## Draft indicator factsheet D8C1: Concentrations of contaminants in accordance with WFD, EQS Directive (Priority Substances) and BSIMAP

**SUMMARY INFORMATION**

* **Indicator name**: Concentrations of contaminants in accordance with WFD, EQS Directive Priority Substances and BSIMAP
* **Indicator summary:** The concentrations of contaminants do not exceed the threshold values set in relevant EU and international legislation (WFD, EQS, BSIMAP in case of BG and RO).

**Concentrations in water**: The regional assessment is provided for heavy metals (cadmium, lead and nickel) and polyaromatic hydrocarbons (anthracene, benzo(a)pyrene, fluoranthene and naphthalene), which are the substances for which common thresholds exist and both countries have data.

**Concentrations in sediment:** Theregional assessment is provided for heavy metals (cadmium, copper, lead, nickel), 14 PAHs, 7 PCBs and 1 organochloride pesticide (OCP) (p,p’DDE).

**Concentrations in biota:** The regional assessment is provided for 2 PAHs (benzo(a)pyrene and fluoranthene) and 1 OCP (heptachlor and heptachlor epoxide).

**Romanian data involve Total metals (dissolved + suspended solids)**

Cadmium and lead both exceeded the annual average concentration thresholds for water in Romanian coastal waters, with cadmium consistently high and above the MAC. Concentration of nickel in sediments was high in coastal waters of both Bulgaria and Romania, possibly reflecting historical contamination / or it could be a natural higher background for nickel in the region, but the concentration in water was consistently below thresholds. Concentration of cadmium, copper and lead in sediments were below thresholds throughout the region, and concentration of cadmium and lead in water were below thresholds in Bulgaria.

The concentration of PAHs in water in Bulgaria was below thresholds, and in Romania was above thresholds, due to failures for anthracene, benzo(a)pyrene, fluoranthene and naphthalene in coastal waters. With the exception of naphthalene and phenanthrene at Romanian coastal sampling stations, all of the other 12 PAHs assessed in sediment were below the threshold levels. All samples assessed in biota for benzo(a)pyrene and fluoranthene were below the threshold levels.

No data were assessed for PCBs in water or in biota. The only assessment is for PCBs in sediment. Four of the seven PCBs assessed were above thresholds in sediment at coastal sampling stations in Romania. In Bulgaria, two of the PCBs were below thresholds, but for five of them, the limit of detection was above the threshold, therefore the results are inconclusive.

For the OCPs assessed, the limit of detection in Bulgaria was above the threshold therefore it is not possible to conclude on status. In Romania, they were below thresholds in sediment, but above the threshold in biota.

* **Background/relevance**: The indicator shows the concentration of contaminants introduced into the marine and coastal ecosystem via human activities. The substances covered in territorial waters and beyond, as well as the threshold levels, are listed in respective EU and other legislation (WFD, EQS, BSIMAP in case of BG and RO).
* **Relevant criterion/a**: D8C1

**MAIN ASSESSMENT**

* **Status and trends**:

The assessment is provided for heavy metals, polyaromatic hydrocarbons (PAHs), polychlorinated byphenyls (PCBs) and organochloride pesticides (OCPs). Data for Romania include coastal and marine stations (East Constanta is beyond 1 nm). An assessment of trends is not possible as only one year of data is available for each country.

**Heavy metals**

***Concentration in water***

Cadmium, lead and nickel are assessed. Their concentrations were below the threshold values in Bulgaria. Nickel was within the thresholds throughout the region, but cadmium and lead both exceeded the annual average concentration thresholds in Romanian coastal waters, at all three sampling stations (Table 1). Cadmium levels were consistently high, and three out of ten samples at Casino Mamaia sampling station (Romania) exceeded the MAC threshold.

See above, total metals are reported, not only dissolved fraction.

All samples were within the MAC thresholds for lead and nickel, and for cadmium in Bulgaria. 80% of samples of cadmium in Romania were within MAC thresholds (Table 2).

It is therefore concluded that heavy metals in water in Bulgarian waters are below thresholds, and in Romanian waters nickel is below thresholds, but cadmium and lead are above thresholds in coastal waters. For this assessment. East Constanta stations, except first one, are beyond 1 nm.

