Development and demonstration of an automated, modular and environmentally friendly multi-functional platform for open sea farm installations of the Blue Growth Industry

D4.5 – Environmental monitoring and restoration measures following the prototype decommissioning

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LIST OF ACRONIMS AND ABBREVIATIONS

EM	Environmental monitoring
EMP	Environmental monitoring plan
EIS	Environmental Impact Study
EIA	Environmental Impact Assessment
BGF	The Blue Growth Farm

1 INTRODUCTION

1.1 Identification of the document and its structure

The present document is identified as Deliverable D4.5 "Environmental monitoring and restoration measures following prototype decommissioning report" of the Blue Growth Farm contract. The document is an output of the activities carried out in Work Package 4, which are mainly dedicated to Environmental Impact Assessment of the Blue Growth Platform and, specifically, it is developed within Task 4.4, "Environmental monitoring and restoration measures following the prototype decommissioning".

The contents of the document are structured as follows:

- Chapter 1: Introduction;
- Chapter 2: Legal framework
- Chapter 3: Environmental monitoring criteria and objectives
- Chapter 4: Monitoring activities
- Chapter 5: Provisional decommissioning plan
- Chapter 6: Expected impacts
- Chapter 7: Monitoring plan
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- References

This document has been written strictly considering the ISPRA Guidelines on Monitoring Plan drawing of Projects submitted to EIA in Annex 2 Part II of D.Lgs. 152/2006.

1.2 Scope of the document

The environmental monitoring is a tool capable of providing the real "measurement" of the evolution of the state of the environment in the different phases of implementation of a project and, above all, of providing the "signals" necessary to activate corrective actions in the event that the environmental responses do not comply with the one expected by the EIA.

The protype characteristics has been defined in D 2.5. Nevertheless, a subsequent amendment on the mooring system has been produced, and being this more efficient in terms of costs and equipment used, will serve as the basis of the present Deliverable.

Differently from other Deliverables produced within the frame of the WP 4 on impact assessment, the present work is concerning the installation in a real environment of a structure that have to be submitted to a process of Environmental Impact Assessment, under the italian environmental law.

Monitoring activities are then be regulated by the law that states the conditions, the actions and the parameters to be monitored. A description of the legislative frame and of the monitoring principles will be made in following paragraphs.

However, the prototype is classified under the italian environmental law as an "experimental device, kept in use for a period not longer than 2 years". Under this definition, no monitoring activities are

due, but the coexistence of the experimental wind turbine installed on board may make the prototype to be classified as an "offshore wind energy installation" thus subjected to the assessment of the State Environmental Authority.

This document deals with the methodological and operational indications to prepare the EMP relating to projects subjected to the EIA procedure by the State Environmental Authority (Annex II to Part Two of the Legislative Decree 152/2006 and amendments)

The design level of reference, and the consequent level of depth of the informations included into the EMP relates here to Projects drawn at level of the "Definitive" Project, as identified in article 5, letter h) of Legislative Decree 152/2006 and amendments.

2 LEGAL FRAMEWORK

2.1 EU Directives

The Directive 2014/52 / EU, which amends directive 2011/92 / EU concerning the Environmental Impact Assessment of certain public and private projects, has introduced fundamental innovations on environmental monitoring, recognized as a tool *aimed at controlling the significant negative effects on the environment*. These effects can either deriving from the construction and operational phase of the project, and the monitoring is expected to identify any significant unforeseen negative effects, and bring to the adoption of appropriate corrective measures. The Directive also states that monitoring:

- it must not duplicate any environmental monitoring already provided for by other EU or national sector laws to avoid unnecessary costs; for this purpose, it is possible to use, when necessary, existing monitoring networks deriving from other community or national regulations.

- is part of the final decision, which defines the details of the EMP in a way adequate and proportional to the nature, location and size of the project and the significance of its effects on the environment.

- The contents of the EIS (Annex IV to Directive 2014/52 / EU) must be integrated with the description of any monitoring measures of the significant negative environmental effects identified, for example through a follow-up analysis of the project.

The EMP phase in the EIA represents the set of activities to be implemented after the decision-making phase (EIA follow-up) aimed at verifying the results expected from the EIA process and concretizing its real effectiveness through measurable, qualitative and quantitative data , avoiding that the whole process is reduced to an administrative procedure and a formal exercise.

