Proceedings of the 14th Canada-USA Scientific Discussions, January 22-25, 2001, MBL Conference Center, Woods Hole, Massachusetts

by

S. Clark and R. O'Boyle, Convenors

May 2001

Recent Issues in This Series:

Proceedings of the 14th Canada-USA Scientific Discussions, January 22-25, 2001, MBL Conference Center, Woods Hole, Massachusetts

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Abstract

This report provides a record of presentations and discussions at the 14th Canada-USA Scientific Discussions meeting held in Woods Hole, Massachusetts January 22-25, 2001. These informal meetings are held every two or three years between Canadian and USA scientists engaged in stock assessments and related research on transboundary resources of the Gulf of Maine and adjacent regions. The goal of these meetings has been to share information on ongoing research projects and to explore options for cooperative work. This meeting included both plenary sessions in which participants reviewed research projects and developments since the previous meeting (October, 1996) and working group discussions which focused on areas for future research collaboration. This report includes summaries of presentations and discussions in plenary and reports and recommendations of the working groups.

Introduction

The Northeast Fisheries Science Center (NEFSC) of the National Marine Fisheries Service (NMFS) hosted a meeting of experts from the Canadian Department of Fisheries and Oceans (DFO) Marine Fish Division, the Center, and other federal and state agencies and academic institutions in Woods Hole, MA January 22-25, 2001. This was the 14th in a series of informal meetings held between Center and DFO scientists every two or three years to review research projects on transboundary resources of mutual interest and to explore options for future collaboration. Previous meetings largely focused on fish and invertebrate stock assessments and related research, but recently, there has been increased emphasis on protected species and habitat related issues.

The meeting was well attended, with over 70 participants. The meeting was loosely organized into three theme sessions. The first session provided an overview of organizational and legislative changes in both countries and programmatic responses to these changes, and new directions in peer review and management. The second session, entitled "Single Species Science and Future Cooperative Research" was largely devoted to new developments in fishery dependent and independent data collection and analysis including systems for data entry at sea, web-based data display, and the NMFS assessment "toolbox" under development at NEFSC and elsewhere. The final session was entitled "Ecosystem-Based Management and Future Cooperative Research" and included presentations on management initiatives; ecosystems modeling, and habitat-related issues and research activities.

One afternoon was devoted to working group meetings where important issues were reviewed in detail and research recommendations made. Five working groups were held on the following: assessment methods; marine mammals and turtles; groundfish distribution and stock structure; Atlantic herring, and sea scallops. These working groups provided opportunities for intensive discussion of current research projects, problems of mutual interest, and recommendations for future work. The Assessment Methods Working Group provided a forum for review of data-based and model-based approaches and their limitations and recommended the establishment of a "Methods Review Group" to address local problems, to insure quality control, and to incorporate ecosystems models into stock assessments. The Marine Mammal and Turtle Working Group reviewed current research progress on both sides and provided the groundwork for standardization of data collection and research methods and future research collaboration on population estimation, stock identification and other issues. The Working Group on Groundfish Distribution and Stock Structure reviewed information for transboundary species, identified research needs, and recommended an overall strategy to meet these requirements, e.g. formation of a steering committee to organize cooperative workshops on stock structure. The Atlantic Herring Working Group reviewed research and data collection activities for both countries including developments in hydroacoustics programs and initiated planning for a joint assessment which will be vetted through the Transboundary Resources Assessment Committee (TRAC) process in 2002. The Sea Scallop Working Group reviewed biology and recent recruitment trends for different populations and identified several research priorities. An *ad-hoc* meeting was also held to consider possible revisions to the TRAC process and to develop terms of reference for the April 2001 meeting. Working group reports were presented in plenary prior to

the close of the meeting. These reports, and summaries of the plenary discussions, are included below.

Overview

Current Organization

Steve Clark reviewed National Marine Fisheries Service (NMFS) organizational changes since 1996. The NMFS, consisting of about 2,600 staff, is one of the five agencies within the National Oceanic and Atmospheric Administration (NOAA). The other agencies are: the National Weather Service (NWS); the National Environmental Satellite Data and Information Service (NESDIS); the National Ocean Service (NOS); and NOAA Research (also called the Office of Oceanic and Atmospheric Research). See *www.noaa.gov* for further details.

The 1995-1997 reorganization was in response to the National Performance Review, directed by then Vice-President Al Gore. In it, NMFS Headquarters was reorganized into five major offices: Operations, Management and Information; Science and Technology; Protected Resources; Sustainable Fisheries; and Habitat Conservation. The latter three have corresponding divisions in the five regional offices, with the five research centers operating in tandem with the Office of Science and Technology.

In the Northeast Fisheries Science Center, the old Conservation and Utilization Division and the Environmental Processes Division were reorganized into four divisions, as follows: the *Resources Evaluation and Assessment Division* (READ), including the Population Dynamics, Protected Species, and Social Sciences Branches (Woods Hole); the *Fisheries and Ecosystems Monitoring and Analysis Division* (FEMAD) including the Ecosystems Surveys, Fisheries Sampling, and Population Biology Branches (Woods Hole and Narragansett, R.I.); the *Aquaculture and Enhancement Division* (two branches), in Milford, CT; and the *Ecosystems Processes Division* (four branches) based in Woods Hole and Sandy Hook, N.J. The NEFSC reorganization was designed to flatten organizational structure, to increase the staff to supervisory ratio, and to eliminate Deputy Division Chiefs. There are now no permanent units below the branch level in the Center. For future information, refer to *www.nmfs.noaa.gov* and *www.nefsc.nmfs.gov.*

The question was raised as to whether the Center had been able to maintain adequate staffing levels in recent years. It was noted that the Center is now staffed by approximately 260 employees, as compared to over 300 in the mid-1990s.

<u>Legislative Mandates</u>

<div align="center">Oceans Act</div>

     Presenter: Faith Scattolon
     Rapporteur: Joe Arbour

Before passage of the Oceans Act, Canada lacked clear goals and accountability and a comprehensive national strategy which could provide a management framework for future resource development and environmental protection. Government's role in the oceans was determined through the Fisheries Act which, although powerful, addressed only fish and fish habitat protection. A great many issues related to Oceans Management were not addressed. The Oceans Act responded to a number of international agendas including the Law of the Sea, the Convention on Biodiversity, and Agenda 21. Some 23 federal agencies, together with provinces, territories and aboriginal groups, are involved with oceans management in Canada; the Oceans Act respects the authorities of other jurisdictions but gives overall responsibility for Oceans Management to the Minister of Fisheries and Oceans.

Part I of the Oceans Act describes the maritime areas in Canada and asserts authority over those areas. Part II outlines Canada's approach to Oceans Management and DFO's responsibilities and key authorities. It also defines the principles underlying these responsibilities, i.e. sustainable development, integrated management, and the precautionary and ecosystem approaches. Part III identifies the specific powers, duties and responsibilities of the Minister of DFO as lead federal authority. It also embeds the use of traditional knowledge in DFO's approach to managing the oceans. The Minister will lead the development of a national oceans management strategy in conjunction with other federal departments, provinces and other interests.

Under the Oceans Act, the Minister will lead and facilitate the development of integrated management plans in Canada's ocean areas. Nested within integrated management is the designation of marine protected areas (MPAs) and the development of guidelines to promote Marine Ecosystem Health. To move these initiatives forward will require a solid science base. The elements to this science base are: development of ecosystem based objectives, the operational definition of the precautionary approach, the development of benthic habitat classification and broader ecosystem classification schemes.

Some of the major challenges facing the department are (1) are existing management processes equipped to participate in this integrated planning environment, (2) are revised and/or additional indicators needed (e.g. human health), (3) scale of data collection / adequacy of existing monitoring programs, and (4) defining Oceans Management Plan (OMP) level objectives vs. sectoral plan level objectives, and how to fund.

A question was raised as to whether the system will allow legal challenges; the reponse was that the process is voluntary at the current time and would not evoke a legal challenge.

SFA and Current FMP Amendments

Presenters: Pamela Mace and Ralph Mayo
Rapporteur: Loretta O'Brien

The Northeast Multispecies Fishery Management Plan (FMP) was implemented in 1986 and retained indirect controls from the previous Interim Groundfish Plan as the primary management tools. These controls included minimum mesh size, minimum fish size, and seasonal area closure.   Minor adjustments were made to the existing management measures in Amendments 1-3 and were implemented between 1987-1989. Amendment 4 was implemented in May 1991 and included an overfishing definition for most large mesh groundfish species based on percent maximum spawning potential (MSP).

The objective of Amendment 5, implemented in 1992, was to eliminate the overfishing of cod, haddock, and yellowtail flounder, primarily by a 50% reduction in days at sea combined with limited access controls. This amendment was in response to a Consent Decree issued in 1991 giving the New England Fisheries Management Council (NEFMC) until March 1992 to develop an FMP to eliminate the overfished condition of cod and yellowtail flounder.   The 18th Stock Assessment Workshop issued a special Advisory in June of 1994 stating that the stocks of haddock and yellowtail flounder were 'collapsed' and that cod was close to a potential collapse and in addition, that projected reductions of fishing mortality (F) implemented in Amendment 5 would not be sufficient to allow stock rebuilding. Subsequently, Amendment 7 was implemented in 1996 to accelerate Amendment 5 mortality reductions and to initiate rebuilding schedules for depleted stocks. Target TACs were first introduced in this amendment.

Amendment 9 was implemented in November of 1999 to bring the FMP into compliance with the Sustainable Fisheries Act (SFA) of 1996 (USA Magnuson-Stevens Fishery Conservation and Management Act). The SFA had many significant changes from the previous USA Magnuson Act including a redefinition of optimum yield, definitions of 'overfished' and 'overfishing', the addition of 3 new National Standards, a moratorium on ITQs and a requirement to identify 'essential fish habitat'. Guidelines based on the Act state that status determination criteria for managed stocks must specify both a maximum fishing mortality threshold and a minimum stock size threshold with respect to maximum sustainable yield (MSY) harvest control rules. Amendment 9 incorporated biological reference points and harvest control rules established by the Overfishing Definition Review Panel and defined target and threshold fishing mortality and biomass levels. 'Overfishing' was defined in terms of Fmsy and 'overfished' was defined in terms of Bmsy.

Amendment 13 is under development to implement rebuilding schedules to bring the FMP into compliance with the SFA. The objectives are to specify rebuilding schedules for overfished stocks and to specify maximum fishing mortality rates to promote rebuilding. Four options are currently being considered to meet these goals: 1) retain existing management measures, 2) 'fine tune' existing measures, 3) area management and 4) sector management. Sectors could be defined by gear, target species, or fishing community.

Species At Risk Act (SARA)

Presenter: Jerry Conway
Rapporteur: Joe Arbour

The Species At Risk Act died on the order table when the election was called in autumn of 2000. However, the Minister of Environment remains committed to passage of the Act. The next phase of activity will likely see the non-government sector pushing for more in-depth consultation on the Act. Of significance in the Act is that it delegates the responsibility for the marine environment to DFO.

Canada already has a federal- provincial accord covering endangered flora and fauna. This accord has established many of the Act's provisions. Key steps are identified, which include the following phases: Assessment; Legal Listing; and Protection, including prohibitions and recovery plans.

The assessment process provides a description of the terms and definitions used. In a listing action, the minister submits a species to the governor in council for listing. Once listed, automatic prohibitions kick in, as well as the requirement to initiate recovery planning to develop strategies and action plans. Recovery plans now in progress include those for the right whale and the beluga whale. Action plans are being developed with multi-stakeholder participation including First Nations.

Critical habitat is defined as that habitat which is considered essential to survival of a given species. The definition of critical habitat will prove to be problematic in marine areas. Species range very widely and often in ways that are not yet understood. The concept of incidental harm has been identified for some species such as northern cod and wolffish. Incidental harm must not jeopardize survival of a species and can invoke requirements for preventive measures.

The habitat stewardship program is currently a major funding issue. This program has garnered significant interest from communities and non-government interests.

In the ensuing discussion the question was raised as to what criteria are used for defining endangered species. In response, it was noted that initially, criteria developed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) were used, but now there is movement towards using International Union for the Conservation of Nature (IUCN) criteria as guidelines. The IUCN criteria would be more applicable for marine species. COSEWIC has been very terrestrially oriented. It was also asked whether whales and dolphins were under federal control (they are, as is the leatherback turtle). Some other species are under provincial control.

