

## Aquaculture Steering Group EGs Resolutions

---

<b>Aquaculture Steering Group EGs Resolutions.....</b>	<b>i</b>
<b>Resolutions approved in 2022 .....</b>	<b>2</b>
WKBBoBICAO - Workshop on the Bay of Biscay and Iberian Coast ecoregion Aquaculture Overview .....	2
WKFaroesAO - Workshop on the Faroes ecoregion Aquaculture Overview.....	4
WGOOA - Working Group on Open Ocean Aquaculture .....	5
<b>Resolutions approved in 2020/2021 .....</b>	<b>8</b>
WGECCA - Working Group on Ecological Carrying Capacity in Aquaculture.....	8
WGPDMO - Working Group on Pathology and Diseases of Marine Organisms.....	10
Working Group on Socio-Economic Dimensions of Aquaculture (WGSEDA).....	12
Working Group on Application of Genetics in Fisheries and Aquaculture (WGAGFA).....	16
Working Group on Risks assessment of Environmental Interactions of Aquaculture (WGREIA) .....	21
<b>EGs dissolved in 2022 .....</b>	<b>22</b>

## Resolutions approved in 2022

---

### WKBBoBICAO - Workshop on the Bay of Biscay and Iberian Coast ecoregion Aquaculture Overview

2022/WK/ASG01 **Workshop on the Bay of Biscay and Iberian Coast ecoregion Aquaculture Overview (WKBBoBICAO)** chaired by Myriam Callier, France\*, and Francis O’Beirn, Ireland\*, will be established and meet (hybrid meeting) in Sète, France (Ifremer Station) in 3–5 October 2023 to:

- a) Review and discuss the data and information collected for the Bay of Biscay and Iberian Coast ecoregion aquaculture overview, identify the gaps and agree next steps to complete the draft overview;
- b) Collate datasets and resources for the aquaculture overview by completing the ICES Data Profiling Tool (<https://www.ices.dk/data/tools/Pages/Data-profiler.aspx>); and
- c) Produce a workshop report detailing the conclusions of ToRs a and b. This report will serve as the foundation for the Bay of Biscay and Iberian Coast ecoregion aquaculture overview.

WKBBoBICAO will report by January 2024 for the attention of the ACOM.

### Supporting information

Priority	Aquaculture is a high-priority topic for ICES. ICES work on aquaculture is part of a wider portfolio of work that seeks to advance and share scientific understanding of marine ecosystems and the services they provide, and to use this knowledge to generate state-of-the-art advice for meeting conservation, management, and sustainability goals. The ICES Strategic Plan states: ‘We will regularly publish, update, and disseminate overviews on the state of fisheries, aquaculture, and ecosystems in the ICES region, drawing as appropriate on analyses of human activities, pressures, and impacts, and incorporating social, cultural, and economic information.’
Scientific justification	The process of establishing ICES AOs was initiated in 2019, with: i) forming a core group consisting of representatives from ACOM leadership, SCICOM and Secretariat, and ii) agreeing on the directions and procedure of further work of the core group. The objectives AOs are to: i) synthesise regional and temporal information on aquaculture activities, practices and production of the cultured taxa; ii) consider environmental and socioeconomic interactions of aquaculture activities and practices; iii) provide insights on cross-sectorial interactions of aquaculture; and, iv) consider future perspectives. The overview will have ten sections: 1) executive summary; 2) introduction; 3) description and location of marine aquaculture activities and practices; 4) production over time; 5) policy and legal foundation; 6) management frameworks; 7) ecosystem/environment interactions; 8) social and economic context; 9) interaction of environmental, economic and social drivers; and 10) future projections, and emerging threats and opportunities.
Resource requirements	There are already several confirmed experts (as suggested by ACOM members) from France, Spain and Portugal to agree to contribute to the work. The lead author of the Bay of Biscay and Iberian Coast ecoregion AO (Myriam Callier) has already started establishing contacts with these experts.
Participants	The WK will be attended by experts contributing to the Bay of Biscay and Iberian Coast ecoregion AO, as well as other interested scientists from ASG.
Secretariat facilities	Setting up conference calls.
Financial	No financial implications.

---

Linkages to advisory committees	Direct link to ACOM.
Linkages to other committees or groups	ASG, WGAGFA, WGECCA, WGOOA, WGPDMO, WGREIA, WGSEDA, WGSPA, WGEEL, WGSOCIAL, WGECON, SICCM, SIHD
Linkages to other organizations	DGMARE

---

## WKFaroesAO - Workshop on the Faroes ecoregion Aquaculture Overview

2022/WK/ASG02 **Workshop on the Faroes ecoregion Aquaculture Overview (WKFaroesAO)** chaired by Gunnvør á Nordi, Faroe Islands, and Henn Ojaveer, ICES, will be established and meet (hybrid meeting) in Tórshavn, Faroe Islands during 31 May – 2 June 2022 to:

- d) Review and discuss the data and information collected for the Faroes ecoregion aquaculture overview, identify the gaps and agree next steps to complete the draft overview;
- e) Collate datasets and resources for the aquaculture overview by completing the ICES Data Profiling Tool (<https://www.ices.dk/data/tools/Pages/Data-profiler.aspx>); and
- f) Produce a workshop report detailing the conclusions of ToRs a and b. This report will serve as the foundation for the Faroes ecoregion aquaculture overview.

