Aquaculture Steering Group EGs Resolutions

Draft Resolutions to be approved

Working Group on Open Ocean Aquaculture (WGOOA) - pending submission

Incoming Co-Chair: Tyler Sclodnick

Pending submission

Resolutions approved in 2022

WKFaroesAO - Workshop on the Faroes ecoregion Aquaculture Overview

2022/WK/ASG04 **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:

a) 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;

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 Faroes ecoregion aquaculture overview.

WKFaroesAO will report by xx of xx 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	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, SICCME, SIHD

Linkages to other organizations	DGMARE

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	TBD	TBD	Interim report by Date to ASG	
Year 2023	TBD	TBD	Interim report by Date to ASG	
Year 2024	TBD	TBD	Final report by Date to ASG	

ToR descriptors

ToR	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 differeent 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 groups 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	Tenerife, Spain	Interim report by 1 May to ASG	Change of chairs: Ryan Carnegie (US) will step down and be replaced by Richard Paley (United Kingdom)
Year 2023	TBD	TBD	Interim report by 1 May to ASG	
Year 2024	TBD	TBD	Final report by 1 May to ASG	

ToR descriptors

ToR	Description	Background	Science Plan Codes	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 groups 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	

WKCSAO - Workshop on the Celtic Seas ecoregion Aquaculture Overview

2021/WK/ASG03 Workshop on the Celtic Seas ecoregion Aquaculture Overview (WKCSAO) chaired by Francis O'Beirn, Ireland*, and Henn Ojaveer*, ICES, will be established and will meet 26–29 April online to:

d) Review and discuss the data and information collected for the Celtic Seas 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 Celtic Seas aquaculture overview.

WKCSAO will report by 15 of June 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 overviews will have nine 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) ecosystem/environment interactions; 7) social and economic context; 8) interaction of environmental, economic and social drivers; and 9) future projections, and emerging threats and opportunities. The process established for the first AO (Norwegian Sea) also involved arranging a workshop (WKNORAO).
Resource requirements	The lead author of the Celtic Seas ecoregion AO (Francis O'Beirn) 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 Celtic Seas 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, SICCME, SIHD
Linkages to other organizations	DGMARE

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	May	France (TBD)	Final report by Date Month May 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 sustainablity outcomes by regionalization of aquaculture across the value chain and across the different sustainabiltiy 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 contexualised 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 occuring costs and contrasting these to their benefits in report form.

Summary of the Work Plan

Year 1	Finalize research paper on potential improved sustainablity outcomes by regionalization of aquaculture across the value chain and across the different sustainabiltiy 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	TBD May	Leuven; BE	Final report by 30 June to ASG, SCICOM and ACOM	Chair: Naiara Rodríguez-Ezpeleta

ToR descriptors

ToR	Description	Background	Science Plan codes	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 commercial species, it is quick and economical to compile WGS for other species, and exponentially-increasing computer	2.7, 5.6, 6.1	3 years	Review paper and metrics for measures of indirect genetic impacts

		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 directly inform the use of genomic approaches to both quantify adaptive diversity and to predict future responses to	1.3, 1.5, 1.7, 2.2, 2.5, 5.2, 6.1, 6.3	3 years	Review paper and recomendations on the use genomic data to predict future population responses to environemtnal change and disturbance.

		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	**WGAGFA & WGSEDA**: Explorative cost-benefit analysis of genetic methods with emphasis on SME and conservation program broodstocks dedicated to aquaculture or natural population enhancement.	Managing genetic relation-ships 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 occuring 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 population throughout the	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.

