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**Conference of the Parties to the
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Geneva, 25–29 November 2019
Item 5 (h) of the provisional agenda*

**Matters for consideration or action by the
Conference of the Parties: effectiveness evaluation**

Global monitoring of mercury: outcomes of a project funded by the Global Environment Facility

Note by the secretariat

The annex to the present note sets out a report on the outcomes of a project on the development of a plan for global monitoring of human exposure to and environmental concentrations of mercury, funded by the Global Environment Facility and implemented by the United Nations Environment Programme. The report was submitted by the United Nations Environment Programme to facilitate consideration by the Conference of the Parties at its third meeting of the sub-item on effectiveness evaluation. It is reproduced as received, without formal editing.

* UNEP/MC/COP.3/1.

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Annex

Global Monitoring of Mercury

Outcomes from the GEF-funded project

Develop a plan for global monitoring of Human exposure to and environmental concentration of Mercury

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Chemicals and Health Branch, Knowledge and Risk Unit
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September 2019

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[1]https://www.unenvironment.org/events/workshop/workshop-elements-towards-global-monitoring-plan mercury

Acronyms and Abbreviations

BRI	Biodiversity Research Institute
COP	Conference of the Parties
CNR-IIA	National Research Council of Italy - Institute of Atmospheric Pollution Research
GEF	Global Environment Facility
GEM	Gaseous Elemental Mercury
GMP	Global Monitoring Plan
GMOS	Global Mercury Observation System
HBM	Human biomonitoring
Hg	Mercury
IAEA	International Atomic Energy Agency
JSI	Jožef Stefan Institute
MeHg	Metil-mercruy
PASs	Passive Air Samplers
QA/QC	Quality assurance and Quality control
RECETOX	Research Centre for Toxic Compounds in the Environment
SOP	Standard Operation Procedure
TGM	Total Gaseous Mercury
UNEP	United Nations Environment Programme
WHO	World Health Organization

1. Introduction

Responding to the need for further guidance on the establishment of a global monitoring system, the Chemicals and Health Branch of UNEP, in collaboration with the Italian National Research Council – Institute for Atmospheric Pollution Research (CNR-IIA), the World Health Organization (WHO-Europe office), the Research Centre for Toxic Compounds in the Environment (RECETOX), the Biodiversity Research Institute (BRI), the Jožef Stefan Institute (JSI) and with financial support from the Global Environment Facility (GEF), recently concluded the successful implementation of the project titled "Develop a plan for global monitoring of Human exposure to and environmental concentration of Mercury".

The objectives of the project were to:

- harmonize approaches for monitoring mercury in humans and the environment, and
- strengthen the capacity for mercury analysis in humans and the environment to accurately determine their concentrations, globally.

The project activities included:

i) a global review of information on existing network for mercury monitoring and worldwide institutional capacities to analyse mercury and mercury compounds;
ii) the establishment of a mercury laboratory databank and the development of the first round of a global interlaboratory assessment;
iii) a one-year pilot study of mercury environmental (air) monitoring and human biomonitoring including the development of Standard Operating Procedure, protocols and manuals for mercury monitoring; and
iv) two reports on technical information on mercury monitoring in biota and soil.

The project enabled the compilation of approaches, existing monitoring networks, laboratory capacities to analyse mercury and review of existing information related to monitoring of mercury in biota and soil. The key deliverables included:

- ✓ A report on elements to consider when designing monitoring plan for Mercury [2];
- ✓ A global review of monitoring networks and worldwide laboratory capacities[3]
- ✓ Standards Operating Procedures (SOPs) for the assessment of prenatal exposure to mercury including survey protocols[4];
- ✓ Guidance for passive air sampling of mercury in ambient air[5];
- ✓ A global assessment of laboratories analysing mercury[6];
- ✓ A report on the review of technical information on mercury monitoring in biota[7];
- ✓ A report on the review of technical information on mercury monitoring in soil[8].

Key findings from the project:

Based on the activities undertaken, following are some of the key findings.

- Biota is a key bioindicator that reflect the potential harm of emissions and releases of mercury to air, water and land;
- Soil is a very complex matrix, mercury monitoring in soil need further science-based development for achieving comparable and cost-effective data;
- Cost-effective methodologies to assess human exposure (human biomonitoring) to and environmental (air sampling) concentration of mercury are well-established;

[2] http://www.mercuryconvention.org/Portals/11/documents/meetings/COP1/English/UNEP-MC-COP.1-INF-15.pdf

[3] http://wedocs.unep.org/bitstream/handle/20.500.11822/21059/UNEP%20-%20Global%20Review%20of%20Mercury%20Monitoring%20Networks_Final.pdf?sequence=1&isAllowed=y

[4] https://www.unenvironment.org/resources/publication/assessment-prenatal-exposure-mercury-standard-operating-procedures-2018

[5] https://www.unenvironment.org/resources/toolkits-manuals-and-guides/practical-instructions-use-cnr-iia-passive-air-samplers-pass

[6] https://www.unenvironment.org/resources/report/final-report-global-assessment-laboratories-analysing-mercury-first-round-2018

[7] https://www.unenvironment.org/resources/report/technical-information-mercury-monitoring-biota

[8] https://www.unenvironment.org/resources/report/technical-information-mercury-monitoring-soil

- A global monitoring plan for mercury can be built on already existing initiatives, however long-term capacity building strategies, especially in some regions, (i.e. Africa, South Asia, Pacific and Latin America) and due consideration of long-term sustainability are still needed; and
- The performance of laboratories undertaking mercury analyses in various parts of the world shows potential of building on already existing analytical capacities and networks.

