The Second Turkish Arctic Science Expedition (TASE-II) Report

13.07.2022-24.07.2022, Jnr. 22/9853

Project Dates: 13.07.2022 – 24.07.2022

Purpose of Cruise: Investigation of the anthropogenic impacts in a global scale and the effects of global climate change.

Scientist in Charge: Prof Dr Burcu Özsoy

Introduction

Polar Research Institute (PRI) was established in 2019 within TÜBİTAK Marmara Research Center to ensure the coordination and logistics of the national polar expeditions. The Institute aims to provide support for R&D and scientific research studies to be conducted in polar regions, to operate Turkey's polar research infrastructure, to plan and coordinate logistics, to facilitate communication among relevant organizations, to conduct bilateral international collaborations, to develop and implement the national polar strategy in cooperation with stakeholders, to raise awareness of polar regions at national scale.

As the umbrella organization for polar research in Türkiye, PRI organizes scientific expeditions to Arctic and Antarctica to provide a better understanding of the past, present and the future of the Earth, and also to investigate the impacts of global climate change and human activities. The first Turkish Arctic Scientific Expedition (TASE-I) was conducted around Svalbard between 13-26 July 2019 on board MY Anakena. RiS ID was 11301 and Cruise Information was specified as 190620 on Directorate of Fisheries. The 2nd Turkish Arctic Science Expedition (TASE-II) was carried out on board R/V PolarXplorer between 13-24 July 2022 in Barents Sea (Figure 1). In line with the permissions obtained in accordance with "Regulations Relating to Foreign Marine Scientific Research in Norway's Internal Waters, Territorial Sea and Economic Zone and on the Continental Shelf" the studies were conducted within the Norwegian Economic Zone and in the Fisheries Protection Zone around Svalbard. No samples were taken within the Norwegian territorial waters. The overall purpose of the scientific research was to investigate the presence and intensity of the anthropogenic impacts on a global scale, as well as, to observe the parameters and effects of global climate change in the Arctic.

Figure 1. R/V PolarXplorer

Conducted Projects

The following projects were carried out within The second Turkish Arctic Science Expedition (TASE-II):

1. Cetacean and Pinniped Observations in the West Antarctic Peninsula and the Barents Sea Regions: Photographic Identification, Encounter Rates, and Abundance Estimation Studies
2. Determination of the Sources of Atmospheric Pollutants Affecting The Arctic Ocean
3. Assessment of the Environmental Effects of Arctic Shipping on the Barents Sea
4. Investigation of Crustacea Taxon of the Barents Sea
5. Determination of Diversity and Genetics of Aquatic Microorganisms in the Barents Sea
6. Investigation of Micro and Mesoplankton Structures of the Barents Sea in 2022 Summer Period and Determination of Ecological Status
7. Examination of Pigment Composition and Contribution of Length Groups on the Barents Sea in 2022 Summer Period
8. Evaluation of Meso and Microplastics According to Different Pollution Index Profiles in the Arctic Region
9. Monitoring Physical Parameters of Barents Sea Surface Water
10. Determination of Levels and Distribution of Heavy Metals in the Barents Sea Surface Water

11. Determination of Total Organic Carbon and Suspended Solid Levels in Barents Sea Surface Waters
12. Arctic Ocean Summer Sea Ice Observations
13. Monitoring of Meteorological Parameters in the Barents Sea Region
14. Determination of the pollution and environmental effects of Drug Active Ingredients, Antidepressants and Seratonin Hormone in the Barents Sea

The members of the expeditions and their affilations are given in Table 1.

Table 1. Expedition members, roles and affiliations

Participant	**Role**	**Institution**
Prof. Dr Burcu Ozsoy	Expedition Leader	TÜBİTAK Marmara Research Center, Polar Research Institute / Istanbul Technical University
Prof. Dr Ersan Başar	Vice Expedition Leader (Science)	Karadeniz Technical University
Cpt. Özgün Oktar	Vice Expedition Leader (Logistics)	TÜBİTAK Marmara Research Center, Polar Research Institute / Istanbul Technical University
Prof. Mustafa Sözen	Researcher	Zonguldak Bülent Ecevit University
Assoc. Prof. Dr Fatma Öztürk	Researcher	Bolu Abant İzzet Baysal University
Dr. Atilla Yılmaz	Researcher	TÜBİTAK Marmara Research Center, Polar Research Institute
Cpt. Doğaç Baybars Işıler	Researcher	TÜBİTAK Marmara Research Center, Polar Research Institute
Özge Elif Kızıl	Press	Anadolu Agency (Turkish National News Agency)
Şebnem Coşkun	Press	Anadolu Agency (Turkish National News Agency)

The titles and brief information of the conducted projects are listed in Table 2.

