

ANNUAL REPORT ON GEOTRACES ACTIVITIES IN SLOVENIA

April 1st, 2018 to March 31st, 2019

New scientific results

This year most of the research was oriented into the study of Hg cycle. The research was performed in deep-sea waters of Mediterranean Sea in the lower food web and lagoon environment.

- Zooplankton and small fish were sampled the neuston layer at both coastal and open sea stations in the Mediterranean Sea in fall 2011 and summer 2012 and 2013. Zooplankton and small fish were sorted by morphospecies, and the most abundant taxa (e.g. euphausiids, isopods, hyperiid amphipods) analyzed for methylmercury (MeHg) concentration. Multiple taxa suggested elevated MeHg concentrations in the Tyrrhenian and Balearic Seas in comparison with more eastern and western stations in the Mediterranean Sea. Spatial variation in zooplankton MeHg concentration is positively correlated with single time point whole water MeHg concentration for euphausiids and mysids and negatively correlated with maximum chlorophyll a concentration for euphausiids, mysids, and “smelt” fish. Taxonomic variation in MeHg concentration appears driven by taxonomic grouping and feeding mode. Euphausiids, due to their abundance, relative larger size, importance as a food source for other fauna, and observed relationship with surface water MeHg are a good candidate biotic group to evaluate for use in monitoring the bioavailability of MeHg for trophic transfer in the Mediterranean and potential globally.
- The aim in research performed in lagoon system was to understand if and where recycling at the sediment-water interface (SWI) may affect metal(loid)s. Short sediment cores were also collected near the chamber to investigate the solid (sediments) and dissolved phases (porewaters). Both diffusive and benthic fluxes were estimated to elucidate the release of metal(loid)s at the SWI. Total element concentrations and their labile fractions were determined in sediments to quantify their potential mobility. The total element contents were found to be two orders of magnitude higher in the Italian marina than in the Slovenian one, especially for Hg (up to 1000 mg kg⁻¹), whereas the labile fraction was scarce or null. The opposite occurred in the Slovenian marina. Metal(loid)s in porewaters showed a clear diagenetic sequence and a close dependence upon the suboxic/anoxic conditions of sediments. The results suggest that although the sediments of the Italian marina exhibit the highest total metal(loid) concentration, these elements are scarcely remobilisable. Conversely, in the Slovenian marina, sediments seem to be comparatively more prone to release metal(loid)s at the SWI.

Other studies were biologically oriented and include:

- The review describes the biotechnological potential of host–microorganism systems and focus on gelatinous zooplankton as a host for the microbiome with biotechnological potential. The basic characteristics of jellyfish-associated microbial communities, the mechanisms underlying the jellyfish-microbe relationship, and the role/function of the jellyfish-associated microbiome and its biotechnological potential are reviewed. It appears that the jellyfish-associated microbiome is discrete from the microbial community in the

ambient seawater, exhibiting a certain degree of specialization with some preferences for specific jellyfish taxa and for specific jellyfish populations, life stages, and body parts.

- The data processing that led to the definition of ecological classification criteria for the Biological Quality Element (BQE) phytoplankton in the coastal waters (CW) of the Adriatic and Tyrrhenian seas, according to the Water Framework Directive (2000/60/EC) was performed. The chosen metric was the annual geometric mean of chlorophyll a concentrations owing to the log-normal nature of chlorophyll a distribution. The sensitivity of this metric to the gradient of pressures was tested by adopting an empirical statistical approach. The dilution factor (F_{dil}), which is the share of freshwater in a sample of seawater, was introduced as a rough, but realistic proxy of nutrient loads from the continent. Correlations between F_{dil} and trophic indicators (i.e. nitrogen and phosphorus concentrations in seawater and the respective N:P ratio) were then evaluated. The F_{dil} approach was also used to derive reference conditions for each typology of coastal waters. Functional relationships between chlorophyll a, as phytoplankton biomass indicator, and nutrient concentrations, as pressure indicators, were computed by means of regression techniques. The classification scale for the BQE phytoplankton was based on the TRIX scale of water quality conditions. Reference conditions, pressure/impact relationships, boundary setting and classification criterion definition were treated separately and discussed for each of the CW Types: Type I, Type II A Adriatic, Type II A Tyrrhenian and Type III W for both the Adriatic and Tyrrhenian seas. Due to the lack of a functional relationship between the gradient of pressures and chlorophyll a, and a narrow range of annual chlorophyll a concentrations, only one threshold value was set for Type III W instead of the whole classification scale.

