



# **Review of environmental impact assessment for aquaculture activities within the Municipality of Poros**

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**Final Report**

**June 2023**

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# Report Information

This report has been prepared with financial support from the *Rauch Foundation*. The views expressed in this study are purely those of the authors and do not necessarily reflect the views of Rauch Foundation, nor in any way anticipates their future policy in this area. The content of this report may not be reproduced, or even part thereof, without explicit reference to the source.

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**Author contact:** [tim@consult-poseidon.com](mailto:tim@consult-poseidon.com)



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**Poseidon Aquatic Resource Management Europe Ltd**  
71 Lower Baggot Street  
Dublin DO2 P593, Republic of Ireland

✉ [europe@consult-poseidon.com](mailto:europe@consult-poseidon.com)  
🌐 [consult-poseidon.com](https://consult-poseidon.com)

## Version control

Version	Date	Changes made	Authors
R/01/A	11 May 2023	Initial draft report	PW, TH
R/01/B	12 May 2023	All area units converted to hectares. Methodological comments section (1.3) added.	PW, TH
R/01/C	05 June 2023	Addressing comments	PW, TH
R/01/D	02 August 2023	Addressing editorial comments	TH, PW

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# Acronyms used

<b>EPHSAA</b> .....	Special Framework for Spatial Planning and Sustainable Development (Ειδικό Πλαίσιο Χωροταξικού Σχεδιασμού και Αειφόρου Ανάπτυξης ΕΠΧΣΑΑ in Greek)
<b>Ha</b> .....	Hectares equivalent to 10 stremmata
<b>HCMR</b> .....	Hellenic Centre for Marine Research
<b>MERAMOD</b> .....	predictive model for aquaculture (see <a href="https://cordis.europa.eu/article/id/81735-meramod-a-predictive-model-for-aquaculture">https://cordis.europa.eu/article/id/81735-meramod-a-predictive-model-for-aquaculture</a> )
<b>POAY</b> .....	areas of organized aquaculture development (POAY in Greek)
<b>PPHSAA</b> .....	Regional Spatial Planning Frameworks for Sustainable Development (Περιφερειακά Πλάγια Χωρικού Σχεδιασμού Αειφόρου Ανάπτυξης in Greek)
<b>S</b> .....	Scenario
<b>SEIA</b> .....	Strategic Environmental Impact Assessment
<b>t</b> .....	(metric) tonne (e.g., 1,000 kilograms)
<b>USD</b> .....	United States dollar

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# Executive summary

An Strategic Environmental Impact Study for aquaculture development within the administrative boundaries of the island of Poros was undertaken by Greek consultants AMBIO in 2015. Based on data collected and analysed in 2015, this strategic environmental impact assessment (SEIA) allows the Government to allocate space production licenses for existing farms and the establishment of new farms.

An examination by independent consultants Poseidon Aquatic Resource Management Ltd finds that the report does not fully cover what would be expected in an environmental (and social) impact assessment study at site level. Whilst the report does follow the required format for the approval of cage site area expansion or new site area and expansion of production to justify the decision to grant the expansion, the study is **insufficient** in the following elements:

Reporting element	Level of weakness
Describing present farm activities and facilities.	Minor
Quantifying planned new facilities (land and sea), use of inputs (feed and fingerlings) and outputs (nutrients released to the water column).	Major
Proposing environmental and social mitigation measures to reduce impact.	Major
Quantification on the use of resources and how these will be addressed (road traffic, marine traffic, additional electricity supply, additional freshwater supply, etc.).	Major
Quantification, solutions and impact from the project outputs such as wastewater treatment, solid waste disposal, organic waste disposal.	Major
The study seriously misinterprets the <i>MERAMOD</i> impact model predictions for the selected alternative 4 with an underestimation of the environmental impacts. The AMBIO study estimates the predicted level of organic sediments deposited below the cages in kg/m <sup>2</sup> /year but makes no judgement where the amount is low, moderate or severe.	Critical
The <i>Meramod</i> model predicts that there are already environmental impacts at the Bisti site (Site 4).	Critical
The study shows no evidence of stakeholder consultation and effort to find mutually agreed mitigation measures to reduce social impacts.	Critical
The marine tourism (yachts, pleasure vessels) would be impacted by the floating cage collars as well as the boating activity during the farm operation.	Minor

# 1. Introduction

## 1.1 Background

Gilthead seabream (*Sparus aurata*) and European seabass (*Dicentrarchus labrax*) are the most commonly farmed species in the Mediterranean at 464,000 tonnes (t) and USD 2.24 billion in 2019. The small Greek island of Poros currently produces around 1,150 t of these finfish, but there are proposals to expand this to 8,831 t by increasing the total leased areas from 9.5 hectares (ha) to 27.5 ha (10 additional hectares for expansion of existing units and 8 ha for new units), some 2.8 times the current area. Furthermore the area allocated to aquaculture around the island is now 270.2 ha., 28 times the current production area. This has raised considerable alarm within the 4,000 residents of the small island of 31 km<sup>2</sup> who consider this will negatively impact the naturalness of the island's seascape on which the tourism industry is so dependent.

## 1.2 Study objective

A series of feasibility studies and environmental impact assessments (EIAs) have been prepared for the designated areas of organized aquaculture development (POAY in Greek). The focus of this review are the following three reports prepared by Ambio in 2015:

1. **Designation of areas of organized aquaculture development (POAY) within the administrative boundaries of the municipality of Poros - Feasibility Study**
2. **Designation of areas of organized aquaculture development (POAY) within the administrative boundaries of the municipality of Poros - Technical Report**
3. **Plan rules of procedure of the management body the area of organized development aquaculture (P.O.A.Y.) within the administrative boundaries of the municipality of Poros**

This SEIA was intended to identify, describe and evaluate the potential significant impacts aquaculture development will have on the physical, environmental and cultural environment of Poros.

The purpose of this short review will be to conduct an independent evaluation into these studies to opine on the validity of their findings, robustness and evidence-base. The output is a reasonably concise report that provide a simple Executive Summary aimed at the lay person, plus a more detailed analysis that lists internationally accepted EIA scoping and evidence requirement criteria and evaluates what the Poros EIA covers or not with an accompanying technical commentary.

The following sections of this review cover the different sections of the SEIA, which are identified where appropriate. The review first provides a 'review of content' that describes what is – or is not – included in the SEIA and (ii) our 'comments' on the adequacy of the SEIA methodology and outputs.

See **Conclusions** (page 20) for a more detailed summary).

## 1.3 Methodology comments

Preparing this report has been constrained by a number of issues which have now been addressed in report version R/01/B. One such issue is the mixture of area units e.g., *stremmata* (1,000 m<sup>2</sup>), hectares (10,000 m<sup>2</sup>) and acres (4,046.86 m<sup>2</sup>) across the different documents. This document is now standardised on hectares (ha.). A second issue is the understanding of the development area. The SEIA in this case covers a production area of 27.5 ha which lies within the POA (total area allocated to aquaculture) of 268.9 ha.

