



## Contents

Background information for reviewers	1
Answers from reviewers	2
1. Is the text self-explanatory, free of jargon and easy to follow? If not, where do you see a need for language revision, or more clarity? Please specify page and line numbers if possible.	2
2. Regarding the initial request made to Eklipse “What is the state of knowledge regarding the potential of macroalgae culture in providing climate-related and other ecosystem services?”, do you agree with the interpretation of and refinements to the request and the knowledge synthesis framework?	4
3. Is the global methodological approach logical, well-formulated and appropriate? Please consider that the budget and timetable of this knowledge synthesis is limited (to see the timeline, please go to page 16).	5
4. Is the combination of methods proposed appropriate and justified?	7
5. Is there an undue emphasis on one step/research question? If so, how might it be overcome? On the contrary, should one step/research question be looked into more?	8
6. Are appropriate and up-to-date sources used? Do you know of any additional sources, examples which we could use and where (please be as precise as possible)?	9
7. Any further general comments:	10
8. Are you interested in the further development of the knowledge synthesis?	11
9. Would you like to be acknowledged as reviewer in the final report and how?	11
10. Glossary	11
11. Introduction	12
12. Focus of the request	13
13. Methodological framework	14
14. Selected methodological approach: Quick scoping review	15
15. Selected methodological approach: Delphi process	16
16. Expected approach to organize knowledge and data	17
17. Visualization of findings	18



# REVIEW OF THE METHOD PROTOCOL

MACROALGAE CULTIVATION AND ECOSYSTEM SERVICES

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18. Limitations of the expected conclusions	19
19. Expected results	20
20. Timeline	21
21. References	21
22. Annex I: Delphi Questionnaire	22
23. How did you get to know about this call for review?	23
24. Any other comments?	23
Further comments from reviewers	24
List of reviewers	24



# REVIEW OF THE METHOD PROTOCOL

## MACROALGAE CULTIVATION AND ECOSYSTEM SERVICES

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### BACKGROUND INFORMATION FOR REVIEWERS

Thank you for taking part in the peer-review of the methodological protocol developed by the selected expert working group to answer the Eclipse request on “What is the state of knowledge regarding the potential of macroalgae culture in providing climate-related and other ecosystem services?”

The form has two main parts: a “general comments” part, and a “comments by section” part where you can provide more specific comments to each section of the protocol. Where possible, please provide page and line numbers so that we can ensure we match your comments to the text.

Eclipse is a science-policy mechanism in the public interest and the lawful basis for processing your personal data under the EU’s General Data Protection Regulation (GDPR) will be public task. Our privacy policy (<http://eclipse.eu/privacy-policy/>) contains further information on the purpose and lawful basis for processing your personal data.

Please note the deadline for submitting comments is Friday 2nd July 2021.

Thank you very much for your support!



## ANSWERS FROM REVIEWERS

(ON THE FORM)

1. IS THE TEXT SELF-EXPLANATORY, FREE OF JARGON AND EASY TO FOLLOW? IF NOT, WHERE DO YOU SEE A NEED FOR LANGUAGE REVISION, OR MORE CLARITY? PLEASE SPECIFY PAGE AND LINE NUMBERS IF POSSIBLE.

**Reviewer 1:** Yes, it is.

**EWG:** Thank you

**Reviewer 2:** The text is overall clear and concise, the methodology that the authors want to use is perfectly clear and makes sense for the scope of this study. It has been considered carefully and rigorously.

On pages 5 and 6, there might be a bit of redundancy regarding the key words used to select scientific papers for the QSR, I would consider revising to make it more straight to the point.

On page 8, line 203: needs precision on what are the exact scales used to differentiate the farm sizes (a farm is considered a pilot up to which scale?).

Page 19, question 2: Macroalgae cultivation and production can be considered to be the same thing for some stakeholders, might need to clarify (for example, commercial production? - might be more relevant to industries as well).

**EWG:** On pages 5 & 6: Although the keywords are redundant, we want to make sure that we conduct a thorough review of all the relevant literature without missing any important contributions. Some authors use the word seaweeds instead of macroalgae or aquaculture instead of cultivation. Therefore, we include all words relevant to macroalgae cultivation in order to make sure we cover all the literature.

On page 8, To the best of our knowledge, there isn't a consensual farm classification size at the moment, but we will provide a size classification in the glossary at the beginning of the methods protocol.

On page 19. We changed the option "macroalgae production" into "macroalgae hatchery/nursery" - this is question 2 of the background assessment

**Reviewer 3:** Language is clear and accessible, however, some terms might present a brief explanation as are mentioned, for example, "Green Deal" (page 5, line 22), "European Blue Bio-economy" (page 5, line 23), "blue growth" (pg. 6, line 57), trade-offs (pg. 5, 6, 7, 8, 11, 20 lines 12, 54, 79, 132, 219, 388) and "blue carbon" (pg. 14, line 292). And the meaning of the acronym "EMFF" (pg. 5, line 27) is not stated in any part of the protocol. Finally, Latin terms should be italicized.

