

2nd Norway-U.S. Science Bilateral on Fisheries

February 16, 2012
National Oceanic and Atmospheric Administration
Silver Spring, Maryland, USA

On February 16, 2012 representatives from the U.S. National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA) and the Norwegian Institute of Marine Research (IMR) came together in Silver Spring, Maryland for a science bilateral focusing on fisheries issues of interest to these two great nations. The gathering offered the opportunity to discuss issues of joint scientific interest, avenues for potential collaborations, and to sign a Memorandum of Understanding (MoU) to support cooperative engagement relative to the suite of common issues facing these two coastal nations. The next science bilateral take place immediately before International Council for the Exploration of the Seas (ICES) Annual Science Conference (ASC) in September 2012 in Bergen, Norway.

Report Content:

- Detailed Workshop Summary
- Appendix 1: List of Attendees
- Appendix 2: Proposed Bilateral Agenda
- Appendix 3: Signed MOU

Welcome and Opening Remarks:

Richard Merrick welcomed everyone to Silver Spring and commented that this is his first time chairing the group. He and Tore Nepstad, the Norwegian Chair and Director of the Norwegian Institute of Marine Research, noted the important milestone of the national level MoU, common fisheries goals for the two nations, and the opportunities for collaboration.

Polar issues

Arctic fisheries:

In June 2011, NMFS and the U.S. Department of State hosted an Arctic fisheries workshop in Anchorage, Alaska. This meeting was held in response to a recommendation from a high-level meeting of the Arctic Border (A5) states that took place in Oslo in 2010. In Anchorage the US, Greenland, Russia, Norway, and Canada focused on what we know about Arctic ecosystems and fisheries, how conditions are changing, and the need for further monitoring and research. The meeting identified opportunities for and impediments to formal programs for exchange of information (e.g., post doctorate positions, technology exchange), proposed a workshop to develop pan-Arctic baseline surveys and workshops to address modeling and forecasting capabilities.

Participants reiterated the need to follow up on these tasks before the momentum from the Anchorage meeting wanes. They underlined the importance of getting baseline information in place given the imminent and rapid changes in the Arctic ecosystem from both anthropogenic (e.g., oil and gas exploration and development and increased shipping) and ecological (e.g., loss of sea ice and ocean acidification). The group agreed to re-energize the planning for the

monitoring and modeling workshops and hold them) back-to-back immediately before the Arctic Frontiers meeting being held in Tromsø Norway, January 2013.

Action Items

- Bill Karp will engage the science participants from the Anchorage meeting.
- Bill Karp will present this plan as a formal proposal to the other A5 nations (Russia, Greenland, and Canada) as a plan for moving forward and seek their input.
- Paul Niemeier and Elizabeth McLanahan will engage the State Department.
- Bill Karp and Alf Håkon Hoel will act as planning group co-chairs.
- Alf Håkon Hoel will provide the agenda to the Arctic Frontiers to be held in Tromsø, January 2013
- Ned Cyr will coordinate with Bill Karp and the other NOAA line offices.

Polar research opportunities:

Norwegian Agreement with United Kingdom

In December 2011 Norway's Prime Minister announced a commitment of \$2.5M to strengthen international cooperation in polar science. While some of those funds are set aside for a Memorandum of Understanding with the United Kingdom, the Norwegian delegation proposed that Alf Håkon Hoel apply for funds for a collaboration with the US to study the biological and physical structure and function of polar ecosystems and how climate change will affect biological production. A secondary, but linked, project to examine North Atlantic stocks in the Arctic basin could be incorporated. The group agreed that the timing for raising these issues was perfect. Old estimates of maximum sustainable yield (MSY) are no longer as effective and Atlantic fisheries are experiencing successive recruitment failures (for example is the poor recruitment of groundfish in the Northeast a result of climate change?). Science such as this could be critical in determining how we assess our stocks now and into the future.

Action Items

- Trond Christensen of Norway has prepared a document. Alf Håkon Hoel and Tore Nepstad will refine Christensen's paper and submit it for funding.
- Ned Cyr will write letters of support, help identify potential scientists to collaborate on the above project as well as potential in-kind contributions from NOAA for the ecosystem structure and function project. The US recommended that the Alaska Fisheries Science Center should be included in this proposal.
- These projects will be reviewed and the collaborations will be discussed at the next science bilateral in Bergen in September 2012, immediately before the ICES Annual Science Conference.

