

ICES Strategic Action area: Aquaculture

Council is invited to review and comment on the list of recommendations that came out of the Aquaculture Dialogue meeting and the links to on-going and proposed work.

The [ICES Strategic Plan 2014-2018](#) identifies a need to further develop science, advisory, and data products in the field of marine aquaculture. To further define ICES focus in this strategic theme area, ICES held an Aquaculture Dialogue Meeting in June 2015 which concluded that ICES has a clear mandate to provide advice broadly on the environmental impacts of aquaculture, and stakeholders and clients within the ICES area are looking to ICES to provide such advice. ICES role is both in support of sustainable aquaculture, which is dependent on the environment, and to provide scientific advice on potential environmental impacts of aquaculture activities. Growing a sustainable aquaculture sector in the North Atlantic requires access to the best available science and information that is independent, quality-assured, and transparent—as ICES has delivered for more than 100 years.

ICES is a leading provider of applied marine science for society, and the Aquaculture Dialogue Meeting was successful in articulating key issues for ICES to focus on moving forward. A summary report of the Dialogue Meeting and the associated sub-group reports are available in the attached annexes. Below is a table mapping recommendations from the Dialogue Meeting, corresponding ICES deliverables (both ongoing and proposed), and an implementation timeline.

Recommendation category	Action	Deliverables (on-going and <i>proposed</i>)	Timing	Responsible actor(s)
Refine ICES role in providing advice on sustainable aquaculture	Conduct a gap analysis to capitalize on synergies and gaps with other organizations to optimize ICES contribution to and advancement of sustainable aquaculture.	Inventory on-going cooperation in the field of aquaculture research	2016	AORAC WP7
Identify key applied science needs of decision-makers	Strengthen the link between scientific knowledge and the needs of decision-makers.	<i>Map of ICES advice domains in terms of Member Country/client policy objectives</i>	2016	WGAQUA , WGSEDA , Secretariat
Respond to identified knowledge needs	Identify adverse impacts and challenges for the natural environment	<i>WGAQUA - Draft 2016 ToR A: Identify and assess tools for monitoring changes in rocky and mixed substrata marine benthic habitats.</i>	2016 - 2018	WGAQUA and relevant expert groups
		<i>WGAQUA - Draft 2016 ToR d: Review and report on the current status of aquaculture impacts.</i>	2016 - 2018	WGAQUA and relevant expert groups
		Report on adaptive strategies for mitigating the effects of climate change.		AORAC WP7
		Workshops that will test and refine Genetic Impact Models		AORAC WP7

Recommendation category	Action	Deliverables (on-going and <i>proposed</i>)	Timing	Responsible actor(s)
	Identify mitigation and preventative measures	<i>WGAQUA - Draft 2016 ToR b: Review and report on the state of knowledge on ecosystem interactions...</i>	2016 - 2018	WGAQUA
	Identify beneficial impacts	Workshops and outcomes focused on raising public awareness		AORAC WP7
		WGSEDA ToR b: Report on the influence of stakeholder inclusion and local ownership on aquaculture.	2016 - 2017	WGSEDA
		WGSEDA ToR c: Identify how social, economic, governance and environmental framing conditions influence aquaculture development.	2016 - 2017	WGSEDA
	Coordinate environmental monitoring and data requirements (including compilation and accessibility)	Identify and report on sensors and models to improve and integrate aquaculture monitoring systems	2016 - 2017	AORAC WP7
		Facilitate harmonisation, coordination and cooperation in the field of environmental monitoring with regards to aquaculture.	2016 - 2017	AORAC WP7
		Operationalise Spatial Planning and impact assessment models and tools	2016 - 2017	AORAC WP7
Define sustainable aquaculture in the ICES context	Define sustainable aquaculture in the ICES context	<i>WGAQUA - (Draft 2016) ToR C: Collate, analyse and assess the various environmental monitoring approaches.</i>	2016 - 2018	WGAQUA
Develop and disseminate tools for knowledge transfer and exchange	Identify funding for a trilateral Aquaculture Research Exchange Program	Secure funding for a trilateral Aquaculture Research Exchange Program on aquaculture		AORAC WP7
	Develop and implement initiatives (e.g. projects) to develop extension services for sustainable aquaculture.	<i>Develop targeted communication tools that facilitate greater use of the ICES knowledge by stakeholders and practitioners</i>	2016 - 2020	Secretariat (via projects)
	Synthesize scientific knowledge on innovations for sustainability for decision-makers through an ICES workshop and report.	WGSEDA ToR D: Identify new emerging issues of socio-economic aspects of aquaculture.	2016-2017	WGSEDA
Provide advice on sustainable aquaculture and aquaculture's environmental impact(s)	Activate ICES network to support sustainable aquaculture through advice that is accessible and useful to decision-makers, stakeholders and the public.	Provide advice on issues that are important to society	Ongoing	ACOM
	Receive requests and develop high-quality, transparent advice that is produced through consensus of all ICES member countries, not just those with a vested interest.	WGSEDA ToR A: Identify individual and crosscutting, integrative methods to support the evaluation of the direct and indirect socio-economic consequences ...	2016-2017	WGSEDA