The follow-up includes the activities, divided into four main phases:

1. Monitoring - the set of activities and environmental data collection, characterizing the initial and subsequent phases of the project;

2. Evaluation – the assessment of compliance with the standards, forecasts or expectations of the project's environmental performance;

3. Management - the definition of appropriate actions to be taken in response to problems arising from monitoring and evaluation activities;

4. Communication - information to the various stakeholder involved on the results of the monitoring, evaluation and management activities.

2.2 National Legislation (D.Lgs.152 / 2006 E S.M.I., D.Lgs. 104/2017).

The Legislative Decree 152/2006 and amendments states the purpose of environmental monitoring by including it within the EIA process (Article 22, paragraph 3, letter e).

Environmental monitoring is identified in Part Two of the Environmental Code (as amended by Legislative Decree 104/17 to Article 11 paragraph 2 point 2, as well as to point 7 of the 'Annex VII) as a "provision of monitoring measures" forming part of the contents of the Environmental Impact Study and is therefore produced by the proposer within the analysis and assessments included in the EIS.

Finally, the monitoring is an integral part of the EIA decision (art. 25 of Legislative Decree 152/2006 and subsequent amendments, paragraph 4 letter e) which contains "*the measures for monitoring significant and negative environmental impacts, also taking into account the contents of the EMP prepared by the proposer (...). The type of parameters to be monitored and the duration of monitoring are proportionate to the nature, location, size of the project and the significance of its effects on the environment.* "

The EIA process does not end with the decision of the competent authority but continues with the environmental monitoring, for the following purposes:

- control of significant environmental impacts caused by the approved works,

- control of the correspondence to the provisions expressed on the environmental compatibility of the work,

- timely identification of unforeseen negative impacts, to allow the competent authority to take the appropriate corrective measures that may result, as a precaution, into the amendment or the provisional suspension of the issued authorization, or into the suspension of the authorized works or activities,

- information to the public on how the monitoring is carried out, on its results and on any corrective measures taken, all this through the websites of the Competent Authority and of the Agencies involved.

3 ENVIRONMENTAL MONITORING CRITERIA AND OBJECTIVES

Pursuant to Article 28 of Legislative Decree 152/2006 and amendments, the Environmental Monitoring represents, for all the projects subject to EIA, the instrument that provides the real measure of the evolution of the state of the environment in the various phases of implementation of the project (construction and operation) and that allows the responsible subjects (proponent and Competent Authority) to identify the signals necessary to activate any corrective actions, in a preventive and prompt way, in the event that the status of the environmental components does not fit the forecasts resulted from the EIA process.

The activities and outcomes of environmental monitoring are shared with the public stakeholders, as well as other highlights of the EIA process (consultation, decision) are; to guarantee this purpose, formats have been established in which the information and data contained in the EMP and those deriving from its implementation must be provided by the proposer for communication and information to the various interested parties and for their re-use within other EIA processes, as wella as a common knowledge heritage on the state of the environment and its evolution.

The objectives of the EM and the consequent activities, that must be planned and adequately characterized in the EMP are:

- verification of the reference environmental scenario used in the EIS and characterization of the environmental conditions to be compared with the subsequent monitoring phases, by detecting the parameters characterizing the state of the environmental components and the relative trends existing before the beginning of the work (pre-construction monitoring or monitoring of the base scenario)

- verification of the forecasts of the environmental impacts contained in the EIS and of the variations of the base scenario, through the detection of the reference parameters for the environmental components subject to a significant impact following the work implementation in its various phases (monitoring of the environmental effects during construction and post-operam or monitoring of environmental impacts);

these activities make it possible to:

a) verifying the effectiveness of the mitigation measures envisaged in the EIS to reduce the significance of the environmental impacts during construction and operation;

b) identify any unanticipated or more significant environmental impacts not described in the EIS and plan the appropriate corrective measures for their management / resolution;

- communication of the results of the activities referred to in the previous points to the authorities in charge of possible controls, and to the public.

The EMP must be consistent with the characterization of the state of the environment contained into the EIS in the reference scenario (ante-operam) and to the forecasts of the significant environmental impacts connected to its implementation (during construction and in operation).

The purpose of the EMP stay in the monitoring planning of the environmental components / factors for which, consistent with what is documented in the EIS, significant environmental impacts have been identified generated by the implementation of the project: the Proponent is therefore not required to schedule environmental monitoring connected to purposes other than those indicated. Consequently, the Proponent is not due to support unjustified charges not related to the objective of monitoring the significant environmental impacts strictly related to the project work.

