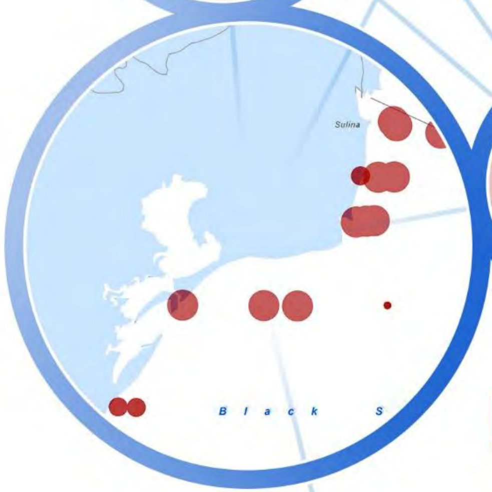
OVERVIEW

The marine environmental monitoring



Bulgaria, Romania and Turkey

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Contributing authors:

National Institute for Marine Research and Development "Grigore Antipa", NIMRD, Romania
L. Boicenco, A.D. Spanu, V. Coatu, A. Filimon, L. Lazar, O. Marin, A. Oros, F. Timofte, D. Tiganus

Institute of Oceanology, Bulgarian Academy of Sciences, IO-BAS, Bulgaria
S. Moncheva, G. Sthereva, K. Stefanova, K. Dencheva

TUBITAK Marmara Research Center, MRC, Turkey
C. Beken

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INTRODUCTION

This document was prepared within the MISIS Project *MSFD Guiding Improvements in the Black Sea Integrated Monitoring System*, whose two of the additional specific objectives were: 1/ to improve availability and quality of chemical and biological data to provide for integrated assessments of the Black Sea state of environment, including pressures and impacts (in line with Annex I and III of the MSFD), and 2/ to develop national integrated monitoring programs in line with the MSFD and WFD.

In order to fulfill these objectives three Package Activities were carried out: **PA1** – *Contribution to development of national integrated monitoring programs compliant with the MSFD and the WFD allowing also compliance* and **PA3** - *Contribution to existing database systems (national, Black Sea Commission, WISE) as far as marine/coastal environment monitoring is concerned.*

The activity PA1.2. *Revision of National and Regional Monitoring Programs* was introduced as a need for revision of monitoring programmes, which was stipulated in the MSFD. MISIS Project came to support the process, which is on-going at the national and regional level in the Black Sea region. For instance, the Concept Paper drafted in October 2012, in the frames of the BSC and its project on the MSFD "Support to the Black Sea Commission for the Implementation of the Marine Strategy", takes into consideration the recommendations of the Diagnostic Reports I and II, and MISIS participants were among the experts identified by the BSC for its preparation.

As for the PA3, it proposed to overview the gaps in data reporting of the beneficiary countries to EEA and BSC, measured against the availability of data in the national systems of the countries. It also describes the trends in reporting, reasons for failure; usage of data by EEA and the BSC, value-added of reporting; Communication of findings at the level of the relevant authorities.

The **Diagnostic Report II** gives *in detail* information on data reporting in the three partner countries, as the contacted stakeholders indicated. The conclusion is the reporting to international organizations, such as BSC, EEA and UNEP/FAO, is in Formats developed by these organizations. All the three countries make reporting to the Black Sea Commission. Usually, all EC FP7, EC DG Env, EC DG Mare etc, project develop their own formats as well and the institutions reporting use them.

The main objective of this document is to revise the Black Sea integrated monitoring system, and the first main outcome of this process is the revised Bulgaria, Romania and Turkey Monitoring and Assessment Strategy accompanied by an overview of current monitoring of the Black Sea marine environment. The process of development of indicators in the Black Sea region is a part of the cooperation existing between BSC and EEA.

The document provides an overview of the number of stations, as well as the number of main biological, nutrients and hazardous substances parameters reported by the three countries, partners in the *MISIS* Project, both to BSC and EEA, in the period 2006-2012. It may be also a basis for a discussion related to monitoring activities: Where do countries monitor currently? What parameters? Are there spatial or temporal gaps?

1. Black Sea Convention (Bucharest Convention) (BSC)

The collection of data/information under the umbrella of the Bucharest Convention started in 2001. Special reporting templates (Excel Format) were initially developed and later several times amended to improve collection of data/information in response to the needs of decision making in the Black Sea region and for calculation of indicators necessary for assessments of the Black Sea ecosystem state and efficiency of implemented policies. Presently, the Black Sea Information System (BSIS) consists of nationally reported data in the fields of land based sources of pollution, conservation of biodiversity, fisheries and other marine living resources, environmental safety aspects of shipping, integrated coastal zone management and pollution monitoring and assessment.

Between 2007 and 2009 the BSC produced three important reports: *Black Sea Transboundary Diagnostic Analysis (2007), State of the Environment of the Black Sea in 2001-2006/7 and Implementation of the Black Sea Strategic Action Plan in 2002-2007*. While working on these reports, the BSC PS faced certain problems, which implied the necessity of self-evaluation in relation to national data reporting (official flow) to BSIS and performance of states in the frames of the BSIMAP. In relation to indicator-based reporting the BSC PS found needed to seek for additional time-series data outside of BSIS, which meant that a good evaluation is also required for the availability of such data in the Black Sea region to assure possibly access and consequently higher quality assessments in future. Later a solution should be sought how these data can become a part of BSIS in a sustainable manner.

The process of development of indicators in the Black Sea region is a part of the cooperation existing between BSC and European Environment Agency. Going back to 2006, in line with the Memorandum of Understanding between the Black Sea Commission and EEA, the BSC PS processed and provided to EEA monitoring data for review and recommendations on development of indicators:

- Fisheries data
- Shipping data (oil pollution)
- Oxygen, BOD5 (Biological Oxygen Demand for 5 days), species of nutrients, hydrocarbons.

2. The Black Sea Integrated Monitoring and Assessment Programme (BSIMAP)

The Black Sea Integrated Monitoring and Assessment Programme seeks to maximize the use of historical data from previously established monitoring sites for trend analysis, supported by new additional sites to improve the assessment of the current chemical/ecological status of the Black Sea.

Products of BSIMAP are data sets compiled, as well as annual and 5-yearly assessment reports. For the compilation of the data/information sets special Excel templates have been developed, which are the basis of the Black Sea Information System (BSIS).

The main purpose of the BSIS and BSIMAP is to provide reliable and consolidated data for 'state of the environment' reporting, 'impact assessments' of major pollutant sources, 'transboundary diagnostic analysis' and SAP implementation reports (BSSAP process) in view of decision-making needs in the Black Sea region. The sites, parameters and monitoring frequencies also reflect data requirements for compliance with relevant national and international legislation and agreements.

The regional monitoring program BSIMAP is based on National monitoring programs, financed by the Black Sea states. Outside of National Programs, pilot monitoring field trips related to various environmental problems have been and are carried out in the frames of different projects, financed by donors, such as EU DG Research and DG Environment, NATO Science for Peace Program, UNDP/GEF and UNEP and others.

Each state decides how many and which stations annually can be observed in the frames of the National Monitoring Program, what should be the frequency of sampling and which of the stations will be reported at the regional level. BSIMAP provides recommendations on parameters, frequency and methodologies. For measurements in water - at least 4 times per year is recommended in BSIMAP. For sediments and benthic communities – once or twice per year at least. Contamination in biota – once per year at least. Oceanographic parameters, nutrients, plankton and *Mnemiopsis* (or other exotic species) – monthly sampling recommended. It is also advised to have stations in impacted and undisturbed areas (reference stations) for the purpose of comparison, in transitional, coastal and marine waters. The monitoring is expected to be integrated, regular and sustained at the same stations in time and space.

2. *Diagnostic Report I*, to guide improvements to the regular reporting process on the state of the Black Sea environment, August 2010.

In 2010 the BSC implemented a small-scale project financed by the EEA to guide improvements to the regular reporting process on the state of the Black Sea environment. The deliverable of this project was shortly named *The Diagnostic Report I* which evaluated mainly the suitability of Black Sea data to apply/calculate EEA and BSC indicators, revealing also associated major gaps in BSIMAP (Black Sea Integrated Monitoring and Assessments Program) and BSIS (Black Sea Information System), with a forward-looking component related to the MSFD Descriptors included.

Many scientific institutions in the region contributed to the checks of availability of data outside of the official reporting flow, submitting often full inventories of cruises and *meta* data on parameters of interest. In total, information about 20 major data-holders, from all of the six Black Sea coastal countries, 30 important projects which carried out cruises and/or produced data outside of BSIS and 30 observation systems operating in the Black Sea area has been compiled. Meta data (outside of BSIS) were reported by 15 Institutes, some of them provided full inventories for nutrients, Chl, macroalgae and contamination of biota.

All collected data/information (BSIS, BSIMAP and outside of them reported by Institutions) were analyzed and cross-tables were produced showing availability of datasets in question and their suitability to calculate indicators. A summary of suitability of Black Sea data (of BSIS and external data sources) for calculation of BSC and EEA indicators and MSFD descriptors was prepared in a special table where 37 types of indicators are included.

3. *Diagnostic Report II,* guiding improvements in the Black Sea integrated monitoring system (including capacity building and utilization of equipment), data management, and assessments, 2012-2013.

The *Diagnostic Report II* has been prepared as part of the *MISIS* Project "*MSFD Guiding Improvements in the Black Sea Integrated Monitoring System*" This Report builds on the findings of the EEA/BSC *Diagnostic Report I*, upgrading it for Bulgaria, Romania and Turkey to include more information on their national monitoring programmes (or any other Black Sea related observations), national data/information management tools (which were not part of the BSC Diagnostic Report), operational monitoring, etc. The Report utilizes also the findings of the EC SeasEraNet Project on laboratory infrastructure, equipment and vessels available with the aim to contribute to more efficient use of them in the Black Sea region.

One of the additional specific objectives of *MISIS* is being imposed by the requirements of the Annex I and III of the MSFD, and it refers to improvement of the availability and quality of the chemical and biological data provided for integrated assessments of the Black Sea state of environment, including pressures and impacts.

4. The Black Sea Integrated Monitoring and Assessment Program (BSIMAP) Revision: Proposal 2012.

In 2012, November, BSC prepared a document with some proposals for a BSIMAP revision. This document was prepared with the financial assistance of EC DG Env., under a MSFD Project “Support to the Black Sea Commission for the Implementation of the Marine Strategy”.

For the following period (2014–2020), the Monitoring and Assessment Strategy (GES / environment targets tracing *inter alia*) should further develop the existing practices (filling the gaps in agreed already observations, improving geographical coverage, etc.) and encompass new issues as well as the development of new methodologies and tools. Issues in need for further development in the BSIMAP include: (a) the impact of climate change and climate change adaptation policies; (b) the development of tools for integrated regional assessment of Black Sea states; (c) incorporation of regular open sea observations; (d) the development of networks (reference stations, trends stations/transects in transitional, coastal and marine waters, stranding, by-catch, etc.); (e) attendance of transboundary environment problems (near-simultaneous observations in states, including Cetacean census, fish stock assessments, etc.); (f) screening for new pollutants; (g) tracing of illegal discharges/dumping; (h) incorporation of habitat mapping and GIS; etc.

The main proposal of the revised BS SAP 2009 is to present the EcoQO together with the relevant MSFD Descriptors to outline additional monitoring and data/information collection requirements, having carefully analyzed the gaps in the present BSIMAP (e.g., Diagnostic I, PERSEUS and MISIS reports, BS SRA, etc.).

Biological parameters

The biological communities associated with the predominant seabed and water column habitats (phytoplankton and zooplankton communities), as well as macro-algae and invertebrate bottom fauna, are requested by the MSFD to the Member States, which must prepare an initial assessment of their marine waters, as the first step in the preparation of the marine strategy. By reference to the initial assessment, Member States shall determine a set of characteristics for *good environmental status*, on the basis of the qualitative descriptors listed in Annex I. Commission Decision 2010/477/EU.

For the Black Sea, the biological parameters (phytoplankton, zooplankton, including *Noctiluca* as indicator species, invasive species, macrozoobenthos and macrophytobenthos) are mandatory parameters for the problem *Biodiversity change and decline, habitat destruction* (BSIMAP Revison: Proposal 2012).

The data regarding the phytoplankton (abundance, biomass and predominating group), zooplankton, including opportunistic species, macrophytes (abundance, biomass, species, indicators species), and macrozoobenthos (abundance and biomass, species, indicators species) are requested by the Conservation of biodiversity Advisory Group (CBD AG) for preparation of the *State of Environment* annual narrative reports.

The number of monitoring stations is not permanently fixed in BSIMAP, and in some of the countries observations do not take place at the same stations each and every year (Table 1). Moreover, in open-sea there are no stations in most of the countries (or they are not reported to the BSC, as not being part of BSIMAP formally), and also reference stations are mainly missing.

Table 1. Number of stations reported to BSC, within the period 2006-2012.

Biological parameters	Bulgaria	Romania	Turkey
Chlorophyll *a*	30	57	81
Phytoplankton	30	57	31
Zooplankton	27	56	23
Zoobenthos	24	55	13
Phytobenthos	27	27	ND

The State of Marine Ecosystem is assessed based on the indicators recommended by the Water Framework Directive and Marine Strategy Framework Directive as well as on the physical, chemical and biological parameters set by the Advisory Group for the monitoring and pollution assessment within the Permanent Secretariat of BSC. Among these biologic parameters are included the phytoplankton, macrozoobenthos and zooplankton. The three parameters are assessed from the point of view of taxonomic composition, seasonal and geographical variability.

Chlorophyll-a

Chlorophyll *a* is a proxy parameter for phytoplankton abundance. Chlorophyll *a* is considered a mandatory parameter used in *Biodiversity change and decline, habitats destruction*. Under the BSIMAP revision: Proposal 2012. It serves assessments under the EU Water Framework Directive quality element for phytoplankton and the EU Marine Strategy Framework Directive qualitative descriptor 5 'eutrophication'.

For the Black Sea, the monitoring of chlorophyll is necessary to respond to some problems, such as the frequency of phytoplankton blooms occurrence, the areas of most frequent phytoplankton blooms, the consequences for the Black Sea flora and Sea flora and fauna (*Diagnostic Report* I, 2010).

Within the period 2006-2012, a total of 168 stations were reported to be monitored by the partners countries, the highest number (81 stations) being reported by Turkey, meaning 1.4 and 2.7 higher than Romania (57 stations) and Bulgaria (30 stations) respectively; however, Turkey reported no station between 2010 and 2012.

A total of 4,247 data were reported by the three countries to BSC, most of them (2,681) were reported by Turkey, followed by Romania (730) and Bulgaria (582). However, NIMRD reported constantly data, the maximum number in 2009 (234), and the minimum one in 2012 (57) (Table 2). Turkey made no reporting in the last three years. Excepting 2009, IO-BAS reported more and more data every year, in 2012 reaching to 582 data, meaning 36 times higher than in 2007 (the lowest number).

Table 2. Number of chlorophyll *a* data reported to BSC.

Chlorophyll-a	2006	2007	2008	2009	2010	2011	2012
RO	96	↘ 89	↘ 85	↗ 234	↘ 88	↗ 138	↘ 57
BG	30	↘ 16	17	....	↗ 71	↗ 120	↗ 582
TR	434	↘ 430	↗ 1057	↘ 760	....	....	....

Only Bulgaria and Romania reported data to EEA, the highest number (245) being reported by Romania, with 109 data higher than Bulgaria (Fig. 1). However, nor Romania neither Bulgaria made reporting each year.

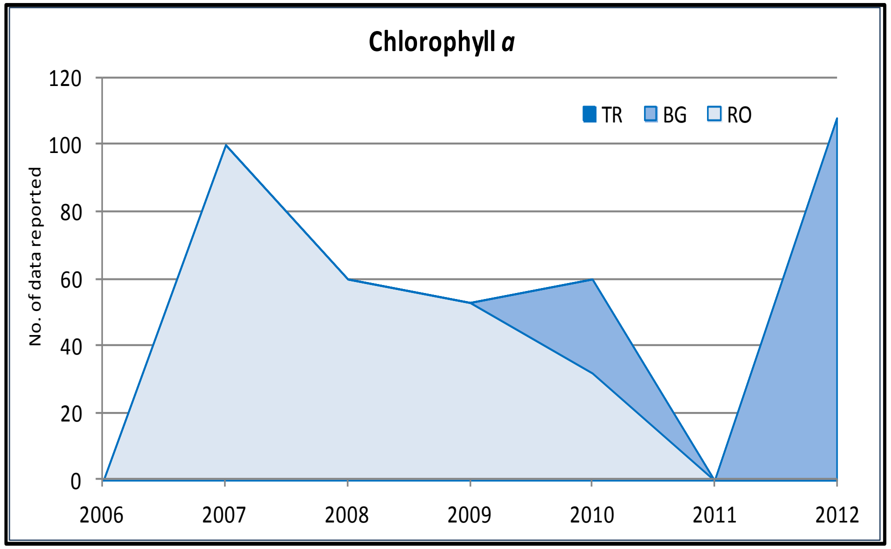


Figure 1. Evaluation of chlorophyll *a* data reported to EEA by Romania, Bulgaria and Turkey.