Recommendation category	Action	Deliverables (on-going and <i>proposed</i>)	Timing	Responsible actor(s)
	Nurture a broad-based, academically and geographically diverse community of experts.	WGAQUA ToR e: Identify emerging aquaculture issues and related science advisory needs for maintaining the sustainability of living marine resources and the protection of the marine environment.	2016-2017	WGSEDA
	Advice to NASCO, June 2015 request	<i>WGAQUA ToR and ongoing work by WGNAS for 2016. Advise on impacts of aquaculture on wild stocks</i>	Spring 2016	ACOM
	Advice to OSPAR 2014 request	WGAQUA ToR 2014. Advised on impacts of aquaculture	Spring 2014	ACOM
	Advice to OSPAR 2010 request	WGNAS ToR 2010. Advised on impacts of mariculture on wild salmonids.	Spring 2010	ACOM

Annex – ICES Aquaculture Dialogue Meeting Summary



ICES
CIEM

International Council for
the Exploration of the Sea
Conseil International pour
l'Exploration de la Mer

Aquaculture Dialogue Meeting/June 2015

Draft summary report

Version 1

Revised on 16 September

Aquaculture Dialogue Meeting Bergen, Norway 1-2 June

This is an initial summary of the outcome of the 2015 Aquaculture Dialogue Meeting¹. It was made and presented in the meeting's final plenary session. In this summary, it was concluded that ICES has a clear mandate to provide advice broadly on the environmental impacts of aquaculture, and stakeholders and clients within the ICES area are looking to ICES to provide such advice. ICES role is both in support of sustainable aquaculture, which is dependent on the environment, and to provide scientific advice on potential environmental impacts of aquaculture activities. In further articulating the ICES framework on aquaculture, it is important that we capitalize on synergies and gaps with other organizations in order to optimize ICES contribution to the field and the advancement of sustainable aquaculture. The Aquaculture Dialogue meeting started this conversation; moving forward further reflection is needed to refine ICES role in this field.

ICES advice could contribute to sustainable management approaches for this sector. Aquaculture is one of the fastest growing food production sectors in the world; it leapt from a 3.2% share of total food fish production in 1950 to 42.2% in 2012 (FAO, 2014)² and future growth is projected to increase further. As such, the sector is experiencing increased environmental and regulatory challenges.

To meet this need, an important step in the near-term is for ICES is to strengthen the link between scientific knowledge and the needs of decision-makers. Scientific research on aquaculture–environmental interactions is a high priority globally and within the ICES area. Several ICES expert working groups investigate key environmental, genetic, and epidemiological effects of aquaculture. To better link the work of ICES with the needs of decision-makers, this dialogue meeting identified the need to better understand the scientific information and advisory needs of managers, industry(s), and intergovernmental organizations, to ensure that the required scientific information is available to inform decision-making.

The Dialogue Meeting identified four knowledge needs where ICES could make an impact in the medium-term (see sub-group chair summary reports):

1. Adverse impacts and challenges of increased production, including:
 - Feed production, and how to deal with a doubling in sea food production and would potentially result in increased demand on wild fish populations.

¹ More information on presenters and their presentations is available online: <http://ices.dk/explore-us/Action%20Areas/Pages/ICES-Aquaculture-dialogue.aspx>

² FAO, 2004. The state of the World Fisheries and Aquaculture 2014. FAO Rome, 223 pp

- Nutrient loads and Harmful Algal Blooms (HABs). In addition, specific issues related to the issue for semi-enclosed seas such as the Baltic, and the possibility of exploring the potential to use the surplus algae production to avoid eutrophication.
- Diseases, prevention and treatment of diseases
- Escapees and interactions with wild stocks, e.g., Atlantic salmon
- Ocean acidification – and the challenges it may create for the industry as it grows, specifically for shellfish operations.

2. Mitigation and preventive measures, including:

- Multi Trophic Aquaculture (MTA)
- Marine Spatial Planning (MSP) with an ecosystem approach perspective
- Risk assessment

3. Positive impacts of aquaculture, including:

- Ecological footprint compared with other animal production sectors (e.g. feed conversion rate and carbon footprint) is lower
- Socio-economic and other local and regional effects (e.g. increasing the resilience of working waterfronts)

4. Data requirements, including:

- Comprehensive and funded data compilation and accessibility

In the near-term, the following operational needs were identified for ICES to progress:

1. Define sustainable aquaculture in operational, practical terms

An integrated framework for operating the concept of sustainable aquaculture is needed in order for decision-makers to evaluate trade-offs, and to decide on acceptable and unacceptable impacts. This would include:

- Integrated indicators for performance evaluation, including both social, economic, environmental, and governance issues;
- Evaluating aquaculture in the light of other activities at land and sea;
- Marine Spatial Planning (MSP) criteria for aquaculture site selection; and
- Creation of landscapes of different aquaculture farms and other activities including fisheries, to ensure multi trophic integration within and/or across farms and with other users of common habitats as appropriate.

