

# WGMARS 2017 REPORT

ICES STEERING GROUP ON INTEGRATED ECOSYSTEM ASSESSMENTS

ICES CM 2017/SSGIEA:12

REF ACOM AND SCICOM

## Interim Report of the Working Group on Maritime Systems

22-26 May 2017

Woods Hole, USA



**ICES**

International Council for  
the Exploration of the Sea

**CIEM**

Conseil International pour  
l'Exploration de la Mer

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Recommended format for purposes of citation:

ICES. 2017. Interim Report of the Working Group on Maritime Systems. WGMARS 2017 REPORT 22-26 May 2017. Woods Hole, USA. ICES CM 2017/SSGIEA:12. 30 pp.

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## Executive summary

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The Working Group on Maritime Systems (WGMARS) held its annual meeting 2017 on 22–26 May 2017 in Woods Hole, MA, USA. The meeting with 19 participants (13 from North America and 6 from Europe), including representatives and chairs from the Working Group on the Northwest Atlantic Regional Sea (WGNARS) and the Working Group on IEAs in the North Sea (WGINOSE), was chaired by Christine Röckmann (Wageningen Marine Research, Netherlands).

WGMARS kicked off their new three-year (2017–2019) work focus on the understanding of Integrated Ecosystem Assessments (IEAs), IEA end-users' expectations, and advancing IEA use in management advice. This focus aligns with international developments to produce more holistic management advice, i.e. ecosystem-based management (EBM), a central objective in the EU's Common Fisheries Policy. EBM addresses not only ecological, but also economic and social needs and explicates information on trade-offs in relation to management objectives. ICES considers IEAs as a tool to achieve EBM.

ICES scientific advice needs to be placed within the real life context and focus on management applications. Therefore, WGMARS emphasizes the importance of identifying ecological, economic, social and cultural, and institutional management objectives before starting in depth modelling. Inspired and guided by examples from the USA and Canada, WGMARS started producing an overview of management objectives relevant to the North Sea. Joining forces, WGMARS and the ICES Strategic Initiative on the Human Dimension (SIHD) have just prepared an ACOM/SCICOM Workshop on Balancing Social, Economic and Institutional Objectives in Integrated Assessments (WKSIHD-BESIO), to be held in November 2017.

During the 2017 meeting, WGMARS, jointly with WGNARS, facilitated a 2-day transdisciplinary stakeholder workshop on IEA in the Northwest Atlantic (WKINWA). The objective of WKINWA was to foster the exchange of knowledge between the North American and European sides of the Atlantic on inter- and transdisciplinary IEA processes.

WGNARS has carried out an extensive interdisciplinary IEA process for the past seven years, and has also reached out to stakeholders for integrating management objectives into the IEA conceptual model for the Northwest Atlantic. The IEA approach of WGNARS has been focused on fisheries. In the future, WGNARS could improve the integration of other maritime sectors into the IEA.

For the North Sea, on the contrary, next to foodweb models a cross-sectoral Cumulative Effects Assessment (CEA) has been developed. WGINOSE has included the CEA in the IEA scoping phase, as it aids in identifying and evaluating effects of human activities on the ecosystem, considering all marine/ maritime sectors, pressures and ecosystem components. The North Sea IEA approach has thus made progress with integrating the various maritime sectors in the IEA, but it is advisable to also improve on inter- and transdisciplinary integration. In particular, WGINOSE needs to involve social sciences in their IEA approach to confront the social and economic aspects of the North Sea ecosystem and start transdisciplinary discussions on management objectives with stakeholders. As a first step, WGMARS proposes an embedded WGMARS-WGINOSE workshop with a focus on IEA in the North Sea during the WGMARS 2018 meeting, scheduled during the week of 19–23 February 2018 in The Hague, Netherlands.

## 1 Administrative details

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**Working Group name**

ICES Working Group on Maritime Systems (WGMARS)

**Year of Appointment within the current cycle**

2016

**Reporting year within the current cycle (1, 2 or 3)**

1

**Chair**

Christine Röckmann, Netherlands

**Meeting venue**

Woods Hole, MA, USA

**Meeting dates**

22-26 May 2017

## 2 Terms of Reference a) – e)

WGMARS 2017–2019 focus: Understanding the implementation of Integrated Ecosystem Assessments (IEA) in ICES

ToR	Description	Background	Science Plan topics addressed	Duration	Expected Deliverables
	Understanding the implementation of Integrated Ecosystem Assessments (IEAs) in ICES	ICES has identified Ecosystem Understanding as their key priority. IEAs play an important role in supporting Ecosystem understanding and enable understanding effects of trade-offs between resource users.	1.1, 1.2, 2.1, 3.2, 4.1	3 years	Two annual reports and a final report with our findings will be presented to ICES. Review paper
a	Understanding of IEAs, definitions, framing	Review of existing IEA reports from the relevant ICES groups; interact with ICES IEA groups to follow developments.	1.1, 1.2	year 1	Review paper
b	Identifying IEA end-users and the required extended peer community	IEAs are seen as an important tool that enable evaluation of trade-offs and sustainable marine management. How do IEAs fit in contemporary governance and management systems?	2.1	year 2	Collaborative reporting in the WGMARS report
c	How have IEAs evolved and how should they be integrated in management advice.	For ICES to provide meaningful IEAs for regional seas or selected marine areas close collaboration between many ICES expert groups and the ICES secretariat is anticipated. Cases studies will be used starting with an analyses of WGNARS IEA work in the Northwest Atlantic with key stakeholders.	2.1, 4.1	3 years	Collaborative reporting in the WGMARS report

d	Analyse interactions between resource users, the governance system and the complex social-ecological marine system with Behavioural Economics	Which findings from Behavioural Economics can be applied to marine ecosystem management settings, including fisheries management. Illustrate how these findings can increase alignment of individual behaviour with societal aims.	1.2, 2.1	3 years	Collaborative reporting in the WGMARS Report
e	Stimulate transdisciplinary research by organizing workshops involving scientist from different fields and stakeholders	Practical exercises and case studies for WGMARS transdisciplinary consultation on how to best integrate available knowledge, including stakeholder knowledge, into IEAs	1.1, 1.2, 2.1, 3.2, 4.1	Each year 1 workshop	Collaborative reporting in the WGMARS report

### 3 Summary of Work plan

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<b>Year 1</b>	Focus on understanding of IEAs
<b>Year 2</b>	Focus on understanding expectations of IEA end-users
<b>Year 3</b>	Focus on advancing IEA in management advice