ESA and MMPA

Presenter: Richard Merrick
Rapporteur: Janeen Quintal

NMFS marine mammal legislative mandates fall mainly under the Endangered Species Act (ESA) of 1973 and the Marine Mammal Protection Act (MMPA) of 1972, supplemented by the Sustainable Fisheries Act (SFA) and the National Environmental Policy Act (NEPA). NMFS goals under these mandates are to recover and maintain protected species populations and to reduce conflicts that affect them.

The **ESA** provides for conservation of threatened or endangered species and their habitats. In the Northwest Atlantic, these include loggerhead turtles (threatened) and leatherback, Kemp's ridley, and green turtles; all large baleen whales and sperm whales; and Atlantic salmon and shortnose sturgeon. After a species is listed, a recovery plan is developed which generally prohibits takes (with some exemptions). Section 7 requires consultation with NMFS concerning potential effects by any Federal agency and applies to actions in US waters and to US citizens in international waters.

The **MMPA** established a moratorium (with some exceptions) on the take of marine mammals in US waters and by US citizens on the high seas and also on importation of marine mammals and marine mammal products. Its major goal is to allow populations to rebuild to and remain at their Optimum Sustainable Population (OSP) level.

The **1994 MMPA Amendments** implemented a comprehensive regime to reduce takes to levels approaching zero (zero mortality rate goal or ZMRG). The following elements are included:

1) Introduction of a "harvest" control model known as Potential Biological Removal (PBR) which addresses population growth rate and quality of data collected;
2) Publication of annual stock assessment reports;
3) Establishment of independent Scientific Review Groups to evaluate assessments;
4) Establishment of a framework for development of Take Reduction Plans (TRPs) to reduce bycatch to below PBR and subsequently to ZMRG (within a short time frame - usually 6 months); and
5) Production of an annual List of Fisheries (LOF).

Potential changes may occur with re-authorization of the ESA and MMPA. Potential changes to the MMPA include the following:

1) Management of recreational marine mammal bycatch;
2) Enhanced co-management in Alaska;
3) Non-lethal removal of "nuisance" pinnipeds; and
4) Increased stranding network support.

Current issues under the MMPA and ESA are:

1) North Atlantic right whale mortalities (from gear entanglement and ship strikes);
2) Gulf of Maine/Bay of Fundy harbor porpoise bycatch in sink and drift gillnet fisheries; and
3) Loggerhead and leatherback turtle bycatch in pelagic longline and coastal gillnet fisheries.

North Atlantic right whales are declining (abundance equals around 300 animals at present). This is the first marine mammal species to be given a PBR of 0. A TRP is in place to reduce entanglement through the use of gear modifications and some fishery closures. More closures may be needed and ship strikes need to be addressed further. NMFS is currently being sued for both entanglement and ship strikes of right whales.

Gulf of Maine/Bay of Fundy harbor porpoise bycatch in the drift and sink gillnet fisheries is an MMPA rather than an ESA issue. The bycatch exceeded PBR (483 animals) through 1998. A TRP was introduced in 1998, which included closures, gear modifications and the introduction of "pingers". Since its introduction, takes have been reduced to below PBR (less than one quarter of previous levels). Also, the 2000 abundance estimate has increased, yielding a higher PBR (747). Pingers have played an important role in the success of the TRP.

Loggerhead and leatherback turtles have long been taken by pelagic longline fisheries. The USA pelagic longline fishery on the Grand Banks was closed from October 2000 to April 2001. NMFS is likely to be sued to reduce turtle takes, especially in the gillnet fishery, and is developing a series of new biological opinions with mitigating measures to reduce "jeopardy" to these species.

Future needs and challenges for the USA and Canada in relation to protected species include:

1) Joint research on bycatch reduction (e.g., reflective net experiments in Gulf of Maine/Bay of Fundy); stock structure; stock assessment techniques, and estimates of takes of transboundary animals;
2) Disentanglement of large whales; and
3) Legal and political challenges over takes of endangered species. There is currently a total of about 130 lawsuits directed toward NMFS, several of which are for marine mammals, particularly right whales, and questions concerning Canadian actions are being raised.

In the ensuing discussion, the question was raised as to the USA definition of a "take", and the response was that "takes" refer to all interactions, including capture and release. It was also asked whether listing decisions are made inside the agency, and the response was yes, subject to public review and comment in the federal register. It was also noted that there are some lawsuits now operative in Canada - one is over seals.

Management Processes and Initiatives

Objective-Based Management/Precautionary Approach

     Presenter: Chris Annand
     Rapporteur: Wayne Stobo

Objective-Based Management and the Precautionary Approach were looked at as part of the larger Canadian government-wide initiative of risk management which aims to develop systematic approaches as a long term strategy to support the government's governance responsibilities. In the context of fisheries and ocean resources management, the intent is to identify and assess the level of risk associated with management objectives and to develop operational strategies to manage those risks. This process is partly the result of increasing public demands to participate in decision-making and the concurrent need for imposing greater accountability on government, and stakeholders, for decisions made.

The introduction of the Objective-Based Management approach builds on DFO's Integrated Fisheries Management Plan Process, and seeks to translate concepts like "conservation", "the Precautionary Approach", and "ecosystem management" into explicit and measurable goals in fisheries planning. In addition to setting goals, Objective-Based Management includes risk analysis that incorporates strategies to avoid or otherwise address potential obstacles to achieving these goals. A formal process of post-season analysis rounds out the approach by developing measures of performance against which to evaluate the success of the Plan.

DFO has only recently embarked on this initiative and is currently in the process of elucidating and developing the various components that need to be addressed in meeting these objectives.

SARC and Relevant Issues

     Presenter: Terry Smith
     Rapporteur: Russ Brown

Terry Smith described the fisheries stock assessment review program employed by the NEFSC. The program uses a two-panel system for completion of the peer review process. The first panel is a working group, open to participation by members, other interested scientists, industry representatives and other stakeholders. This group is responsible for evaluating input data and performing analyses required to meet assigned terms of reference. The working group prepares an assessment report to be evaluated by the second panel, the Stock Assessment Review Committee (SARC).

The SARC is an external review panel that includes 12+ members from the NEFSC and other NMFS facilities; scientists from other regional, national, and international agencies; and industry representatives and members from academic institutions. Recently, the SARC

has included 1-3 representatives from the Center for Independent Experts, jointly administered by the University of Miami and NMFS. The primary role of the SARC is to provide an evaluation of tabled assessments and to write management advice. The SARC produces two primary documents: a SAW Advisory Report containing a brief and stylized summary of the assessments, and a SAW Consensus Summary that contains detailed assessment information, a summary of discussions occurring at the SAW and research recommendations.

Positive aspects of the process include a detailed and thorough review of assessments, high quality participation in the review process, and an established, independent and accepted review process. Negative aspects include questions regarding the actual independence of the review process and high levels of demand for assessment review that exceed the ability to perform such reviews.

The group discussed the issue of the perception of independence of the review among stakeholders, noting that this is a commonly expressed concern when stakeholders disagree with the scientific advice produced. It was noted that distrust may arise when stakeholders have difficulty understanding technical details, but note that both the assessment personnel and reviewers appear to "speak the same technical language." It was noted that two interventions are common in the Center's peer review process: National Academy of Sciences reviews and lawsuits. It was noted that the Northeast Center has been involved in four NAS reviews in the past 6 years, and that a number of lawsuits have been filed challenging the scientific integrity of stock assessments.

National Stock Assessment Review and the TRAC Process

      Presenter: Bob O'Boyle
      Rapporteur: Wayne Stobo

Bob O'Boyle described the National Stock Assessment Review now in progress and outlined the RAP and TRAC processes. As part of DFO's ongoing evaluation of efficiencies, this review was intended to help focus Science activities to priority areas, stemming from a perception that allocation of Science resources may not be occurring in proportion to stock importance. Objectives of the Review were to describe a vision for 2010, to describe DFO's current situation, and to investigate how the vision was to be achieved. The review process, attributes of the analysis and the timetable of events were outlined.

The major conclusions were that the Science resources were proportional to the importance of the stock, though the method of ranking importance differed between regions. Also noted during the review was that as resources allocated to stocks increased, knowledge levels increased and uncertainty decreased, but the benefits of continuing to increase funding tapered off after a certain point. On the down side, it was noted that performance measures of success were inadequate. It was also observed that there were gaps and imbalances in many areas at both the single species and ecosystem levels.

The various areas which needed to be addressed to make the stock assessment process more efficient included the need to develop new technologies and methods for delivering advice to management bodies, to address staffing levels and workloads, to provide for training staff in new scientific methodologies, to improve data management and availability, and to expand the suite of analyses used in evaluating stock status including the use of models which are less data demanding. As well, the need to improve and redefine the peer review process and the frequency and nature of management advice from Science was highlighted. It has been suggested that the assessment and advisory process could shift to a system of intensive fishery assessments (IFAs) involving comprehensive evaluations at a lower than annual frequency supplemented by updates, scheduling to be determined by resource and fishery characteristics.

He also described essential features of the Regional Advisory Process (RAP) and the Transboundary Resources Assessment Committee (TRAC) process. The RAP considers many stocks, some being full-model formulation or "benchmark" assessments, with most being updates. The process includes both a scientist or working group preparing a draft working paper on a stock, which is then peer reviewed in an open RAP meeting; in the Maritimes, the latter reviews the full or benchmark assessments but not the updates. Increasingly, the detailed technical review is being undertaken in the pre RAP working groups, which are generally not open to the public. This is because the open RAP meetings are too short to allow major changes to assessments, and consequently an "accept or reject" format is used. The National Stock Assessment Review has proposed a new model in which full assessments become IFAs on selected stocks and are conducted outside of the management cycle. The updates being done would be done annually as part of the management cycle.

The TRAC process was established in 1998 to deal with transboundary resources and to date has considered Georges Bank stocks of cod, haddock and yellowtail. The process includes a working group (the Transboundary Working Group or TAWG) which produces the assessments and other analyses as requested by the TRAC; and the TRAC itself, which peer-reviews the assessments. There is limited time for revision. Both update and benchmark assessments are reviewed by the TRAC. There may be room in the TRAC process for an IFA type of approach.

Single-Species Science and Future Cooperative Research

<u>Government Survey Programs</u>

Canada-Trawl Surveys and Hydroacoustics

    Presenters: Joe Hunt and Gary Melvin
    Rapporteur: Wayne Stobo

Joe Hunt summarized Canadian research vessel (RV) trawl survey time series for the Scotian Shelf and Georges Bank, providing information on vessels, areas covered and time frames. He included references to additional cooperative industry surveys. Recent years have seen expansion of existing RV surveys to greater depth ranges, additional hydrographic sampling, and improved data audits and timeliness of data availability through real-time at-sea editing.

The attempts to redefine the RV surveys from fish abundance surveys to resource multi-tasking were described along with the challenges and problems in achieving that objective.

He also described ongoing research on fish 'catchability' in the Georges Bank survey. Over time, the mean date of the survey has progressively moved earlier; and along with that shift, changes in mean bottom temperature have been observed, along with changes in the maturity status of cod. The study is examining if such changes could result in changes in catchability of fish resources to the research trawl. If catchability is modified, then does the time series, as currently analysed, adequately reflect population status?

Gary Melvin reviewed the distribution of primary herring fisheries and stocks in the Scotian Shelf and Bay of Fundy region and described the use of hydroacoustics in herring assessment and management. In response to concerns expressed by industry over the potential elimination of local populations within overall catch restrictions for larger stock areas, a process was initiated in 1995-96 to protect these components. This process is a cooperative one between the industry and DFO and involves real-time hydroacoustic assessment of biomass levels in potential fishery areas prior to initiation of fishing activity. Several herring purse seiners are now equipped with hydroacoustic systems which are used to conduct multiple standardized surveys of fishing grounds to assess the quantities of herring available to the fishery. Once biomass estimates have been determined, the agreed management strategy is to allow a 10% take of the estimated biomass; this is considered a precautionary approach. The surveys are now being conducted using standardized survey areas and procedures, providing a time series of abundance estimates for multiple fishing areas.