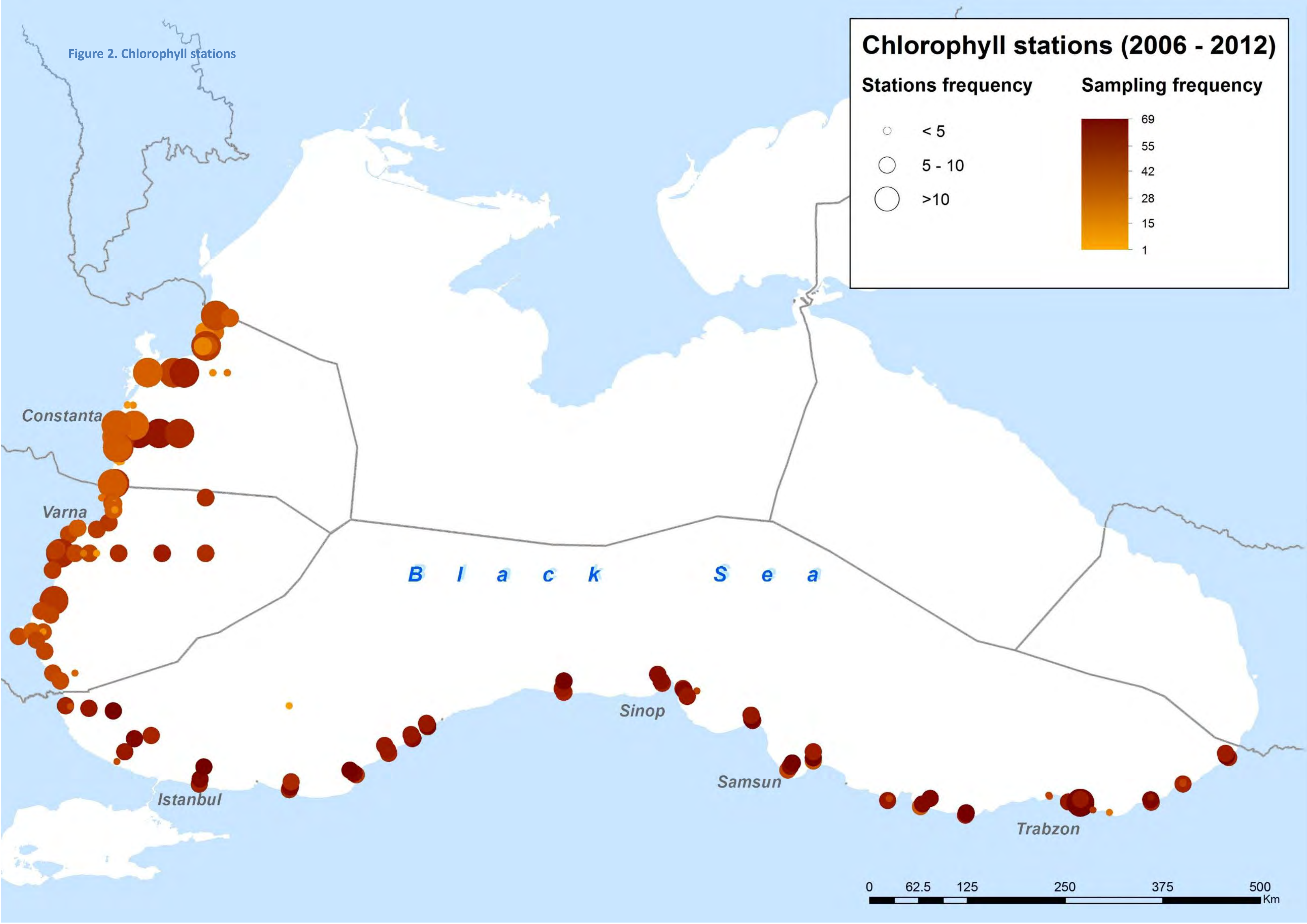
The Black Sea bottom algoflora is the impoverished derivative of the Mediterranean one. Many of the species have either disappeared completely or impoverished, whereas some others flourished during the last decades due to the severe impact of eutrophication on the bottom phytocoenosis. The most well-known sign of the transformations in macrophytobenthos community was the loss of *Phyllophora* in the region of Zernov's *Phyllophora* field of the northwestern Black Sea. The drastic decrease of macrophytes diversity and almost total disappearance of perennial algae were among the most important changes that had occurred as a result of natural and man-made factors. Given the importance of macroalgae as food and refuge for animals, as well as source of external metabolites and oxygen, their decline affected the entire benthos life.

Phytobenthos are plants living attached to the seabed. Phytobenthos is considered a mandatory parameter used in *Biodiversity change and decline, habitats destruction* under the *BSIMAP revision: Proposal 2012*, EU Water Framework Directive quality element for macrophytes and the EU Marine Strategy Framework Directive qualitative descriptor 1 "biodiversity", 5 "eutrophication", 6 "sea-flor integrity".

During period 2006-2012, phytobenthos has been reported to be monitored at coastal stations only by Romania and Bulgaria, but not every year. In 2012, each of the two countries reported the same number of stations (27), the smaller number reported pertained to Bulgaria (5 stations in 2006). There are two (Romania) and three (Bulgaria) years without reporting.

During the seven years of reporting, altogether 304 data were reported by the two countries (Table 3), out of which 234 were made by Romania.

Figure 2. Chlorophyll stations



Phytobenthos

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During the seven years of reporting, altogether 304 data were reported by the two countries (Table 3), out of which 234 were made by Romania.

Table 3. Number of phytobenthos data reported to BSC.

Phytobenthos	2006	2007	2008	2009	2010	2011	2012
RO	29	....	....	↗ 38	↗ 44	↘ 42	↗ 81
BG	5	↗ 18	↘ 15	....	....	....	↗ 32
TR	....	....	....	....	....	....	....

Phytoplankton

Phytoplankton as the foundation of marine trophic chain is among the best indicators for assessment of the state of eutrophication. Nutrient enrichment/eutrophication often gives rise to shifts in phytoplankton species composition (e.g. from diatoms to dinoflagellates) and an increase in the frequency and/or magnitude and/or duration of phytoplankton (including nuisance/potentially toxic) blooms.

Phytoplankton is considered a mandatory parameter used in *Biodiversity change and decline, habitats destruction* under the *BSIMAP revision: Proposal 2012*, the EU Water Framework Directive quality element for phytoplankton, the EU Marine Strategy Framework Directive and descriptor 1 'biodiversity', descriptor 2 'non-native', descriptor 4 ' food-web' and descriptor 5 'eutrophication'.

In 2010, *Diagnostic Report I* identified phytoplankton as a priority parameter to be monitored giving information of some policy question, such as how often phytoplankton blooms occur, what are the areas of most frequent phytoplankton blooms, what are consequences for the Black Sea flora and fauna.

Harmful algal blooms is also an MSFD indicator, and it is regularly studied in the Black Sea. However, the BSIS data are not enough to support this indicator, external data are sufficient for regional assessment (*Diagnostic Report I*).

Information regarding the status of the phytoplankton abundance, biomass, predominating group from Romanian, Bulgarian and Turkey waters are included in the 5-yearly *State of Environment* reports edited by the BSC PS. Phytoplankton monitoring of the Romanian Black Sea coastal waters started ever since 1980s.

Presently, the marine ecosystem state research is a part of the National Project "The influence of river input on the chemical composition and trophic status of transitional and coastal Romanian waters, viewing the common implementing of the Water Framework and Marine Strategy Directives", financed through the Programme NUCLEU "Conservation of the marine ecosystem and promotion of its sustainable use – CEMAR" (PN09-320202). The achieving of the objective is made through the inventory of the benthic and planktonic species from the Romanian continental shelf. One of the expected results is to establish reference conditions for the main parameters involved in the calculation of indicators and HELCOM Eutrophication Assessment Tool TRIX (HEAT) (nutrients, dissolved oxygen, chlorophyll *a*, phytoplankton).

The data about identification of qualitative and quantitative composition of phytoplankton as well as the algal blooms, as an indicator of eutrophication, are introduced in the Chapter "Conservation of the nature and biodiversity" from the *State of marine environment*, prepared by NIMRD. The same data are included in chapter dedicated to the marine and coastal environment, of the annual *Report State of Environment* of the Constanta County, prepared by the Environmental Protection Agency.

Data of the phytoplankton development are part of the environmental impact studies prepared for issuing the environmental agreement for the activities developed in the Romanian Black Sea waters.

In the period 2006-2012, altogether 118 sampling stations were reported for phytoplankton to BSC, NIMRD (Romania) monitored the highest number stations (57), with 27 and 26 stations respectively higher than Bulgaria and Turkey. Also, must be noted, NIMRD performed continually monitoring the phytoplankton, while Bulgaria and Turkey interrupted it for one or two years (Table 4). However, the highest number of reported data (779) pertained to Turkey, almost the same number was reported by Bulgaria (712); Romania reported only 431 data.

Table 4. Number of phytoplankton data reported to BSC.

Phytoplankton	2006	2007	2008	2009	2010	2011	2012
RO	70	↗ 92	↘ 70	↘ 35	↗ 46	↗ 58	↗ 60
BG	26	↘ 16	....	↘ 12	↗ 71	↗ 131	↗ 456
TR	199	↘ 164	168	168	....	↘ 80	....

Zooplankton

Zooplankton community structure serves as a critical trophic link between the autotrophic and higher trophic levels. On the one hand, zooplankton as consumer of phytoplankton and microzooplankton controls their abundance; on the other hand, it serves as food resource to small pelagic fishes and all pelagic fish larvae and thus controls fish stocks.

Zooplankton is used in assessments under the BSIMAP revision proposal 2012 problem objective *Biodiversity change and decline, habitat destruction*, and the EU Marine Strategy Framework Directive qualitative descriptors 1 'biodiversity', 2 'non-native' and 4 'food webs'.

During 2006-2012 the zooplankton monitoring is reported to be carried out at 106 sites, settled on the whole Romanian, Bulgarian and Turkey coasts. There are visible differences in the geographical coverage of the stations, while Romania reported a high number of stations (56), the Bulgarian and Turkey coasts were poor covered, only 27 and 23 stations respectively.

However, Bulgaria performed a continuing sampling during the seven years, and the number of data reported increased from 5, in 2006, up to 256, in 2012 (Table 5). On the whole, Bulgaria reported 338 data, Romania 293, and Turkey only 154. Both Romania and Turkey reported almost the same number of data reported each year.

Table 5. Number of zooplankton data reported to BSC.

Zooplankton	2006	2007	2008	2009	2010	2011	2012
RO	32	↗ 47	↗ 61	....	↘ 41	↗ 57	↘ 55
BG	5	↗ 12	↗ 17	↘ 12	↗ 24	↘ 12	↗ 256
TR	22	21	↗ 44	42	↘ 10	15	....

Figure 3. Macroalgae stations

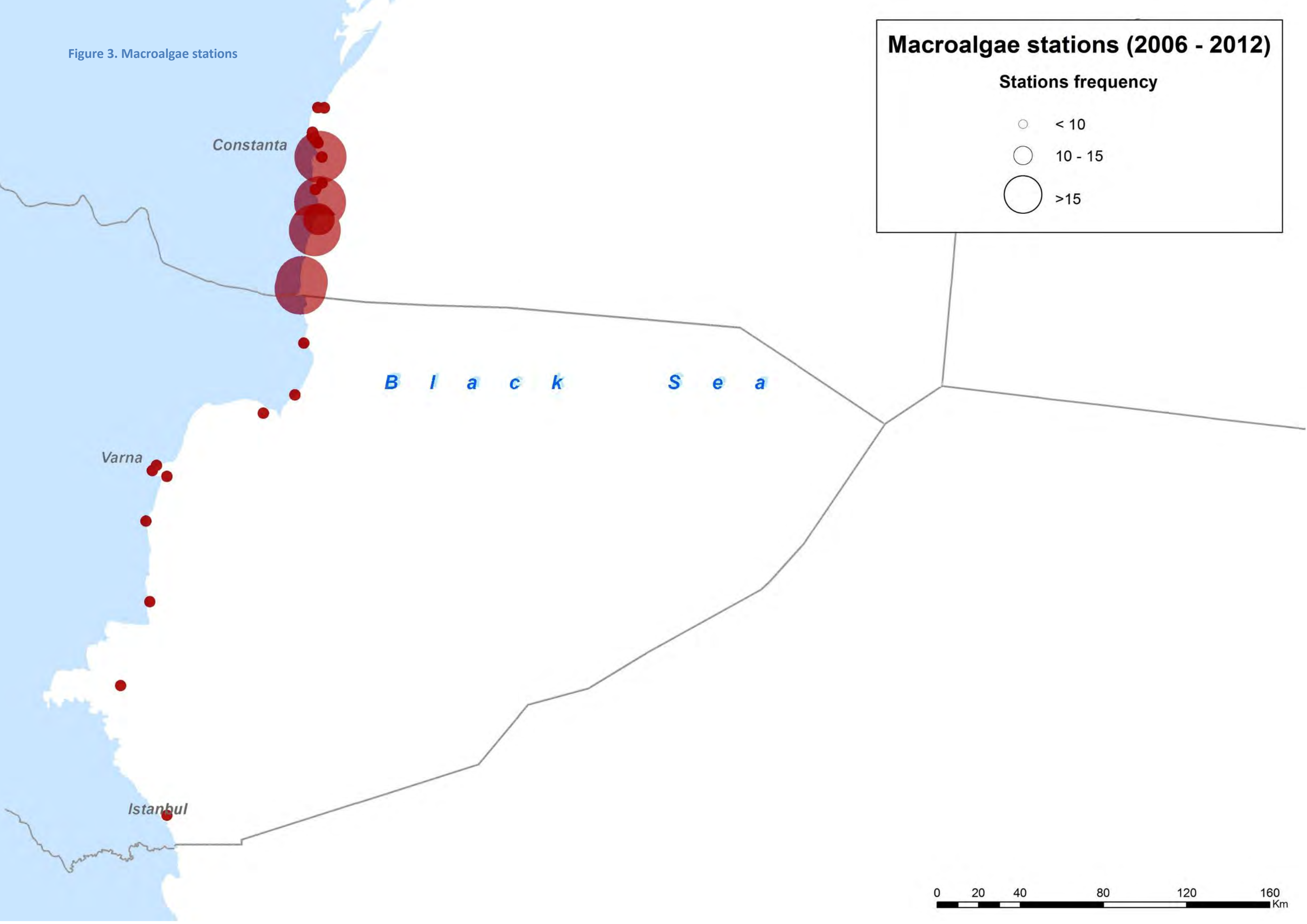


Figure 4. Phytoplnkton stations

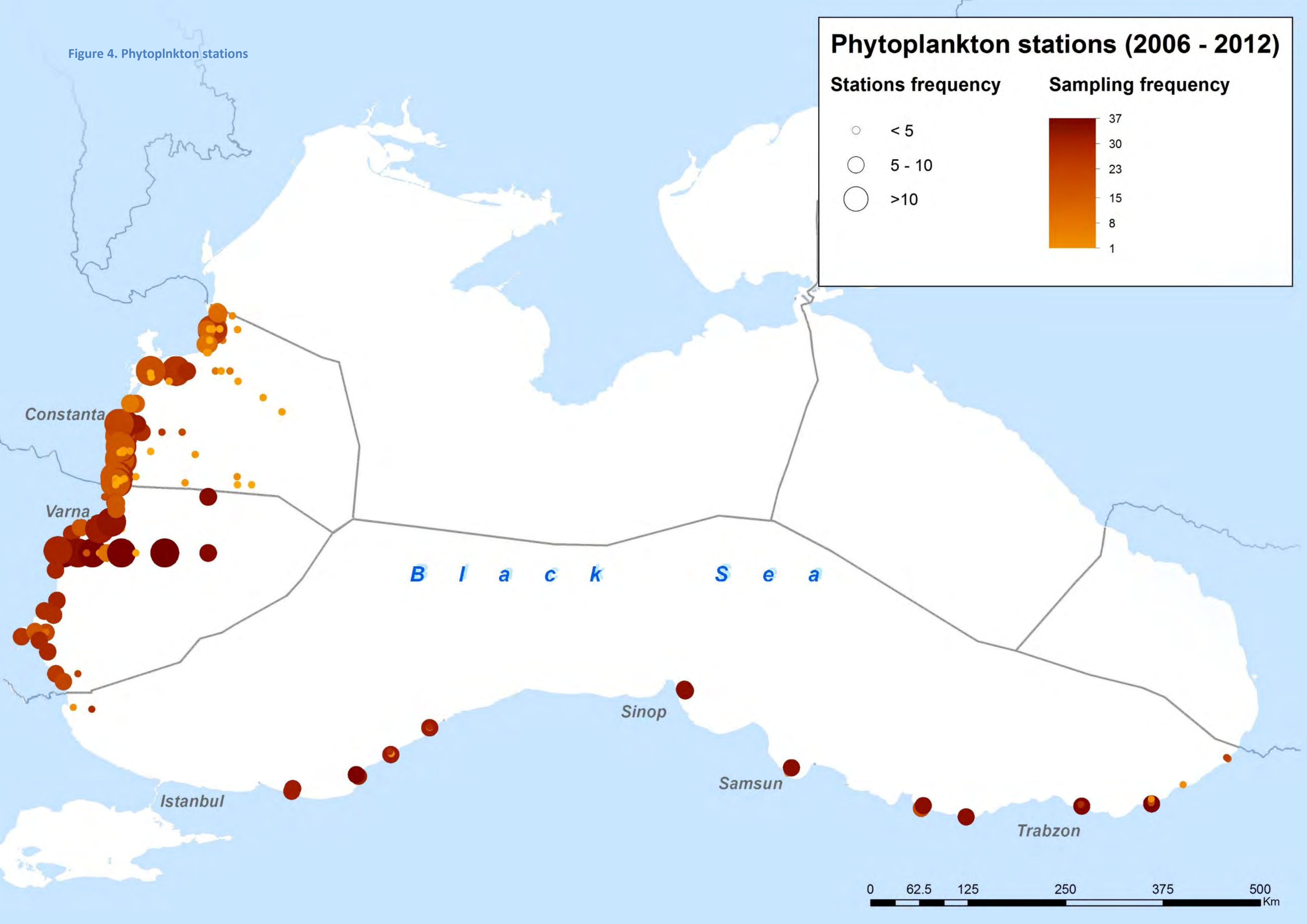
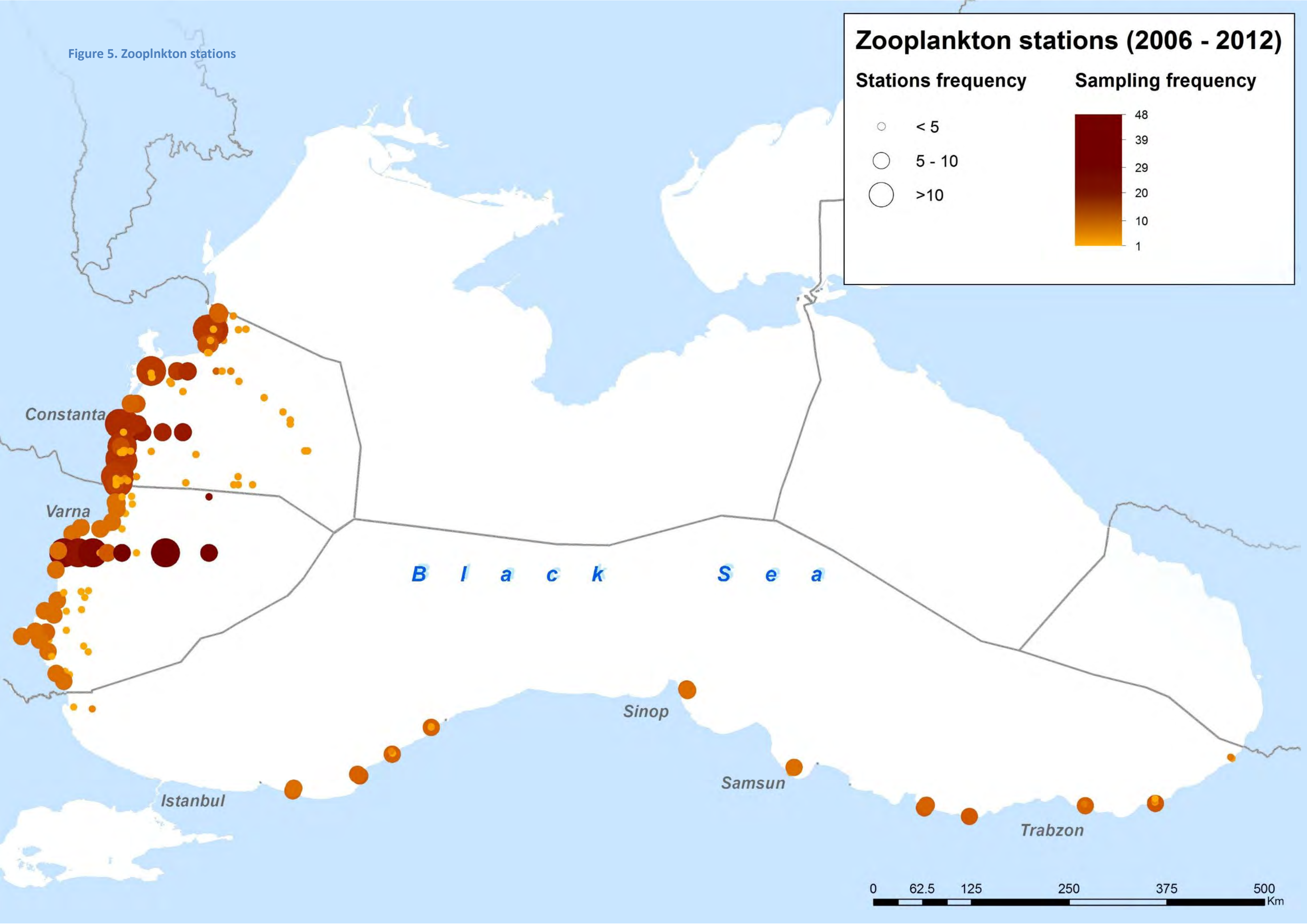