#### 4 List of Outcomes and Achievements of the WG in this delivery period

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- Preliminary overview table created of environmental, economic, social, and institutional North Sea marine management objectives (cf. 5.2);
- WGMARS and ICES SIHD jointly prepare ACOM/SCICOM Workshop on Social, Economic and Institutional Objectives in Integrated Assessments (WKSIED-BESIO), to be held in November 2017;
- WGNARS and WGINOSE collaborate with WGMARS;
- WGNARS' Northwest Atlantic IEA process was discussed and evaluated with stakeholders (see also separate WKINWA 2017 report);
- First North Sea IEA mental modelling exercise carried out;
- WGINOSE plans to move towards inter- and transdisciplinary assessments:
  - Next step: transdisciplinary WGMARS-WGINOSE meeting on North Sea management objectives with North Sea managers/stakeholders from the fisheries/food, renewable energy, environment sectors (2 days in week 8, 2018, The Hague, Netherlands).
  - WGMARS-WGINOSE meeting is deliberately planned to take place before WGINOSE 2018, serving as the first phase (scoping) of IEA, in preparation for the WGINOSE 2018 meeting (16–20 April 2018)
- Template started for carrying out a survey about the nature of the different ICES IEA groups (WGCOMEDA, WGEAWESS, WGIAB, WGIBAR, WGICA, WGINOR, WGINOSE, and WGNARS) (cf. Annex 4)
- First structural outline started for manuscript targeted at the ICES (and international) IEA community on how to move beyond the natural sciences when developing methods for IEAs (cf. Section 5.1)
- WGMARS joins forces with WKIDEA (2016) to prepare a Cooperative Research Report (CRR) on IEAs over the next two years; WGMARS will contribute specifically on the first aspect of outlining “in general terms the framework of IEA”
- WGMARS proposes anthropologist Patricia M. (Trish) Clay (NMFS-NOAA, USA) as WGMARS chair

## 5 Progress report on ToRs and workplan

The WGMARS 2017 meeting kicked off WGMARS new 3-year work focus on Integrated Ecosystem Assessments (IEAs). In this first year, WGMARS focused on understanding IEAs.

Short overview of the ToRs, as used in the subsequent subheaders:

ToR	description
a	ICES IEA review, framing/ understanding
b	IEA end-users, extended peer community (EPC) → year 2
c	Evolution, integration in management advice – CS
d	Stakeholder interactions, behavioural economics → postponed to year 2
e	transdisciplinary research/ workshops – CS

### 5.1 ToR a- ICES IEA review, framing/ understanding

The nature of **transdisciplinary** research was discussed, and a common understanding agreed upon (Figure 5.1): By combining and integrating different disciplinary and local knowledge and expertise, i.e. from both many types of scientists and from other stakeholders, scientific management advice can move beyond disciplinary boundaries, leading to synergy, broader experiences and scientific results that are more applicable to management problems than results based on (single/multi) disciplinary approaches or only scientific sources of knowledge.

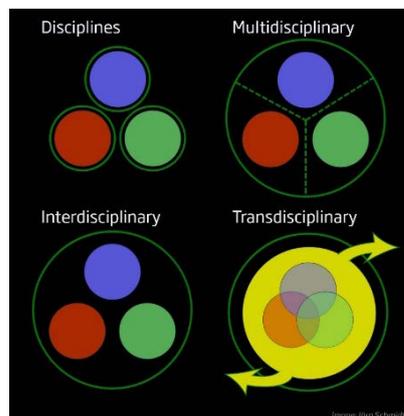


Figure 5.1 Approaches for different disciplinary work-collaboration approaches.

ICES has prioritized IEAs as a way to develop methods to address more comprehensive knowledge needs of fisheries and environmental managers. Knowledge and evidence to examine likely trade-offs between management measures needs to be developed and translated for use by multiple groups. This development and translation requires a new way of acting by ICES as it moves into the realm of interdisciplinary research, and also transdisciplinary interactions. Such an approach is for instance needed when providing advice on the trade-off between seafloor impact of trawling and the provision of fish and the profits from the sale of fish or the trade-off between profits

from any given maritime industry and fishing communities' cultural identity<sup>1</sup> and sense of place<sup>2</sup>. Countries, the EU and Regional Sea Conventions are developing indicators of impacts on benthic habitats from anthropogenic activities, particularly bottom trawling. ICES received a request from the European Commission (DGENV) to "*Evaluate indicators for assessing pressure and impact on the seafloor from bottom-contacting fishing. Using this assessment, demonstrate trade-offs in catch/value of landings relative to impacts and recovery potential of the seafloor*". To answer the question, an inter- and transdisciplinary approach is required. ICES ran three workshops:

- Workshop to evaluate regional benthic pressure and impact indicator(s) from bottom fishing ([WKBENTH](#));
- Workshop on scoping stakeholders on production of operational guidance on assessment of benthic pressure and impact from bottom fishing ([WKSTAKE](#));
- Workshop to evaluate trade-offs between the impact on seafloor habitats and provisions of catch/value ([WKTRADE](#)).

The last two were transdisciplinary in nature. WKSTAKE engaged with stakeholders to raise awareness around the linked issues and to create a dialogue about the methods and approaches used in the analysis. WKSTAKE provided the opportunity to learn about the methods, chat to fisheries representatives, managers and scientists, and offered an opportunity for decision-makers to hear the diverse views of these different stakeholders. WKSTAKE represented a further development in the way ICES is enhancing its knowledge base and capacity for providing advice on fisheries and the environment. WKTRADE used a worked example from the North Sea to illustrate trade-offs between seafloor impacts and landed value of the fisheries. ICES has just published its response<sup>3</sup>).

There are two main challenges for ICES: How can we show the value of an inter- and transdisciplinary IEA process

1. to our single-disciplinary scientific expert colleagues, and
2. to ICES clients, managers/ policy-makers/ practitioners?

An iterative process incorporating dialogue and the willingness to learn new languages and common terminology in order to understand each other is crucial. This awareness and willingness is prerequisite for IEA groups to move beyond disciplinary comfort zones, where needed and appropriate, and to produce increasingly valuable integrative products for EBM. Figure 5.2 illustrates that disciplinary and sectoral integration varies between ICES Expert Groups and is often a progression. Different groups begin at different stages, but IEA groups need to move towards transdisciplinarity during the IEA process. This does not mean that stakeholders need to be involved in every

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<sup>1</sup> Donkersloot, Rachel. "The Politics of Place and Identity in an Irish Fishing Locale," *Journal of Maritime Studies* 9(2) (2010): 33–53.

<sup>2</sup> Khakzad, Sorna, and David Griffith. "The role of fishing material culture in communities' sense of place as an added-value in management of coastal areas." *Journal of Marine and Island Cultures* 5, no. 2 (2016): 95-117.