## 2. Review of the SEIA

### 2.1 Scope of the SEIA

#### *Review*

The study notes that in addition, the potential impacts on the natural and man-made environment in the area directly affected by the operation of the expanded facilities were analysed, but also in the wider study area. The potential significant effects on the environment and the organisation of the site, in particular primary and secondary, cumulative, synergistic, short-term, medium-term, long-term, permanent and temporary, positive and negative impacts in areas such as: land use, residential space, biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets data, cultural heritage including architectural and archaeological heritage, landscape, economic basis, spatial organisation of the wider project area, and the relationships between the above factors.

#### *Comments*

The scope does not mention the stakeholder engagement and consultation undertaken during the study.

### 2.2 Section 3 of the SEIA: Feasibility and objectives

#### *Review of content*

The study assesses the present (2015) status of the environment:

- Surface water and groundwater aquifers
- physicochemical parameters of marine waters
- Seabed type
- Seawater Microbial load
- pollution sources
- Habitat types - Flora and fauna
- Climate
- Oceanographic conditions
- Coastal type

The study assesses the present (2015) social status:

- Demographics
- Employment and unemployment
- Tourism
- Infrastructure and services
- Economic conditions
- Land use
- Cultural heritage



The study also assesses.

- Potential areas where there may be significant impact (3 pages)
- Existing environmental problems

The *in situ* measurements were carried out by the Hellenic Centre for Marine Research (HCMR) in the framework of the project "Assessment of the ecological quality of the marine environment for the establishment of the expanded facilities. Poros", which was completed in October 2015.

The study notes that the Municipality of Poros has been characterized entirely as a Landscape of Outstanding Natural Beauty (Government Gazette 559/B/23/ 23-6-1980).

The study also identifies some of the key factors to be considered and mitigation measures identified.

- Population growth in coastal areas and islands has been twice the Community average over the last decade. Coastal areas are destination of the majority of tourists, where the need arises to reconcile economic development, environmental sustainability and the quality of life of the inhabitants of these areas.
- The need to establish a key instrument for balancing sectoral interests, based on the sustainable use of marine resources and on the principle of an ecosystem approach, is expressed by the Integrated Maritime Policy and the Roadmap for Maritime Spatial Planning: achieving common principles of EU".
- Aquaculture has contributed and continues to contribute to local and regional development by improving the socioeconomic situation in coastal areas.
- Despite its dynamics and positive results, it faces significant problems in the business and socioeconomic environment, as it is – exaggerated – assessed as a threat to other activities and uses.
- The controversy over the occupation of living space of other uses – mainly tourism activity – the criticism of environmental damage, must lead in a direction of dialogue, balanced activity and mutual benefit.

### **Comments**

The baseline survey carried out by HCMR is adequate to good in terms of scope and detail. The study does identify the potential areas of conflict between aquaculture and other users of the space and communities in Poros and advises that there must be dialogue, balanced activity and mutual benefit but there is little evidence that other stakeholders were consulted, and solutions agreed.



## 2.3 Section 3 of the SEIA: Feasibility and objectives

### 2.3.1 Legal requirements (Section 3)

#### *Review*

The study lists the National strategies and laws

- National Strategy for Sustainable Development
- National Strategy for the Protection and Management of the Marine Environment
- Law No. 3937/2011 "Biodiversity conservation and other provisions"
- Multi-annual National Strategic Plan for the development of aquaculture in Greece, 2014-2020

The EIA is drafted on the basis of the provisions of the number YPEHODE/EYPE/oik.107017/28-8-2006 (Government Gazette 1225B/2006) JMD.

For the characterization and delimitation of the proposed expanded facilities, a series of criteria was taken into account, as defined in Article 3 of No. U.S.17239/30- 8-2002 (Government Gazette 1175B/2002).

These criteria include:

1. the determination of the compatibility of the proposed expanded facilities with the guidelines of spatial planning and land use, such as: these are defined in points 1 and 4 respectively of Article 3 of No. U.S.17239/30-8-2002 (Government Gazette 1175B/2002),
2. the determination of the adequacy and suitability of the maritime space,
3. the investigation of the existence and adequacy of the land support facilities necessary to serve the expanded facilities,
4. the identification and recording the particular environmental characteristics of the intervention site and its wider area and assessing the impact of the operation of the expanded facilities in the marine ecosystem.
5. In addition, according to this Framework, the location of the necessary facilities (escorts and supporters) for the smooth operation of aquaculture farming units is foreseen on land:
  - a) Accompanying facilities: Facilities referred to in paragraph 2a1 of Article 4. The location of these units shall be carried out in accordance with Article 4, para. 2a1 of the ESDP for Aquaculture.
  - b) Supporting land facilities: this category includes facilities serving aquaculture units, but which do not form a constituent part of the base facility and are located at a distance from it.

These are:

1. juvenile production stations (hatcheries for fish and other freshwater and marine species);
2. hatcheries;
3. fish pre-fattening units;
4. facilities for packaging, preserving and production of unprocessed fishery products;

Categories a and b shall be located outside the seashore or bank and preferably close to them, in order to facilitate the abstraction of water to serve the needs of the installations. The other facilities shall be located in accordance with the provisions of Article 7, para. C ii (Government Gazette 2505/B/4- 11-2011).

It should be noted that according to the PPHSA for Tourism (Government Gazette 3155/B/2013), the activity of aquaculture is not considered desirable in principle in areas characterized as developed or developing touristically. This, of course, on the other hand, does not necessarily indicate an incompatibility between the two activities and does not constitute a proposal for exclusion, since, as characteristically stated in Article 8 para D. Tourism Aquaculture: The siting of new aquaculture units in areas classified as developed or developing tourism is generally not encouraged. Exceptionally, they may be allowed, provided that there is evidence that measures are taken to address any negative effects on tourism, in particular with regard to existing tourism facilities.

The issue regarding the interaction of tourism activities and aquaculture is also highlighted in the ESDP for Aquaculture, where the possibility of developing alternative tourism is mentioned as complementary - towards recreation and environmental education- activity, according to with international experience and practice (fishing tourism, fish tourism), highlighting the positive role that can arise in the local economy and society.

### **Comments**

The description of the legal requirements is adequately covered.

### **2.3.2 EU, national and local environmental protection objectives (Section 3.1)**

#### **Review**

The study describes the objectives and how the study have been taken into account

- EU Community objectives
- National Strategic Environmental Protection Objectives
- Local Strategic Environmental Protection Objectives

### **Comments**

The description of the EU, National and local environmental protection objectives is adequately covered.

## **2.4 Section 4 of the SEIA: Project Description**

#### **Review**

The study makes a brief description of the project (only 6 of 367 pages)

The study notes that the expanded facilities will consist of two (2) production zones intended for the establishment of production facilities, within which all rearing processes will take place. In addition, one (1) following zone is defined, providing for the temporary relocation of units from production zones if ecosystem degradation is detected at the initial locations.