The EMP must be commensurate with the significance of the impacts foreseen in the EIS (extension of the geographic area concerned and sensitivity / criticality characteristics of the areas potentially subject to significant impacts; qualitative and quantitative order, probability, duration, frequency, reversibility, complexity of impacts); consequently, the EM activity to be programmed must be adequately proportioned in terms of extension of the survey areas, number of monitoring points, number and type of parameters, frequency and duration of sampling, etc .;

The EMP must, where possible, be coordinated or integrated with the networks and the monitoring activities carried out by the authorities institutionally responsible for environmental quality control. This condition guarantees that the EM performed by the proposer does not duplicate or replace activities carried out by other competent subjects with purposes other than the monitoring of the environmental impacts generated by the project; in compliance with the different roles and competences, the proposer may use the data and information deriving from the networks and from the environmental monitoring activities, carried out by other subjects according to their institutional competences (ISPRA, ARPA , regions, provinces, ASLs, etc.) to effectively support the specific EM of the environmental impacts generated by the Project;

The EMP represents a technical-operational tool for programming environmental monitoring activities that derive from data, analysis and assessments already contained in the Project and in the SIA: therefore, its contents must be effective, clear and synthetic and must not be duplicated, and the descriptions of general aspects not strictly related to the specific operational purposes of the EMP must to be reduced to a minimum.

At the same time, the EMP must be structured in a sufficiently flexible manner to be able to be eventually reformulated during the technical investigation under the competence of the EIA Board and / or in the planning and operational phases following the EIA procedure: in these phases it may emerge the need to modify the EMP, both following specific requests made by the various competent environmental authorities and following real situations that may affect the technical feasibility of the activities planned by the Proponent.

The monitoring plan should be prepared based on the following methodology:

1-identification of the project actions that generate, for each phase (pre-construction, construction, operation), significant environmental impacts on the individual environmental components (source: project, EIS and related specialistic surveys); for each project action it will also be necessary to highlight and quantify the design parameters that characterize the activity (e.g. for the construction site activities the number and type of operating machines used) as this detail makes it possible to

direct any environmental monitoring to specific type of emission source (eg emissions of diesel engines) and the relative potentially critical environmental parameters (eg PM10)

2 - identification of the environmental components / factors to be monitored (source: project, EIS and related specialist surveys); on the basis of the activity referred to in point 1, the environmental components / factors are selected, since they are affected by significant environmental impacts and for which mitigation measures have been identified, whose effectiveness must be verified through the EMP.

To provide the preliminary and necessary information to set up the activities referred to in points 1 and 2 and not to duplicate what has already been documented in the Project and in the EIS, the use of a synthetic and exhaustive format (tables, matrices, graphics) is advised.

Following the activities indicated in the above points for each environmental component identified in point 2, the following must be defined:

- the areas of investigation where to plan the monitoring activities and the monitoring stations / points where to carry out the sampling;
- the analytical parameters describing the quali-quantitative state of the component to control the evolution in space and time of its characteristics and the consistency with the forecasts made in the EIS,
- sampling, measurement, analysis and related instrumentation techniques
- the sampling frequency and the overall duration of monitoring in the different time phases,
- the methodologies of quality control, validation, analysis and processing of monitoring data
- any actions to be taken in relation to the occurrence of abnormal conditions or unexpected criticalities compared to the reference values assumed (communication to the competent authorities, verification and effectiveness of corrective actions, integrative investigations on the territorial and environmental dynamics in progress, updating of the works program, EMP update)

In relation to the scope of the activities to be implemented, the EMP will provide an adequate organizational structure in charge of managing and implementing the EM activities.

The different professionals involved, selected on the basis of the specific skills required, will have to report to a single responsible person who carries out the technical-operational coordination of the various activities, and acts as an interface with the Competent Authorities responsible for verifying and monitoring the implementation of the EM and its results.

3.1 Areas of investigation

In the EMP, on the basis of the analyzes and evaluations contained in the Project and in the EIS, the areas of investigation where the significant impacts generated by the construction / operation of the work are expected, must be identified and defined for each environmental component.

Although the area of investigation does not include those areas in which the expected impacts are negligible, it must be extended to the portions of territory that are deemed necessary for the characterization of the environmental context of reference (ante-operam); in particular, the area of investigation must include the existing environmental monitoring networks and the relative stations identified as significant for the purposes of the EM and necessary for the characterization of the qualitative and quantitative state of the environmental component in a vast area.

