Harmonization and Networking for contaminant assessment in the Ionian and Adriatic Seas

Methodological proposal for transnational harmonization of monitoring of impacts due to offshore platforms Deliverable T1.3.1

Work Package T1 - Sharing best practices for transnational harmonization for EQSD implementation and link with UNEP/MAP MEDPOL Program and Offshore Protocol of Barcelona Convention

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- ## Introduction

The deliverable T1.3.1 aims to share a methodological proposal for transnational harmonization of monitoring the impacts due to offshore platforms, in case of installation and Produced Formation Water (PFW) discharge.

Briefly, an analysis of legislation and procedure for monitoring offshore platform impacts was carried out at ADRION level, highlighting communalities and dissimilarities between five countries (Croatia, Greece, Italy, Montenegro, and Slovenia). Based on information acquired, harmonized Guidelines for the Environmental Monitoring Plan are also proposed.

- ## Questionnaire

- ### Structure of the Questionnaire

A questionnaire was sent in April 2019 to HarmoNIA partners involved from six countries (Albania, Croatia, Greece, Italy, Montenegro, and Slovenia), in order to gather information on:

- -national legislation for monitoring impacts due to offshore platforms;
- eventual guidelines for drawing up and carrying out the Environmental Monitoring Plan (EMP) in case of offshore platform installation and Produced Formation Water (PFW) discharge;
- describe objectives, procedure, and strategy of EMP for both cases.

- ### Analysis of results

The institutions that replied to the questionnaire were:

- Institute of Oceanography and Fisheries (IOF) and Rudjer Boskovic Institute (RBI), Croatia
- Hellenic Centre for Marine Research (HCMR) and Region of Western Greece (RWG), Greece
- Italian National Institute for Environmental Protection and Research (ISPRA) and National Institute of Oceanography and Applied Geophysics (OGS), Italy
- Institute of Marine Biology University of Montenegro - Institute of Marine Biology (UoM-IMB)
- National Institute of Biology (NIB), Slovenia

Overall, the Questionnaires were completed by 5 out of 6 countries. In Slovenia, according to Mining Act, offshore oil and gas exploration and exploitation is prohibited and there are not offshore platforms. Therefore, the results of the comparative analysis among Croatia, Greece, Italy and Montenegro are described below.

In all countries, EMP is mandatory for monitoring impacts due to offshore platform installation and PFW discharge. Usually, this plan is part of the Environmental Impact Assessment (EIA) procedure. In particular, Italian legislation provides an EMP in case of PFW discharge authorization (procedure not subjected to EIA).

EMP contains the strategy applied to monitor potential environmental impacts due to the project (installation or PFW discharge). It is a flexible tool, which can be reformulated according to circumstances. The monitoring plan has to be related to the nature, location, size of the project and its significant environmental effects. Previous environmental monitoring datasets, when available, should be taken into consideration to modulate monitoring activities and costs.

The elaboration and application of EMP is obligation of the Company holder and monitoring activities are usually carried out by accredited institutions or technical bodies, with specific expertise in marine environmental monitoring and protection. The Company holder is the only responsible for covering the costs for EMP, within the licensed area for exploration and exploitation of hydrocarbons.

EMP aims to assess eventual negative impacts and possible hazards on the environment due to the project.

During EMP elaboration, three steps are usually followed for assessing any potential impacts:

- analysis of the Environmental Impact Study or the environmental state overview before the project;
- determination of monitoring activities to assess environmental impacts due to the project;
- application of corrective/mitigation measures and verification of their effectiveness.

The monitoring strategy includes the measurement of suitable biological, chemical and physical parameters in different matrices (e.g. water, sediment, and biota).

Corrective (mitigation) measures offer prevention, reduction and elimination of significant negative impacts on the environment. Corrective actions are mentioned in EMP strategy in Italy and Montenegro but not in Greece.

Another step of EMP procedure is the Public information about the monitoring activity, its results and any corrective measures. Monitoring results are publically shared by websites of the Competent Authority or Environmental protection Agency or local authorities involved.

Only Italian guidelines are in place for elaboration and execution of the EMP.