**EWG:** As some of the terms might not be consensual, we added link to official websites on the subject (see below)

Terms	
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## REVIEW OF THE METHOD PROTOCOL

MACROALGAE CULTIVATION AND ECOSYSTEM SERVICES

Green Deal	<a href="https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en">https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en</a>
European Blue Bioeconomy	<a href="https://ec.europa.eu/info/research-and-innovation/research-area/environment/bioeconomy/blue-bioeconomy_en">https://ec.europa.eu/info/research-and-innovation/research-area/environment/bioeconomy/blue-bioeconomy_en</a>
Blue-Growth	<a href="https://s3platform.jrc.ec.europa.eu/blue-growth">https://s3platform.jrc.ec.europa.eu/blue-growth</a>
Trade-offs	A situation in which you balance two opposing situations or qualities: <a href="https://dictionary.cambridge.org/pt/dicionario/ingles/trade-off">https://dictionary.cambridge.org/pt/dicionario/ingles/trade-off</a>
Blue Carbon	<a href="https://www.iucn.org/resources/issues-briefs/blue-carbon">https://www.iucn.org/resources/issues-briefs/blue-carbon</a>
EMFF	European Maritime and Fisheries Fund: <a href="https://ec.europa.eu/oceans-and-fisheries/funding/european-maritime-and-fisheries-fund-emff_en">https://ec.europa.eu/oceans-and-fisheries/funding/european-maritime-and-fisheries-fund-emff_en</a>

**Reviewer 4:** Yes, the text is readable for non- native speakers and provide a clear scope for the desired answers.

**EWG:** Thank you

**Reviewer 5:** Generally, although it is a little unclear in the methods around the timing of work having been completed or to be completed. Some details around how systematic the literature review and it will be really important that the 2 experts who review each set of papers in the ASR have a framework that includes weightings or some metrics for each section, e.g., lines 188 onwards.

**EWG:** Regarding the work timeline, this will be adjusted based on the current situation. While there is a significant part already done, concerning the Delphi Process, the actual Delphi questionnaire will only be sent out when the Methods Protocol Review is done and approved. On the other hand, the requester (DGMARE) is aware of time constraints and possible adjustments are possible, focusing primarily on the quality of the work to be delivered. Regarding the QSR, we are considering simple metrics of 1 (suitable) or 0 (not suitable) followed by notes. If each paper has two 0s is rejected, if it has two 1s is accepted and if there are differences between the two reviewers a third reviewer will also check the content and suitability of the paper.

**Reviewer 6:** In general, yes, however, I would clarify in the text which specific ecosystem services have already been attributed to macroalgae cultivation including carbon sequestration which doesn't appear in the text.



## REVIEW OF THE METHOD PROTOCOL

### MACROALGAE CULTIVATION AND ECOSYSTEM SERVICES

**EWG:** Changes will be made according to suggestion.

**Reviewer 7:** it is OK

**EWG:** OK

**Reviewer 8:** yes, but struggling with the definition of ecosystem services, which can be multi interpreted and is confusing. For me it also should mean the service of the seaweed activity to the ecosystem and not just the ecosystem to the human well-being.

**EWG:** The CICES definition for ecosystem services was followed

**Reviewer 9:** Yes, the document is well prepared and easy to follow. The language is quite ok and clear. However, including a simple flow chart diagram representing the whole process of method protocol would be a nice idea for an easy understanding.

**EWG:** Good point, we will include this flow chart

**Reviewer 10:** The text is very well written, flows easily and I could not identify important drawbacks

**EWG:** Thank you

## 2. REGARDING THE INITIAL REQUEST MADE TO EKLIPSE “WHAT IS THE STATE OF KNOWLEDGE REGARDING THE POTENTIAL OF MACROALGAE CULTURE IN PROVIDING CLIMATE-RELATED AND OTHER ECOSYSTEM SERVICES?”, DO YOU AGREE WITH THE INTERPRETATION OF AND REFINEMENTS TO THE REQUEST AND THE KNOWLEDGE SYNTHESIS FRAMEWORK?

**Reviewer 1:** Yes.

**EWG:** OK

**Reviewer 2:** Yes, the methodology used should cover a wide range of ecosystem services and gather enough information to depict the current state of knowledge for this field

**EWG:** OK

**Reviewer 3:** I do, but I believe that papers prior to the year 2000 can also be considered.

**EWG:** Due to time restraints and the enormous work effort involved, we need to limit the number of references and therefore chose to include work only from the past 20 years. We also consider that the Ecosystem Services concept only gained momentum with the millennium assessment.

**Reviewer 4:** Yes, the methodology focuses on the request.

**EWG:** OK

**Reviewer 5:** yes

**EWG:** OK



## REVIEW OF THE METHOD PROTOCOL

### MACROALGAE CULTIVATION AND ECOSYSTEM SERVICES

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**Reviewer 6:** Yes

**EWG:** OK

**Reviewer 7:** I do agree.

**EWG:** OK

**Reviewer 8:** not yet, I missed the way how results from the numerous subsidized EU and national projects on the subject will be included in the QSR. Grey literature is not well specified, and could perhaps be your most important source.

**EWG:** In terms of the grey literature the group decided not to use them. We decided to use only peer reviewed and original publications. As for the EU projects we assume that the main results were published (as the publications are also key performance indicators of these projects) and for those that did not we expect to capture that information with the Delphi process.

**Reviewer 9:** Yes, overall, I agree with the interpretation, refinements to the request, and the methodology adopted by the expert group will support the required knowledge synthesis. Interpretation or the calculation of the ecosystem services will be a challenge for the expert group, since it is not well documented or available in the review of literature. Also, there is a limitation to receive (accurate) climate change related feedback through the Delphi process. However, the major ecosystem services can be identified from the methods that are adopted and also it will be great if any climate change related feedbacks from the contacted experts are available.

**EWG:** in order to standardize the definition of ecosystem services, we follow the CICES guidelines. We acknowledge that there are limitations to the Delphi process, and that is why we decided to simultaneously conduct the QSR

**Reviewer 10:** Generally, agree. I am a bit concerned by the large number of secondary goals: finding or identifying the knowledge gaps of a large variety of ES (which are not quite identified by themselves), AND also identifying gaps on seaweed cultivation per se.

**EWG:** Understandable, but the knowledge gaps will begin to materialize themselves as we search for ecosystem services. Any identified potential services that are not well documented in the literature will be considered a knowledge gap. We also trust that some of the gaps will be identified by the experts answering the Delphi questionnaire

### 3. IS THE GLOBAL METHODOLOGICAL APPROACH LOGICAL, WELL-FORMULATED AND APPROPRIATE? PLEASE CONSIDER THAT THE BUDGET AND TIMETABLE OF THIS KNOWLEDGE SYNTHESIS IS LIMITED (TO SEE THE TIMELINE, PLEASE GO TO PAGE 16).