In relation to the specificities of the territorial and environmental context and the expected impacts, the survey area can be identified and delimited based on further criteria that must be adequately motivated and described within the framework of the EMP. In the case of use of simulation models (for example atmospheric, acoustic, hydraulic models, etc.) the area of investigation must include that part of the calculation domain where the output of the model has returned a situation of potential impact with respect to the state before the project beginning.

If deterministic procedures are not available for estimating the environmental impacts (for example for the vegetation, flora, fauna, ecosystems, landscape components) but other criteria are used (qualitative or quantitative checklists, matrices, overlay mapping, etc.) the identification of the area of investigation must be based on the most cautious assumptions deriving from the specific analysis and assessments contained in the EIS, which must be adequately motivated and described within the framework of the EMP.

In addition to the general criteria, the identification of the area of investigation must be carried out taking into account the characteristics of the environmental and territorial context with particular regard to the presence of receptors, paying a special attention to those considered as "sensitive".

The receptors are represented by the elements of a natural or anthropic system, which are potentially exposed to the impacts generated by a given source of environmental pressures.

The "sensitivity" of the receiver can be defined in relation to:

- type of pressure to which the receiver is exposed.
- social, economic, environmental and cultural receptor’s value.
- vulnerability: it is the capacity of the receptor to suffer the negative effects determined by the impact in relation to his ability to face the specific pressure.
- resilience: it is the capacity of the receptor to restore its original characteristics after having suffered the impact generated by a pressure.

3.2 Monitoring stations

Within the survey area, the location and number of monitoring stations must be selected based on general criteria and integrated with specific criteria relating to the individual components / factors:

- significance / magnitude of expected impacts (qualitative and quantitative order of magnitude, probability, duration, frequency, reversibility, complexity);
- territorial extension of the survey areas;

- sensitivity of the environmental and territorial context (presence of "sensitive" receptors)
- criticality of the environmental and territorial context
- presence of other environmental monitoring networks / stations managed by public or private entities that provide data on the qualitative and quantitative status of the monitored environmental factor / factor and constitute a valid reference for the analysis and evaluation of the data acquired during the MA;
- presence of environmental pressures not related to the Project's implementation that can interfere with the results of EM and which must be avoided or duly considered; their prior identification makes it possible not to compromise the results and the validity of the EM carried out and to correlate the results of the monitoring (parameter values) to different possible causes (determinants and pressures).

The localization and quantitative choices of the monitoring stations / points must be adequately motivated and be consistent with the analysis and evaluations contained in the Project and in the EIS, and with any preliminary investigations in preparation for the EMP

3.3 Analytical parameters

The choice of the environmental parameters (chemical, physical, biological) that characterize the qualitative and quantitative state of each component represents the most important element for achieving the EM objectives. The focus must be on the parameters that are actually significant for the control of the expected environmental impacts.

For each analytical parameter identified to characterize both the baseline scenario of the various environmental components (pre-operation monitoring) and the expected environmental effects (work-in-progress and post-operation monitoring), the EMP must indicate:

- limit values set by the relevant sector legislation, where existing; in the absence of terms of reference, the criteria and methods used for the allocation of standard qualitative and quantitative values will be indicated; for these latter cases (generally referable to the environmental components of vegetation, flora, fauna, ecosystems, landscape and cultural heritage) it is necessary to explain and exhaustively document the methods used since the results of the monitoring and the relative assessments are strongly conditioned by the methodological approach used ;
- range of natural variability established on the basis of the data contained in the SIA, integrated, where appropriate, by historical data series, data taken from studies and surveys of a local nature, analysis of the boundary conditions (both anthropogenic and natural) that may represent, during the EM, causes of variations and deviations from the values foreseen within the EIS.

- “threshold” values deriving from the assessment of environmental impacts carried out within the SIA. These values represent the terms of reference to be compared with the values gathered by the EM during construction and post operam in order to:

1. check the correctness of the estimates made in the EIS and the effectiveness of any mitigation measures envisaged;
2. determine any "anomalous" conditions indicating potential critical situations in progress, not necessarily attributable to the work but worthy of adequate investigations aimed at ascertaining the causes and / or possible corrective actions;

3.4 Methodologies of reference for sampling and analysis

Sampling activity and subsequent analysis must be carried out in compliance of recognized methodologies, that duly consider:

- Data significance: the raw data collected must be significant in relation to the objective set by the EM. It is therefore necessary to establish a specific procedures for each environmental component that regulate data validation in relation to the surrounding conditions; the methodologies can be descended by standards codified at regulatory level or by specific procedures, standardized and repeatable, which must be clearly established within a specific "operating protocol" in which the roles and responsibilities of each figure are indicated, in addition to the operating methods of the working group in charge of the EM.