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	**ToR a)** 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). **ToR 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. **ToR c)** 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 identifing where especially eDNA and stomach contant DNA analysis are being used or could be used in the mesopelagic ecosystem. Identify the key species in the mesopelagic ecosystm with respect to the trophic network – create a simple flowchart. **ToR d)** Report on explorative study on market available genetic advices and genotyping services, evaluating the occuring costs and contrasting these to their benefits in report form. Evaluation of outcome and value of further deepening of anlysis. Decision as to whether ToR will be carried on.
Year 2	**ToR a)** 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. **ToR b)** Evaluate new methods which build on a genomic understanding of adaptive diversity, to predict future responses of marine populations to distburbance These will include but not be limited to an examine of genomic vulnerability. **ToR c)** 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. **ToR d)** To be determined. Pending decision of year 1. **ToR e)** Provide a review of the recent genetic studies on white anglerfish (Aguirre-Saraiba et al., 2021).
Year 3	**ToR a)** Complete review paper for publication and develop recommendations. **ToR b)** Complete a review paper for publication and develop recommendations. **ToR c)** 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 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 Commitee 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	Bergen, Norway	Final report by 8 July to ACOM/SCICOM	

ToR descriptors

ToR	Description	Background	Science Plan Codes	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.

Resolutions approved in 2018

Working Group on Open Ocean Aquaculture (WGOOA)

2018/MA2/ASG06 A **Working Group on Open Ocean Aquaculture (WGOOA)**, chaired by Bela H. Buck, Germany, will be established 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 2019	20-22 March	Copenhagen	Interim report by 1 July	Constitutive/scoping meeting
Year 2020	26-27 May	Online meeting	Interim report by 7 June	
Year 2021	7 & 14 June	Online meeting	Final report by 29 July	

ToR descriptors

ToR	Description	Background	Science Plan codes	Duration	Expected Deliverables
a	Identify and develop descriptions and guidelines for various types of open ocean aquaculture systems and their characteristics needed to develop an ecosystem approach for sustainable management of open ocean aquaculture including methods for assessing potential interactions and synergies between open ocean aquaculture operations and the wider socio-ecological-system (SES).	The aim of this ToR is to support authorities and/or the work of extension agents who work at the interface between decision-making, research and business, helping investors and agencies understand, structure and articulate types of open ocean aquaculture and develop objective management tools. A description of various types of offshore aquaculture including where these types of aquaculture interact with legal or cultural values associated with the environment is needed to understand where and what types of offshore aquaculture are appropriate in various ICES regions.	5.7 – 5.8	Yr 1 & 2. 2019, 2020	To be reported on as a review paper.
b	Identify risk and mitigation measures for potential interactions between open ocean aquaculture operations and structures and protected species, such	The aim of this ToR is to calculate risks of entanglement of whales, seals and turtles by offshore aquaculture structures and identify	5.7 – 5.8	Yr 1 & 2. 2019, 2020	Organise and conduct a workshop to develop as an ICES Viewpoint.

	as marine mammals and turtles.	structural (engineering) and management methods to reduce potential negative impacts. Mitigation can be of technical (e.g. system design), ecosystem, environment and/or management nature.			
c	Collate existing information relevant for open ocean aquaculture on a regional sea-basin system level to identify site-specific opportunities for different types of open ocean aquaculture in the ICES area.	Using information from ToR a and b, this ToR will help to identify space in the ICES region that will support various types and combinations of offshore aquaculture from an oceanographic and environmental point of view. This ToR will develop a framework to evaluate potential which can be used in different basins. This evaluation will also articulate knowledge gaps, and be designed to provide data that can be inputs to economic impact and optimization models.	5.7 – 5.8	Yr 2-3. 2020-2021	To be reported on as a position paper.
d	Collect and summarize data on large scale open ocean aquaculture.	New systems for large scale offshore aquaculture are now coming on line in Norway and Asia. How these perform environmentally, structurally and economically needs to be documented and evaluated to identify and articulate the potential of these new large systems to significantly increase seafood production globally.	5.7 – 5.8	Yr 1-3. 2020-2021	Annual reports with a position paper in year 3.
f	Describe the effect of OOA related to ecosystem services, carbon footprint, artificial (seasonal) ecosystems (the crop), carrying capacity, and MPAs.	OOA interact with its surrounding ecosystem being influential in supporting ecosystem services, beyond the production of aquatic products by providing		Yr 3	

	provisioning, regulating, habitat, supporting, and cultural services. As the provision of these services will vary over time, season and location interacting with the biotic and abiotic parameters benefits and effects may vary.