Figure 5. ZoopInkton stations



Zoobenthos

The state of zoobenthos community structure and functioning may be considered as one of the most conservative indicators for assessing the structural and functional changes and thus its ecological health. In the 1960s, the northwestern shelf was used to be represented by very rich fauna and nourishing place for economically valuable fish species. The anthropogenic disturbances made this biocoenosis less vulnerable to the environmental changes in the 1970-1980s, and diminished its benthic populations particularly in the discharge regions of Danube, Dnieper, and Dniester Rivers. As a result, the zoobenthos community structure shifted to the dominance of smaller size hypoxia tolerant groups and opportunistic species that resulted in an increase in total zoobenthos abundance but decrease in total biomass. Degradation of benthic communities has further been intensified by other forms of pollution, impacts of exotic invaders and their unsustainable exploitation. Regarding to exotic invasions, wide diversity of biotopes and low species diversity of the Black Sea has provided favourable conditions for exotic invaders, which find unoccupied ecological niches without competitors and/or predators. The rate of alien species introductions has been constantly increasing and degrading benthic community structures.

Benthic macrofauna is used in assessments BSIMAP revision proposal 2012 problem objective *Biodiversity change and decline, habitat destruction*, the EU Water Framework Directive quality element for zoobenthos, and the EU Marine Strategy Framework Directive qualitative descriptor 1 'biodiversity', 4 `food-web` and 6 ‘sea-floor integrity’.

For the whole period 2006-2012, the number of reported monitoring stations for zoobenthos was 92, Romania reported the highest number of stations (55); a number of 2.3 times lower was reported by Bulgaria (24) and 4.2 by Turkey (13 stations).

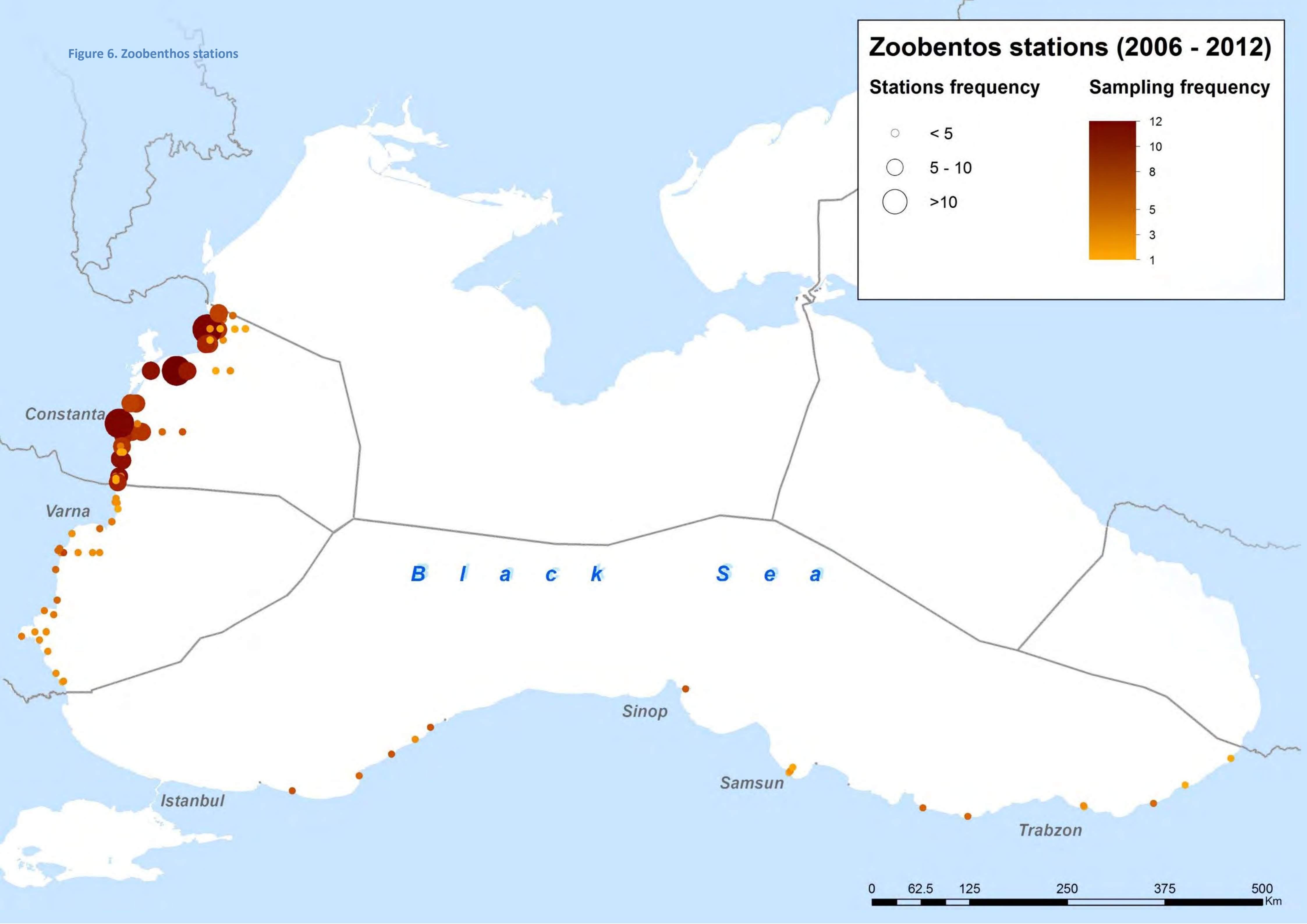
Consequently, the highest number of data reported pertained to Romania (268), only 77 data were reported by Bulgaria and 47 by Turkey.

Only Romania monitored the zoobenthos every year, Bulgaria and Turkey ceased the monitoring two or three years respectively (Table 6).

Table 6. Number of zoobenthos data reported to BSC.

Zoobenthos	2006	2007	2008	2009	2010	2011	2012
RO	35	↘ 24	↗ 33	↘ 24	↗ 41	↗ 56	55
BG	10	8	....	....	↗ 13	↗ 21	↗ 25
TR	10	....	↗ 15	↘ 9	↗ 13	....	....

Figure 6. Zoobenthos stations



Hydrography

Temperature

There are altogether 1,740, 907 and 4,359 temperature data reported by Romania, Bulgaria and Turkey respectively to BSC. Excepting Turkey, the data were reported every year since 2006 to 2012. However, as can be seen Turkey reported the highest number of data (Table 8)

Table 7. Number of Temperature data reported to BSC.

Temperature	2006	2007	2008	2009	2010	2011	2012
RO	374	294	200	356	209	169	138
BG	34	16	17	12	95	152	581
TR	862	435	1252	882	465	463	

Salinity

The highest number of salinity data was reported by Turkey (4,359) and the lowest one Bulgaria (907) (Table 7). However Turkey made no reporting in 2012. Romania made reporting every year, the total number of data was 1,733.

Table 8. Number of Salinity data reported to BSC.

Salinity	2006	2007	2008	2009	2010	2011	2012
RO	373	294	198	356	209	169	134
BG	34	16	17	12	95	152	581
TR	862	435	1252	882	465	463	

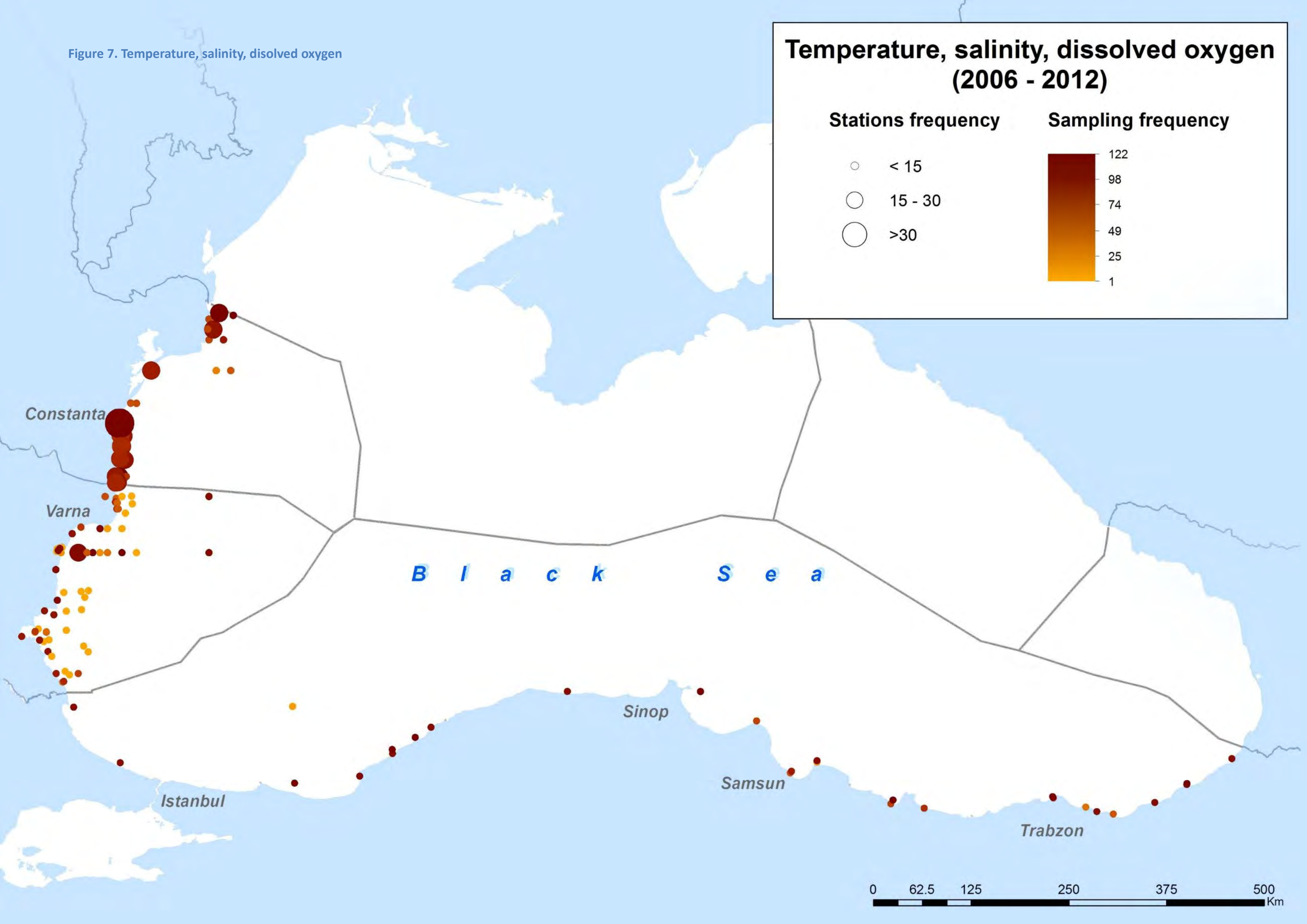
Dissolved Oxygen

Turkey reported the highest number of dissolved oxygen data (4,367), followed by Romania (1,725) and Bulgaria (851). Also, Turkey ceased to report dissolved oxygen data in 2012 (Table 9).

Table 9. Number of Dissolved Oxygen data reported to BSC.

Dissolved Oxygen	2006	2007	2008	2009	2010	2011	2012
RO	374	294	200	357	192	169	139
BG	34	16	17	12	71	120	581
TR	862	435	1252	882	465	463	

Figure 7. Temperature, salinity, disolved oxygen



Nutrients

Marine eutrophication of coastal waters is considered to be a significant problem worldwide. The Black Sea is no exception, where considerable increase in the nutrient load has led to marked changes in the ecosystem structure and functioning. Eutrophication is defined here as excessive supply of nutrients (silicate, nitrogen and phosphorus) into water that subsequently leads to accelerated growth and over-production of algae and species of higher trophic levels, high rate of oxygen depletion, development of hypoxia or anoxia near the bottom of productive areas and subsequent degradation of benthic community structure. A key to successful management of coastal waters is reliable scientific assessment of eutrophication and of its governing processes.

On the basis of the numbers of BS indicator that exist in relation to the EEA and MSFD "needs" the following conclusions were drawn. Among the eutrophication indicators (inorganic nutrients, chlorophyll and N/P ratio), N/P is not specifically reported to the BSC but as a generic indicator it can be easily derived from BSIS (*Diagnostic Report I*, 2010).

The chemical features, meaning the spatial and temporal distribution of nutrients (DIN, TN, DIP, TP, TOC), are requested by the MSFD to the Member States, which must prepare an initial assessment of their marine waters, as the first step in the preparation of the marine strategy. Also, they must include an analysis of the predominant pressures and impacts, among them the input of fertilisers and other nitrogen and phosphorus-rich substances (e.g. from point and diffuse sources, including agriculture, aquaculture, atmospheric deposition).

The three MISIS partner countries have reported the following nutrients parameters:

- Ammonium nitrogen (NH4)
- Nitrate nitrogen (NO3)
- Nitrite nitrogen (NO2)
- Phosphate phosphorus (PO4)
- Silicate (SiO4)
- Total nitrogen (TN)
- Total Phosphorus (TP)
- Total Organic Carbon (TOC)

During period 2006-2012, there was a good coverage of the nutrient monitoring in the Black Sea. There are some gaps in all parameters, for example Turkey monitored only 6 parameters comparatively with Romania and Bulgaria, which monitored 8 and 9 parameters respectively. There are no NH4 and TN monitored stations in Turkish waters (Table 10).

Table 10. Number of reported stations to BSC.

Nutrients	Bulgaria	Romania	Turkey
N (NH4)	30	61	
N (NO3)	30	61	81
N (NO2)	30	61	81
P (PO4)	30	61	81
SiO4	30	61	81
TN	19	16	
TP	21	60	81
TOC [mg/L]	19	35	81

Ammonium nitrogen (NH4)

Only Romania and Bulgaria reported ammonium nitrogen (NH_4) stations, but only Romania made reporting each year. On the whole, a number of 61 and 30 stations respectively were reported by the two countries. Bulgaria reported stations only in 2008 and 2012 (Table 11).

The highest number of ammonium nitrogen data pertained to Romania (1,738), and the number was ranging between a minimum value (139), in 2012, and a maximum one, in 2006 (373) (Table 8). Bulgaria reported a number of data almost three times lower (599), but the great majority of them were reported in 2012 (582).

Table 11. Number of NH_4 data reported to BSC.