**Reviewer 1:** Yes, it is

**EWG:** OK

**Reviewer 2:** The global methodological approach is logical and covers the main actors of the field (science and industrial/NGOs stakeholders) and should gather the bulk of the knowledge currently available. However, the document could benefit from a project search as well, for



## REVIEW OF THE METHOD PROTOCOL

MACROALGAE CULTIVATION AND ECOSYSTEM SERVICES

example a small table presenting the main macroalgae-related project that are currently undergoing in Europe, this could give an idea of the current research trend that might not be published yet (as mentioned in the document on page 12).

**EWG:** Good suggestion that relates to the statement above from reviewer 8. We will include such a table of ongoing projects

**Reviewer 3:** It is logical, but I'm not sure that it'll be possible to do all research in 8 months.

**EWG:** We are in permanent contact with the requester, who is aware of the time constraints. We also know that the requester values the quality of the work delivered rather than the initial deadline established so, if an extension is necessary, we will negotiate with the requester

**Reviewer 4:** Yes

**EWG:** OK

**Reviewer 5:** Task timeline seems optimistic as the QSR could be quite involved.

**EWG:** We are in permanent contact with the requester, who is aware of the time constraints. We also know that the requester values the quality of the work delivered rather than the initial deadline established so, if an extension is necessary, we will negotiate with the requester

**Reviewer 6:** Yes. I would only add that while doing the literature search and synthesis, the modelling papers and the conclusions driven from them, need to be taken with caution.

**EWG:** Agree

**Reviewer 7:** It is OK

**EWG:** OK

**Reviewer 8:** I don't understand why just 30% of expert from outside Europe are consulted, because likely more expertise exists outside Europe as inside. Would consider 50/50. Would also consider a larger contribution from industry and lower input from NGO's. This because the NGOs are biased and not economy driven. This is typically an economical driven question!

**EWG:** We discussed this issue thoroughly and decided that because the requester is specifically interested in seaweed cultivation in Europe, and expertise outside of Europe may be regionally-specific, we would mainly focus on this region, but include 30% external experts. We would argue that the industry is also biased, simply because it is economically driven, and therefore representatives from both the industry and NGOs should be equally considered. The requester is interested in ecosystem services provided by macroalgae cultivation, not simply economic value. In any case, our list of experts has a ratio of industry to NGO of 3:2. We would also argue that cannot assume that all NGO are focused on the environment

**Reviewer 9:** The methods put forward by the expert committee are logical and can be executed with a minimum budget. However, the accuracy of the knowledge collected from the following methods largely depends on the quality of the scientific publications or reports that are only openly available. The given time for an expert to give the feedback, i.e., 7days for each round is a good idea, but considering the required recommunication to achieve





## REVIEW OF THE METHOD PROTOCOL

MACROALGAE CULTIVATION AND ECOSYSTEM SERVICES

more clarity on a given information, there should be a short transitional time before going for the next round.

**EWG:** Between the members of the EWG, we have access to most publications and reports. There will most certainly be a transitional time before the next round as we collect, sort, and analyse the results from the first feedback. We will make an effort for the transitional time to be as short as possible.

**Reviewer 10:** Yes, the methodology is good, and appropriate. There might be significant time constraints when viewing the large number of goals.

**EWG:** We are in permanent contact with the requester, which is aware of the time constraints. We also know that the requester values the quality of the work delivered rather than the initial deadline established so, if an extension is necessary, we will negotiate with the requester

### 4. IS THE COMBINATION OF METHODS PROPOSED APPROPRIATE AND JUSTIFIED?

**Reviewer 1:** Yes, it is

**EWG:** OK

**Reviewer 2:** Yes

**EWG:** OK

**Reviewer 3:** it is possible because the methodologies are independent

**EWG:** OK

**Reviewer 4:** Yes

**EWG:** OK

**Reviewer 5:** Yes, but the real value of the QSR will be in getting the detail on the services provided and their value. It will also be really important to then compare these with other options e.g., bivalve culture etc. as this will be critical to inform the decision-making process.

**EWG:** Although we find the idea interesting, we believe it is outside the scope of this task

**Reviewer 6:** Yes. The only thing I would add is to include a search and compilation for ongoing projects that might already be addressing some of the knowledge gaps identified.

**EWG:** a useful comment in line with the previous suggestions. We will include a table of relevant ongoing projects

**Reviewer 7:** Yes

**EWG:** OK

**Reviewer 8:** I like the combination of the QSR and Delphi method! Strong approach.

**EWG:** Thank you



## REVIEW OF THE METHOD PROTOCOL

MACROALGAE CULTIVATION AND ECOSYSTEM SERVICES

**Reviewer 9:** Yes, the synthesis of knowledge and the further data visualizations based on the combinations of the QSR and Delphi methods are appropriate and justified in the method protocol. However, other than review of literature survey, data repositories, or data agencies, if any, can also provide the required knowledge. Also, the knowledge on the history of macroalgal cultivation in Europe is important, since it could act as a reference to compare with the present scenario for the cultivation, ecosystem services and most importantly climate change related aspects.

**EWG:** We appreciate the value of data repositories and data agencies, however we decided to use only peer reviewed and original publications. Potentially missing information can be captured with the Delphi process.

**Reviewer 10:** Yes

**EWG:** OK

### 5. IS THERE AN UNDUE EMPHASIS ON ONE STEP/RESEARCH QUESTION? IF SO, HOW MIGHT IT BE OVERCOME? ON THE CONTRARY, SHOULD ONE STEP/RESEARCH QUESTION BE LOOKED INTO MORE?