<sup>3</sup> [ICES Special Request Advice sr.2017.13](#) "EU request on indicators of the pressure and impact of bottom-contacting fishing gear on the seabed, and of trade-offs in the catch and the value of landings" [Published 6 July 2017](#).

single process step; mono-disciplinary (e.g. fundamental research) substeps can be necessary. As Röckmann *et al.* (2015) pointed out, the degree of interaction with stakeholders depends on context-specific factors, such as stakeholders' willingness for interaction and transparency, resources (time, money, man-power), trust, or state of knowledge<sup>4</sup>.

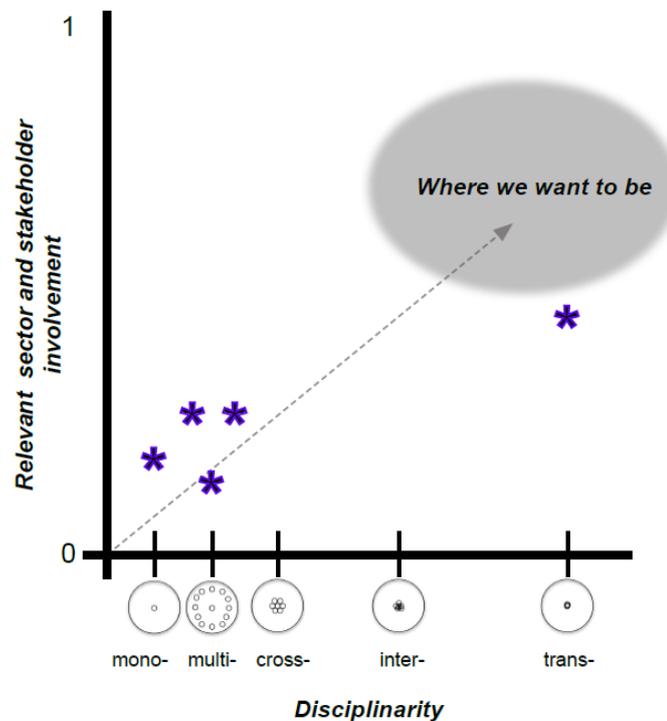


Figure 5.2 Different steps of integration over scientific disciplines and local/ non-scientific knowledge (x-axis), and over different sectors and stakeholders. Each integration step moves ICES work closer to holistic IEA for EBM. Note: EBM is place based, if a regional ecosystem has only one sector, then the y-axis is ranges from 0 to 1.

WGMARS decided to work on a manuscript (review paper) focusing on how to move beyond the natural sciences when developing methods for IEAs for marine/maritime management, targeting the ICES and international IEA community, as most of ICES IEA groups currently face this problem. In order to learn from experiences worldwide, WGMARS plans to dig into literature from Phil Levin<sup>5</sup>, South African and Australian IEA experiences, MSE literature (Management Strategy Evaluation), IWC, stakeholder processes with managers and objectives, and include management experiences in data poor situations. The concept and notion of IEA are obviously still developing, but how can we best advance this applied scientific tool in the diverse European contexts within the ICES IEA Expert Groups? A legitimate IEA process should follow a set of minimum standards that are relevant and acceptable within the different scientific disciplines (natural, life, and social sciences) as well as humanities (history and philosophy, for

<sup>4</sup> Röckmann, C., van Leeuwen, J., Goldsborough, D., Kraan, M. and Piet, G. (2015) The interaction triangle as a tool for understanding stakeholder interactions in marine ecosystem based management. *Marine Policy* 52, 155-162.

<sup>5</sup> Levin, P. S., Fogarty, M. J., Murawski, S. A., and Fluharty, D. 2009. Integrated ecosystem assessments: Developing the scientific basis for ecosystem-based management of the ocean. *PLoS Biology*, 7(1): 23-8.

example). The review paper aims at highlighting these, including options for extending the peer community and peer review of IEAs, i.e. stakeholder deliberation and other participatory approaches.

We see the importance of offering definitions in that paper of the words INTEGRATED, ASSESSMENT, and ECOSYSTEM. Although ICES clearly states that ecosystems include humans, not every ICES scientist is aware and acknowledges the human dimensions inherent in IEA frameworks and supporting data.

We also aim to investigate the extent to which IEAs have been used in management, and provide specific examples of such cases. Strategically, Management Strategy Evaluations (MSEs), are currently extensively used in the EU and North America<sup>6</sup> as concrete simulation exercises in marine fisheries. WGMARS sees the logic of an MSE process nested within an IEA process to provide additional support in defining and illustrating the inherent trade-offs within a specific context of a marine and maritime system. MSEs include the human dimension through explicit objectives that link directly to management. So, should MSEs be a specific component of IEAs? If so, how could we design successful MSE processes within a larger IEA process?

To create an overview of the state-of-the-art of the individual ICES IEA groups, WGMARS will conduct a survey to investigate the nature/characteristics and working approaches of the different ICES IEA groups (WGCOMEDA, WGEAWESS, WGIAB, WGIBAR, WGICA, WGINOR, WGINOSE, and WGNARS).<sup>7</sup> WGMARS prepared a survey template, and made a first attempt at describing the groups, based on the executive summaries of their annual meetings (see Annex 4). Based on a comparison of the different states of the ICES IEA groups we will be able to discuss what kind of work these groups are really doing and how this fits into Levin's definition of IEAs.

## 5.2 ToR c – Evolution, integration in management advice

ICES considers IEAs as a tool to achieve ecosystem-based management (EBM), a central objective in the CFP's Basic Regulation. EBM requires and explicates information on trade-offs in relation to management objectives. WGMARS 2017 emphasizes the importance of identifying ecological, economic, social, cultural, and institutional management objectives before starting in-depth biological modelling in order to ensure a focus on management applications. The ICES Strategic Initiative on the Human Dimension (SIHD) has recently highlighted this need to identify particularly social and economic management objectives for EU waters<sup>8</sup>. SIHD and WGMARS are to propose an

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<sup>6</sup> See examples in the recent book *Management Science in Fisheries*, 2016. Edited by C.T.T. Edwards and D.J. Dankel. <http://www.tandfebooks.com/isbn/9781315751443> <sup>7</sup> Note that the Workshop on Integrated Ecosystem Assessment Methods (WKIDEA 2016) identified common problems and solutions of the ICES IEA Expert Groups, focussing on exchanging ideas, methodologies and analytical approaches. In contrast, WGMARS focuses on the characterization of objectives and ways of (net)working and collaborating of these IEA groups.

<sup>7</sup> Note that the Workshop on Integrated Ecosystem Assessment Methods (WKIDEA 2016) identified common problems and solutions of the ICES IEA Expert Groups, focussing on exchanging ideas, methodologies and analytical approaches. In contrast, WGMARS focuses on the characterization of objectives and ways of (net)working and collaborating of these IEA groups.