In the solution chosen, the total area occupied by the proposed production zones amounts to 2,690 ha. The leased areas in the whole of the expanded facilities occupy an area of 27.5 ha. In other words, it is proposed to increase the total area of leased areas by 189.47% (18 ha.), of which 105.26% (10 ha.) is for the expansion of existing units and 84.21% (8 ha) is for a new area.

The total proposed annual capacity of the expanded facilities amounts to 8,831 t, corresponding to an increase of 669.61% (7,684 t) of the existing capacity, of which 446.57% (5,124 t) concerns the increase of the capacity of the existing units and 223.04% (2,559 t) the establishment of new units.

The total area to be occupied by the following zone (unused area) amounts to 35.95 ha. The layout of the production and following zones shall be shown in the drawings and topographic diagrams annexed hereto (no Annexes were provided).

The study noted that land support and port facilities are currently located in the area of responsibility of the body in Bisti, Municipality of Poros, P.E. Islands, Attica Region. The analysis of the adequacy of the existing onshore installations shows that the above facilities cover the needs of the existing production. With the proposed increase in the capacity of floating installations, the need for ground support is also increased. This will require the modernisation and expansion of existing facilities as well as the establishment of new ones. In the present study, for the establishment of new facilities, two sites are identified that are considered in principle suitable for the location of land support and port facilities for aquaculture, in accordance with the terms and conditions of EPHSAAY and the other statutory land uses in the wider area. More specifically, it is proposed to locate new land support facilities at Kalami, as well as new land support and port facilities at Ormos Varnianias. Both of these proposed locations are within the administrative boundaries of the Municipality of Poros. As regards the needs for packing and supplying fry, these will be covered by containers and hatcheries in adjacent areas to the Municipality of Poros.

### **Comment**

The project description is poor for both the existing farm areas and the proposed expansion and new areas.

It does not describe the proposed physical and technical facilities in terms of:

- number or type of cages and nets proposed to be used;
- species to be cultured;
- type of feed and feeding systems; and the
- support facilities that will be built on shore (offices, workshops, hatcheries, nurseries, net washers, Jetties, feed and net stores, etc).

It does not describe the operational activities in terms of:

- estimated number of additional personnel;
- projected fish FCR and survival;
- net washing facilities on shore; and
- additional requirement for fresh water.

These details are essential as they affect the level of environmental and social impact that the project will have on the environment and society.

## 2.5 Section 5 of the SEIA: Mandatory assessment of alternatives

### 2.5.1 Presentation of the alternatives (Section 5.4)

#### *Review*

The study identified four alternatives based on scale of production:

1. **Scenario 1 (Zero solution or S0)**, in which no expansion of leased land and increase of the capacity of the units, other than those foreseen by the spatial planning of aquaculture, is foreseen until the establishment of the expanded facilities. It also includes the spatial reorganization of the units, in accordance with the conditions and limitations of the legislation in force, as well as the planning and the plan of productive reconstruction prepared by the operators of the units. It occupies an area of 11.5 ha, i.e. there is no provision for an increase in the total area of leased land. The total annual capacity of the expanded facilities amounts to 1,612 t, which corresponds to an increase of 40.52% (465 t) of the existing capacity.
2. **Scenario 2 (S2)**, in which the layout and area of the leased areas of scenario 1 are maintained, but the capacity of the units is calculated based on the formula of the joint circular EC :121570/1866/12-06-2009 of the joint circular of the Ministry of Public Works and the Ministry of Public Works. Under scenario 2, leased land across the expanded facilities occupies 11.5 ha, i.e. there is no provision for an increase in the total area of leased land. The total annual capacity of the expanded facilities amounts to 3,375 t, corresponding to an increase of 194.12% (2,227 t) of the existing capacity.
3. **Scenario 3 (S3)**, in which an extension of existing units of scenario 1 and 2 up to 100 hectares is foreseen. These units are rearranged to meet minimum distances from neighbouring units and from the coast, in accordance with current legislation. Areas for the installation of new units are also included. The capacity is calculated based on the formula of oik:121570/1866/12-06-2009 joint circular of the Ministry of Public Works and the Ministry of Environment. Under scenario 3, leased land across the expanded facilities. They occupy an area of 35.5 ha. In other words, an increase of the total area of leased areas by 273.68% (26.0 ha) is foreseen, of which 25.263 (24.0 ha) concerns the expansion of existing units and 21.05% (2.0 ha) concerns new areas. The total annual capacity of the expanded facilities amounts to 11,784 t, corresponding to an increase of 927% (10,637 t) of the existing capacity.
4. **Scenario 4 (S4)**, which foresees an extension of existing units of scenario 1 and 2 up to 4.0 ha. and their rearrangement in order to meet the minimum distances from neighbouring units and from the coast, in accordance with the provisions of current legislation. Areas for the installation of new units are also included. The capacity is calculated based on the formula of oik:121570/1866/12-06-2009 joint circular of the Ministry of Public Works and the Ministry of Environment. Under scenario 4, leased land in the expanded facilities-wide including individual units occupy an area of 27.5 ha. In other words, an increase in the total area of leased hectares is foreseen by 189.47% (18.0 ha) of which 105.26% (10.0 ha) concerns the expansion of existing units and 84.21% (8.0 ha) of new land. The total proposed annual capacity of the expanded facilities amounts to 8,831.25 t, corresponding to an increase of 669.61% (7,683.75 t) of the existing capacity, of which 446.57% (5,124.38 t) concerns the increase of the capacity of the existing units and 223.04% (2,559.38 t) the establishment of new units.

## Comment

The alternatives are based on levels of increasing size and production. S0 is the level of production at the time of the study (1,148 tonnes in 2015). The company was producing less than the allowed annual production level. S1 is the level if the company produced to the maximum of its present licence (1,613 tonnes). S2 is an increase in area and production until 3,375 tonnes. S3 is a major expansion of space and production. S4 was the chosen scenario of an increase in area (expansion and new) allowing a significant increase in production.

