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CIEM Conseil International pour l'Exploration de la Mer

Our front cover image is taken from Galicia, Spain where hundreds of researchers, stakeholders and science communicators will attend the 2014 Annual Science Conference in A Coruña.

The conference coincides with the centenary year of the Spanish Institute of Oceanography (IEO). The institute has changed dramatically since the early days of its founder Odón de Buen and its history is charted in this year's issue.

ICES has also undergone some major changes in recent years, not least in its focus areas. The new ICES Strategic Plan was implemented in 2014 and works towards integrated ecosystem understanding. While a number of publications are available on the ICES website explaining what the strategy now means for ICES, we thought it important to hear what the strategy means to our partners. Some of the organizations ICES partners with have outlined collaborative areas as we move forward with the new strategy.

Collaboration is key to ICES and a number of scientists from our network are participating in the GAP2 EU project which looks at bridging the divide between research, policy and practice. Their progress is outlined further in this issue.

We also look at the challenges facing recreational fisheries and the considerations needed to develop mixed-fisheries advice. And hear the latest from the 2014 eel expedition to the Sargasso Sea.

We hope you enjoy it and would love to hear more from our readers. Any feedback or suggestions for future articles are welcome at info@ices.dk.

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CONTENT

Searching for eel larvae in the Sargasso Sea

TO IMPROVE UNDERSTANDING OF THE DECLINE IN THE EUROPEAN EEL POPULATION, A DANISH RESEARCH EXPEDITION WITH DTU AQUA'S RESEARCH VESSEL "DANA" EXPLORED THE SPAWNING AREAS IN THE SARGASSO SEA IN MARCH–APRIL 2014.

By Line Reeh, Torkel Gissel Nielsen, and Peter Munk, DTU Aqua

The identification, spawning, and early life stages of the European eel was among the topics considered by the "Committee A" at ICES in the early 1900s. Knowledge of the biology of this species was very poor at that time; no mature eel had been observed and the position of spawning sites was completely unknown. However, during a cruise in 1913 the Danish scientist Johannes Schmidt, after a decade-long search, found small eel larvae in the Sargasso Sea, far from the European continent. This finding was first announced in 1914, but because of World War I, the final delimitation of the spawning area had to await further cruises (by the RVs "Dana" I and II in 1920–22). Hence Schmidt was unable to publish his renowned findings on eel spawning areas until 1923. Since Schmidt's first observations, the Sargasso Sea spawning areas have

been revisited over a series of dedicated cruises organized by different countries. Despite good progress in the understanding of the eel's early life processes, there are still several unresolved questions such as those on the subjects of larval feeding and drift.

The recruitment of the European eel, monitored by the amount of glass eel returning to Europe from the Sargasso Sea has been in dramatic decline over the last 30 years, and is now at a severe low of only 3–5% of earlier magnitude. This change and the consequences for eel fisheries in Europe have led to intensified research on the oceanic life phase of the European eel. Further field studies have been proposed, and in 2014 a Danish eel expedition set out on DTU Aqua's RV "Dana IV", targeting the eel spawning grounds in the Sargasso Sea and the areas to the east. The cruise was carried out in coordination with a German expedition which covered the same time period and areas.

The Danish Eel Expedition 2014 was focused on improving our understanding of the importance of oceanographic processes for the eel's choice of spawning site and for its early life. Will the apparent climate change in the Sargasso Sea, which

The eel larva's favourite food

The samples collected include plankton species such as jellyfish and appendicularians, which are believed to make up the favourite diet of the eel larva. Plankton of this kind – known as jelly plankton – are difficult to collect because they tend to disintegrate in the nets and are generally very hard to preserve. However, we were able to collect jelly plankton from the same area in which we found the youngest eel larvae. By matching the DNA of the jelly plankton with DNA from the stomach contents of the eel larvae, we hope to reach a definitive conclusion on the diet of the young eel larvae. This knowledge is also in great demand to successfully raise eel larvae in aquaculture.

> **THERE ARE STILL SEVERAL UNRESOLVED QUESTIONS SUCH AS THOSE ON THE SUBJECTS OF LARVAL FEEDING AND DRIFT**

shows a significant increase in temperature over the last 40 years, impact larval life and drift and – ultimately – their survival?

The expedition

The expedition, led by senior scientist Peter Munk from DTU Aqua, was carried out in March–April 2014 and was divided into three legs: the first covered the central spawning areas, the second the eastern parts towards the Azores, and in the third leg the expedition searched for eel larvae and juveniles east of the Azores. With a total of 82 stations during the expedition the distribution of larvae was delimited both on the latitudinal and longitudinal axis. The larvae are distributed across a huge area, 500 km in length and 2000 km wide, which means an area three times the size of the North Sea. Larvae were found in "fair" concentration at certain sites (i.e. 0.2 larvae/m^3), but generally densities were very low. Overall abundance of larvae appeared to have declined to about 10% of what was estimated in the period of good eel recruitment, before the decline started about 35 years ago.

Warmer water and more northerly larvae

The preliminary findings from the expedition indicate that a number of changes have taken place in the spawning areas that may affect the eel larvae's chances of survival as well as their journey to Europe. The area was obviously warmer than during earlier expeditions in the 1970s and 1980s. The increase in temperature had moved the fronts (the transition zone between the hot and cold water masses) further north than previously observed. And as the eel larvae are often concentrated at these fronts, these groups had also shifted northward.

The extension of the spawning area towards the east appeared limited by the water masses of especially high surface salinity located centrally in the Atlantic Ocean. Only few earlier expeditions have systematically investigated the easterly parts of the spawning areas in the Sargasso Sea, but the 2014 expedition extended sampling to these areas and landed some of the 'most easterly' newly hatched larvae ever caught.

The eel larvae are adapted to a very special ecosystem; the Sargasso Sea can best be described as an ocean 'desert'. However, the fronts in the area, together with related processes, generate a relatively higher plankton production, and it is here the eel larvae are concentrated. Our preliminary observations indicate that the plankton population in several aspects differs from what has been observed during previous expeditions in these areas. The conditions for the larvae may therefore have changed, and this may have had an impact on their chances of survival. There are still numerous samples to analyze and we will know much more about the ecosystem composition and function when these samples are fully processed.

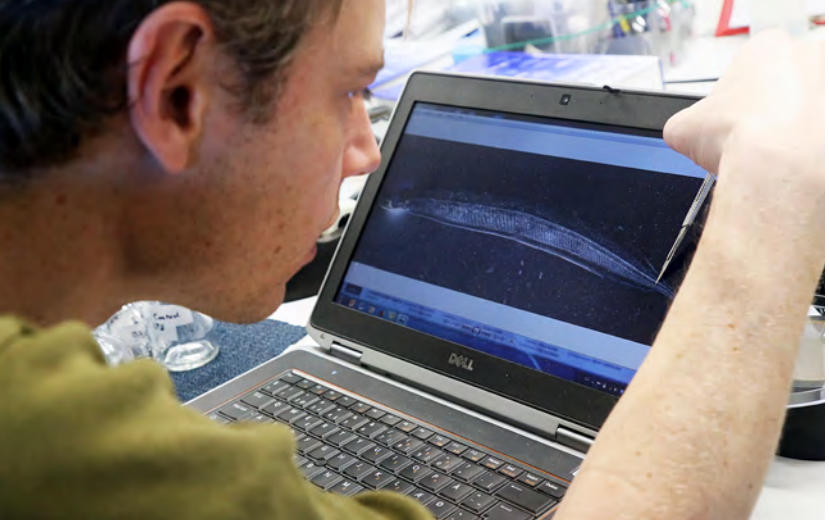
A total of 33 Danish and international researchers participated in the expedition. It was headed by DTU Aqua and funded by the Danish Centre for Marine Research and the Carlsberg Foundation.