-criteria for processing the acquired data;

- management of "anomalies": in the presence of "anomalies" highlighted by the EM in the different phases (PC, CI, OD) the appropriate procedures aimed primarily at ascertaining the relationship between the anomalous value and the relative environmental pressures, and subsequently to take any corrective action.

The management of these situations can be appropriately adjusted in relation to the specific case and to the reference context, by:

- description of the anomaly
- verification of the anomaly through new surveys / analysis / elaborations, control of the instrumentation for sampling / analysis, in-situ verifications, communications and feedback from the subjects responsible for work site activities, or for other activities not attributable to the Project.

In the event that, following the anomaly assessment activities, the issues has been fixed, the results of the checks carried out and the reasons why the anomalous condition detected is not attributable to the work site / work activities and is not necessary to activate further actions must be reported.

In case that, following the checks above, the anomaly persists and is attributable to the Project (construction site / operation), for its resolution it is necessary to define the operating indications of the second level by:

- communication of data and assessments carried out to the control bodies/Authorities,
- activation of corrective measures for the mitigation of unexpected environmental impacts,
- planning of further surveys / analyzes / elaborations in agreement with the control bodies.

3.5 Temporal phases of activities

The monitoring activities described in the EMP must be articulated following the different project's time phases, as in the following Table.

Table 1: Project's phases

PHASE	DESCRIPTION
PRE-CONSTRUCTION (PC)	Period before the start of building activities, that can be set up after EIA decision
CONSTRUCTION/INSTALLATION(CI)	Period including all building activities to realize the project, as well building site dismantling and restoring to previous state
OPERATION/DECOMMISSION (OD)	Period including all phases of operation and decommission of the project, as: - prior the Project operation within its full functional capability - project operational period - all building activities of the Project decommissioning at its life cycle ending.

3.6 Data format

The EMP must describe the methods for restitution of functional data, to state the methods of implementation and the results and for information purposes to the public.

Using standard data restitution methodology it will be possible:

- share data with the public (also through webGIS services for dynamic data interrogation);
- increase the knowledge on the state of the environment and its evolution, by reuse environmental information
- re-use the data for the preparation of further environmental studies.

3.7 Technical reports and monitoring data

The technical reports prepared periodically following the implementation of the MA must contain:

- the specific purposes of the monitoring activity conducted in relation to the environmental component / factor;

- the description and location of the survey areas and the monitoring stations / points;

- the parameters monitored;

- the temporal articulation of the monitoring in terms of frequency and duration;

the results of the monitoring and the related elaborations and assessments, including any criticalities found and the related corrective actions taken.

In addition to the description of the above, the technical reports must include for each station / monitoring point specific summary sheets containing the following information:

• station / monitoring point

• area of investigation (which includes the station / monitoring point)

• sensitive receptors

• monitored parameters

4 MONITORING ACTIVITIES

4.1 Pre-construction survey

In order to obtain an assessment of potential environmental impacts on the biotic and abiotic compartments, a dedicated boat-based survey is conducted prior starting of the construction/installation phase.

The pre-construction survey should be carried out at least two weeks before construction starts in order to have the most up-to-date and detailed baseline information. The pre-construction survey will collect data on the abiotic and biotic components identified into the EIS.

The following table shows the parameters, the technique and the frequency of the pre-construction monitoring carried out during a dedicated boat-based survey.

Table 2: Pre-construction Survey

Component	Parameters	Monitoring Technique	Frequency
Sediment	• Physical features	One sample for each station	One survey at least 15 days before construction

Component	Parameters	Monitoring Technique	Frequency
Benthic algae	• Abundance	One sample for each station + 1 in the control point	One survey at least 15 days before construction
Birds/Bats	• Presence/absence • Identification • Abundance	Visual observation from the coast	One survey at least 15 days before construction

4.2 Construction/Installation phase

The construction/installation phase requires short-term monitoring, so that potential impacts on environmental components in and around the installation can be assessed in a short time.

The following table shows the parameters, the technique and the frequency of the construction/installation phase environmental monitoring activities.