Table 1 Annual Average (AA) and Maximum Allowable Concentration (MAC) values of heavy metals (cadmium, lead, nickel) in water at Bulgaria (2015-2016) and Romania (2013). Threshold values are shown in italics ; values exceeding the thresholds are highlighted in red.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Contaminant, area** | **Country** | **n** | **AA value (μg/l)** | **No samples  exceeding MAC** | **Comments** |
| ***Cadmium*** | | | ***0.2*** |  |  |
| Coastal | Bulgaria | 75 | 0.093 | 0 |  |
| Romania | 15 | 1.026 | 3 | Failures at 3/3 stations  There are 10 stations in the working example |
| Territorial | Bulgaria | 24 | 0.065 | 0 |  |
| Offshore | Bulgaria | 36 | 0.070 | 0 |  |
| ***Lead*** | | | ***1.3*** |  |  |
| Coastal | Bulgaria | 75 | 0.309 | 0 |  |
| Romania | 15 | 3.254 | 0 | Failures at 3/3 stations  There are 10 stations in the working example |
| Territorial | Bulgaria | 24 | 0.328 | 0 |  |
| Offshore | Bulgaria | 36 | 0.343 | 0 |  |
| ***Nickel*** | | | ***8.6*** |  |  |
| Coastal | Bulgaria | 75 | 1.978 | 0 |  |
| Romania | 15 | 2.156 | 0 |  |
| Territorial | Bulgaria | 24 | 1.937 | 0 |  |
| Offshore | Bulgaria | 36 | 2.161 | 0 |  |

Note: the averaging of concentrations across sampling stations/assessment areas does not mask any failures at individual locations.

Table 2 Percentage of samples within MAC thresholds for heavy metals

|  |  |  |  |
| --- | --- | --- | --- |
| **Contaminant** | **Bulgaria** | **Romania** | **Overall** |
| **Cadmium** | 100% | 80% | 98% |
| **Lead** | 100% | 100% | 100% |
| **Nickel** | 100% | 100% | 100% |

***Concentration in sediment***

Cadmium, copper, lead and nickel are assessed. The concentrations of heavy metals in sediment are generally low in the areas sampled. Concentrations above the threshold were detected only for nickel, in coastal waters of both Bulgaria and Romania (Table 3). In Bulgaria, the stations that were above the thresholds were Ahtopol, Galata and Irakli.

Table 3 Average concentrations of heavy metals (cadmium, copper, lead, nickel) in sediment at Bulgaria (2015) and Romania (2014) sampling stations, in coastal and territorial waters. Threshold values are shown in italics ; vales exceeding the thresholds are highlighted in red

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contaminant, area** | **Country** | **n** | **Average value  (μg/g dry weight)** | **Comments** |
| ***Cadmium*** | | | ***1.2*** |  |
| Coastal | Bulgaria | 6 | 0.500 |  |
| Romania | 9 | 0.213 |  |
| Territorial | Bulgaria | 2 | 0.500 |  |
| ***Copper*** | | | ***40*** |  |
| Coastal | Bulgaria | 6 | 23.833 |  |
| Romania | 9 | 27.836 |  |
| Territorial | Bulgaria | 2 | 28.750 |  |
| ***Lead*** | | | ***47*** |  |
| Coastal | Bulgaria | 6 | 20.367 |  |
| Romania | 9 | 5.458 |  |
| Territorial | Bulgaria | 2 | 12.150 |  |
| ***Nickel*** | | | ***35*** |  |
| Coastal | Bulgaria | 6 | 38.383 | Failure at 3 out of 6 stations |
| Romania | 9 | 69.449 | Failure at 1. There are 10 stations in the working example |
| Territorial | Bulgaria | 2 | 26.200 |  |

Note: the averaging of concentrations across sampling stations/assessment areas does not mask any failures at individual locations.

***Concentration in biota***

Heavy metals are assessed in biota (fish, molusks) in Romania, including Cd and Pb that have threshold in EU legislation.. A threshold exists for mercury, but there were no data for mercury from Romania.

***Summary for heavy metals***

Cadmium and lead both exceeded the annual average concentration thresholds for water in Romanian coastal waters, with cadmium consistently high and above the MAC. Concentration of nickel in sediments was high in coastal waters of both Bulgaria and Romania, possibly reflecting historical contamination/ or it could be a natural higher background for nickel in the region, but the concentration in water was consistently below thresholds. Concentration of cadmium, copper and lead in sediments were below thresholds throughout the region, and concentration of cadmium and lead in water were below thresholds in Bulgaria.

**Romanian data involve Total metals (dissolved + suspended solids)**

**PAHs**

***Concentration in water***

Anthracene, benzo(a)pyrene, fluoranthene and naphthalene were assessed in water. Concentrations of anthracene, benzo(a)pyrene and naphthalene in water were below the threshold values in Bulgaria. All PAH contaminants assessed (anthracene, benzo(a)pyrene, fluoranthene and naphthalene exceeded the annual average threshold values at one or more coastal sampling stations in Romania. Of these, samples for anthracene and benzo(a)pyrene also exceeded the MAC thresholds.