**Table 1: Alternative scenarios based on area (ha)**

#	INSTITUTION	S0	S1	S2	S3	S4
1A	SELONDA FISH FARMS S.A.	2.0	2.0	2.0	5.0	4.0
1B		2.0	2.0	2.0	5.0	4.0
2A	SELONDA FISH FARMS S.A.	1.0	2.0	2.0	5.0	4.0
2B					5.0	
3A	SELONDA FISH FARMS S.A.	1.0	2.0	2.0	5.0	4.0
3B					5.0	
4	SELONDA FISH FARMS S.A.	3.5	3.5	3.5	3.5	3.5
5	NEW FARM				2.0	4.0
6	NEW FARM					.40
	Total area (ha.)	9.5	11.5	11.5	35.5	27.5
	Increase in area		1.2	1.2	3.7	2.9

**Table 2: Alternative scenarios based on production (t/year)**

#	INSTITUTION	S0	S1	S2	S3	S4
1A	SELONDA FISH FARMS S.A.	460	575	1,294	3,525	2,925
1B						
2A	SELONDA FISH FARMS S.A.	100	300	647	3,525	1,463
2B						
3A	SELONDA FISH FARMS S.A.	150	300	647	3,084	1,097
3B						
4	SELONDA FISH FARMS S.A.	438	438	788	788	788
5	NEW FARM				863	1,463
6	NEW FARM					1,097
	Total production (t/year)	1,148	1,613	3,375	11,784	8,831
	Increase in production		1.4	2.9	10.3	7.7

## 2.5.2 Choice of Alternatives (Section 5.5)

### Review

The study reported that the proposal of alternative scenarios 3 and 4 took into account the existing legal framework, spatial planning, carrying capacity of the ecosystem, interactions with other activities, human activity in the wider area and the need for its development aquaculture sector within the requirements of a POAY study. The reasons why the alternative solutions were chosen are summarized as follows:

- Ability to secure suitable and sufficient land area.
- Absence of protected habitats (at these points no habitats are identified for which special conditions and restrictions apply by EU and national legislation).
- Possibility of coexistence of similar activities, with the creation of economies of scale, which do not contradict institutionalized land uses and do not create nuisance phenomena and land use conflicts.
- Possibility of positive economic and social consequences.
- Existence of the necessary infrastructure (energy, roads, telecommunications) and/or the possibility of improving existing ones and creating new ones, in terms of technical adequacy, economic viability and environmental protection.
- Minimised effects of land area on aquatic ecosystem (e.g. absence of estuarine ecosystems).

Scenario 4 was chosen as the proposed capacity. Under scenario 4, the expanded facilities' annual capacity Poros amounts to 8,831.25 t and considered to be the most cost-effective solution.

### Comment

Four alternative scenarios are considered which are based on increasing levels of expansion in production area and production volume. The selected alternative is Scenario 4, which would increase production from 1,147.5 t to 8,831.25 t (a factor of 7.7x) and increase the production area from 9.5 ha. to 27.5 ha (a factor of 2.9x). However, the interpretation of the predictions made by the *MERAMOD* model have been seriously underestimated and this should be reconsidered or the cage sites moved further offshore where environmental impacts would be less and sustainable carrying capacity levels higher. There should be less or only be a very small amount of the footprint above 50g/m<sup>2</sup>/day to be an acceptable level of impact, where as they are saying that an impact with 75g/m<sup>2</sup>/day and above is acceptable.

**Table 3: Comparison of existing situation with favoured Scenario 4**

#	Institution	Location	Existing Project		Scenario 4		Capacity Increase
			Area (ha)	Capacity (t)	Area (ha)	Capacity (t)	
1A	Selonda Fish Farms	Papanikola Rock	2.0	460.0	4.0	2,925.00	6.3
1B			2.0		4.0		
2	Selonda Fish Farms	Reed	1.0	100.0	4.0	1,462.50	14.63
3	Selonda Fish Farms	Pyrkali	1.0	150.0	4.0	1,096.88	7.31
4	Selonda Fish Farms	Bisti	3.5	437.5	3.5	787.50	1.8
5	New Farm	Plate	n/a		4.0	1,462.50	new
6	New farm	N of Variarnia Bay	n/a		4.0	1,096.88	new
<b>Total P.O.A.Y.</b>			<b>9.5</b>	<b>1,147.5</b>	<b>27.5</b>	<b>8,831.25</b>	<b>7.7</b>

## 2.6 Section 6 of the SIEA: Identification of environmental impacts

### *Identification of Environmental impact factors*

#### *Review*

The study identifies the key theoretical potential impacts to the environment, including:

Impact on the *abiotic* environment:

- Soil - Sediment
- Sea water and freshwater
- Air

Impact on the *living* environment:

- Biodiversity
- Flora and fauna

Impacts related to the *solid* wastes.

#### *Comments*

The theoretical impact of cage culture on the environment is given in sufficient detail.

## 2.7 Section 7 of the SEIA: Assessing effects on the environment

### 2.7.1 Benthic impacts

#### *Review*

To assess the impact of the expanded facilities' operation on the benthic ecosystem of the area, the MERAMOD forecasting model was used for each of the above scenarios. In this study, the MERAMOD model was used for:

1. The dispersal of by-products of the rearing process (escaped food, fish faeces) on the bottom.
2. The expected effects on benthic macrofauna by calculating the change of various indicators determining the biodiversity that meet the requirements of the Framework Directive 2000/60/EC for Waters such as the Shannon-Weiner index.
3. The change in the redox potential of the sediment in the area.

#### *Comments*

The choice of environmental impact criteria to be assessed is good (organic deposition, Shannon-Weiner index and Redox potential). The *MERAMOD* model has been validated in the Mediterranean to predict environmental impact from fish cage farms. However, the interpretation of the predictions in this case have been highly under-estimated.

- Even with **Scenario 1** where there is a slight increase in production, the level of impact is already moderate (e.g. deposition rates of 15 – 45 g m<sup>-2</sup> d<sup>-1</sup>, see Error! Reference source not found. for more definitions of impact).
- In the chosen alternative **Scenario 4**, where interpretation identifies minimal impact, it is in fact moderate (and in some cases >45 g m<sup>-2</sup> d<sup>-1</sup> which is unacceptable in Europe) or severe (e.g. > 75+ g m<sup>-2</sup> d<sup>-1</sup>).



This is examined further below (for Scenarios 1 and 4 only):

- **Scenario 1:** Scenario 1, in which no expansion of leased land and increase of the capacity of the units, other than those foreseen by the spatial planning of aquaculture, is foreseen until the establishment of the expanded facilities. In addition, units under establishment are included, i.e. units that have administrative acts but their licensing and installation has not been completed. It also includes the spatial reorganization of the units, in accordance with the terms and restrictions of the current legislation, the results of the audits carried out by HCMR, as well as the design and the plan of productive reconstruction prepared by the operators of units in the area.