The present report highlights some of the major outcomes, lesson learnt, and key documents and tools produced through the project, as well as their contribution, in general, to the implementation of the Minamata Convention on Mercury, and in particular to the ongoing work in relation the effectiveness evaluation and monitoring arrangements under the Convention (article 22).

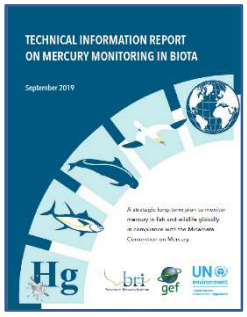
2. Contribution to the discussion on Effectiveness Evaluation under the Minamata Convention

Through the project activities, technical information related to monitoring of mercury in biota, soil, human and air matrices were collected globally and complied to facilitate consideration in the deliberations related to the Minamata Convention. It also included a comprehensive assessment of global capacity for monitoring mercury in all four matrices and some key elements to facilitate harmonized approach in measuring the levels.

Some of the project results and outcomes, as available, were presented during the first and second Conferences of the Parties to Minamata convention in the form of Information Document (UNEP/MC/COP.1/INF/15) and during selected side-events[9]. Further, technical contributions on the outcomes of the project activities were presented during the meetings of the ad hoc group of experts stablished by the COP for establishing the arrangement of and effectiveness evaluation.

A complete overview of the deliverables that contribute to the work of the Minamata Convention, including those already presented at various occasions, are presented in the following sections. Detailed reports on each of the deliverables can be found in the links provided in respective sections.

2.1. Technical information on mercury monitoring in biota[10]



Biota are important bioindicators because they reflect the potential harm of emissions and releases of mercury to air, water and land. Because there are not suitable models to predict the methylation process and the entry of methylmercury into the food web, high trophic level biota is recommended (i.e., trophic level 4 or higher). High trophic level biota can therefore be used to identify spatial gradients, including ecosystem sensitivity spots, and to track changes over time.

The pilot desk study was based on the experiences by Biodiversity Research Institute (BRI) including the comprehensive database on published biotic mercury data called the "Global Biotic Mercury Synthesis" or GBMS[11]. Compilation of this database was partly funded by GEF - Scientific and Technical Advisory Panel (STAP). The technical report compiled and synthesized information available through this database on mercury in biota and identified information and data gaps, comparability, options for filling gaps, available modelling capabilities to assess changes, baselines, and proposed monitoring approaches with an estimated budget.

An approach for the monitoring of mercury in biota was developed based on the Expert consultation meeting held in Monaco[12] (section 2.6.3) and discussions thereafter. A summary of that approach is presented herein and can be viewed in greater detail within the UNEP report on Technical information on mercury monitoring in biota[13]. The technical report also includes an exercise of a generalized budget considerations for setting up a program of 5 years monitoring of biota, in which are included two components, continental and oceanic and using six regional country hubs.

[9] https://www.unenvironment.org/events/workshop/human-exposure-and-environment-concentration-mercury-outcomes-and-lessons-learnt-1

[10] https://www.unenvironment.org/resources/report/technical-information-mercury-monitoring-biota

[11] Evers, D.C., Taylor, M., Burton, M. and Johnson, S. 2018. Mercury in the Global Environment: Understanding spatial patterns for biomonitoring needs of the Minamata Convention on Mercury. Biodiversity Research Institute. Portland, Maine, USA. BRI Science Communication Series 2018-21. 21pp.

[12] https://www.unenvironment.org/events/workshop/expert-consultation-meeting-mercury-monitoring-soil-and-biota

[13] https://www.unenvironment.org/resources/report/technical-information-mercury-monitoring-biota

The results of this report have actively contributed to the discussion of the ad hoc technical group on effectiveness evaluation.

Some general highlights regarding the use of biota as a matrix to consider for the effectiveness evaluations:

- Review of the comprehensive biotic Hg database GBMS which compile data from peer-reviewed literature.
- Review of Biota mercury monitoring networks with examples illustrated for three spatial scales:
    a. Global (e.g. AMAP),
    b. Regional (e.g. Caribbean Region Mercury Monitoring Network), and
    c. Local (e.g. New York State, USA).
- Identification of data gaps, namely, related to:
    a. Spatial (identified through models depicting ecosystem sensitivity spots)
    b. Temporal trends that use standardized data
    c. Percent of Methyl-mercury of the total-mercury in some fish species (as identified by the International Atomic Energy Agency Environment Laboratory)
- Discussion of the why, how, what, when and where of a global biomonitoring approach and reasons for each.

Based on a comprehensive review on the biotic tissues of interest, biotic mercury data available, known mercury monitoring programs with biota, an assessment of relevant data availability was determined at a biome scale for ecological and human health bioindicators (Table 1).