Further reading: http://www.aqua.dtu.dk/english/Research/Eel-Expedition-2014

Assessing recruitment variability

Henrik Sparholt, ICES Deputy Head of Advisory Programme, was a member of the expedition team. His objective was to collect information for designing a standard monitoring survey in which measurements of the density of small eel larvae in the Sargasso Sea – taken every three years, for example – are used to produce a relative measurement of the number of spawning eel found in a given year.

http://ices.dk/news-and-events/Blogs/Pages/default.aspx



> **THE INCREASE IN TEMPERATURE HAD MOVED THE FRONTS FURTHER NORTH**

Recreational sea fishing – the high value forgotten catch

By Kieran Hyder[1], Mike Armstrong[1], Keno Ferter[2,3] and Harry V. Strehlow[4]

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In a nutshell

- Many millions of people throughout Europe participate in recreational sea fishing. Recent surveys show that for some species, recreational fishery harvests – the weight of fish removed from the sea – can be as large as some commercial fishing fleets, but have not been accounted for until recently in stock assessments.
- Europe lags behind countries like the USA and Australia in collecting and using recreational fishery data. In the USA, nationwide recreational fishery surveys have been undertaken since the 1980s and recreational catch estimates are routinely incorporated into assessments to support co-management of many commercial and recreational fisheries.
- In Europe, marine recreational fishery survey data are sparse and only a few stock assessments use these data to estimate recreational fishing mortality. This means we have poor understanding of marine recreational fishing impacts and how to account for them in management.
- There are statutory requirements to report recreational catches of some marine species in Europe, but the surveys are demanding in

terms of expertise and infrastructure, and vary between countries. ICES established its Working Group on Recreational Fisheries Surveys to help countries run statistically sound surveys and develop other supporting studies.

- A large proportion of recreational catch is often released, so accurate estimates of post-release mortality are also required for stock assessment. Post-release mortality is difficult to measure and is dependent on many factors including capture depth, gear, and species. More studies are needed in this area.
- Recent surveys in Europe show that recreational sea fishing has a high economic value. In addition to addressing conservation goals, future co-management of European fish stocks for recreational and commercial purposes should consider how to maximize the economic and social values of the different fisheries. New methods are required to address this.

Why is recreational sea fishing a high-value forgotten catch?

Recreational sea fishing (RSF) is a high-value leisure activity in Europe, with more than 8 million anglers spending over €8 billion on the pursuit each year. During 2012, this expenditure amounted to £1.23 billion (€1.55 billion) on sea fishing, and this was estimated to support over 10,000 full-time equivalent jobs (Armstrong *et al.*, 2013). In a similar study in France, the annual outlay in 2006 and 2007 was estimated at €1.3 billion (Herfaut *et al.*, 2013). As well as the financial aspect, fishing recreationally also confers significant social benefits like relaxation, exercise, and environmental improvement (Armstrong *et al.*, 2013).

Despite recreational sea fishing catches being significant, they have been the 'forgotten catch' in Europe because the mortality from such fishing is not factored into most stock assessments. This is a particular problem for fish species that are important for both recreational and commercial fishing, and could lead to bias in stock estimates and a failure of stocks to respond as expected to management measures. Recognizing this, the European Commission includes in its Data Collection Framework (DCF) a requirement, stipulated in 2002, for Member Countries to estimate recreational catches of Atlantic salmon, European eel, European sea bass, Atlantic cod, sharks, and Atlantic bluefin tuna. On top of this, the EU Control Regulation also requires the reporting of recreational catches of depleted stocks that are subject to EU recovery

plans (such as Atlantic cod). Other species that are important recreationally and commercially, such as European lobsters and pollack, have no statutory reporting requirements for recreational catches. Recreational fishery catches of Atlantic salmon are well documented and included in assessments, but the catch is predominantly in freshwater.

Despite the DCF requirement, it has taken time for European countries to develop suitable survey methods for recreational sea fisheries and build the scientific expertise. Various surveys in France, England, the Netherlands, and Belgium since 2009 have shown that recreational fishing (mainly sea angling) was responsible for around a quarter of the total fishery harvest and fishing mortality of sea bass in the stock occupying the North Sea, English Channel, Celtic Sea, and Irish Sea (ICES, 2014). In Germany meanwhile, recreational fishing has been responsible for around 10% of the Baltic cod harvest since 2005 and has represented as much as 70% of the German commercial cod landings (Eero *et al.*, 2014; Strehlow *et al.*, 2012).

It is important of course, from a broader ecosystem perspective, to be able to quantify human impacts on all species. This is reflected in the need for data as was evident in a 2006–2007 French survey which calculated the total annual multispecies catch by RSF to be 24,000 t of fish and 3,100 t of shellfish (Herfaut *et al.*, 2013) – a level of catch not unusual across the continent (ICES, 2013b). Excluding such data from stock assessments means it is not possible to accurately determine all the human impacts on stocks, thus lessoning the likelihood of achieving sustainable fishing. It is also possible that recreational fishing impacts local stocks or stock components, and that it may inhibit recovery of depleted stocks (cf. Eero *et al.*, 2014).

How can recreational catches be included in stock assessments?

In the past, RSF in the EU has received little attention from governments and research institutions compared with data collection from commercial fisheries. However, it is not all doom and gloom – the situation is changing, some major survey efforts have been made, and recreational catch estimates have been included in the assessment of stocks like European sea bass (ICES, 2014) and Baltic cod (ICES, 2013a). However, a lack of sufficient time-series represents the main barrier to the inclusion of recreational fishery data in a greater number of stock assessments.


CHEMNITZ
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Estimating recreational fishery catches is not straightforward. Surveys that generate precise estimates of catch with minimal bias are both difficult and expensive, particularly where there is no register of fishers or vessels. Without such a register, nationwide population surveys are needed to quantify the number of recreational fishers and their fishing effort (ICES, 2013b). The choice of method is often dictated by the fragmented nature of recreational fishing methods (e.g. line, spear, hand-gathering, nets, traps, pots, set-lines) and platforms (e.g. shore, boat) to be included in the survey. There are many different survey methods for collecting these data, with several well-known sources of bias that need to be minimized through statistically sound survey design (see e.g. Hyder and Armstrong, 2013).