WKFaroesAO will report by 21 of October 2022 for the attention of the ACOM. The ADG will take place in early 2023.

### Supporting information

Priority	Aquaculture is a high-priority topic for ICES. ICES work on aquaculture is part of a wider portfolio of work that seeks to advance and share scientific understanding of marine ecosystems and the services they provide, and to use this knowledge to generate state-of-the-art advice for meeting conservation, management, and sustainability goals. The ICES Strategic Plan states: 'We will regularly publish, update, and disseminate overviews on the state of fisheries, aquaculture, and ecosystems in the ICES region, drawing as appropriate on analyses of human activities, pressures, and impacts, and incorporating social, cultural, and economic information.'
Scientific justification	The process of establishing ICES AOs was initiated in 2019, with: i) forming a core group consisting of representatives from ACOM leadership, SCICOM and Secretariat, and ii) agreeing on the directions and procedure of further work of the core group. The objectives AOs are to: i) synthesise regional and temporal information on aquaculture activities, practices and production of the cultured taxa; ii) consider environmental and socioeconomic interactions of aquaculture activities and practices; iii) provide insights on cross-sectorial interactions of aquaculture; and, iv) consider future perspectives. Sections of the overview: 1) executive summary; 2) introduction; 3) description and location of marine aquaculture activities and practices; 4) production over time; 5) policy and legal foundation; 6) management frameworks; 7) ecosystem/environment interactions; 8) social and economic context; 9) interaction of environmental, economic and social drivers; and 10) future projections, and emerging threats and opportunities.
Resource requirements	The lead author of the Faroes ecoregion AO (Gunnvør á Nordi) has already established an expert team and started the work. This will serve as the main input for the meeting.
Participants	The WK will be attended by experts contributing to the Faroes ecoregion AO, as well as other interested scientists from ASG.
Secretariat facilities	Setting up webex calls.
Financial	No financial implications.
Linkages to advisory committees	Direct link to ACOM.
Linkages to other committees or groups	ASG, WGAGFA, WGECCA, WGOOA, WGPDMO, WGREIA, WGSEDA, WGSPA, WGEEL, WGSOCIAL, WGECON, SICCOME, SIHD
Linkages to other organizations	DGMARE

## WGOOA – Working Group on Open Ocean Aquaculture

2022/MA2/ASG03 A **Working Group on Open Ocean Aquaculture** (WGOOA), chaired by Bela Buck, Germany, and Tyler Sclodnick, Canada, will work on ToRs and generate deliverables as listed in the Table below.

	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS (CHANGE IN CHAIR, ETC.)
Year 2023	May 9 - 12	Portland, ME, USA	Interim report by July 7, 2023	
Year 2024	June 29 – 30	Stavanger, Norway	Interim report by July 26, 2024	
Year 2025	TBD	TBD	Final report by July 30, 2025	

## ToR descriptors

ToR	DESCRIPTION	BACKGROUND	<a href="#">SCIENCE PLAN CODES</a>	DURATION	EXPECTED DELIVERABLES
a	Describe the effect of OOA on ecosystem health, ecosystem services, carbon footprint, carrying capacity, and resource value relative to alternative uses including traditional nearshore farming	Uncompleted ToR from 2018 resolution. This ToR remains an important area of investigation as aquaculture of all forms is frequently criticized for negative environmental impacts and held to higher standards than incumbent ocean uses and protein producers. A thorough understanding of these factors is essential to industry planning and the effective communication and promotion of open ocean farming.	5.6, 5.7, 5.8, 6.6	Years 1 & 2	Review paper

b	Review the regulatory environment for several key ICES countries to assess their effectiveness at encouraging industry development, protecting natural resources, and accomodating competing ocean user groups	As an emerging industry, aquaculture, and open ocean aquaculture in particular, is subject to a diverse array of regulatory environments, many of which are still developing. The effectiveness of these regulatory systems in encouraging development while protecting resources and managing competing uses is widely varied. Many of these challenges are unique to open ocean operations. Providing a review, through a scientific and industry-development lense, would enable the WG to make a recommendation to ICES on how the industry can be most effectively managed.	5.5, 5.7, 5.8, 7.5	Year 1 & 2	Position paper
c	Investigate and describe key differences in capital expenses, operations, and production efficiencies between open ocean farms and traditional nearshore farms to characterise financial potential of open ocean aquaculture in different environments.	Several open ocean facilities for each major species group (seaweed, bivalve, and finfish) have been in operation for several years, creating an opportune time for new insights. Aquaculture is ultimately a business activity and it is critical to consider the economic potential of open ocean farming, especially relative to other farming methods.	5.7, 5.8, 7.3	Years 2 & 3	Review paper
d					

**Summary of the Work Plan**

Year 1	THE FIRST PRIORITY IS TO COMPLETE EFFORTS OF THE PREVIOUS TORs. WE WILL ENSURE WE HAVE THE NECESSARY EXPERTISE WITHIN THE GROUP TO COMPLETE THE CURRENT RESOLUTION AND RECRUIT NEW MEMBERS TO FILL ANY GAPS. RESEARCH AND ANALYSIS WILL BEGIN ON TORs A & B.
Year 2	Work will continue on TORs A & B as well as coordinating publication. Efforts will begin on TOR C.
Year 3	Complete and publish remaining work.