New publications (published or in press)

- PALATINUS, Andreja, KOVAČ VIRŠEK, Manca, ROBIČ, Uroš, GREGO, Mateja, BAJT, Oliver, ŠILJIĆ, Jasna, SUARIA, Giuseppe, LIUBARTSEVA, Svitlana, COPPINI, Giovanni, PETERLIN, Monika. Marine litter in the Croatian part of the middle Adriatic Sea: simultaneous assessment of floating and seabed macro and micro litter abundance and composition. *Marine pollution bulletin*, ISSN 0025-326X, 2019, vol. 139, 427-439, doi: 10.1016/j.marpolbul.2018.12.038.
- BAJT, Oliver, RAMŠAK, Andreja, MILUN, Vesna, ANDRAL, Bruno, ROMANELLI, Giulia, ALFONSO, Scarpato, MITRIĆ, Milena, KUPUSOVIĆ, Tarik, KLJAJIĆ, Zoran, ANGELIDIS, Michael, ÇULLAJ, Algi, GALGANI, François. Assessing chemical contamination in the coastal waters of the Adriatic Sea using active mussel biomonitoring with *Mytilus galloprovincialis*. *Marine pollution bulletin*, ISSN 0025-326X, 2019, vol. 141, 283-298, doi: 10.1016/j.marpolbul.2019.02.007.
- TINTA, Tinkara, KOGOVIŠEK, Tjaša, KLUN, Katja, MALEJ, Alenka, HERNDL, Gerhard J., TURK, Valentina. Jellyfish-associated microbiome in the marine environment: exploring its biotechnological potential. *Marine drugs*, ISSN 1660-3397, 2019, vol. 17, no. 2, 1-34 doi: 10.3390/md17020094.
- BUCKMAN, Kate L., LANE, Oksana, KOTNIK, Jože, BRATKIČ, Arne, SPROVIERI, Francesca, HORVAT, Milena, PIRRONE, Nicola, EVERS, David C., CHEN, Celia Y. Spatial and taxonomic variation of mercury concentration in low trophic level fauna from the Mediterranean Sea. *Ecotoxicology*, ISSN 0963-9292, [in press] 2018, doi: 10.1007/s10646-018-1986-5.