NH_4	2006	2007	2008	2009	2010	2011	2012
RO	373	↘ 294	↘ 198	↗ 357	↘ 208	↘ 169	↘ 139
BG	....	....	17	....	....	....	582
TR	....	....	....	....	....	....	....

Nitrate and nitrite nitrogen (NO3 – NO2)

The nitrate and nitrite nitrogen is reported being measured at altogether 344 stations and there is a good geographical coverage in the whole Black Sea. The three countries reported the same number of stations for each of the two nitrogen species.

At most monitoring stations samples are being taken every year in Romanian waters, the exception is a number of stations along the Bulgarian and Turkey coasts, which ceased to monitor in one (2009) or two years (2010 and 2011) respectively (Table 12).

Consequently, the same number of nitrite and nitrogen data are reported each year; a total of 11,550 data being reported in the whole period of reference. Turkey reported the highest number of nitrate (3,201) and nitrite (3,201) data, followed by Romania with 1,738; Bulgaria reported the lowest number, only 836.

Table 12. Number of NO_3 - NO_2 data reported to BSC.

NO_3 - NO_2	2006	2007	2008	2009	2010	2011	2012
RO	373	↘ 294	↘ 198	↗ 357	↘ 208	↘ 169	↘ 139
BG	30	↘ 16	17	....	↗ 71	↗ 120	↗ 582
TR	865	↘ 387	↗ 1167	↘ 782	....	....	....

Phosphate phosphorus (PO4)

Within period 2006-2012, there are altogether 172 reported monitoring stations for phosphate phosphorus (PO4) in the Black Sea resulting in a good geographical coverage; the highest number of stations is sampled at the Turkish littoral (81), followed by Romania with 61 stations. The exception is the Bulgarian coast, were sampling is done only in 30 stations. Romania and Turkey performed a balanced reporting the differences between years are smaller.

Only Romania took samples every year, Bulgaria ceased sampling in 2009, and Turkey in the last three years (2010-2012) (Table 13).

Table 13. Number of phosphat phosphorus (PO_4) data reported to BSC.

PO_4	2006	2007	2008	2009	2010	2011	2012
RO	354	↘ 291	↘ 191	↗ 357	↘ 209	↘ 169	↘ 134
BG	30	↘ 16	17	....	↗ 71	↗ 120	↗ 582
TR	836	↘ 426	↗ 960	↘ 852	....	....	....

A total of 5,615 data were reported by the three countries, most of them (3,074) being reported by Turkey; with a total of 1,705 data, Romania occupies the second place. Comparatively, the number of data reported by Bulgaria is reduced (836); also the number ranged between a minimum value of 16 (2007) and a maximum one of 582 (2012) (Table 13).

Figure 8. Ammonium stations

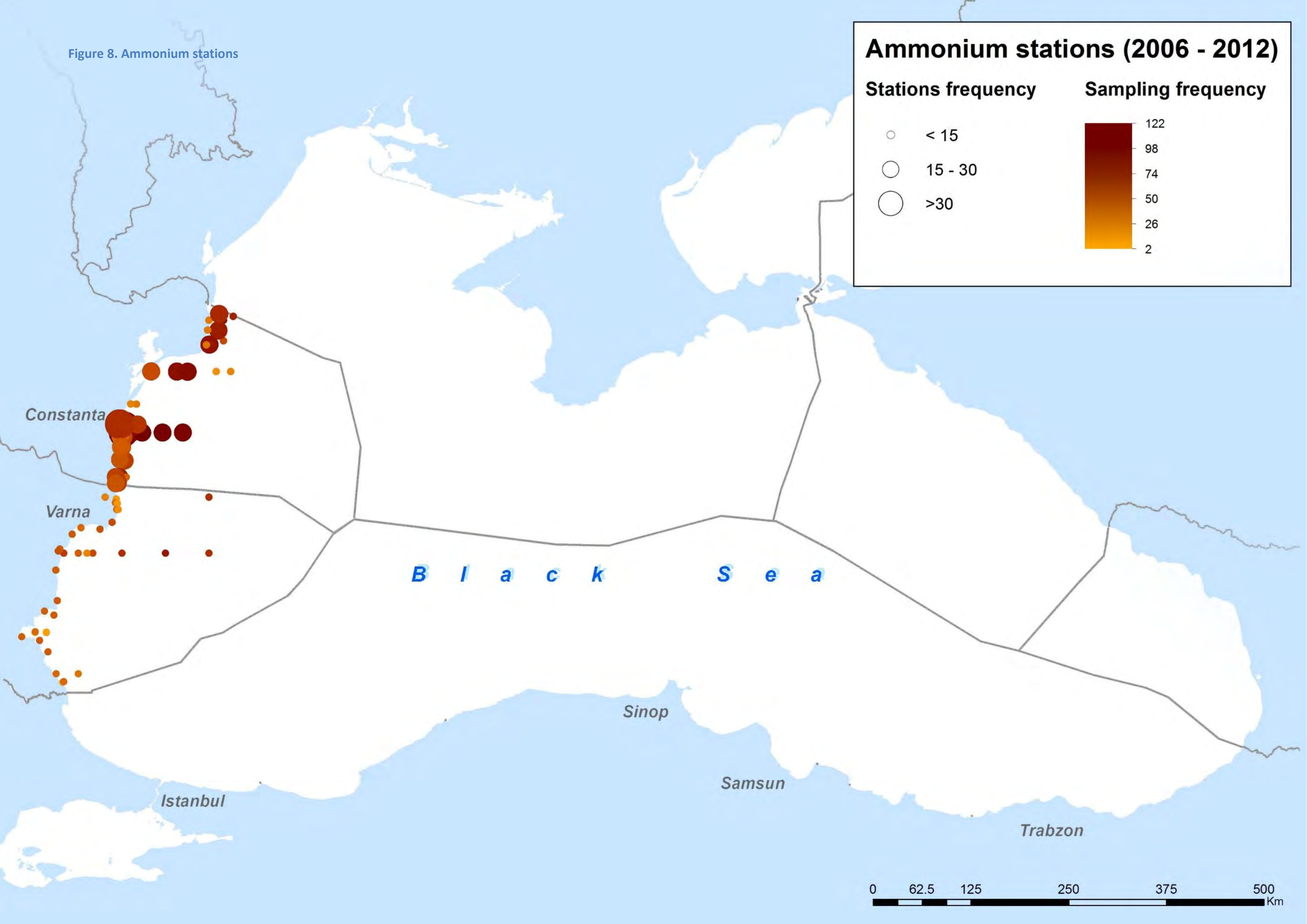


Figure 9. Nitrate stations

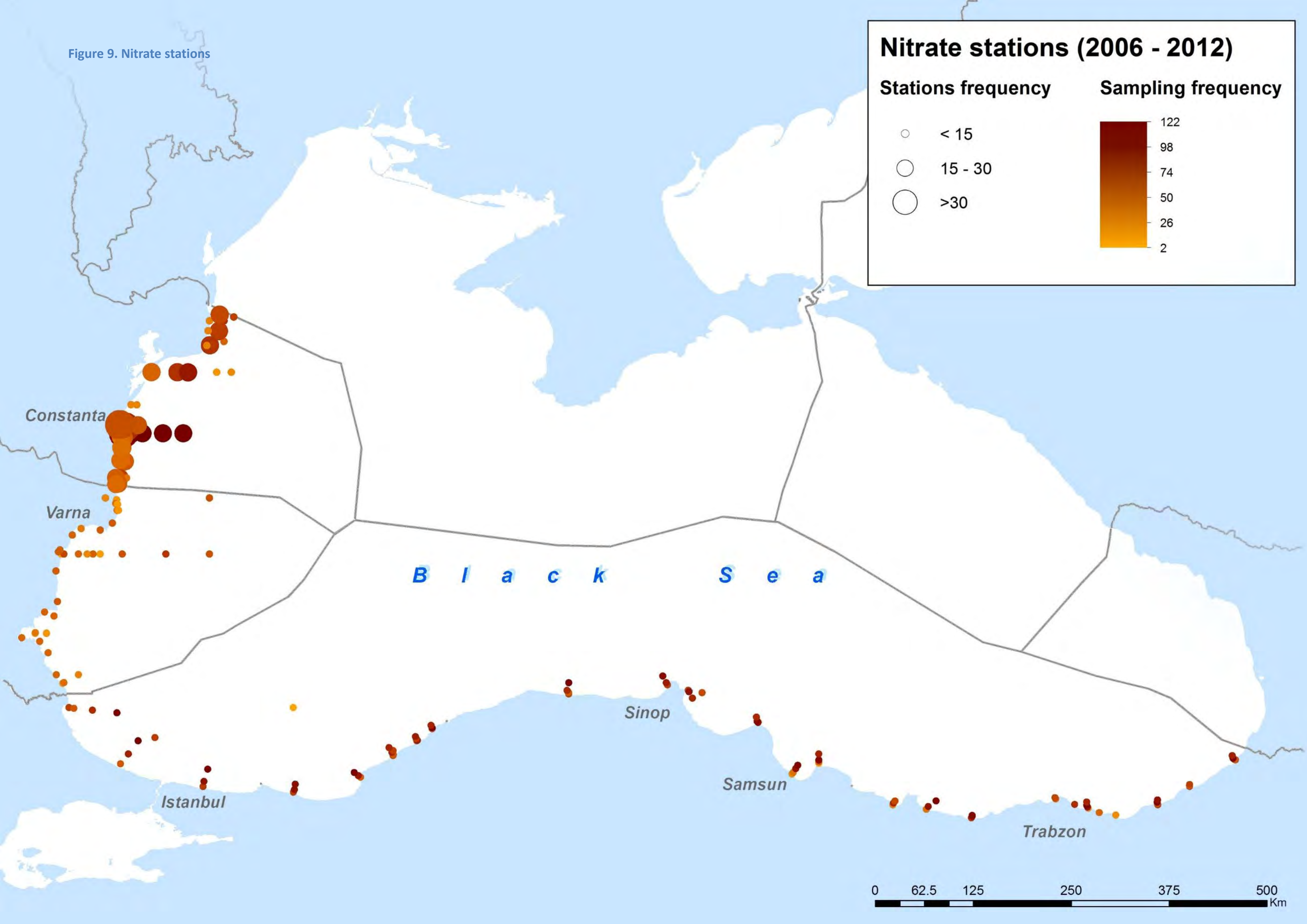
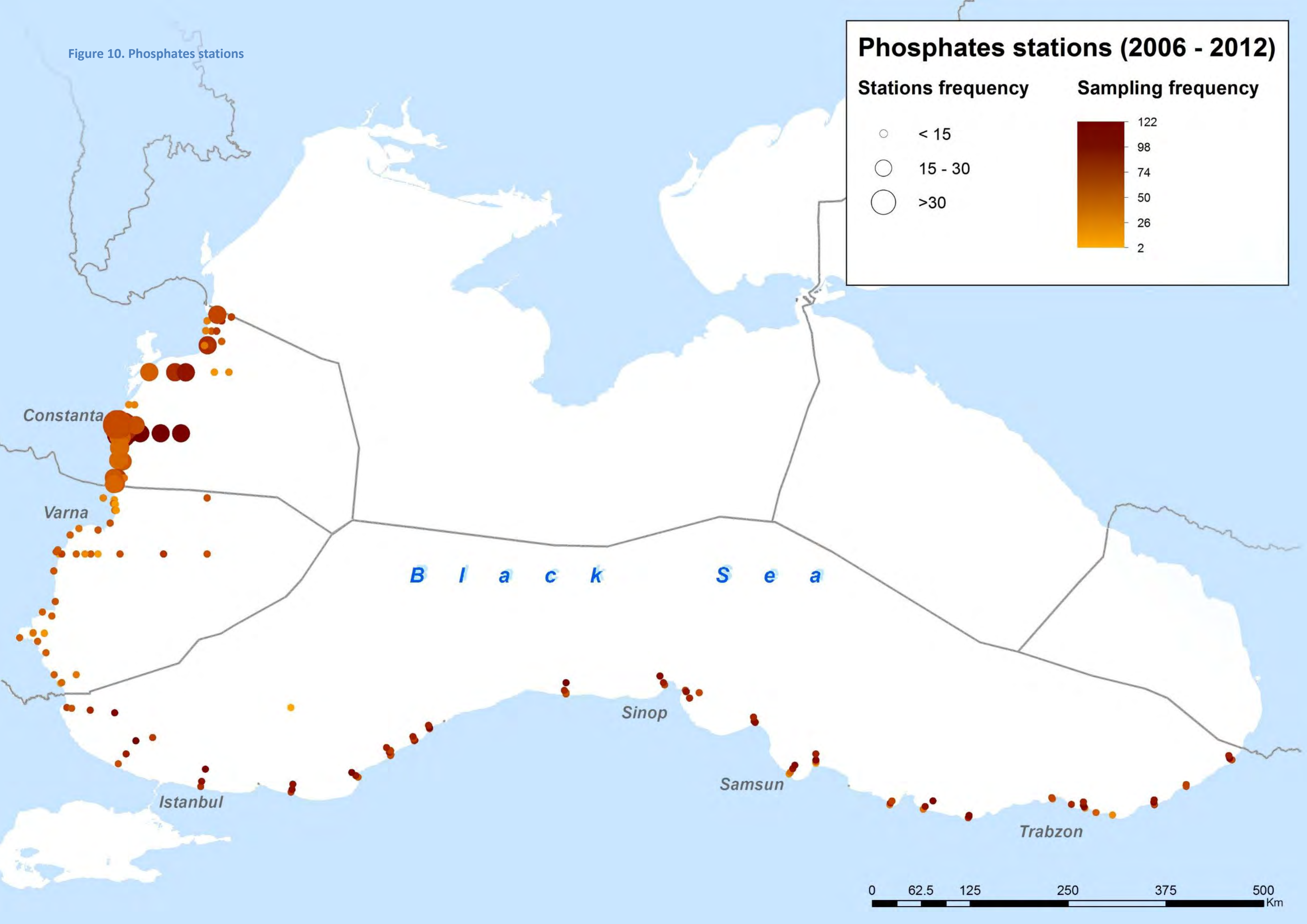


Figure 10. Phosphates stations



Silicate (SiO_4)

The number of stations and silicate data reported by the three countries is similar with these for the nitrate and nitrite nitrogen. 172 stations were reported by the three countries during the seven years.

At most monitoring stations samples are being taken every year in Romania waters, the exception is a number of stations along the Bulgarian and Turkey coasts which ceased to monitor in one (2009) or two years (2010 and 2011) respectively (Table 14).

A total of 5,943 data was reported in the period 2006-2012. Turkey reported the highest number of silicate (3,369) data, followed by Romania with 1,738; Bulgaria reported the lowest number, only 836.

Table 14. Number of SiO_4 data reported to BSC.

SiO_4	2006	2007	2008	2009	2010	2011	2012
RO	373	↘ 294	↘ 198	↗ 357	↘ 209	↘ 169	↘ 138
BG	30	↘ 16	17	....	↗ 71	↗ 120	↗ 582
TR	865	↘ 431	↗ 1193	↘ 880	....	....	....

Total nitrogen (TN)

There is a weak reporting of this parameter in the three countries, 16 and 19 stations were reported by the Romania and Bulgaria, but while Romania made reporting in the first three years, Bulgaria made reporting only in 2011.

Comparatively with the three nitrogen species, the number of TN data is much more reduced, only 185 data in Romania and 38 in Bulgaria (Table 15).

Table 15. Number of total nitrogen data reported to BSC.

TN	2006	2007	2008	2009	2010	2011	2012
RO	56	↗ 100	↘ 29	....	....	....	....
BG	....	....	....	....	....	38	....
TR	....	....	....	....	....	....	....