Table 1 Relevant data availability at a biome scale for ecological and human health bioindicators

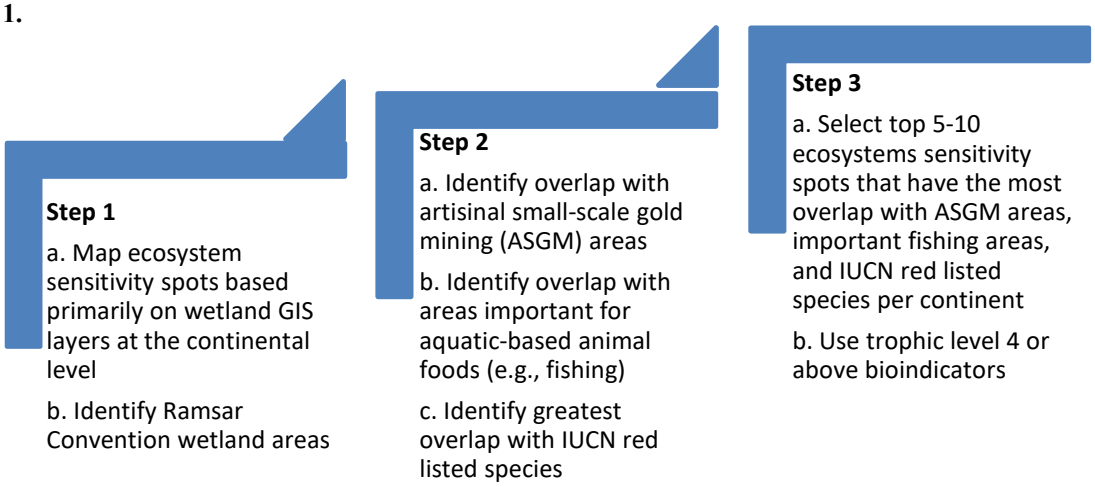
Terrestrial Biomes and Associated Marine Areas	Ecological Health Bioindicators			Human and Ecological Health Bioindicators		
	Freshwater Birds	Marine Birds	Marine Mammals	Freshwater Fish	Marine Fish	Marine Mammals
Arctic Tundra and Arctic Ocean	XX	XX	XX	XX	XX	XX
Boreal Forest-Taiga and N. Pacific and Atlantic Ocean	X	X	Data gap	XX	X	Data gap
Temperate Mixed Forest and Pacific and Atlantic Ocean	XX	X	Data gap	XX	X	Data gap
Tropical Rainforest and S. Pacific and Atlantic and Indian Ocean	Data gap	Data gap	Data gap	Data gap	Data gap	Data gap

Further, based on options for filling gaps using various criteria for ranking purposes and the availability of modelling capabilities to understand spatial gradients and temporal trends a proposed monitoring arrangement was made using two overarching approaches: (1) a Continental Framework and (2) an Oceanic Framework.

For the Continental Framework, a three-step process is discussed based on an ecosystem sensitivity analyses that results in a matrix of a sampling strategy for trophic level 4 or greater biota in 7 regions of the world (Figure 1). An estimated number of samples and an approximate coverage of existing data and monitoring programs is incorporated into a decision matrix for freshwater, nearshore marine and terrestrial (freshwater wetlands) ecosystems. This matrix can be viewed in the final report[14].

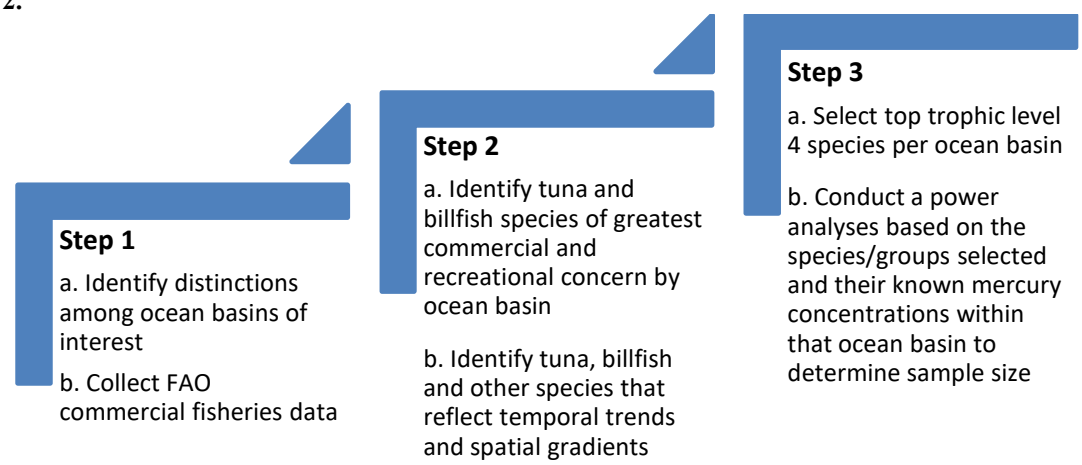
[14] https://www.unenvironment.org/resources/report/technical-information-mercury-monitoring-biota

Figure 1.