**Reviewer 1:** No there is not

**EWG:** OK

**Reviewer 2:** NA

**EWG:** OK

**Reviewer 3:** the research could also focus on the socio-environmental issue, after all the emergence of macroalgae in urbanized coastal regions is intrinsically related to human activities

**EWG:** We try to cover this using specific keyword related to cultural ecosystem services

**Reviewer 4:** How is the industrial sector displayed? How about start-ups and lifetime?

**EWG:** We believe this out of the scope of the work. As for the industrial experts identified for the Delphi, they are selected individually (based on their experience, influence and presence in the actual scenario, not based on the companies' age)

**Reviewer 5:** The value, quantification of the services provided and a comparison with other key interventions e.g., other aquaculture is the most important part of the project and the data gaps associated with this.

**EWG:** We believe this is out of the scope of this request

**Reviewer 6:** No, it seems balanced.

**EWG:** OK

**Reviewer 7:** It is OK

**EWG:** OK



## REVIEW OF THE METHOD PROTOCOL

### MACROALGAE CULTIVATION AND ECOSYSTEM SERVICES

**Reviewer 8:** Yes, as mentioned, I miss the economy very much. This is perhaps the major gap in knowledge. So, Delphi should certainly give an answer not only on technical or biological knowledge gaps, but certainly how an ecosystem service can be business wise brought to the market and generate cash.

**EWG:** OK

**Reviewer 9:** No, there is no undue emphasis on questions. Nevertheless, the recent or emerging challenges, social acceptance, market demands and the advancements (e.g.- IMTA) in the macro algal cultivation can be emphasized.

**EWG:** OK

**Reviewer 10:** Indeed, step-research questions (= “goals”) are numerous on the one hand, and not quite described in details, on the other hand. May I suggest that perhaps the number of questions to address the knowledge gaps might be reduced.

**EWG:** We are not sure about this comment. The request only has two questions, fine-tuned with the requester

#### 6. ARE APPROPRIATE AND UP-TO-DATE SOURCES USED? DO YOU KNOW OF ANY ADDITIONAL SOURCES, EXAMPLES WHICH WE COULD USE AND WHERE (PLEASE BE AS PRECISE AS POSSIBLE)?

**Reviewer 1:** It is appropriate and up to date for me.

**EWG:** Many thanks

**Reviewer 2:** No additional sources

**EWG:** many thanks

**Reviewer 3:** ASVELD, Lotte. Inclusion and Resilience in the Bioeconomy. Bio# Futures, p. 605. MOREIRA, Anthony et al. The underexplored potential of green macroalgae in aquaculture. Reviews in Aquaculture, 2021.

**EWG:** Moreira et al 2021 is a review paper on potential uses of green macroalgae in aquaculture. Although very interesting it would not meet our selection criteria (of only original papers). The Asveld book chapter seems to be very high level, it seems focused on agriculture, with no direct mention to seaweed, and discusses biosphere capacity, reliability in value chains, control over genetic resources and digitalization of farming. We decided to use only peer reviewed, original publications.

**Reviewer 4:** <http://www.fao.org/3/w3732e/w3732e06.htm>

**EWG:** this link seems to be about phytoplankton / microalgae cultures, which isn't so relevant to the subject at hand

**Reviewer 5:** Not sure what sources. Do you mean the references found in the QSR or the methods?

**EWG:** N/A



## REVIEW OF THE METHOD PROTOCOL

MACROALGAE CULTIVATION AND ECOSYSTEM SERVICES

**Reviewer 6:** I would add a review of ongoing research projects working on the topics and companies that are already addressing some of the gaps in knowledge.

**EWG:** That is a good suggestion. Thank you.

**Reviewer 7:** In the GLOSSARY: Land-based cultivation and transitional lines need key references.

**EWG:** definitions for these terms will be added

**Reviewer 8:** EU database for reports of EU projects; FAO; patent databases; national project (report) databases; some recent book chapters.

**EWG:** Many thanks, this will be added

**Reviewer 9:** Yes, the expert group tried to use the recent and appropriate sources for generating the method protocol. I would like to give the following sources:

1. The impact of seaweed cultivation on ecosystem services - a case study from the west coast of Sweden (Hasselström et al. 2018)- <https://doi.org/10.1016/j.marpolbul.2018.05.005>- For identifying and classifying ecosystem services (Table).
2. An Ecosystem Approach to the Culture of Seaweed (<https://spo.nmfs.noaa.gov/sites/default/files/TMSPO195.pdf>)- conceptual diagrams for seaweed farming and IMTA,
3. Seaweed aquaculture: cultivation technologies, challenges and its ecosystem services (Kim et al. 2017)- <https://doi.org/10.4490/algae.2017.32.3.3>
4. Seaweed industry in Europe- [https://www.seaweed.ie/irish\\_seaweed\\_contacts/doc/Filieres\\_12p\\_UK.pdf](https://www.seaweed.ie/irish_seaweed_contacts/doc/Filieres_12p_UK.pdf)- The potential strains of seaweeds used for cultivation in European countries can be identified from the document.

**EWG:** Many thanks for your suggestions. Good documents to be cited.

**Reviewer 10:** Updated sources

**EWG:** Many thanks

### 7. ANY FURTHER GENERAL COMMENTS:

**Reviewer 1:** For the exploration of the literature, do you choose specifically research papers that performed their research in Europe or not? Since this document is meant for EU, I presume that you focus your search within EU.

**EWG:** our literature search is not limited to the EU, as we focus on any example of ecosystem services that macroalgal cultivation can provide

**Reviewer 2:** NA

**EWG:** NA

**Reviewer 3:** *no comment*

**EWG:** NA



**Reviewer 4:** Sorry for delay

**EWG:** The timing was good. Thanks

**Reviewer 5:** *no comment*

**EWG:** NA

**Reviewer 6:** *no comment*

**EWG:** NA

**Reviewer 7:** None

**EWG:** NA

**Reviewer 8:** I miss some keywords which I consider as very important, also to approach is from the positive side and opportunities: integrated - biodiversity- sequestration - disease - pests - credits - economy

**EWG:** Thank you. We decided the selected keywords to avoid any bias in the search. Secondary keywords will be used in the next phase for data representation and paper selection, possibly including the ones suggested here.