Summary of the Work Plan

Year 1	Focus on ToR a and d. Develop descriptions of different types of offshore aquaculture including new large-scale fish systems. Organize workshop for ToR b.
Year 2	Publish review paper from ToR a and turn over Viewpoint from ToR b for external review. Develop framework to analyze basins and apply to a test case. Draft paper.
Year 3	Publish papers on framework for basin development and analysis of large-scale systems.

Supporting information

Priority	Offshore aquaculture has the potential to be highly appropriate to the ICES region and become a significant producer of sustainable seafood. As a new sector, the time for development in accordance with the ICES vision is now. In addition, this is a time of great change and evolution in this field to large scale systems which could fundamentally alter where our seafood comes from and create increased demand for advice.
Resource requirements	There is limited current work in this area in ICES and parts of the ToR are to evaluate the requirements. It is envisaged that an international project will be developed by the working group which could consider how to cooperate on currently funded national research but may need to develop and seek resources to work on specific case study scenarios.
Participants	Scientists and engineers will be key to this working group, with contributions from oceanographers, economists, GIS specialists and marine mammal/turtle experts.
Secretariat facilities	None.
Financial	No financial implications envisaged for ICES.
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. The whale and turtle issue are already a management need.
Linkages to other committee 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 organizatior	EFARO, EATiP, DGMARE, AORA, EAS (European Aquaculture Society), WAS, NOAA, DFO. Industry – aquaculture businesses and producer groups, marine management organizations.

Working Group on Scenario Planning on Aquaculture (WGSPA)

2018/MA2/ASG01 A **Working Group on Scenario Planning on Aquaculture (WGSPA)**, chaired by Ben **Halpern**, USA, will be established 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 2018	8–10 November	ICES HQ, Copenhagen, Denmark	Interim report by 1 March	Seminar/ scoping meeting
Year 2019	7-8 September	Gothenburg, Sweden	Interim report by 30 November	
Year 2020	15-16 October	By correspondence	Interim report by 13 November	
Year 2021	Cancelled			Secretariat has been informed that 2021 meeting will be delayed till 2022.
Year 2022	TBD	TBD	TBD	

ToR descriptors

ToR	Description	Background	Science Plan codes	Duration	Expected Deliverables
a	A review of the application of Scenario planning for aquaculture, Identification of knowledge gaps and recommendations for research	There is a need to determine the state of the art in scenario planning and how this has been applied in aquaculture. It can be done through an exhaustive literature revision including "grey" material and the results of previous aquaculture scenarios. In addition to reviewing the use and application of scenario planning in other areas. The review will include the identification of knowledge needs and priorities in this new area and develop a coherent proposal for research and funding.	5.5, 6.1, 7.1	Yr 1 & 2. (2018, 2019)	To be reported on as a review.
b	Develop Scenario plan	Encourage the development of	5.5, 6.1, 7.1	Yr 3-4	To be reported scenario

	for one region in the ICES area (potentially the same region as choosen for the first atlas)	one international project on scenario planning to complement the work under ToR a. Will require planning in yr 2 from the position paper, identification of potential resourcing and proposal development.		(2020-2021)	planning for aquaculture.
c	Integration of Scenario planning and Atlas approaches to one product capable of communicating the environmental, economic and social options of marine aquaculture development in one region in the ICES area.	Encourage the development of one international project building on the products and techniques developed in ToR a, b and c to an example of a complete science-based analysis of the potenital and consequences of marine aquaculture development for one region in the ICES area .	5.5, 5.7 ,7.6	Yr 3-4 (2020-2021)	2020 – Submit proposal for Viewpoint to SCICOM/ACOM 2021 - Publish paper for focus region.