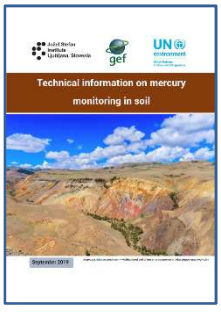


For the Oceanic Framework, a three-step process is also discussed based on distinguishing relevant areas within the ocean basins of interest and most relevant commercial fisheries at a global level (Figure 2). An estimated number of samples and an approximate coverage of existing data and monitoring programs is incorporated into a decision matrix for monitoring temporal trends and spatial gradients. This matrix can be viewed in the final report.

Figure 2.



2.2. Technical information on mercury monitoring in soil[15]



Soil plays an important role in the global and regional mercury fluxes, which includes (i) the mercury which is biologically available or potentially available in the ecosystem (e.g. sorbed to soils or sediments), (ii) the mercury which is released from geogenic sources (e.g. ore deposits and geothermal sources) and, (iii) the mercury which is released by anthropogenic activity. A major issue is the importance of anthropogenic mercury relative to the mercury content in pristine environments.

The pilot report compiles and synthesizes available information on mercury in soil in the context of global mercury cycles as it acts as a source and a sink of mercury. The complexity of mercury behaviour in soil is addressed and the new evidence in relation to the role of soil under changing climate and land-use is also addressed. Comparability of data for soil characterisation points to the need of further harmonisation and standardisation of monitoring strategies, including sampling design, sampling, sample processing and detection of mercury and its compounds in soil. Elements to be considered for mercury in the effectiveness evaluation are also addressed.

[15] https://www.unenvironment.org/resources/report/technical-information-mercury-monitoring-soil

General highlights of using soil as a potential matrix for mercury monitoring under the effectiveness evaluation revealed that:

Mercury in soil systems

- Mercury is present in the soil due to geogenic (natural) sources, atmospheric wet and dry deposition and litterfall and due to anthropogenic activity. Soil plays an important role in global mercury cycling as it can act as a sink and source.
- Mercury may be present under different phases in soil systems: dissolved in the aqueous phase either as a free ion (Hg^{2+}) or complexed with inorganic and organic ligands, metallic (or elemental) Hg^0 as a non-aqueous liquid phase liquid (NAPL), sorbed onto soil minerals and insoluble organic matter, in the gas phase, and in the solid (precipitated) phase.

Mercury sources and sinks in soils

- All time anthropogenic mercury releases to land and water at the global scale are estimated to be much higher than into the atmosphere. The anthropogenic mercury contamination may result in much higher Hg concentrations in soil systems than from other sources, particularly at contaminated site. Overall, mercury loading to soil needs better quantification including sources that have not been accounted for in the present inventories (i.e. sewage sludge).
- Mercury stored in soil is a source of mercury to (i) the atmosphere due to volatilization of elemental mercury and (ii) to the ground and surface water due to leaching, dissolution and colloidal transport. In this context global vs local implications of mercury contaminated sites need to be carefully evaluated.
- Long-time scales need to be considered for removal of Hg from soil due to complex nature of Hg dynamics in non-homogenous solid, gaseous, aqueous, and biological phases present in soil.
- Mercury mobility in soil is considerably impacted by the land use and climate change induced processes (i.e. thawing of the permafrost, erosion, flooding, etc.)

Existing capacities – monitoring networks

- Although several networks exist for soil monitoring at the national and international level, mercury is rarely included in such programmes; nonetheless, several maps exist across wider geographical regions, based on measurement results and modelling. The main issue when comparing Hg soil monitoring programmes at national or international scales is the comparability of data due to differences in monitoring designs, sampling grid resolution, soil profile depth, and soil fractions analysed. Also, data evaluation and interpretation lack harmonization, particularly the ancillary data that is needed to determine the mobility of mercury in soils.
- Comparability of data for total mercury in soil needs to be evaluated carefully as some data are based on the *aqua regia* extractable fraction of mercury, which provides only the leachable acid fraction of mercury. Such methodological biases may provide scattered data in particular in the characterisation and identification of contaminates sites, and a strict distinction between acid leachable and total mercury in soil needs to be documented when data are reported and evaluated.

General conclusions

- Monitoring total Hg in soil provides limited data to assess Hg bioavailability, potential toxicity and health risk, therefore speciation/fractionation analysis of mercury is needed. However, methodologies for speciation/fractionation of mercury in soils are not fully harmonized and agreed, consequently such method-specific protocols should be avoided unless they provide biogeochemically meaningful information.
- In terms of the regional and global relevance of the mercury present in the terrestrial environment, particularly in soil, the evaporation of elemental mercury is of considerable concern and must be considered for the proper understanding of the elemental mercury oscillations at monitoring sites. However, measurement of elemental mercury flux from the terrestrial environment and the determination of elemental mercury in the soil are not harmonized/standardized and comparability of such data is questionable. Overall, methodologies for mercury fluxes measurements between environmental compartments (soil/water/atmosphere) require further harmonization and standardization.

Therefore, several elements would need to be considered for soil as a monitoring matrix. Careful evaluation of the relevance of the matrix, the mercury compounds and fractions to be monitored and the frequency of monitoring. These elements suggest that soil monitoring needs further science-based developments, especially for background sites. However, in the case of terrestrial mercury contaminated sites, mercury determination in soils is needed as part of the characterization and identification methodologies and particularly for the evaluation of the effectiveness of remedial actions.