- RUELAS-INZUNZA, Jorge R., ŠLEJKOVEC, Zdenka, MAZEJ, Darja, FAJON, Vesna, HORVAT, Milena, RAMOS-OSUNA, M. Bioaccumulation of As, Hg, and Se in tunas *Thunnus albacares* and *Katsuwonus pelamis* from the Eastern Pacific: tissue distribution and As speciation. *Environmental science and pollution research international*, ISSN 0944-1344, 2018, vol. 25, 19499-19509, doi: 10.1007/s11356-018-2166-0.
- PETRANICH, Elisa, CROCE, Sara, CROSERA, Matteo, PAVONI, Elena, FAGANELI, Jadran, ADAMI, Gianpiero, COVELLI, Stefano. Mobility of metal(loid)s at the sediment-water interface in two tourist port areas of the Gulf of Trieste (northern Adriatic Sea). *Environmental science and pollution research international*, ISSN 0944-1344, 2018, vol. 25, no. 27, 26887-26902, doi: 10.1007/s11356-018-2717-4.
- PETRANICH, Elisa, COVELLI, Stefano, ACQUAVITA, Alessandro, FAGANELI, Jadran, HORVAT, Milena, CONTIN, Marco. Evaluation of mercury biogeochemical cycling at the sediment-water interface in anthropogenically modified lagoon environments. *Journal of Environmental Sciences(China)*, ISSN 1001-0742, 2018, vol. 68, 5-23, doi: 10.1016/j.jes.2017.11.014.
- PETRANICH, Elisa, COVELLI, Stefano, ACQUAVITA, Alessandro, DE VITTOR, Cinzia, FAGANELI, Jadran, CONTIN, Marco. Benthic nutrient cycling at the sediment-water interface in a lagoon fish farming system (northern Adriatic Sea, Italy). *Science of the total environment*, ISSN 0048-9697, 2018, vol. 644, 137-149.
- GIOVANARDI, Franco, FRANCÉ, Janja, MOZETIČ, Patricija, PRECALI, Robert. Development of ecological classification criteria for the Biological Quality Element phytoplankton for Adriatic and Tyrrhenian coastal waters by means of chlorophyll a (2000/60/EC WFD). *Ecological indicators: integrating monitoring, assessment and management*, ISSN 1470-160X, 2018, vol. 93, 316-332, ilustr., doi: 10.1016/j.ecolind.2018.05.015.
- ARKITZI, Ioanna, FRANCÉ, Janja, BASSET, A., COZZOLI, Francesco, STANCA, Elena, ZERVOUDAKI, Soultana, GIANNAKOUREOU, Antonia, ASSIMAKOPOULOU, G., VENETSANOPOULOU, Amalia, MOZETIČ, Patricija, TINTA, Tinkara, SKEJIĆ, Sanda, VIDJAK, Olja, CADIOU, Jean-François, PAGOU, Kalliopi. Pelagic habitats in the Mediterranean Sea: a review of Good Environmental Status (GES) determination for plankton components and identification of gaps and priority needs to improve coherence for the MSFD implementation. *Ecological indicators: integrating monitoring, assessment and management*, ISSN 1470-160X, 2018, vol. 95, pt. 1, 203-218, doi: 10.1016/j.ecolind.2018.07.036.
- KOS KRAMAR, Maja, TINTA, Tinkara, LUCIĆ, Davor, MALEJ, Alenka, TURK, Valentina. Bacteria associated with moon jellyfish during bloom and post-bloom periods in the Gulf of Trieste (northern Adriatic). *PloS one*, ISSN 1932-6203, 2019, vol. 14, iss. 1, 1-21, doi: 10.1371/journal.pone.0198056.

Invited lectures

- Ogrinc, Nives. Compound specific isotope analysis: new challenges in environmental and food studies. V: TREBŠE, Polonca (ur.), LEBEDEV, Albert T. (ur.), DAHMANE, Raja (ur.). *Petromass 2018: book of abstracts, XI International Mass Spectrometry Conference on Petrochemistry, Environmental and Food Chemistry, Bled, Slovenia, 15-18 April 2018*. Ljubljana: Maseco. 2018, 4.

- Horvat, Milena. Analytical challenges in the implementation of the Minamata convention. V: Mercury Monitoring Workshop: 1-2 November 2018, Jeju, Korea: The Korean Society for Environmental Analysis. 2018, 8.
- Ogrinc, Nives. CSIA in the environment and food: presented at Training Workshop on Isotope Techniques in Ecological, Food and Environmental Research, 29-30 January 2019, Ljubljana, Slovenia.