USA Surveys- Recent Developments

Presenters: Tom Azarovitz, Holly McBride, Bill Michaels
Rapporteur: Henry Milliken

Tom Azarovitz presented an overview of the NEFSC survey program. Most bottom trawl survey cruises have been completed using RV ALBATROSS IV; the autumn survey time series is now 35 years long with very little change in vessels or gear used. The surveys sample inshore and offshore waters to 200 fathoms from the Bay of Fundy to Cape Hatteras. Conversion coefficients have been developed to account for changes in vessels or gear.

The frequencies and the start dates for the various surveys are as follows:

> * Bottom Trawl
>   Autumn (1963), Spring (1968), Winter (1992), Summer (Intermittent)
> * Surf Clam / Ocean Quahog
>   Summer, alternate years (1965, 1982)
> * Sea Scallops
>   Summer (1975)
> * Northern Shrimp
>   Summer (1983)
> * Hydroacoustic - Herring
>   Autumn (1998)
> * Hydroacoustic - Mackerel
>   Winter (2001)
> * Ecosystem Monitoring, MARMAP (Ichthyo/zooplankton)
>   Seasonal, six annually (1977)
> * Other, e.g. vessel/gear fishing power
>   Intermittent years

Recent developments include (1) a new data entry at sea system (the Fisheries Scientific Computing System or FSCS) and (2) an acoustics program to obtain abundance estimates on pelagic resources.

FSCS: Holly McBride reviewed the Center's FSCS system, to be implemented during the Spring 2001 field season. The Office of Marine and Aviation Operations (OMAO) and the NEFSC have designed and developed this system over the past 2 years. It will completely replace data entry on paper logs.

Hardware includes LCD touch screen displays with built in heaters, SCANTROL electronic measuring boards, Marel digital scales, and label printers and bar-code readers. The system is set up to run from a server through a network, but can be run from an individual workstation if necessary. The workstations and servers are backed up whenever information is input to FSCS.

The software converts data to digital form; and built in audits are included to check the data when entered. Bar codes attached to age envelopes are utilized to record pertinent information for each sampled specimen. The bar-coded envelope is permanently associated with that individual fish. Upon completion of a station, data may be loaded into an Oracle table and audited. With some minor post processing, these files will be ready for archival to master data immediately upon returning to dockside.

Hydroacoustics: Bill Michaels reviewed the NEFSC hydroacoustics program. The Center now conducts annual hydroacoustic surveys for Atlantic herring during autumn in the Gulf of Maine and Georges Bank regions. These surveys employ EK500 echo-integration (12, 38, 120 kHz), omni-directional sonar (64 kHz), midwater trawling, CTD measurements, and underwater video operations. Acoustical biomass estimates for offshore spawning stocks of Atlantic herring have closely matched VPA estimates of 2 to 3 million metric tons. In-situ and laboratory experiments have been completed to measure the individual target strength of herring in an effort to refine the estimates. Acoustical data are also being collected from other NEFSC surveys (including bottom trawl and marine mammal surveys). A pilot survey and in-situ experiment will be conducted in winter of 2001 in the Mid-Atlantic shelf region to identify acoustic measurements from other stocks (Atlantic mackerel, *Loligo* squid, silver hake, and butterfish) to expand program capabilities.

Joint Projects With Industry

Canada

Presenters: Paul Fanning, Steve Smith
Rapporteur: Don Clark

Paul Fanning described the Fishermen and Scientists Research Society (FSRS) which promotes interaction among fishermen and scientists. It has provided a forum for discussing cooperative work, which has been useful in building and maintaining interest in such studies. The Society now has 225 members (190 fishermen) and is involved in a variety of studies ranging from diet and fish condition to surveys of fishermen to identify historical spawning areas. It is involved to some degree in many cooperative projects including the 4VsW fixed gear ('Sentinel' survey); this is a stratified random survey, mostly DFO funded. It extends into shallower water than the DFO RV survey, with about double the sampling intensity.

Industry/science projects with other partners include the ITQ survey. This is funded by industry from its pooled quota. The survey is conducted by mobile gear, employs a fixed station design and, like the Sentinel survey, has a higher sampling intensity and broader geographic coverage than the DFO RV survey. Another example is the Halibut survey which is a fixed gear stratified random survey focusing on halibut fishing grounds from Grand Banks to the Hague line. A quota allocation is used to fund this survey.

In the case of partnerships DFO has developed a process of Joint Partnership Arrangements (JPAs). These are formal arrangements of a contractual nature, specifying each partners'

commitments and contributions to a given project or process. These have become standard in the case of emerging species fisheries. The policy on these fisheries requires that a 5-year science evaluation be included prior to any decisions regarding the eventual development of the species as a fishery. JPAs have been routinely used to specify arrangements for cooperative studies during the initial phase of fishery development.

Steve Smith described a number of cooperative surveys for invertebrates. Offshore scallop surveys have been conducted using industry vessels since the mid-1980s. The shrimp survey is done with industry participation and vessels, as is the case for surf clam and rockweed surveys. Catch sampling for these fisheries is also conducted (and paid for) by industry. Industry has provided equipment and expertise for conducting studies and designing surveys. These surveys have augmented resources and sea time but cannot replace the long-term monitoring done by government agencies.

Data from these surveys are archived in databases as for standard data sources; one outstanding issue involves ownership of the data in relation to access.

USA

Presenter: Steve Murawski
Rapporteur: Ann Richards

Steve Murawski gave an overview of joint research projects completed or planned by NEFSC. These include research surveys to estimate distribution and abundance for several species (clams, squid, scallops, monkfish), tagging studies (e.g. cod) and use of study fleets to obtain high quality commercial fishery data and bycatch information. Funding for most of these projects has been made available from "disaster-relief" funds. Steve discussed some specific programs in detail (scallops, monkfish) and provided the following general observations: (1) using programs from other regions as models may not always work, (2) teaching the scientific method is possible, but difficult (3) communication is best done in small groups (also at sea), (4) fishermen care about gear, while scientists care about design, (5) peer review standards must apply to the science which is produced, (6) fishermen can apply political pressure to get money for projects they care about, and (7) if the federal government doesn't become involved with joint industry projects, others will (e.g. academia).

Databases and Web-Enabled Data Display

  Presenter: Jerry Black
  Rapporteur: Don Clark

Jerry Black described the Virtual Data Centre, which is currently an intranet website. Data are generally archived in Oracle tables and the website is designed around staff, projects or data sets, all of which are linked. The site provides direct access to the data, and can produce standard data products and maps and in many instances allows for customization. Many products and maps are hot-linked so that the user may click on them (drill-down) for further summaries. The capability exists for linking otherwise disparate databases in some cases, so as to provide linked summaries.

Data dictionaries are available for Oracle tables, which reflect data structure. Survey data, including data from invertebrate (lobster, shrimp and scallop) surveys, are available in the system, as are commercial landings and commercial sampling data. An image gallery is available with ~ 750 digital images catalogued on the site. The data visualization package ACON is used for most of the mapping; applications are run on an NT server and Oracle databases are accessed on separate servers. Queries are made in SQL and PLSQL language. SPLUS should be available for statistical analyses on-line shortly.

The developmental website

http://mfdvdc.bio.dfo.ca/mflib/plsql/mwmfdweb.splash

is currently available only from within the DFO firewall. A public access version of this site will not be available until the last quarter of 2001 at the earliest.

Pollock Ageing Research

  Presenter: John Neilson
  Rapporteur: Don Clark

John Neilson gave a brief review of previous and current age validation research on pollock. Age determinations for the first few years of life have been validated through analysis of length modes, and chemical marking has also been used to distinguish annuli in older fish. Juvenile pollock of known age (based on modes) have also been tagged, providing definitive ages when recovered after several years at large. Lengths at age determined from these fish have been compared with lengths at age determined from otoliths taken in commercial samples. Ages derived from these otoliths were validated from the mark recapture data, as the lengths at age matched those for known age fish. Differences in growth among regions within the management area were also corroborated; with lengths at age being higher in the west.

Assessment Models and Software

Traffic Light

Presenter: Bob Mohn
Rapporteur: Stephen Smith

A common criticism of the population model approach to stock assessment (e.g., VPA) is that relevant information on stock status (e.g., prey abundance, condition factors) is excluded from the process. As well, methods are needed for comparing and summarizing disparate indicators when model-based approaches are not possible. Bob Mohn presented the traffic light method as means of dealing with these situations. The method consists of identifying potential indicators of stock status such as biomass estimates from a population model, indices from trawl surveys, trends in growth rates, etc. Levels for each indicator corresponding to specific states of stock status (good, intermediate and bad) are defined. The traffic light method then presents the time series of each of these indicators color-coded in a visual display as green, yellow and red, respectively. Indicators that measure similar quantities are grouped and summarized as single series referred to as characteristics. For example, trends in growth rates, size at age and recruitment are grouped as the productivity characteristic. The method also includes direct summaries that combine indicators of various kinds or indirect summaries that combine characteristics. Bob presented an example using software developed by MFD to visually display trends for 4VsW cod.

One area of active work and contention involves methods for combining different series and assignment of colors. The colors of the summaries are intended to suggest a level of action as in red indicating that a serious intervention is required because current fishing levels are detrimental. Yellow may indicate that some adjustments to fishing levels may be required and green would correspond to fishing not having a detrimental effect. Concerns have been expressed that these three states may be too coarse to allow for appropriate management action. Methods for expanding on these three states such as using fuzzy sets or a more continuous gradation from red to green have been suggested. A workshop is planned for June/July 2001 to look at these and other issues.

While the value of the traffic light method as a communication tool was acknowledged, a number of participants noted that the method was similar in its goals to methods such as expert systems, multi-attribute utility analysis and decision analysis. Comparisons between these methods and the traffic light method have not yet been done. It was also noted that in its current state the method may not be capable of evaluating alternative management strategies. More development of the traffic light method is planned including evaluations of quality and use of current indicators. Those who have experience with the method felt that it was a useful tool for developing consensus for a wide range of indicators of stock status.

Assessment Toolbox

Presenter/Rapporteur: Paul Rago

The Fisheries Assessment Computation Toolbox (FACT) is part of a national program within NMFS to improve stock assessments. This national focus has resulted in the incorporation of standard software from within the USA and the UK. It has been under development at NEFSC for the past three years.

The toolbox incorporates a variety of frequently used methods within a common interface. File management and alternative model configurations are easily implemented and self documenting. Hence the program both facilitates the communication of methodology and results and provides a degree of quality assurance. Diagnostic plots and other methods are included as a means of testing model assumptions and performance. An important feature of the toolbox is a comprehensive documentation and help system. Each model that is incorporated into the toolbox is documented with respect to the underlying theory and guidelines on using the model.   Textual hyperlinks aid understanding of the model theory and a search engine allows one to search across documentation for all models.   The toolbox is designed to be flexible to allow incorporation of new methods and can also serve as a baseline for comparison of new methods with standard formulations.

At present, FACT contains software for age-based models (Adapt), production models (ASPIC), and a stage-based approach (Modified Delury or Catch-Survey Analysis). Two of the packages include stochastic projection models (AgePro and ASPIC Projection) which allow for evaluation of alternative management measures. In addition, techniques for estimation of biological reference points (YPR and Precautionary Approach) have been included.   Via agreement with the Centre for Fisheries, Environment and Aquaculture Science (CEFAS) the software package known as FishLab is also included. This package contains models commonly used by the International Council for the Exploration of the Sea (ICES), i.e. Adapt, cohort analysis, the Extended Survivors Approach (XSA), the Jones length-based model, a surplus production model with indices and finally a separable VPA. Hence it is possible to rapidly compare estimates from several different models and to gain additional insights into resource dynamics. Various output options allow users to export model outputs to statistical and graphics software packages for further analyses.

Several areas of concern have also been addressed including problems with pooled age groups in VPA assessments, alternative approaches to bootstrapping and correction for bias, and incorporation of formal theories for model building. These will be incorporated into future versions of FACT. It may also be desirable to include a general simulator which would allow tests of the ability of alternative models to recover known parameters. Tests for robustness to noisy data and the ability of model building strategies (e.g., information theoretic approaches) to identify appropriate suites of candidate models could also be included; and policy simulation methods could be developed to evaluate management decision rules and effects of uncertainty. Longer term considerations also include preparation for new and richer types of data including real-time measures of fleet dynamics,

catches and bycatch, ancillary environmental data (e.g., bottom habitat typing), improved biological information, and alternative management regimes such as ITQs.