Figure 11. Silicates stations

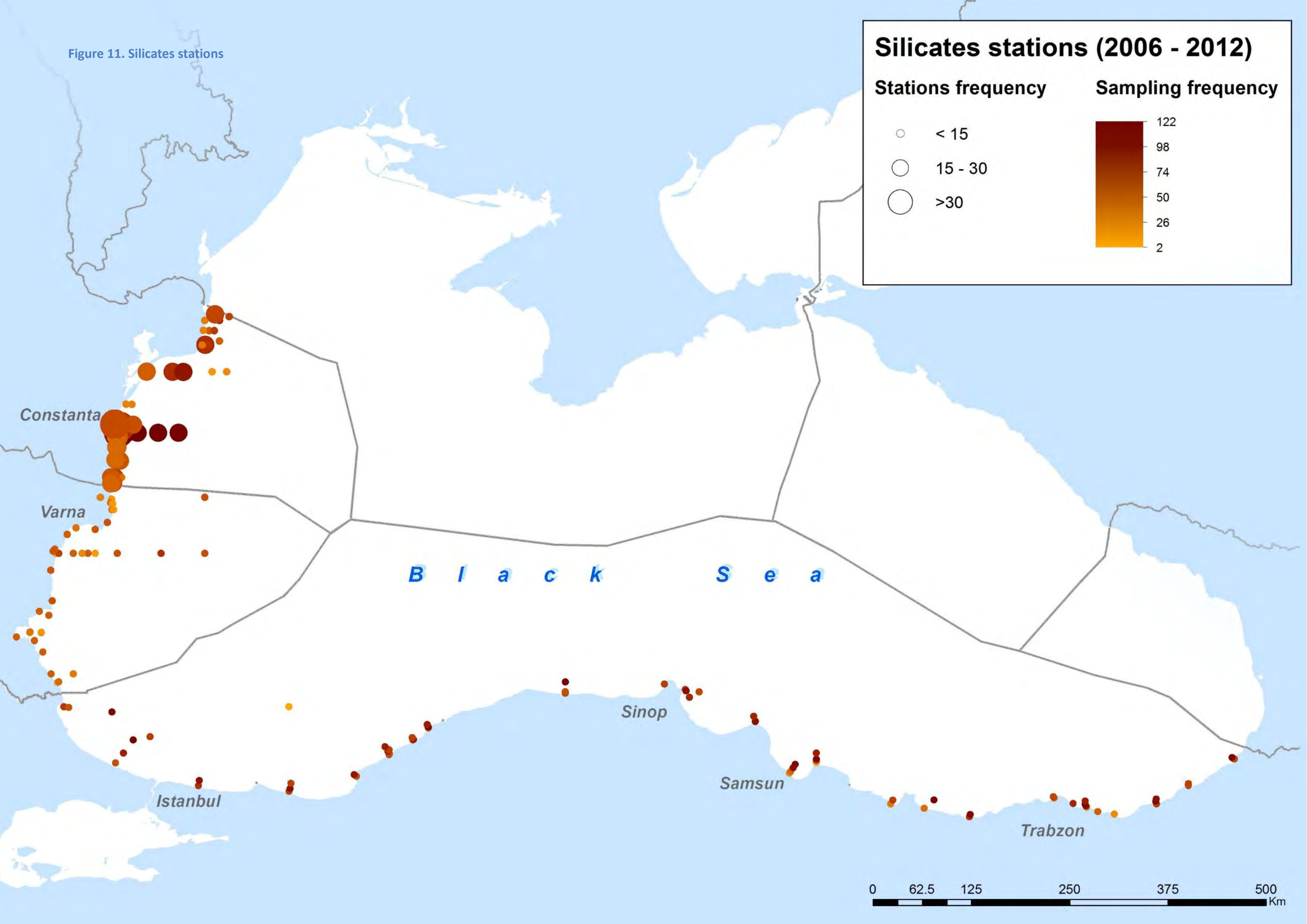
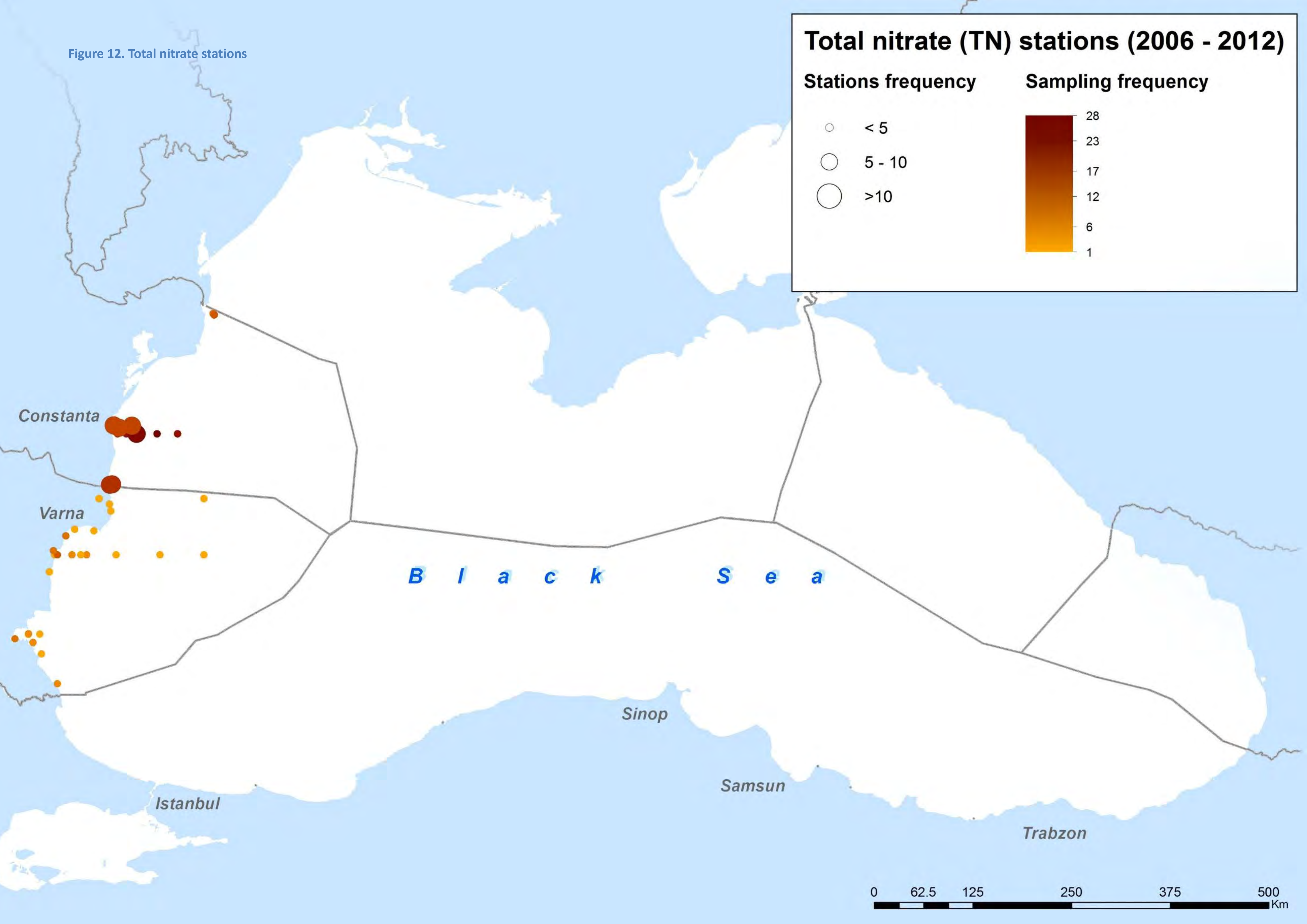


Figure 12. Total nitrate stations



Total phosphorus (TP)

Within period 2006-2012, total phosphorus (TP) is reported being monitored at 162 stations and there is a good geographical coverage in the whole Black Sea. Turkey reported the highest number of stations (81); Romania reported 60 stations. Bulgaria reported only 21 stations and only in 2011.

With a total of 1,275 reported data, Romania made reporting almost every year, excepting 2012 (Table 16). Although Turkey has no reporting in the last three years (2010-2012), it reported the highest number of data (3,393); Bulgaria reported the lowest number of data (42).

Table 16. Number of total phosphorus data reported to BSC.

TP	2006	2007	2008	2009	2010	2011	2012
RO	259	↘ 204	↘ 149	↗ 352	↘ 142	↗ 169	....
BG	....	....	....	....	....	42	....
TR	865	↘ 435	↗ 1211	↘ 882	....	....	....

As a whole, the three countries reported 4,899 nutrients data to EEA, Romania reported the highest number (3,690), and Turkey the lowest number (237) (Fig. 13). Romania sent data each year, excepting 2012.

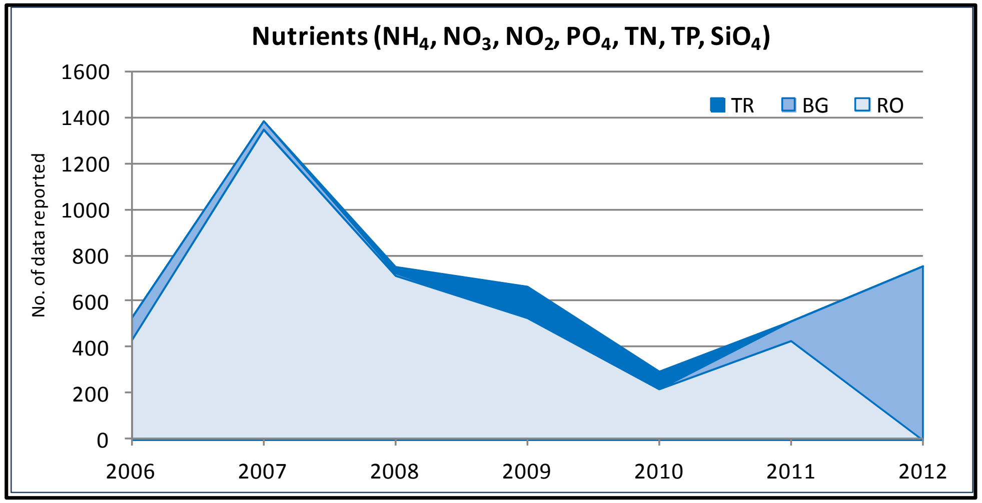


Figure 13. Evaluation of nutrients data (NH_4, NO_3, NO_2, PO_4, TN, TP, SiO_4) reported to EEA by Romania, Bulgaria and Turkey.

Total organic Carbon (TOC)

Total Organic Carbon (TOC) is reported being monitored only by Romania and Bulgaria; only Romania performed sampling in six years, in a number of 35 stations, while Bulgaria reported one year (2011) a small number of stations (19). Romania reported the highest number of data (374); Bulgaria reported only 38 data (Table 17).

Table 17. Number of TOC data (in water) reported to BSC.

TOC	2006	2007	2008	2009	2010	2011	2012
RO	35	↗ 74	↗ 114	↘ 64	↗ 87	....	....
BG	....	....	....	....	....	....	....
TR	....	....	....	....	....	....	....

Figure 14. Total phosphates stations

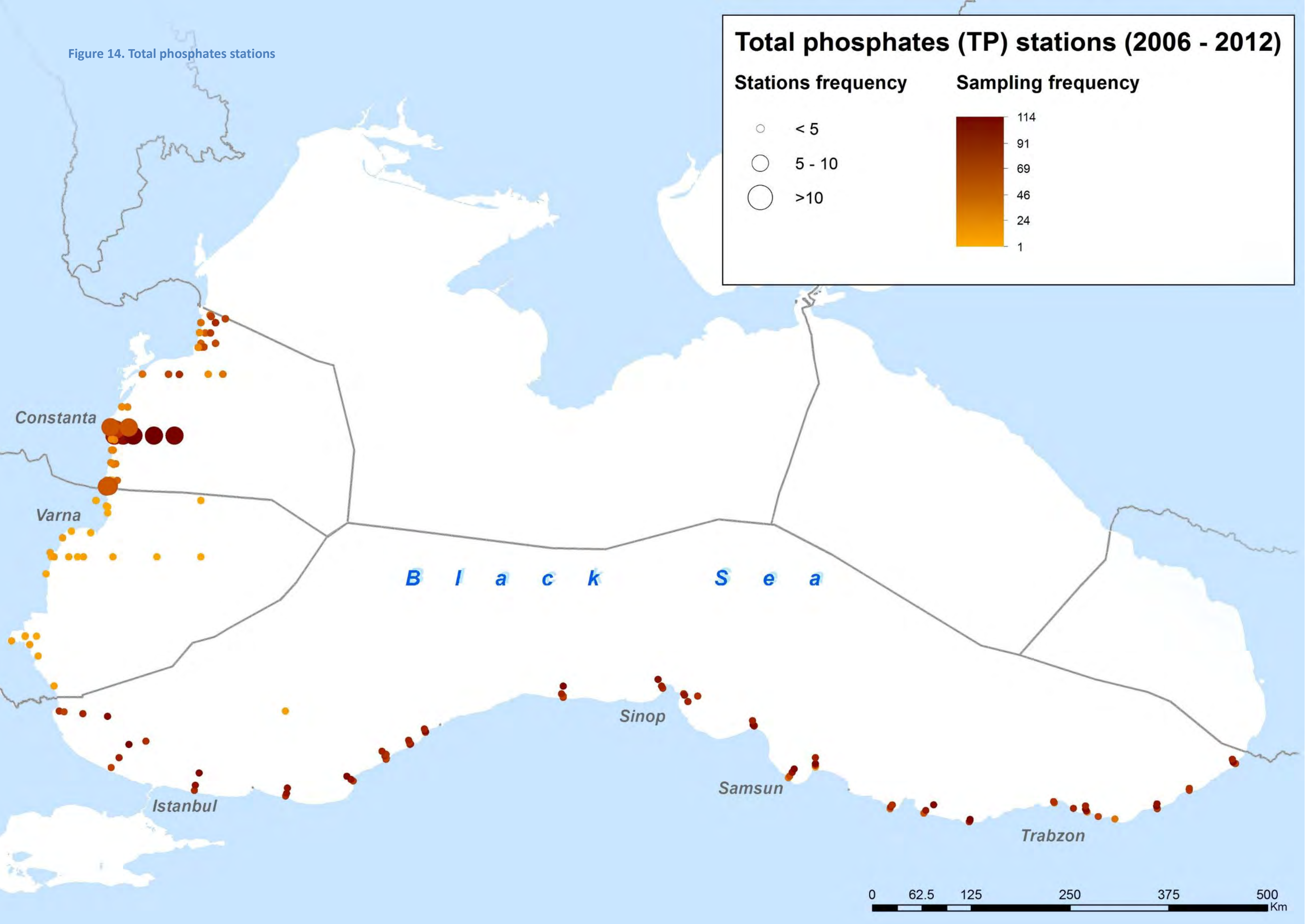
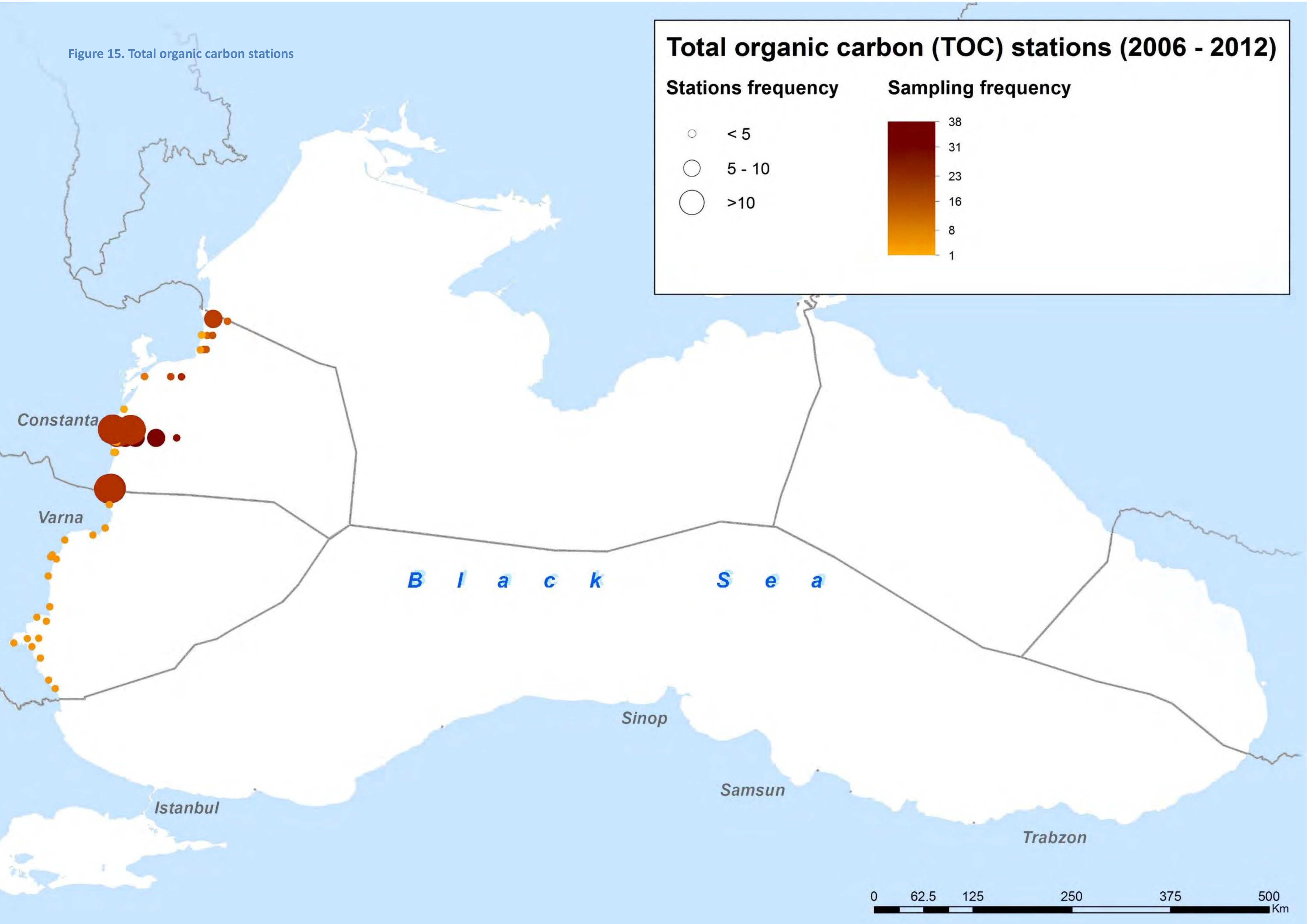


Figure 15. Total organic carbon stations



Hazardous Substances

There is a high discrepancy regarding the number of years, the number of contaminants, the number of stations and the number of data reported by the three countries to BSC and EEA. That is way we made a discussion about each of them.

Heavy metals (HM)

Contamination with heavy metals of the coastal areas is directly influenced by the urban and industrial sources. The rivers are also a major source of metals, especially particulate forms, and the extreme hydrological events can intensify this influx. In the same way, the atmospheric flux is considered of a great influence for the European seas, both coastal and offshore waters. The concentration in sediments is under the influence of the natural and anthropogenic source and depends on the mineralogical and granulometric characteristics of the sediments; the fine sediments may accumulate higher concentrations of heavy metals.

Cadmium, mercury and lead are metals that have adverse impacts in the marine environment. All three of them are included in the EU list of Priority Substances. Although they also occur naturally in the Black Sea, the anthropogenic sources have greatly increased their concentrations, causing pollution effects, and no clear decline has been found in the larger scale.

At the Romanian littoral, the monitoring of heavy metals was made analyzing the samples of water (superficial layer) and superficial sediments. The sampling was carried out in the transitional waters (Sulina-Portita, 5-20m), coastal areas (Gura Buhaz south to Vama Veche, isobaths between 0 and 20m) and marine areas (more than 20m depths) (Table 18).

Within the period 2006-2012, 5 heavy metals were analyzed (Ni, Cr, Pb, Cu and Cd) in water. All stations are reported being monitored every year. On the whole period, there are 25 reported water stations. 598 data were reported, the highest number being reported in 2007 (113) and the smallest one in 2012 (64). An equal number of data was reported for each of the five compounds during the seven years.

