huete-Ortega, M., Marañón, E., Varela, M., Bode, A. (2010) General patterns in the size scaling of phytoplankton abundance in coastal waters during a 10-year time series Journal of Plankton Research 32:1-14.

MacKinnon, J.A., Z. Zhao, C.B. Whalen, A.F. Waterhouse, D.S. Trossman, O.M. Sun, L.C. St. Laurent, H.L. Simmons, K. Polzin, R. Pinkel, A. Pickering, N.J. Norton, J.D. Nash, R. Musgrave, L.M. Merchant, A.V. Melet, B. Mater, S. Legg, W.G. Large, E. Kunze, J.M. Klymak, M. Jochum, S.R. Jayne, R.W. Hallberg, S.M. Griffies, S. Diggs, G. Danabasoglu, E.P. Chassignet, M.C. Buijsman, F.O. Bryan, B.P. Briegleb, A. Barna, B.K. Arbic, J.K. Ansong, Alford, M.H. (2017) Climate Process Team on Internal Wave–Driven Ocean Mixing. Bull. Amer. Meteor. Soc. 98:2429–2454.

Marie, D., Partensky, F., Vaulot, D., Brussaard, C. (2001) Enumeration of Phytoplankton, Bacteria, and Viruses in Marine Samples. Current Protocols in Cytometry. https://doi.org/10.1002/0471142956.cy1111s10

Morrongiello, J., Thresher, R. (2015) A statistical framework to explore ontogenetic growth variation among individuals and populations: a marine fish example. Ecol. Monogr. 85:93–115.

Smoliński, S., Zuzanna, M. (2017) Otolith biochronology as an indicator of marine fish responses to hydroclimatic conditions and ecosystem regime shifts. Ecological Indicators 79:286-294

Mullison J. (2017) Backscatter estimation using broadband Acoustic Doppler Current Profilers – Updated. Available at http://www.teledynemarine.com/Documents/Brand%20Support/RD%20INSTRUMENTS/Technical%20Resources/Technical%20Notes/WorkHorse%20-%20ADCP%20Special%20Applications%20and%20Modes/FSA031.pdf

Nunes, G.T., Bertrand, S. & Bugoni, L. (2018) Seabirds fighting for land: phenotypic consequences of breeding area constraints at a small remote archipelago. Sci Rep 8:665.

Picheral M, Guidi L, Stemmann L, Karl DM, Iddaoud G, Gorsky G (2010) The Underwater Vision Profiler 5: An advanced instrument for high spatial resolution studies of particle size spectra and zooplankton. Limnology and Oceanography: Methods 8:462-473

Rose, J.M., Caron D. A., Sieracki, M.E., Poulton, N. (2004) Counting heterotrophic nanoplanktonic protists in cultures and aquatic communities by flow cytometry. Aquatic Microbial Ecology 34:263-277.

Schafstall, J., Dengler, M., Brandt, P., Bange, H. (2010) Tidal induced mixing and diapycnal nutrient fluxes in the Mauritanian upwelling region, J. Geophys. Res., 115:C10014, doi:10.1029/2009JC005940.

Schwamborn, R., Giarrizzo, T. (2015) Stable Isotope Discrimination by Consumers in a Tropical Mangrove Food Web: How Important Are Variations in C/N Ratio? Estuaries and Coasts 38:813.