2.3. Pilot studies on mercury in ambient air and the exposure of mercury in Humans

Building on existing experiences in mercury monitoring, the project has created methodologies and tools for monitoring mercury in air and humans at global, regional and local levels.

The project partners developed methodologies for the assessment of mercury in ambient air and in human biomonitoring.

- Ambient air was analysed using the newly develop device by CNR-IIA for Passive Air Sampling (PASs) of ambient air.
- Human biomonitoring (HBM) was performed using newly developed: Standard Operating Procedures (SOPs) for the assessment of prenatal exposure to mercury and the Master survey protocol as the basis for the development of National protocols.

The applicability of PASs methodology and the SOPs for HBM has been pilot tested globally, over a one-year period. It included 10 sampling sites for air monitoring, and 6 countries for human biomonitoring (HBM).

2.3.1. Pilot study on mercury in ambient air

Ambient air is an important matrix because it has a very short response time to changes in atmospheric emissions and is a relatively well-mixed environmental medium. It is also an entry point into food chains and a global transport medium. Mercury ambient air monitoring allows assessing time trends as well as regional and global transport of mercury.

In 2017, a one-year pilot study to perform a global scale validation of the sampling devices PAS and gather ambient mercury data was performed. The pilot study was based on the experiences of the National Research Council of Italy - Institute of Atmospheric Pollution Research (CNR-IIA) through the Global Mercury Observation System (GMOS) project [16].

A selection of 4 of 10 monitoring stations established within the GMOS network, background sites, and additional list of 6 polluted sites were selected, the sampling sites including: Argentina, China, Costa Rica, Ghana, India, Italy, Japan, Mongolia, Russian Federation and South Africa. For the pilot study, CNR-IIA developed a novel passive sampling system of mercury based on nanostructured materials and the Practical instruction on how to use it. Details are available in English, French and Spanish in the **final technical progress report on the air monitoring component of the- UNEP-GEF Project "Development of a Plan for Global Monitoring of Human Exposure to and Environmental concentration of Mercury"** [17]

The report presents the detailed report on the work for the implantation of the pilot study on mercury in ambient air. The report includes an introduction to the technical and analytical aspect of the methodology of PAS, and the compressive results of the one-year pilot study conducted in ten sampling site using passive air sampling of total gaseous mercury.

2.3.2. Practical instructions to use CNR-IIA Passive Air Samplers (PASs) for Total Gaseous Mercury (TGM) monitoring[18]

The pilot study included the study of the performance of the newly developed passive samplers (PAS) for mercury and discussed the results of three seasonal air sampling campaigns at selected GMOS ground-based monitoring sites and of two seasonal sampling campaign at polluted sites selected by WHO. At the GMOS ground-based sites active and passive sampling were deployed simultaneously.

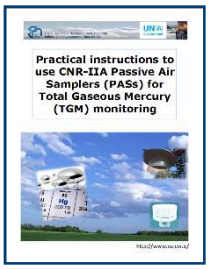
The developed PAS were designed to give information about the average mercury pollution levels over times of few weeks to months, which seems to provide, as a preliminary analysis, acceptable performance compared to active samplers in terms of sensitivity. On the other hand, they also presented in some cases variable results, probably due to uncorrected management, added to the influence of local conditions (i.e., dust, high wind speed, etc.) along with other parameters and factors. In conclusion, further work into the testing of the developed Hg passives is essential to argue their validity in every condition.

[16] http://www.gmos.eu/

[17] https://wedocs.unep.org/bitstream/handle/20.500.11822/26449/UNEP-GEF_GMP_Hg_Final_Report.pdf?sequence=1&isAllowed=y

[18] https://www.unenvironment.org/resources/toolkits-manuals-and-guides/practical-instructions-use-cnr-iia-passive-air-samplers-pass

The following two document were prepared on the frame of the project.



The practical instructions describe the steps for installing, handling and storing the Passive Air Samplers used for measuring the concentration of total gaseous mercury in ambient air. The document is available in English, French and Spanish.

A video[19] to illustrate Practical instructions for Mercury Passive Sampling.

2.3.3. Pilot study on mercury human biomonitoring

Mercury human biomonitoring (HBM) using a harmonized approach can provide reliable information on mercury concentration in humans at global level. HBM of mercury can be a tool used as a scan to the reduction of mercury risk at global level and serve as an indicator to evaluate the effectiveness of the Convention. In-utero development is the most vulnerable stage for the long-term adverse neurodevelopmental effects of mercury. Characterizing prenatal exposure is critical for evaluating public health impacts of mercury and assessing public health benefits of exposure reduction measures. Approaches to estimating exposure to mercury include measuring mercury levels in different biological matrices. The level of mercury in tissues can be an indicator of exposure to various types of mercury. The validity, usefulness and meaning of such measurements depend on the form of mercury exposure, type of tissue measurement and other factors. The Standard Operating procedure describing the assessment of mercury in hair, cord blood and urine. Quality control is essential to get reliable results.

The pilot survey of HBM was implemented in 6 countries (China, India, Ghana, Kyrgyzstan, Mongolia and Russian Federation). In addition, a pilot HBM survey in Croatia, as part of a different project, using the same methodology was performed. The pilot study confirmed the applicability of the Standard Operating Procedures and the feasibility of conducting HBM studies in developing countries and countries with economies in transition. They further demonstrated that capacities for reliable mercury human biomonitoring exist or can be built in countries with different levels of economic development.