For farming units 1,2 3 and 4, **Figure 1a** and **2a** overleaf show that the organic waste deposition below and southwest of the cages. The maximum values for each site are as follows;

**Table 4: Benthic deposition rates under Scenario 1**

Unit	Kg/m <sup>2</sup> /year	g/m <sup>2</sup> /day	Classification
1A and 1B	10.20	27.94	Moderate
2	4.67	12.79	Light
3	3.78	10.37	Light
4	9.30	25.48	Moderate

- **Scenario 4:** Under Scenario 4, which foresees an extension of existing units of scenario 1 and 2 up to 4 ha. and rearranges them to meet minimum distances from *neighbouring* units and from the coast, in accordance with the provisions of current legislation. Areas for the installation of new units are also included. **Figure 1b** and **2b** overleaf shows that the organic waste deposition below and southwest of the cages. The maximum values for each site are as follows:

**Table 5: Benthic deposition rates under Scenario 4**

Unit	Kg/m <sup>2</sup> /year	g/m <sup>2</sup> /day	Classification
1A and 1B	29.33	80.36	Severe
2A and 2B	16.87	46.22	Moderate*
3A and 3B	16.77	45.95	Moderate*
4	31.39	86.00	Severe
5	15.80	43.28	Moderate
6	10.10	27.67	Moderate

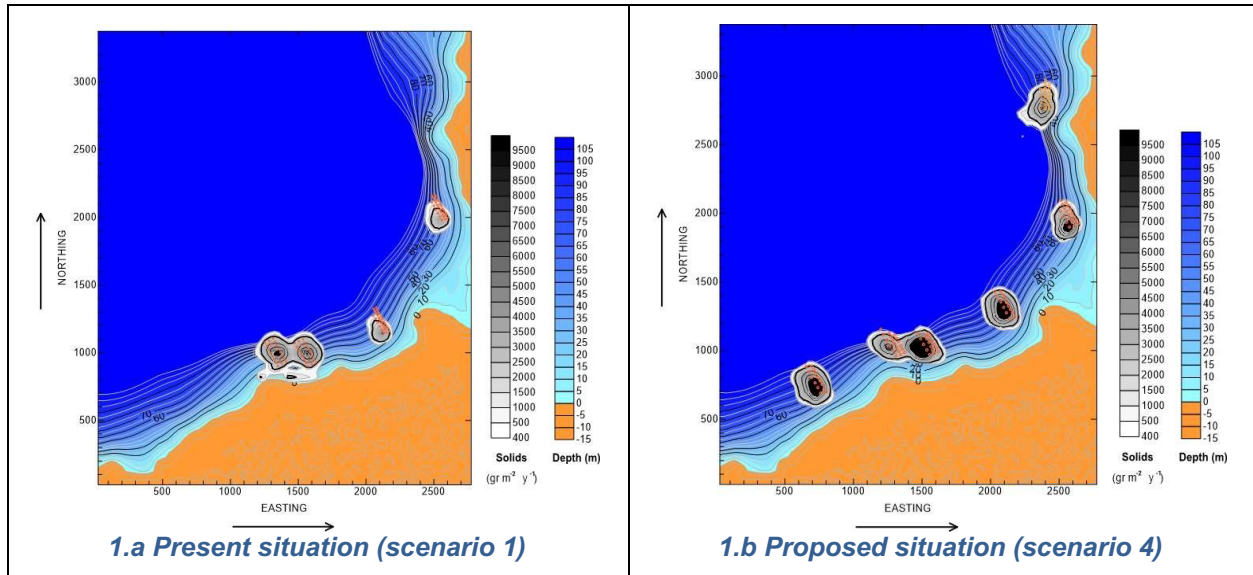
\* Moderate but not generally acceptable in Europe (see **Appendix B**)

## 2.7.2 Cumulative effects on the environment

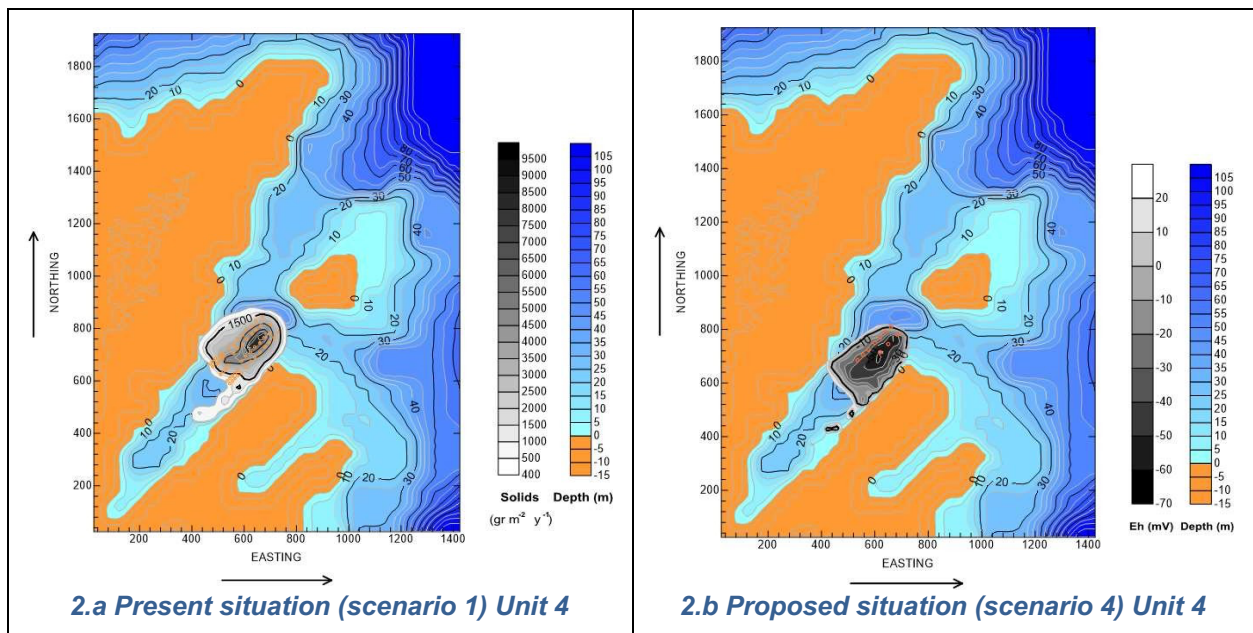
### Review

The SEIA report states that according to the results of MERAMED in the case of scenario 4, no cumulative effects are observed, as there are no interactions between both units and production areas.

**Figure 1: Organic waste deposition below and southwest of the cages of units 1, 2 & 3**



**Figure 2: Organic waste deposition below and southwest of the cages of unit 4**



**Comments**

The *MERAMOD* model (not *MERAMED*) predicts deposition of solids (organic nutrients) on the seabed and impact tends to be local. However nutrients also enter the water column from excretion and affect water quality by increasing the nutrient concentration in the water with high levels increasing the risk of triggering algal blooms. The fish also extract oxygen from the water. These higher nutrient and lower oxygen levels are then moved by seawater current. Unit 1A and 1B are only 230 meters apart (centre mooring to centre mooring). The other farms are at a distance of 650 to 900 meters apart. Cumulative impacts on water quality would be expected to be minor to moderate and should be assessed

The SEIA study recommends the monitoring of cumulative nutrient impacts during operation but does not try to predict this.

### **2.7.3 Identification of other impact factors**

The SEIA does briefly cover identification of other impacts.