Norwegian Institute of Marine Research Arctic Research Report:

Key points from the report on Norway's Arctic Research focused around two main issues (1) putting more emphasis on annual Arctic research cruises and linking them more closely to the IMR mission and (2) setting up a standing group focusing on IMR's Arctic activities. The increasing focus on Arctic issues within the Institute is derived from an increased awareness of climate change and the increase in oil exploration activities in the Arctic ecosystem. This is of special concern given the significant, productive fisheries within Norway's Arctic EEZ.

Within the US agreements are being developed with oil companies engaging in exploration and the protocols for Arctic oil spills. The group agreed that sharing these with Norway would make for a more consistent approach for Arctic oil issues. Within Norwegian waters the use of dispersants is prohibited. They are concerned about oil spill protocols that rely on the dispersants such as those used in the Deepwater Horizon. One of the key issues to discuss will be what chemicals to allow in the relatively pristine polar region.

Action Item

- Beth Lumsden will check to see if the dispersant formulation used during deepwater Horizon is publicly available. If it is, it will be shared with the Norwegian delegation.

Brief on US Arctic Implementation Plan

Ashley Chapel gave a presentation on NOAA's Arctic Vision and Strategy Implemental Plan. The Plan looks at conservation, management, and use of arctic as well as the effects of climate change and the impacts of what happens in the arctic on the rest of the world. There are 6 key goals:

1. Forecasting sea ice – modeling is a key component of this goal
2. Strengthening foundational science – assessing change, main focus is Distributed Biological Observatory
3. Weather and water – improving observations to improve forecasts, NOAA has an agreement with oil companies to feed NOAA real time data and is urging ships to participate in the voluntary observing program
4. International and national partnerships
5. Improving the stewardship and management of ocean and coastal resources in the arctic
6. Advancing resilient and healthy arctic communities and economies – oil spill response, assistance to coastal communities to adapt to climate change, hydrographic surveying

Climate Change

Austevoll ocean acidification workshop

Erlend Moksness reported that the workshop was successful, but that there are no clear recommendations arising from it. The group agreed to identify the top three shared research priorities relative to Ocean Acidification and make some proposals at the September meeting.

Action:

- Look for opportunities for joint programs and species of common interest in examining the impacts of ocean Acidification.

NOAA Ocean Acidification Plan

NOAA's Ocean and Great Lakes Acidification Research Plan outlines a plan to increase NOAA's understanding of the impacts of ocean acidification on ecosystem processes. Because ecosystem responses are difficult before individual species responses are known, current work is focusing on responses of calcifying organisms. Advanced seawater systems have been set up in the NMFS Northwest Fisheries Science Center (NWFSC) to study the combined impacts of rising sea temperature and ocean acidification. The NMFS Northeast Fisheries Science Center

(NEFSC) is studying OA impacts on diatoms and fin fish, including examining early life history influences. The NMFS Alaska Fisheries Science Center (AFSC) is studying impacts on king crab development, specifically impacts of pH on early life history stages. The NMFS Pacific Islands Fisheries Science Center (PIFSC) is studying the impacts of OA on accretion rates of crustose coralline algae and corals. NOAA's Ocean and Atmospheric Research (OAR) Atlantic Oceanographic and Meteorological Laboratory (AOML) is examining impacts of OA on Caribbean corals.

The group discussed opportunities and facilities for potential collaborations with the Sandy Hook Lab in New Jersey proposed as a potential site. Many of these projects could have broader implications than just OA, such as the production of kelp which is used in climate mitigation strategies to sequester CO₂ in addition to biofuel production and pharmaceuticals.

Action Items

- Erlend Moksness and Bill Karp will have a proposal for at least one joint research plan to present in September at the next science bilateral.