There are national guidelines for the preparation of the EMP of the projects subject to EIA procedure, in which offshore platforms can also be included. There are specific guidelines for monitoring impacts of PFW discharge into the sea.

Nevertheless, the following EMP topics are common among Italy, Croatia and Greece:

- defining the survey area,
- sampling stations (number and spatial distribution)
- matrices to investigate,
- parameters to investigate,
- sampling methodologies
- sampling frequency,

In Montenegro, the relative legislation does not specify EMP details but oblige that EMP should contain parameters on the basis of which adverse environmental impacts can be identified (location, method, frequency of measuring).

In Italy, Croatia, and Montenegro, EMP is characterized by three phases of monitoring: pre-installation, installation, and post-installation of the offshore platform. In case of PFW discharge, the monitoring covers the period before discharging PFW into the sea and during the whole period of discharge authorization.
Greece declared monitoring of pre- and post-installation: an initial sampling survey is required to define baseline values (background) for environmental parameters; then, final monitoring is carried out, with a minimum survey frequency once per year. It is recommended that data should also be collected on a more frequent basis within the year in order to enable the assessment of trends within shorter time scales.

Generally, the survey area corresponds to the portion of the sea and seafloor in which significant impacts are expected on the environmental components due to the platform installation. This is a broader licensed area for exploration and exploitation of hydrocarbons and it includes the area close to the platform too. In the case of PFW discharge, Italian guidelines establish the survey area of 500 m from the discharge point.

Commonly, the sampling strategy depends on:

- expected impacts,
- sea and seafloor extension of the survey area and its vulnerability,
- monitoring parameters,
- presence of other environmental monitoring networks,
- presence of anthropogenic and natural "external" environmental pressures (not attributable to the project) that can interfere with the monitoring results.

In particular, sampling details are established in Italian guidelines in case of installation and PFW discharge as follows:

- Installation – radial sampling design, by stations located at increasing distance from the platform, along one or more transects, taking into account sea currents; (further stations are provided, if vulnerable ecosystems are near the platform).

- PFW discharge - water and sediment stations placed at increasing distance from the discharge point, along a transect which will be selected according to sea currents; biota stations should be closed to platform pylons.

Air, seawater, sediment and biota are reported as matrices potentially affected during the construction/operation of the offshore platform. In particular, Italy considers water, sediment and biota as representative of marine environment. Greece details physical/chemical properties and current dynamics of marine waters; local meteorology; the seabed especially on its role in the health of marine ecosystems; parameters related to the avoidance of accidents with environmental impacts in the area closer to the platform.

A different approach is applied in the ADRION area to define sampling frequency and parameters to monitor in water (W), sediment (SED) and biota (B). Usually, 1-2 campaigns per year are carried out for all matrices, but only Italian guidelines include sampling frequency based on project phase (installation or PFW discharge):

- Installation: every six months (W, SED) or also seasonal (B) before installation, during the various installation phases (W) and once at the end of the project or the main construction phases involving the bottom movement (SED, B), every six months after installation (W, SED, B) should be repeated until the initial conditions are restored).

- PFW discharge: one sampling immediately before of discharge starting, twice (summer and winter) during the first monitoring year and once time (summer) in next monitoring years, regardless of the matrix.

Specific details about parameters were not reported from all partners because the national law often does not include such information. Greece reported physicochemical and chemical-biological properties of marine water, analysis of metals and hydrocarbons in sediment in case of PFW discharge. In addition, Greece indicated some biological analyses (assessment of ecological status of important benthic communities, including *Posidonia*, coral and chemosynthetic meadows communities, and bioaccumulation of hydrocarbons and heavy metals in bivalves and fish), without referring to the type of impact (installation or PFW discharge). Indicators of ecosystem services that the sea offers to local societies, including fishing and tourism are also mentioned. Croatia declared biological and toxicological analysis in mussels. Italy indicates specific parameters for water, sediment and biota for monitoring impacts of projects subject to EIA procedure (e.g. platform installation) or PFW discharge (Table 1).