**Supporting information**

Priority	Open ocean aquaculture is an important and growing industry in the ICES region and is likely to become a major ocean use and significant producer of sustainable seafood. As a new sector, the industry is at a critical junction and can benefit greatly from expert analysis.
----------	---

Resource requirements	The working group operates mainly on the volunteered time of its membership. Although obtaining time commitment can be challenging, the team is committed to the completion of this work. Additional resource requirements are negligible. The group will cooperate and engage with funded research projects to extent resource usage where specific opportunities allow.
Participants	The working group is normally attended by 20–25 members consisting of biologist, farmers, engineers, economists, and spatial analysts from academia and industry.
Secretariat facilities	None.
Financial	No financial implications.
Linkages to ACOM and group under ACOM	This project sets the stage for future advice products from ICES as governments need to manage open ocean aquaculture development.
Linkages to other committees or groups	There is a close working relationship with all the groups of the Aquaculture Steering Group. We will seek to form links with the Working Group on Socio-Economic Dimensions of Aquaculture (WGSEDA), Working Group on Pathology and Diseases of Marine Organisms (WGPDMO), Working Group on Application of Genetics in Fisheries and Mariculture (WGAGFM), Working Group on Environmental Interactions of Aquaculture (WGEIA), Working Group on Scenario Planning in Aquaculture (WGSPA), and Working Group on Ecological Carrying Capacity in Aquaculture (WGECCA). There are also likely linkages to other groups not listed.
Linkages to other organizations	EFARO, EATiP, DGMARE, AORA, EAS (European Aquaculture Society), WAS, NOAA, DFO, SINTEF, Cawth. Industry – aquaculture businesses and producer groups, marine management organizations.

## Resolutions approved in 2020/2021

### WGECCA - Working Group on Ecological Carrying Capacity in Aquaculture

2021/FT/ASG01 A Working Group on Ecological Carrying Capacity for Aquaculture (WGECCA), chaired by Carrie J. Byron, USA, and Dror Angel, Israel, will work on ToRs and generate deliverables as listed in the Table below.

	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS (CHANGE IN CHAIR, ETC.)
Year 2022	26 September (monthly meetings)	Online		
Year 2023	Monthly	Online		
Year 2024	TBD	TBD	Final report by Date to ASG	

### ToR descriptors

TO R	DESCRIPTION	BACKGROUND	SCIENCE PLAN CODES	DURATION	EXPECTED DELIVERABLES
	This should capture the objectives of the ToR	Provide very brief justification, e.g. advisory need, links to Science Plan and other WGs	Use codes (max 3 per ToR)	1, 2 or 3 years	Specify what is to be provided, when and to whom
a	Estimate the development potential of underutilized lower trophic level aquaculture species in ICES countries including (i.e. macroalgae, invertebrates, detritivores) towards understanding carrying capacity thresholds. Identification of social, economic and environmental advantages, barriers and knowledge gaps; recommendations for research.	The cultivation of lower trophic level (LTL) species has been proposed as the most sustainable approach to optimize biomass extraction from the ocean. Many of the LTL species, e.g., macroalgae, invertebrates are not widely cultivated in Europe and the Americas. This review will identify social, economic and environmental barriers, priorities, advantages, and knowledge gaps within LTL aquaculture.	5.5	year 1-2	ICES report to inform future research proposals.



b	A review of the transfer of energy and nutrients between farm sites (e.g., algae, bivalves, finfish) and the surrounding ecosystem as it influences carrying capacity limits; Identification of knowledge gaps and recommendations for research.	It is not clear if energy and nutrients derived from aquaculture sites is a net benefit or detriment to wild populations. There is a need to provide an overview of the transfer of energy between farm sites and the surrounding environment and the implications of this to the greater ecosystem and associated organisms. The review will include the identification of knowledge needs and priorities in this new ToR.	5.6, 1.3, 1.4	Year 1-2	Manuscript for publication
c	Review Ecological Carrying Capacity (ECC) monitoring techniques with potential to identify more efficient applications to support ECC as a management strategy.	Given the current levels of understanding and experience in the implementation of ECC monitoring, there is now a need to explore the possibility of developing guidelines for more cost effective, less data intensive ECC monitoring techniques. It is important that these guidelines draw on expert knowledge to (i) identify the environmental drivers relevant to the types of aquacultures being monitored and the waterbody they occur in (ii) provide guidance on the choice of proxy for ECC and (iii) guide the establishment of the ECC thresholds.	6.1	Year 3	ICES report of identified knowledge gaps for future research

### Summary of the Work Plan

Year 1	Gather background information and begin typing summaries of findings for ToR a & b.
Year 2	Write report and manuscript for ToR a & b. Begin preliminary work for ToR c.
Year 3	Synthesize information and write report for ToR c.