Fortunately, there is a lot of expertise on recreational survey methods worldwide. ICES established its Working Group on Recreational Fishing Surveys, WGRFS , to bring together experts from Europe, Australia, and the USA to provide methodological guidance. The WGRFS has laid down guidelines for best practice in designing and carrying out surveys to obtain reliable biological and catch estimates, and the group advises on how to assess the quality of national RSF data. More recently, the group has also highlighted the importance of evaluating the economic and social value of recreational sea fishing and engaging with the angling community.

The post-release mortality of those fish caught and then thrown back by anglers is also part of the picture. In some European countries, recreational sea anglers release more than 50% of their Atlantic cod, European sea bass, pollack, and sea trout catches (Ferter *et al.*, 2013). However, the post-release mortality of these fish is mostly unknown. Such mortality can vary significantly between different species and fisheries and depends on many factors, including water temperature, hooking injuries, and how the fish are handled after being landed (Bartholomew and Bohnsack, 2005). Studies have shown that unaccounted hooking mortalities

of about 30% or more rendered many fishing regulations like minimum sizes and bag limits far less effective than intended (Coggins *et al.*, 2007). Sub-lethal effects can also occur as a consequence of hooking and handling stress (e.g. skipping of spawning – Suski *et al.*, 2003), and behavioural changes can lead to increased mortality from other causes (e.g. due to predation – Cooke and Philipp, 2004). To be able to account for post-release mortality and sub-lethal effects when recreational catch data are included in stock assessments, it is important to conduct more species-specific post-release mortality studies or make reasonable inferences from other comparable species.

What are the future challenges for recreational sea fishing?

Co-management of fish stocks for recreational and commercial purposes has been successful in other

parts of the world, including Australia and the USA. Although the initial allocation between the commercial and recreational sectors in the USA fisheries were determined by historical harvest patterns, the Magnuson–Stevens Act – the primary basis for fisheries management – makes it very clear that allocation decisions should not be guided by economic principles alone, but also take into account whether or not the allocation decision is 'fair and equitable' (Eero *et al.*, 2014). A good example of co-management in the USA can be seen with the striped bass fishery, where a stock collapse and fishery moratorium in the 1980s was followed by the introduction of the Atlantic Striped Bass Conservation Act to give coastal states the necessary tools to cooperatively and more effectively conserve and manage striped bass stocks. Many states closed their commercial fisheries and the population began to rebuild itself. In 1995 Atlantic coastal striped bass stocks were declared fully recovered, and the stock continues to be managed on the basis of scientific assessments, which include commercial and recreational fishery data with annual catch allocations to each sector . Since the 1990s, recreational harvests have far exceeded the commercial harvest, and the growth of the recreational fishery has had major economic benefits for the coastal states.

In Europe, there is currently no equivalent management framework that attempts to balance environmental, economic, and social effects of recreational and commercial fishing, or which sets clear management goals within an ecosystem services framework. Development of this framework is the next major challenge as it involves a multi-disciplinary approach that includes biologists, ecologists, economists, social scientists, modellers, and policy-makers, and works closely with stakeholders to co-produce knowledge. This also needs to take into account the potential for increasing the value of these ecosystem services and to assess the potential for growth in the value of both the recreational and commercial fisheries under different management regimes.

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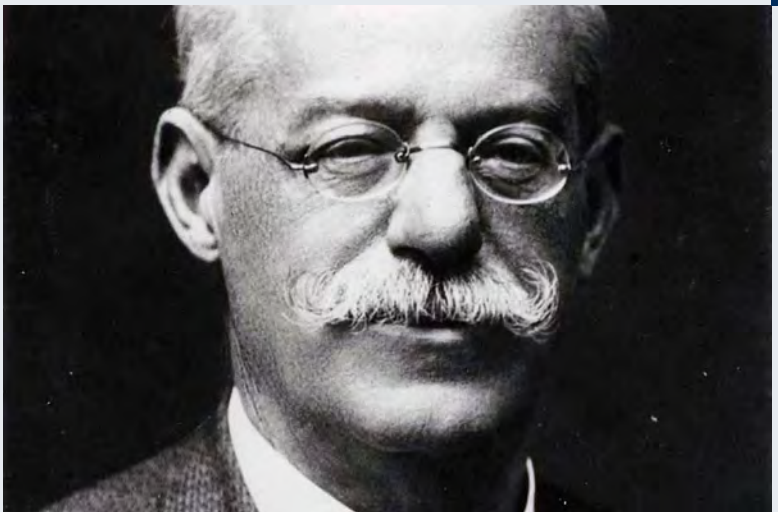
A century of research at the Instituto Español de Oceanografía

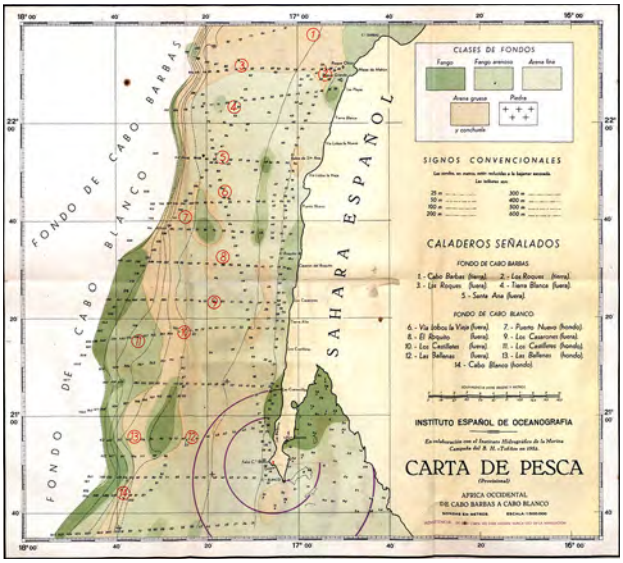
By Santiago Graiño

On 17 April, the Spanish Institute of Oceanography (IEO) celebrated one hundred years of marine research, aimed at improving the understanding of the marine environment and advising governments on a more rational development of human activities with regard to natural resources. It is impossible to talk about the IEO without mentioning its founder, Odón de Buen. A multifaceted personality, a scientist, politician, and teacher, he not only managed to convince reluctant governments to make the investment in science which led to the establishment of the IEO – a very difficult achievement in Spain at the time – but also created a focus which was very much ahead of its time. Long before ecology became a discipline whose paradigms would dominate marine research, de Buen advocated a methodology very similar to what we now call the ecosystem approach. At the time this was a completely revolutionary thought, as the normal approach at the end of the nineteenth and beginning of the twentieth centuries was to study each scientific discipline separately.

> **DE BUEN ADVOCATED A METHODOLOGY VERY SIMILAR TO WHAT WE NOW CALL THE ECOSYSTEM APPROACH**



The first Spanish centre for the scientific study of the sea – the Santander Maritime Station of Experimental Zoology and Botany – was opened in 1889, followed by two other state laboratories, one in Mallorca (1908) and the other in Malaga (1913). The following year, de Buen founded the IEO, integrating the two Mediterranean laboratories and later those in Santander, Vigo, and the Canary Islands. The other IEO centres (A Coruña, Gijón, Murcia, and Cádiz) were all established in the second half of the twentieth century.