The same situation is reported for sediments, the same five compounds (Ni, Cr, Pb, Cu and Cd) were analyzed each year, in a number of 25 stations. 598 data were reported.

IO-BAS (Bulgaria) carried out a monitoring of the heavy metals only in 2011, and only for water, in a number of 10 stations. The data reported ranged between 22 and 40, for a number of 11 compounds (Fe_2O_3, MnO, Hg, Zn, Ni, Co, Pb, Cu, Cd, As, Al).

From 2006 till 2009, Turkey analyzed 7 heavy metals (Mn, Fe, Hg, Cr, Pb, Cu, Cd) from water samples collected in a number of 32-41 stations. The highest number of data reported was reported in 2008, the highest number (202) pertained to Cu and Fe, the lowest one (133) for Cr.

In sediments, the sampling was carried out during five years (2006-2009), for 8 elements (Fe, Hg, Zn, Ni, Cr, Pb, Cu, Al); in 2010, were analyzed another five elements (V, Pb, Cu, Cd, Al). The number of stations ranged among 9 (2006) and 61 (2007). For the whole period (2006-2012), the highest number of reported data (215) pertained to Cu, while only 26 data were reported for V and Cd.

Trace metals	Romania	Bulgaria	Turkey
Fe_2O_3, %		40	
MnO, %		40	
Mn, µg/l			590
Fe, µg/l			606
Hg, µg/l		22	482
Zn, µg/l		22	
Ni, µg/l	598	28	
Cr, µg/l	598		452
Co, µg/l		20	
Pb, µg/l	598	22	571
Cu, µg/l	598	22	607
Cd, µg/l	598	36	605
As, µg/l		20	
Al, µg/l		20	

Table 18. Number of trace metals (in water) data reported to BSC.

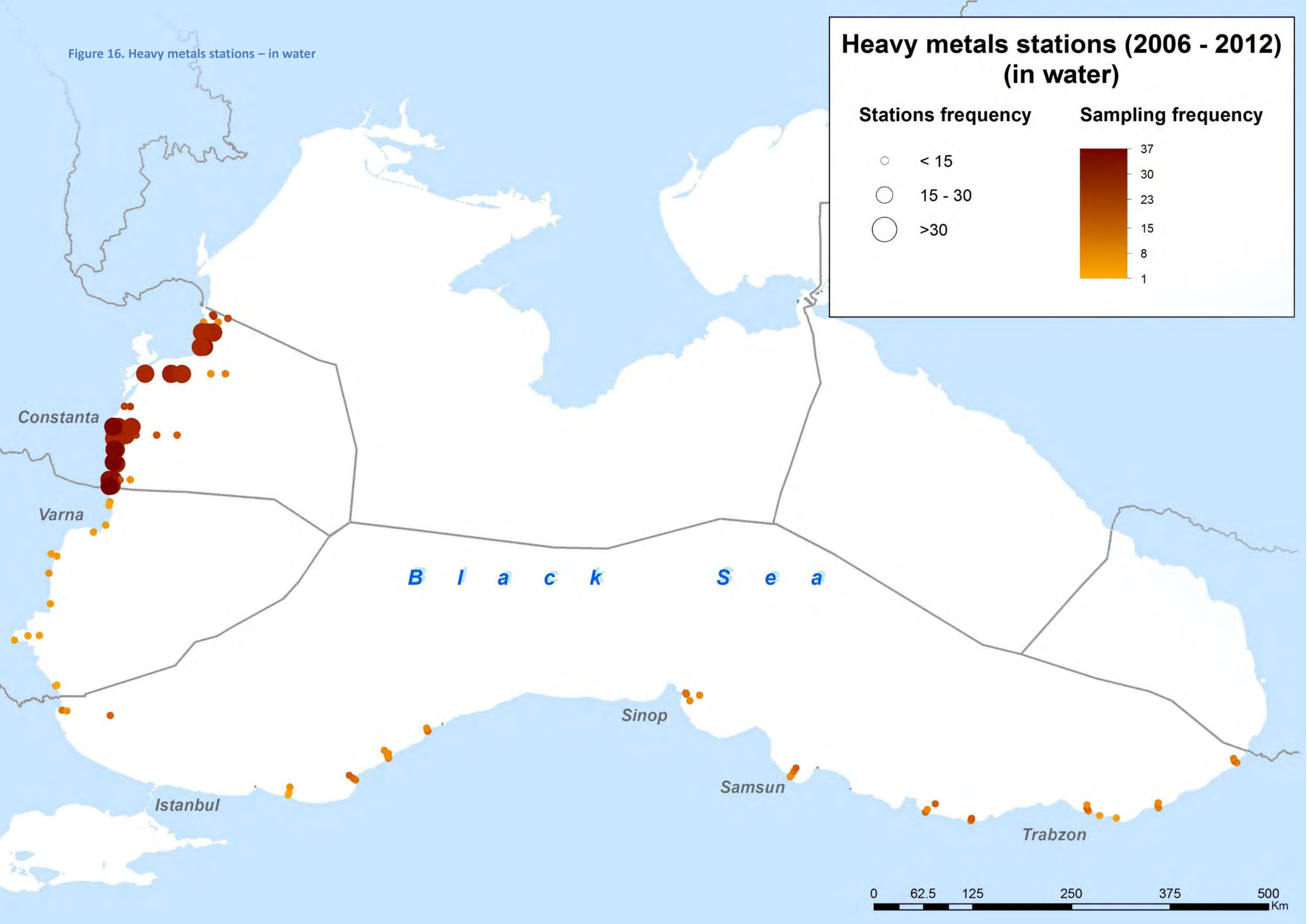
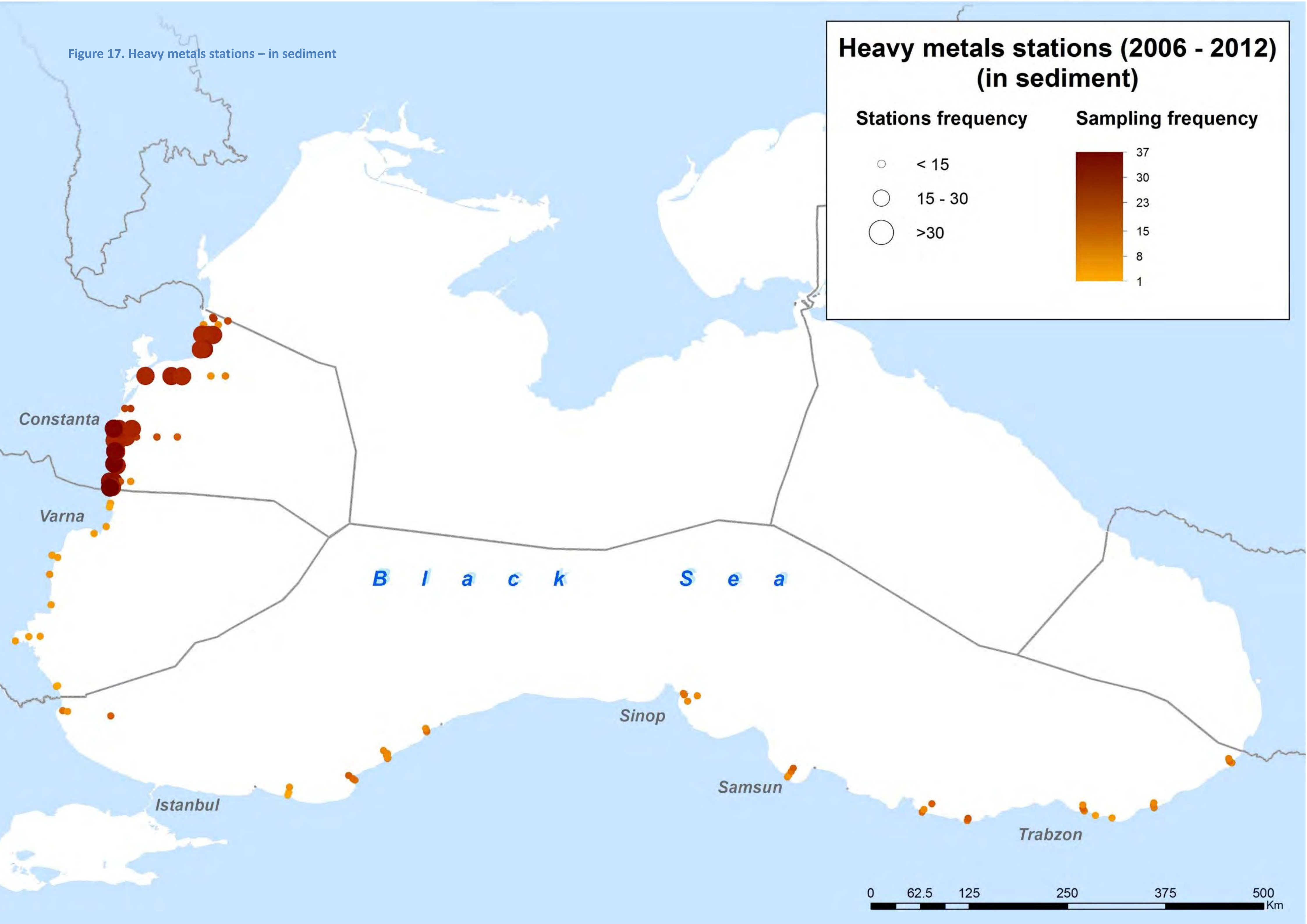


Figure 16. Heavy metals stations – in water

Figure 17. Heavy metals stations – in sediment



Total petroleum hydrocarbons (TPHs)

The organic pollutants were analyzed in 28 stations (along Romanian coasts, between Sulina and Vama Veche). The monitoring of water samples covers the typologies included in Water Directive Framework and MSFD, for transitional, coastal and marine waters. A total number of 676 data from water samples were reported, the maximum in 2012 (159), and the minimum one in 2010 (42).

For sediments, the sampling for TPHs, was performed in 22 stations; 413 data were reported, ranged in a minimum values of 40 (2010), and a maximum one of 70 (2007).

No data are collected from the Bulgarian waters or sediments related to this parameter - total petroleum hydrocarbons.

Turkey reported TPHs data, both for water and sediments, during 2006-2010. A minimum number of 66 (2007) and a maximum of 177 (2008) of data were reported, for a number of 65-81 stations. A total number of data of 305 were reported for sediments, the samples obtained from a number of 55-70 stations.

Polinuclear aromatic hydrocarbons (PAHs)

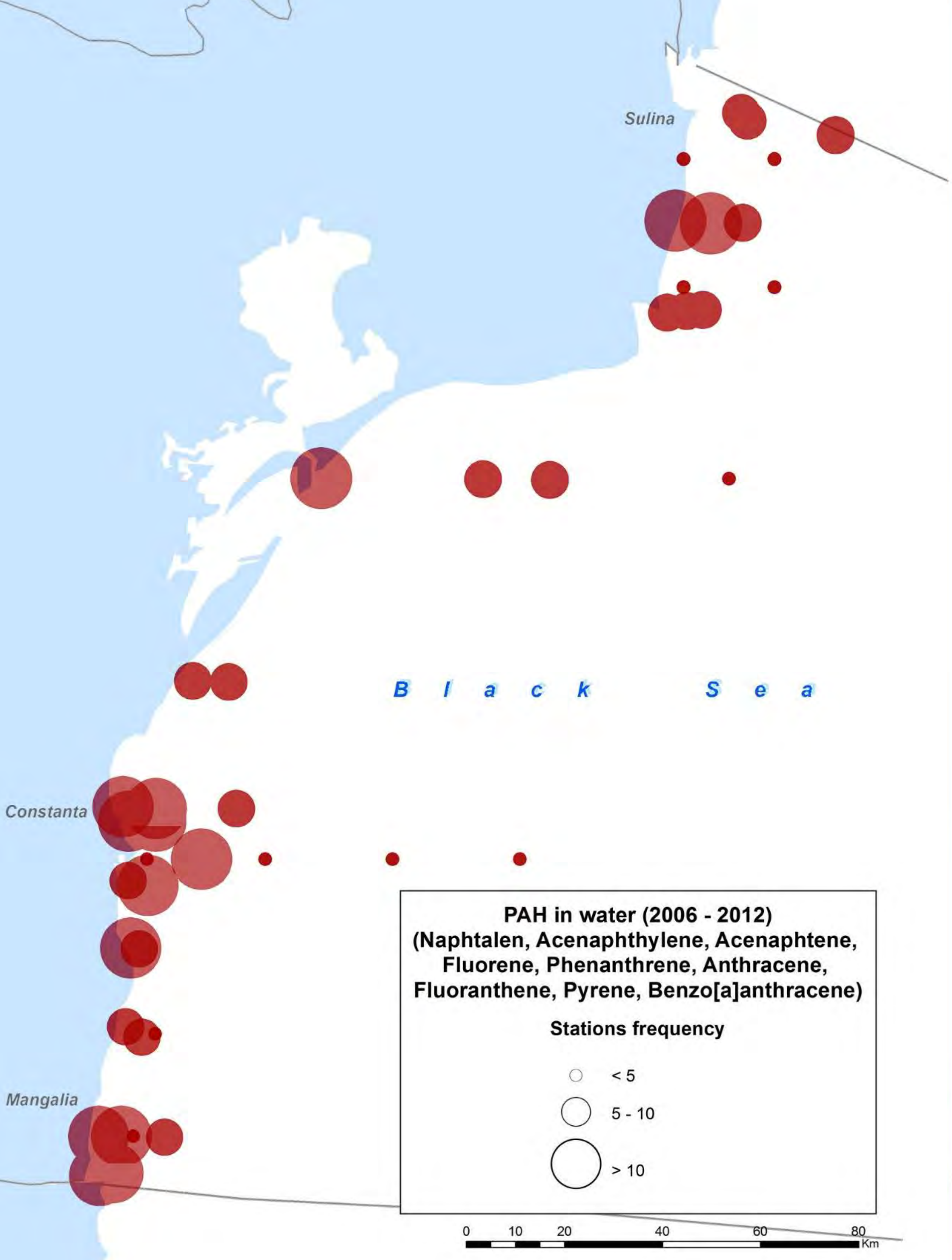
At the Romanian littoral, the monitoring of PAHs, performed between 2006 and 2012, was made analyzing both water and sediment samples. 15 organic contaminants - prioritary dangerous substances (naphtalene, acenaphthylene, acenaphthen, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo[a]anthracen, crysene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, benzo(g,h,i)perylene, dibenzo(a,h)anthracene) were identified. The monitoring of the last six compounds started in 2009, so we tried to represent them in separate maps.

The number of reported stations was almost the same for each of the analyzed contaminants (minimum 25, maximum 32) in the water. For sediment, the number of stations investigated varied between 17-20. Some of the data were under the detection limit that is why the total number of data reported seems to be different for different contaminants. Thus, naphthalene (398), fluoren (329) and phenanthren (312) were the most present contaminants in the Romanian samples.

IO-BAS (Bulgaria) analyzed 11 PAH compounds only in one year (2011) (4-tert-octilphenol, naphtalene, anthracene, fluoranthrene, benzo(b)fluoranthren, benzo(k)fluoranthrene, benzo(a)pyrene, ideno(1,2,3-c,d)pyrene, benzo(g,h)perylene, pentachlorbenzene, hexachlorbenzene), from a network of 11 stations. Between 16 and 22 data were reported for each compound.

Tubitak (Turkey) reported 6 PAH compounds (benzo-fluoranthene, benzo pyrene, siklopentan, dibenzo anthracene, pyrene , Ideno 1,2,3 – pyrene) in 2010. The number of data varied among 4 and 25 sediment data; sampling was carried out in a number of 4-25 stations.