**Reviewer 9:** Identifying and classifying ecosystem services based on the collected information is preferred.

**EWG:** Secondary keywords will be used in a second phase to group the papers. In any case, we will have to work with accepted and recognized ES and not identify new ones, as that is outside the scope of this working group.

**Reviewer 10:** I judge this a very relevant project lead by a quality EWG. The contribution will be immense in boosting seaweed cultivation in Europe.

**EWG:** Many thanks

## 8. ARE YOU INTERESTED IN THE FURTHER DEVELOPMENT OF THE KNOWLEDGE SYNTHESIS?

All reviewers: Yes, I am interested

**EWG:** Many thanks

## 9. WOULD YOU LIKE TO BE ACKNOWLEDGED AS REVIEWER IN THE FINAL REPORT AND HOW?

All reviewers: Yes, you can include name and institution

## 10. GLOSSARY

**Reviewer 1:** For land based and transitional, I think it will be better to include the key reference. You may find many articles mention about it.

**EWG:** we will add clearer definitions



## REVIEW OF THE METHOD PROTOCOL

MACROALGAE CULTIVATION AND ECOSYSTEM SERVICES

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**Reviewer 2:** Precise cultivation of macroalgae on land (in tanks or other systems)

**EWG:** Please see reply to reviewer 1

**Reviewer 3:** Should be added the terms: “Green Deal”, “European Blue Bio-economy”, “blue growth” “trade-off” and “blue carbon”

**EWG:** These terms will be added to the glossary

**Reviewer 4:** Helpful and fruitful

**EWG:** Many thanks

**Reviewer 5:** *no comment*

**EWG:** NA

**Reviewer 6:** Appropriate.

**EWG:** Many thanks

**Reviewer 7:** Need to be completed.

**EWG:** Thank you. New terms were added to the glossary section.

**Reviewer 8:** *no comment*

**EWG:** Many thanks

**Reviewer 9:** Check for any other relevant terms (e.g., “Climate change”)

**EWG:** We will include this term, as well as those suggested by other reviewers

**Reviewer 10:** Short but precise. Key references could have been expanded

**EWG:** Thank you. We will take that into consideration

### 11. INTRODUCTION

**Reviewer 1:** *no comment*

**EWG:** NA

**Reviewer 2:** *no comment*

**EWG:** NA

**Reviewer 3:** I believe that the state of the art on macroalgal studies on a global scale could be added in the introduction

**EWG:** Thank you. However, that would probably be a task on itself and out of the scope. However, since we are considering papers from all over the world (not just Europe) that state of the art will in a sense appear in the final report of our work

**Reviewer 4:** Provides a good intro to the topic



**EWG:** Thank you

**Reviewer 5:** *no comment*

**EWG:** NA

**Reviewer 6:** Appropriate

**EWG:** Thank you

**Reviewer 7:** OK

**EWG:** Thank you

**Reviewer 8:** Include more the vision on market and economy: ecosystem service for whom and who is going to pay for it

**EWG:** In this WG we are investigating the state of knowledge regarding the potential of macroalgae culture in providing climate-related and other ecosystem services with specific focus on knowledge gaps to be addressed before harvesting this potential. Although interesting, the point flagged by the reviewer is outside the remit of our work.

**Reviewer 9:** No changes required

**EWG:** Thank you

**Reviewer 10:** OK

**EWG:** Thank you

## 12. FOCUS OF THE REQUEST

**Reviewer 1:** *no comment*

**EWG:** NA

**Reviewer 2:** *no comment*

**EWG:** NA

**Reviewer 3:** could also focus on the socio-environmental relationship

**EWG:** Following the reviewer's advice, we will consider the socio-environmental relationship, as long as it is relevant to ES.

**Reviewer 4:** The aim of the request is clear

**EWG:** thank you

**Reviewer 5:** *no comment*

**EWG:** NA



## REVIEW OF THE METHOD PROTOCOL

MACROALGAE CULTIVATION AND ECOSYSTEM SERVICES

**Reviewer 6:** In objectives I would add “carbon sequestration” as one of the key ecosystem services that macroalgae can provide to mitigate climate change.

**EWG:** Will do

**Reviewer 7:** *no comment*

**EWG:** NA

**Reviewer 8:** see before: economy, market and minimum scale for being effective

**EWG:** Please see the reply to your previous comment.

**Reviewer 9:** No changes required

**EWG:** Thank you

**Reviewer 10:** It is encouraging to see that the focus is on off-shore and coastal macroalgae cultivation. Nonetheless, quite challenging.

**EWG:** Please note that we are also considering cultivation in transitional waters and land-based

### 13. METHODOLOGICAL FRAMEWORK

**Reviewer 1:** Maybe it can be mentioned that the literature review focuses on the research papers performed in EU, since it is meant for EU. Or if you include research paper outside EU, you can mention the percentage and in what way you consider this paper within your search. Thus, we can understand that though this report is meant for EU, there are influences to certain extent coming from other countries, especially in terms of global supply and value chain.

**EWG:** We will provide an analysis of the demographics of the reviewed literature. However, the influences captured will not be in terms of global supply and value chain, they will always be focused on ES than can be transposed to the EU context.