Presentations at conferences

- MOZETIČ, Patricija, PETELIN, Boris, FRANCÉ, Janja, FLANDER-PUTRLE, Vesna, KLUN, Katja, LIČER, Matjaž, TINTA, Tinkara, TURK, Valentina, MALAČIČ, Vlado. Linking long-term changes of pelagic microbial communities to fluctuations in climate and hydrological regime in a coastal ecosystem (Adriatic Sea). V: The Effects of Climate Change on the World's Oceans: book of abstracts, 4th International Symposium The Effects of Climate Change on the World's Oceans, June 4-8, 2018, Washington, D.C., USA. 109. <https://meetings.pices.int/publications/book-of-abstracts/2018-ECCWO-Book-of-Abstracts.pdf>.
- FRANCÉ, Janja, PETELIN, Boris, MOZETIČ, Patricija. Can we track climate related changes in the HAB species assemblage in a highly variable coastal sea (Gulf of Trieste, Adriatic Sea)? V: The Effects of Climate Change on the World's Oceans: book of abstracts, 4th International Symposium The Effects of Climate Change on the World's Oceans, June 4-8, 2018, Washington, D.C., USA. [S. l.: s. n. 2018], str. 179. <https://meetings.pices.int/publications/book-of-abstracts/2018-ECCWO-Book-of-Abstracts.pdf>.
- OGRINC, Nives. Isotopic techniques for studying the sources and processes of pollutants in the environment. V: Book of abstracts, XXII. International Mass Spectrometry Conference, IMSC 2018, August 26-31, 2018, Florence, (Italy). [S. l.]: International Mass Spectrometry Foundation. 2018, str. 234-235.
- KRAJNC, Bor, TAMŠE, Samo, OGRINC, Nives. CO₂ fluxes and vulnerability to acidification of coastal waters in the Gulf of Trieste (N Adriatic). V: Goldschmidt Conference, August 12-17, 2018, Boston, USA. [S. l.]: Geochemical Society. 2018. <https://goldschmidt.info/2018/abstracts/abstractView?id=2018001872>.
- KRAJNC, Bor, TAMŠE, Samo, OGRINC, Nives. Carbonate system in the Gulf of Trieste: presented at International Conference THEMES 2018 - Oceanic and atmospheric variability, from long-term trends to abrupt shifts, 28th-30th November 2018, Venice, Italy.
- FAGANELI, Jadran, KLUN, Katja, FALNOGA, Ingrid, MAZEJ, Darja, KOVAČ, Nives. Colloidal metal(loid)s and their bioaccumulation in plankton in a coastal ecosystem. V: AGU 100, Fall Meeting, Washington, D.C., 10-14 Dec. 2018. [S. l.]: American Geophysical Union. 2018.

New projects and/or funding

- Department of Environmental Sciences at Jožef Stefan Institute (JSI-O2) is involved in the National Key Research & Development Program of China “Mechanisms of red tides and hypoxia as ecological marine disasters and technologies for its early warning and emergency security along the sea of ‘Belt and Road’ countries” (2016YFE0202100). The project coordinated by IHB-CAS has started in September, 2017 and will end in July,

2020. According to the implementation plan, part of the work is conducted in Adriatic Sea



in the Gulf of Trieste. There is a need to extend the joint research temporally and spatially. JSI-O2 is responsible for collecting and analyzing the phytoplankton and chemical analysis at two sites in the Gulf of Trieste four times a year from 2018 to 2020. The first sampling campaign was performed in September 2018. The analysis are still in progress.

- Scientific visits (10-14.12.2018) - training programme of Roberto Meigikos dos Anjos (Brazil), Carlos Manuel Alonso Hernandez (Cuba) and Saif Uddin (Kuwait) under the IAEA's INT7019 project: Supporting a Global Ocean Acidification Observing Network towards Increased Involvement of Developing States was performed. The training was held at Jožef Stefan Institute and Marine Biological Station (National Institute of Biology). We presented several techniques that can be used in research concerning the ocean acidification: The use of radioactive isotopes in marine studies, the principles and use of k_0 -INAA in the marine environment, and methods to investigate dissolved inorganic carbon (DIC) in the marine ecosystem where we demonstrated methods for measuring the isotopic composition of decomposed inorganic carbon in seawater. The main objective of the training was to establish the infrastructure and measurement operational procedure for the determination of isotopic composition of DIC in sea water.
- From 7th till 8th March 2019 Ocean Acidification and Climate Change (OACC) Working Group Meeting was held at Marine Biology Station in Piran. Nives Ogrinc (JSI), Jadran Faganelj (NIB), and Nives Kovač (NIB) were introduced as new members of the Working Group. Beside the discussions about accomplished work and planning of future activities three invited lectures were performed:
 - ⇒ Nives Ogrinc (Jožef Stefan Institute, Ljubljana, Slovenia): Stable isotopes in the study of the impact of increasing CO_2 levels on C and Hg cycling in coastal waters in the northern Adriatic Sea.
 - ⇒ Serena Zunino (Istituto Nazionale di Oceanografia e di Geofisica Sperimentale, OGS, Trieste, Italy): Effects of ocean acidification on Posidonia and coralligenous in the Mediterranean Sea.
 - ⇒ Nina Bednaršek (SCCWRP - Southern California Coastal Water Research Project, USA): The effects of OA on marine calcifiers.

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