<sup>8</sup> Julie Urquhart, Tim Acott, Matt Reed, Paul Courtney, Setting an agenda for social science research in fisheries policy in Northern Europe, *Fisheries Research*, Volume 108, Issue 2, 2011, Pages 240-247, ISSN 0165-836, <http://dx.doi.org/10.1016/j.fishres.2010.12.026>.

ACOM/SCICOM Workshop on the social, economic and institutional aspects in Integrated Assessments (WKSCIA). Following the WGNARS US/Canada and Canadian Fisheries Research Network examples (Figure 5.3), WGMARS 2017 made a first step towards identifying North Sea management objectives (Table 5.1).

## Candidate objectives for sustainable fishery

### Ecological objectives

- Productivity and trophic structure
- Biodiversity
- Habitat and ecosystem integrity



### Economic objectives

- Economic viability and prosperity,
- Livelihoods,
- Distribution of access and benefits,
- Regional economic benefits to community

### Social objectives

- Health and wellbeing,
- Sustainable communities,
- Ethical fisheries

### Institutional objectives

- Legal obligations including to indigenous peoples,
- Good governance structure,
- Effective decision-making processes

**Including performance indicators  
Linked explicitly to policy statements**



Figure 5.3 List of ecological, economic, social/cultural, and institutional management objectives relevant to sustainable fisheries, by the Canadian Fisheries Research Network (Rob Stephenson working document 2017, manuscript in preparation).

Table 5.1. First overview of North Sea marine/maritime management objectives (~indicates relevant legal text).

	Draft objective topic	Examples of objectives in legal texts (e.g. IMP, Basic Regulation)	Candidate indicators
Environmental sustainability	<ul style="list-style-type: none"> <li>productive fish stocks/ ecosystem</li> </ul>	<ul style="list-style-type: none"> <li>– MSY ~CFP ~MSFD ~EUBioDivStrat</li> <li>– commercial fish species within Safe biological limits (SBL) ~CFP~MSFD</li> </ul>	<ul style="list-style-type: none"> <li>• MSY</li> <li>• Stocks above SSB</li> <li>• 10% reduction of F per year</li> <li>• minimum conservation reference sizes</li> </ul>
	<ul style="list-style-type: none"> <li>Ecosystem health</li> </ul>	<ul style="list-style-type: none"> <li>– eliminating discards/landing obligation ~CFP~IMP</li> <li>– Biological diversity is maintained ~MSFD~EUBio-DivStrat</li> </ul>	
	<ul style="list-style-type: none"> <li>Habitat</li> </ul>	<ul style="list-style-type: none"> <li>– marine foodwebs ~MSFD</li> <li>– Seafloor integrity... not adversely affected ~MSFD</li> <li>– special areas of conservation (SAC) ~N2000; improve the status of threatened and/or declining species and habitats ~OSPAR (MPA network)</li> </ul>	
	<ul style="list-style-type: none"> <li>climate change</li> </ul>	<ul style="list-style-type: none"> <li>– reduce CO2 and other greenhouse gas emissions ~IMP</li> <li>– reduce underwater noise ~MSFD</li> </ul>	
Economic sustainability	<ul style="list-style-type: none"> <li>Employment</li> <li>Market/resource access</li> <li>Flexibility/ entrepreneurial</li> <li>Stability</li> <li>Tourism</li> </ul>	<ul style="list-style-type: none"> <li>– maritime jobs: enhancing professional qualifications to offer better career prospects in the sector ~IMP, CFP</li> <li>– Blue jobs focus on: tourism, renewable energy, aquaculture, biotechnology, seabed resources ~IMP</li> <li>– developing the maritime potential of the EU's outermost regions and islands ~IMP, CFP</li> </ul>	<ul style="list-style-type: none"> <li>• # of jobs in maritime sectors; type of employment/contracts; salary level</li> <li>• max 15% variation in TAC, until SBL are reached</li> </ul>
	<ul style="list-style-type: none"> <li>Employment</li> <li>Food security</li> <li>Tourism</li> <li>Diversity</li> </ul>	<ul style="list-style-type: none"> <li>– maritime jobs: enhancing professional qualifications to offer better career prospects in the sector ~IMP, CFP</li> <li>– developing the maritime potential of the EU's outermost regions and islands ~IMP</li> </ul>	

<sup>9</sup> Colburn, L. L., Jepson, M., Weng, C., Seara, T., Weiss, J., & Hare, J. A. (2016). Indicators of climate change and social vulnerability in fishing dependent communities along the Eastern and Gulf Coasts of the United States. *Marine Policy*, 74, 323-333.

	Draft objective topic	Examples of objectives in legal texts (e.g. IMP, Basic Regulation)	Candidate indicators
Institutional	<ul style="list-style-type: none"> <li>• Quality of life/well-being, health</li> <li>• Equity</li> </ul>	<ul style="list-style-type: none"> <li>– Healthy seafood for EU citizens</li> <li>– encouraging coastal and maritime tourism ~IMP</li> <li>– developing the maritime potential of the EU's outermost regions and islands ~IMP</li> <li>– distributional equity ~FAO voluntary guidelines SSF</li> </ul>	<ul style="list-style-type: none"> <li>• Community social vulnerability indicators<sup>10</sup></li> <li>• # of tourists at EU coasts; # of tourists on cruise ships/ sailboats...</li> <li>• sense of place, cultural identity within local management plans<sup>11</sup></li> </ul>
	<ul style="list-style-type: none"> <li>• Good governance (GG)</li> </ul>	<ul style="list-style-type: none"> <li>– Open, transparent, participatory, accountable, coherent, effective ~EU white paper on GG</li> <li>– Relative stability ~CFP</li> <li>– Access to space/ resources ~IMP</li> </ul>	<ul style="list-style-type: none"> <li>• Public access to documents</li> <li>• # of different stakeholders/sectors included</li> <li>• Level of stakeholder inclusion: e.g. use of fishing/ oil/ etc. platforms for conduct of research planned by scientist; one-off requests of stakeholder knowledge/ opinions; joint research planning, conduct, and analysis.<sup>12</sup></li> </ul>

<sup>10</sup> Jepson, M., & Colburn, L. L. (2013). Development of social indicators of fishing community vulnerability and resilience in the US southeast and northeast regions. *NOAA Technical Memorandum NMFS-F/SPO-129*.

<sup>11</sup> For example: Donatuto, J., & Poe, M. R. (2015). Evaluating sense of place as a domain of human wellbeing for Puget sound restoration. *Final Report, Puget Sound Institute, Tacoma, WA*. <https://www.eopugetsound.org/articles/evaluating-sense-place-domain-human-well-being-puget-sound-restoration>

<sup>12</sup> For a good overview of participatory research see: Wiber, M., Berkes, F., Charles, A., & Kearney, J. (2004). Participatory research supporting community-based fishery management. *Marine Policy*, 28(6), 459-468.