Table 2. TASE-II projects and related information.

Project	**Information**
Cetacean and Pinniped Observations in the West Antarctic Peninsula and the Barents Sea Regions: Photographic Identification, Encounter Rates, and Abundance Estimation Studies	The abundance and distribution of cetacean and pinnipeds were recorded and documented along the expedition route. The observed species were photographed and will be compared with the catalogues for validation.
Determination of the Sources of Atmospheric Pollutants Affecting The Arctic Ocean	Two high volume samplers were installed to the deck of the expedition vessel. These devices performed active air sampling during the whole expedition. The collected filters will be analysed for particulate matter. The content and the sources of the contaminants in the filters will be examined.
Assessment of the Environmental Effects of Arctic Shipping on the Barents Sea	Vessels along the expedition route were observed . Automatic Identification System (AIS) data of these vessels were recorded. The obtained data will be compared with the online AIS databases and a traffic intensity map will be generated. The most preffered routes will be determined and the most impacted areas will be estimated.
Investigation of Crustacea Taxon of the Barents Sea	Surface seawater was sampled from 6 stations for individuals of crustacea taxon. The samples were visually examined and no samples were transported.
Determination of Diversity and Genetics of Aquatic Microorganisms in the Barents Sea	Plankton nets were vertically towed from six station and 100 mL of surface sea water was sampled from 6 stations. The collected samples will be investigated for identification of microorganisms.
Investigation of Micro and Mesoplankton Structures of the Barents Sea in 2022 Summer Period and Determination of Ecological Status	Plankton nets were towed at 6 stations and 1 liter of surface seawater was sampled at each point. The collected samples were filtered through 0.45 µm pore sized filters. The filters will be examined for micro and mesoplankton structures.
Examination of Pigment Composition and Contribution of Length Groups on the Barents Sea in 2022 Summer Period	1 liter of surface seawater was collected from 6 stations. The samples were filtered through 0.22 µm pore sized filters. The filters will be analysed for pigments and the contribution of length groups will be investigated.

Evaluation of Meso and Microplastics According to Different Pollution Index Profiles in the Arctic Region	250 mL surface sea water were sampled from 6 stations. The collected samples will be extracted for micro and mesoplastics. The results will be evaluated according to different pollution index profiles.
Monitoring Physical Parameters of Barents Sea Surface Water	Conductivity, temperature, dissolved oxygen, pH and salinity values were measured with a portable multimeter in the surface waters of the specified stations. The collected data will be used to support other marine research studies within the expedition.
Determination of Levels and Distribution of Heavy Metals in the Barents Sea Surface Water	100 mL of surface water samples were collected from each station. The samples will be analysed for heavy metal elements to compare with former data and assess sources and anthropogenic impacts.
Determination of Total Organic Carbon and Suspended Solid Levels in Barents Sea Surface Waters	100 mL of surface water samples were collected at each station to determine total organic carbon levels. 1 litre of sea water sample were filtered through 0.45 µm Whatman filter papers.
Arctic Ocean Summer Sea Ice Observations	Types, floe size, thickness, topography and snow types of sea ice were visually observed based on AsPect (Antarctic Sea-ice Processes & Climate) form. The observations were recorded in the forms and will be compared with the remote-sensing (satellite) data.
Monitoring of Meteorological Parameters in the Barents Sea Region	Meterological parameters (namely temperature, wind speed, wind direction, relative humidity) were periodically recorded along the route of the expedition.
Determination of the pollution and environmental effects of Drug Active Ingredients, Antidepressants and Seratonin Hormone in the Barents Sea	300 mL of surface seawater samples were collected from six stations. The samples will be analysed for drug active ingredients, hormones and antidepressants.

The coordinates of the sampling stations are given in Table 3. In addition, the stations were shown in map in Figure 1.

Table 3. Coordinates of the sampling stations.