Using harmonized approach for assessment of human exposure to mercury at global level brings a number of benefits including: collection of reliable and comparable data; identification of highly exposed population groups for prioritization of actions at global and regional levels; effective use of human, technical and financial resources; and, in total, assessment of effectiveness of global efforts aiming at protection of human health from negative impact of mercury.

Based on the activities implemented the following documents were developed and published.

Assessment of prenatal exposure to mercury: standard operating procedures (2018) [20]

This document consists of standard operating procedures describing the assessment of mercury in hair, cord blood and urine. The document also provides information on alternative methods that can be used to conduct the chemicals analysis of mercury in human matrices.

[19] https://drive.google.com/file/d/1JrcXpEsuB-qSL73yHVgqkht5pSoHrlcd/view?ts=5bd8160c

[20] https://www.unenvironment.org/resources/publication/assessment-prenatal-exposure-mercury-standard-operating-procedures-2018

Assessment of prenatal exposure to mercury: human biomonitoring survey - The first survey protocol A tool for developing national protocols (2018).

This publication describes the design of a survey to assess prenatal exposure to mercury, using human biomonitoring. The selection of target populations and biological matrix, planning of the survey, recruitment and fieldwork, data management and communication, community involvement strategy and ethical considerations are described in the protocol.

2.4. Existing global mercury monitoring networks and worldwide laboratory capacities

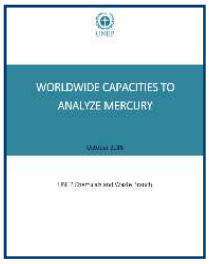
2.4.1. Global review of Mercury Monitoring Networks[21]

This review compiles and synthesizes available information on existing mercury monitoring networks for mercury in air, human, biota and soil. It also highlights some of the gaps identified in the coverage and scope of the monitoring networks, in particular in terms of geographical distribution and institutional organization (global, regional, national and local studies).
The summary results of the global review of the mercury monitoring networks show that some regions with the highest mercury emissions into the atmosphere (i.e. Asia, Latin America, and Africa) are also those regions where atmospheric monitoring stations are scarce or information is not well documented publicly and therefore the information or data is not easily available. However, there are efforts to enhance monitoring networks at global (e.g. Global Mercury Observation System - GMOS), regional and local (e.g. the GBMS database or Consortium to Perform Human Biomonitoring on European Scale - COPHES, DEMO-COPHES) levels.

More detailed information was presented to the first Conference of the Parties to the Minamata Convention, as an information document: UNEP/MC/COP.1/INF/15

2.4.2. Worldwide Capacity to Analyse Mercury and UNEP Laboratory databank

In August 2016, invitations to participate to the Databank of laboratories were sent out to laboratories all around the world accompanying a questionnaire to provide information on existing facilities available for mercury analysis in each country. In total 210 laboratories from 60 countries provided feedback on their sampling and analytical capacities.



This document presents worldwide capacities to analyse mercury, including a comprehensive compilation of information on the laboratories from all UN regions capable of identifying and quantifying mercury species in biotic and abiotic samples.

Based on the responses to the questionnaire a databank[22] of laboratories analysing mercury was developed in 2017 (the databank is a joint effort with the POPs laboratories databank). The Hg databank lists laboratories from both developed and developing countries, capable of identifying and quantifying mercury species in biotic (human urine, cord blood, fish etc.) and/or abiotic (ambient air, sediment etc.) samples.

[21] http://wedocs.unep.org/bitstream/handle/20.500.11822/21059/UNEP%20-%20Global%20Review%20of%20Mercury%20Monitoring%20Networks_Final.pdf?sequence=1&isAllowed=y

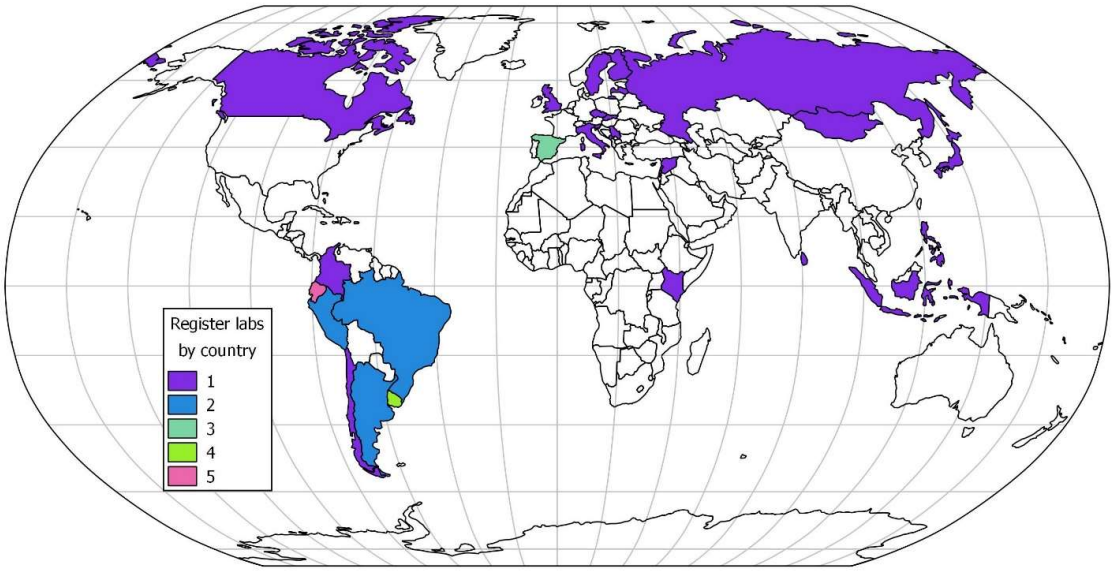
[22] http://informea.pops.int/HgPOPsLabs/index.html