### Supporting information

Priority	The current activities of this Group will inform ICES on issues related to the ecological carrying capacity for different aquaculture species in different regions. Consequently, these activities are considered to have a very high priority.
----------	---

Resource requirements	None at this time.
Participants	The Group is normally attended by a dozen members.
Secretariat facilities	None.
Financial	No financial implications.
Linkages to ACOM and group under ACOM	There are no obvious direct linkages.
Linkages to other committees or groups	There is a very close working relationship with all the working groups in ASG.
Linkages to other organizations	

### WGPDMO - Working Group on Pathology and Diseases of Marine Organisms

2021/FT/ASG02 A Working Group on Pathology and Diseases of Marine Organisms (WGPDMO), chaired by Richard Paley (United Kingdom) will work on ToR and generate deliverables as listed in the Table below.

	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS
Year 2022	TBD			Change of chairs: Ryan Carnegie (US) will step down and be replaced by Richard Paley (United Kingdom)
Year 2023	7-10 March	ICES, HQ	Interim report by 1 May to ASG	
Year 2024	TBD	TBD	Final report by 1 May to ASG	

### ToR descriptors

TOR	DESCRIPTION	BACKGROUND	<a href="#">SCIENCE PLAN CODES</a>	DURATION	EXPECTED DELIVERABLES
a	Summarize new and emerging disease trends in wild and cultured fish, molluscs and crustaceans based on national reports.	New disease conditions and trends in diseases of wild and cultured marine organisms will be reviewed. This is an annual, ongoing ToR for WGPDMO and will provide information for ToRs b-e.	Code 1.7, 5.2, 5.6	3 years	Summary in annual reports
b	Deliver leaflets on pathology and diseases of marine organisms.	A number of ICES publications currently in preparation will be reviewed by WGPDMO. This is an ongoing, annual ToR.	Code 1.7, 5.6	3 years	Publications in ICES Identification Leaflets for Diseases in Fish and Shellfish

c	Continue to refine application of the Fish Disease Index (FDI).	Results of assessment of the FDI will be reviewed as it continues to be applied to new fish systems, and data harmonization and quality assurance will be addressed as refined guidelines are produced for FDI application.	Code 1.7, 2.5	3 years	Summary in annual reports
d	Provide expert knowledge and management advice on fish and shellfish diseases, if requested, and related data to the ICES Data Centre.	This is an annual ToR in compliance with requests from the ICES Data Centre.	Code 6.4	3 years	Reporting as requested
e	Develop a synthesis integrating pathogen life history and ecology and the approaches to, and effectiveness of, management of different pathogens	Understanding the effectiveness of different approaches to disease management in aquaculture and fisheries is critical for disease control. Yet the pathogens of key resource species vary greatly in their biology and their ecological roles, with some management strategies likely to be more effective than others given the biological and functional diversity of host-pathogen relationships. This ToR will use a global synthesis of these relationships as well as approaches to management to identify strategies most likely to be effective for different types of disease systems.	Code 1.4, 1.7, 5.6	Year 1	Peer-reviewed journal article

### Summary of the Work Plan

Year 1	Complete annual work on ToRs a-c, and if necessary ToR d. Complete ToR e. Consider proposal of new ToRs as necessary. Complete interim report.
Year 2	Complete annual work on ToRs a-c, and if necessary ToR d. Consider proposal of new ToRs as necessary. Complete interim report.
Year 3	Complete annual work on ToRs a-c, and if necessary ToR d. Consider proposal of new ToRs as necessary. Complete final report for the cycle.

### Supporting information

Priority	The current activities of this Group provide essential perspective on diseases of economic and ecological significance in the ICES, including intersections with fisheries and aquaculture industries. Identifying strategies for aquatic animal health management through a better understanding of diseases is a fundamental interest. Consequently, these activities are considered to have a very high priority.
Resource requirements	The research programmes which provide the main input to this group are already underway, and resources are already committed. The additional resource required to undertake additional activities in the framework of this group is negligible.
Participants	The Group is normally attended by some 15-20 members and guests.
Secretariat facilities	None.
Financial	No financial implications.
Linkages to ACOM and group under ACOM	There are no obvious direct linkages.
Linkages to other committees or groups	There is a close working relationship with all the groups in the ASG.
Linkages to other organizations	

### Working Group on Socio-Economic Dimensions of Aquaculture (WGSEDA)

2020/FT/ASG01 The Working Group on Social and Economic Dimensions of Aquaculture (WGSEDA), chaired by Gesche Krause, Germany and Ramón Filgueira, Canada, will work on ToRs and generate deliverables as listed in the Table below.