2. Knowledge transfer

The need for knowledge transfer and exchange, and to make high-quality science accessible for different stakeholders was stressed. For example:

- Synthesis and translation of scientific information for uptake by stakeholders, e.g., as is done in the USA through the use of extension services – making use of doctoral students at universities, to translate/condense comprehensive reports.
- Making better use of information from the farm-level, and ensuring its inclusion into the scientific process. Find commonalities between data from

different countries, and ensure access to and use of these data in the scientific process.

Participants highlighted the role that ICES should play in filling the need for better and more targeted information for the public that is based on scientific research and advice. For example, a comparison of the footprint of aquaculture compared to other animal farming sectors. Additionally, unconventional and creative methods could be employed, such as cooperating with new partners (e.g., partnering with chefs to act as aquaculture ambassadors).

3. Innovation

This is an important part of improving sustainability and specific examples were:

- Multi Trophic Aquaculture (MTA) impacts within an operation and among sites (landscape level).
- Exploring lower-trophic level organisms for aquaculture production and feed for aquaculture.

ICES is a leading provider of applied marine science for society, and the Aquaculture Dialogue Meeting was successful in articulating key issues for ICES to focus on moving forward. The importance of involving stakeholders in the scoping and development of ICES advice on aquaculture was stressed, and a focus on documentation, transparency, and openness in the scientific and advisory process was highlighted by the participants. Examples of ICES advisory products mentioned by the participants are listed below.

- Site-specific standards and guidelines on a regional basis
- International standards and guidelines, applicable across regions – for common issues
- Monitoring and data needs
- Governance models that are capable of outlining a process to be followed or operationalizing different scenarios (“Tools for Rules”)
- Synthesis of peer reviewed articles
- Framework(s) for Environmental Impact Assessments (EIA)
- Best Environmental Practices (BEP) and Best Available Techniques (BAT)

ICES has a long tradition in aquaculture science and advice, and it is one of two action areas in the ICES Strategic Plan 2014–2018. The Aquaculture Dialogue Meeting brought together industry, stakeholders, policy-managers, and scientists to discuss where ICES should go from here. The participants clearly identified a need for knowledge and advice on aquaculture that lives up to ICES standards of independent, quality-assured, transparent advice that is based on the best available science.

ICES Aquaculture Dialogue Meeting

Bergen 1-2 June 2015

Report from breakout group 1 - Management tools - Across scales – from farm to ecosystem

Chairperson: Tammo Bult (IMARES, Netherlands)

Rapporteur: Anne Cooper

Breakout group 1 focused on the theme of management. The group started with a list of sub-themes to inspire discussion:

- Marine Spatial Planning
- Targets and indicators / GES
- Eco-certification
- Thresholds and risk assessment
- Policy frameworks
- Interaction with Aquaculture Advisory Councils
- Conflict Resolution

At the plenary the following points were presented:

Main issues

1. Facilitate process towards more responsible aquaculture

Science and society need to collaborate to identify what ecological aspects may be impacted by aquaculture, the magnitude of impact, whether it can be measured in a reasonable fashion, and which ecological aspects are socially and ecologically important and should be protected.

- This iterative risk assessment discussion will facilitate an informed and transparent decision on not only what is better or cheaper, but what is possible and what is sufficient for society and the environment.

- ICES is well positioned to partake in this discussion given our mission for sustainable seas at the regional level and beyond.

2. Coordinate and build from ICES strengths

ICES core pillars: science, data, and advice, and our history of scientific coordination play well to the needs of aquaculture advice in the north Atlantic.

- **Data:** ICES has the demonstrated ability to coordinate both the collection of data and the management of data.
- Coordination of **research** activities towards common applied science goals for the ICES community.
- Production of **advice** for decision makers that is based on sound science, is transparent, and produced through consensus of all parties, not just those with a vested interest in the activity.

3. ICES involvement

- **Marine Spatial Planning (MSP)** is an important tool in siting fish farms. ICES has experience with **MSP** with fisheries and MPAs and a logical extension of this would be a consideration of aquaculture, not just a farm by farm approach, but a sectoral approach throughout a region or ecoregion (e.g. blue mussel farming in the Baltic).
- Develop **agreed procedures for risk assessment and impact** to facilitate discussions on acceptable effects, helicopter view and labelling criteria
- Coordinate and direct research on **optimal sustainable use of ocean resources and nutrient security, including food web and GAP analyses**
- **Monitoring;** more efficient, standardisation and data management for more cost effective and socially relevant results.