2.4.2.1. Global Assessment of Laboratories Analysing Mercury - First Round 2018

UNEP, in partnership with RECETOX, conducted in 2018 the first round of a global assessment of laboratories analysing mercury. A selection of laboratories was invited to analyse the same samples of three different matrices (Standard solution, Hair and Fish) for total mercury within a limited time frame. No matrix was compulsory, and laboratories could select one or more matrix(es). The laboratories reported their results for subsequent evaluation according to international standards. 38 laboratories from 28 countries in all 5 UN regions participated in the assessment.

The report "Global Assessment of Laboratories Analysing Mercury - First Round 2018"[23] presents the outcome of the assessment and shows a state-of-the-art information regarding the worldwide capacity of laboratories to analyse mercury as available in 2018.

Figure 3.- Number of laboratories participated in the Interlaboratory assessment.



There were 26 out of 38 laboratories (68%) that analysed samples of all three matrices and 19 of them (73%) did deliver satisfactory results (z-score in the interval > -2 and < +2) in all three matrices (Figure 2). Only one laboratory did not succeed producing satisfactory result in any of the three test samples. Five laboratories registered for two matrices (13.1%), and 7 analysed one matrix (18.4%).

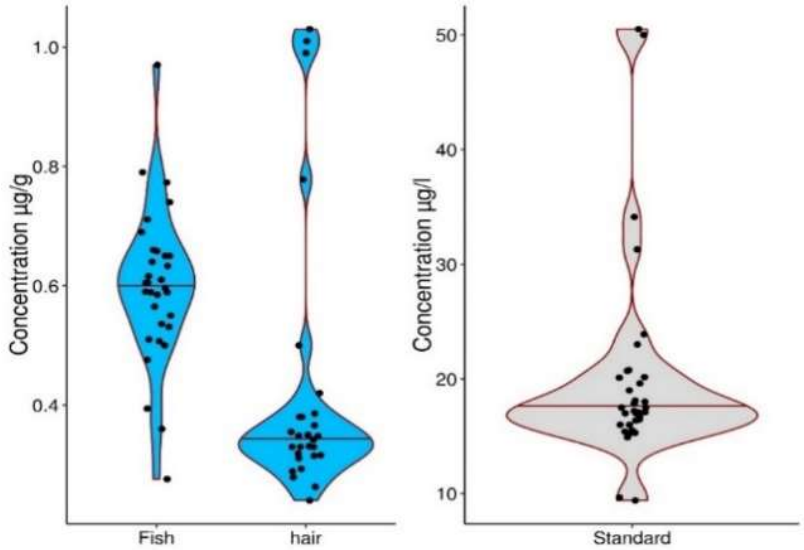
Table 2. Results received per matrix, and percentage of laboratories reporting satisfactory results

Type of samples	Number of laboratories delivering data	Percentage of satisfactory results*
standard solution	34	79.4 %
fish sample	32	84.4 %
human scalp hair	28	82.1 %

*Considered satisfactory results if the z-scores were in the interval > -2 and < +2.

[23] https://wedocs.unep.org/bitstream/handle/20.500.11822/28381/LabAssess.pdf?sequence=1&isAllowed=y

Figure 4. Violin plot showing the probability density of all results for Fish, Hair and Standard Solution.



2.5. Capacity Assistance by the International Atomic Energy Agency for mercury monitoring

- The Environmental Laboratories of the International Atomic Energy Agency (IAEA), are assisting countries inter alia in the quality assurance and quality control (QA/QC) of their environmental monitoring of hazardous pollutants, such as trace elements like mercury and its organic species. Some of the primary activities include: development of criteria for generating high-quality data for monitoring programmes; validation and distribution of recommended analytical procedures for determination of mercury and methyl mercury in different environmental samples and at different concentration levels; production of matrix certified reference materials; organization of global inter-laboratory comparisons; training and capacity building of laboratory practitioners from Member States laboratories; and assisting Member States with mercury monitoring when requested.
- These activities are implemented by
    a. Providing fit-for-purpose and fully validated analytical procedures for the determination of mercury and its species in biota and sediment according to the requirements of the accepted international standards[24,25]. Specific guidelines for the analysis of mercury and its species in biota comprising recommended methods for sampling, sample preservation and preparation, instrumental analysis, data treatment and uncertainty evaluation could be developed upon receiving a mandate for this.
    b. Producing and distributing matrix certified reference materials, with certified mass fractions of mercury and methyl mercury in biota. The current inventory includes[26]:
        i. IAEA-407: Hg and MeHg in fish homogenate
        ii. IAEA-436: Hg and MeHg in tuna homogenate
        iii. IAEA-452: Hg and MeHg in scallop[27]
        iv. IAEA-461: Hg and MeHg in marine biota (Gafrarium tumidum)
        v. IAEA-450: Hg in algae