No	Lattitude	Longitude
1	71° 19' 13.20" N	24° 25' 28.85" E
2	70° 36' 05.38" N	32° 27' 38.43" E
3	73° 05' 09.53" N	35° 55' 31.56" E
4	73° 42' 34.43" N	36° 47' 01.29" E
5	75° 32' 59.43" N	31° 43' 15.53" E
6	75° 50' 25.20" N	37° 34' 46.43" E
7	76° 47' 05.97" N	37° 43' 30.21" E
8	77° 54' 07.71" N	33° 54' 19.10" E
9	78° 34' 45.69" N	37° 37' 40.21" E
10	79° 14' 45.10" N	34° 50' 24.18" E
11	80° 11' 40.43" N	34° 46' 28.68" E
12	81° 06' 59.06" N	34° 14' 10.32" E
13	81° 12' 50.51" N	24° 08' 55.20" E
14	80° 54' 46.53" N	13° 31' 59.40" E
15	80° 00' 36.33" N	02° 24' 44.41" E
16	80° 00' 08.57" N	10° 18' 23.10" E
17	79° 38' 44.66" N	09° 12' 25.05" E
18	79° 03' 47.36" N	09° 33' 44.92" E
19	78° 33' 01.32" N	09° 48' 20.72" E
20	78° 03' 49.75" N	11° 03' 22.70" E
21	77° 59' 26.69" N	12° 03' 27.41" E
22	77° 33' 14.85" N	12° 51' 23.41" E
23	75° 55' 01.03" N	14° 12' 04.46" E
24	75° 12' 35.74" N	16° 33' 50.72" E