In the IEO's founding decree the main objective is stated as: "the study of the physical, chemical and biological conditions of the seas which surround our territory, with its applications to the problems of fisheries". The first oceanographic campaigns were carried out thanks to the Navy. As early as 1928 the IEO had already conducted seventeen surveys in the Atlantic and the Mediterranean, performing around five thousand operations and deploying eleven different military vessels. The results of the studies were published in Spanish and international magazines; by mid-1932 these totalled 10,356 pages of text, excluding tables and figures. This was mostly spread out over the 255 publications in the series *Notas y Resúmenes* (*Notes and Summaries*) and *Boletín de Pescas* (*Fisheries Bulletin*), fifteen *Memorias* (*Reports*), and the nine volumes of *Resultados de campañas* (*Campaign Results*) and *Trabajos* (*Works*).

Scientific activity thus flourished in Spain during the first three decades of the twentieth century, dramatically interrupted by the Spanish Civil War. The institute was greatly affected, suffering the political exile of some of its members such as de Buen's family, while the remaining workers at the Institute were subjected to investigations during the post-war period in order to clarify their backgrounds.

1939 was a crucial year for the future of the Institute. The country's oceanographic laboratories were appropriated by the recently created Spanish National Research Council (CSIC), but fortunately another decree meant that the IEO and its personnel would answer directly to the Marine Ministry, which gave it administrative stability. Thus, from 1939 to 1970, naval officials acted as administrative directors of the Institute.

During the long, hard post-war period, worsened until 1945 by global conflict, the IEO began its internal reconstruction and worked towards the

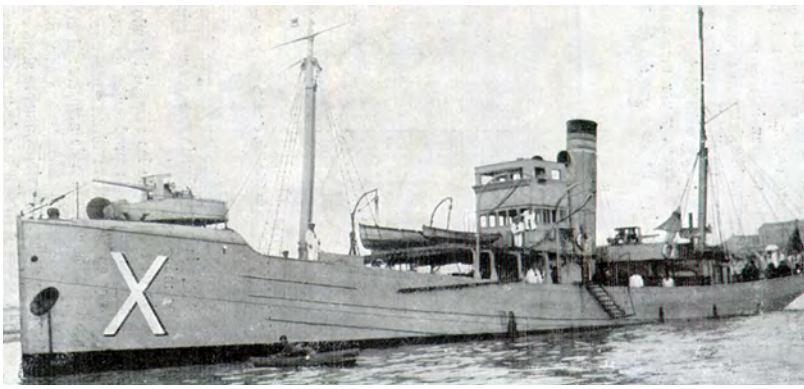
> **IEO HAS GREATLY STRENGTHENED ITS LINKS AND COLLABORATIONS BOTH NATIONALLY AND INTERNATIONALLY**

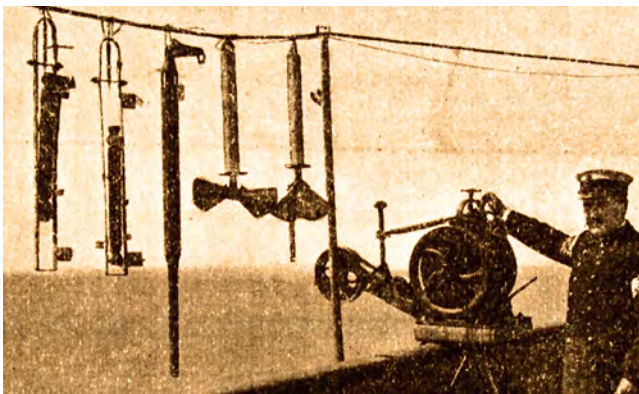
recovery of marine research and the renewal of international relations. The improvement of the Spanish economy at the end of the 1950s strengthened the high-seas fishing fleet, and, as a result, marine research saw an increase.

From 1970 came a period of expansion. Modern oceanographic ships were put into service, the Pollution and Geology departments were created, and studies were carried out in aquaculture and prospecting for fisheries in distant waters. In 1980 the IEO became answerable to the Ministry of Agriculture, within whose remit it would remain until 2000. From 1986 to 1996, with Rafael Robles as director, the Institute began to adapt to the recently passed Science Act – in which the IEO was classified as a public research organization – and to the directives of the Commission of the European Communities, where the IEO would become the official representative of the Spanish state in scientific issues pertaining to the sea and fisheries. These years showed a period of growth for the IEO. The number of staff at the Institute went from a little over 260 in 1985 to around 440 in 1996.

After various difficulties, and having been on the brink of disappearing, the IEO had managed to lay the necessary foundations to reclaim its status as the research, advisory, and coordinating body that de Buen wished it to be. It had achieved a complete reorganization in its way of working; it had gained great respect and national and international recognition for its cooperation, coordination, and scientific work, having made its presence at all levels much more organized and active, increasing its participation in international scientific institutions and forums, and providing scientific guidance and support to various public administrations and private sectors.

In 1996 IEO acquired the oceanographic RV "Cornide de Saavedra" – an iconic ship for decades in Spanish oceanography. The period 1998–2003 saw 44 new researchers and specially trained tech-





nicians join the IEO, strengthening the research teams. This resulted in a notable increase in the projects obtained in the EU Framework Programme for Research, and also in a substantial financial boost (European financing increased from 17 million to 38 million euros between 1997 and 2003).

The Institute, under the Spanish Marine and Fishery Administration, had over the years passed through the varying ministries in charge of these issues, such as Marine, Transport, and others, and had from 1980 answered to the Ministry of Agriculture, Fisheries and Food. In 2000 the IEO – along with other public research organizations which until then, like the IEO, had had a clear sectoral approach – again answered to the Ministry of Science and Technology. This marked a progressive change in the Institute which, without losing its sectoral identity, entered the core of Spanish scientific research. From then the IEO has successively answered to the ministerial agencies in charge of science and technology, currently the Ministry of Economy and Competitiveness.

In 2003 the construction of new oceanographic ships was outlined, an idea which had been developed for years and which resulted in the current RV "Ramón Margalef" and RV "Ángeles Alvariño", launched in 2011 and 2012, respectively. Research teams were strengthened and great efforts were made in the press and in public communications – which until then had been almost non-existent – with the creation of a magazine. These efforts were continued by the successive directors and in less than ten years the IEO went from being little known outside of the sector to becoming one of the most widely cited research organizations in the Spanish press.

From 2006 the process of integrating the IEO into the Spanish system of research, technological development, and innovation was strongly pushed forward. Research work was strengthened greatly in terms of scientific excellence, without abandoning the traditional works of guidance and support to governments and production sectors.

In recent years, the IEO has faced the difficult task of maintaining its scientific work during a very harsh economic crisis, with strict budgetary restrictions – something which it has managed to achieve with great efforts. In this period, the IEO has greatly strengthened its links and collaborations both nationally and internationally, assisting the creation of multidisciplinary research teams with the participation of other organizations.

Currently the IEO has an annual budget of over 65 million euros and a staff of around 700, spread across its research centres (the central headquarters in Madrid, nine oceanographic centres, and four experimental plants for marine cultures). It maintains twelve tide stations and a satellite image receiving station. Its oceanographic fleet counts seven smaller vessels and four oceanographic research vessels.