### 5.3 ToR e - Transdisciplinary research/workshops<sup>13</sup>

WGMARS has a tradition of organising transdisciplinary stakeholder workshops. During the 2017 meeting WGMARS, jointly with WGNARS, facilitated the two-day workshop on IEA in the Northwest Atlantic (WKINWA, 23–24 May 2017). The objective of WKINWA was to facilitate knowledge exchange between the North American and European sides of the Atlantic on inter- and transdisciplinary IEA processes. WKINWA day 1 consisted of an overview of activities of two ICES IEA groups (the Working Group on the Northwest Atlantic Regional Sea (WGNARS) and the Working Group on IEA for the North Sea (WGINOSE)), as well as a review of the needs of US regional fisheries managers with respect to Ecosystem Based Management. Day 2 consisted of a group exercise wherein WGNARS, WGINOSE, and WGMARS members began constructing a conceptual model of the North Sea, starting with a foodweb model developed by WGINOSE and a set of management objectives derived from EU policy and legislation.

Comparison of the two ICES IEA groups and of Northwest Atlantic and North Sea conceptualizations of integrated ecosystem management provided insight into the range of scientific achievements, gaps, and further needs for developing IEAs. Overviews of WGNARS and WGINOSE demonstrate different approaches to and ideas about IEA (which inspired and encouraged our proposed approach to deal with ToR a).

Based on Levin *et al.* (2009)<sup>14</sup>, WGNARS has carried out an extensive interdisciplinary IEA process with natural and social scientists and has also reached out to stakeholders in order to integrate management objectives into their IEA conceptual model. The long (>7 years) process has provided insight into best practices for each process step<sup>15</sup>. WGNARS has incorporated social scientists as members since its second year (2011), and has evolved from working on separate IEA components to working in a more interdisciplinary fashion on joint products. WGNARS spent considerable effort deriving example management objectives from policies and legislation for use in the IEA process; these have been used in initial dialogue with regional fishery managers and to structure the most recent ecosystem status reports delivered to these managers.

WGINOSE has assembled substantial empirical data, analysed in space and time, from physical through biological aspects of the ecosystem. WGINOSE initially focused on state changes and has recently focused more on processes and functions. The current focus is on assessment and modelling for management advice – however, the WGINOSE chair explained it was difficult to focus the assessment outputs without having clear management objectives, a situation likened to a “ship without a rudder”. Current products include conceptual models of system processes, and more recently, foodwebs including fisheries, based on the assembled data and expertise. Also, a cross-sectoral Cumulative Effects Assessment (CEA) has been developed for the North Sea.

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<sup>13</sup> Note: More details in the separate WKINWA report.

<sup>14</sup>footnote 3 = Levin, P. S., Fogarty, M. J., Murawski, S. A., and Fluharty, D. 2009. Integrated ecosystem assessments: Developing the scientific basis for ecosystem-based management of the ocean. *PLoS Biology*, 7(1): 23-8.

<sup>15</sup> DePiper, G.S., Gaichas, S.K., Lucey, S.M., Pinto da Silva, P., Anderson, M.R., Breeze, H., Bundy, A., Clay, P.M., Fay, G., Gamble, R.J. and Gregory, R.S., 2017. Operationalizing integrated ecosystem assessments within a multidisciplinary team: lessons learned from a worked example. *ICES Journal of Marine Science*, <https://doi.org/10.1093/icesjms/fsx038>

This is a scientifically grounded, formal approach to evaluate effects of human (economic) activities on the ecosystem, considering all marine/maritime sectors, pressures and ecosystem components. A CEA can be included in the scoping step of an IEA process. The CEA's iterative approach facilitates the identification of knowledge gaps and the gradual incorporation of the best available information.

Invited WKINWA stakeholders (representatives of US Fishery Management Councils in the Northeast US) described the US fishery management system as a co-management system<sup>16</sup> with regional councils comprised of stakeholders involved in decision-making and considerable scientific support from NOAA Fisheries. The two regions that overlap with the US portion of WGNARS include the Mid-Atlantic and New England Fishery Management Councils. Both Councils are working on EBFM (Ecosystem Based Fisheries Management) in one way or another, although using different names and approaches. The Mid-Atlantic Council engaged in an extensive stakeholder "visioning" process to develop a strategic plan addressing stakeholder concerns. Considering ecosystem processes was a high priority across all stakeholder groups. The Mid-Atlantic Council has developed policy guidance for an Ecosystem Approach to Fishery Management that includes IEA components such as risk assessment, conceptual models, and Management Strategy Evaluation (MSE). The New England Council was described as a fairly contentious environment with many conflicting views, but one where there is an interest in Ecosystem Based Fishery Management as evolution rather than revolution. Both Councils appreciated the alignment of objectives and indicators in the recent state of the ecosystem report that included management objectives for the first time and their placement at the beginning of the report. The goals were followed by social and economic analyses that previously had been presented last and then the biological and ecological analyses. These changes resulted from the WGNARS process and lead to improved engagement and communication with some potential users of IEAs in the US portion of the WGNARS region.

The conceptual modelling exercise on day two of WKINWA focused on integrating human dimensions and management objectives with the North Sea foodweb model developed by WGINOSE (Figures 5.4, 5.5). Key outcomes of this exercise were first, that learning by doing is very effective; the process itself is valuable. For example, the group worked together on taking objectives from policy statements as a starting point for discussion; this generated improved clarity on what the outputs of an IEA can relate to.

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<sup>16</sup> Note that the Councils are not true co-management because they do not have actual power to enact rules; the power lies with the Department of Commerce.

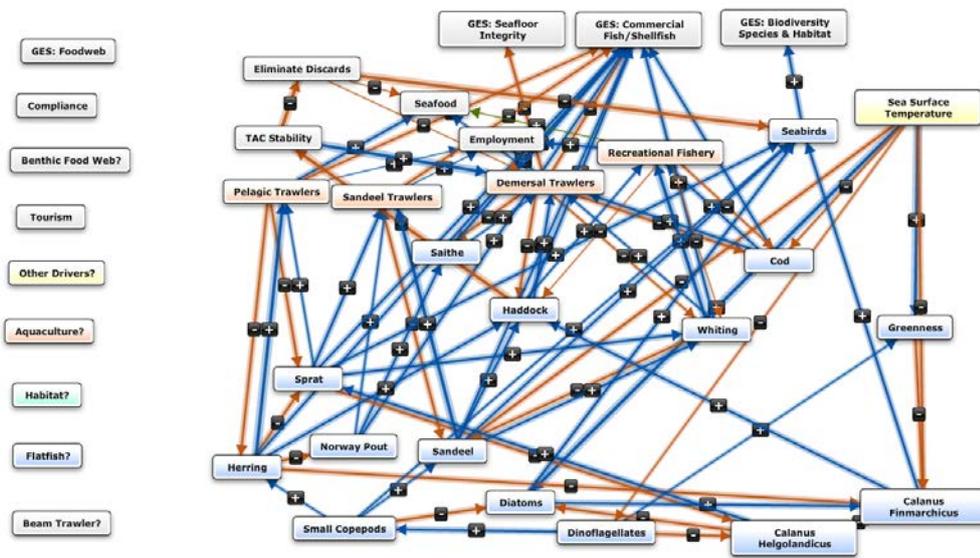


Figure 5.4 Example of a preliminary conceptual model focusing on fisheries and the human dimension as one component/submodel of a North Sea IEA .