In response to questions from the audience it was noted that FACT software is available for general distribution although installation may be difficult on older computers and for Windows 95 and earlier operating systems. Exhaustive debugging has not been done although the models have performed well on test datasets. Incompatibilities among models or difficulties in running a particular sequence of operations may still exist but have been addressed via actual application of FACT for assessments.

Stock Definition Research for Transboundary Mammals

Presenters: Dave Potter, Gordon Waring, Phil Clapham
Rapporteur: Janeen Quintal

Harbor porpoise. Currently, fourteen putative stocks of harbor porpoise are recognized as proposed by Gaskin (1984) based on summer distributions and breeding times. This hypothesis has been supported by contaminant studies and mtDNA and nuclear microsatellite data. Studies of organochlorine and heavy metal contaminants published in 1995 both found significant differences between the Gulf of Maine/Bay of Fundy, Gulf of St. Lawrence and Newfoundland populations. Results of restriction fragment length polymorphism (RFLP) analyses of mtDNA suggest the presence of a weak cline in mtDNA genotype frequencies from Newfoundland to the Bay of Fundy. Additional studies using mtDNA sequences and nuclear microsatellite data including animals from west Greenland have further supported the existence of different stocks. Movements of tagged animals have also been used to support these genetic findings. Life history parameters from the different putative stocks indicate that the reproductive cycle is very seasonal and there are slight differences, which may indicate stock differences between the Gulf of Maine/Bay of Fundy and Gulf of St. Lawrence. Animals from Newfoundland and W. Greenland have not been studied in as much detail.

One 1999 study included samples of 41 stranded harbor porpoises from the Mid-Atlantic states (NY to NC) between December and May. The study revealed 8 haplotypes that were unique to this Mid-Atlantic sample. That is, they were not seen in any of the summer samples indicating either an unknown stock or, more likely, inadequate sampling. Of the remaining 33 haplotypes, results indicate a mixture of individuals from the Gulf of St. Lawrence, Gulf of Maine/Bay of Fundy, Newfoundland and West Greenland stocks. There are still 145 harbor porpoise samples from bycaught or stranded animals remaining to be analyzed from the Mid-Atlantic region. By-caught animals were healthy when captured and are probably representative of the animals that normally inhabit Mid-Atlantic waters. Further studies to determine the relative contributions of porpoises from the summer populations to this larger Mid-Atlantic sample are needed as well as the collection and analyses of additional samples.

Seals. The four seal species found in New England and mid-Atlantic waters are: harbor seal (*Phoca vitulina*), grey seal (*Halichoerus grypus*), harp seal (*Phoca groenlandica)* and hooded seal (*Cystophora cristata*). Harp and hooded seal populations are centered in Canadian Atlantic waters, and there is no evidence of pupping in U.S. waters. Harbor and grey seals are the most numerous and are present year-round with pupping occurring in both U.S. and Canadian waters.   Following extirpation in the 1960s from bounty removals, grey seals bearing Sable Island brands were re-sighted in the 1980s around Nantucket Island and outer Cape Cod. They currently have a year-round presence on the outer Cape and 2-3 documented pupping sites in eastern Maine waters. Harbor seal breeding and pupping continued in Maine coastal waters despite earlier bounty programs and since passage of the MMPA (1972), the harbor seal population has increased at least 5-fold. The current population size of approximately 31,000 represents the largest and most widespread seal population in U.S. Atlantic waters (Maine to Maryland). Stock structure analysis will be used to improve our assessment reports and to guide future abundance surveys. In spring 2001, the NEFSC plans to tag seals using VHF and visual detection tags. While the principal goal is to obtain a correction factor for the spring abundance survey (pupping season), we expect that the visual tags will provide new information on seal dispersal, particularly into Canadian waters.

Right Whales. The right whale population declined in the 1990s due to high mortality and low reproductive rates. This year, however, 14 calves have been counted to date. There is only one known calving ground. However, while many mature females take their calves to the Bay of Fundy, more than 20 do not, suggesting that there is a second undiscovered nursery area (or that these animals scatter widely in summer). Recent genetic studies suggest that Bay of Fundy and non-Bay of Fundy animals represent two distinct sub stocks, but the evidence is not conclusive. Much of the population is missing in winter. Concerning distribution in historic habitats, it was noted that eastern North Atlantic stocks were wiped out at the turn of the century, but animals show up there occasionally. Also, some animals seen occasionally in the western North Atlantic disappear for several years at a time. Present research needs include: improved mortality reporting for transboundary animals; rapid retrieval of dead animals; improved disentanglement coordination and safety standards; and continuation of the productive cooperation with DFO in aerial survey fieldwork.

Humpback Whales. The North Atlantic humpback population estimate was about 10,600 animals in 1992 and the population is probably growing. The Gulf of Maine growth rate is estimated at 6.5%. A comprehensive assessment will be undertaken by the IWC at its annual meeting this year. The management unit used by the NMFS for stock assessment recently changed from the North Atlantic stock to the Gulf of Maine stock and a new abundance estimate and PBR calculation is needed. There are stock boundary questions relating to the Scotian Shelf and mid-Atlantic areas. Stock definition is being addressed using vessel-based photo-ID surveys. Fifty-six individuals were photographed on the Scotian Shelf in 1998 and 1999; 21% matched to the GOM stock but there were no year-to-year matches, suggesting that the population in this area is large. In the mid-Atlantic, 48% of the identified individuals were from the Gulf of Maine, but 24% were Canadian Atlantic animals (four from Newfoundland and one from the Gulf of St. Lawrence). Four of 16 dead animals from the

mid-Atlantic matched to the Gulf of Maine. Thus, this area appears to have considerable mixing.

The question was raised as to feeding habits. Humpbacks feed on herring, sandlance and euphausiids.

Ecosystem-Based Management and Future Cooperative Research

Ecosystem-Based Management-USA Initiatives

      Presenter: Pamela Mace
      Rapporteur: Jon Brodziak

Pamela Mace described eight USA initiatives relevant to ecosystem-based management of fishery resources, including existing legal mandates, recommendations of scientific groups, and ongoing legislative efforts.

The National Environmental Policy Act of 1969 provides the most holistic initiative that encourages an ecosystem-based approach. This legislative act requires environmental impact statements and assessments. The NMFS has been sued for lack of compliance with NEPA for failure to take account of ecosystem effects of fishing, especially on forage species and protected species.

The Sustainable Fisheries Act of 1996 amendments require incorporation of ecosystem considerations in fisheries management, including bycatch restrictions and essential fish habitat requirements. The term "ecosystem-based management" (EBM) is not explicitly used in this law, however. Another recent initiative, the National Research Council's report (October 1998) on sustaining marine fisheries, concluded that reducing fishing mortality was the most comprehensive and immediate approach to rebuilding and sustaining fisheries and marine ecosystems and that marine protected areas should be established where fishing is prohibited. This report also stated that, in general, more information and research on ecosystem processes is required for effective ecosystem-based management. Similarly, the Ecosystem Principles Advisory Panel was created by Congress to report on EBM. In its April 1999 report, the panel recommended that fishery ecosystems plans (FEPs) be developed and also provided some guidelines for their preparation. As a first step towards EBM, the panel recommended that one or more demonstration FEPs be developed.

The 6th National Stock Assessment Workshop (NMFS, March 2000) was focused on incorporation of ecosystem considerations into stock assessment and management advice. There were four subthemes in this workshop: ecosystem properties, biological and technological interactions, effects of short and long-term climate change, and the indirect or secondary effects of fishing.

The NMFS stock assessment improvement plan is an initiative that proposes three scenarios of additional funding to improve assessments. The most ambitious of these proposes to conduct next generation assessments that would explicitly incorporate ecosystem considerations such as species interactions and environmental effects, as well as socioeconomic impacts.

The reauthorization of the Sustainable Fisheries Act (2000) was not completed prior to the USA presidential election and this legislation will likely be revised in the future. Nonetheless, the House of Representatives version did include a new section on conserving marine ecosystems and requirements for FEPs. The Senate version included a requirement for reports on ecosystem research priorities and also a requirement that the "best scientific information" must be based on "a sufficient statistical sample...such that any conclusions are reasonably supported." This provision would presumably make the practical application of EBM very challenging.

The Oceans Act of 2000 is the most recent USA initiative relevant to EBM. The main purpose of this act was to establish a bipartisan commission to make recommendations for a coordinated and comprehensive national ocean policy. The report of this commission will be the first review of national ocean policy since the one by the Stratton Commission in 1966 which recommended the creation of NOAA and laid the groundwork for the Magnuson Fisheries Conservation and Management Act of 1976.

Ecosystem Models

Scotian Shelf Initiative

Presenter: Paul Fanning
Rapporteur: Joe Hunt

The Comparative Dynamics of Exploited Ecosystems in the Northwest Atlantic (CDEENA) project was created in 1997 to collect and interpret data for the dynamics of exploited ecosystems in the Newfoundland area (northern cod), the Gulf of St. Lawrence, and the eastern and western Scotian Shelf for three time periods - 1970s, 1980s and 1990s. Objectives included descriptions of each system, demonstration of differences between systems and evaluation of causes for lack of recovery to pre-collapse conditions. Elements studied included trophic interactions, system biomass and total production. Supplemental funding from integrated management objectives has allowed progress on broad scale objectives. Diet content and prey/predator interactions have been the main focus of work in the eastern Scotian Shelf area including new collections and recovery of historical data. Modeling of natural mortality in cod using seal/cod interactions for 1980-1985 suggests that M is variable both across age groups and across years.

Data collections from research surveys are an essential part of the program and may require additional observations and expansion of coverage to meet objectives. The project is presently supported by non-core internal funds.

Georges Bank Modeling Initiatives

        Presenter: Mike Fogarty
        Rapporteur: K. Sosebee

Mike Fogarty presented information on ecosytem modeling initiatives by the USA for
Georges Bank over the last three decades. Several approaches have been explored, including
energy budget models, aggregate biomass production models, age structured simulation
models, multispecies cohort models, donor control production models and delay difference
models. Species groups on Georges Bank have shifted historically from a biomass
dominated by groundfish and flatfish to one dominated by pelagics and elasmobranchs. Total
biomass on the Bank has remained more stable suggesting interactions among components.
Energy budgets suggest that there is barely enough energy to account for yields from the
Bank. There seems to be an inefficient transfer of energy from primary levels to secondary
and tertiary levels.

Ongoing modeling efforts include energy budget modeling with information from the
GLOBEC project, including improved estimates of secondary production and inclusion of
the microbial loop. The Georges Bank ecosystem appears to be loosely coupled with many
links with low interaction strength. Comparisons with more northern systems with fewer
species suggest that stronger predator-prey interactions may be present in these simpler
systems.

GLOBEC Progress

        Presenters: David Mountain, Jim Manning
        Rapporteurs: Jim Manning, Dave Mountain

The waters in the Gulf of Maine and on Georges Bank are a mixture of two primary sources:
cold, low salinity water from the Scotian Shelf (SSW) entering in the surface layer around
Cape Sable, and warm, higher salinity Slope Water (SLW) entering at deeper levels through
the Northeast Channel. Direct measurements of these inflows during the GLOBEC program
(by Peter Smith at BIO) show a balance of two parts SSW to one part SLW. Similar
measurements in the late 1970s estimated about the same total transport, but with a reverse
proportion - two parts SLW to one part SSW. The increased contribution of SSW can
account for the generally lower salinities observed during the GLOBEC period, compared to
the 1980s. More importantly, the change in the balance of the source waters to the Gulf
system implies changes to the inflow of nutrients, plankton and other characteristics, which
may have important consequences for the Gulf ecosystem.