The Spanish Institute of Oceanography has been Spain's representative as a member of the International Council for the Exploration of the Sea since 1924, its first delegate being Odón de Buen.

This text is based on some of the chapters of the book "100 años investigando el mar. El Instituto Español de Oceanografía en su Centenario" (100 years studying the sea. The centenary of the Spanish Oceanography Institute), edited by Juan Pérez de Rubín; in particular, Pérez de Rubín's introduction and the texts by former directors Rafael Robles, Álvaro Fernández, Octavio Llinás, Concepción Soto, Enrique Tortosa, and current director Eduardo Balguerías. Many parts of this article, compiled by Santiago Graiño, are quoted almost verbatim from these authors.

Partners in progress

HOW DOES THE NEW ICES STRATEGIC PLAN MEET THE NEEDS OF OTHER ORGANIZATIONS?

2014 was a momentous year for ICES with the launch of the ICES Strategic Plan 2014–2018, paving the way towards integrated ecosystem understanding. We asked a selection of ICES partners to identify strategic areas of collaboration between various organizations. Darius Campbell, Executive Secretary of the OSPAR Commission, Lars-Otto Reiersen, Executive Secretary of the Arctic Monitoring and Assessment Programme and Kjell Maroni, President of the European Aquaculture Society share their views.

OSPAR Commission

OSPAR is the mechanism through which the governments of countries bordering (or linked by rivers to) the Northeast Atlantic are able to collaborate to protect the marine environment. Since 2003 OSPAR has put the ecosystem approach at the core of its decision-making on the management of impacts on the marine environment. But what does this mean in practice? How do we reach an understanding of matters that is simple enough for assessment to be feasible and affordable, while reflecting enough of the complexity of the interactions of natural and man-made systems to be useful in management?

OSPAR is a meeting point for policy and science; assessing the elements of the marine environment, such as the status of biodiversity or the level of various pollutants, is therefore a key element of its activities. However, going beyond sectoral assessments to integrate the various man-made pressures and assess these against the sensitivity of the ecosystem for the making of management decisions remains a major challenge.

OSPAR has a long-standing relationship with ICES, in particular via specific advice requests. Having access to sound scientific expertise, as well as to ICES high quality data services with its clear audit trails leading back to the underlying data for assessments, are an important part in meeting the requirements for evidence-based decision-making. At the moment we are strategically expanding our relationship, in particular to deal with integrated approaches to ecosystem management for the protection of the marine environment. With a view to this more integrated approach, OSPAR has been exploring relevant socio-economic data from its contracting parties and comparing methodologies for cumulative impacts assessment. OSPAR has also been involved in ICES work on ecosystem overview assessments. More recently we have been working closely with the first ICES joint SCICOM–ACOM workshop on ecosystem overviews (WKECOVER), which attempted to describe not just the respective ecosystem states of marine areas but also the changing human activities and resultant pressures. Describing such environmental flux is at least as important as assessing the general state of the ecosystem when making management decisions

such as those on fisheries. Regardless of which methods are used in the future, though, the work will need to be carried out in an affordable and iterative way.

We therefore welcome the announcement in the ICES Strategic Plan that in '*building a foundation of science*' the importance of integrated ecosystem understanding is highlighted. A fundamental aspect to moving an ecosystem approach towards feasible implementation is having a basic understanding of the functional dynamics of the ecosystem itself. It is pleasing to see that ICES deems it essential to understand both the human pressures and the natural changes in working out what the net effect may be, before taking this understanding through to '*producing the information and advice decision-makers need*.' OSPAR particularly welcomes the fact that, as ICES takes forward its strategy, there is original thinking being exhibited by its staff and new directions being sought in a policy environment that is rapidly changing.

Beyond the specifics of the science that ICES can offer us, I believe its role across several seas – with other regional seas conventions and with regional fisheries management organizations – means that ICES has an opportunity to be a facilitator and interlocutor to help link marine policy. This challenge is partly geographical but is particularly acute between sectors in the marine environment. We hope that ICES may continue to play a valuable and expanding role in this.

Arctic Monitoring and Assessment Programme

The Arctic Monitoring and Assessment Programme (AMAP) and ICES have a relationship spanning more than 20 years – as strong and complementary partners in both policy–advisory roles and in advancing science. This is hardly surprising when the strategic 'missions' of the two organizations are compared:

ICES vision is "to be a world leading scientific organization concerning marine ecosystems and to provide the knowledge to secure the sustainable use of the seas" in order to "advance the scientific understanding of marine ecosystems, and provide information, knowledge, and advice on the sustain-

able management of human activities affecting, and affected by, marine ecosystems" (ICES Strategic Plan 2014–2018).

AMAP's overarching mission is "to provide world-class scientific assessments and credible analyses and public outreach products on a range of environmental issues in the coming decades of anticipated environmental change and to provide strong science-based policy-relevant recommendations for the protection and sustainability of Arctic ecosystems and people" (AMAP Strategic Framework 2010+). Both organizations therefore strive to produce work of the highest standards of quality, recognizing the need for independence, integrity, and objectivity in scientific work, and to use this work as a basis for informing policy- and decision-making.

Other common aspects of our strategies include the participation of experts across a wide range

of disciplines and maintaining partnerships with other regional and international organizations. AMAP's scientific activities extend beyond the marine environment, but the aim is to support the development of integrated ecosystem assessment methodologies and the establishment of integrated ecosystem observation and monitoring systems, as well as advanced data and information services to support scientific requirements. In recent years, AMAP has moved from single-theme environmental assessments to more integrated assessments that have included socio-economic aspects.

AMAP recognizes the value of increasing the cooperation with ICES in several sectors of our work. ICES has served as the Marine Thematic Data Centre for AMAP for nearly 20 years and AMAP and ICES are now actively collaborating to expand this cooperation with the inclusion of data from more Arctic countries, in addition to the current European Arctic countries. Additional parameters are being included in the AMAP marine monitoring programme as AMAP work expands to address Arctic Ocean acidification; this is also an issue on which AMAP and ICES are working together (including with other organizations such as OSPAR) to develop the monitoring programmes and to define protocols and quality assurance (QA) requirements.

AMAP monitoring efforts are also contributing to Sustaining Arctic Observing Networks (SAON), co-sponsored by the Arctic Council and the International Arctic Science Committee (IASC). The AMAP Secretariat hosts the SAON Secretariat. SAON is built on existing observing and data networks and aims to enhance Arctic-wide observation activities and promote sharing and synthesis of data and information to serve societal needs. SAON is therefore relevant to ICES data and information services in areas of interest to ICES in the Arctic.