Key Recommendations

Local, regional, and global cooperation and understanding is key to facilitating the sustainable development of aquaculture in the North Atlantic. ICES has the proven capacity to facilitate sustainable fisheries advice and aquaculture is a natural extension of this.

Notes from the break-out session

ICES needs to find its focus with aquaculture. ICES is known for having quality, objective, transparent and non-political advice on fisheries. This will be the case with aquaculture as well. In addition, unlike other institutions, ICES works through consensus on each and every issue. Managers are looking for this type of advice on aquaculture. With this in mind, ICES can make a difference. ICES should build on its current and relevant expertise. Marine Spatial Planning, Good Environmental Status, WFD.

Issues ICES should consider:

- Eco-certification
- Provide aquaculture advice in a broader, more integrated fashion. The stock by stock approach, currently used in fish stock assessment advice is out of date for the needs of decision makers today. The same applies to aquaculture; let's avoid the farm by farm approach to advice.
- Aquaculture advice in relation to MSP, targets, GES, indicators, monitoring programs, standards.
- Develop data collection, coordination and sharing for aquaculture.
- Working in the Mediterranean.
- Hosting and maintaining an aquaculture–environment information repository.
 - So many authorities are asking the same questions of scientists, and it is diluting the response. A central source for information could help with this.

Issues ICES should not be involved with:

- Eco-certification
- Standards

ICES Aquaculture Dialogue Meeting

Bergen 1-2 June 2015

Report from breakout Group 2: How to Define Sustainable Aquaculture

Chairperson: Doris Soto

Rapporteur: Olav Moberg

Breakout group 2 focused on the theme of how to evaluate the sustainability of aquaculture. The group was given a list of sub-themes to inspire their discussion:

- Inclusive stakeholder involvement
- Transparency in decision-making
- Mechanisms for knowledge exchange
- Communicate and interpret scientific knowledge
- Definition of sustainable aquaculture
- Training and knowledge transfer

At the plenary the following points were presented:

Main issues

1. The concept of Sustainable Aquaculture and what it means. This includes economic, social, and environmental aspects.
2. The importance of knowledge transfer/exchange.
3. The public perception of aquaculture
4. Aquaculture production is a global activity – e.g., food production and imports from countries outside ICES.

Key Recommendations:

1. Explore lower trophic levels for food production as well as for feed. And to look into the landscape of multi-trophic integration as part of marine spatial planning.
2. Look at the aquaculture footprint in the context of other food sectors –an integrated and comparative approach is needed.
3. Develop a framework for operationalising the concept of sustainable aquaculture. This includes the need to develop integrated indicators for performance evaluation (social, economic, environment, governance), in

order for decision-makers to take into account all relevant parameters, and be able to evaluate the trade-offs.

4. Investigate knowledge transfer/exchange. Two levels:
 - a. transfer/ translate scientific information to stakeholders (extension services/synthesize topics/peer review).
 - b. how to make better use of information from farm level, through national administrations, and include to the scientific level – find commonalities between countries and ensure common access to data.
5. Suggestions on more targeted information to the public, based on scientific research and advice.
6. Collaboration with other IGOs, such as PICES – to expand global perspective.

Notes from the break-out session: How to evaluate the sustainability of aquaculture?

- **Inclusive stakeholder involvement**
While acknowledging the need for inclusive stakeholder involvement and transparency in decision-making the break-out group chose to focus on the others issues.
- **Transparency in decision-making**
- This is important to facilitate public and stakeholder acceptance.
- **Mechanisms for knowledge exchange**
The group found it important to look into various means of knowledge exchange. Ranging from scientific information (see further below), farm level information, and information from national administrations. The group acknowledged that a lot of information is available at farm level, some of this information is reported to national administrations, and used as the basis for governance and decision making. For this reason the group also found that it could be worthwhile to compare data from different countries administrations, to find commonalities and possibilities for general use. To improve the public perception of aquaculture, the group found that it would be important to target information to the public to help an informed evaluation of this food production sector compared to other animal production sectors.
- **Communicate and interpret scientific knowledge**

The groups discussed how best to disseminate scientific information, and found that there was a need to communicate in a more targeted way, taking into account the end-users. Examples were given from various countries, including the USA where University Extension Services are used to provide information to different target groups based on research reports.

- **Definition of sustainable aquaculture**

The group discussed the need for a definition of what constitutes sustainable aquaculture, and found that many generic definitions already existing. While the principles of these definitions were clear, i.e., sustainability covering the social, economic, and environmental dimension, their application was not always equally clear.