Climate and Fisheries

The US National Climate Assessment will, for the first time, include a chapter on marine impacts. The final report is to be released in 2013. Key work is being done in the Bering Sea combining biological and physical observations and ecological modeling to try to get a better sense of climate change and ecosystem impacts on the arctic system. They are also looking at downscaling climate models to get sense of regional and fisheries level impacts, information on the status of ice-dependent seals, and information on the fisheries that will be potentially opened up to commercial exploitation. The Norwegians suggests coordination with their climate fisheries group, it has been in operation for 5 years and has a special focus on fisheries and marine mammals. Richard Merrick pointed very few nations have climate adaptation strategies and those that do should be coordinating more and facilitating better science-level communication.

Action Items

- Kenric Osgood will contact the Norwegian group, specifically Olav Rune (olav.rune.godoe@imr.gov). Potential collaborations will be discussed at the September meeting in Bergen.

Joint Expeditions

2014/2015 Antarctic/Atlantic Cruise

The Norwegians would like to get multiple nations (e.g., US, Brazil, and Caribbean nations) involved in a 2014-15 krill survey in the Antarctic and combine that survey with additional research projects on the cruise traversing to the Antarctic. The Norwegians have committed \$15M to this effort. The tentative plan is in the December/January timeframe focus on mapping of vulnerable marine ecosystems (VMEs) in the Western Central Atlantic, spend 12 weeks in the CCAMLR region conducting two six-week krill surveys, and return via the Benguella Current in the April/May timeframe. Additional potential options include:

1. Acoustic survey of Deepwater Horizon spill zone in the Gulf of Mexico to look for oil on the bottom.

2. Survey of Brazilian (and Uruguay) fisheries.
3. Continuing survey of the mid-Atlantic ridge.
4. Conduct survey of fisheries and sea birds around the Falkland Islands.

Action Items

- Beth Lumsden and Ned Cyr will get someone from the SWFSC and SEFSC involved to discuss NOAAs potential role, timing, and issues of interest to both nations. They will report out at the March science steering committee call.
- Tore Nepstad will put together a proposal for joint projects and then work to find funding. The US participants were very interested but wanted to be clear about NOAA's proposed role.
- Discussion of this Antarctic cruise should be on the agenda for the September meeting.

R/V Nansen

NOAA has set aside funds for 1-2 scientists to participate in R/V Nansen cruises in 2012. Keith Chanon is coordinating this effort for NOAA Fisheries Office of Science and Technology. He will work with the NOAA Fisheries Science Centers to identify participants and coordinate with the Norwegians. This process will begin once NOAA receives the 2012 F/V Nansen cruise schedule from IMR.

Action Items

- Erlend Moksness will provide contact information for the appropriate Nansen point of contact.

International cooperation with focus on NOAA IMR

NEFSC/IMR

The NEFSC and IMR have been involved in collaborative research for many years. The NEFSC and IMR held a workshop supported by CAMEO funding, International Surplus Production Modeling Workshop. The workshop was held on May 2-6, 2011, at the National Academies of Science's Jonsson Center in Woods Hole, MA. The workshop objectives were to compare ecosystems of Canada, Norway and the US (many of the systems are Ecosystem Studies of Sub-Arctic Seas (ESSAS) regions); continue, refine and organize analyses and outputs; and identify similarities and differences between ecosystems and the relative effects of physical forcing, trophodynamics, and fisheries exploitation drivers on fish production. A special issue of Marine Ecology Progress Series (MEPS) will summarize where we are and point the way forward.

Action Item

- Erlend Moksness will provide motivation for finishing the workshop publications.

NEFSC (Milford Lab)/IMR

See below under Aquaculture

AFSC/IMR

Hydroacoustics research conducted in collaboration between the AFSC and IMR continues to be fruitful.