A new area of potential cooperation between ICES and AMAP relates to the AMAP-coordinated work on the Arctic Council project Adaptation Actions for a Changing Arctic (AACA), especially with regard to the Barents Sea region. The aim of this project is to prepare an integrated assessment of the multiple drivers of Arctic change, helping regional decision-makers and stakeholders develop adaptation tools and strategies to better deal with climate change and other pertinent environmental stressors. Climate change is a key driver in this work; other drivers of change include fisheries, global resource demands, global transport, tourism, and economic development in the Arctic. Regional scientists, representatives of local and regional governments, and relevant stakeholders are participating in this work, which is supported by scenarios of climate change and anticipated trends in the other drivers considered. Cooperation between the AACA Barents Sea Regional Integration Team and the ICES Working Group on the Integrated Assessments of the Barents Sea would be useful, particularly in terms of the fisheries aspects of the project, and could bring fruitful results for both groups.

The compatibility between the ICES Strategic Plan (especially with its new focus on the Arctic) and AMAP's own strategic framework, the common membership of the Arctic countries in both organizations, overlapping regional areas and shared goals of supporting high-quality scientific research and monitoring activities, the preparation of integrated ecosystem assessments, data management and sharing, and the development of science-based policy recommendations or advice for marine environmental management and the sustainability of ecosystems – all of these are compelling reasons for ICES and AMAP not just to continue, but also to enhance our partnership in the coming years.

European Aquaculture Society

If aquaculture, specifically in Europe, is to develop further and reach its true potential it needs access to the most appropriate water – whether this is in ponds, rivers, wetlands,

estuaries, coastal areas, or further offshore. The process through which aquaculture operators obtain their production licence is long and costly, and rests within complex legal frameworks at local, national, and regional levels. The competition with other potential users of that space is strong and will get more so. Decision-makers with the authority to issue a licence to produce high quality food need political will that is underpinned by evidence-based advice across industry sectors and across ecosystem components.

The EAS and ICES communities have considerable synergies in aquaculture and have enjoyed past cooperation – especially through ICES working groups on mariculture and on shellfish. As aquaculture becomes more strategically important for ICES through the Working Group on Aquaculture (WGAQUA), our two communities now need to work even closer together to align objectives, prioritize approaches, avoid duplication, and develop outputs that are useful to our mutual stakeholders. Cooperation could be enhanced in areas that have implications for aquaculture, e.g. climate change, quantifying ecosystem services, developing certain types of aquaculture production in areas that are 'protected' by environmental legislation, and management of parasites or predators. These areas produce diverse knowledge that should be appropriately packaged and shared between our communities for communication to our targeted end users.

Our respective annual 'showcase' events, the ICES Annual Science Conference in September and the EAS Aquaculture Europe event in October, are arenas for scientific communication, and both events will take place in Spain this year. The EAS Aquaculture Europe 2014 is concerned with all aspects of aquaculture and the scientific core of the events is complemented by a trade exhibition and special workshops targeted for aquaculture producers. It is good to see ICES providing more emphasis on aquaculture within the frame of ecosystem services. Both societies should encourage young scientists and students to attend the parts of our events that are best suited to their interests and aspirations.

Aquaculture can only be sustainable if it is economically viable. And this viability is inherently dependent upon an integrated ecosystem assessment that is at the core of the ICES Strategic Plan. Achieving, maintaining, and improving good environmental status and advising on ecosystem health and productivity is paramount in supporting policies and providing the tools decision-makers need to approve aquaculture production licences and thereby allow the sector to develop.

Third International Symposium on the Effects of Climate Change on the World's Oceans

23–27 March 2015 Santos, Brazil

Discussing the effects of climate change on the world's oceans is critical to understanding what is changing, how is it changing and how these changes will influence society.

The strong linkage between ocean dynamics and societal needs, underlined by the role of science, represents the background for a series of climate change meetings coordinated by ICES, PICES, and the Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO).

Here, the symposium convenors highlight the importance of this latest meeting to future research.

Manuel Barange, ICES

The Third International Symposium on Climate Change in the World's Oceans is a significant milestone in the long-standing cooperation between ICES, PICES, and IOC. There is no other topic of global importance requiring broader cooperative arrangements than climate change. This symposium will provide opportunities to share the latest information, understanding, and assessments of the impacts of climate change on our oceans whilst covering themes from physical processes and their interaction with ecosystem dynamics to resource provision and ocean governance. The symposium is hosted under the umbrella of the ICES/PICES Strategic Initiative on Climate Change Impacts on Marine Ecosystems (SICCME), a mechanism set up to coordinate northern hemisphere efforts to understand, estimate, and predict the impacts of climate change on marine ecosystems.

It will follow events in Spain and Korea, where ICES, PICES, and the IOC also teamed up to show their commitment and desire to respond to this global stressor.

I am personally incredibly excited to be involved in this event. My own research in recent years has focused on the impacts of climate change and economic globalization on marine resources and commodities, globally and regionally, in the developed and the developing world. I cannot think of a better venue to bring my research to the international arena. For ICES, this is also a unique opportunity to continue demonstrating global leadership, setting up the research agenda, and placing North Atlantic issues in a global context. I hope to see many ICES scientists in Brazil in March 2015.

Jacquelynne R. King, PICES

As a natural scientist providing scientific advice for marine resource management, the impact of climate change on the oceans is a personal interest. These impacts have been evident in my own research, from warming trends in sea surface temperature time-series to changes in fish community composition. Along the Pacific coast of Canada, these observed changes have had major consequences for the coastal communities and stakeholders that utilize marine ecosystem services, both as lost resources and as opportunities for new resources. The sustainable management of marine resources in the face of climate change requires quantification of uncertainty and risk in our climate, ocean, and ecosystem modeling and forecasts. This symposium continues to build on the latest developments and innovations in these fields and bridges to the human dimensions of climate change impacts, with a focus on coastal communities, management objectives, and governance adaptation. It will be an integrated forum for physical, natural, and social scientists from around the world, providing the opportunity to present research on a suite of climate change pressures and system responses including advection, nutrient transport, ocean acidification, carbon pumps, phenology, biodiversity, resilience, and evolutionary adaptation. It is a unique opportunity to advance, discuss, and debate the scientific understandings of climate change effects on marine systems in conjunction with the forethought to the societal implications of reliance on those systems' services.

Luis Valdés, IOC

Since its creation, the IOC–UNESCO has played a pivotal role in the development of oceanography at an international level by providing mechanisms to guide and complement ongoing research by national states. At the IOC we are convinced that climate change is not only a challenging scientific issue that has developed a corpus of observations, models, and hypotheses on possible consequences affecting critical processes for the functioning of Earth's ecology, but that it has also had a dragging effect in other disciplines that have modified the approaches to classical topics such as risk analyses, socio-economics, ethics and politics, energy, natural resources management, geo-engineering, and even evolution, which are now addressed from a different perspective. The scientific debate has moved very fast from observations to impacts and from impacts to discussion on potential mechanisms to mitigate and adapt to this new reality. This is likely due to the fact that there was, and still is, an urgent need for actions to minimize the impacts of global warming, and obviously the decisions must be based on credible scientific knowledge. The debate on climate change needs input from science as one of the essential elements, and symposia like this that bring together experts from different disciplines to exchange observations, results, models, and ideas are crucial to consolidating our understanding and knowledge on a global scale. This Third International Symposium on the Effects of Climate Change on the World's Oceans aims to deliver new insights into the ways in which climate change and variability is affecting marine ecosystems, especially in Latin America and the Southern Hemisphere, to reduce the scientific uncertainty behind environmental change, and to provide a solid basis for future comparisons and research.