Summary of the Work Plan

Year 1	Hold a seminar as part of the first Working Group meeting to establish this area of science and identify additional experts to join the WG.
Year 2	Develop an outline for an Atlas of marine aquaculture potential for one region in the ICES area. Provide a review and position paper on Scenario Planning in aquaculture together with knowledge gaps and recommendations for research.
Year 3	Further ToR to be developed out of the position paper. To include a scenario to be chosen in yr 2. Expand and improve Atlas to an opperational level for one example region in the ICES area .
Year 4	Integrate two approaches. International cooperation through a research project on aquaculture potential analysis. Publish paper for focal region.

Supporting information

Priority	There is a high priority for scientifically informed planning for marine aquaculture. This has been successfully applied in other areas by the use of scenario planning where potential multiple future scenarios are possible that provide uncertainty regarding the stability of policies or conditions and where adaptation is likely to be required and yet unpredictable. Information from multiple points of view (economic, environmental, social, geographical, oceanographical and so on) that is both general and specific to a place is needed for planning to be meaningful. There are now some marine spacial analysis approaches that allow potential to be analized for specific locations (see Kapetsky et al 2013, Gentry et al 2017 and Lester et al 2018) e.g. not only what could happen, but where, what inputs would be needed and what outputs could be expected. While there has been some application of scenario planning and spacial analysis in aquaculture this has yet to be evaluated in scientifc terms and applied in a consistant way. For example, scenario planning has been used in evaluating investment opportunities and predicting returns on investment but not in a particularly robust way. It is proposed that the working group develop the methodologies for spacial analysis and scenario planning for Aquaculture in the ICES area that enables:

	1. Researchers to develop realistic options for industry development and to evaluate the impact of different policies. 2. Future Experts Groups to further develop tools to evaluate resilience to environmental change, diseases and parasites, resouce needs, implications of managemnet decisions and so on focused on a specific geography. 2. Governments and populations from a variety of jursdictions to understand the implications and options of marine aquaculture development in their areas. 4. Industry and local populations to have a discription of the production potential in a format that will allow meaningful econmic impact modelling for a specific jurisdiction. This is not about predicting the future but evaluating what different future scenarios mean, trade-offs among scenarios and for example, how scenarios interact with the different policies, changes and demands likely to happen in the future, within a realistic place-based context.
Resource requirements	There is limited current work in this area and part of the ToR are to evaluate the requirements. It is envisaged that an international project will be developed by the working group which could consider how to cooperate on currently funded research but more likely need to develop and seek resources to work on specific scenarios. Modelling and GIS capacity could be limiting and it will be important to engage other relevant ICES experts in this area and bring together the knowledge and technical expertise.
Participants	This is a new group and expected attendance is 15-20 members.
Secretariat facilities	Standard secretarial support. Meeting room at ICES HQ.
Financial	No financial implications envisaged for ICES.
Linkages to ACOM and groups under ACOM	This project sets the stage for future advice products from ICES as governments need to manage aquaculture development based upon knowledge of the economic and social benefits and risks.
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 andAquaculture (WGAGFA) and proposed Working Groups on Environmental Interactions of Aquaculture (WGEIA) and Ecological Carrying Capacity in Aquaculture (WGECCA).
Linkages to other organizations	EFARO, EATiP, Industry – aquaculture businesses and producer organisations, marine mangement organisations, EAS (European Aquaculture Society), WAS, NOAA, DFO.

EGs dissolved in 2021

Res. Code	EG name	Chairs
2021/WK/ASG05	Workshop on the Norwegian Sea Aquaculture Overview (WKNORAO)	Terje Svåsand, Norway, and Henn Ojaveer, ICES
2020/WK/ASG04	Workshop on the manual for genetic sampling from fisheries products in the NAFO area (WKGenMan)	Jann Martinsohn, Italy and Naiara Rodriguez-Ezpeleta, Spain