For this reason the group highlighted the need for operationalizing the concept of sustainable aquaculture, and stressed the importance of an integrated approach, through activities that could include one or more of the following:

- the use of indicators covering all three dimensions;
- the comparison with other animal producing sectors;
- the inclusion in marine spatial planning, covering both risk assessments, and site selection criteria considering an ecosystem approach¹
- the investigation of multi trophic aquaculture, and its potential impact on the sustainability of an individual farm, a region, and beyond.

Acknowledging that aquaculture is a global business, the group stressed the need for ICES to work across marine regions, and to seek cooperation and collaborations with other inter-governmental organizations. From a scientific perspective the North Pacific Marine Science Organization (PICES) was mentioned.

- **Training and knowledge transfer**

The groups stressed the importance of training as one way to ensure knowledge transfer in an interactive way, and also tailored to specific target groups.

¹ FAO.2010. Aquaculture development. 4. Ecosystem approach to aquaculture. *FAO Technical Guidelines for Responsible Fisheries*. No. 5, Suppl. 4. Rome, FAO. 2010. 53p.
<http://www.fao.org/docrep/013/i1750e/i1750e.pdf>

ICES Aquaculture Dialogue Meeting

Bergen 1–2 June 2015

Report from breakout group 3 International standards

Chairperson: Rob Raynard (Scotland, UK)

Rapporteur: Vivian Piil

Breakout group 3 – focused on the theme International standards. The group was given a list of sub-themes to inspire their discussion:

- Best available techniques and practices/guidelines
- Environmental Impact Assessment
- Carrying capacity/Assimilative capacity
- International review of topics based on peer reviewed publications

At the plenary the following points were presented:

Main issues discussed:

1. There are existing international standards; ICES should not develop these.
2. Environmental Impact Assessments (EIAs) and Strategic Environmental Assessments (SEAs):
 - Template examples available but lack of standard methods for completion
 - Could ICES help managers complete the assessments through provision of methodologies and data needs
3. Shared/regional problems
4. Data collection framework in support of aquaculture.

Key Recommendations:

Industry / authorities' needs for advice

- ICES should not intrude on national competencies and should not validate or comment on specific procedures.

- ICES could provide recommendations for methodologies and data requirements and standards.
- ICES could review EIAs, collate lessons learned from countries, or recommend what an environmental impact assessment (EIA), or strategic environmental assessment (SEA) should look like. ICEC could assist with the development of frameworks and identify most appropriate procedures.
- Water bodies – Aquaculture is having effects at different scales. Where there is connectivity among water bodies and aquaculture facilities, there is a need for regional assessments, e.g. the Baltic Sea.

Industry / authorities' needs in research

- A Gap analysis could be provided by expert groups and then linked to EFARO on research needs. Transparency of report outputs. Future work plans. These have been reviewed.
- ICES community should consider the capability to support aquaculture advice in the way that fisheries does i.e. Data Collection Framework (DCF) structures for primary data.

Stakeholder involvement in ICES

- Requires a formal process, to be established if this is to be successful. Currently stakeholders can write to the chair for an invitation to participate in science expert groups. Specific invitation could be sent to stakeholders.
- Ensure relevant communications are wide-reaching, accessible, and understandable.
- When it comes to formalising advice then the scientific experts should be the authors to maintain independence of advice.
- Expert groups working on thresholds could benefit from stakeholder and social science involvement when assessing scenarios of acceptable impacts.

1. Notes from the International standards breakout sessions

ICES role in international standards

There are currently many different standards and schemes available and the group did not see a role for ICES to develop anything in that area.

ICES is liaising with the International Organization for Standardization (ISO) on international standards, and therefore work should continue in this manner, duplication of effort should be avoided. There is an ISO standard on marine fish

farming, how to do benthic monitoring, but there is a limit to how specific you can get.

ICES role is on the international review side of best approach/best practices and guidelines, environmental interactions on aquaculture, and on specific advice requests.

In the event there are environmental changes that could affect the type of methodologies, ICES could ensure the assessments are appropriate.

There is a cross-over looking at climate change impacts. Looking at changes in the environment and making that information available.

Definition

What are international standards referring to? Production standards? Codes of practise? There are certain standards available already – could also be interpreted as monitoring regulations, frameworks. A lot of work has been done but some areas have not yet been touched.

International standards – is there a template set by EU?

There is an [IFOAM Aquaculture Forum](#) and an [IFOAM EU Aquaculture Expert Group](#) was established to help obtain legislation that protects organic aquaculture producers' needs. IFOAM EU takes an active role in discussions on organic aquaculture implementing rules and derogations at European level.

There is a need to distinguish between international standards and international best practices. ICES needs to define which way to go. Production standards are outside of ICES competence. The role for ICES is more related to the standards that a regulator would be looking at, or the fish farm would be managing around.