The deadline for abstract submission is October 31, 2014.
More information: www.pices.int/climatechange2015.aspx.

Working together for a sustainable future

HOW COLLABORATION AMONG FISHERS, SCIENTISTS, AND POLICY MANAGERS IS PAVING THE WAY TOWARD RESPONSIBLE RESEARCH AND INNOVATION IN FISHERIES.

By Steven Mackinson,
Coordinator of the GAP2 Project

> *"Our hope for the future is not only to grow the red shrimp fishery, but to grow it sustainably"*
>
> *– Conrad Massaguer, skipper of the "Nova Gasela", Palamos, Spain.*

Conrad Massaguer is a participant in the GAP2 project's Mediterranean red shrimp case study, where a team of scientists, fishers, and regional policy managers have successfully brought red shrimp stocks back from the brink of collapse through the introduction of a collaboratively-produced and voluntary long-term management plan.

As an example of how mutual learning and collaboration on research can lead to positive outcomes for management, Massaguer's hopes for the future of the Palamos fishery reflect the over-arching aspirations of the project partners: a thriving, sustainable future for European fisheries.

Why collaborate?

Since 2008, scientists and fishers involved in the GAP projects have been working together on developing the knowledge base to support sustainable fisheries in Europe (www.gap2.eu). Simply put, the project is all about collaboration.

In the past, thoughts of 'participatory research' conjured images of social scientists gathering fishers' stories or less-than-scientific studies solely supporting fishers' views. But today, this is not the case. For many projects operating in Europe and around the world, participatory research is about real engagement with a range of players involved in creating knowledge that is both scientifically credible and legitimate.

The logic is simple: participation in research enables partners with various perspectives yet common interests to construct knowledge which meets shared needs. The incentive to do this may be founded upon a mutual curiosity for understanding ecology and fisheries and/or the value of such knowledge in terms of improving fisheries management. Rooted in respectful and engaging dialogue, the participatory approach deepens both individual and collective learning, creating a sense of shared responsibility for action.

During its second phase, the GAP project has evolved by connecting policy managers with participatory research and by engaging with the changing policy landscape, focused on safeguarding Europe's seas and the livelihoods of the fishing communities dependent on them.

Accepting that tension is always likely to arise when short-term objectives are at odds with econo-

> **PARTICIPATORY RESEARCH IS ABOUT REAL ENGAGEMENT**

mic survival, the incentive for collaboration among EU fisheries stakeholders, scientists, and policy managers appears to be strong because parties can agree easily on one clear objective: sustainable fisheries. In putting this to the test 'in the field', GAP2 has established 13 collaborative case studies in 11 countries (see: http://gap2.eu/case-studies/).

Why is collaboration more important now?

The regional approach to fisheries management, established in the reform of the Common Fisheries Policy (CFP), means that EU Member Countries now need to collaborate when deciding how to best manage fisheries in regions where they share fishing interests. Working closely with industry and scientists will be important in achieving this so that the knowledge base for management plans and how they are implemented is accepted by society and those whose livelihoods depend upon fisheries.

While the regionalized approach may take some time to produce mature collaborative partnerships, it's important to begin moving in the right direction. European citizens today expect their seafood to come from sustainable, responsible, and ethical fisheries, and this puts the spotlight of responsibility on fishers, managers, and scientists. Indeed,

societal acceptance, or 'the social licence' to fish has never been more important given the public awareness of the wasteful discarding of fish and the environmental imperative for healthy ecosystems.

With the experience gained from participatory research case studies, it has become clear that the basic idea of collaboration in research and innovation is deeply connected with the principles of inclusive governance, which are embodied within the ecosystem approach to fisheries (EAF). Fifty years of experience on the principles and operational guidance for ecosystem management (the FAO Code of Conduct for Responsible Fisheries, the 5th Conference of the Convention on Biological Diversity (CBD), the 2001 Reykjavik Declaration, the FAO Technical Guidelines on EAF; for other instruments dealing with the subject, see http://www.fao.org/fishery/topic/13261/en) shows that elements of inclusive governance form part of the foundations of EAF: '*Involve all stakeholders in knowledge-sharing, decision-making and management; Ensure coordination, consultation and cooperation, including joint decision-making, between fisheries and other sectors; Recognize that management objectives are a matter of societal choice; Decentralize decision and action to the lowest appropriate level*'.

A prominent example of this from GAP2's case studies is the work done in Galicia on expanding the 'Territorial Use Rights in Fisheries' (the TURF model – the 'ecosystem approach' to fisheries (EAF)).

Without taking too great a leap then, it is reasonable to expect that the CFP's focus on an ecosystem approach in the context of regionalization has the potential to lead to the proliferation of participatory research practices, supporting a transition to inclusive governance.

Collaboration: becoming the norm

Research undertaken by EU-funded projects like GAP, MEFEPO, Jakfish, MYFISH, Ecofishman, and Mareframe, among others, show that participatory

approaches are becoming increasingly common, indicating the growing recognition of the value of bringing together different types of knowledge in forming the foundation for management.

The advisory councils, another example of the growing support for collaboration, are now increasingly working in collaboration 'mode' and regularly team up with research projects. The importance of collaboration is also laid down in ICES strategic plans, where the range and diversity of stakeholders needed to deliver integrated advice has extended considerably. This is also reflected in ICES advisory and working groups. An example is ICES Working Group on Marine Systems, WGMARS, which included the importance of stakeholder integration into the Terms of Reference (ToRs) for its 2013 meeting, seeking to establish a forum within the ICES expert group structure to help facilitate a stronger working relationship between fishers and scientists.

What next for GAP2?

GAP2 is just one example of the broader range of Responsible Research and Innovation (RRI) projects funded by the European Commission. It is necessary now that the lessons learnt from this contribute to helping research policy-makers and funders understand how they can build collaborative approaches into future projects – both within fisheries and beyond. By evolving what it takes to carry out RRI in practice and to ensure its utility in management, future work will aim at embedding collaborative approaches in a systematic way.

One of our greatest challenges has been how to best communicate the outcomes and value of collaborative research to a non-scientific audience – and particularly the policy audience? We have addressed this by trying to be creative. As well as a series of targeted policy briefs, we have also produced a short feature film on the GAP2 red shrimp case study in the Mediterranean, which we've distributed using the reach and fluidity of social media. (Watch the video at http://tinyurl.com/oq937pc)

Moreover, we've produced the 'Methodological Toolbox' – an easily accessible set of resources for researchers and policy managers looking to learn about what participatory methods are and how they can be used. The toolbox includes potential pitfalls in collaborative research methods and offers guidance on how to avoid these. Future toolbox accessories will include an infographic which provides a visual summary of the collaborative approach, as well as a photographic exhibition highlighting some of the personal stories involved in participatory research.

In making the knowledge we have gained from the project accessible in such ways, GAP2 hopes to live beyond the natural conclusion of the project and to use it help evolve collaboration in other areas of research. By continuing to build strong working relationships between partners in such diverse fisheries as the UK crab, Danish herring, Norwegian cod, Dutch flatfish, and Italian cuttlefish, it is the aim of the project to leave a footprint of – or rather a blueprint for – collaboration.