Fluoranthene was above the annual average threshold value in Romanian waters, but no samples exceeded the MAC threshold. In Bulgaria, all samples tested were below the limit of detection of the test (0.012 μg/l), but this value is itself above the threshold value (0.0063 μg/l).

Therefore the concentration of PAHs in Bulgarian waters was below thresholds, and in Romanian waters was above thresholds, due to failures for anthracene, benzo(a)pyrene, fluoranthene and naphthalene in coastal waters.

Table 4 Annual Average (AA) and Maximum Allowable Concentration (MAC) values of PAHs (anthracene, benzo(a)pyrene, fluoranthene and naphthalene) at Bulgaria (2015-2016) and Romania (2013) sampling stations. Threshold values are shown in italics ; values exceeding the thresholds are highlighted in red

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Contaminant, area** | **Country** | **n** | **AA value (μg/l)** | **No samples  exceeding MAC** | **Comments** |
| ***Anthracene*** | | | ***0.1*** |  |  |
| Coastal | Bulgaria | 78 | 0.012 | 0 |  |
| Romania | 20 | 0.275 | 3 | Failures at 1/3 stations |
| Territorial | Bulgaria | 24 | 0.012 | 0 |  |
| Offshore | Bulgaria | 36 | 0.012 | 0 |  |
| ***Benzo(a)pyrene*** | | | ***0.00017*** |  |  |
| Coastal | Bulgaria | 78 | 0.000 | 0 |  |
| Romania | 20 | 0.018 | 5 | Failures at 3/3 stations |
| Territorial | Bulgaria | 24 | 0.000 | 0 |  |
| Offshore | Bulgaria | 36 | 0.000 | 0 |  |
| ***Fluoranthene*** | | | ***0.0063*** |  |  |
| Coastal | Bulgaria | 78 | 0.012\* | 0 |  |
| Romania | 20 | 0.038 | 0 | Failures at 3/3 stations |
| Territorial | Bulgaria | 24 | 0.012\* | 0 |  |
| Offshore | Bulgaria | 36 | 0.012\* | 0 |  |
| ***Naphthalene*** | | | ***2*** |  |  |
| Coastal | Bulgaria | 78 | 0.031 | 0 |  |
| Romania | 20 | 2.315 | 0 | Failures at 2/3 stations |
| Territorial | Bulgaria | 24 | 0.033 | 0 |  |
| Offshore | Bulgaria | 36 | 0.030 | 0 |  |

Note: the averaging of concentrations across sampling stations/assessment areas does not mask any failures at individual locations.

\* In Bulgarian data, where the concentration was below the limit of detection, the value was entered as the limit of detection. In the case of fluoranthene, the limit of detection was above the threshold value.

***Concentration in sediment***

The concentration of PAHs in sediment is assessed for 14 PAHs (see Table 5). With the exception of naphthalene and phenanthrene at Romanian coastal sampling stations, all other PAHs assessed were below the threshold levels.

Table 5 Average concentrations of PAHs in sediment at Bulgaria (2015) and Romania (2014) sampling stations, in coastal and territorial waters. Threshold values are shown in italics ; vales exceeding the thresholds are highlighted in red