### **2.7.4 Impacts related to aesthetics**

#### **Review**

- Noise and light pollution (1/3 page)
- Landscape (1 page)
- Cultural heritage (1/2 page)

#### **Comment**

The study concludes that there will not be any significant impacts. There is very little tourism, rural or urban development along the northern coast and so the potential for conflict is low except for hikers. However, the marine tourism (yachts, pleasure vessels) would be impacted by the floating cage collars as well as the boating activity during the farm operation.

### **2.7.5 Impacts of noise and light pollution**

#### **Review**

The SEIA study stated that low-intensity lighting is used to guard the units, as well as to avoid causing stress to fish populations during storms, which is not expected to affect animal behaviour, as it is limited within the boundaries of leased land.

#### **Comments**

The SEIA does not consider the perimeter mooring warning lights at night and land security lighting at night. It is prudent to have flashing warning lights at night at the perimeter of the sea cage sites together with radar reflectors to prevent collision of boats with the cages at night. The flashing lights can be designed to be shielded from the light penetrating the water and causing light pollution. Unshielded lights might affect sea turtle behaviour, esp. in terms of nesting.

### **2.7.6 Impacts on the landscape**

#### **Review**

The SEIA study recognises that the coastal zone is important for vacation and leisure and are an important national asset. The study concludes that no adverse aesthetic effects are envisaged as the units are located in isolated areas without visual contact with other anthropogenic activities. In any case, when building new land or sea infrastructure, it will be a priority to find ways to integrate it into the surrounding landscape.

## **Comments**

The SEIA study does not quantify the number or size of additional land-based facilities are expected to be constructed or location<sup>1</sup>. This is a major omission as it does not take into consideration the necessary land services and infrastructure requirements that are needed to support the expansion, road traffic increase, freshwater requirement, electricity requirement, housing requirement, sewage and water treatment, etc. Without quantification of these facilities and their locations, it is not possible to make an informed judgment on impact on the landscape. The SEIA study does not take into consideration the visual seascape and impact on yachting in the area and the use of sheltered space and bays.

### **2.7.7 Impact on cultural heritage**

#### **Review**

The SEIA concluded that no impact on cultural heritage is expected during the construction phase, as there are no indications of antiquities at the construction sites (e.g. cage attachment sites), which could be degraded by these works. In addition, in the marine study area there are no declared underwater archaeological sites, while the land facilities are not located near cultural monuments and their operation will not have any impact on cultural heritage.

#### **Comments**

The area appears to be free of important historical cultural heritage. The SEIA does cover identification of residential / spatial impacts

### **2.7.8 Identification residential /spatial impacts**

#### **Review**

Impacts related to land use: In terms of land use, the SEIA report states that proposed location of the cage farms, as well as of the land installations, does not conflict with other important anthropogenic activities. With regard to support facilities, the SEIA states that the permitting will be undertaken on a case by case basis and will comply with local requirements.

#### **Comment**

The SEIA study does not estimate the additional land-based facilities that will be required or provide the area or location of the facilities. The study states that the permitting will be undertaken on a case by case basis and will comply with local requirements. The SEIA does not attempt to quantify the amount and type of land use change.

The SEIA study does not estimate the additional land-based facilities that will be required or provide the area or location of the facilities. The support facilities will include coastal installations such as jetties, net washing facilities including net wash effluents (organic and solid waste). Without quantification of such

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<sup>1</sup> With similar scale cage farms, the onshore facilities would typically include: (i) tank based fish nursery facilities, (ii) offices & accommodation for key staff, (iii) net washing, net repair & net stores; (iv) feed stores, (v) jetty & cranes, (vi) fish packing facility with fish box storage, (vii) maintenance workshop with stores, (viii) spare materials area (cage pipes and stanchions) and (ix) parking area for trucks live fish tanks, etc.

facilities the impact cannot be assessed. For example, the farm will use approximately 150 cages with each cage requiring at least 3 sizes of net that need to be washed annually. The net washing process creates high nutrient effluent that needs treatment before released back to the sea. Net washer effluent is small volume but high nutrient loading and inorganic particle loading (mussel shells). This requires a high level of treatment as well as sludge and solid waste disposal.

**Table 6: Comparison of liquid waste of a net washer and EU standards**

<b>Element</b>	<b>AVG.</b>	<b>Class 3 (EU guidelines)</b>
<i>Suspended solids (mg/l SS)</i>	197	30
<i>Total phosphorus (mg/l P)</i>	13	0.4
<i>Total nitrogen (mg/l N)</i>	24	0.8
<i>COD mg/l</i>	290	15
<i>BOD mg/l</i>	126	15

Source: AMBIO S.A., 2015 and EU.

This will require significant seawater treatment systems to be constructed on the coast. A farm that produces 8,831 t of fish per year will require on land nursery facilities for approximately 26.5 million fingerlings per year that would be housed in tanks onshore provided with seawater. The fish nursing process creates nutrient effluent that needs treatment before released back to the sea. Hatchery effluent is high volume low nutrient can be treated with some reoxygenation.

**Table 7: Comparison of liquid waste from hatchery wastewater and EU standards**

<b>Element</b>	<b>AVG..</b>	<b>Class 3 (EU guidelines)</b>
<i>Suspended solids (mg/l SS)</i>	20	30
<i>Total phosphorus (mg/l P)</i>	0.11	0.4
<i>Total nitrogen (mg/l N)</i>	0.50	0.8
<i>COD mg/l</i>	46.3	15
<i>BOD mg/l</i>	4.6	15

Source: AMBIO S.A., 2015.and EU

A farm that produces 8,831 t of fish per year will require on land fish packing facilities that creates nutrient effluent. Wastewater from packaging plants is high nutrient but relatively low volumes (approximately 2 m3 of effluent per tonne of fish produced) and this needs treatment before released back to the sea.

**Table 8: Comparison of liquid waste from a packaging wastewater and EU standards**

<b>Element</b>	<b>AVG..</b>	<b>Class 3 (EU guidelines)</b>
<i>Suspended solids (mg/l SS)</i>	283	30
<i>Total phosphorus (mg/l P)</i>	23	0.4
<i>Total nitrogen (mg/l N)</i>	72	0.8
<i>COD mg/l</i>	250	15
<i>BOD mg/l</i>	125	15

Source: AMBIO S.A., 2015. and EU

## 2.7.9 Impacts related to Infrastructure

### **Review**

Under infrastructure, the study states that freshwater supply will come from local water supply network or boreholes and that both floating and land units require the existence of road infrastructure for the distribution of products.

**Road traffic:** the SEIA study notes that the state of the road network of the Regional Unit of Islands is characterized as moderate with significant room for improvement. The areas of inland, west – exterior of the Saronic Gulf and Kythira-Antikythera are served by local provincial road networks, which have serious deficiencies. The SEIA notes that there will be generally more vehicular traffic, which is necessary to transport food and other equipment to the premises, will be carried out via the roads connecting the land installations to the main road network and noise may occur. The impact of these activities is limited in scope and duration, therefore are not expected to affect the environment of the wider region.