**Reviewer 2:** *no comment*

**EWG:** NA

**Reviewer 3:** It's ok

**EWG:** Thank you

**Reviewer 4:** A balanced choice of methods to go through the actual literacy

**EWG:** Thank you

**Reviewer 5:** *no comment*

**EWG:** NA

**Reviewer 6:** Appropriate

**EWG:** Thank you





## REVIEW OF THE METHOD PROTOCOL

### MACROALGAE CULTIVATION AND ECOSYSTEM SERVICES

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**Reviewer 7:** OK

**EWG:** Thank you

**Reviewer 8:** involve large industrial partners: food - feed – energy

**EWG:** Thank you. We try to involve those in the Delphi process.

**Reviewer 9:** The methodological framework in a flow chart will be more clear

**EWG:** Thank you, we will follow the suggestion

**Reviewer 10:** OK

**EWG:** Thank you.

#### 14. SELECTED METHODOLOGICAL APPROACH: QUICK SCOPING REVIEW

**Reviewer 1:** *no comment*

**EWG:** N/A

**Reviewer 2:** *no comment*

**EWG:** N/A

**Reviewer 3:** could add to keywords: “cultivation techniques”. papers prior to the year 2000 could be considered.

**EWG:** As explained before, due to time restraints and the enormous work effort involved, we need to limit the number of references and therefore chose to include work only from the past 20 years. We also consider that the Ecosystem Services concept only gained momentum with the millenium assessment. Furthermore, as we use the term “cult\*” for the search, the term “cultivation techniques” is already included.

**Reviewer 4:** might be a bias, due to a larger number of “commercial seaweed” publication.

**EWG:** We would not consider this a “bias” rather a “focus” or “scope”, as the objective is to study the role of seaweed aquaculture, and this aquaculture by definition will be focused on species of commercial interest.

**Reviewer 5:** *no comment*

**EWG:** N/A

**Reviewer 6:** Appropriate

**EWG:** Thank you

**Reviewer 7:** OK

**EWG:** Thank you



## REVIEW OF THE METHOD PROTOCOL

MACROALGAE CULTIVATION AND ECOSYSTEM SERVICES

**Reviewer 8:** I miss some keywords which I consider as very important, also to approach it from the positive side and opportunity: integrated - biodiversity- sequestration - disease - pests - credits - economy - market

**EWG:** These keywords will be included

**Reviewer 9:** The method is well described and is easy to follow.

**EWG:** Thank you for your positive comment

**Reviewer 10:** OK

**EWG:** Thank you.

### 15. SELECTED METHODOLOGICAL APPROACH: DELPHI PROCESS

**Reviewer 1:** *no comment*

**EWG:** N/A

**Reviewer 2:** *no comment*

**EWG:** N/A

**Reviewer 3:** It's ok.

**EWG:** Thank you.

**Reviewer 4:** My concerns are written in line 150.

**EWG:** Thank you for pointing that out. As stated in the Methods Protocol we are aware that can happen and, to reinforce that, the experts group is being supported by Eclipse Methods Experts with vast experience in recognizing those problems.

**Reviewer 5:** *no comment*

**EWG:** N/A

**Reviewer 6:** I would add here a bit of emphasis on local communities directly impacted of benefited by macroalgae cultivation. They should be included as key stakeholders in the process.

**EWG:** Good point. Thank you.

**Reviewer 7:** *no comment*

**EWG:** N/A

**Reviewer 8:** involve large industrial partners: food - feed - energy -chemical; not only specific marine organisations, but yes, marine service providers (offshore companies). Also, insurance companies; investors (impact investors)

**EWG:** Thank you. We will try to involve those in the Delphi process



## REVIEW OF THE METHOD PROTOCOL

MACROALGAE CULTIVATION AND ECOSYSTEM SERVICES

**Reviewer 9:** Is there any standard protocol to be followed while adopting a Delphi process? Whether the 3 round questioning is standard or it is flexible? - need more clarity. Otherwise, it is well described.

**EWG:** Thank you, The Delphi process does have flexibility and we rely on the Eclipse Methods Expert to advise the Expert Working Group on that matter. In particular, Round 3 is flexible but we believe it would be useful in our case.

**Reviewer 10:** OK

**EWG:** Thank you.

### 16. EXPECTED APPROACH TO ORGANIZE KNOWLEDGE AND DATA

**Reviewer 1:** *no comment*

**EWG:** N/A

**Reviewer 2:** *no comment*

**EWG:** N/A

**Reviewer 3:** Could be added "Affiliation"

**EWG:** Thank you, we will incorporate the term "Affiliation" in the excel sheet of the QSR

**Reviewer 4:** Excel might be popular, but there had been issues with autocorrect and lost data. I'd recommend something like MySQL.

**EWG:** Thank you. We will take that into consideration

**Reviewer 5:** Methods need to provide quantitative data where relevant and identify gaps e.g., cultural services are hard to value/asses. Some details of how the services etc are to be valued and methods used would be important and a standard format. See Watson, S.C., Preston, J., Beaumont, N.J. and Watson, G.J., 2020. Assessing the natural capital value of water quality and climate regulation in temperate marine systems using a EUNIS biotope classification approach. *Science of the total Environment*, 744, p.140688.

**EWG:** Reviewer's suggestion will be considered in the discussion of the results and in further studies. This is a first approach to this topic and due to time and resources constraints, a QSR rather than a Systematic Review or a Rapid Evidence Assessment was chosen, for this reason further methodological analyses (e.g. metaanalyses) were not considered in this first assessment.

**Reviewer 6:** It is not clear how this knowledge and data will be then made available for the general public (if at all).

**EWG:** EKLIPSE reports are all publicly available.

**Reviewer 7:** OK

**EWG:** Thank you



## REVIEW OF THE METHOD PROTOCOL

### MACROALGAE CULTIVATION AND ECOSYSTEM SERVICES

**Reviewer 8:** I miss the possibility to integrate seaweed farming with for instance fish farming. This concept of IMTA is known and effective. Include this perhaps under Ecosystem services. 211: I don't understand cultural, do you mean cultivation?