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contaminant, area** | **Country** | **n** | **Average value (μg/g dry weight)** | **Comments** |
| ***Acenaphthene*** |  |  | ***0.016*** |  |
| Coastal | Bulgaria | 6 | 0.010 |  |
| Romania | 19 | 0.007 |  |
| Territorial | Bulgaria | 2 | 0.010 |  |
| ***Acenaphthylene*** |  |  | ***0.044*** |  |
| Coastal | Bulgaria | 6 | 0.010 |  |
| Romania | 19 | 0.004 |  |
| Territorial | Bulgaria | 2 | 0.010 |  |
| ***Anthracene*** |  |  | ***0.085*** |  |
| Coastal | Bulgaria | 6 | 0.010 |  |
| Romania | 19 | 0.014 |  |
| Territorial | Bulgaria | 2 | 0.010 |  |
| ***Benzo(a)anthracene*** |  |  | ***0.261*** |  |
| Coastal | Bulgaria | 6 | 0.010 |  |
| Romania | 19 | 0.005 |  |
| Territorial | Bulgaria | 2 | 0.010 |  |
| ***Benzo(a)pyrene*** |  |  | ***0.43*** |  |
| Coastal | Bulgaria | 6 | 0.012 |  |
| Romania | 19 | 0.036 |  |
| Territorial | Bulgaria | 2 | 0.010 |  |
| ***Benzo(g,h,i)perylene*** |  |  | ***0.085*** |  |
| Coastal | Bulgaria | 6 | 0.013 |  |
| Romania | 19 | 0.005 |  |
| Territorial | Bulgaria | 2 | 0.010 |  |
| ***Crysene*** |  |  | ***0.384*** |  |
| Coastal | Bulgaria | 6 | 0.010 |  |
| Romania | 19 | 0.003 |  |
| Territorial | Bulgaria | 2 | 0.010 |  |
| ***Dibenzo(a,h)anthracene*** |  |  | ***0.063*** |  |
| Coastal | Bulgaria | 6 | 0.010 |  |
| Romania | 19 | 0.005 |  |
| Territorial | Bulgaria | 2 | 0.010 |  |
| ***Fluoranthene*** |  |  | ***0.6*** |  |
| Coastal | Bulgaria | 6 | 0.015 |  |
| Romania | 19 | 0.032 |  |
| Territorial | Bulgaria | 2 | 0.010 |  |
| ***Fluorene*** |  |  | ***0.019*** |  |
| Coastal | Bulgaria | 6 | 0.010 |  |
| Romania | 19 | 0.008 |  |
| Territorial | Bulgaria | 2 | 0.010 |  |
| ***Indeno(1,2,3-c,d)pyrene*** |  |  | ***0.24*** |  |
| Coastal | Bulgaria | 6 | 0.013 |  |
| Romania | 19 | 0.003 |  |
| Territorial | Bulgaria | 2 | 0.010 |  |
| ***Naphthalene*** |  |  | ***0.16*** |  |
| Coastal | Bulgaria | 6 | 0.010 |  |
| Romania | 19 | 0.309 | Above threshold at 3 of 3 sampling stations |
| Territorial | Bulgaria | 2 | 0.010 |  |
| ***Phenanthrene*** |  |  | ***0.24*** |  |
| Coastal | Bulgaria | 6 | 0.010 |  |
| Romania | 19 | 0.602 | Above threshold at 2 of 3 sampling stations (Cazino Mamaia, EstConstanta) |
| Territorial | Bulgaria | 2 | 0.010 |  |
| ***Pyrene*** |  |  | ***0.665*** |  |
| Coastal | Bulgaria | 6 | 0.013 |  |
| Romania | 19 | 0.026 |  |
| Territorial | Bulgaria | 2 | 0.010 |  |

Note: the averaging of concentrations across sampling stations/assessment areas does not mask any failures at individual locations. Thresholds from USEPA.

***Concentration in biota***

Two PAHs are assessed in biota – benzo(a)pyrene and fluoranthene. All samples were below the threshold values (from the EQS Directive 2013/39/EU) (Table 6).

Table 6 Average concentrations of PAHs in biota from Bulgaria (2015-16) and Romania (2013). Threshold values are shown in italics ; vales exceeding the thresholds are highlighted in red

|  |  |  |  |
| --- | --- | --- | --- |
| **Contaminant, area** | **Country** | **n** | **Average value (μg/kg dry weight)** |
| ***Benzo(a)pyrene*** | |  | ***5*** |
| Coastal | Bulgaria | 12 | 0.300 |
| Romania | 8 | 0.407 |
| Territorial | Bulgaria | 3 | 0.333 |
| Offshore | Bulgaria | 1 | 0.200 |
| ***Fluoranthene*** | |  | ***30*** |
| Coastal | Bulgaria | 12 | 2.184 |
| Romania | 6 | 0.123 |
| Territorial | Bulgaria | 3 | 2.617 |
| Offshore | Bulgaria | 1 | 2.620 |

***Summary of PAHs***

The concentration of PAHs in water in Bulgaria was below thresholds, and in Romania was above thresholds, due to failures for anthracene, benzo(a)pyrene, fluoranthene and naphthalene in coastal waters. With the exception of naphthalene and phenanthrene at Romanian coastal sampling stations, all other PAHs assessed in sediment were below the threshold levels. All samples assessed in biota for benzo(a)pyrene and fluoranthene were below the threshold levels.

**PCBs**

***Concentration in water***

Not included in regional assessment, due to no common thresholds between the two countries.