**Marine traffic:** the SEIA does not address boat traffic.

### **Comment**

The SEIA study does not estimate the increase in road traffic. The expansion of production will cause significantly higher levels of road traffic on an already poor road infrastructure. Road traffic might include:

- Feed deliveries to the feed store
- Deliveries of fry from hatcheries to the onshore nursery unit
- Harvested fish delivered to the packing facilities and from the packing facilities to the main markets
- It is estimated that there will be a need for an additional 300 workers and these workers will have to travel to the farms and back to home on a daily basis

The SEIA study does not estimate the increase in marine traffic. There will also be a significant increase in marine vessel traffic, e.g.,

- Changes of nets (nets taken to shore to be washer, nets taken out Changes washing
- Feed supply to each cage
- Fish harvesting
- Cage servicing
- Divers inspection of each cage
- Cage security at night

## 2.7.10 Fresh water supply

### **Review**

The SEIA study notes that the water supply to the areas of Methana, Troizinia and island of Poros are served by pumped quantities of water from local springs and boreholes. The water supply of the settlements of Kythera is done exclusively by local boreholes while the settlements of Antikythera are served by local sources.

It also notes that overall, taking into account the water supply of urban and non-urban centres in the Regional Unit of Islands, it is concluded that the presence of summer tourism may aggravate the situation.

## **Comments**

The SEIA study does not quantify the freshwater requirement. The production of 8,831 t of fish will require significant freshwater supply in terms of the following:

- Worker drinking water
- Cleaning water (tanks, packing facility, etc.)
- Domestic toilet water
- Water for ice (harvesting, packing)

It is estimated that there will be a need of around 75 m<sup>3</sup>/day for the expanded production. Although this is not a large volume, but it does need to be considered against water availability.

### **2.7.11 Electricity supply and waste water**

The SEIA does not quantify or recommend solutions for the additional requirement of electricity, not does it quantify or recommend solutions for the additional wastewater treatment from toilets, packing facility washing and ice melt.

### **2.7.12 Solid waste disposal**

#### **Review**

The SEIA study states that all solid waste and animal by-products will be disposed of through an approved management body. The remaining waste streams falling under alternative management (lubricating oils, accumulators, batteries, waste electrical and electronic equipment including light bulbs, tyres, end-of-life vehicles) will be collected and delivered to licensed collectors or approved alternative management systems

#### **Comment**

The SEIA report makes no estimate of the scale, type of solid waste that will be generated or give any details on how and where the solid waste will be disposed. The report does not mention the main sources of solid waste which include

- Feed bags
- Discarded nets
- Fish mortalities
- Net washer sludge and shells

### **2.7.13 Employment**

#### **Review**

The SEIA study states that in order to meet the increased production, the recruitment of additional staff will be required, resulting in the strengthening of sectoral employment, contributing to the reduction of unemployment at local level. The SEIA notes that although unemployment levels in the Municipality of Poros record lower levels compared to those in the country (14.86%), young unemployed constitute about 5-6% of the economically active population.



### **Comment**

We estimate that the expansion will create 300 full time jobs. Many of these jobs can be filled by local workers but some positions require specialised training and so a number of technicians will have to be recruited. There will be additional opportunities for part time employment in the fish packing facility

#### **2.7.14 Housing**

##### **Review**

The SEIA study does not mention the additional housing needs for the workers.

##### **Comment.**

There will be a need for additional housing for technicians and managers that will be brought in from outside the island. An increase of additional workers will put pressure on availability (and rental price) for year-round accommodation in a population of 4,000 inhabitants.

#### **2.7.15 Stakeholder consultation**

##### **Review**

The SEIA report states that the involvement of all stakeholders in decision-making is a central element in planning and operation of the expanded facilities, esp. in the following:

- Good spatial planning will help to separate the uses of marine and coastal space, avoiding disputes and conflicts between stakeholders and finding synergies between the activities and the respective environment in which they are carried out.
- Ensure proper involvement of stakeholders and appropriate information to the public.
- Ensure adequate monitoring of the aquaculture sector.

All the above were taken into account when formulating the proposed plan, as well as the objectives and priority areas given by the EU

##### **Comments**

No details of any stakeholder consultation is given in the report even though the SEIA report states that the involvement of all stakeholders in decision-making is a central element in planning and operation of the expanded facilities. If this is the case then there is a serious omission in a SEIA study. There is no mention of social responsibility measures for the local community.

#### **2.7.16 Developing Monitoring Measures (Section 7.4)**

##### **Review**

The SEIA report describes the monitoring measure requirements as follows:

**Mitigation and Compensation Measures:** The SEIA report states the following requirements

- The project promoter will comply with the provisions on the "Protection of the Marine Environment" and take all necessary measures, as well as any additional measures indicated by the competent Port Authority, to avoid pollution of the sea. In particular, the provisions requiring the collection and legal disposal of all petroleum products will be complied with, lubricating oils, sewage, waste and

all kinds of polluting substances, in reception facilities or in a designated land area, with the relevant permission of the competent authorities.

- The floating means (e.g. boats) that carry out movements within the leased area of the unit must be equipped with all the necessary permits and comply with the safety and environmental protection standards provided for in the provisions of the current legislation.
- It is forbidden to catch and trap free fish (wild) within the leased sea area.
- Cage nets shall be kept clean to ensure maximum water circulation and shall be changed whenever their state of cleanliness and the size of the fish so require. If washing is required, it should be done only in a suitable facility.
- The unit will have plenty of electric lighting, so that its outline can be seen by the vessels that are manoeuvring.
- The feed used (artificial, concentrated - pellets) will be of good quality and will be dispersed throughout the cages.
- In order to ensure excellent quality of the final product and maximum consumer safety, the fish feed used must comply with the applicable EU and National regulations regarding their composition.
- Under the responsibility of the project promoter, characteristic parameters of the water quality of the plant and its immediate area will be systematically monitored, in order to assess the conservation status of the plant's environment, and the relevant results of the operation of the project. The results of the above measurements should be kept in paper and electronic form and sent once a year to the Environment Agency of the relevant Region and to the Agency which issues the Authorisation to establish and operate an aquaculture unit. If serious degradation of the ecosystem is detected, the management measures provided for in Chapter 8 shall be applied, depending on the intensity of the adverse effects.
- A chronological record shall be kept of the quantities of waste, its nature, origin and, where appropriate, destination, frequency of collection and mode of transport

### **Comments**

The SEIA report lists the monitoring that is necessary but gives very little information or guidance on any mitigation measures of Environmental Management Plan. The report mentions, feed quality but not measures to reduce FCR and feed wastage, prevent fish escapes, measures to control predators and impacts to biodiversity, use of vaccines to reduce disease and use of medication and chemicals, use of antifoulants on nets and hulls of boats.