**EWG:** Seaweed and IMTA will certainly be considered. IMTA can be a keyword to be included in the QSR. As explained in line 236, we are using the CICES classification of ecosystem services, including provisioning, cultural, regulating and maintenance, which explains the listed

**Reviewer 9:** The format for the classification scheme (QSR) in the excel sheet is good.

**EWG:** Thank you

**Reviewer 10:** OK, data gathering and organization for final presentations is smart, well thought.

**EWG:** Thank you

## 17. VISUALIZATION OF FINDINGS

**Reviewer 1:** *no comment*

**EWG:** N/A

**Reviewer 2:** *no comment*

**EWG:** N/A

**Reviewer 3:** network diagrams can be used in the literature review

**EWG:** A diagram of the process with numbers of articles will be provided in further drafts of the protocol for the literature review

**Reviewer 4:** Purity of figures (no 3D- stuff) is eye candy. Pie charts are good for commercial purposes. Line 277: One has to skip in the table to compare "Saccharina" or "Ulva" near/offshore.

**EWG:** We thank the reviewer for the honest opinion. We will modify figure 2 by merging the terms near-shore, off-shore, land-based to ease the reading. In addition, we will modify the colour code to avoid confusion in figure 1, which we will leave as pie chart- as even as used also for commercial purposes- it is easy to read. Anyway as figure 1 t 3 provide as stated in the legend only examples their final layout might differ

**Reviewer 5:** Seem simplistic and really need to somehow look at the value/process comparisons.

**EWG:** Thank you for your note. The reviewer's suggestion is interesting but it implies a meta-analysis which is beyond the scope of this request. In any case, the given graphics are only examples and can be re-shaped in the final version.

**Reviewer 6:** Synthesis schemes that are a little bit more appealing visually would be desired.

**EWG:** Thank you. We will take that into consideration

**Reviewer 7:** OK

**EWG:** Thank you.



**Reviewer 8:** include estimated value

**EWG:** Thank you. We can include the estimated value if that is present in the literature, otherwise is out of our mandate

**Reviewer 9:** This section is fine.

**EWG:** Thank you

**Reviewer 10:** Including Tables with raw data could be beneficial for readers to get a better acquaintance with the figures as suggested.

**EWG:** Thank you. Raw data presented in tables will be provided as “supplementary material” or “appendix” in the last version of the report

## 18. LIMITATIONS OF THE EXPECTED CONCLUSIONS

**Reviewer 1:** *no comment*

**EWG:** N/A

**Reviewer 2:** *no comment*

**EWG:** N/A

**Reviewer 3:** even with the limitations, the research should reach a result in which the methodology can be replicated in other places outside Europe

**EWG:** Thank you

**Reviewer 4:** The competition “food or fuel” is announced, but the role of seaweeds in daily nutrition in Europe is missing.

**EWG:** Thank you for the note, we will take that into consideration if it comes up in the QSR and/or in the Delphi questionnaire.

**Reviewer 5:** *no comment*

**EWG:** N/A

**Reviewer 6:** If no ongoing projects are included in the synthesis review and only scientific peer reviewed papers are included, a big portion of the research going on right now will be left out. In the past 3-5 years the field has been moving rapidly and I am not sure if peer reviewed publications are the best way to assess the state of the art of this field. Maybe adding conference content and ongoing funded projects would be a way to circumvent this.

**EWG:** Thank you, we will take that into consideration as mentioned in previous comments

**Reviewer 7:** Seeing my remarks on glossary

**EWG:** Thank you

**Reviewer 8:** QSR should secure the recent, not published results by interviewing people involved in running projects; companies.

**EWG:** Thank you, the combination of QSR and Delphi method is chosen to secure we make use of scientific literature and of latest insights from experts



**Reviewer 9:** The expected limitations and conclusions are well briefly addressed

**EWG:** Thank you

**Reviewer 10:** Generally, OK. In addition, why the EWG expects a lag?

(Lines 287-289). What do they mean by "recent and ongoing research"? As timetable is limited then I would not be missing a significant piece of evidence that would affect the conclusions

**EWG:** Thank you. The EWG recognizes that there is information from ongoing or recently finished EU projects (and there are several) that may not have reached the literature, resulting in the referred lag. This was also pointed out before by other reviewers and we will work to minimize that impact.

## 19. EXPECTED RESULTS

**Reviewer 1:** *no comment*

**EWG:** N/A

**Reviewer 2:** *no comment*

**EWG:** N/A

**Reviewer 3:** It's ok

**EWG:** Thank you

**Reviewer 4:** There might be some SME underneath the RADAR.

**EWG:** Thank you

**Reviewer 5:** *no comment*

**EWG:** N/A

**Reviewer 6:** Appropriate

**EWG:** Thank you

**Reviewer 7:** *no comment*

**EWG:** N/A

**Reviewer 8:** Little too much formulated towards technology and biology; include economy

**EWG:** Thank you. We will include it if that information arises, either from the the QSR or from the DELPHI

**Reviewer 9:** No modifications required

**EWG:** Thank you

**Reviewer 10:** OK

**EWG:** Thank you



## 20. TIMELINE

**Reviewer 1:** *no comment*

**EWG:** N/A

**Reviewer 2:** *no comment*

**EWG:** N/A

**Reviewer 3:** It's ok, but 8 months seems too short to finish the research

**EWG:** Thank you. As mentioned before, the EKLIPSE staff is in contact with the requester to make sure that more time is possible, if needed, ensuring above all the quality of the work

**Reviewer 4:** Well.

**EWG:** Thank you

**Reviewer 5:** Seems ambitious especially with covid and holiday period of August for many in the EU.

**EWG:** Thank you. As mentioned before, the EKLIPSE staff is in contact with the requester to make sure that more time is possible, if needed, ensuring above all the quality of the work