***Concentration in sediment***

Seven PCBs (PCB28, PCB52, PCB101, PCB118, PCB138, PCB153, PCB180) were assessed in sediment. Four of the PCBs were above thresholds at coastal sampling stations in Romania. In Bulgaria, for five of the PCBs (PCB28, PCB52, PCB101, PCB118, PCB138) the LOD was above the threshold. The remaining two were below thresholds.

Table 7 Average concentrations of PCBs in sediment at Bulgaria (2015) and Romania (2014) sampling stations, in coastal and territorial waters. Threshold values are shown in italics ; vales exceeding the thresholds are highlighted in red

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contaminant, area** | **Country** | **n** | **Average value (μg/g dry weight)** | **Comments** |
| ***PCB28*** |  |  | ***0.0017*** |  |
| Coastal | Bulgaria | 6 | 0.010\* | Threshold above LOD |
| Romania | 19 | 0.004 | Above threshold in 3 out of 3 stations |
| Territorial | Bulgaria | 2 | 0.010\* | Threshold above LOD |
| ***PCB52*** |  |  | ***0.0027*** |  |
| Coastal | Bulgaria | 6 | 0.010\* | Threshold above LOD |
| Romania | 19 | 0.106 | Above threshold in 3 out of 3 stations |
| Territorial | Bulgaria | 2 | 0.010\* | Threshold above LOD |
| ***PCB101*** |  |  | ***0.003*** |  |
| Coastal | Bulgaria | 6 | 0.010\* | Threshold above LOD |
| Romania | 19 | 0.010 | Above threshold in 2 out of 3 stations |
| Territorial | Bulgaria | 2 | 0.010\* | Threshold above LOD |
| ***PCB118*** |  |  | ***0.0006*** |  |
| Coastal | Bulgaria | 6 | 0.010\* | Threshold above LOD |
| Romania | 19 | 0.002 | Above threshold in 2 out of 3 stations |
| Territorial | Bulgaria | 2 | 0.010\* | Threshold above LOD |
| ***PCB138*** |  |  | ***0.0079*** |  |
| Coastal | Bulgaria | 6 | 0.010\* | Threshold above LOD |
| Romania | 19 | 0.002 |  |
| Territorial | Bulgaria | 2 | 0.010\* | Threshold above LOD |
| ***PCB153*** |  |  | ***0.04*** |  |
| Coastal | Bulgaria | 6 | 0.010 |  |
| Romania | 19 | 0.009 |  |
| Territorial | Bulgaria | 2 | 0.010 |  |
| ***PCB180*** |  |  | ***0.012*** |  |
| Coastal | Bulgaria | 6 | 0.010 |  |
| Romania | 19 | 0.001 |  |
| Territorial | Bulgaria | 2 | 0.010 |  |

Note: the averaging of concentrations across sampling stations/assessment areas does not mask any failures at individual locations.

\* Bulgarian data where the limit of detection (LOD) is above the threshold.

***Concentration in biota***

No PCBs were assessed in biota, due to a lack of threshold values.

***Summary for PCBs***

No data were assessed for PCBs in water or in biota. The only assessment is for PCBs in sediment. Four of the seven PCBs assessed were above thresholds in sediment at coastal sampling stations in Romania. In Bulgaria, two of the PCBs were below thresholds, but for five of them, the limit of detection was above the threshold, therefore the results are inconclusive.

**OCPs**

***Concentration in water***

Not included in regional assessment, due to no common thresholds between the two countries, and no data for Bulgaria.

***Concentration in sediment***

One organochloride pesticide (OCP) is included in the regional assessment, p,p’DDE. The concentration in sediment is below the threshold in Romania, and the limit of detection in Bulgaria is above the threshold (Table 7).

Table 8 Average concentrations of OCPs in sediment at Bulgaria (2015) and Romania (2014) sampling stations, in coastal and territorial waters. Threshold values are shown in italics ; vales exceeding the thresholds are highlighted in red

|  |  |  |  |
| --- | --- | --- | --- |
| **Contaminant, area** | **Country** | **n** | **Average value (μg/g dry weight)** |
| ***p,p'DDE*** |  |  | ***0.0022*** |
| Coastal | Bulgaria | 6 | 0.010\* |
| Romania | 19 | 0.000 |
| Territorial | Bulgaria | 2 | 0.010\* |

Note: \* Bulgarian data where the limit of detection (LOD) is above the threshold.

***Concentration in biota***

Only heptachlor and heptachlor epoxide is assessed in biota. All Bulgarian samples were analysed using the limit of detection value, however, this was above the threshold value. The samples from Romanian coastal waters were above the threshold value. Threshold values were from the EQS Directive (2013/39/EU).