        Sediment:
        vi. IAEA-456: Hg and MeHg in marine sediment[28]
        vii. IAEA-457 and 458: Hg in marine sediment
        viii. IAEA-475: Hg and MeHg in marine sediment
        ix. IAEA-SL-1: Lake Sediment

[24] A. Krata, E. Vassileva, E. Bulska, Reference measurements for total mercury and methylmercury content in marine biota samples using direct or species-specific isotope dilution inductively coupled plasma mass spectrometry, Talanta160(2016)562–569,

[25] L. Carrasco, E.Vassileva, Determination of methyl mercury in marine biota samples: Method validation,Talanta122(2014)106–114

[26] https://nucleus.iaea.org/rpst/ReferenceProducts/ReferenceMaterials/Trace_Elements_Methylmercury/index.htm

[27] E. Vasileva, S. Azemard, J. Oh, P. Bustamante, M. Betti, Certification for trace elements and methyl mercury mass

fractions in IAEA-452 scallop (Pecten Maximus) sample, Accred Qual Assur (2011) 16:439–447, DOI 10.1007/s00769-011-0793-y

[28] E. Vassileva, S. Azemard, P. Mandjukov, Certification for trace elements and methyl mercury mass fractions in IAEA-456 marine sediment sample, Accred Qual Assur (2018) 23:29–37, https://doi.org/10.1007/s00769-017-1297-1

Other reference material of specific biota species can be produced and certified within a timeframe of 2-3 years, subject to the availability of raw material and funding.

c. Organizing of targeted proficiency tests and inter laboratory comparisons for the analysis of trace elements including Hg and MeHg in marine matrix samples, such as fish, mussels, clams, marine sediment to check laboratories performance. Examples include:
   i. 2017 Worldwide Inter Laboratory Comparison on trace elements in fish (IAEA-MESL-ILC-TE-BIOTA-2017) [29]
   ii. 2011 Worldwide Inter Laboratory Comparison on trace elements in marine sediment (IAEA-457) [30]

Reports of Interlaboratory Comparisons routinely provide a list of laboratories that have taken part in the exercise and could therefore be used to identify laboratories capable to participate in Hg monitoring.

- Given the extensive expertise in quality assurance measures, the IAEA is well placed for consideration when exploring options to oversee and coordinate regional QA/QC centres, by providing training and advice for experts in regional hubs.
- Through the framework of its Technical Cooperation (TC) Programme, the IAEA has been involved in training and capacity building of laboratory practitioners from Member States laboratories.
- The Environmental laboratories of the IAEA are prepared to assist the United Nations Environment Programme and IAEA Member States to establish or strengthen environmental mercury monitoring efforts through the above listed activities. Additional funding will be required to increase the IAEA's involvement in this area of the Minamata Convention's implementation.

2.6. Meetings

2.6.1. Workshop "Element to Consider When Designing a Global Monitoring Plan for Mercury"[31]

The meeting was hosted by CNR-IIA from 13-14 February 2018, in Roma, Italy.

The workshop discussed the results and lessons learned of the pilot studies of the Global Plan for monitoring mercury.

2.6.2. Human Exposure to and Environment Concentration of Mercury Outcomes and lessons learnt Global environment Facility Project[32]

The meeting was held the 17 November 2018, back to back to the second meeting of Conference of the Parties to Minamata convention in Geneva, Switzerland.

During the meeting, outcomes of the entire project and lessons learnt, including the key outputs were presented.

2.6.3. Expert consultations meeting on mercury monitoring on Soil and Biota[33]

The Second Meeting of the Conference of the Parties to Minamata Convention discussed the arrangement regarding comparable monitoring data and elements of an effectiveness evaluation framework. During the discussion, among others biota was included as a key matrix in the framework of the effectiveness evaluation, and some delegation highlighted soil as matrix of interest.

[29] 2017 Worldwide Inter Laboratory Comparison on trace elements in fish (IAEA-MESL-ILC-TE-BIOTA-2017)

[30] 2011 Worldwide Inter Laboratory Comparison on trace elements in marine sediment (IAEA-457)

[31] https://www.unenvironment.org/events/workshop/workshop-elements-towards-global-monitoring-plan-mercury

[32] https://www.unenvironment.org/events/workshop/human-exposure-and-environment-concentration-mercury-outcomes-and-lessons-learnt-1

[33] https://www.unenvironment.org/events/workshop/expert-consultation-meeting-mercury-monitoring-soil-and-biota

In order to contribute to the above discussion, UNEP organized an expert consultation meeting to initiate discussion and gather information on mercury and mercury compounds in these two matrices.

The meeting was hosted by the International Atomic Energy Agency (IAEA) Environment Laboratories, from 13-14 May 2019 in Monaco. The meeting brought together a variety of stakeholders, including representatives from parties to the Convention, scientists, the Minamata Convention Secretariat, and UNEP, to discuss the technical aspect of monitoring biota and soil as potential matrices of interest for the discussion of the effectiveness evaluation and the convention.