Table 3: Environmental monitoring during Construction/Installation phase

Component	Parameters	Monitoring Technique	Frequency
Sediment	• Physical features	• One sample for each station + 1 in the control point	• 1 survey
Benthic algae	• Abundance	• One sample for each station + 1 in the control point •	• 1 survey
Birds	• Presence/absence • Identification • Abundance	• Visual observation from the coast	• 1 survey

4.3 Operation phase

The operation phase requires short-term monitoring in the first period in which the plant will start operating, while, subsequently, monitoring can be carried out with reduced frequency in order to observe the evolution of the situation over a long period of time.

The following table shows the parameters, the technique and the frequency of the operation phase environmental monitoring activities.

Table 4: Environmental monitoring during Operation phase

Component	Parameters	Monitoring Technique	Frequency
Sediment	• Physical features	• One sample for each station + 1 in the control point	• 1 survey
Benthic algae	• Abundance	• One sample for each station + 1 in the control point	• 1 survey
Birds/Bats	• Presence/absence • Identification • Abundance	• Visual observation from the coast	• 1 survey/month

4.4 Decommissioning phase

The decommissioning phase includes monitoring aimed at verifying the restoration of the initial conditions. A survey must be carried once a year for the following 3 years (long term monitoring).

The following table shows the parameters, the technique and the frequency of the decommissioning phase environmental monitoring activities.

Table 5: Environmental monitoring during Decommissioning phase

Component	Parameters	Monitoring Technique	Frequency
Sediment	• Physical	• One sample for each station + one in the control station	• 1 survey for next 3 years
Benthic algae	• Abundance	• One sample for each station + one in the control station	• 1 survey for next 3 years
Birds/Bats	• none	• none	• none

5 PROVISIONALS DECOMMISSIONING PLAN

The installation, operation and subsequent decommissioning of the Noel prototype will make necessary the installation of a platform's anchoring system by a dedicated pontoon, each mooring line composed as follows:

1: 1 ton anchor, type Vryhof Mk5

2: 70 m of 100mm studless bottom chain

3: 25 m of 24 mm studless chain

4: 50 m of syntethic mooring rope

5: 10 m of 24 mm studless chain.

this system will remain in operation for the whole duration of the trial, scheduled starting from Spring until Winter 2020.

Table 6: Prototype life timing at Noel site

Installation	Operation	Decommission
start: 01.04.2020	start: 01.05.2020	start: 01.11.2020
end: 30.04.2020	end: 30.10.2020	end: 31.12.2020

the decommissioning steps envisaged are as follows:

1 - removal of equipment: removal of on-board equipment, electrical and signal cables, removal of nacelles and mast;

2 - preparation for towing: preparation of suitable towing lines on eyebolts or bollards suitable for withstanding the force exerted by the towing unit;

3 - platform dismantling: opening of connections between platform attachment points and anchor lines; release of mooring lines to bottom;

4 - recovery of mooring lines: by means of lifting equipment as crane and winch, the whole moring lines will be recovered on board, starting from anchors and recovering bottom chain, mooring chain and textile line.

5 - platform towing in the port of Reggio Calabria.

6 - **pulling on dry dock**, cleaning, steel plates cutting.

7 - **start recycling** or proper disposal, following CER material classification.

The operational machines to be used will be:

Phase 1 -5: towing boat or pontoon suitable for lifting and towing, according to the requirements of the Maritime Authority.

Phase 6: operational machines at shipyard

Phase 7: operational machines for handling and transporting heavy loads.

6 EXPECTED IMPACTS

The main impacts resulting from the decommissioning of the BGF prototype installed in Reggio Calabria within the Noel concession, has resulted in charge of the environmental components “Marine Ecosystems”, better addressed by the factors "Marine communities " and “Marine sediments”, following the issue of the Environmental Impact Study, in D 4.3.

Visual inspections and photographic recordings made on the occasion of NOEL's request to extend the concession for the installation of the platform, have revealed that the seabed is composed of sediments of mixed nature, clastic and organogenic soil, in which the fraction of fine sediment is scarce, also due to the strong currents present inside the Strait, which dilate the fine fractions of the sediment. It is therefore not considered that there may be clouding of the water, which would be readily dispersed by the currents.

It is hypothesized that the mechanical removal of the anchors may leave tracks in the sediments, causing incisions of several m2 of surface that would remain visible until the sediments are re-arranged and re-located due to incident currents and waves.

The impacts expected during the decommissioning phase are as follows:

Marine ecosystem component

Marine sediments: smoothering and consequent disturbance of the seabed due to the chain movement on the seabed; sediment disturbance during mooring lifting operations.