Table 1- Parameters for monitoring impacts of projects subject to EIA procedure and PFW discharge into the sea according to Italian guidelines.

Monitoring of the impact of PFW discharge	**Monitoring of the impact of the offshore platform installation**
Water column salinity, temperature, density, pH, transmittance, current[1], fluorescence (chlorophyll), dissolved oxygen, nutrients[2], total hydrocarbons, aliphatic hydrocarbons[3], BTEX[4]	*Water column* current, temperature, salinity, density, turbidity, dissolved oxygen, chlorophyll (fluorescence), pH, suspended matter
Sediment macroscopic (visual and descriptive) analysis,	*Sediment* grain size, percentage of humidity, specific gravity,

grain size, total organic carbon , total hydrocarbons, aliphatic hydrocarbons[3], BTEX[4], polycyclic aromatic hydrocarbons (PAHs)[5], metals[6]	metals (Hg, Cd, Pb, As, total Cr, Cu, Ni, Zn, Mn, Al and Fe), total hydrocarbons, PAHs, PCBs, organochlorine pesticides, butyltin compounds (tributyltin , dibutyltin , monobutyltin), total organic matter, total nitrogen and phosphorus, total organic carbon , microbiological parameters (total and fecal coliforms, fecal streptococci), ecotoxicological assays Further parameters can be added according to the type of work and the potential impact expected in the EIA report others (e.g. Se, Ba, V)
Biota (by catching platform leg mussels or mussel cages) lipid content, total hydrocarbons, aliphatic hydrocarbons, BTEX[4], polycyclic aromatic hydrocarbons (PAHs)[5], metals[6]	*Biota* (by catching platform leg mussels) metals (Hg, Cd, Pb, As, total Cr, Cu, Ni, Zn, and Fe), PAHs, PCBs, organochlorine pesticides, butyltin compounds (tributyltin , dibutyltin , monobutyltin), Further parameters can be added according to the type of work and the potential impact expected in the EIA report (e.g. Ba, Se, V, halogenated compounds, etc.), biomarkers, fish assemblages analysis, macrozoobenthic community analysis, visual census of cetaceans
PFW pH, total suspended matter, temperature, total nitrogen, nutrients[2]*, sulphates, sulphides, sodium chloride, salinity, metals[6]*, mineral oils, total organic carbon (TOC), dissolved organic carbon (DOC), particulate organic carbon (POC), biochemical oxygen demand (BOD5), organic aromatic solvents, aliphatic hydrocarbons > C12, hydrocarbons < C12, diethylene glycol, other declared additives	*Sea bottom* bathymetry and morphology

[1] current measurements at the PFW discharge depth to identifying the direction of the sampling transect
[2] Ammonia, nitrites and nitrates as nitrogen, phosphate as phosphorus in dissolved phase (*for PFW: ammonia, nitrites and nitrates as nitrogen)
[3] C_6-C_{12} and C_{12}-C_{20}
[4] Benzene, Toluene, Ethylbenzene, o,m,p-Xylene
[5] Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Crysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenzo(a,h)anthracene, Benzo(g,h,i)perylene, Indenopyrene
[6] Lead, Vanadium, Chromium, Barium, Copper, Iron, Mercury, Arsenic, Cadmium, Zinc, Nickel (*for PFW all these metals without Vanadium and Barium to be determined in total and particulate phase)

The quality status of water column, sediment and biota is assessed on the basis of reference standards (quality limit values) reported in national laws (e.g. Legislative Decree 152/2006, Ministerial Decree 260/2010 and Legislative Decree 172/2015 for Italy) and/or European Directives (WFD 2000/60/EC). For Montenegro and Croatia, quality limit values depend on decision of the relevant authority licensed for environmental monitoring.

- ## Harmonized Guidelines for monitoring impacts of installation and PFW discharge on marine ecosystem

Only Italian guidelines are in place for monitoring impacts of projects subject to EIA procedure (e.g. platform installation) and PFW discharge. Italian EMP is the result of

almost twenty years of experience to assess potential environmental impacts linked to offshore platforms, by monitoring activities and laboratory analyses. Here, we propose to share these guidelines and modify them on the basis of expertise of all partners involved in HARMONIA project. A Harmonized EMP (HEMP) is proposed in order to achieve a transnational harmonization of monitoring of impacts due to offshore platforms.