WGAQUA will consider regulations from around the world to see how the governments have looked at thresholds.

The challenge for ICES is that every national authority is a potential client. There may be a strategy but it is up to the local authority to decide. ICES has to develop a common ground for international assessment, for assessment at the intergovernmental level.

Defining sustainable aquaculture is really the core of the issue. This should be discussed by all breakout groups.

Environmental Impact Assessment (EIAs), Strategic environmental assessment (SEA) and carrying capacity/assimilative capacity

There is a role for ICES in ensuring that the best science is applied in Environmental Impact Assessment (EIAs). The ICES role could be to bring together the best available, most comprehensive science.

SEA and EIA and carrying capacity have a strong local component, but ICES can add value informing the SEA and EIA process. There is scope for international review of EIA/SEA. There are some good lessons learned on how they can be applied and how the process has worked in different countries. One way forward could be to look at what each country is doing well and create a template which is made available for others.

There are a lot of different approaches on carrying capacity and there is (could be?) a whole range of advice depending on the type of question asked.

ICES could help collate the science in these areas to inform international standards and practices. Providing information on what is the state of the art for assessing carrying capacity.

Shared/regional problems

The group identified a need for ICES to tackle shared problems. The Baltic Sea was brought up as an example. It would be interesting for ICES to explore the possibilities for aquaculture in the Baltic. For instance general carrying capacity assessments in the Baltic Sea or in other regional areas could be made.

Should there be different sets of regional standards? A general scientific framework for regional standards could be developed for application in a local context.

There are advantages of engaging with scientists who know the environment (region) in question. This would speak for regional WGs on aquaculture. However, there are also benefits related to having groups such as WGAQUA that promote intra-regional learning.

Data collection framework for aquaculture

There is no data collection framework (EU) in place to support aquaculture. On the fisheries side, there are standard methods for stock assessments and a lot of resources have gone into this area. This would be a big step in terms of money, people, and time.

International review of topics based on peer reviewed publications

This is a strength of WGAQUA.

What ICES should not do:

- ICES should avoid becoming a rubber stamp 'certification' organisation. ICES should not intrude on national competencies; but should provide access to the best available science.

ICES Aquaculture Dialogue Meeting

Bergen 1-2 June 2015

Report from breakout group 4 Interactions with natural environment

Chairperson: Maria Emilia Cunha

Rapporteur: Ellen Johannesen

Breakout group 4 focused on the theme - Interactions with natural environment. The group was given a list of sub-themes to inspire their discussion:

- Escapees
- Pests and disease
- Carrying capacity
- Predator management
- Climate change
- Goods and services
- Impact on wild fish and fisheries

At the plenary the following points were presented:

Main issues discussed

1. Climate change anticipating effects on aquaculture and fisheries – (EU Call Forecasting and anticipating effects of climate change on fisheries and aquaculture and the transatlantic perspective).
2. Data issues (mining big data, accessibility, and availability).
3. Gathering existing data and information and recognizing patterns (modelling).
4. Differences between national responsibility (legislation and jurisdiction) and where ICES can add value.

Key Recommendations

1. ICES strength could be to aggregate, anonymize, and facilitate accessibility of data at international level (e.g. for pests and disease).
2. Standardization/guidelines (e.g. escapees).

3. Regional mapping – making information accessible for stakeholders and management decisions (e.g. disease, pests).
4. Develop modelling to help make science based decisions (Carrying capacity and mapping at wider scales e.g. modelling of nutrients, organic loads, and climate change, ecological services and their valuation).

2. Notes from the Interactions with natural environment break-out session:

Escapees

New technologies are being used to help track and regulate escapees. The Institute of Marine Research (IMR) in Norway, has a research station running a program to use genetics to trace escapees back to the farm, helping to identify the source of the leak.

Escapees are also an issue beyond finfish/salmon, for instance for bivalves.

The risk associated with escapees is regionally specific. There are lower risks if escapees are grown and found in their natural environment (not being grown outside their natural environment).

There are differences in national regulations to control for escapees. In Norway for instance farmers can be held liable if individuals escape (financially responsible).

The use of sterile individuals (triploids) in aquaculture may reduce risks associated with escape and interactions with wild populations. However, triploids have their own risk issues – they may not be as productive for industry, and may be less desirable for consumers/general public.

From a management point of view, it might be helpful to consider if indicators could be developed to help advise on the use of triploids in certain areas.

Closed containment farms are a way of reducing risks related to escapees.

Communication between scientists, industry, and regulators is important to help reduce risks presented by interactions between wild and farmed populations. One national example provided was where risk was minimized by issuing guidelines for industry/regulators based on a scientific recommendation of a slaughter weight before maturity to prevent breeding (with wild populations)/escapees.