- In May 2011, Alex De Robertis and Patrick Ressler were invited participants in a EUR-OCEANS workshop entitled 'Toward a global observation and modeling system for studying the ecology of the open ocean using acoustics' at IMR in Bergen, Norway. IMR funded Patrick's participation in the workshop. Alex was in Bergen to participate on a research cruise with IMR scientists (see below). A paper summarizing the workshop has been submitted to the journal Fish and Fisheries.
- Alex De Robertis participated in a research survey on the IMR research vessel, JOHAN HJORT in April 2011. The purpose of trip was to compare acoustic survey methods and gain familiarity with approaches used at IMR, particularly their approach to use of multi-frequency acoustic information for species classification, and gain familiarity with the Large Scale Survey System (LSSS) software developed at IMR for this purpose.
- Alex De Robertis has prepared a review of fish reactions to research vessels with Dr. Nils Olav Handegard at IMR. This work is to be published in the peer-reviewed literature.
- Alex De Robertis is participating in an IMR project to observe the collective behavior of herring in response to sound stimuli. He participated in an organizational meeting for the project in July of 2011, and intends to participate in experiments conducted in the summer of 2012 and 2013 in Norway. Participation in this work is funded by IMR.
- Patrick Ressler is planning a collaborative project with IMR scientists in 2012 that will focus on acoustic surveys of euphausiids ('krill') in the Barents and Bering Seas and a comparison of fish-zooplankton interactions in those two ecosystems. IMR has tentatively agreed to fund travel and living expenses for an extended stay (ca. 6 months) in Bergen to work on this. NOAA-AFSC has tentatively agreed to allow Patrick's participation.

Technology

Numerous meetings have been held on all aspects of technology, from hardware, software to data management.

- Though not technology oriented, a successful 2010 data management conference on fisheries dependent data held in Galway Ireland, was co-sponsored by NOAA, IMR, MRI (Ireland), ICES and FAO. A follow up symposium is set for 2014.
- A theme session, planned for this year's ICES Annual Science Conference, will consider the extent to which technological innovation has actually impacted the assessment process (will be co-convened by Bill Karp, Olav Rune Godø (Norway) and Nicolas Bez (France))
- The US has indicated an interest in hosting the next ICES International Fisheries Acoustics Conference and Norway has indicated an interest in acting as co-sponsors. These conferences have been held every 5-7 years. The last one took place in Bergen in 2008. The ICES Working Group on Fisheries Acoustics Science and Technology (WGFAST) will likely develop a proposal for the next conference to be held in the NE US in 2015.

Norway has developed a more sophisticated software system for acquiring, visualizing, processing and archiving fisheries acoustics data. This new software can identify species,

measure stomach contents, and determine school size distributions. Norway would like to know whether the US is interested in partnering with them on further developments of this software system.

IMR is partnering with the Norwegian fishing industry and fishing gear manufacturers in a venture known as CRISP (Center for Research-Based Innovation in Sustainable Fish Capture and Preprocessing) Technologies. There are many aspects to this program including the development of bycatch reduction technologies (by avoiding fish of the wrong size, avoiding mixed groupings of fish, catching the wrong species, and scale slippage). CRISP is also developing technology to improve harvesting efficiency thereby conserving fuel and reducing costs. Opportunities exist for NOAA to work with IMR on some of these CRISP projects. The US agreed that bycatch is a major issue that technological innovation can greatly improve and we would like to move forward on this as soon as possible. There was consensus that there is a great deal of overlap in the nations' work and that all parties would benefit from collaboration on these topics.

Action Items

- Bill Karp will find out whether there is any interest within NOAA in partnering with Norway on the development of LMSS.
- Tore Nepstad will set up a meeting with Bill and the Director of the Christian Michelsen Institute (CMI) in Bergen in September. CMI is the developer of LMSS and is working in close collaboration with IMR.

Trilateral - Norway, Canada, and USA

Norway-Canada-US Initiative for Marine Spatial Planning set as a goal to develop comparable data sets from each of the 3 nations and present them in ways that are useful to each. The group originally agreed that each nation would contribute \$100K each year for 3 years for a total of \$900K. The goals of the project are:

1. Come to a common understanding of what they want to accomplish for spatial planning.
2. Determine how much they have in common (where they can use similar approaches and where they have to differ as a result of data sets or management needs).
3. Define analytical steps and tools to use for spatial planning decision making.
4. Confirm that selected approaches are appropriate and identify gaps in terms of data sets and tools used.
5. Develop new tools and visualization techniques.

Michael Fogarty, head of the Ecosystem Assessment Program at NEFSC, has been developing tools in the northeast US. Businesses in search of permits for wind farms are pushing a need to plan for areas that are important for wind and for fish and fishermen. The EAP tool can currently look at about 80 data layers (physical features, habitat, benthic community information, protected species distribution patterns, information about lower trophic levels, potential prey indicators, fish communities, fish independent surveys, forage fish and potential prey indicators, commercial and recreational fishery, impact metrics, management area designations, and other human use locations). These layers have been used to identify ecologically vulnerable areas, and

areas with conflicting use patterns in the development of wind farms and energy corridors. Next steps include expanding the data layers to include additional anthropogenic impact metrics, developing models for spatial vulnerability and impacts, and developing additional visualization tools to represent US, Norwegian, and Canadian data layers together.