**Reviewer 6:** I would put it a bit in context with COP26 and the Paris Agreement and EUs decarbonisation goals.

**EWG:** Thank you. We will try to have that into consideration if considered within the scope

**Reviewer 7:** OK

**EWG:** Thank you

**Reviewer 8:** middle of holiday season??

**EWG:** Thank you. Please see previous replies

**Reviewer 9:** Reasonable timeline is given to achieve the objectives

**EWG:** Thank you. Please see previous replies

**Reviewer 10:** Short

**EWG:** Thank you. Please see previous replies

## 21. REFERENCES

**Reviewer 1:** *no comment*

**EWG:** N/A

**Reviewer 2:** *no comment*

**EWG:** N/A



## REVIEW OF THE METHOD PROTOCOL

MACROALGAE CULTIVATION AND ECOSYSTEM SERVICES

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**Reviewer 3:** could have more references on macroalgae studies

**EWG:** Thank you. More references will certainly be included in the final report.

**Reviewer 4:** No comments.

**EWG:** N/A

**Reviewer 5:** *no comment*

**EWG:** N/A

**Reviewer 6:** Appropriate although I generally miss one big topic: The *Sargassum* golden tides that are causing problems in the Caribbean, West Africa and recently the Azores.

**EWG:** This request is focused on Europe, so we don't believe this is relevant to this request

**Reviewer 7:** To be completed

**EWG:** Please consider this is not a review document. Just a method protocol.

**Reviewer 8:** I miss Sander van den Burg:-)

**EWG:** N/A :)

**Reviewer 9:** Uniform reference format is followed.

**EWG:** Thank you

**Reviewer 10:** I would expect a large, highly specific reference list

**EWG:** Please consider this is not a review document. Just a method protocol. The large reference list will be done to be created during the QSR

## 22. ANNEX I: DELPHI QUESTIONNAIRE

**Reviewer 1:** *no comment*

**EWG:** N/A

**Reviewer 2:** *no comment*

**EWG:** N/A

**Reviewer 3:** could have more questions related to social-environmental issues

**EWG:** Thank you. We do not want to influence the outcome giving emphasis to particular issues

**Reviewer 4:** It provides a good overview, including concerns about SME and start-ups.

**EWG:** Thank you

**Reviewer 5:** *no comment*

**EWG:** N/A

**Reviewer 6:** In question number 6 I would specify that the years of experience are referring to the years of experience in macroalgae cultivation. There might be scientists like myself that





## REVIEW OF THE METHOD PROTOCOL

MACROALGAE CULTIVATION AND ECOSYSTEM SERVICES

have years of experience in academia in general but recently switched topics to focus on macroalgae.

**EWG:** Thank you. We will take that into consideration, even though we do value “general” experience as well as specific experience with macroalgae

**Reviewer 7:** OK

**EWG:** Thank you

**Reviewer 8:** follows from the former comments

**EWG:** Thank you

**Reviewer 9:** Expert working groups can go ahead with the questions prepared for Delphi process

**EWG:** Thank you

**Reviewer 10:** OK, very useful

**EWG:** Thank you

### 23. HOW DID YOU GET TO KNOW ABOUT THIS CALL FOR REVIEW?

**Reviewer 1:** Email from Eklipse

**Reviewer 2:** Email from Eklipse

**Reviewer 3:** Email from Eklipse

**Reviewer 4:** Email from Eklipse

**Reviewer 5:** Colleague

**Reviewer 6:** Email from Eklipse

**Reviewer 7:** Email from Eklipse

**Reviewer 8:** Email from Eklipse

**Reviewer 9:** Email from Eklipse

**Reviewer 10:** Eklipse website ([www.eklipse.eu](http://www.eklipse.eu))

### 24. ANY OTHER COMMENTS?

All reviewers: no comment



## FURTHER COMMENTS FROM REVIEWERS

(Email exchange with Tânia Pereira)

**Reviewer 5:** do let me know if I (or the RaNTrans project team can help in any other way. We are testing and developing kelp and red algae cultivation methods in the UK so this is important for the project and also the UK coastal area.

**EWG:** Thank you. Within our EWG there are members involved in the RaNTrans project.

**Reviewer 10:** responded to the Delphi questionnaire (sent attached to the email)

**EWG:** Thank you

**Reviewer 11:** (responded to the invitation to review): What is there to review in this 21-page method protocol document?

I went through it. This is a very general and vague document, not describing in details a proposed methodology. Consequently, it is hard for me to “see if I find it adequate, if I find any kind of bias in the methodology, if everything is clear”.

So, I am not too sure what there is really to review, except to say that it seems OK at this stage.

“My suggestions to improve the final result”: get to the specifics and then one will be able to evaluate/review appropriately.

**EWG:** Thank you. As the Delphi and the QSR is an iterative and ongoing process, the second phase is a stepwise procedure and the implementation of the methodology will be adapted depending on the outcome of the first phase, we cannot provide further details at this stage. In any case we are happy that the reviewer did not find any bias in the proposed methodology.

## LIST OF REVIEWERS

Ajin Madhavan - Department of Marine biology, School of Marine Science, CUSAT, Kochi, India

Alvaro Israel - IOLR-Haifa, Israel

Fleuriane Fernandes - Swansea University, UK

Gordon Watson - University of Portsmouth, UK

Job Schipper - SEAWISER - Hortimare Projects & Consultancy BV, Netherlands

Mar Fernandez Mendez - GEOMAR Helmholtz Center for Ocean Research Kiel, Germany

Maya Puspita - Indonesian Seaweed Association and SELT Marine Colloids, Indonesia

Norbert Tchouaffe - University of Dschang, Cameroon



# REVIEW OF THE METHOD PROTOCOL

MACROALGAE CULTIVATION AND ECOSYSTEM SERVICES

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Samara Fadigas - Movimento Água é Vida (MAV), Brazil

Wolfgang Schuster – MaRenate, Germany