Are expected:

1 - movement and disturbance of marine sediments on an area equal to the physical footprint of the mooring line lying on the sea bed, thus calculated:

a: anchor area;

the smallest anchor reported in Vryhof manual is the MK5 of 1.5 ton; this anchor has a fluke area of approx. 3.6 m2.

In this area it is expected that the sediments will be reworked to a depth equal to the working depth of the anchor, on a surface equal to the projection of the anchor area on the surface of the seabed.

b: area swept by the chain, equal to length x width x angle of movement.

For lines 3 and 4, (at the sea side), the area covered by the bottom chain lying on the seabed is equal to: length x width = 70 x 0,32 = 22,4 m2:

Considering as fixed the anchor head, and the chain sweeping laterally on the bottom due to platform movement, at an angle of 4° (see D 5.2), this lead to a maximum swept surface, per single line, equal to **171** m2 (approx.) following the formula:

Triangle Area = 0.5a*b*sinγ., with a and b triangle sides, and γ included angle.

Due to the relevant weight of the bottom chain (200 kg /m), it is assumed that this can penetrate the seabed to varying degrees, depending on the compactness of the seabed and the movements impressed in case of bad weather.

Therefore, 3 hypotheses are reported, which must be verified during monitoring:

1- complete chain sinking under sediment;

2- sinking limited to the proximal portion at the anchor, arbitrarly set at 10 m;

3- no sinking.

For the two extreme cases, the displaced sediment volume is calculated, equal to:

Case 1: 171 x 0,32 = 54,7 m3 of sediment;

Case 3: 0 x 0,32 = 0, no sediment displacement, only superficial smoothering

In the intermediate case (case 2), it may be hypotesized that the the proximal part of the chain would be totally embedded into sediment, down to the anchor working depth, thus reworking/displacing a sediments volume grossly similar to the chain volume; the distal part would partially remain on sediment surface, displacing sediments by its lateral movements. At the present stage, is not possible to calculate the surface and the volume interested, and this finding would be posponed to the monitoring phase.

For line 1 and 2, the bottom chain length is equal to 45 and 50 m respectively. The maximum angle of lateral shift is calculated (see D 5.2) in 19 °.

The swept areas, calculated as above, are of **329,6** and **406,9** m^2, for chains of 45 and 50 m respectively.

As above, the 3 possible cases of chain embedment in sediment can be solved only by the monitoring activity.

7 MONITORING PLAN

The proposed monitoring plan is based on the impacts identified in Deliverable D4.4.

In particular, the monitoring plan is defined with reference to:

- the practical implementation of conditions and plans arising from the EIA;
- the state of the environment in the proximity of the experimental site;
- the state of the environment more widely, which may be influenced by other activities.

The monitoring plan is structured at the aim of describing the state of the environmental components potentially subject to impacts, both in the **short** and **long-term** timeframes.

In particular, the experimental activity in the NOEL site has a short duration, and will generate impacts of minor significance. In fact, the most of the impacts are limited in space, reversible and of short duration. However, the impacts on sediment and on benthos may reveal a medium/long time recovery, therefore these two receptors have been chosen for the monitoring actions subsequent to decommission, at the aim of recording their recovery on a long time-frame. Should not be this frame sufficient for total recovery, the monitoring plan can be extended forward.

7.1 Monitoring design

The monitoring strategy has been established considering the following aspects:

Areas – the zone impacted is limited to the track generated on seabottom by the mooring line; no other impacts are expected, being these mainly due to the mechanical action of the chain and anchor.

Frequencies – sediment and sessile and long-live algae are not subjected to seasonal dynamics, therefore the annual frequency has been considered appropriate to record the seabottom evolution, either from a physical than from a biological point of view.

Replicates – a minimum number of three replicates has been considered, to reveal a likely patchy distribution of benthic algae. Number is the minimum to obtain a statistically significant average and variance, to be further analyzed by analysis of variance to detect statistically significant differences.

Data analysis – data collected will be analyzed by common statistical software, after been organized in .XLS files. Picture of the bottom will be stored in proper file, to be analyzed in sequence.

Data control – before applying the analysis of variance, a test of data normality will be applied. Pictures will be checked for their clarity, and repeated in case of scarce sharpness.

Mitigations – due to the small surfaces interested by the impact , mitigation are not necessary.