	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS (CHANGE IN CHAIR, ETC.)
Year 2021	3-7 May	Online meeting	Interim report by 21 May to ASG	Change in chair: Incoming: Ramón Filgueira, Canada  Outgoing: Cornelia Kreiss, Germany
Year 2022	10-12 May	Online	Interim report by 27 May to ASG	
Year 2023	2-5 May	Germany	Final report by July to ASG	

## ToR descriptors

TOR	DESCRIPTION	BACKGROUND	SCIENCE PLAN CODES	DURATION	EXPECTED DELIVERABLES
a	Identify and develop methods to determine the socio-economic effects of aquaculture	Social and cultural aspects of aquaculture production are an understudied subject. Methods of how to capture and document observations on socio-economic effects of that aquaculture development are still emerging, especially in relation to how to address these social effects across different scales and contexts of the industry. Links to Science plan topic "Sea and society".	7.1, 7.2	3 years	Summary within Report, Research paper on potential improved sustainability outcomes by regionalization of aquaculture across the value chain and across the different sustainability dimensions.
b	Identify trajectories and monitor emerging issues of socio-economic concerns of aquaculture development	Continuous TOR to identify the emerging socio-economic issues of aquaculture and related science advisory needs for maintaining the sustainability of living marine resources and the protection of the marine environment on a regular basis. Further, factors causing an aquaculture system to garner social opposition/acceptance and if these factors are shared or differ across different aquaculture systems and countries. Links to Science plan topics "Seafood production", "Emerging techniques and technologies" and "Sea and society".	4.5, 5.8, 7.1	3 years	Summary within Report, Research paper on collated case studies that capture crucial issues of social opposition/acceptance of aquaculture across ICES member states.

---

c	Review governance and economic interventions important for socio-economic dimensions of aquaculture and its future development	Aquaculture scenario development needs to include policies and perceptions (i.e. social drivers) and economic constraints. The latter is closely linked to governance interventions that are not always cost-effective or meaningful to boost sustainability effects of aquaculture. The review aims to make trade-off decisions more consistent and easier to perform, and to suggest more contextualised aquaculture policies and measures. Links to Science plan topics “Conservation and management science” and “Sea and Society”.	6.2, 7.4	3 years	Summary within Report, Review on governance and economic interventions important for socio-economic dimensions of aquaculture.
---	--	---	----------	---------	--

---

d	Explorative cost-benefit analysis of genetic methods with emphasis on SME and conservation program broodstocks dedicated to aquaculture or natural population enhancement.	Managing genetic relationships and diversity within broodstock enables a long-term basis for both selection of improved food fish material for aquaculture production and supportive augmentation of natural populations. The loss of genetic variability due to inbreeding is detrimental for the cost-effectivity of re-stocking and it may even be impossible to retrieve variability again from the wild. While the use of genetic tools is part of day-to-day routines in large breeding companies, the lack of logistically feasible and cost-effective tools has so far prevented proper broodstock genetic management in SME's and conservation programs. This ToR is planned as a shared ToR between WGAGFA and WGSEDA and has linking points to WGs with fish stock conservation focus (e.g. WGNAS) and contributes to the Science Plan topics "Emerging techniques and technologies", "Seafood production" and "Sea and Society".	4.4., 5.5, 7.6	1 (initially appointed for 1 year, but reserving the possibility to extend further)	Explorative study on market availability for genetic breeding consultation and genotyping services, evaluating the occurring costs and contrasting these to their benefits in report form.
---	--	--	----------------	---	--

**Summary of the Work Plan**

Year 1	Finalize research paper on potential improved sustainability outcomes by regionalization of aquaculture across the value chain and across the different sustainability dimensions (ToR a), discuss emerging issues of socio-economic concerns of aquaculture development (ToR b) and work on research paper on collated case studies that capture crucial issues of social opposition/acceptance of aquaculture across ICES member states (ToR b) as well as start working on the review on governance and economic interventions important for socio-economic dimensions of aquaculture (ToR c). Conducting an explorative cost-benefit analysis of genetic methods as described in ToR d.
Year 2	Finalize research paper on social opposition/acceptance of aquaculture (ToR b) discuss and collate emerging issues of socio-economic concerns of aquaculture development (ToR b) and continue work on the review on governance and economic interventions important for socio-economic dimensions of aquaculture (ToR c).
Year 3	Discuss emerging issues of socio-economic concerns of aquaculture development (ToR b) and finalize review paper on methods to address socio-economic dimensions of aquaculture (ToR c).