Table 9 Average concentrations of OCPs in biota from Bulgaria (2015-16) and Romania (2013). Threshold values are shown in italics ; vales exceeding the thresholds are highlighted in red

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contaminant, area** | **Country** | **n** | **Average value (μg/kg dry weight)** | **Comments** |
| ***Heptachlor and heptachlor epoxide*** | | | ***0.0067*** |  |
| Coastal | Bulgaria | 12 | 2.750\* | Threshold above LOD |
| Romania | 14 | 5.318 |  |
| Territorial | Bulgaria | 3 | 2.000\* | Threshold above LOD |
| Offshore | Bulgaria | 1 | 2.000\* | Threshold above LOD |

Note: the averaging of concentrations across sampling stations/assessment areas does not mask any failures at individual locations.

\* Bulgarian data where the limit of detection (LOD) is above the threshold.

***Summary for OCPs***

For the OCPs assessed, the limit of detection in Bulgaria was above the threshold therefore it is not possible to conclude on status. In Romania, they were below thresholds in sediment, but above the threshold in biota.

* **Map** (21, Assessment result- map, optional): Map(s) (where possible) showing: sampling points; status; … *[Category: Assessment findings]*
* **Confidence assessment**

Bulgaria: Low (not all substances covered; data assessed only from 2015-16)

Romania: Low (data only for coastal waters included in the assessment; not all substances covered, e.g. mercury and some OCPs missing; data assessed only from 2013 and 2014)

* **Knowledge gaps**

Bulgaria: not all substances covered in all matrices, lack of long-term data to assess trends.

Romania: not all substances covered in all matrices, lack of long-term data to assess trends.

**SUPPORTING INFORMATION/FURTHER DETAIL/METADATA**

* **Geographical coverage**: BG, RO
* **Date of data used for assessment**

Bulgaria: 2015-2016

Romania: 2013 (biota); 2014 (water, sediment)

(32, Temporal Coverage) (may be different for each country): BG: YYYY-MM-DD; RO: YYYY-MM-DD e.g. BG: 2012-01-01; RO: 2012-01-01 *[Category: Temporal scope]*

* **Data products**: link to data
* **Contact and ownership**

Bulgaria: Black Sea Basin Directorate/Varna/BG

Romania: National Institute for marine research and development "Grigore Antipa"/Constanta/Romania

* **Method for assessment (optional)**: short description of method – or link/reference to relevant website/papers.
* **Date of publication/preparation**: (preparation 04 February 2017)

**N.B. These are the first tables I did for heavy metals and PAHs in water, showing the average value for each individual station. However, with all the other data (in sediment, in biota etc), they are too long, so I have replaced them with shorter tables that show the average per area (coastal/territorial/offshore waters). They could be deleted from here, or kept in for reference.**