The analysis of cod and haddock egg and larval data from the Broad Scale Survey
component of the GLOBEC program was described. Mortality estimates through the early
development of the year classes will be determined and compared to physical forcing, food
availability and predation to gain understanding of the factors contributing to recruitment

variability. Early larval mortality for the 1995 and 1996 year classes of cod has been shown to range from 5-8 percent per day.   The 1998 haddock year class did not originate from an unusually large egg production, but was characterized by high larval abundance, implying that mortality rates during the egg and at least early larval stages were low compared to other years sampled by GLOBEC.

Georges Bank GLOBEC process studies were conducted in three separate field programs focused on 1) water column "stratification" in 1995, 2) "source, retention, and loss" in 1997, and 3) "cross-frontal exchange" in 1999. The effect of these processes on the distribution and abundance of larval fish and their prey was examined on nearly a dozen cruises each year. Larval distribution studies in 1995 revealed that cod larvae were concentrated on the northeast peak of Georges in March; the concentration then shifted to the central offshore edge of the Bank in April and to Great South Channel in May. Examples of oceanographic structures such as a slope water intrusion in May 1995 and an intensified tidal-front jet in May 1997 were described in their relation to the distribution of cod and haddock. The Dartmouth Circulation Model (a good example of successful USA-Canadian collaboration) was used to demonstrate the potential for larval advection on the southern flank. The application of this model in "real-time" mode was noted as one highlight of 1999 shipboard operations.

The transition from GLOBEC to more "operational oceanography" will be the focus of the next few years. As an example of this effort, the "Environmental Monitors on Lobster Traps" program has been introduced to contribute to the long-term monitoring of the physical oceanographic conditions in the Gulf of Maine. Further information on this program is available from *http://www.wh.whoi.edu/~jmanning/emolt.html*.

The question was raised as to whether there was evidence for larval swimming behavior, as modeling of larval retention would have to consider this. The response was that earlier work has indicated an on-bank movement by older larvae as they move toward the bottom. There was also a question as to how cod and haddock eggs could be separated for the purpose of estimating egg production by the two species. The response was that the proportion of cod vs. haddock eggs is determined for the older eggs, where species can be distinguished, and applied to earlier stage eggs, on a station by station (or net by net) basis.

The question was also raised as to the point at which cod begin to exhibit schooling behavior. This sparked some discussion; the conclusion being that there is no evidence for this at the larval and juvenile stages. Direct observations of juvenile cod on the north side of Georges Bank from submersibles show them to be scattered in the gravel substrate, without any indication of schooling behavior. Finally, there was a question as to whether there is any indication of changes in the relative contribution of eastern vs western Georges Bank to cod or haddock spawning; the response was that the GLOBEC modeling group is actively investigating this question, largely from historical data. In the synthesis phase of the program, data from GLOBEC sampling will be included in this type of analysis.

A number of comments were made suggesting that 1998 was unusual in the region for species other than haddock (e.g., redfish). This may be a more general issue to be looked at. This was the first year since the 1960s that slope water of Labrador Sea origin extended far enough to the southwest to enter the Gulf of Maine, indicating that there were other aspects of the physical environment that were unusual that year, as well.

Early Life History Modeling

       Presenter: Dave Brickman
       Rapporteur: Paul Fanning

Dave Brickman described results of a research program to study larval retention on Browns Bank. In spring, the flow field would carry particles from Browns Bank into the Gulf of Maine in approximately two months; and the question may be raised as to what fraction of larvae produced on Browns Bank is actually retained there.

An early life stage (ELS) model was constructed which includes flow fields, particle tracking, egg production, and growth and survival equations for both eggs and larvae. In southwest Nova Scotia diel migration has not been seen and was not included in the ELS model. The model has been 'tuned' to resemble the egg and larval distribution data from the Fisheries Ecology Program or FEP.

For Browns Bank haddock, a retention survival index (RSI, Shackell *et al.*, 1999, CJFAS V.56, 1-12) was constructed. Since some larvae are advected to the Bay of Fundy from Browns while others are retained on Browns, the population is split early in life (egg or larval stages) and the two components are segregated until about Age 2. Examination of RV length frequencies of Age 2 fish showed two modes, corresponding to faster growth in the Bay of Fundy and slower growth on the Scotian Shelf. The RSI is simply the proportion of total Age 2 numbers attributed to the Scotian Shelf component i.e. retained on Browns. The ELS model was divided into the same areas and the model RSI computed. There was a correlation of about 0.7 between model and observed RSI but the model values are much lower, suggesting the Bay of Fundy component has lower survival rates in spite of faster growth.

To predict recruitment, an Age 1 recruitment model needs to have, in addition to the ELS model, an improved egg production model, which includes reproductive potential. This is an active research area at this time. An important element is the treatment of mortality to account for the fact that there are about $1e^{13}$ eggs spawned, while Age 1 numbers are about $1e^{7}$. This points to the need to include predation by pelagic fish and invertebrates if possible. As well, an 0-group survival model is needed including density dependence, other species, and temperature and size dependence effects.

From all of this, Age 1 abundance and distribution could be optimally estimated using the RV and VPA age-1 data.

From looking at the average RV distribution of Age 1 captures, the question may be raised as to why so many Age 1 individuals are to be found upstream of the spawning grounds (Browns Bank) and next to none in the downstream area offshore. This distribution can be interpreted as a survivability map, and is consistent with low survivability in the Bay of Fundy as indicated by the RSI. The particle model puts no larvae in the upstream areas which show high abundance of Age 1, but FEP data showed large numbers of pelagic juveniles upstream (at least in 1983). The flow fields in that area suggest that larvae may be from the Western/Emerald spawners in (NAFO) Div. 4W. Thus, Div. 4X haddock may be part of a metapopulation including Western and Emerald Banks upstream. If this were the case, it appears that Georges Bank is the end of a metapopulation conveyer belt, which, given the warm water and high productivity, may explain the historical stability of Georges Bank haddock production.

There are some 'hot spots' of settlement in Div. 4X but the greatest concentration of drift suggests that most settle offshore and possibly go to Div. 5Y but it is more likely that they don't survive at all. Using a rough indicator of habitat (bottom sediment types), Age 1 survival appears highly correlated with sandy gravel bottom habitat, and it is possible that this may be an important regulator of survival to Age 1.

In the ensuing discussion it was noted that crossover of water masses and presumably larvae from Browns Bank to Georges Bank is well documented. Tagging results show that returns from downstream areas could be by movement of adults upstream. This would provide a classic metapopulation closure. It was noted that the large 1975 year class would be an interesting case to examine.

SEAMAP

> Presenter: Gary Rockwell
> Rapporteur: Paul Fanning

Gary Rockwell described the Canadian Seabed Resource Mapping (SEAMAP) initiative and gave examples of its capabilities and use. SEAMAP is multi-departmental, including the Canadian Hydrographic Service within DFO, the Geological Survey of Canada within Natural Resources Canada (NRCan) and the Navy Route Survey Office from the Department of National Defense (DND). The ultimate goal of this initiative is the mapping of all the submerged lands of Canada. Increasing degrees of detail are available through multibeam and sidescan sonar, seismic surveys, and video and bottom sampling. The mapping efforts in Canada's marine areas were originally based on the needs of safety of navigation. This is still an important issue but other requirements have emerged as well. These include marine geological processes and resources and national defense issues such as mine countermeasures and submarine warfare. The fishing industry has used new mapping information which permits them to reduce expenses, fuel consumption and habitat impact. Some of the new mapping capabilities were mobilized immediately after the Swissair crash and contributed greatly to locating the debris field.

SEAMAP objectives are to provide systematic mapping of bathymetry, sediments, habitat, and benthic communities of the sea floor; to provide basic information for decision making in areas of marine management and policy; and to form partnerships with industry to develop methodology and to complete surveys. (Many charts of remote areas of Canada have little or no sounding data and in some cases data are more than 100 years old).

A recently completed survey using multibeam and sidescan sonar provides an example of SEAMAP's potential. Through this survey a vast amount of highly detailed data on bathymetry was acquired. Analysis of backscatter provided indications of the texture or composition of the seafloor which was matched to surficial sediments. The resulting information was used by scallop draggers to place their fishing effort precisely on bottom areas most appropriate for scallops. They achieved a 2/3 reduction in their fishing effort with large savings in energy and significantly reduced habitat impacts through use of lighter gear and far fewer hours of dragging.

In summary, the technology and user community for SEAMAP exists today; improved data and information is needed now for many applications, and enhancing technologies are being developed. Accessible seabed images are essential as a base for informed decision-making.

In the discussion it was noted that costs (per unit area) are highly variable depending on area and depth surveyed as well as the degree of detail (amount of additional ground truthing, sidescan, etc.), type of hardware (e.g. multibeam), and bottom sampling intensity needed. Mapping of Stellwagen Bank has cost about \$4KK US for about 1000 km^2.

Marine Protected Areas (MPAs) and Habitat Impacts

Canadian MPAs

Presenter: Joe Arbour
Rapporteur: Paul Fanning

Joe Arbour reviewed recent developments with respect to MPAs for Canada. The 1997 Oceans Act has been the driving impetus behind introducing MPAs as ocean management tools. Over the last few years, DFO has focused on a process of MPA identification, which involves a combination of scientifically - based criteria and stakeholder input. The first phase in this process has been the identification of areas of interest (AOIs), which is a short list of areas that could become MPAs but need closer examination. AOIs currently extend across Canada and now the hard work of deciding which of these are to become MPAs is at hand. Three AOIs mentioned in the Maritimes include the Musquash AOI (an estuarine ecosystem), the Sable Gully AOI (an offshore submarine canyon) and the Bay of Fundy AOI (part of the Gulf of Maine complex of marine ecosystems). In the Gulf of Maine area, there are a number of opportunities for a collaborative USA/Canada MPA approach. However, this would require a jointly agreed-on approach to be effective. This is potentially a very useful area for joint work.

In the ensuing discussion, it was pointed out that as part of the Eastern Scotian Shelf Integrated Management (ESSIM) project, a project has been initiated to first define the benthic ecosystem types in the project area, and then to identify 10 percent of each type for special protection. This raised the issue of benthic classification. It was felt important that both countries use at least similar classification schemes in order to avoid confusion on area designations. As a first step, it was recommended that USA scientists be invited to participate in the ESSIM benthic classification initiative.

The question was raised as to how stakeholders have responded to the MPA initiative. While there has been some resistance, there is a general recognition of the importance of safeguarding habitat from all human activities (fishing, mining, oil & gas, etc). In this respect, progress has been made.

USA MPAs

Presenter: Brad Barr
Rapporteur: Steve Clark

Brad Barr gave a brief review of the status of MPAs in the Gulf of Maine (GOM) region. This is a very high activity area, contributing more than a dozen of the more than 50 major MPA-related initiatives currently ongoing in North America. The Gulf of Maine Council, which includes states, provinces, and both federal governments is approaching the subject in an ecosystem context and will be a major player in the future. Specific activities of note include (a) the GOM MPA Inventory, now being updated by the Center for Marine

Conservation (CMC); (b) the University of New Hampshire Gulf of Maine MPA initiative; (c) the Wild Seas Report by the Conservation Law Foundation, describing how the various units will function together as an ecological entity; and (d) current updating of the management plan for the Studds-Stellwagen Bank National Marine Sanctuary. Other possibilities for future action include a proposed GOM "ocean wilderness" along the Hague Line and a GOM Integrated Marine Protection Area (IMPAS) system which would tie together existing areas for protection in a logical framework. He stressed that GOM is a high priority area for MPAs and is a frequently cited example of what can be done.

He then reviewed President Clinton's Executive Order #13158, which was signed in May 2000. This order directs the Department of Commerce (DOC), the Department of the Interior (DOI) and other federal agencies to strengthen and expand the existing MPA system. Significant progress has already been made. An advisory committee has been selected and will initiate meetings in 2001; a website has been created (*http://www.mpa.gov*), and preliminary work has been initiated on an MPA inventory. An MPA Center has also been established which will develop and provide information to stakeholders; and an Institute for MPA Science (in Santa Cruz, CA) and an MPA Institute for Training and Technical Assistance (in Charleston, SC) have been established. Other agencies, e.g. the EPA, have supporting roles. This order is a significant development, which is expected to greatly enhance MPA programs in USA waters.