## Supporting information

Priority	The current activities of this Group will lead ICES into issues related to the impacts of seafood production (aquaculture) on society focusing on economic and social aspects. Consequently, these activities are considered to have a very high priority.
Resource requirements	The research programmes which provide the main input to this group are already underway, and resources are already committed. The additional resource required to undertake additional activities in the framework of this group is negligible.
Participants	The Group is normally attended by some 8-16 members and guests. During the virtual meeting in 2020, 25 members/guest attended.
Secretariat facilities	None.
Financial	No financial implications.
Linkages to ACOM and group under ACOM	ACOM, WGEIA
Linkages to other committees or groups	Through the shared ToR a close working relationship will be build up with WGAGFA. It is also very relevant to the Working Group on WGSOCIAL, WGSCENARIO, WGICZM, WGMSP.
Linkages to other organizations	

## Working Group on Application of Genetics in Fisheries and Aquaculture (WGAGFA)

**2020/FT/ASG02** The **Working Group on the Application of Genetics in Fisheries and Aquaculture (WGAGFA)**, chaired by Naiara Rodriguez-Ezpeleta, Spain, will work on ToRs and generate deliverables as listed in the Table below.

	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS (CHANGE IN CHAIR, ETC.)
Year 2021	10–14 May	Olhao, PT	E-evaluation to SCICOM	Chair: Naiara Rodríguez-Ezpeleta
Year 2022	17–19 May	Online	E-evaluation to SCICOM	Chair: Naiara Rodríguez-Ezpeleta
Year 2023	9–12 May	Algarve, Portugal	Final report by 30 June to ASG, SCICOM and ACOM	Chair: Naiara Rodríguez-Ezpeleta

## ToR descriptors

ToR	Description	Background	<a href="#">Science Plan codes</a>	Duration	Expected Deliverables
a	Documentation: How the rapid advances in genomics and analytical methods are revolutionising population identification in marine fish and invertebrate species	Stock identification has always been a major aspect of fisheries genetics. In the genetic context, the term “stock” means population or discrete breeding stock, and has biological reality. For populations to be accepted as the fundamental units on which assessment is based, it is essential to accurately classify these units, and ideally describe how they originated and are maintained. Until recently, population identification has been limited by the availability of sufficiently powerful molecular markers and analytical methods. Now however complete genome sequences are available for several	2.7, 5.6, 6.1	3 years	Review paper and metrics for measures of indirect genetic impacts



commercial species, it is quick and economical to compile WGS for other species, and exponentially-increasing computer power has led to a plethora of new analytical methods. The aim of this proposed TOR would be to list and describe these methods, and their actual or potential application in population identification. It would be presumed that details would be constantly updated during the next three year period, thus ultimately producing an up-to-date document for publication. Power analyses would be invoked to calculate suitable sample sizes and locus number, and relative implications of different approaches would be compared. How these population entities were formed during post glacial range expansion and are maintained, for example, by heterogeneous spawning habitat, oceanic barriers and other factors would also be investigated. Many marine species, while homing to discrete natal areas to spawn, mix at other life history stages. These stages, usually involving harvest, would be investigated using mixed stock analysis (MSA) methods, presuming that sufficiently large differences can be demonstrated between component populations. Adaptive loci, under directional selection, might be particularly useful in the latter context, but also in investigating population response to climate change.

b	To review and evaluate the potential of adaptative variation for assessing fisheries.	A growing body of evidence suggests marine species display local adaptation over moderate to fine spatial scales, and the genes and genomic regions contributing to adaptive diversity (e.g., temperature, pathogens, etc.) have been identified in a variety of marine species. Yet despite this knowledge and widespread biodiversity losses across the North Atlantic, we still lack an understanding of species responses to disturbance, such as future climate change, in many commercially, culturally, and ecologically important marine species. The overarching goal of this ToR is to evaluate the current capacity to quantify relevant adaptive diversity in marine species; and explore how this information may be utilized in predictions of future biodiversity response to change. Specifically, we will review the literature regarding the genomic basis of adaptation in marine species, and examine how genomic architecture (e.g., single loci, CNVs, and chromosomal rearrangements) influences phenotype associations and our ability to resolve relevant variation. Secondly, we will evaluate new methods that utilize genomic data to establish an evolutionary framework for understanding adaptive diversity and to predict future responses. These will include “genomic vulnerability”, a metric that quantifies the shift in genomic variation required to adapt to future change and uses machine learning to incorporate genomic descriptions of adaptive diversity, climate projections, and ecological modelling. Such approaches have the potential to identify highly vulnerable marine populations and transform science advice regarding fisheries management and marine conservation. Thirdly, we will provide recommendations for how this information could be practically integrated with existing advisory and management frameworks in the Northern Atlantic. Ultimately, this ToR will	1.3, 1.5, 1.7, 2.2, 2.5, 5.2, 6.1, 6.3	3 years	Review paper and recommendations on the use genomic data to predict future population responses to environmental change and disturbance.
---	---	--	--	---------	--