Table 10 Annual Average (AA) and Maximum Allowable Concentration (MAC) values of heavy metals (cadmium, lead, nickel) at Bulgaria (2015-2016) and Romania (2013) sampling stations. Threshold values are shown in italics ; values exceeding the thresholds are highlighted in red.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contaminant, area** | **Country, sample station** | **n** | **AA value (μg/l)** | **MAC value (μg/l)** |
| ***Cadmium*** | | | ***0.2*** | ***1.5*** |
| Coastal | **Bulgaria** | **75** | **0.093** | **1.12** |
| Ahtopol 12nm | 12 | 0.091 | 0.35 |
| Burgas 12nm | 12 | 0.062 | 0.08 |
| Galata 12nm | 12 | 0.095 | 0.39 |
| Irakli 12nm | 12 | 0.086 | 0.21 |
| Kaliakra 12nm | 12 | 0.168 | 1.12 |
| Krapets 12nm | 12 | 0.066 | 0.13 |
| Vromos | 3 | 0.060 | 0.06 |
| **Romania** | **15** | **1.026** | **1.59** |
| CazinoMamaia | 3 | 0.883 | 0.98 |
| ConstantaNord | 2 | 0.980 | 1.02 |
| EstConstanta | 10 | 1.078 | 1.59 |
| Territorial waters | **Bulgaria** | **24** | **0.065** | **0.11** |
| Depo\_Burgas | 12 | 0.068 | 0.11 |
| Depo\_Varna | 12 | 0.063 | 0.09 |
| Offshore | **Bulgaria** | **36** | **0.070** | **0.37** |
| Ahtopol - offshore | 12 | 0.086 | 0.37 |
| Galata - offshore | 12 | 0.065 | 0.12 |
| Krapets 12nm | 12 | 0.060 | 0.06 |
| ***Lead*** | | | ***1.3*** | ***14*** |
| Coastal | **Bulgaria** | **75** | **0.309** | **0.98** |
| Ahtopol 12nm | 12 | 0.300 | 0.3 |
| Burgas 12nm | 12 | 0.300 | 0.3 |
| Galata 12nm | 12 | 0.300 | 0.3 |
| Irakli 12nm | 12 | 0.300 | 0.3 |
| Kaliakra 12nm | 12 | 0.357 | 0.98 |
| Krapets 12nm | 12 | 0.300 | 0.3 |
| Vromos | 3 | 0.300 | 0.3 |
| **Romania** | **15** | **3.254** | **4.71** |
| CazinoMamaia | 3 | 3.167 | 3.97 |
| ConstantaNord | 2 | 4.380 | 4.71 |
| EstConstanta | 10 | 3.055 | 4.01 |
| Territorial waters | **Bulgaria** | **24** | **0.328** | **0.96** |
| Depo\_Burgas | 12 | 0.355 | 0.96 |
| Depo\_Varna | 12 | 0.300 | 0.3 |
| Offshore | **Bulgaria** | **36** | **0.343** | **1.83** |
| Ahtopol - offshore | 12 | 0.428 | 1.83 |
| Galata - offshore | 12 | 0.300 | 0.3 |
| Krapets 12nm | 12 | 0.300 | 0.3 |
| ***Nickel*** | | | ***8.6*** | ***34*** |
| Coastal | **Bulgaria** | **75** | **1.978** | **5.31** |
| Ahtopol 12nm | 12 | 2.159 | 5.31 |
| Burgas 12nm | 12 | 1.968 | 4.28 |
| Galata 12nm | 12 | 2.173 | 4.6 |
| Irakli 12nm | 12 | 2.016 | 4.55 |
| Kaliakra 12nm | 12 | 1.753 | 3.1 |
| Krapets 12nm | 12 | 1.847 | 3.4 |
| Vromos | 3 | 1.800 | 3.4 |
| **Romania** | **15** | **2.156** | **7.71** |
| CazinoMamaia | 3 | 1.817 | 2.15 |
| ConstantaNord | 2 | 1.625 | 1.9 |
| EstConstanta | 10 | 2.364 | 7.71 |
| Territorial waters | **Bulgaria** | **24** | **1.937** | **7.68** |
| Depo\_Burgas | 12 | 1.758 | 3.5 |
| Depo\_Varna | 12 | 2.115 | 7.68 |
| Offshore | **Bulgaria** | **36** | **2.161** | **7.68** |
| Ahtopol - offshore | 12 | 2.573 | 7.68 |
| Galata - offshore | 12 | 1.822 | 3.6 |
| Krapets 12nm | 12 | 2.088 | 4.05 |

Table 11 Annual Average (AA) and Maximum Allowable Concentration (MAC) values of PAHs (anthracene, benzo(a)pyrene, fluoranthene and naphthalene) at Bulgaria (2015-2016) and Romania (2013) sampling stations. Threshold values are shown in italics ; values exceeding the thresholds are highlighted in red