In addition, the process of creating a conceptual model was useful. The group learned that constructing conceptual models can serve multiple purposes. First, conceptual models are excellent tools to help diverse scientists work together on an interdisciplinary product that is important to scope an IEA. Each discipline can see where their own knowledge feeds into the larger model of the system, and learns about how information from other disciplines may actually change the behaviour of the system, especially when one or another aspect of the system being modelled is perturbed. Conceptual models can also be a good way to work with stakeholders and incorporate their local and traditional knowledge into IEAs.



Figure 5.5 Conceptual modelling group exercise, on day two of WKINWA, focusing on the North Sea.

For ICES IEA groups, some general lessons learned from the conceptual modelling exercise were apparent. First, objectives embedded within the conceptual model as done by WGNARS can be a good way to acknowledge the needs of stakeholders and identify management priorities. In discussion with stakeholders, looking at trade-offs is important, and including the objectives is a good entry point into that discussion. Second, there is a clear need to have feedback loops explicitly incorporated into the modelling

process in order to understand relationships between system components. For this, multiple tools in the form of qualitative/conceptual modelling frameworks (e.g. not just Mental Modeler but also Qpress or other software packages) are valuable in simulating perturbations to understand how the various components might interact.

The IEA knowledge exchange mutually benefitted both IEA groups. The IEA approach in the Northwest Atlantic has been focused on fisheries. In contrast, for the North Sea, a cross-sectoral Cumulative Effects Assessment (CEA) has been developed, which is a scientifically grounded, formal approach to evaluate effects of human (economic and social) activities on the ecosystem, considering all marine/maritime sectors, pressures and ecosystem components. A CEA can be included in the scoping step of an IEA process. The CEA's iterative approach facilitates the identification of knowledge gaps and the gradual incorporation of the best available information.

The CEA's iterative approach is very comparable to the WGNARS IEA approach, but the approaches differ in how and what they integrate. WGNARS has already reached interdisciplinary integration and is currently working on transdisciplinary approaches, but has not integrated other maritime sectors than fisheries. WGINOSE and the North Sea CEA integrate the different maritime sectors, but need to improve on inter- and transdisciplinary integration levels.

The presentation and discussion of the WGNARS IEA process has stimulated WGINOSE to also follow a more inter- and transdisciplinary IEA approach. In particular, WGINOSE needs to involve social sciences in their IEA approach and start discussions on management objectives with stakeholders. As a first step, WGMARS proposes an embedded WGMARS-WGINOSE workshop with a focus on IEA in the North Sea during its 2018 annual meeting, scheduled during the week of 19–23 February 2018 in The Hague, Netherlands. The workshop's objective is to conduct a scoping process with relevant stakeholders to frame the subsequent WGINOSE IEA modelling. The transdisciplinary scoping results will be used during the WGINOSE 2018 annual meeting from 16– March 2018. Questions (for internal preparation) include:

- What should be the purpose and thus focus of the IEA exercise?
- What is the question to be 'answered' by the IEA model?
- What are stakeholders'/ICES groups' expectations for the exercise and the IEA (conceptual model and IEA process)?
- What are the risks? Of the conceptual modelling exercise specifically, and of the IEA process in general?

#### 5.4 Cooperation with other WGs

- Working Group on the Northwest Atlantic Regional Sea (WGNARS)
- Working Group on IEAs in the North Sea (WGINOSE)
- Strategic Initiative on the Human Dimension (SIHD)
- Workshop on Integrated Ecosystem Assessment Methods (WKIDEA)

#### 5.5 Science Highlights

Overall, WGMARS drew several conclusions as regards the natural and social sciences working jointly on IEAs, and why it is important and useful to get beyond disciplinary comfort zones.

In the multi-, inter- and transdisciplinary contexts in which IEAs are found, many data and information are available, but they are only relevant if they can be placed within the scope of the IEA. Framing of the scope should include take into account the ecological, economic, social/cultural, and institutional contexts and management objectives,

because knowledge without the context of management objectives is of little use for implementing policies<sup>17</sup>.

In the field of applied science for management advice there is a trade-off between disciplinary precision and looking at the big picture. Scientific precision does not necessarily further apply sustainability science for Ecosystem Based Management. Instead transparent discussions of uncertainties and risks are required; an IEA process can facilitate. Uncertainties can be addressed by multimodel inference, a way to formalize multiple viewpoints and uncertainties.

ICES IEA Expert Groups need to move beyond disciplinary comfort zones, where needed and appropriate, i.e. expand from single-, multi- and cross- to inter- and transdisciplinary science. This requires learning new languages, common terminologies and improving inter- and transdisciplinary communication. Also, ICES clients, stakeholders/managers/policy-makers need to understand and acknowledge that an IEA inter- and transdisciplinary process itself is valuable for building trust and creating continuity, despite outcomes that can change over time.

Building on the lessons learned from the Northwest Atlantic IEA process, WGMARS proposes to facilitate a transdisciplinary WGMARS-WGINOSE stakeholder workshop on IEA in the North Sea, identifying and discussing North Sea management objectives relevant to the fisheries, environment and renewable energy fields together with regional (North Sea) managers/stakeholders in February 2018 in The Hague, Netherlands. The workshop's objective is to identify the relevant management objectives that should frame future North Sea IEA work in WGINOSE. The date (February 2018) was chosen such that the WGINOSE 2018 meeting, scheduled for April 2018, can take into account the identified management objectives in their further elaboration of IEA and ecosystem submodels/components.

## 5.6 Challenges and future perspectives

IEAs need to analyse and discuss not only scenario alternatives, but also alternatives around management objectives. The IEA process and associated (modelling) tools are important for developing and exploring useful, salient, credible, legitimate, coherent and consistent scenarios.

Understanding the management context is crucial. Therefore, in addition to environmental/ ecological and physical aspects that have already been integrated into ICES science, for IEAs ICES also needs to consider economic, social, political, administrative, legal, cultural, ethical, and technical issues in future.