Anomalies – in case of detection of a lack of redistribution of benthic algae by hydrodynamic agents, of in case of lack of reforming of sedimentary bottom structures, the Responsible may decide to extend further the monitoring.

Responsibilities – responsibility and coordination of actions is due to Ing.F. Arena, as responsible of the BGF prototype installation.

Requested competences – skilled divers with professional competencies in sedimentology and algology are requested.

The monitoring plan dedicated to sediment disturbance will be structured as follows.

Table 7 - Monitoring plan on sediment disturbance

Project phase	Installation	Operation	Decommission
Environmental Component	Marine Ecosystem		
Pressure	Mooring removal		
Impacts	Sediment smoothering or disturbance		
Receptors	Marine sediment, seabed features		
Monitoring parameters	Sediment surface structures		
Sampling devices	Underwater camera, 20 and 50 mm lenses		
Data quality control	Visual inspection		
Data processing	Cartographic restitution on small scale maps		
Sampling station	1- anchor area 2- half bottom chain 3- distal head bottom chain 1 randomly chosen land-side and 1 sea-side line, mantained in the following sampling actions		
Survey area	Area swept by anchors and mooring lines		
Sampling rate	Seasonal, spring	Seasonal, summer	Annual, fall
Sampling duration	One campaign	One campaign	3 campaigns
Sampling start	Before installation work	At mooring on site	Immediately after mooring removal
Mitigations	None		
Possible anomalies	Lack of re-dislocation and distribution on areas of surrounding sediments		
Anomaly corrections	None		
Responsible for carrying out the monitoring plan	Ing. F. Arena		

Specific skills/competence required	Diver-Geologist/Naturalist

The biocenoses reported for the areas of intervention belong to the Coastal Detritic (**EUNIS A 5.46**), in the area related to the anchorages towards the sea, and to a population of Photophilic algae (A 3.2) in the area of the land-side anchorages.

Since the surface affected by the anchors is small and the impacts in general are not very visible and limited to small areas, it has considered not feasible to carry out a number of benthos analysis according to the classical benthos sampling methods, as it is likely that the areas are rapidly recolonised from neighboring communities and the possible disturbing effect would not be visible inside the sampling variability. It was therefore decided to carry out surveys of sessile components of the biocoenosis, which better respond to episodes of displacement of the sediment. In the particular biocenosis under examination, these components act as key or structuring species, determining with their presence the community structure. The choice therefore fell on the estimation of the abundance of living thalli of free rhodolites (Lithothamnion spp.), easily recognizable even in photography for their pink / red color evident on the sediment white/brownish appearance.

The monitoring plan dedicated to benthic biocoenoses will be structured as follows.

Table 8 - Monitoring plan on benthic communities disturbance

Project phase	Installation	Operation	Decommission
Environmental Component	Marine Ecosystem		
Pressure	Mooring removal		
Impacts	Benthic communities change		
Receptors	Benthic communities		
Monitoring parameters	Surface density of living calcareous thallii		
Sampling devices	Underwater camera, 50 mm lenses, 20x20 cm frame with 3 replicates/station		
Data quality control	Visual inspection		
Data processing	Abundance/m^2, variance between replicates, both on the station concerned and on “blank” station. Variance analysis between stations.		

Sampling station	1- anchor area 2- half bottom chain 3- distal head bottom chain 1 randomly chosen land-side and 1 sea-side line, kept in the following sampling actions. 1 station "blank" at a distance of 50m, with the same sedimentary characteristics		
Survey area	Area swept by anchors and mooring lines		
Sampling rate	Seasonal, spring	Seasonal, summer	Annual, fall
Sampling duration	One campaign	One campaign	3 campaigns
Sampling start	Before installation work	At mooring on site	Immediately after mooring removal
Mitigations	None		
Possible anomalies	Failure to re-dislocate or passively recolonize live thallii from surrounding areas		
Anomaly corrections	None		
Responsible for carrying out the monitoring plan	Ing. F. Arena		
Specific skills/competence required	Diver-Naturalist		

8 CONCLUSIONS

This document analyses strategies to allow a medium- and long-term monitoring of environmental impacts of the BGF prototype at NOEL site.

Thus, on the basis of the results of the environmental impact assessments developed for the same site, a monitoring strategy has been outlined.

The plan is defined in detail for the decommissioning phase, while for the previous phases some indications are given, in order to cover both the short and long-term perspective. The monitoring plan for the decommissioning phase addresses the monitoring of the most relevant impact expected during platform removal from site to shipyard.

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