		directly inform the use of genomic approaches to both quantify adaptive diversity and to predict future responses to disturbance in marine species.		
c	To evaluate available genetic-based solutions to better understand the mesopelagic ecosystem.	Recent estimates suggest that mesopelagic fish represent 90% of the fish biomass of the planet, which has raised interest in exploitation of this unknown ecosystem. Yet, the high estimated biomass also suggests that mesopelagic fish might play a key role in sustaining other commercially relevant species and carbon sequestration. Thus, there is an urgent need to understand this still pristine ecosystem before it becomes too late to take protecting actions. This ToR could be dedicated to explore and evaluate the different alternative genetic methods available that could be used for that aim such as environmental DNA samples for estimating biomass and species identification, stomach content DNA analysis for understanding trophic networks, population genomics for species connectivity and diversity as proxies for resilience, etc.	1.4, 1.6	3 years Review Paper and non-technical review topic sheet.
d	<b>WGAGFA &amp; WGSEDA:</b> Explorative cost-benefit analysis of genetic methods with emphasis on SME and conservation program broodstocks dedicated to aquaculture or natural population enhancement.	Managing genetic relationships and diversity within broodstock enables a long-term basis for both selection of improved food fish material for aquaculture production and supportive augmentation of natural populations. The loss of genetic variability due to inbreeding is detrimental for the cost-effectivity of re-stocking and it may even be impossible to retrieve variability again from the wild. While the use of genetic tools is part of day-to-day routines in large breeding companies, the lack of logistically feasible and cost-effective tools has so far prevented proper broodstock genetic management in SME's and conservation programs. This ToR is planned as a shared ToR between WGAGFA and WGSEDA and has linking points to WGs with fish stock conservation focus (e.g. WGNAS) and contributes to the Science Plan topics "Emerging techniques and technologies", "Seafood production" and "Conservation and management science"	4.4, 5.5, 7.6	1 (initially - Reserving the possibility to extend further) Explorative study on market availability for genetic breeding consultation and genotyping services, evaluating the occurring costs and contrasting these to their benefits in report form.
e	Provide a review of the recent genetic studies on white anglerfish (Aguirre-Saraiba et al., 2021). Molecular genetic data have found widespread application in the identification of aquatic species' population and conservation units. For white anglerfish, the recent study shows that i) the species forms a panmictic	Request from the Working Group for the Bay of Biscay and the Iberian Waters Ecoregion (WGBIE)	1.8	1 year Provide input to SIMWG for further inclusion in contribution/ response to WGBIE.

---

population throughout the Northeast Atlantic (the two stocks belong to the same population), ii) there is hybridization between white anglerfish; iii) there is misidentification between the white and black anglerfishes even if the color of the peritoneum is used for taxonomic identification.

---

## Summary of the Work Plan

---

Year 1	<p><b>ToR a)</b> Review the literature, with special focus on the application of genomic data analysis to the study of population structure and connectivity in exploited (directly or indirectly) marine species (vertebrates and invertebrates).</p> <p><b>ToR b)</b> Review the literature regarding the genomic basis of adaptation in marine species, and examine how genomic architecture influences phenotype associations and our ability to resolve relevant variation. We will identify approaches that build on this genomic understanding of adaptive diversity, to predict future responses of populations to disturbance.</p> <p><b>ToR c)</b> Produce an overview of the mesopelagic ecosystem, identify key species and review the literature on different genetic methods available to study this ecosystem. In addition to this overview, focus will be on identifying where especially eDNA and stomach content DNA analysis are being used or could be used in the mesopelagic ecosystem. Identify the key species in the mesopelagic ecosystem with respect to the trophic network – create a simple flowchart.</p> <p><b>ToR d)</b> Report on explorative study on market available genetic services and genotyping services, evaluating the occurring costs and contrasting these to their benefits in report form. Evaluation of outcome and value of further deepening of analysis. Decision as to whether ToR will be carried on.</p>
Year 2	<p><b>ToR a)</b> Identify analytical approaches used and evaluate their power and accuracy. Start drafting an “analytical framework” that will attempt at standardising the sampling/processing/ statistical approaches to be used when producing results that will feed into management measures.</p> <p><b>ToR b)</b> Evaluate new methods which build on a genomic understanding of adaptive diversity, to predict future responses of marine populations to disturbance. These will include but not be limited to an examine of genomic vulnerability.</p> <p><b>ToR c)</b> Continue the evaluation and identification of genetic methods as well as key species for studies of the mesopelagic ecosystem, including any relevant studies describing the ecosystem. Evaluate any new genetic methods for utilisation in studies of the mesopelagic ecosystem. Start to formulate review paper manuscript.</p> <p><b>ToR d)</b> To be determined. Pending decision of year 1.</p> <p><b>ToR e)</b> Provide a review of the recent genetic studies on white anglerfish (Aguirre-Saraiba et al., 2021).</p>
Year 3	<p><b>ToR a)</b> Complete review paper for publication and develop recommendations.</p> <p><b>ToR b)</b> Complete a review paper for publication and develop recommendations.</p> <p><b>ToR c)</b> Finalise and update the evaluation: identify problematic areas requiring future research as well as identify areas where novel techniques show particular promise. Finish review paper and non-technical</p>

---

---

review topic sheet.