As a result of this meeting, NOAA and DFO have begun to develop plans for a workshop, to be held in autumn of 2001, to establish transboundary agreements on identification of ecosystem boundaries, strategies and methods for habitat characterization, and other related issues for the Gulf of Maine, Georges Bank, and Scotian Shelf areas. It will contribute to USA and Canadian efforts involving integrated management and MPA network design and management.

Trawling and Dredge Impact Studies

Presenter: Frank Almeida
Rapporteur: Jason Link

Frank Almeida provided a review of some recent US efforts to examine trawling/dredging impacts on Georges Bank closed areas and essential fish habitat (EFH). When EFH was described for the 59 species that the New England and Mid-Atlantic Fishery Management Councils regulate, virtually the entire continental shelf was designated EFH. Recently, all EFH designations have been overturned by the US court system; more clarity in defining EFH is required. Current NEFSC research has focused primarily on three closed areas: CA-I, CA-II, and the Nantucket Lightship CA. These areas were closed in December 1994 primarily to protect and allow for recovery of groundfish stocks but were re-opened to the scallop fishery for short periods during 1999 and 2000. There have been four research cruises into these areas conducted both before and after the open seasons with a broad group of collaborators. The main research objectives were to assess the recovery of the habitat after the cessation of dredging/trawling (from days to 5 years) and to quantify the impact of

scallop dredging on the bottom habitat after the open seasons. These cruises employed a variety of sampling methods, including video transects and still photographs, bottom grabs for benthos and chemistry, hydrography, fish trawls, and sidescan sonar. Much of the data and samples are still being processed but one main conclusion is that habitat type is one of the biggest factors determining both impact and recovery times from dredging/trawling.

Working Group Reports

<u>Assessment Methods and Modeling</u>

Participants: Gerry Black, Jon Brodziak, Paul Fanning, Wendy Gabriel, Chris Legault, Pamela Mace, Ralph Mayo, Bob Mohn (Co-chair), Bob O'Boyle, Loretta O'Brien, Paul Rago (Co-chair), Gary Shepherd, Tim Smith

General Discussion:

Topics discussed ranged from specific, short term concerns to much broader philosophical issues. Spirited debates of the philosophical issues consumed most of the allotted time. While this reduced the number of topics that could be addressed, it provided a basis for important future interactions. A synthesis of these discussions is given below.

The dichotomy between data-based and model-based assessments served to focus much of the discussion. Data-based approaches may be characterized as the qualitative analysis of multiple time series of resource and fishery attributes. These attributes may be observed quantities (e.g., survey indices, catch data), derived quantities (survey-based estimates of Z), or model estimates (e.g., F, SSB etc.). The underlying motivation for such approaches is the synthesis of disparate pieces of information into a coherent picture of stock status. For example, the traffic light approach is data-based analysis while the ASPIC analysis would be model-based. Regardless of whether formal modeling approaches are sufficient to identify stock status, data-based methods have been proposed as a way of visually depicting important attributes for management decisions.   Data that may not be incorporated in the formal assessment model can be introduced to complement the deductions of model-based approaches.

It was noted that all data are interpreted via some model and it is important to consider each time series carefully before ascribing a value to a given data point. This is of particular importance in data-based approaches. Examples include the average size or age of a population over time, changes in condition factors and so forth. A small average size may be "good" if it reflects a rapidly recovering stock dominated by recent strong year classes. Alternatively, high fishing mortality that removes larger individuals can also generate the same result but the same value would be "bad". Thus the qualitative assignment of value must also include alternative hypotheses that could generate the same result.

The group also noted that use of indicator variables could improve communication with user groups. Fishing mortality rates and SSB are abstract derived quantities, whereas average size, low catch per tow, or thin fish are observable quantities. By using a suite of such measures it is possible to translate theoretical constructs into practical measurements that are well understood. Nonetheless it is imperative that interpretations of index data are based on a sound underlying theory.

The use of index measures to detect an "altered" state also implies that a "normal" state can be specified. When measures of normal conditions are dependent on historical data (e.g., using quantiles of data) the problem of a moving baseline becomes an important consideration. Additional years of data will generally improve our ability to interpret historical trends but it may also alter decision thresholds. The working group noted that the interpretation and analysis of index data might be facilitated by drawing upon theory from other disciplines, notably decision theory. Examples include utility theory for multi-attribute data, statistical process control, and acceptance sampling. These approaches will probably be necessary before index methods become fully functional in fisheries management environments.

Index data complement more formal modeling approaches by providing a context for the evaluation of historical conditions. For example, data used in the fitting of more formal models may not cover the entire period of available catch or survey data. Hence index data can be used to extend the domain of inference to earlier time periods and prevent myopia associated with an attenuated data set for modeling.

The working group also noted that many contemporary models might oversimplify the richness of the underlying data. For example, concentration of landings in either space (e.g., inshore vs offshore) or time (within season) may be biologically important but not incorporated in most models. Errors induced by model mis-specification are tolerable when stock abundance is high, but become much more important when populations are reduced by overfishing or other causes.

With respect to model selection, a number of formal approaches have been applied beyond the contemporary variety, including information-theoretic methods such as Akaike's Information Criterion (AIC) and various Bayesian approaches. Methods for model averaging may also be useful when one or more candidate models appear to fit the data equally well. It was noted that tuning indices should be checked for internal consistency before using them in model building.

More formal model building approaches are necessary for multi-index models such as ASPIC and especially VPA models like ADAPT. ADAPT and other VPA formulations rely on the assumption that catch at age is measured without error. Reductions in the quantity and quality of biological sampling, changes in discarding patterns, and changes in reporting systems have resulted in gradual degradation of the catch at age data for many USA assessments. (In contrast, catch data in Canada are probably improving as regulations and scientist involvement has increased.) In some instances statistical catch at age methods may

be more appropriate for stock assessment; but in all instances, the variability in estimates of catch at age should be considered. Collectively, the group favored parsimonious models but it was noted that the more highly parameterized models provide more explicit depictions of underlying processes.

The Working Group noted that many of the ideas discussed were conceptual and long range. At a more pragmatic level it was recognized that much could be facilitated by simply exchanging existing software and data visualization packages used in assessments. The Fisheries Assessment Computation Toolbox (FACT) will be distributed to Canadian colleagues and the ACON package for modeling and graphics has been distributed to USA scientists. Access to the Virtual Data Center by USA scientists will occur as soon as technical problems of external access to the DFO local area network have been resolved.

Participants proposed the formation of a Methods Review Group. This proposal recognizes the commonality of existing assessment issues between the Atlantic labs in both countries and the reliance on common types of data. The Group also recognized that existing review processes are not an efficient way of providing sound critiques of new methodology, since technical details of stock assessment, tight schedules and lack of critical mass often impede the review, dissemination and implementation of new methods. A methods review group could examine issues more thoroughly and apart from the provision of management advice. The methods review group would initially be a bilateral group and address pressing "local" concerns in an informal working environment. Later, if the work is productive, it is anticipated that the group would expand its remit and geographic range. The group would also provide quality assurance and control and would facilitate incorporation of ecosystem models into stock assessments.

The first meeting of the Methods Review Group would take place in 2001 and terms of reference will be a necessary precursor. The list of candidate topics is large but a meeting to specifically address index based methodology might provide timely input to current management needs. Other issues might be the application of formal model building processes to assessments, or the implications of stock rebuilding for VPA model formulation (e.g., influence of closed areas, use of plus groups, "dome-shaped" partial recruitment patterns, etc.)

Recommendations:

1. **Continue exchange of software programs currently in use (e.g., ACON) and under development (FACT), and provide access to data visualization software such as the Virtual Data Center.**

2. **Form a bilateral Methods Review Group in 2001 to evaluate and review methodology related to stock assessments. Candidate topics for initial review include index-based qualitative assessments, model building strategies, and selected VPA topics.**

3. The bilateral Methods Review Group should meet once in 2001 to review the efficacy of such a group and its products, and to advise on establishment of a permanent working group.

Plenary Discussion:

Participants supported the concept of a group to explore these and other related issues, in a free thinking environment. It was noted that there is a SARC Assessment WG but it has not been active; and a similar Canadian body has also been moribund. ICES has a Methods WG, but there was general sentiment for an independent initiative. It was agreed that this Working Group on Assessment Methods would provide the initial focus for discussion on assessment techniques. It would be a 'bottom - up' driven group which would meet sometime within the year. It was noted that the TAWG is tentatively planning to meet in September 2001. The group could meet in conjunction with this meeting.

Terms of Reference for the Group are as follows:

1. Evaluate the use of index measures of abundance and resource status for the assessment of fishery resources. Focus on the use of ranking scale measurements and visualization techniques and their utility for communicating assessment results. Consider applicability of multi-attribute decision theory.

2. Compare and contrast current methodologies used in USA and Canadian versions of ADAPT and recommend modifications to existing software as appropriate.

3. Review diagnostic methods and model-building approaches for sequential population analysis and recommend further work.

Marine Mammals and Turtles

Participants: Kathryn Bisack, Phil Clapham, Tim Cole, Jerry Conway, Harold Foster, Richard Merrick (co-chair), David Potter, Richard Pace, Janeen Quintal, Marjorie Rossman, Cheryl Ryder, Fred Serchuk, Tim Smith, Gary Stenson, Wayne Stobo (co-chair), Gordon Waring

Canadian representatives were from DFO, Maritimes (Conway and Stobo) and Newfoundland (Stenson). Other DFO invitees from Quebec (Hammill) and Nova Scotia (Bowen) were unable to attend due to fieldwork commitments. USA participants were from the NEFSC, Resource Evaluation and Assessment Division and the Protected Species Branch.

Discussion and Recommendations:

The morning session was devoted to a discussion of the organization of protected species-related activities within the NMFS (focusing on the NE Region), and at DFO (including contemplated changes under SARA). DFO activities have been heavily impacted by the overall program review in the mid-1990s. Implementation of an expanded Protected Species responsibility under SARA or its final derivatives will have equally profound impacts; in many ways, similar to those within NMFS resulting from 1994 amendments to the MMPA. Each of the DFO Regional offices is expected to add:

      a. Two staff members to "Science" to deal with SARA sciences issues (especially small and large cetaceans); and
      b. Up to three staff to "Science" or "Fisheries Management" (varying by Region) to support the management component of SARA.

The organization of DFO for protected species will be remarkably like that at NMFS. One difference is that permitting of science activities will be from the Regional SARA offices, rather than from a national office.

Funding will also change. Under this new regime funding for new staff will be available immediately. Additional funds will then be available competitively, which can be used to fund staff, field work or additional programs (increasing from $3.5M at present to $12.5M in 5 years). Funds will also be available for some projects under the Habitat Stewardship Fund, though these funds are not meant for "science" and require a 50% match.

Science practiced by the DFO and NEFSC groups are similar in some ways (both focus on abundance estimation), and dissimilar in others (DFO staff focus heavily on ecological issues, while the NEFSC focuses on mortality estimation and bycatch reduction).

Marine Turtles

The USA longline fishery on the Grand Banks was closed during October 10, 2000 through April 9, 2001 as a result of takes of leatherback and loggerhead turtles. NMFS is now developing a revised set of Reasonable and Prudent Alternatives (RPAs) as part of the ESA Section 7 review of the USA fishery. A workshop was held with USA fishers to attempt to develop a list of gear modifications that would serve as RPAs. Similar changes may be useful in the Canadian fishery. A meeting will be hosted by DFO in March to consider this issue.

Data are collected on marine mammal and turtle bycatch in various USA and Canadian fisheries, although differences in types of data collected and methods used exist. It would facilitate communication of bycatch results and data usage if data collection were standardized. **The group recommended that NEFSC and DFO staff in the Maritimes and Newfoundland Regions collaborate to address this issue.**

The USA is initiating a leatherback turtle disentanglement network. Similar efforts may begin in Canada. **The group recommended that the NMFS and other USA participants in this network coordinate their efforts with their Canadian counterparts.**

Harbor Porpoise

Gillnet fishery takes for the Bay of Fundy/Gulf of Maine stock of harbor porpoise have been reduced below PBR. This is due partly to the Harbor Porpoise Take Reduction Plan, and partly to changes in the commercial fishery. Results from the 1999 NEFSC abundance survey indicate that the population is stable or increasing, thus increasing PBR. Issues remain, however, on stock identification and abundance for other stocks. These appear to be important issues for both DFO and NMFS. **The group recommended that the two agencies collaborate on additional stock identification studies and on abundance surveys.**

Specifically, the NEFSC invited DFO participation in its summer 2001 survey. This will provide field training for DFO's new cetacean biologists. Further, NMFS and DFO should coordinate harbor porpoise surveys planned for summer 2002 or 2003, if these surveys are funded. NMFS will participate in the DFO workshop on harbor porpoise biology planned for Halifax in March 2001. Should DFO hold a second workshop later in 2001 on survey methods, NMFS would be willing to participate if requested to do so.