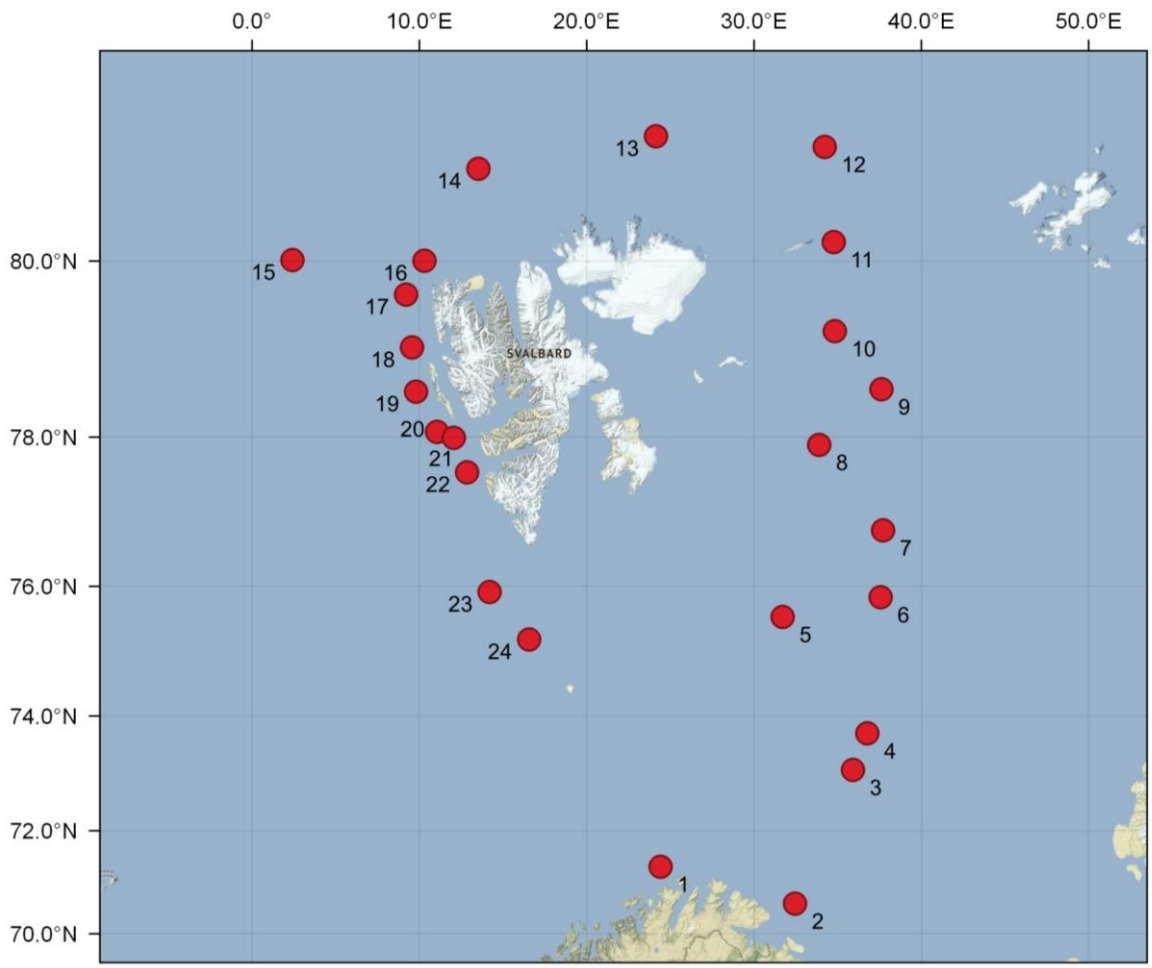

Figure 1. TASE-II sampling points

Results

In situ measurements were carried out in the surface waters of specified stations, namely pH, dissolved oxygen (DO), conductivity, total dissolved solids, sigma-T and seawater temperature (Table 4). For chlorophyll-a concentrations, the measured filters were thawed and extracted by acetone-water (90:10) solution in +4 °C overnight. Then, the samples were centrifuged for 10 minutes at 3000 rpm. The supernatant phases were measured in fluorescence spectrometer at 430 nm (excitation) and 663 nm (emission) wavelengths. The measured chlorophyll-a concentrations varied between the detection limits and 2.4 mg/m^3 among the sampling stations (Table 4).

Table 4. Properties of surface sea water in stations.

Station	pH	DO (%)	DO (ppm)	Conductivity (mS/cm)	Total Dissolved Solids (ppt)	σ_T (kg/m^3)	Temperature (°C)	Chlorophyll-a (mg/m^3)
1	8.16	95.7	8.53	51.92	25.96	26.1	10.28	0.349
2	8.32	91	8.15	52.38	26.19	26.4	10.10	0.410
3	8.29	94	8.90	53.31	26.66	27.2	7.77	0.641
4	8.34	99.7	9.70	54.05	27.03	27.7	6.54	0.496
5	8.23	96.5	9.41	53.84	26.92	27.6	6.51	2.207
6	8.17	94.7	9.77	53.92	26.96	27.7	4.19	bdl*
7	8.25	98.7	10.41	53.80	26.90	27.6	3.18	0.073
8	8.24	98.1	10.28	53.51	26.76	27.4	3.16	bdl
9	8.18	99.3	10.42	53.49	26.75	27.4	2.99	0.073
10	8.25	102.6	10.66	53.60	26.80	27.5	3.39	0.159
11	8.32	102.4	10.88	53.75	26.88	27.5	5.00	0.218
12	8.48	105.4	12.50	51.94	25.97	26.0	-1.20	bdl
13	8.36	91.75	10.75	51.35	25.68	25.8	-0.62	bdl
14	8.44	98.5	11.42	52.02	26.01	26.0	-0.55	bdl
15	8.36	100.4	12.13	50.74	25.37	25.3	-1.58	0.205
16	8.25	104.8	10.18	53.37	26.69	27.3	6.11	0.555
17	8.19	108.5	10.18	54.04	27.02	27.6	8.11	1.256
18	8.23	113.4	10.61	54.02	27.01	27.6	8.22	0.833
19	8.35	111.5	10.70	53.88	26.94	27.6	7.24	2.075
20	8.26	108.5	10.24	53.94	26.97	27.5	7.93	0.701
21	8.28	111.7	10.58	54.03	27.02	27.6	7.77	1.183
22	8.27	112.9	10.76	53.18	26.59	27.1	7.59	1.315
23	8.20	110.8	11.44	52.41	26.22	26.8	4.32	2.425
24	8.24	108.7	11.26	53.49	26.75	27.4	3.88	0.965

***** bdl: below detection limits

For determination of the atmospheric pollutants sources affecting the Arctic Ocean, particulate matter (PM) samples were collected along the expedition route. Two high volume samplers with cascade impactors were operated in parallel for this purpose (Figure 2). During the expedition, 72-hr long samples were collected by the impactor and daily samples were collected by the PM10 sampler on pre-fired quartz filters. The collected samples will be analyzed in terms of different organic and inorganic ions. The size segregated data will provide information about the anthropogenic and natural origin of PM. The data will be input to one of the advanced receptor modelling techniques namely Positive Matrix Factorization (PMF) to apportion the sources affecting the chemical composition of PM. In addition, backward

trajectories will be calculated and cluster analysis will be performed to find the dominating source regions.

Figure 2. High volume air samplers installed onboard the expedition vessel.