**ToR d)** To be determined. Pending decision of year 1 and 2.

---

### Supporting information

Priority	The WGAGFA Terms of Reference for the reporting period 2021 to 2023 will produce information, knowledge and advice in line with the ICES Science priorities. Particularly ecosystem science, impacts of human activities, observation and exploration, emerging techniques and technologies and seafood production, as well as conservation and management will be tackled and reported upon.
Resource requirements	The research programmes which provide the main input to this group are already underway, and resources have been committed.
Participants	The Group is normally attended by some 15-25 members and guests.
Secretariat facilities	None.
Financial	No financial implications.
Linkages to ACOM and groups under ACOM	Joint SCICOM/ACOM group.
Linkages to other committees or groups	There is a very close working relationship with EPDSG, EOSG and EPISG. Additionally, several EGs, particularly WGSEDA but also including WGITMO, WGBIODIV, WGBOSV.
Linkages to other organizations	European Commission; Scientific, Technical and Economic Committee for Fisheries (STECF); European Fisheries Control Agency (EFCA); GFCM; FAO; IFREMER, NOAA, DFO Canada.

### Working Group on Risks assessment of Environmental Interactions of Aquaculture (WGREIA)

2020/FT/ASG03 The Working Group on Risk assessment of Environmental Interactions of Aquaculture (WGREIA), chaired by Ellen Sofie Grefsrud, Norway and will work on ToRs and generate deliverables as listed in the Table below.

	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS (CHANGE IN CHAIR, ETC.)
Year 2021	4-6 May	Copenhagen, Denmark	E-evaluation to SCICOM by 21 May 2021	
Year 2022	10-12 May	Online	E-evaluation to SCICOM by 26 May 2022	
Year 2023	9-11 May	Copenhagen, Denmark	Final report by 8 July to ACOM/SCICOM	

### ToR descriptors

TO R	DESCRIPTION	BACKGROUND	<a href="#">SCIENCE PLAN CODES</a>	DURATION	EXPECTED DELIVERABLES
a	Publication of review of laws and regulatory standards for monitoring and managing environmental impacts of marine aquaculture, and the corresponding thresholds values established by ICES countries and China, and knowledge gaps and prioritized research.	This work was initiated in WGEIA (2018-2020). Here we will complete the work and publish the results in a peer-review journal.	5.6,7.4	Year 1	Peer-review publication
b	Risk assessment methods for environmental impacts of aquaculture	Building on ToRa, ToRb aims to review and compare methods and models for assessing risk of negative environmental impacts due to aquaculture production.	2.1, 5.6, 5.8	Year 1, 2 &3	Write a review publication of when and how risk assessment is used for aquaculture. TIMES publication detailing Methods for risk assessment and risk analysis for environmental impacts of aquaculture.

### Summary of the Work Plan

YEAR	
Year 1	ToRa (Review of laws and regulatory standards for monitoring and prioritised research) will be reported as a peer-review paper, and ToR b (Risk assessment methods) will be initiated.

Year 2	Continue discussion on risk assessment methods aiming to make a foundation for a common understanding on best practice within risk assessment and risk analysis of environmental impact of aquaculture. Peer-review publication of when and how risk assessment is used for aquaculture
Year 3	ToRb will be reported included a TIMES publication detailing Risk assessment methods for environmental impacts of aquaculture

### Supporting information

Priority	The current activities of this Group will continue to lead ICES into issues related to aquaculture including elucidating the legal structure under which the environmental interactions of aquaculture are managed in different ICES countries. Scientific work on ecosystem interactions will lay the scientific foundation for further sustainable aquaculture growth to meet or surpass legal requirements. Consequently, these activities are considered to have a high priority.
Resource requirements	Hosting of the first meeting in Copenhagen.
Participants	The Group will be established of 15-25 experts of aquaculture - environment interactions, regulators, legal expertise, risk experts and others
Secretariat facilities	None.
Financial	No financial implications.
Linkages to ACOM and group under ACOM	This WG sets the stage for future advice products from ICES as governments need to do risk assessment of the growing aquaculture industry in Europe and North-America.
Linkages to other committees or groups	There is a very close working relationship with all the groups of the Aquaculture Steering Group. We will seek to form links with the Working Group on Socio-Economic Dimensions of Aquaculture (WGSEDA) Working Group on Pathology and Diseases of Marine Organisms (WGPDMO), Working Group on Application of Genetics in Fisheries and Mariculture (WGAGFM), Working Group on Scenario Planning on Aquaculture (WGSPAQ), and Working Group on Ecological Carrying Capacity (WGECCA)
Linkages to other organizations	National regulatory authorities in ICES countries and China, EU, FAO.

### EGs dissolved in 2022

Res. Code	EG name	Chairs
2021/WK/ASG03	Workshop on the Celtic Seas Aquaculture Overview (WKCSAO)	Francis O'Beirn, Ireland and Henn Ojaveer, ICES
2018/MA2/ASG01	Working Group on Scenario Planning on Aquaculture (WGSPA)	Ben Halpern, USA