DFO expects to continue its experiments with reflective nets as a means for reducing harbor porpoise bycatch during summer 2001 in the Bay of Fundy. The NEFSC expects to begin experimental work with these nets in 2001-2002 in New England waters. Continued Canadian work and collaboration in this area was encouraged.

NEFSC staff agreed to provide reprints of various manuscripts on bycatch estimation to their DFO counterparts.

Large Whales

The status of large whales in USA waters and of the Atlantic Large Whale Take Reduction Plan was reviewed, as well as the roles of the ESA related NE and SE Implementation Teams. The group then discussed the various surveys being used to support large whale take reduction in the Bay of Fundy and in USA waters. The use of zooplankton data to focus aerial surveys was also discussed, and the NEFSC agreed to provide data to DFO on prey distribution in the Roseway Basin and elsewhere.

The difficulties of photo-identification were considered, which led to discussion of various forms of automated pattern recognition. It was suggested that these procedures and available software be further researched.

USA and Canadian protective measures were discussed. DFO pointed out that lobster gear is not a significant source of right whale interactions in the Bay of Fundy (BOF) as the area is closed to lobster fishing from April to November. Gillnet gear could continue to be a problem.

Disentanglement gear caches will soon be in place on both sides of the BOF, which will allow quick response to entangled large whales. Fisheries officers in the BOF area have all had Level 1 training for disentanglement, and it is possible that two Fishery Officers will be designated solely to respond to right whale events.

The collection of data on entanglements, serious injuries, and mortalities will be discussed further on a staff to staff level; and NEFSC will provide materials and data sheets currently being used by the USA for collection of these data to DFO. The NEFSC will also provide copies of the report from the NMFS workshop on defining serious injuries, and will also work with the Canadian stranding network to standardize data collection procedures.

Peer Review of Science

DFO has historically participated in an ex-officio capacity on NEFSC Take Reduction Teams and on the Atlantic Scientific Review Group. **The group recommended that this relationship continue and perhaps be expanded.**

The group also recommended that NMFS and DFO consider a joint meeting of the two nations' marine mammal scientific review groups.

Next Steps

The group recommended another meeting in either November 2001 or February 2002. This meeting could also include planning for the 2002 joint harbor porpoise survey. The

NEFSC extended an invitation for new DFO staff to visit the Center to exchange ideas and to explore the data available on marine mammals and turtles in Canadian waters.

Plenary Discussion:

It was asked whether listing criteria had been discussed. The ESA has no criteria and Canadian COSEWIC criteria appear inappropriate for marine resources. The PBR provisions of MMPA appear to be the most useful ones at present for quantifying impacts of takes. It was noted that, as many of these resources are transboundary, PBR would need to be allocated between both nations. It is therefore important to have agreed-on criteria. It was recommended that this issue be discussed further to coordinate with current discussions of listing criteria for marine species occurring within the IUCN, CITES, and the ESA community.

There was only limited discussion on joint work on seals, but interactions have been occurring between the two countries at a high level for some time, and will continue.

It was recommended that the USA and Canada collaborate more closely on monitoring ship traffic in the Gulf of Maine, to be better prepared for International Maritime Organization action.

Groundfish Distribution and Stock Structure

Participants: Steve Cadrin (co-chair), Don Clark (co-chair), Joe Hunt, Steve Murawski, John Neilson, Stacy Paul, Mark Soboil, Kathy Sosebee, Sue Wigley.

General Discussion and Recommendations:

The Working Group focused on general stock ID issues for principal transboundary groundfish resources (i.e., those currently assessed through the Transboundary Resources Assessment Committee (TRAC) process: cod, haddock and yellowtail) and secondary groundfish resources as determined by the expertise in the group. Many other transboundary groundfish resources were not discussed due to time restrictions.

Introductory statements identified the need to consider many aspects of stock structure such as movements, geographic variation, and environmental signals to evaluate the suitability of current management units for conserving spawning components and optimizing yield. Stock identification studies for many species-stocks in the region are transboundary in nature, and will require close cooperation between Canada and the U.S. to insure their ultimate success.

One recurring theme was the need for updated summaries of stock structure information. Perhaps the most valuable source for transboundary groundfish is a Canadian report of a 1986 workshop (CAFSAC Res. Doc. 87/21). However, many specific contributions and advances in stock identification methodology have been made since that workshop.

Participants agreed that management areas should be re-evaluated through cooperative Canada-USA workshops to draw on specific expertise from both countries and to promote consistent evaluations. The group felt that a series of iterative workshops might be required to achieve successive goals. A diverse scope for workshops, including pelagic, invertebrate and marine mammal species may strengthen the ability to develop effective evaluations.

Recommendation #1: Establish a Steering Committee to organize cooperative workshops on stock structure of transboundary resources. The Steering Committee, comprising experts on stock identification from Canada and the USA, should establish a time frame, and facilitate a series of workshops. A series of goals should be considered for successive workshops, such as 1) development of approved criteria for stock identification decisions, 2) summarization and dissemination of information in the form of review papers authored by species experts from both countries, 3) application of approved criteria to comprehensive summaries for consistent conclusions on stock structure of transboundary resources, and 4) development of cooperative research priorities.

The group considered tagging studies to be of primary importance, because adequate observations on movements are lacking for most stocks. Conducting tagging studies through binational efforts will greatly increase the power of tagging studies for transboundary resources. Simultaneous tagging of fish in all areas where returns are expected, and cooperation of fishermen from both countries will reduce the effect of reporting bias. Expanding cooperative tagging research to multiple species may also lend efficiency. However, each species presents slightly different problems and may require unique considerations.

Recommendation #2: Consider expanding cooperative tagging studies to include multiple species.

Distributional analyses provide another primary source of information for stock identification decisions. The development of geographic information systems and advances in quantitative techniques for describing spatial distributions greatly expand the capacity of distributional studies for contributing to stock structure research. For some groundfish species, stock identification information is lacking and decisions may be based solely on distribution patterns. However, most distributional studies are currently limited to the spatial extent of national research surveys. For many species with continuous distributions across survey areas, distributional analyses should include survey data from both countries.

Recommendation #3: Allow easy access of survey data to researchers from both countries.

Specific Discussions and Recommendations:

Cod - Participants reviewed developments in cod stock structure research including proposals for tagging work through the DFO Strategic Research Program and NMFS

cooperative work with the fishing industry. The Group concluded that such proposals should be coordinated to maximize returns and minimize bias.

Recommendation #4: Coordinate national tagging initiatives for cod so that design features are complementary and results can be easily compared and combined.

The group also discussed the need to consider current management restrictions in the interpretation of tag returns. Trip limits and rolling area closures may affect return patterns. The need to implement mechanisms of recapturing tagged fish within closed areas was discussed.

Yellowtail flounder - Recent progress in studying yellowtail stock structure was reported, including a brief summary of DFO tag returns on Georges Bank and USA MARFIN research on genetic and phenotypic patterns. While information to date suggests only localized movements in comparison to other groundfish, yellowtail tagging studies are needed to address smaller-scale issues e.g. quantifying movements from the "yellowtail hole" to other portions of Georges Bank, movements from Closed Area II, and ontogenetic movements in the Cape Cod area.

Recommendation #5: Coordinate tagging initiatives for yellowtail to ensure adequate reporting rates from all fisheries.

Considering the small scale of yellowtail tag recaptures, mixing of early life history stages may be more important for identifying self-sustaining geographic groups. The approach used in the GLOBEC project for understanding the dynamics of gadid eggs and larvae may be also valuable for yellowtail research. However, models and field sampling would require modification to account for later spawning of yellowtail as compared to cod and haddock.

Recommendation #6: Investigate application of GLOBEC models for studying dispersion of yellowtail eggs and larvae.

Haddock - Recent research developments were reviewed, including genetic sampling and ongoing microconstituent work. It was noted that a recent publication (Begg 1998; Marine Fisheries Review) summarizes historical and recent research and may provide a model for review papers for the recommended cooperative workshops. Recent DFO tagging efforts confirm earlier observations of low survival of tagged haddock. Perhaps alternative capture techniques could increase survival. Failing this, distributional studies may be the most fruitful approach to studying haddock stock structure.

Recommendation #7: Explore spatial patterns of haddock distribution over time using quantitative geostatistical techniques.

Witch flounder - In contrast to cod, haddock and yellowtail, witch flounder presents a more "data-poor" resource with respect to stock identification studies. There have been technical recommendations to include Scotian Shelf data in the USA assessment. Similarly, Canadian

assessments have considered including Gulf of St. Lawrence data in the Scotian Shelf (4VWX) assessments. The extremely long pelagic stage of witch ichthyoplankton suggests large-scale dispersal. The most effective approach to witch flounder stock identification may be a cooperative, broadscale distributional analysis.

Recommendation #8: Explore wide-scale spatial patterns of witch flounder distribution using U.S. and Canadian survey data.

White Hake - Again, little stock structure information is available. Although resources are assessed in separate jurisdictions, white hake are continuously distributed from the Gulf of Maine to the Scotian Shelf. Based on a comparison of length samples from the Scotian Shelf and the USA age-based assessment, there appear to have been coincident recent recruitment events.

Recommendation #9: Develop an exchange of data or otoliths to investigate age structure of white hake on the Scotian Shelf.

Atlantic Halibut - The rarity of halibut eggs in USA and Canadian ichthyoplankton surveys suggests spawning in deep water. It appears that the USA resource is a fringe of a much larger population. Participants felt that advances in assessing Canadian halibut resources should be applied to the USA resource.

Recommendation #10: Develop a commercial hook survey of the USA halibut resource in cooperation with U.S. fishermen to complement Canadian surveys.

Redfish - The pattern of a relatively abrupt increase in abundance of redfish at many ages in the Gulf of Maine suggests large-scale movement among areas.

Recommendation #11: Explore wide-scale spatial patterns of redfish distribution using Canadian and USA survey data.

Pollock - The difference in management units between Canada and the USA was noted. The group agreed that DFO and NMFS should consider cooperative assessments of pollock.

Recommendation #12: Cooperative research should be continued, perhaps as a precursor to more formal assessments for review through the TRAC process.

Plenary Discussion:

The list of topics discussed by the WG was reviewed. It was recommended that the priorities of the recommendations be clearly outlined in the proceedings. There was agreement that work on cod, haddock and yellowtail is of high priority, although work on all species in the transboundary area is ultimately needed.

There was a question on the accessibility of the 1987 CAFSAC Research Document on stock structure. R. O'Boyle agreed to have it scanned and placed on the Maritimes RAP Website.

There was a question on the reporting relationship of the Steering Committee. It will report to the TRAC, which in turn reports to the line managers of each country.

There was some discussion of Recommendation #3, relative to access to the raw data of each country. It was noted that Canadian scientists now have routine access to USA survey data and that the reverse is possible through the website for Canadian data.

Atlantic Herring

Participants: Matt Cieri, Mike Jech, David Libby, Gary Melvin (co-chair),
                 Bill Michaels, Bill Overholtz (co-chair)

General Discussion and Recommendations:

2002 Assessment: Herring in the Gulf of Maine-Georges Bank region will be assessed as a complex within the 2002 TRAC process. However, there will be some attempts to disaggregate the components by area by some of the methods used in previous assessments and by hydroacoustics results.

Data Issues: Commercial sampling and timing for assembling the 2001 catch at age were reviewed. Samples, landings and catch at age for the USA will be completed by the State of Maine. Landings reporting for the USA is via a phone-in system and biological sampling is relatively good. Canada has very detailed dockside sampling of landings with all ports and fleet components being sampled. The DFO will provide Canadian catch at age for the 2002 assessment. The State of Maine has reviewed sampling back to 1960 and will complete a historical revision of the USA catch at age, possibly in time for the 2002 assessment. The New Brunswick weir fishery will be included in the 2002 assessment, but recent Canadian tagging information suggests that the appropriateness of including this may have to be reviewed in the future.