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contaminant, area** | **Country, sample station** | **n** | **AA value (μg/l)** | **MAC value (μg/l)** |
| ***Anthracene*** | | | ***0.1*** | ***0.1*** |
| Coastal | **Bulgaria** | **78** | **0.012** | **0.020** |
| Ahtopol 12nm | 12 | 0.012 | 0.020 |
| Burgas 12nm | 12 | 0.012 | 0.020 |
| Galata 12nm | 12 | 0.012 | 0.020 |
| Irakli 12nm | 12 | 0.012 | 0.020 |
| Kaliakra 12nm | 12 | 0.012 | 0.020 |
| Krapets 12nm | 12 | 0.012 | 0.020 |
| Vromos | 6 | 0.017 | 0.020 |
| **Romania** | **20** | **0.275** | **4.110** |
| Cazino Mamaia | 6 | 0.042 | 0.075 |
| Constanta N | 4 | 1.105 | 4.110 |
| EstConstanta | 10 | 0.062 | 0.295 |
| Territorial waters | **Bulgaria** | **24** | **0.012** | **0.020** |
| Depo\_Burgas | 12 | 0.012 | 0.020 |
| Depo\_Varna | 12 | 0.012 | 0.020 |
| Offshore | **Bulgaria** | **36** | **0.012** | **0.020** |
| Ahtopol - offshore | 12 | 0.012 | 0.020 |
| Galata - offshore | 12 | 0.012 | 0.020 |
| Krapets - offshore | 12 | 0.012 | 0.020 |
| ***Benzo(a)pyrene*** | | | ***0.00017*** | ***0.027*** |
| Coastal | **Bulgaria** | **78** | **0.000** | **0.000** |
| Ahtopol 12nm | 12 | 0.000 | 0.000 |
| Burgas 12nm | 12 | 0.000 | 0.000 |
| Galata 12nm | 12 | 0.000 | 0.000 |
| Irakli 12nm | 12 | 0.000 | 0.000 |
| Kaliakra 12nm | 12 | 0.000 | 0.000 |
| Krapets 12nm | 12 | 0.000 | 0.000 |
| Vromos | 6 | 0.000 | 0.000 |
| **Romania** | **20** | **0.018** | **0.046** |
| Cazino Mamaia | 6 | 0.016 | 0.034 |
| Constanta N | 4 | 0.012 | 0.016 |
| EstConstanta | 10 | 0.021 | 0.046 |
| Territorial waters | **Bulgaria** | **24** | **0.000** | **0.000** |
| Depo\_Burgas | 12 | 0.000 | 0.000 |
| Depo\_Varna | 12 | 0.000 | 0.000 |
| Offshore waters | **Bulgaria** | **36** | **0.000** | **0.000** |
| Ahtopol - offshore | 12 | 0.000 | 0.000 |
| Galata - offshore | 12 | 0.000 | 0.000 |
| Krapets - offshore | 12 | 0.000 | 0.000 |
| ***Fluoranthene\**** | | | ***0.0063*** | ***0.12*** |
| Coastal | **Bulgaria** | **78** | **0.012\*** | **0.020** |
| Ahtopol 12nm | 12 | 0.012**\*** | 0.020 |
| Burgas 12nm | 12 | 0.012**\*** | 0.020 |
| Galata 12nm | 12 | 0.012**\*** | 0.020 |
| Irakli 12nm | 12 | 0.012**\*** | 0.020 |
| Kaliakra 12nm | 12 | 0.012**\*** | 0.020 |
| Krapets 12nm | 12 | 0.012**\*** | 0.020 |
| Vromos | 6 | 0.017 | 0.020 |
| **Romania** | **20** | **0.038** | **0.096** |
| Cazino Mamaia | 6 | 0.043 | 0.074 |
| Constanta N | 4 | 0.029 | 0.058 |
| EstConstanta | 10 | 0.039 | 0.096 |
| Territorial waters | **Bulgaria** | **24** | **0.012\*** | **0.020** |
| Depo\_Burgas | 12 | 0.012**\*** | 0.020 |
| Depo\_Varna | 12 | 0.012**\*** | 0.020 |
| Offshore waters | **Bulgaria** | **36** | **0.012\*** | **0.020** |
| Ahtopol - offshore | 12 | 0.012**\*** | 0.020 |
| Galata - offshore | 12 | 0.012**\*** | 0.020 |
| Krapets - offshore | 12 | 0.012**\*** | 0.020 |
| ***Naphthalene*** | | | ***2*** | ***130*** |
| Coastal | **Bulgaria** | **78** | **0.031** | **0.050** |
| Ahtopol 12nm | 12 | 0.030 | 0.030 |
| Burgas 12nm | 12 | 0.030 | 0.030 |
| Galata 12nm | 12 | 0.031 | 0.040 |
| Irakli 12nm | 12 | 0.031 | 0.040 |
| Kaliakra 12nm | 12 | 0.030 | 0.030 |
| Krapets 12nm | 12 | 0.032 | 0.050 |
| Vromos | 6 | 0.030 | 0.030 |
| **Romania** | **20** | **2.315** | **11.701** |
| Cazino Mamaia | 6 | 3.079 | 11.701 |
| Constanta N | 4 | 1.127 | 2.384 |
| EstConstanta | 10 | 2.213 | 6.015 |
| Territorial waters | **Bulgaria** | **24** | **0.033** | **0.080** |
| Depo\_Burgas | 12 | 0.033 | 0.060 |
| Depo\_Varna | 12 | 0.034 | 0.080 |
| Offshore | **Bulgaria** | **36** | **0.030** | **0.040** |
| Ahtopol - offshore | 12 | 0.030 | 0.030 |
| Galata - offshore | 12 | 0.030 | 0.030 |
| Krapets - offshore | 12 | 0.031 | 0.040 |

Note: \* In Bulgarian data, where the concentration was below the limit of detection, the value was entered as the limit of detection. In the case of fluoranthene, the limit of detection was above the threshold value.