The following topics may be considered for the elaboration of HEMP:

- defining the survey area,
- sampling phases,
- sampling design,
- matrices to investigate,
- parameters to investigate,
- sampling frequency

For each topic, we report the considerations shared among the partners involved in the HARMONIA project.

Defining the survey area

This may be the broader licensed area for exploration and exploitation of hydrocarbons and it may also include the area close to the platform. In case of PFW discharge, the survey area should be about 500 m from the discharge point.

Sampling phases

HEMP may take into account the following three phases of monitoring:

- pre-project: an initial sampling survey to define background/baseline values for environmental parameters before the project;

- during project*: a sampling during implementation of the project, if possible, to define possible alterations within shorter time scales;

- post-project: a final monitoring to enable the assessment of trends of possible alterations within shorter and longer time scales.

*In case of PFW discharge, the monitoring covers the whole period of discharge authorization.

Sampling design

In order to investigate the impact of the platform structure, a radial sampling ~~design~~ pattern can be selected for all matrices, allocating stations around the platform according to fixed distance from it, rather than using a randomized placement. Further stations can be included, if vulnerable ecosystems are near the platform. This sampling design is considered more appropriate for tracing any environmental changes when the point source of disturbance is known (e.g. installation).
In regard to PFW discharge impact, the water samples can be collected on a transect taking into consideration local hydrodynamics, if possible, that may affect PFW

dispersion from the point of discharge, while sediment can be collected along a transect oriented towards the dominant current. Stations for biota collection may be closed to platform pylons.
Furthermore, in order to obtain an exhaustive rigorous environmental framework, all matrices should be sampled also in a control area, presenting the same geo-morphological characteristics of the investigated area, but not directly influenced by the offshore activities.

Matrices to investigate

All matrices potentially affected by the projected activity? have to be monitored. In particular, water, sediment and biota are investigated in marine environment; in addition air might be monitored too.

Parameters to investigate

The HEMP proposes to monitor all suitable environmental and biological parameters in order to control potential impacts (due to the project) on the marine ecosystem. Monitoring of chemical-physical characteristics of water and sediment, together with ecotoxicological assays, bioaccumulation analyses (e.g. mussels, fish) and ecological investigations (e.g. macrozoobenthic soft-bottom community structure), may provide the necessary information for assessing the actual spatial and temporal perturbations occurring in the marine ecosystem. Numerical modelling should be considered: a) as one of the first steps in the design of monitoring programme of PFW discharge for a prevention-first policy; b) as one of monitoring tools for assessing risk associated to PFW dispersion into the sea.
The HEMP couples information on physical, chemical and biotic variables to give the best description of the environmental quality status.
In table 2 is reported a list of recommended parameters that should be analyzed for monitoring impacts of offshore platform installation and PFW discharge into the sea. These parameters have been selected according to Italian guidelines and expertise of all partners involved to HARMONIA project. In particular, only the core parameters which are essential for monitoring impacts of installation were chosen among those reported in Italian guidelines and in Norwegian guidelines for monitoring impacts of projects subjected to EIA procedure.

Table 2- List of recommended parameters that should be analyzed for monitoring impacts of offshore platform installation and PFW discharge into the sea.

Monitoring of the impact of PFW discharge	Monitoring of the impact of the offshore platform installation
Water column salinity, temperature, density, pH, transmittance, turbidity, fluorescence (chlorophyll), dissolved oxygen, current[1], nutrients[2], suspended matter, total hydrocarbons, aliphatic hydrocarbons[3], BTEX[4], phenols, ecotoxicological assays, passive sampling, PFW dispersion model	*Water column* current, temperature, salinity, density, turbidity, dissolved oxygen, chlorophyll (fluorescence), pH, suspended matter, transmittance, BTEX, total hydrocarbons, aliphatic hydrocarbons, phenols, passive sampling
Sediment macroscopic (visual and descriptive) analysis, grain size, total organic carbon (TOC), total hydrocarbons, aliphatic hydrocarbons[3], BTEX[4], polycyclic aromatic hydrocarbons (PAHs)[5], metals[6],	*Sediment* grain size, percentage of humidity, specific gravity, metals (Hg, Cd, Pb, As, total Cr, Cu, Ni, Zn, Mn, Al and Fe), total hydrocarbons, PAHs, butyltin compounds (tributyltin , dibutyltin , monobutyltin)[7],