The group agreed to work with Canada to reinvigorate the trilateral status of this project. Norway does not currently have the tools that this program is developing and they remain interested in the project.

Action Items

- Michael Fogarty will write a proposal seeking funding under IEA.
- Bill Karp will find funding to send someone from the NEFSC to the Halifax meeting.
- Ned Cyr will look into what 2012/2013 funding opportunities are available for this work.
- Erlend Moksness will contact the Canadians to determine their level of interest and desired involvement.
- Erlend Moksness will confirm that Norway has funds available for the work.
- Should be on the agenda for the September meeting in Bergen.

Aquaculture

NMFS Aquaculture Program

David O'Brien gave an overview of the NOAA Aquaculture Program including its ongoing research and potential areas for collaboration. In the US most aquaculture is in freshwater. Marine aquaculture activities can mainly be found in NE, NW, Puerto Rico, and HI. Many aquaculture projects have met with regulatory roadblocks resulting in flat growth for US aquaculture production over the last 20 years, while both Norway and China are increasing dramatically. In fact, 70% of world aquaculture comes from Asia, with the US producing under 2% even though the US has the largest EEZ in the world and import 85% of their seafood. There is interest in expanding US aquaculture, which would reduce the seafood trade deficit and produce jobs. There is also, however, strong opposition to aquaculture based on real and perceived environmental impacts. NOAA's role is to support sustainable aquaculture. Some of the concerns associated with aquaculture include pollution (eutrophication, sediment deposition, benthic impacts), escapes, disease, finfish feeds, and socioeconomic impacts. Broadly, NOAA's priorities are regulations/policy, outreach/education, international projects, science and research (regulatory and policy decision informing (i.e. modeling), innovation, and technology development).

Three key areas of national research priorities:

- 1) Alternative Feeds – reduce amount of fish products used
- 2) Impacts on genetics – impacts of aquaculture escapees on wild populations
- 3) Environmental Impacts – assess the range of models currently available to assess aquaculture impacts and determine which are best for answering different types of questions – a workshop is scheduled for last week in March and there are plans to ground truth the models post-workshop.

Finally, Dave O'Brien expressed his pleasure that US the tariffs on Norwegian salmon had recently been lifted.

NEFSC (Milford Lab)/IMR

Chris Brown, from the NEFSC, briefed the group on the NEFSC work on aquaculture conducted at the Milford, CT lab. Key areas of work include exploring protein alternative to fish meal in feeds, response of larval fish to increases in PCO₂, and the effects of pH on phytoplankton communities. He also discussed areas of potential joint interest:

1. Interactions of cultured shellfish with their benthic communities,
2. Molecular and genetic shellfish research (e.g., disease resistance mechanisms, bacterium responsible for acute shellfish poisoning, selective breeding),
3. 32nd annual Milford Aquaculture Seminar (March 12-14 2012), which is unique in its mix of scientific and commercial representation,
4. Cod Academy in Maine, which trains people on deep water cod farming techniques, and
5. Bioextraction (i.e. experimenting with use of ribbed mussels to concentrate nutrients in polluted waters).

Norway feels its research should focus on carrying capacity and environmental effects (both locally and regionally). Norwegian salmon and cod farms have dealt with several severe diseases for which they are working on developing vaccines. There was a consensus that there was a great deal of common ground between the nations and that the nations should move forward with cooperative work.

While there is a fairly well developed advisory process regarding effects on stocks, environment, and climate for fisheries, no similar system exists for aquaculture. Norway advocated for setting up an international body to produce the generic science and knowledge for aquaculture development and management. As the appropriate international venue for such discussion, Norway submitted a proposal to ICES to create a working group focused on aquaculture or alter the terms of reference of an existing working group. Norway would like the support of the US in this effort.