Assessment Models and Methods: The current assessment is a VPA tuned with USA spring and winter bottom trawl survey data. It is a low precision assessment with some retrospective problems, but is at present considered to be the best available approach. Log-transformed survey indices will be investigated as tuning indices. The USA has completed several surplus production (ASPIC) analyses, which will be reviewed prior to the 2002 assessment. In addition, several biomass-based models, *e.g.* DeLury, Delay Difference, or Bayesian models will also be tested for their applicability prior to the 2002 assessment. The State of Maine will update a VPA for the Gulf of Maine component.

Recommendation # 1: It was agreed that the group would try to have an interim meeting sometime in late 2001 to review model results and other issues prior to the TAWG meeting in 2002.

Hydroacoustics Issues: The USA will continue to survey offshore spawning concentrations of herring on Georges Bank during autumn, and a cooperative hydroacoustics survey is planned on the Bank with Canada in October 2001. As well, the USA will be doing cooperative analysis work with Dr. Pat Sullivan from Cornell University. This work will focus on a geostatistics-based modeling approach for analysis of acoustics data. Additional work currently being conducted by The Maine Aquarium Development Corporation in Maine inshore waters was also discussed. Hydroacoustic estimates of abundance and biomass will be included in the 2002 assessment as well as attempts at using acoustics results to tune or anchor terminal year biomass estimates.

Recommendation #2: A coordinated joint herring hydroacoustics survey, conducted with vessels from both countries, will be completed in early October 2001.

Predation Mortality: Recent work in the USA indicates that herring are important in the diets of many predatory fish, including cod, spiny dogfish, white hake, and silver hake. Herring consumption has been quantified for the major predatory fishes during 1977-1998 and work on M2s at age has progressed. Predatory fish diets follow herring abundance fairly well and predation estimates could be included in the catch-at-age matrix for 1977-2002.

Recommendation #3: The group agreed that including some information and at least some qualitative advice on the impact of predation on assessment results should be included in the 2002 assessment.

Plenary Discussion:

The question was raised as to stock structure assumptions for the 2002 assessment. The response was that the assessment would be of the complex (Georges Bank, Nantucket Shoals and Gulf of Maine). Questions were also asked relative to stock associations of the NB weir fishery, and the reponse was that status quo associations would be assumed. It was pointed out that until now, the joint assessment has been delayed due in part to differing views in Canada and the USA on stock structure. The next assessment should include a review of the components within the complex. Given that the complex is being assessed for Canadian management purposes as well, the Georges Bank component would need to be identified via acoustics, egg and larval and/or bottom trawl surveys.

There was discussion on the recommendation for a joint USA/Canada meeting in autumn of 2001 to review modeling approaches and related issues. It was suggested that this could be conducted as part of the fall TAWG, the exact timing of which needs to be established.

Concerns were raised on statistical aspects of the acoustic survey. There has been substantial communication between USA and Canadian scientists on acoustics, which will continue.

However, joint survey work may not be possible in autumn of 2001 due to funding problems in Canada.

Sea Scallops

Participants: Christina Annand, Dvora Hart (co-chair), Larry Jacobson, John Quinlan, Ginette Robert, Stephen Smith (co-chair)

General Discussion:

Recruitment: The 1996 and 1998 year-classes have been observed as being strong on both sides of the ICJ line. In particular, the 1998 year class has also been observed as being the strongest in years on Georges Bank and in the Bay of Fundy and approaches. While there may be a relationship between higher scallop spawning stock biomass in the closed areas and recruitment on the American side of Georges Bank, there is little evidence of a stock-recruitment relationship on the Canadian side or in the Bay of Fundy. Environmental factors that may be driving these strong year classes have not been studied in detail and more work will be directed to this area.

Growth: Research has shown that there are demonstrable spatial and temporal changes in growth. Studies on both sides of the ICJ line have shown that the strong 1996 and 1998 year-classes have grown faster than expected. In fact, the 1996 year class appeared to be one year older than expected in 1999 based upon historical growth models. Canadian stock assessments have reported that all animals exhibited larger meat weights at size in 1999 than has been observed in the past. Unfortunately, there were no American observations of meat weights to compare with.

Spatial patterns in catch rates: American and Canadian scallop vessels are required to carry vessel monitoring systems (VMS) and participants were able to compare temporal/spatial patterns of fishing and catch rates of scallop vessels on their respective grounds. The American example was particularly interesting in that it showed the interaction between market price, meat weight size and density with the location, intensity and spatial distribution of fishing. These interactions make it difficult to evaluate catch-rate trends in terms of changes in abundance.

Population models: There is a pressing need on both sides of the border to develop a population model for scallops that incorporates the spatial/temporal variability in growth and fishing mortality. It is very important to take this information into account when defining recruits by shell height ranges and predicting meat weight yields.

Reference points: There is a need on both sides of the border to define reference points and overfishing in a way that takes into account the spatial nature of these populations. Current definitions were developed based on finfish population dynamics and are not suitable for scallops. In addition, closed area management on the American side creates special

complications. At this time a project proposal has been submitted to DFO's Strategic Science Fund for an international workshop in 2001/2002 on developing reference points for sessile and sedentary invertebrates.

Recommendations

1. Conduct a joint project to evaluate recent recruitment on Georges Bank and the Bay of Fundy in terms of stock-recruitment relationships and environmental factors. This evaluation has to be done with data from both sides of the ICJ line. In addition, data and results from GLOBEC will be used to describe larval transport.

2. Conduct a joint project to develop population models that incorporate spatial patterns in growth, recruitment and fishing mortality.

Plenary Discussion:

There was discussion on recruitment estimates from US RV surveys in relation to measured eggs/tow data. This led to discussion on the 1998 year class, which is the largest and most widespread ever observed. It is not apparent what has caused this major event. It was queried as to whether or not the strong year-classes observed in the Gulf of Maine area have also been seen further south; some have, but not all. Evidently, this is a fruitful area for further research. Questions were also raised on ageing research, focusing on the relative differences of growth increments between open and closed areas.

With respect to management, the impact of closed areas was discussed and the efficacy of refugia considered.

TRAC Process and Peer Review

Participants: Chris Annand, Steve Clark, Ralph Mayo, Bob O'Boyle, Loretta O'Brien

An ad-hoc meeting was held to further explore issues relating to the TRAC process. Overall, there was a desire to involve external experts in the technical peer review, separate from public discussion on interpretation and communication of assessment results. The Transboundary Assessment Working group (TAWG) would conduct benchmark evaluations intersessionally i.e. outside of the management cycle. The benchmarks would focus on ensuring that the assessment models are the most appropriate. Canadian and USA scientists, along with the external experts, would work in a workshop environment to conduct the benchmark assessments. The TAWG would subsequently update the benchmark with the latest data to provide annual advice as part of the management cycle; and the TRAC would review the status reports without getting into 'reruns'. It would also define when benchmarks would need to be done. In essence, the majority of the technical peer review would be undertaken in the TAWG, the activities of which would be overseen by the TRAC, analogous to peer review structures elsewhere (ICES, CAFSAC).

TRAC planning for April 2001 included updates of the five Canadian and USA management units, critical review of the methods used to calculate biological reference points, and proposed changes to the TRAC process. If accepted, benchmark assessments would be planned for cod and possibly Atlantic herring in autumn of 2001. Then, in 2002, assessment updates for cod, haddock, yellowtail and herring assessments would be completed and peer-reviewed.

Plenary Discussion:

It was noted that a benchmark assessment on herring in the autumn of 2001 may not be possible due to time limitations. However, it was agreed that it would be appropriate to do the cod and herring benchmarks through the TAWG.

There was general acceptance that the detailed peer review could be performed by the TAWG. However, it was not clear what level of peer review assessment updates would receive. The proposal appeared to indicate none. There was strong sentiment that the updates need to be peer reviewed. Indeed, there was concern that the proposal overall did not meet the standards of peer review, i.e. one independent team reviewing the results of another team. These concerns were duly noted and it was agreed that a new proposal, which addressed these concerns, would be prepared and presented at the April 2001 TRAC.

Appendix I

AGENDA
14th Canada-USA Scientific Discussions
Meigs Room, SWOPE Center
22 - 25 January 2001

Monday January 22

Introduction and Overview

13:00 - 13:15 Welcome & approval of agenda (S. Clark, O'Boyle)

13:15 - 13:45 Current organization; DFO, NMFS (Scattolon, S. Clark)

13:45 - 14:45 Legislative mandates   (Legislation and current activities)

- Oceans Act (Scattolon) - 30 min
- SFA, current FMP amendments (Mace, Mayo) - 30 min

14:45 - 15:00 BREAK

15:00 - 16:00 Legislative mandates (cont'd)

- SARA (Conway) - 30 min
- ESA, MMPA (Merrick) - 30 min

16:00 - 17:00 Management processes & initiatives

- Canada: Objective-based management/Precautionary Approach (Annand) - 30 min
- USA: SARC and relevant issues (T. Smith) - 30 min

17:30 -   Pre-dinner Social   (SWOPE Center)

Tuesday January 23

Single Species Science and Future Cooperative Research

08:30 - 09:00 National Stock Assessment Review / TRAC and peer review (O'Boyle)

09:00 - 10:00 Government survey programs

- Canada: bottom trawl surveys (Hunt) - 15 min

Appendix I (contd.)

- Canada: hydroacoustics (Melvin) - 15 min
- USA Overview (Azarovitz): hydroacoustics (Jech, Michaels), FSCS (Despres) - 30 min

10:00 - 10:15 BREAK

10:15 - 11:15 Joint projects with industry

- Canada (Fanning/Smith) - 30 min
- USA (Murawski) - 30 min

11:15 - 11:45 Databases / web-enabled data display (Black)

11:45 - 12:00 Pollock ageing/tagging project (Neilson)

12:00 - 13:00 LUNCH

13:00 - 14:00 Assessment models and software

- Canada: Traffic Light (Mohn, Fanning) - 30 min
- USA: Toolbox, other developments (Rago) - 30 min

14:00 - 14:30 Groundfish distribution / stock structure (Murawski, D. Clark)

14:30 - 15:00 Stock definition research for transboundary mammals (Waring, Potter)

15:00 - 15:15   BREAK

Ecosystems-based Management and Future Cooperative Research

15:15 - 16:15 Ecosystems-based management

- Canadian initiatives (Arbour) -30 min
- USA initiatives (Mace) - 30 min

16:15 - 17:15 Ecosystem Models

- Canada: Scotian Shelf Initiative (Fanning) - 30 min
- USA: (Georges Bank modeling initiatives (Fogarty) - 30 min

Appendix I (contd.)

Wednesday January 24

08:30 - 09:00   Fisheries Oceanography-GLOBEC progress (Mountain)

09:00 - 0930   Early life history modeling (D. Brickman)

09:30 - 10:00   SEAMAP (MacDougall)

10:00 - 10:15   BREAK

10:15 - 11:15   MPAs and habitat impacts

- Canada: MPAs (Arbour) - 15 min
- USA: MPAs (Barr) - 15 min
- USA: Trawling and dredge impact studies (Almeida) - 30 min

11:15 - 12:00   Directions to working groups

12:00 - 13:00   LUNCH

13:00 - 17:00   Working group discussions

- Assessment methods (Mohn, Rago)

- Protected species; right whales, harbor porpoise, turtles (Merrick, Stobo)

- Groundfish distribution & stock structure (Murawski, D. Clark)

- Atlantic herring (Overholtz, Melvin)

- Sea scallops (Smith, Hart)

Thursday January 25

Meeting Wrap-up

08:30 - 10:30   Plenary presentation of working group reports

10:45 - 12:00   Plenary presentation of rapporteur reports

12:00   Adjournment

Appendix II. List of Participants.

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This report's publication history is as follows: manuscript submitted for review -- April 10, 2001; manuscript accepted through technical review -- April 26, 2001; manuscript accepted through policy review -- May 1, 2001; and camera-ready copy submitted for publication -- May 14, 2001. This report may be cited as:

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