Figure 18. PAH in water RO



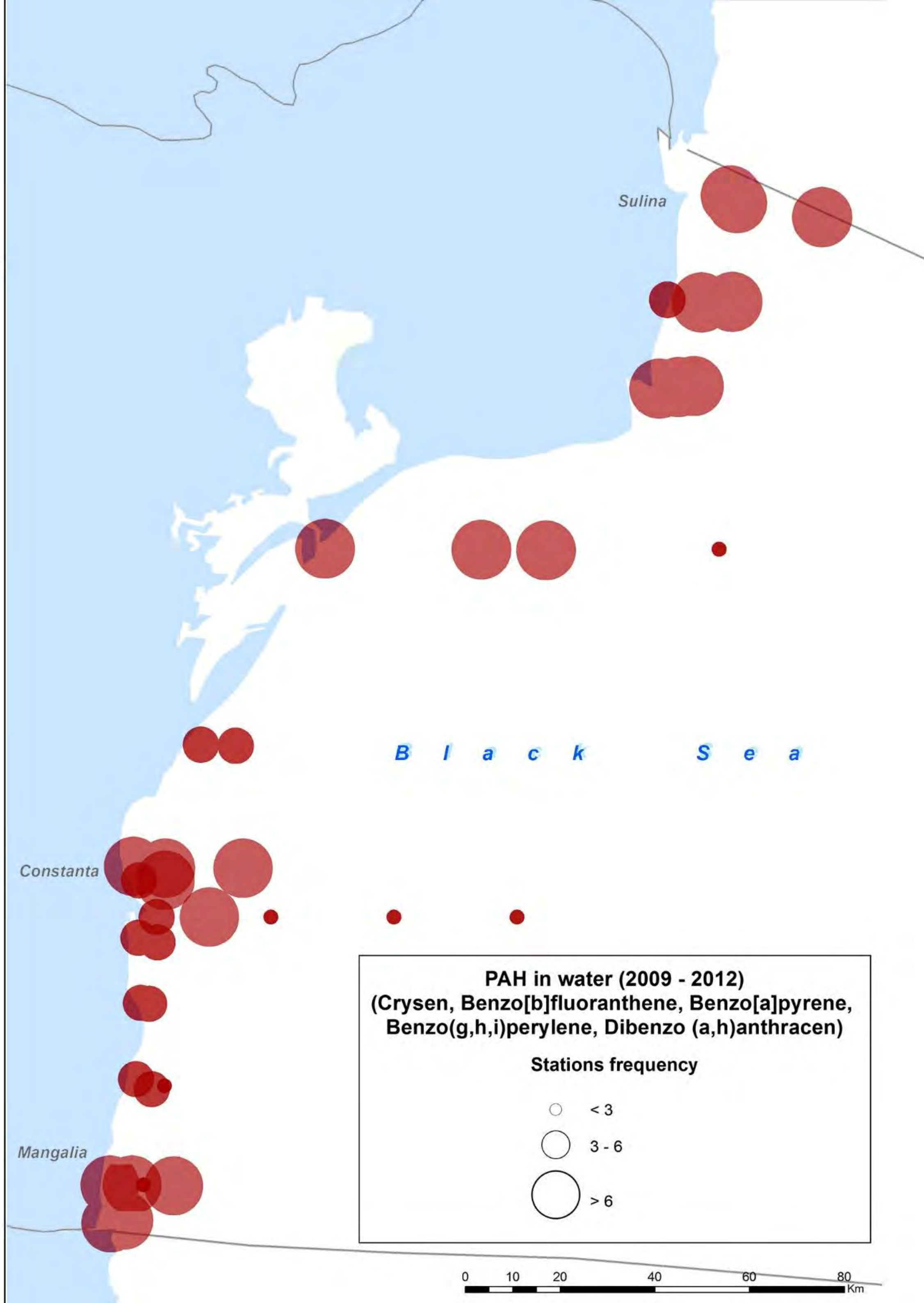


Figure 19. PAH in sediment RO

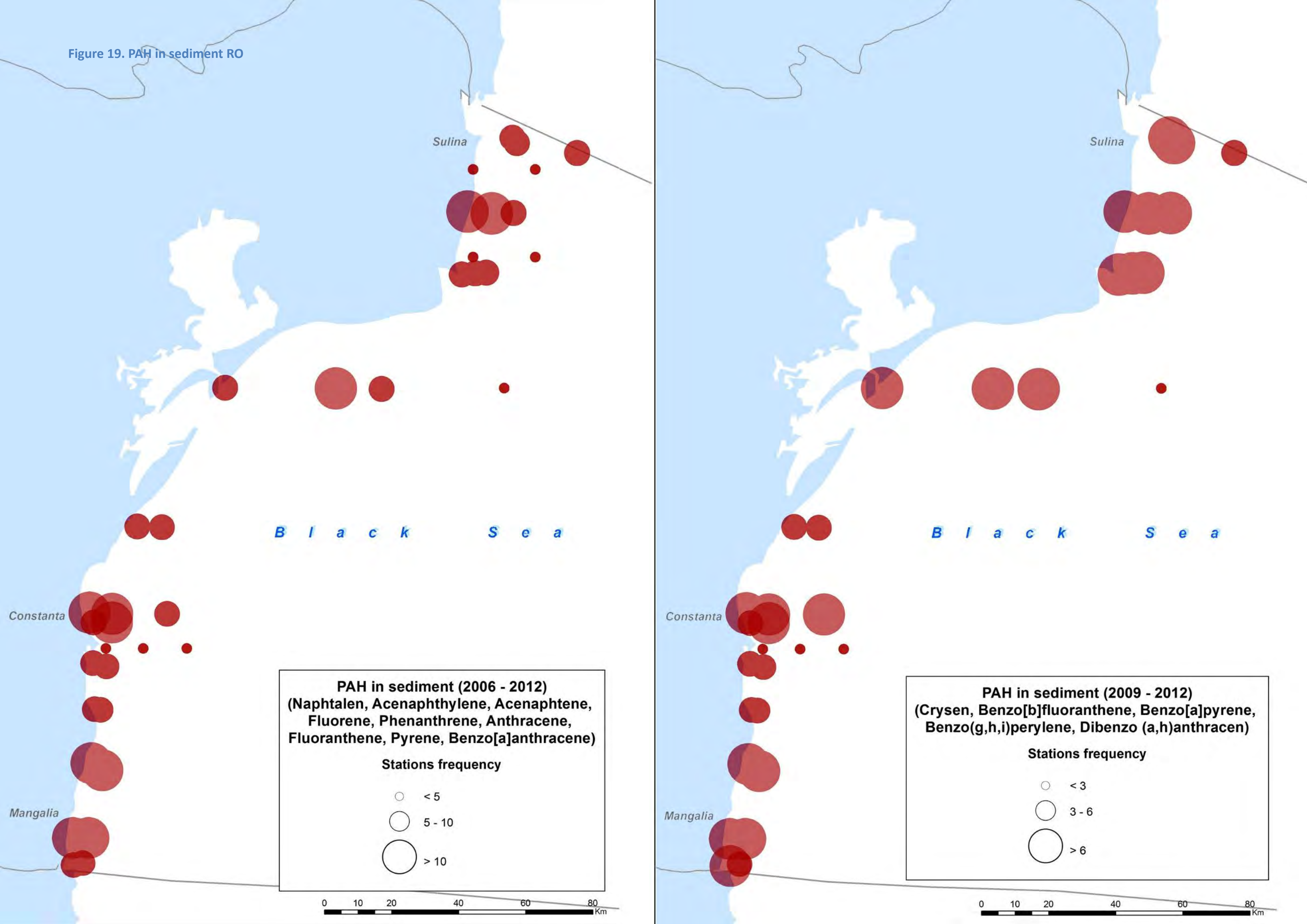


Figure 20. PAH in water BG

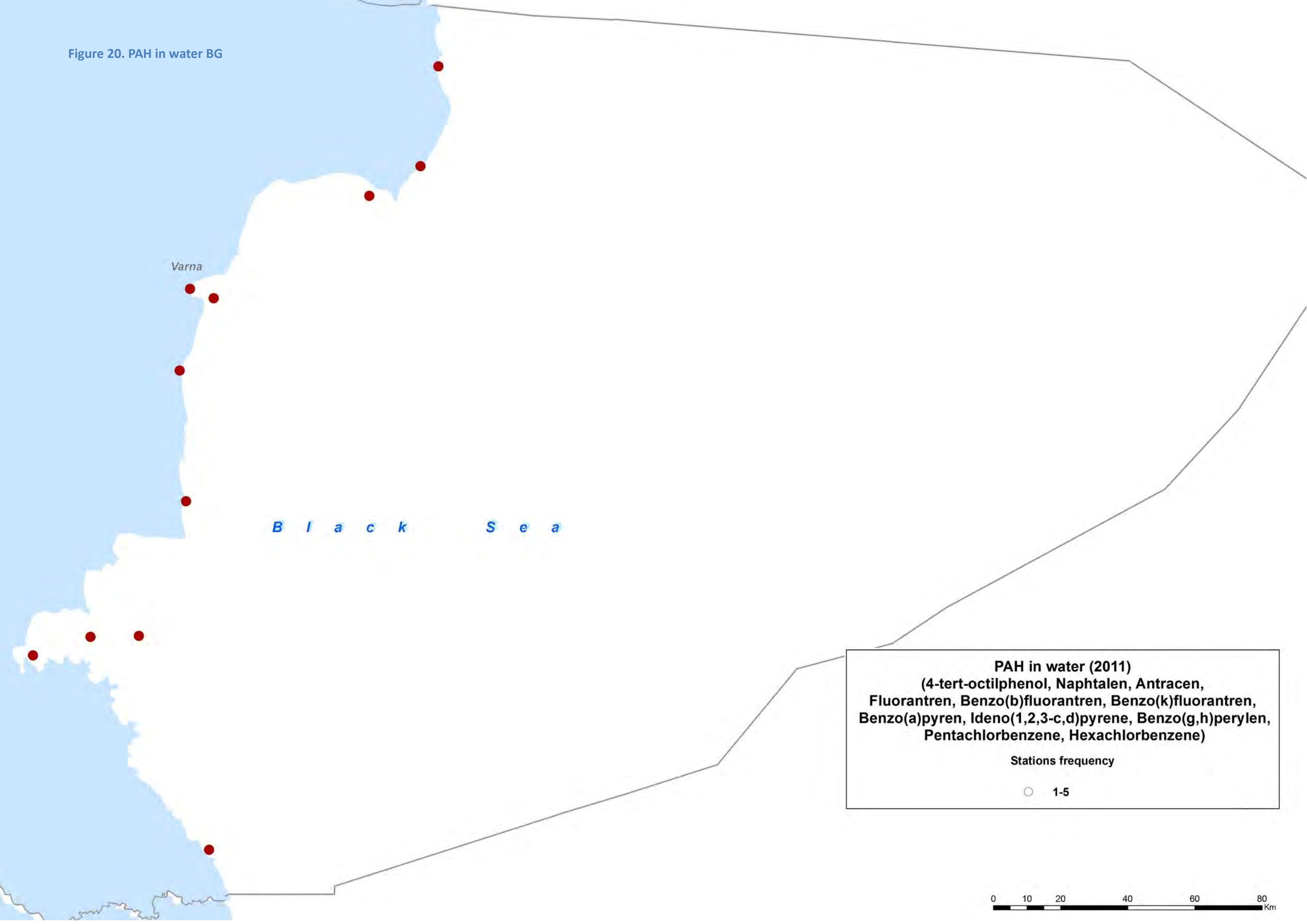
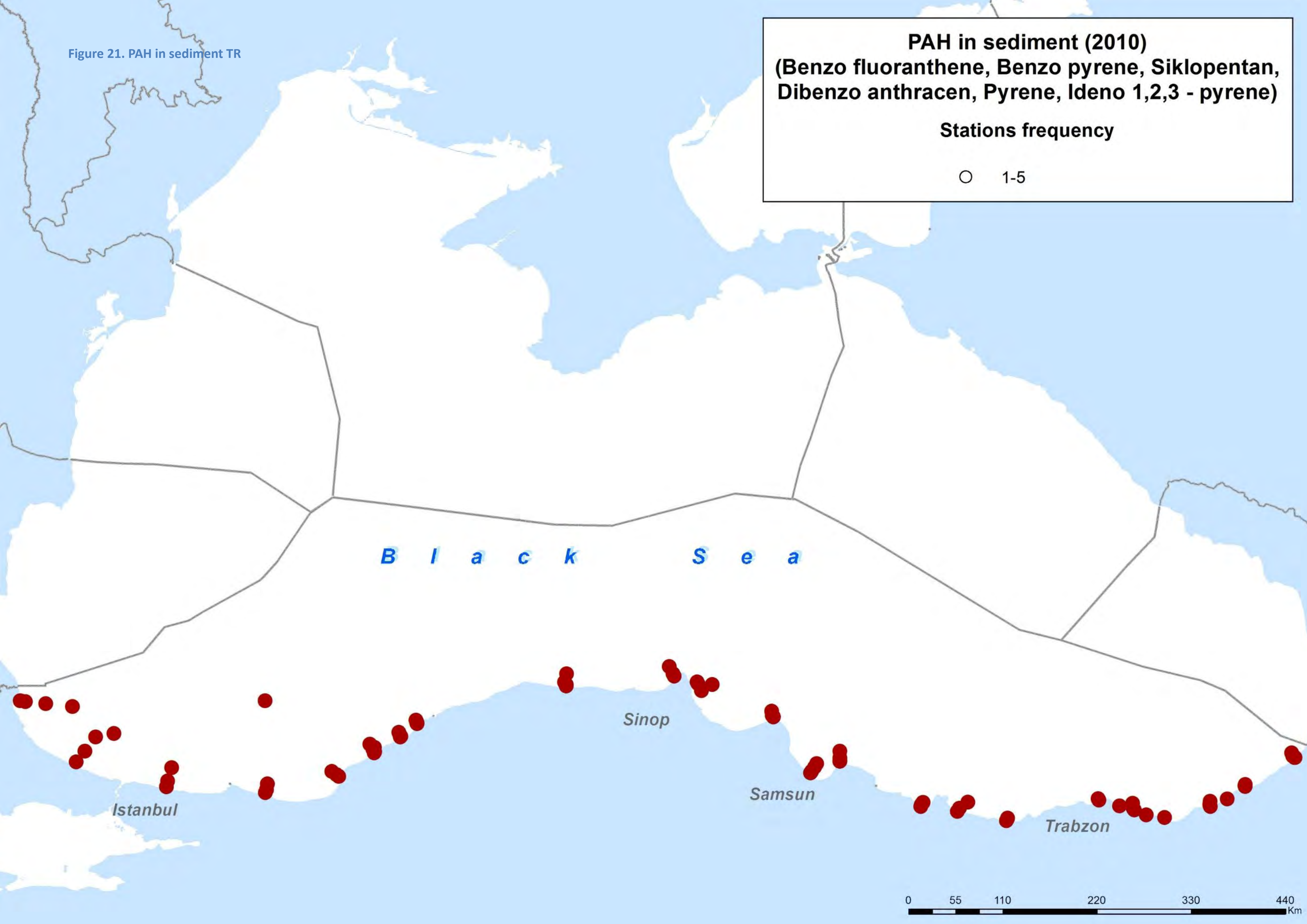


Figure 21. PAH in sediment TR



Organo Chlorine Pesticides (OCPs)

Organochlorine pesticides are highly resistant to degradation by biological, photochemical or chemical means. They are also liable to bioaccumulate, are toxic and probably hazardous to human and/or environmental health. Most are prone to long-range transport. Due to the toxic effects of organochlorines in humans and aquatic organisms, the use and/or sale of most organochlorine pesticides has been banned or restricted in many European countries since the mid-1970s, although DDT is still used to control mosquito vectors of malaria in numerous countries of the world. In most countries of the Black Sea, however, the use of these pesticides has also been restricted or banned.

At the Romanian littoral, the monitoring of OCPs, performed between 2006 and 2012, was made analyzing both water and sediment samples. Nine organic contaminants - HCB, lindan, heptaclor, aldrin, dieldrin, endrin, p,p'DDE, p,p'DDD, p,p'DDT - were identified. The number of reported stations was almost the same for each of the analyzed contaminants (minimum 25, maximum 32) in the water. For sediment, the number of stations investigated varied between 17-20, and a number of 330 data for each contaminat was reported to BSC for the mentioned period.

Within 2006-2012, Bulgaria reported data for OPCs, but only for 2011. 9 OCP compounds (2,4' DDE2, 4' DDD4, 4' DDD, 2,4' DDT, terbutrine, ethilbenzene, m-ksilen, o-ksilen, p-ksilen) were identified in the Bulgarian waters sampled in the 11 stations; 11-22 data were reported.

Polychlorinated biphenyl (PCBs)

PCBs are toxic, bioaccumulating and very persistant substances which are partly side products of industrial processes. Although their production has been a subject of constant restriction and their levels have been declining in the environment, the substances are still found plenty in the environment. PCBs are included in the Black Sea Action Plan list of hazardous substances and have been introduced into the EU list of Priority Substances (EC/39/2013).

Romania started to analyse PCBs in water and sediment with 2012, the number of data being 126 for each substances (PCB28, PCB52, PCB101, PCB118, PCB153, PCB138, PCB180) collected from 43 stations.

For our reference period, Bulgaria reported data for 9 compounds of PCB analysed just for water samples in 2011 (2,4,4 - trichlorobiphenil, 2,2,5,5 - tetrachlorobiphenil, 2,2,4,5,5 - pentachlorobiphenil, 2,3,3,4,4 - pentachlorobiphenil, 2,3,3,4,4,5 - pentachlorobiphenil, 2,2,4,4,5 - hexachlorobiphenil, 2,2,4,4,5,5-hexachlorobiphenil, 2,3,3,4,4,5-hexachlorobiphenil, 2,2,4,4,5,5-hexaclorobiphenil). A number of 11 stations and 12-20 data were reported.

Turkey has no data for PCBs.

All of the three countries made some reporting to EEA (Table 19). Romania is the single country which carried out a continuous reporting of hazardous substances in water, sediment and biota.The highest reported data referred to the hazardous substances content of water (6,292); 5,038 data were for sediment, and only 439 for biota (Fig. 3, 4 and 5).

Bulgaria reported only 298 data about the hazardous substances in seawater and sediment, but only in two years; the data reported for sediment is very small (9) (Fig. 3 and 4).

Turkey reported a few data about the hazardous substances in sediment (54) and only in 2008 and 2009 (Fig. 4); no data about the hazardous substances in seawater and biota to EEA were done.