Action Items

- Tore Nepstad will send David O'Brien the contact information for key aquaculture researchers at IMR.
- David O'Brien will invite an IMR representative to participate in the March environmental impacts workshop.
- Chris Brown will send IMR the website for the 32nd annual Milford Aquaculture Seminar (March 12-14 2012).
- Identify possible opportunities within US and Norwegian aquaculture programs to best utilize existing knowledge.
- At least one joint aquaculture project should be developed and discussed at the September meeting.
- Tore Nepstad will look into whether this work would require an additional MoU with NoFIMA.
- Bill Karp will discuss the idea of an ICES aquaculture committee with the US representative (Fred Serchuk).

3/19/2012

Draft Report US-Norway
Fisheries Science Bilateral

Discussion and signing of the Memorandum of Understanding between NOAA's National
Marine Fisheries Service and Norway's Institute of Marine Research

Appendix 1: Attendees

United States Delegation

Richard Merrick	Chief Science Advisor, NMFS
Chris Brown	Director, Northeast Fishery Science Center Milford Laboratory, NMFS
Ashley Chappell	Coastal Goal Arctic Objective Lead, Office of Coast Survey, NOS
Keith Chanon	International Science Program Manager, NMFS
Ned Cyr	Director, Office of Science and Technology, NMFS
Mike Fogarty	Division Chief, Northeast Fishery Science Center, NMFS
William Karp	Acting Director, Northeast Fishery Science Center, NMFS
Beth Lumsden	Chief of Staff for Science, NMFS
Elizabeth McClanahan	Deputy Director of International Affairs, NOAA
Paul Niemeier	Office of International Affairs, NMFS
David O'Brien	Aquaculture Program Manager, NMFS

Norwegian Delegation

Tore Nepstad	Director, Institute of Marine Research
Alf Håkon Hoel	Regional Research Director, Institute of Marine Research
Erlend Moksness	Regional Research Director, Institute of Marine Research
Richard L. Pedersen	Counselor for Fisheries, Embassy of Norway

Appendix 2: Agenda

Science Bilateral Agenda
Institute of Marine Research, Norway
and
NOAA's National Marine Fisheries Service
Office of Science and Technology
February 16 -17, 2012
Bldg 3 Rm. 13836

Thursday February 16, 2012

- 8:30 Coffee
- 9:00 – 9:30 Welcome and Opening remarks
- Erlend Moksness/Tore Nepstad
 - Ned Cyr/ Richard Merrick
- 9:30 – 12:30 Polar issues
- Following up on the report from science meeting on Arctic fisheries In Anchorage, June 2011 (Karp)
 - Outstanding issues and opportunities for collaboration
 - Polar Research Opportunities
 - Brief on NO agreement with UK (IMR - Hoel)
 - Brief on IMR plan (IMR - Hoel)
 - Brief on US Arctic Implementation Plan (Karp)
 - Climate Change
 - Austevoll ocean acidification meeting Oct 25-27 2011 (IMR - Moksness)
 - NOAA Ocean Acidification Plan (Cyr)
 - Climate and Fisheries (Osgood)
- 12:30 – 2:00 Lunch
- 2:00 – 4:00 International cooperation (with focus on NOAA IMR)
- Norway, US
 - NEFSC/IMR (Karp/Moksness)
 - AFSC/IMR (Karp/Moksness)
 - Advanced Technology (Cyr)
 - Norway, Canada and USA
 - Status from Norway and US (Moksness/Fogarty)
 - Upcoming Joint USA-Canada-Norway meeting at ICES (IMR - Moksness)
 - Norway, UK and USA.(Hoel)
 - Norway, USA, Canada, Russia and Greenland (Polar 5) - Nepstad

- 4:00 – 5:30 Aquaculture
- NMFS Aquaculture program (Rubino/O'Brien)
 - NEFSC and NO science collaboration opportunities (Brown/IMR)

Friday February 17, 2012

- 8:00 Coffee
- 8:30 – 10:30 Joint Expeditions
- 2014 Joint USA-Norway cruise in the western Atlantic
 - R/V Nansen
- 10:30 – 12:00 Discussion of MoU/Signing of the MoU between NOAA Fisheries and IMR
- Wrap up - Norwegian Delegation to visit Sloan Foundation