UK brown crab fisher Allan Steer, who now also works with the collaborative 'Fishing into the Future' project – a new charity, initially established by Prince Charles' International Sustainability Unit – comments on how the GAP2 project and the participatory research approach is changing working relationships for the better: "*It's [now] a little bit of give from both sides. The scientists have realized they've got to work with the fishermen and they've got to understand exactly how the industry works. The fishermen are understanding it's something they have to do for the future of the industry.*"

ICES Training Courses 2014

Strengthen your career, broaden your knowledge, and widen your professional network with a training course at ICES.

This autumn we have an array of exciting courses on the programme, including *Social Science Methods for Natural Scientists* (13–16 October, Copenhagen, Denmark), *Marine Spatial Planning, Processes and Tools* (27–31 October, Copenhagen), and the *Application of Geostatistics to Analyse Spatially Explicit Survey Data in an Ecosystem Approach* (8–12 December, Fontainebleau, France).

Social Science Methods for Natural Scientists is a course which aims to facilitate cooperation across disciplines, effective stakeholder collaboration, and appreciation of the strengths of social sciences in fisheries research. Increasingly, natural scientists need to work with fishers, collaborating, communicating, and participating together to increase the knowledge base and policy relevance of our work.

Marine Spatial Planning, Processes and Tools will provide participants with information on, and experience of the developmental process through serious gaming (the interactive simulation game "MSP–challenge") and spatial tools, defining value and zonation as well as addressing process design and governance issues. Marine Spatial Planning is a tool used throughout the ICES region, and the course is intended to provide good instruction to scientists, managers, or graduate students with some experience of marine management and issues related to Marine Spatial Planning.

Application of Geostatistics to Analyse Spatially Explicit Survey Data in an Ecosystem Approach is one of the most popular courses at ICES, which aims to provide a thorough grounding in the use of geostatistical methods to analyse spatially geo-referenced survey data. Students will be guided through the different steps of geostatistical analyses based on case studies.

Please see more information about all of our courses as well as registration information on the ICES website:

http://ices.dk/news-and-events/Training/Pages/default.aspx

Singling out the mixed-fisheries advice

By Simon Cooper and Barbara Schoute

As a silvery sphere of herring schools through the open North Sea spatially uninterrupted by other species, its whereabouts is picked up clearly by the colour echo sounder of the fishing vessel pursuing it. The ship in question has set out for that particular species and, as it deploys its gear and subsequently hoists up its catch, it can do so safe in the knowledge that the net will contain next to no other species of fish as bycatch.

In fisheries assessment terms, this could be called a 'clean' or 'single-stock' fishing operation. Whether herring or other pelagic fish species, a ship's haul in this case will fall in line with the total allowable catch (TAC) for that species and the allocation of that given to the vessel.

Mixed fisheries

Yet the picture stretches beyond that. Whilst individual fishers head out to sea to search for grounds which yield the fish they are permitted to land, they can actually end up filling their nets with a range of different fish species that share seawater space and prey resources with each other. Catching certain species that are supposed to be left in the sea, and thus not covered by the TACs, is sometimes unavoidable , especially with the disparate size (and respective price and interest) shown by different stocks. This predominantly occurs in demersal zones, as those in the North Sea, where deeper-water species like cod and haddock exist alongside bottom-dwelling flatfish such as plaice and sole. It is this marine intermingling of fish coupled with the likelihood of a mixed bag in the net that characterizes mixed fisheries.

Defining interactions

The crux of mixed-fisheries advice lies in the technical interactions between the resource – the fish stocks or species being targeted – and the activity of fishing itself. A technical interaction here means that fish interact through ending up in the same fishing net. Though of equal advisory importance, this concept is in contrast to multi-species advice, which revolves around how fish biologically interact, as they do through predation. An example is cod preying on capelin.

Fishing activity in the North Sea takes place in the shape of fleets of vessels – numbering 27 and representing eight countries – deploying a range of gear such as otter trawls, demersal seines, and gillnets. Some of these can be more effective in targeting the chosen species than others; indeed, certain sorts of gear are more selective than others, resulting in the mixed bag of fish found in the net. This, in what is one of the challenges for mixed-fisheries management, can lead to bycatch and discards as well as jeopardizing the recovery of weak stocks.

A group for the times

The job of mapping, for ICES mixed-fisheries advice, the complexities of what happens at sea – and the reality that actual catches don't always mirror advice – rests with the Working Group on Mixed Fisheries Advice for the North Sea (WGMIXFISH-NS), an ensemble which held its 2014 annual meeting at ICES Secretariat in May.

Since 2002, when the limitations of the traditional, single-species approach to advice were brought to light by the conflicting states of demersal North Sea fish stocks, ICES and its expert groups have acted to evolve a fisheries-based alternative. Born from a string of mixed-fisheries modelling workshops and at the request of ICES clients, WGMIXFISH took over to supply advice for mixed fisheries, taking the advice drawn up on multiple single stocks as the basis of its work. The North Sea has been a trail-blazer in this way; such advice for other ecoregions – the Celtic Seas, Bay of Biscay and Iberian waters –is still in the development pipeline, with WGMIX-FISH-METH looking for the relevant methodology.

Setting the scenarios

One of the primary tasks for WGMIXFISH members is to devise forecasts for mixed fisheries based on

> **"CATCHING CERTAIN SPECIES NOT COVERED BY THE TACS IS SOMETIMES UNAVOIDABLE**

the individual species advice on North Sea cod, haddock, whiting, saithe, plaice, sole, and *Nephrops* (Norway lobster). For these projections, the group employs several different approaches – including the long-term management plan for each stock, if one is in place, and the maximum sustainable yield (MSY) – through which it formulates five separate scenarios for the ecoregion, each of which helps predict a number of landings per stock. Unlike single-stock advice, mixed-fisheries advice carries no single recommendation , so these scenarios assume the roles of conceivable catch options. Since it isn't possible to achieve all management objectives simultaneously, this method aims at presenting sets of trade-offs for whatever choices are made at sea.

Adopting a modelling tool known as Fcube, the group processes single-stock data into the following five scenarios: '*min*', where fleets stop fishing when their first quota is exhausted; '*max*' when their last quota is exhausted; '*cod*', when the cod quota is

"UNLIKE SINGLE-STOCK ADVICE, MIXED-FISHERIES ADVICE CARRIES NO SINGLE RECOMMENDATION

exhausted; '*status quo effort*', where effort is equal to the most recent year; and '*effort management*', where effort is reduced according to regulations. In the third outcome, cod is commonly, though not always, designated as a 'choke species', i.e. a low-quota species that would lead to vessels having to cease fishing activity altogether.

In terms of ICES advice, these scenarios are then accompanied by an analysis of the implications of mixed fisheries under the fishery's total allowable catches (TACs) and the effort regime. The evaluation and scenarios have formed part of ICES 2014 advice for the EU on the Bay of Biscay, Celtic Sea, and North Sea fish stocks.

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