For the distribution and evaluation of microplastics (MP), the collected water samples will be extracted and analysed for microplastics. The detected MPs will be further subdivided into size, shape, color, and density categories. The surface and morphological changes will be also evaluated by Fourier Transform Infrared Spectrometer (FTIR) and Scanning Electron Microscope. Pollution index profiles will be evaluated depending on the abundance of microplastics. For this purpose, a generic carbonyl index will be used to rate the degree of polymer. This approach will lead to identifying the chemical changes that occur during the life of the material by detecting the functional groups in different bands with FTIR analysis.

Zooplankton and phytoplankton samples were collected by using 200 µm and 20 µm mesh size plankton nets, respectively. Additionally, surface sea water samples were collected from and filtered through filters with a 0.45 µm filters for pigment analysis. To assess the microbial community composition through eDNA metabarcoding the sampled water samples were filtered through 0.22 µm filters. In addition, 3 mL of water samples were collected for flow cytometric analysis for pico- and nanoplankton counts and were stored in Eppendorf tubes. The phytoplankton and zooplankton samples will be studied under the binocular and dissection

microscopes, respectively. The biomass amounts and species composition will be compared according to the stations. In eDNA metabarcoding study, bacterioplankton will be identified with next generation sequencing and bacterioplankton community compositions will be assessed. The abundances of pico- and nanophytoplanktonic groups at each station will be determined using the BD Accuri Flow Cytometer. For phytoplankton pigments which includes fucoxanthin, diadinoxanthin, peridinin, 19′-hexanoyloxyfucoxanthin, zeaxanthin, chlorophyll-b (Chl-b) and Chllorophyl-a (Chl-a) will be measured by using HPLC. The distribution of phytoplankton groups will be determined from the pigment additive ratios. Diagnostic pigments (DP), the sum of 7 selected biomarker pigments, will be used to estimate the contribution of phytoplankton size classes.

Conclusion

The collected samples were stored at refrigerator (+4 C) and freezer -18 depending on the sample type. The samples were then transferred to Türkiye via air transportation and distributed to the related laboratories for analyses and further examination. Although the finalization period of the studies may vary (months to years), the reports or scientific publications prepared from these studies will be shared with the relevant authorities of Norway once they are published.

Contact Information:

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Date: **13.07.2022**

RV PolarXplorer. Consent to conduct marine scientific research in the period 13.07.2022-24.07.2022

The Directorate of Fisheries, MSR Office refers to the Embassy's Note Verbale Z-2022/70521452/34617359 dated 27th June 2022, sent 4th July 2022 by the Norwegian Ministry of Foreign Affairs to the Directorate of Fisheries. Reference is also made to the Embassy´s application form for marine scientific research submitted to the Directorate of Fisheries 6th July 2022, and the requested information received 7th July 2022.

The Directorate of Fisheries hereby informs the Embassy that Norwegian authorities have granted consent in accordance with regulations laid down by Royal Decree of 30th March 2001 No. 360.

The marine scientific research is to be conducted by Turkey

with the research vessel "PolarXplorer", call sign LAOS8,
during the period from 13th to 24th July 2022
in the Norwegian Economic Zone and
in the Fisheries Protection Zone around Svalbard.

The purpose of this cruise is to investigate the presence and intensity of the anthropogenic impacts on a global scale, as well as, to observe the parameters and effects of global climate change.

Please be informed that utilisation of this consent is regarded as an acceptance of conditions given by authority of § 11 in the Royal Decree of 30th March 2001 No. 360. The consent granted is subject to compliance with the following conditions:

Final results and conclusions (§ 11 litra b) second alternative) from the planned cruise should be made available to the Directorate of Fisheries *within six - 6 - months* after the completion of the cruise.
If final results cannot be presented within six months, a preliminary report (§ 11 litra b) first alternative) should be made available pending the research state's final scientific results and conclusions. The report(s) is(are) to be presented to us as a data file, preferably in PDF format, or in RTF/MS Word or ASCII formats. The report(s) are to be sent to us on our e-mail address:

info@fiskeridir.no

Results and conclusions should be marked "06.07.2022, 13.07.2022-24.07.2022, Jnr. 22/9853".

A copy of the colleted data (§ 11 litra c) from the planned cruise should be made avilable to the Institute of Marine Research by Programme Director dr. Henning Wehde (henning.wehde@hi.no) within *six – 6 – months* after the completion of the cruise.

It is requested that a copy of this document shall be kept on board the research vessel.

Yours sincerely

Trond Ottemo
Head of Section

Agny Laukeland Bygnes
Senior Advisor

This letter is approved for electronic submission and does not need a handwritten signature.

List of recipients:
Turkish Embassy Oslo

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