Appendix 3: Memorandum of Understanding

First Addendum to Memorandum of Understanding

**Between
NOAA's National Marine Fisheries Service, USA and
the Institute of Marine Research, Norway
On
Cooperation in Marine Ecosystems Research and Assessment**

With the increased commitments of our respective governments to responsible fishing, and multispecies and ecosystem-based management, we are particularly interested in encouraging cooperation and exchange in marine ecosystem and aquaculture research and assessment. The term marine ecosystem encompasses both the large marine systems (LME) in the northern hemisphere and the related coastal ecosystems. The cooperation includes productivity/oceanography, living resources and fisheries, pollution, climate change, ecosystem health, impact of aquaculture, socioeconomics, governance and ecosystem models.

In September 2008, the Ministry of Fisheries and Coastal Affairs of Norway and the National Oceanic and Atmospheric Administration of the United States of America executed a Memorandum of Understanding intended to strengthen, promote and further develop cooperation on the conservation and management of living marine resources. This First Addendum to the Memorandum of Understanding (Addendum) will serve to encourage and support cooperation in four topic areas:

Article 1: Joint sponsorship of workshops or symposia on the assessment and management of living marine resources of the northern hemisphere and aquaculture

Such meetings would review the status of knowledge in North Pacific and North Atlantic ecosystems and provide a focus for future cooperation. They would provide fora for evaluating and advancing the scientific basis for conservation, management, and utilization of the living marine resources of the North Pacific and North Atlantic and development of healthy aquaculture. Each meeting would be organized and sponsored jointly by the two institutions and would encompass the international community as appropriate. These meetings would not duplicate existing efforts but would be closely coordinated with the activities of regional scientific organizations such as ICES, PICES and NAFO.

Article 2: Exchange of expertise and information

The results of scientific investigations carried out at our institutions are reported at scientific meetings and in the literature. Information is also exchanged on an ongoing basis among scientists working on similar problems in different institutions. We wish to encourage informal communication among scientists in our organizations and improved availability of research results.

Article 3: Extended visits of scientists

Extended visits (a few weeks to a year) of scientists between the different institutions would provide opportunity to exchange information and methodologies in depth and would encourage development of scientific expertise in fields of common interest. Such visits might be supported for their educational or training value, or for direct research interaction or collaboration. In some cases, it may be desirable to exchange scientists in parallel jobs or with similar expertise to do work in corresponding programs in the other country.

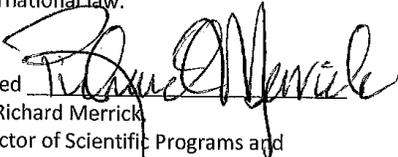
Article 4: Cooperative research on common scientific issues and methodological problems

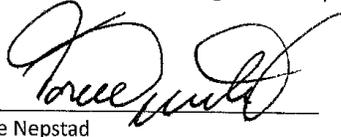
Joint research would be developed among existing programs within our institutions or through establishment of problem-specific cooperative research programs that would include participants from our two institutions. In such cases, a team of scientists from the institutions would address a common problem together, develop a research plan, and work jointly toward its solution.

Article 5: Coordination and planning

Each signatory institute agrees to appoint a coordinator for the joint program. A coordinator's meeting would be held every two years. Following each of these meetings, the coordinators would draft a cooperative plan for the next two years. Following review and acceptance by the directors of the signatory institutions, this plan would provide a framework for cooperative activities during the succeeding biennium.

This Addendum is not intended to limit cooperative activities to the signatory institutions. We strongly encourage participation by scientists at universities and other research institutions linked closely activities at NOAA Fisheries and the Institute of Marine Research. When possible, the research activities should include cooperation with Department of Fisheries and Oceans of Canada (DFO). This Addendum provides no financial commitment. While this Addendum shall serve to encourage and support cooperation, the parties do not intend this Addendum to be legally binding, and this Addendum shall not be governed by international law.

Signed 
Dr. Richard Merrick
Director of Scientific Programs and
Chief Science Advisor
NOAA's National Marine Fisheries Service
Silver Spring, Maryland, USA

Signed 
Dr. Tore Nepstad
Director,
Institute of Marine Research
Norway

Date:

16 FEB 2012

Date:

16.02.12