A clear definition of what is a regulatable escapee and what is not would be helpful. In aquaculture, there are many ways to escape. Guidelines/best practice on methods for monitoring and identifying escapees are needed.

Standardized methods/fingerprinting of farmed animals could also be an area for ICES science to contribute.

Pests

Pests such as biofouling, predators (e.g. cormorants, seals, otters, jellyfish), HABs and pest deterrents/management still require more research.

ICES should not focus solely on sea lice. There are many other important pest issues that require attention.

Pests and disease are a transnational issue that could be addressed through better coordination and reporting information. A large interactive map of important disease and pathogens, and reporting overview as a help for management decisions could help with coordinated treatments.

Missing from the list provided to the group: transnational persistent organic pollutants in terms of filter feeding and water quality.

National regulations on chemical use for aquaculture has ongoing work striving for similar regulations in the EU, Norway, Turkey, other areas to help make an even playing field for industry that are all selling to the same international market. (Though this was not seen as a task for ICES).

ICES could consider a pathogens and disease database as help for management decisions.

Standardized monitoring and reporting on pests and disease. Parasite data – where does it end up? Would be good to have a central place where data flows could be mapped out.

Norwegian Fish farm reporting on sea lice is available on a publically accessible website. This is not the same everywhere (e.g. UK). Making this information easily accessible would be really good.

Greater pest/predator management research is needed.

ICES strength could be to aggregate and anonymize data for pests and disease at an international level.

Carrying capacity

Carrying capacity (species, ecosystem, or nutrients) is an important science topic. Pests such as sea lice are also a factor that can limit carrying capacity.

The definition of carrying capacity is important but is also regionally specific. A potential science question for ICES to address could be to help define a structured way of considering carrying capacity for regions. A collection of national definitions and monitoring approaches to centralize the information was considered a helpful potential role.

Ecological carrying capacity, is a traditional ICES science area where a broader scale overview could be helpful. ICES could consider regional aspects e.g. synthesizing data on carrying capacity at larger scales for instance organic load for the North Sea.

Modelling aquaculture interactions with nutrient loads, etc. is an area where ICES could help with broad scale regional carrying capacity indicators and assessing knowledge gaps. Integrated monitoring of aquaculture farms is also an area where more progress is needed. Such models would be helpful for decision-making.

Detecting, monitoring and forecasting algal blooms could also improve through modelling. Modelling tools are also important with climate change and could be used for zoning and spatial planning. Integrated Multi-trophic zoning temperature limitations could also be built in (e.g. Canada frozen in the winter though has a high carrying capacity).

Climate change

Carrying capacity and the poleward expansion/migration of species is a global issue and consortia have formed around the EU call *Forecasting and anticipating effects of climate change on fisheries and aquaculture*.

Climate change and its relation to aquaculture should be looked at by ICES as it will affect feed, sites, and it is particularly the link between farming and fishery where ICES would have a natural role. Disease will also be driven by climate change, and mapping, modelling, and scenario building.

Historical farm data needs collation and could be used to support modelling.

A big challenge for researchers is integrated assessments. The development of integrated assessments may need to be accelerated to match the aquaculture growth aspirations of the EU and North America.

Field studies and monitoring is important for climate change as well and as input for modelling. Existing data should be collated before creating new monitoring programmes.

ICES should search for patterns in the monitoring data.

Poleward migration of species, and the differences between being invasive and expanding distribution in response to climate change – When are non-native species living in the natural environment not considered invasive and when can they be farmed? Important to distinguish between species which spawn in the surrounding environment and other species such as anadromous salmon.

Discussing what is not relevant for ICES

ICES should avoid work that may infringe on national competences. The importance of avoiding duplication and adding value by focusing on broad overarching issues at international level was stressed. The fluid nature of the marine environment makes international coordination of science related to supporting sustainable aquaculture an important role.

ICES Aquaculture Dialogue Meeting

Bergen 1-2 June 2015

Report from breakout group #5: Innovation

**Chairperson: Eduardo Balguerías Guerra (ICES Council
Delegate, Spain)**

Rapporteur: Wojciech Wawrzynski

17 participating persons

Breakout group 5 focused on the theme – Innovation. The group was given a list of sub-themes to inspire their discussions.

- Integrated Multi-Trophic Aquaculture (IMTA)
- Off-shore issues
- Gamete resources/strain development
- Species diversification
- Bioremediation
- Disease resistance
- Animal welfare and domestication
- Knowledge from production data

Main issues discussed

It was noted that there are networks already dealing with aquaculture issues in Europe (e.g. EATIP, FEAP, EFARO, COFASP, EC, different NGOs) and their actions and products should be taken on-board to avoid duplication and to build on what has already been achieved.