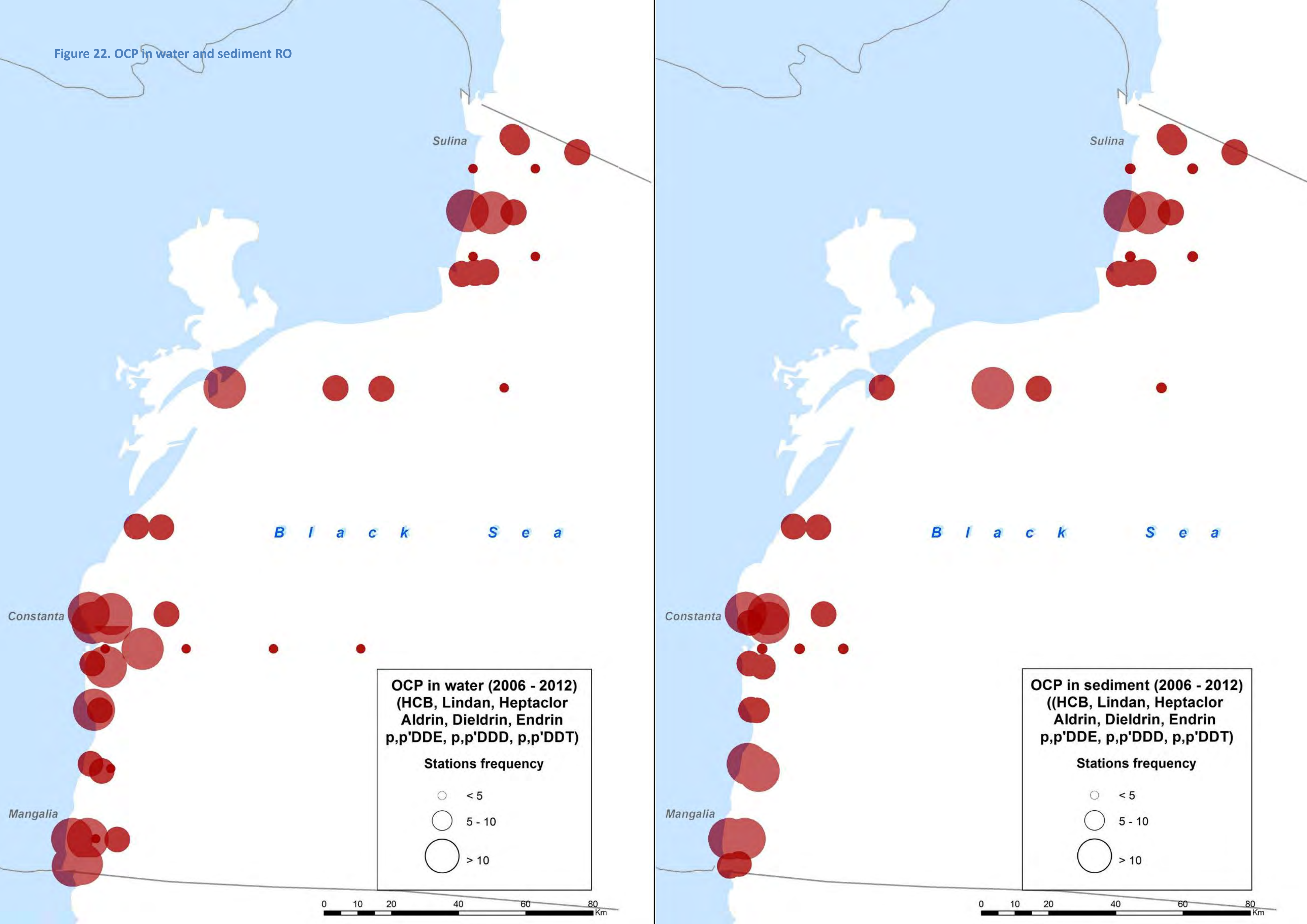
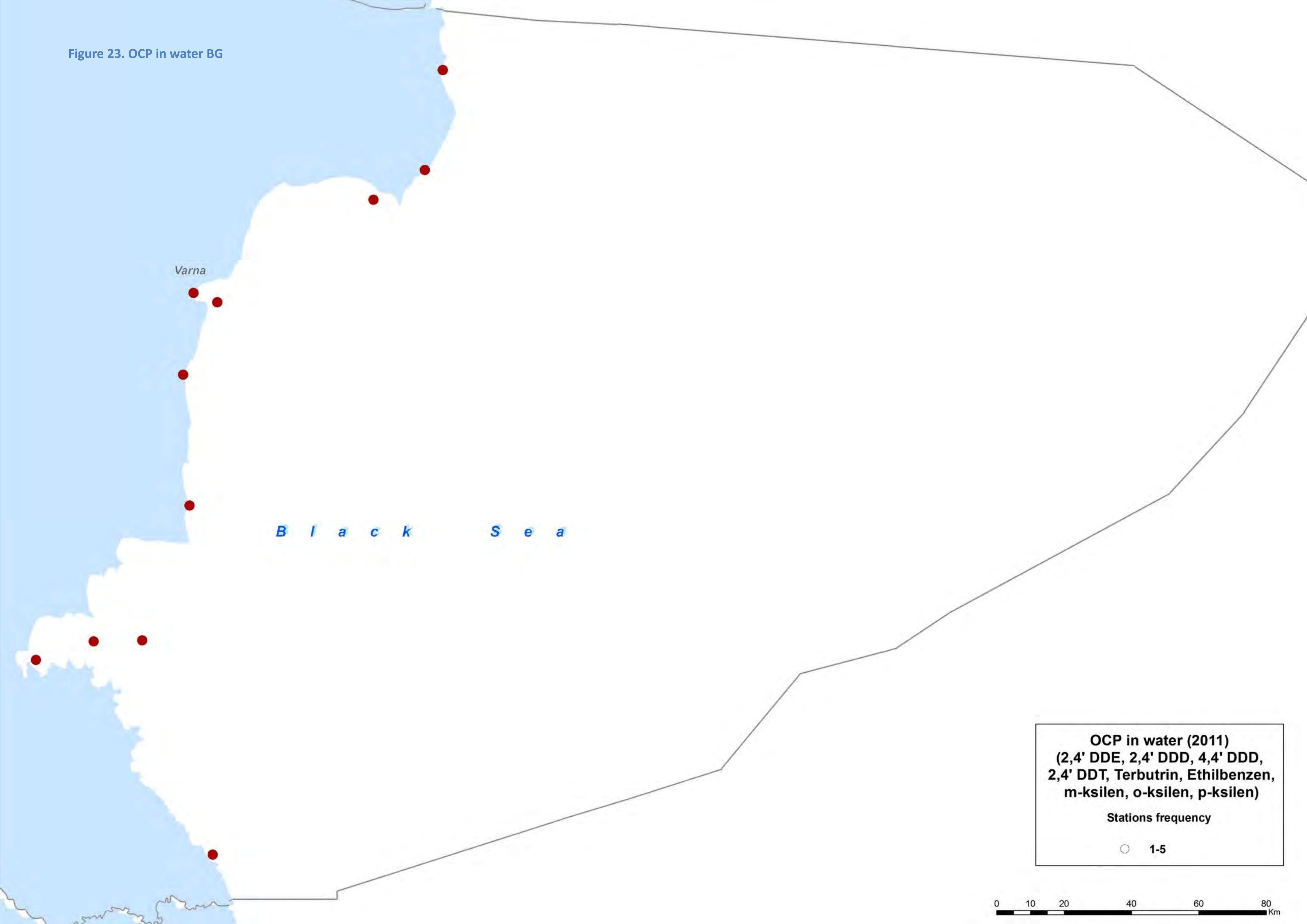


Figure 22. OCP in water and sediment RO

Figure 23. OCP in water BG



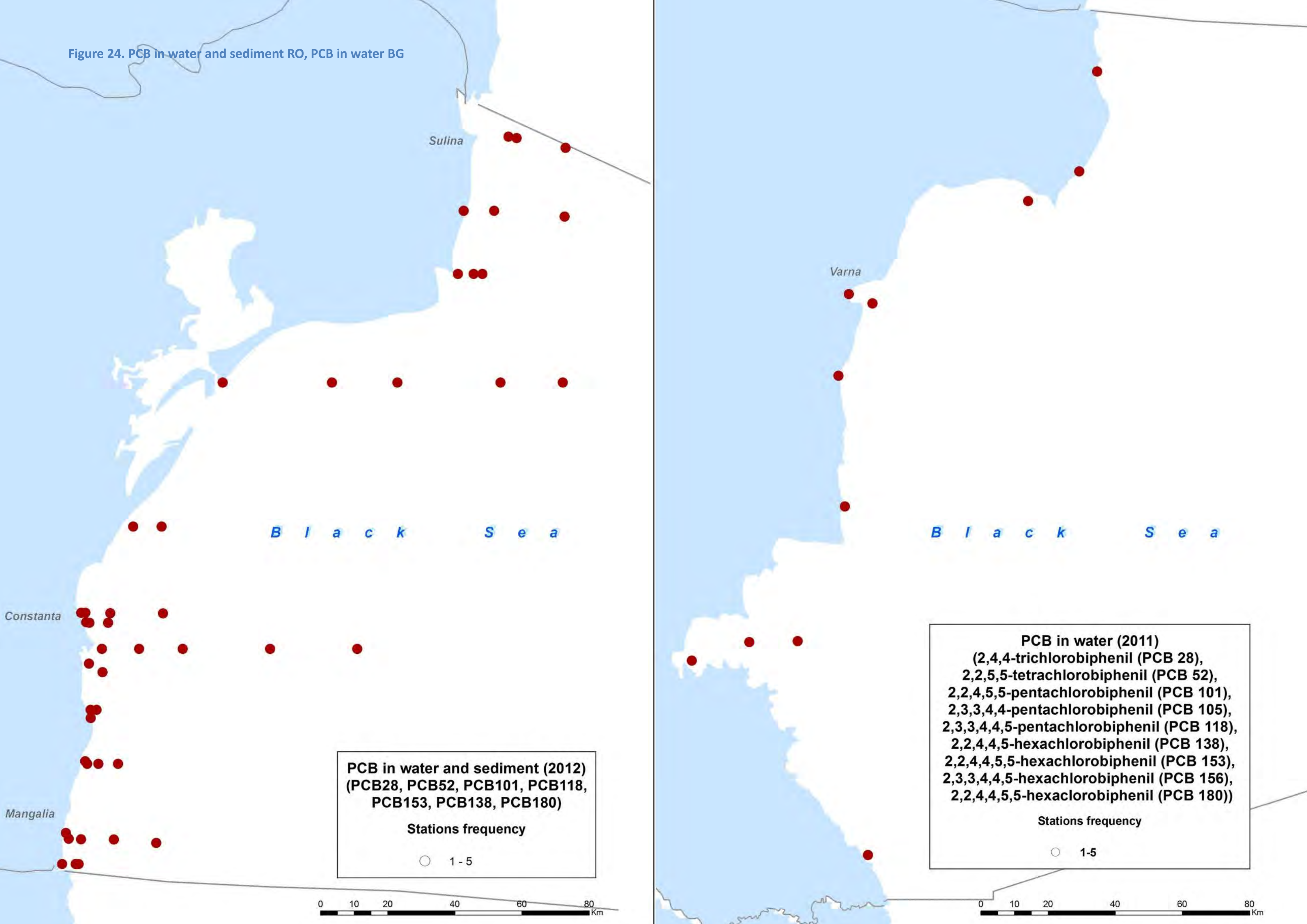


Figure 24. PCB in water and sediment RO, PCB in water BG

Table 19. Parameters reported to the EEA in the period 2006 - 2012.

ROMANIA			
Heavy metals	**PAH**	**OCPs**	**PCBs**
Cu, Cd, Pb, Ni, Cr	(naphtalene, acenaphthylene, acenaphthen, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo[a]anthracen, crysene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, benzo(g,h,i)perylene, dibenzo(a,h)anthracene)	HCB, Lindan, Heptaclor, Aldrin, Dieldrin, Endrin, p,p'DDE, p,p'DDD, p,p'DDT	PCB28, PCB52, PCB101, PCB118, PCB153, PCB138, PCB180
BULGARIA			
Heavy metals	**PAH**	**OCPs**	**Other contaminants**
Aluminium and its compounds, Arsenic, Cadmium, Chromium, Cobalt and its compounds, Copper, Iron and its compounds, Lead, Manganese and its compounds, Mercury, Nickel, Zinc	Anthracene, Benzo(a)pyren, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Fluoranthene, Ideno(1,2,3-cd)pyrene, Naphtalene, chloro derivatives	DDE,o,p' , Hexachlorbenzene(HCB)	Pata-tert-octylphenol, Terbutryn
TURKEY			
Heavy metals			
Cu,Pb, Ni, Cr, Al, Fe, Hg, Zn	Total Petroleum Hydrocarbons		

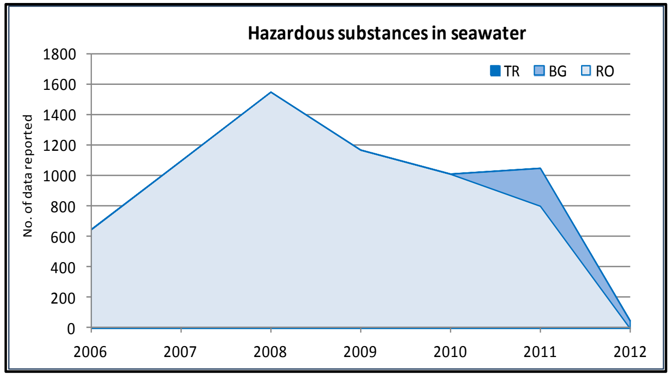


Figure 25. Evaluation of hazardous substances in seawater - data reported to EEA by Romania, Bulgaria and Turkey

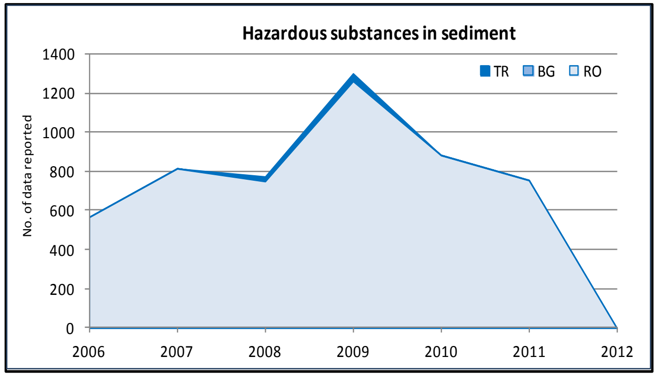


Figure 26. Evaluation of hazardous substances in sediment - data reported to EEA by Romania, Bulgaria and Turkey

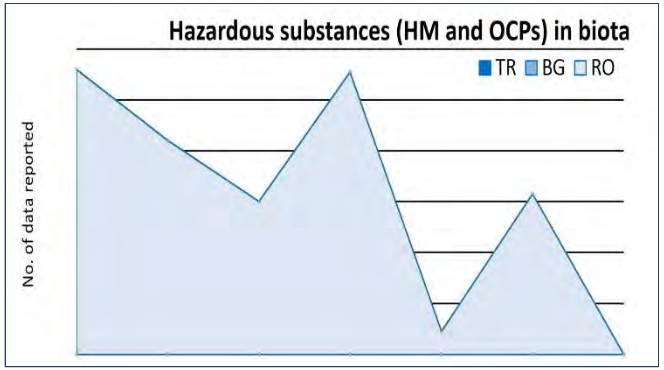


Figure 27. Evaluation of hazardous substances in biota - data reported to EEA by Romania, Bulgaria and Turkey

CONCLUSIONS

The number of monitoring stations is not permanently fixed in BSIMAP and in some of the countries observations do not take place at the same stations each and every year. The majority of the stations are located in coastal and shelf waters. In Turkey, the sampling stations are within 1 NM distance from the coastline. Moreover, in open-sea there are no stations in most of the countries or they are not reported to the BSC, as not being part of BSIMAP formally. The reference stations are mainly missing.

The State of Marine Ecosystem is assessed, in Bulgaria and Romania, based on the indicators recommended by the Water Framework Directive and Marine Strategy Framework Directive as well as on the physical, chemical and biological parameters set by the Advisory Group for the monitoring and pollution assessment within the Permanent Secretariat of BSC. Among the biologic parameters are included the phytoplankton, macrozoobenthos and zooplankton. The three parameters are assessed from the point of view of taxonomic composition, seasonal and geographical variability.

The three MISIS partner countries have reported the following nutrients parameters: Ammonium nitrogen, Nitrate nitrogen, Nitrite nitrogen, Phosphate phosphorus, Silicate, Total nitrogen, Total Phosphorus, and Total Organic Carbon.

During period 2006-2012, there was a good coverage of the nutrient monitoring in the Black Sea. There are some gaps in all parameters, for example Turkey monitored only 6 parameters comparatively with Romania and Bulgaria, which monitored 8 and 9 parameters respectively. There are no NH_4 and TN monitoring in Turkish waters.

There is no regular reporting of data to BSC nor to EEA due to a non-regular monitoring programme supported by responsible ministries in the three countries. As an example Turkey had no BS monitoring programme financed during the 2012 year.

The data reported could be used in the future for integrated assessment based on indicators of following descriptors: D1 (phytoplankton, zooplankton, zoobenthos, phytobenthos - partial data); D2 (partial data to discuss non-native indicators); D6 (incomplete data to characterize habitat condition, extend); D5 (there are data to asses the eutrophication but not based on all indicators required by MSFD), D8, D9 (limited sets of data, mainly for trace metals).

Fish, mammals and birds data are not taken into consideration within this report. As well as we did not propose to do an inventory of the marine litter data, even if some of the partner countries started pilot programme to gather data for D10.

Gaps in monitoring data reported to the BSC in the frame of member countries responsibilities stated by the Bucharest Convention should be covered or decrease through a cost-efficient monitoring programme established / endorsed / approved / agreed / assumed by each responsible ministry with the MSDF implementation in Romania, Bulgaria as EC countries and Turkey as accessing country.

ABBREVIATIONS

BSC	Black Sea Convention (Bucharest Convention)
BSIMAP	The Black Sea Integrated Monitoring and Assessment Programme
BSIS	The Black Sea Information System
BSC PS	Permanent Secretariat of the Black Sea convention
BSSAP	Black Sea Strategic Action Plan
CBD AG	Conservation of biodiversity Advisory Group EEA - European Environment Agency
EC	European Commission,
EcoQO	Ecosystem Quality Objectives
EEA	European Environment Agency
EU	European Union
EU DG	European Union Directorate General
GES	Good environmental status GIS Geographic Information System
HELCOM	Helsinki Commission (regional Agreement in the Black Sea)
IO-BAS	Institute of Fishery, Varna, Bulgaria
MoU	Memorandum of Understanding
MISIS	*MSFD* Guiding Improvements in the Black Sea Integrated Monitoring System
MSFD	EU Marine Strategy Framework Directive
NIRMD	National Institution for Marine Research and Development
NATO	North Atlantic Treaty Organization
TUBITAK	Turkish Scientific and Technological Research Council

OVERVIEW

The marine environmental monitoring

Bulgaria, Romania and Turkey

MSFD Guiding Improvements in the Black Sea Integrated Monitoring System

Address for correspondence:
National Institute for Marine Research and Development "Grigore Antipa"
300, Mamaia Bdv., Constanta, Romania
Email: misisproject@alpha.rmri.ro

www.misisproject.eu