### **2.7.17 Monitoring (Section 7.4)**

#### **Review**

The SEIA report states that it is necessary to collect samples at the time when maximum effects are expected from the farm, i.e. at the end of a production cycle. However, depending on the nature of the parameter being measured, it is recommended to be repeated over time in order to determine any temporal variation in the effects. Details are given on monitoring parameters and sample location.

#### **Comments**

The proposed environmental monitoring surveys are adequate to monitor impacts on the environment.

### 3. Summary

The Strategic Environmental Impact (SEIA) study was undertaken in 2015 by AMBIO S.A. The environmental study data collection and analysis was undertaken the same year by the Hellenic Centre for Marine Research (HCMR), a governmental research organisation with a specialist marine research institute, the Institute of Marine Biology, Biotechnology and Aquaculture (IMBBC).

The study *adequately* describes the existing laws, regulations, and governmental framework for aquaculture development and theoretical potential environmental impacts. This will have been sufficient to request increases in production licenses for existing farms and the establishment of two new farms in 2015.

However, the study *does not provide sufficient quantification of environment and social impacts or provide sufficient recommendations on mitigation measures*. In addition, there appears to have been very little stakeholder consultation during the study to be able to find mutually agreed solutions to avoid conflict with other users of the space and the neighbouring communities and tourist trade on the island.

Specifically, the study is **insufficient** in:

- Describing present farm activities and facilities e.g., the number, size of cages, fish production at sea and the land-based facilities, vessels and trucks, etc. It does not provide summaries of regular environmental monitoring surveys indicating the present level of impact and how this is validated with the *MERAMOD* model prediction.
- Quantifying planned new facilities (land and sea), use of inputs (feed and fingerlings) and outputs (nutrients released to the water column). This detail is required to quantify the changes that might occur with the expansion of production and project area.
- Proposing environmental and social mitigation measures to reduce impact. This should be a key part of the study to identify and recommend areas of mitigation to minimise potential conflicts.
- Quantification on the use of resources and how these will be addressed (road traffic, marine traffic, additional electricity supply, additional freshwater supply, etc.) within the level of infrastructure and services available on the island.
- Quantification, solutions and impact from the project outputs such as wastewater treatment, solid waste disposal and organic waste disposal. A major increase in production will generate a large waste water treatment requirement from sewage, facility and equipment washing, etc. This, as well as the other solid and organic waste disposal, needs to be quantified to assess predict scale and potential solutions.
- The study seriously misinterprets the *MERAMOD* impact model predictions (not *Meramed* as referred to in the text) for the selected alternative 4 with an underestimation of the environmental impacts. This misinterpretation minimises the environmental impact of the expanded production on the sediment quality under the cages in the proposed scenario 4.
- The *MERAMOD* model predicts that there are already significant environmental impacts at the Bisti site (Site 4)
- The study shows no evidence of stakeholder consultation and effort to find mutually agreed mitigation measures to reduce social impacts.

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## Appendix B: Definitions of different scales of benthic impact

The following definitions of impact are used:

**Table 9: Contour levels – guide to interpretation based on model validation & application at other sites**

Impact contours	What the contour describes	Reference
<b>Light</b> 1 – 15 g m <sup>-2</sup> d <sup>-1</sup>	1 g m <sup>-2</sup> d <sup>-1</sup> is the contour used to predict footprint. Such low levels of flux to the seabed are often barely detectable above natural background levels in basic sediment trap studies.  This contour is used as an indication of the potential extent of influence of the deposition footprint on the seabed and overlapping between adjacent farm lease areas.	MERAMOD benthic response model and validation studies in Eastern Mediterranean - Cromeu <i>et al.</i> (2012).  TROPOMOD model and sediment trap studies in Philippines – PHILMINAQ study (PHILMINAQ (2008)).  Regulatory modelling of fish farms in Scotland use 250 g m <sup>-2</sup> yr <sup>-1</sup> (0.7 g m <sup>-2</sup> d <sup>-1</sup> ) as an extent boundary – see 'Interim New DEPOMOD guidance' Sep 2022 ( <a href="http://www.sepa.org.uk">www.sepa.org.uk</a> ).
<b>Moderate</b> 15 – 45 g m <sup>-2</sup> d <sup>-1</sup>	The 15 g m <sup>-2</sup> d <sup>-1</sup> is used to predict footprint severity. A moderate to high impact on the sea bed is expected above this level of flux. This level of flux is commonly measured in sediment traps close to the cages in published studies.	As above for MERAMOD and TROPOMOD.  Weise <i>et al.</i> (2009) use 15 g m <sup>-2</sup> d <sup>-1</sup> as a threshold for above which significant benthic alterations were observed – this is for benthic impact observed at shellfish farming sites and the validated model SHELLFISH-DEPOMOD.
<b>Moderate (but not generally acceptable in Europe)</b> 45 – 75 g m <sup>-2</sup> d <sup>-1</sup>	The 45 g m <sup>-2</sup> d <sup>-1</sup> contour was used to compare differences between scenarios when only subtle changes were seen in the 75 g m <sup>-2</sup> d <sup>-1</sup> contour.  Areas which had this level of impact would be expected to approach azoic conditions.	No specific references for this contour; it is a halfway point between the 15 and 75 g m <sup>-2</sup> d <sup>-1</sup>  For both MERAMOD and DEPOMOD studies maximum fluxes for these sites were approximately 50 g m <sup>-2</sup> d <sup>-1</sup>
<b>Severe</b> 75+ g m <sup>-2</sup> d <sup>-1</sup>	The 75 g m <sup>-2</sup> d <sup>-1</sup> contour represents a very high level of flux and is expected to cause azoic conditions on the seabed. This level of flux was modelled and observed at TROPOMOD sites underneath the cages in Asia but was less commonly seen at MERAMOD sites (Eastern Mediterranean).	TROPOMOD model and benthic validation data sets in Philippines – PHILMINAQ and AquaPark projects (PHILMINAQ (2008) & AquaPark (2012))

Published data shows that depositional sites in other environments where predictions of flux are greater than 50 g m<sup>-2</sup> d<sup>-1</sup> (18 kg/m<sup>2</sup>/year) are no longer favoured by the industry.

For comparison with other studies, these daily flux thresholds are equivalent to annual flux rates of 100's g m<sup>-2</sup> yr<sup>-1</sup> (for 1 g m<sup>-2</sup> d<sup>-1</sup>), 1000's g m<sup>-2</sup> yr<sup>-1</sup> (for 15 g m<sup>-2</sup> d<sup>-1</sup>) and 10 000's g m<sup>-2</sup> yr<sup>-1</sup> (for 75 g m<sup>-2</sup> d<sup>-1</sup>).

# Notes



Windrush, Warborne Lane  
Portmore, Lymington  
Hampshire SO41 5RJ  
United Kingdom

Telephone: +44 1590 610168  
[tim@consult-poseidon.com](mailto:tim@consult-poseidon.com)  
<http://www.consult-poseidon.com>