Should an IEA process focus first on identifying management objectives or on creating a conceptual model to build the crucial interdisciplinary understanding between scientists? It is not clear what the optimal chronological order of these crucial steps in an IEA process should be. WGNARS felt the identification of management objectives needed to come first, in order to be clear on what aspects of the ecosystem needed to be fleshed out and to what level of detail. Then the conceptual model could be built to include those specifically.

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17 Neither "knowledge" nor "information" means anything without reference to a context that permits the data, measure or ideas to be interpreted and to take on significance or meaning." Quote from Douguet *et al.*, 2009. Uncertainty Assessment in a Deliberative Perspective (Chapter 2). In: Science for Policy. 2009 Edited by: Â.G. Pereira and S. Funtowicz. Oxford University Press (India). ISBN13: 9780195698497/ISBN10: 0195698495, Hardback, 390 pages.

In order to create scientific as well as societal/ managerial support for IEA processes, their benefits need to be made known and communicated to our colleagues and managers in multiple ways (reports, journal articles, workshops of various types, etc.) and formats (text, graphics, other visuals). Building a common understanding of IEAs that acknowledges the necessity of inter- and transdisciplinary work for a full understanding of EBM trade-offs is crucial to create momentum among both ICES EG chairs and policy-makers. Ultimately it is the science for management advice that needs to adapt.

The question of “Who are the stakeholders that need to be involved?” remains a challenge in any participatory science setting. But knowing the management objectives can help to identify which groups are likely to be affected and thus the critical stakeholders.

Finally, ICES has already started moving from providing purely fisheries management advice towards marine/ maritime management advice. Hence, other human pressures/ activities at sea need to be taken into account in IEAs.

## **6 Revisions to the work plan and justification**

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Re ToR d – stakeholder interactions, behavioural economics: It was unanimously decided by WGMARS 2017 to postpone this ToR to year 2, in particular due to the absence of the expert who proposed this ToR (Sarah Kraak, TI, Germany).

Re ToR a – IEA review paper: WGMARS 2017 has started the planning the work and structuring this review paper. Ground work needs to be done first, though. Therefore, WGMARS is going to continue working on this ToR through 2018.

## **7 Next meeting**

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The WGMARS 2017 participants agreed to meet for their 2018 annual meeting on 19–23 February 2018 in The Hague, Netherlands.

During this annual meeting, WGMARS plans to organize and facilitate a transdisciplinary WGMARS-WGINOSE stakeholder workshop on North Sea management objectives together with regional (North Sea) managers/stakeholders, probably on Wednesday-Thursday, 21–22 February 2018 also in The Hague, Netherlands. The objective of this workshop will be to identify management objectives for framing the scope of the WGINOSE 2018 meeting to be held 16–20 April 2018.

## Annex 1: List of participants

### WGMARS 2017 + WKINWA participants

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\* experts/ stakeholders, participating only at WKINWA

## Annex 2: Recommendations

Recommendation	Adressed to
1. Finalize survey questions/table and e-mail to IEA EG chairs	WGMARS ICES Secretariat to assist in sending the e-mails to the EA EG chairs
2. Reply to WGMARS IEA survey questions before February 2018	Chairs of the ICES IEA groups WGCOMEDA, WGEAWESS, WGIAB, WGIBAR, WGICA, WGINOR, WGINOSE, WGNARS
3. Announce a transdisciplinary WGMARS-WGINOSE stakeholder workshop on North Sea management objectives together with regional (North Sea) managers/stakeholders – suggestion: 20-21 or 21-22 February 2018 in The Hague, Netherlands	ICES Secretariat WGMARS WGINOSE
4. Plan the ACOM/SCICOM Workshop on the social, economic and institutional aspects in Integrated Assessments (WKSCIA) before February 2018	SIHD, WGMARS, WGINOSE, ICES Secretariat, SCICOM

### **Annex 3: Preliminary classification of ICES IEA Expert Groups**

Overall objective of the ICES IEA Expert Groups: working towards better understanding and/or carrying out IEAs in their specific regional seas. *Preliminary* classification of each IEA EG in the tables below.

#### **Overview of the ICES IEA Expert Groups**

**In alphabetical order**

<b>Acronym</b>	<b>Full name</b>
WGCOMEDA	Working Group on Comparative Analyses between European Atlantic and Mediterranean marine ecosystems to move towards an Ecosystem-based Approach to Fisheries
WGEAWESS	Working Group on Ecosystem Assessment of Western European Shelf Seas
WGIAB	ICES/HELCOM Working Group on Integrated Assessments of the Baltic Sea
WGIBAR	Working Group on the Integrated Assessments of the Barents Sea
WGICA	ICES/PAME Working Group on Integrated Ecosystem Assessment (IEA) for the Central Arctic Ocean
WGINOR	Working Group on the Integrated Assessments of the Norwegian Sea
WGINOSE	Working Group on Integrated Assessments of the North Sea
WGNARS	Working Group on the Northwest Atlantic Regional Sea

**WGCOMEDA**

<http://www.ices.dk/community/groups/Pages/WGCOMEDA.aspx>

<b>Objective</b>	Working towards strategic goals: Develop an integrated, interdisciplinary understanding of the structure, dynamics, and the resilience and response of marine ecosystems to change. Understand the relationship between human activities and marine eco-systems, estimate pressures and impacts, and develop science-based, sustainable pathways.
<b>Regional focus</b>	Mediterranean Sea compared with Atlantic
<b>Working since - until</b>	2014–2016 +3 years
<b>Disciplines involved</b>	Natural scientists: (Atlantic, Mediterranean; ecological – population - community - ecosystem level; Climate, fisheries)
<b>Stakeholders involved</b>	none
<b>Other collaborations?</b>	ICES/HELCOM Working Group on Integrated Assessments of the Baltic Sea (WGIAB) and the ICES Working Group on Ecosystem Assessment of Western European Shelf Seas (WGEAWESS)
<b>Who collaborates with whom?</b>	Natural scientists with natural scientists
<b>Disciplinarity? (multi, inter)</b>	Multi and inter but within the natural sciences
<b>Main Methods</b>	Time-series and other ecological analyses
<b>Scoping/ problem framing</b>	No
<b>Process Description</b>	?
<b>Products/Output</b>	comparison of marine ecosystems in the Atlantic and the Mediterranean: discussions on sensitive ecological processes (species/ population/ interspecific/ trophic), climate variability, fishing impact