Need for advice in aquaculture governance: In Europe, contrary to the fisheries, aquaculture is in competence of member states. There is a need for innovation in governance framework of aquaculture sector. **ICES could provide guidelines to promote innovation in the governance system itself** (e.g. in the EU or Norway there are no standards for dealing with risk

assessment and so ICES could develop such instruments, coming with expertise from fishery sector and having its unique global perspective).

The main issue discussed from the innovation prospective was **how ICES could help the global aquaculture industry to acquire more marine feed from fisheries bycatch** (estimated at +30 m tonnes globally) and underexploited marine resources. This is the point where fisheries and aquaculture meet on business basis. This is the point in which ICES expertise is located. Another aspect of this issue (implicit in the landing obligation of the CFP) is how to prevent fishermen from specifically targeting bycatch in case it is profitable to market them.

More knowledge is required in growing feed ingredients for fish farms. Innovation is needed in **low-trophic aquaculture** to ease introduction of **(integrated) multi-trophic aquaculture** in Europe. Many knowledge gaps in Europe in this area.

Disease prevention and treatment in aquaculture (to some extent responsibility of the International Animal Health Organization). More innovative global solutions are needed.

Providing guidelines in the field of maritime spatial planning in relation to implementation of national aquaculture action plans (which allow countries to use the European Maritime and Fisheries Fund).

Asian farmers tend to ask for a set of universal principles of aquaculture management (valid for all regions, species, e.g. distance between farms, fallowing practices). Sometimes (IMR experience from Indonesia) the more you expand in quantity the lower the final production because of rapidly growing environmental problems and diseases. With expanded innovation human kind reaches the point where nature cannot cope anymore (e.g. fishing capacity) - same with multiplying fish production. **ICES could provide advice on carrying capacities in aquaculture and transfer best practices between macroregions.**

ICES strength in the field of ecosystem approach of fisheries management could be used to providing knowledge on the **ecosystem approach to aquaculture**. **ICES could provide guidelines, frameworks and definitions such of sustainability itself.** Europe is lacking common grounds there.

With aquaculture production growing (e.g. in Norway) **ICES could provide advice on the ecosystem / environmental effects** of such an expansion. Institutes delegating experts to ICES fisheries advice usually deal with aquaculture research so the expertise is there and could be used. Having in mind that a small fish farmer can make huge damage to environment / biodiversity **recommendations on control frameworks and trade-offs between growth and sustainability could be provided.**

Stakeholder involvement: especially in risk management ICES should take into consideration voices of local communities and stakeholders and find out what needs to be solved and how to solve issues taking into consideration possible implications on a nation or local communities.

With slower structural development in Southern Europe ICES could use its global dimension and make use of best practices from other parts in the world and try to demonstrate their applicability in Southern Europe. ICES could be a forum of opinion exchange with industry like it takes place more efficiently in livestock or salmon (in contrary to other aquaculture species).

ICES should perhaps **not** provide advice on technical issues like technology of escapee prevention or low-stress grading as expertise is already available.

3. Listed recommendations

- stakeholders' needs for advice

- **ICES could help the global aquaculture industry to acquire more marine feed from fisheries bycatch** (estimated at +30 m tonnes globally) and underexploited fisheries. This is the point where fisheries and aquaculture meet on business basis. This is the point in which ICES' expertise is located; (attention to the landing obligation clause in the CFP!!!).
- **Providing guidelines in the field of maritime spatial planning in relation to implementation of national aquaculture action plans** (which allow countries to use the European Maritime and Fisheries Fund);
- **ICES could provide advice on carrying capacities in aquaculture and transfer best practices between macroregions;**
- **ICES could provide advice on the ecosystem / environmental effects** of aquaculture sector expansion. This includes **recommendations on control frameworks and trade-offs between growth and sustainability could be provided.**

- stakeholders' needs in research

- **ICES could provide guidelines to promote innovation in the governance system itself** (e.g. in the EU or Norway there are no standards for dealing with risk assessment and so ICES could develop such instruments, coming with expertise from fishery sector and having its unique global perspective);
- More knowledge is required in growing feed ingredients for fish farms. Innovation is needed in **low-trophic aquaculture** to ease introduction of **(integrated) multi-trophic aquaculture** in Europe;
-
- **Disease prevention and treatment in aquaculture;**
- ICES strength in the field of ecosystem approach of fisheries management could be used to providing knowledge on the **ecosystem approach to aquaculture**. **ICES could provide guidelines, frameworks and definitions such of sustainability itself.**

- stakeholder involvement in decision making

Especially in the field of risk management ICES should take into consideration voices of local communities and stakeholders and find out what needs to be solved and how to solve issues taking into consideration possible implications on a nation or local communities.

With slower structural development in Southern Europe ICES could use its global dimension and make use of best practices from other parts of the world and try to demonstrate their applicability in Southern Europe. ICES could be a forum of opinion exchange with industry like it takes place more efficiently in livestock or salmon (in contrary to other aquaculture species).