phenol, ecotoxicological assays	total organic matter, total nitrogen and phosphorus, total organic carbon, microbiological parameters (total and fecal coliforms, fecal streptococci), ecotoxicological assays, others (e.g. Se, Ba, V), BTEX, phenols
Biota (by catching *M. galloprovincialis* individuals on the platform legs or mussel cages) lipid content, total hydrocarbons, aliphatic hydrocarbons, BTEX[4], polycyclic aromatic hydrocarbons (PAHs)[5], metals[6]	*Biota* (by catching platform leg mussels/polychetes) metals (Hg, Cd, Pb, As, total Cr, Cu, Ni, Zn, and Fe) others (e.g. Ba, Se, V), IPA, butyltin compounds (tributyltin , dibutyltin , monobutyltin)[7], fat content, biomarkers, fish assemblages analysis, macrozoobenthic community analysis, visual census of cetaceans
PFW pH, total suspended matter, temperature, total nitrogen, nutrients[2]*, sulphates, sulphides, chlorides, salinity, metals[6]*, mineral oils, total organic carbon (TOC), dissolved organic carbon (DOC), particulate organic carbon (POC), biochemical oxygen demand (BOD5), organic aromatic solvents, aliphatic hydrocarbons > C12, hydrocarbons < C12, diethylene glycol, other declared additives, PAHs, phenols, ecotoxicological assays, radionuclides (^{226}Ra, ^{228}Ra, ^{210}Pb in certain cases, also ^{228}Th)	*Sea bottom* bathymetry and morphology

[1] current measurements at the PFW discharge depth to identifying the direction of the sampling transept
[2] Ammonia, nitrites and nitrates as nitrogen, phosphate as phosphorus in dissolved phase (*for PFW: ammonia, nitrites and nitrates as nitrogen)
[3] C_6-C_{12} and C_{12}-C_{20}
[4] Benzene, Toluene, Ethylbenzene, o,m,p-Xylene
[5] Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Crysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenzo(a,h)anthracene, Benzo(g,h,i)perylene, Indenopyrene
[6] Lead, Vanadium, Chromium, Barium, Copper, Iron, Mercury, Arsenic, Cadmium, Zinc, Nickel (* for PFW all these metals without Vanadium and Barium to be determined in total and particulate phase)
[7] The butyltin compound should be recommended particularly in the old platforms tributyltin as biocides in antifouling paints were used
Note: stable isotope ratio of carbon, nitrogen and sulphur in dissolved, particulate and sediments may be analyzed in order to trace the eventual contamination source in case of impact of platform installation and PFW discharge

Sampling frequency

Sampling frequency can comprise of:

- one or two sampling campaigns before the installation of the platform or before the beginning of PFW discharge;
- two sampling campaigns, during the first year of the platform life, or after the beginning of PFW discharge, aimed at capturing the conditions before and after winter mixing of the water column;
- one survey, scheduled for each following year of activity, to monitor both types of impacts.

Conclusions

On the basis of the outcomes of the questionnaires, a Harmonized Environmental Monitoring Plan (HEMP) has been developed among partners involved in the HARMONIA

Project to monitor the potential impacts due to offshore platforms, in case of installation and PFW discharge.
The proposed approach is based on long-term multidisciplinary studies, which provided integrated data on offshore platform monitoring. In the framework of an ecosystemic approach, as recommended by the latest most innovative legislation in the field of environmental monitoring, a HEMP provides guidelines particularly useful towards consistent marine data that serve as a useful tool in order to safeguard the marine ecosystems.

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