**WGEAWESS**

<http://www.ices.dk/community/groups/Pages/WGEAWESS.aspx>

<b>Objective</b>	No IEA focus but: focuses on biodiversity, climate change issues, large marine ecosystem functioning, and the context of ecosystem health indicators development for the Marine Strategy Framework Directive
<b>Regional focus</b>	North Atlantic European continental shelf  (Western European Shelf Seas)  Regional areas of interest include the Celtic sea, bay of Biscay and Western Iberia, encompassing five countries (Ireland, UK, France, Spain, and Portugal)
<b>Working since - until</b>	2014–2016
<b>Disciplines involved</b>	natural scientists: Physical + Biological oceanography, habitat/fish ecology, Ecosystem modelling, Statistics/quant methods
<b>Stakeholders involved</b>	Yes: 750 stakeholders reported, direct linkage to WWF, DC-MAP, DG-MARE, MSFD DG ENV, OSPAR
<b>Other collaborations?</b>	
<b>Who collaborates with whom?</b>	Natural scientists and stakeholders
<b>Disciplinarity? (multi, inter)</b>	Trans ?
<b>Main Methods</b>	Conceptual model as ecosystem overview, PC as quantitative technique for ecological trends
<b>Scoping/ problem framing</b>	No
<b>Process Description</b>	Annual meeting
<b>Products/Output</b>	Indicators; Develop a conceptual model as overview of the ecosystem, integrated trend analysis as pilot studies for ecosystem models on regional level

**WGIAB**

<http://www.ices.dk/community/groups/Pages/WGIAB.aspx>

<b>Objective</b>	Develop and combine ecosystem-based assessments with management efforts for the Baltic Sea. Increase understanding of Baltic Sea ecosystem functioning (emphasis on foodweb); The human dimension in IEAs (conceptual model)
<b>Regional focus</b>	Baltic Sea
<b>Working since - until</b>	2007 to present
<b>Disciplines involved</b>	Marine/fisheries biologists, social scientists
<b>Stakeholders involved</b>	?
<b>Other collaborations?</b>	
<b>Who collaborates with whom?</b>	ICES EG scientists
<b>Disciplinarity? (multi, inter)</b>	multi
<b>Main Methods</b>	Indicator development (foodweb and socio-ecological), case studies, meta data collection, development of conceptual model, biological traits analysis, use of time-series analyses
<b>Scoping/ problem framing</b>	Yes, through focusing on case studies (salmon, herring)
<b>Process Description</b>	?
<b>Products/Output</b>	Improved conceptual model for ecological- social system; Indicators of ecosystem structure, functioning, and pressure-state links Pressure assessment for EO; Salmon and Herring case studies; 2 conceptual models (DPSIR and another model) for looking at how to link ecosystem function and human dimension)

**WGIBAR**

<http://www.ices.dk/community/groups/Pages/WGIBAR.aspx>

<b>Objective</b>	conducts and develops integrated ecosystem assessments for the Barents Sea as part of the Ecosystem Approach to Fisheries Management
<b>Working since - until</b>	2013 to present
<b>Disciplinarity? (multi, inter)</b>	multi

To be continued in 2018.

**WGICA**

<http://www.ices.dk/community/groups/Pages/WGICA.aspx>

<b>Objective</b>	<b>IEA Arctic</b>
Regional focus	Arctic

To be continued in 2018.

**WGINOR**

<http://www.ices.dk/community/groups/Pages/WGINOR.aspx>

<b>Objective</b>	
<b>Regional focus</b>	Norwegian Sea
<b>Working since - until</b>	2015 to present
<b>Disciplines involved</b>	Physical + Biological oceanography
<b>Stakeholders involved</b>	End-user WGIPS (international pelagic surveys)
<b>Other collaborations?</b>	Not identified.
<b>Who collaborates with whom?</b>	Natural scientists with natural scientists
<b>Disciplinarity? (multi, inter)</b>	Multi/ cross : different natural sciences collaborating
<b>Main Methods</b>	Framework based on IEA benchmark, Levin <i>et al.</i> , 2009 Ecosystem models: ENAC, NORWECOM, Atlantis
<b>Scoping/ problem framing</b>	Have looked at management plans but no clear link to management
<b>Process Description</b>	Annual meeting
<b>Products/Output</b>	Indicators (ocean heat, bio: zooplankton to fish to marine mammals and birds) Plan to follow Levin <i>et al.</i> , 2009 framework as in WKBEMIA

**WGINOSE**

<http://www.ices.dk/community/groups/Pages/WGINOSE.aspx>

<b>Objective</b>	<b>develops links between the science-base of IEA and ecosystem management advice in ICES greater North Sea ecoregion</b>
<b>Regional focus</b>	North Sea
<b>Working since - until</b>	2006 to present
<b>Disciplines involved</b>	Physical and biological oceanographer and modellers
<b>Stakeholders involved</b>	No
<b>Other collaborations?</b>	JNCC, Aberdeen (seabird and marine mammal data) SAHFOS, Plymouth (plankton data) ICES WGEXT (marine aggregate dredging data) The UK Crown Estates (data on non-fishing human activities)
<b>Who collaborates with whom?</b>	Natural scientists
<b>Disciplinarity? (multi, inter)</b>	Multi-/cross (natural scientists)
<b>Main Methods</b>	PCA trends and BBNs
<b>Scoping/ problem framing</b>	Not yet, will start in February 2018
<b>Process Description</b>	Annual working group meeting with occasional additional intersessional meetings and workshops
<b>Products/Output</b>	Temporal trends in state for each spatial strata

## WGNARS

<http://www.ices.dk/community/groups/Pages/WGNARS.aspx>

<b>Objective</b>	IEA process
<b>Regional focus</b>	Northwest Atlantic
<b>Working since - until</b>	2009-10 to present
<b>Disciplines involved</b>	Physical + biological oceanography; Habitat/fish ecology Ecosystem modelling; Statistics/quantitative methods; Economics; Anthropology; Policy
<b>Stakeholders involved</b>	Yes: Members work with fishery management councils, agencies
<b>Other collaborations?</b>	?
<b>Who collaborates with whom?</b>	Natural and social scientists, fisheries stakeholders
<b>Disciplinarity? (multi, inter)</b>	Interdisciplinary (natural and social scientists) and recently transdisciplinary
<b>Main Methods</b>	Framework based on Levin <i>et al.</i> , 2009 Empirical analysis Risk assessment Qualitative network models Model based simulation (multiple existing models)
<b>Scoping/ problem framing</b>	yes
<b>Process Description</b>	Annual meeting Interim work combines disciplinary subgroups and national interdisciplinary subgroups, 2017 added interim international calls on specific ToRs
<b>Products/Output</b>	Indicators (many from climate/physics to people) Empirical indicator thresholds General objectives Risk assessment Conceptual models linking physics/ecology/human activities/objectives Ecosystem reporting including objectives, human dimensions placed first (2017)