# HAKE 2010

## INTERNATIONAL SYMPOSIUM ON THE BIOLOGY, HARVESTING, MANAGEMENT & CONSERVATION OF HAKES


11-12 MAY 2010

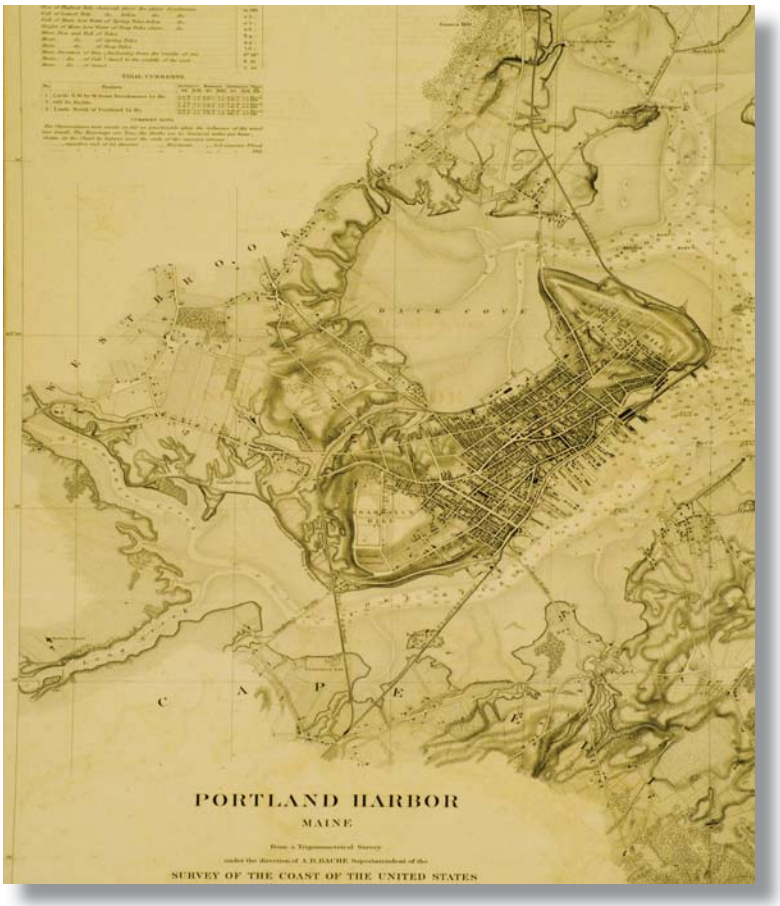
PORTLAND REGENCY HOTEL
PORTLAND, MAINE, USA

# HAKE 2010

## International Symposium on the Biology, Harvesting, Management & Conservation of Hakes

11 - 12 May 2010

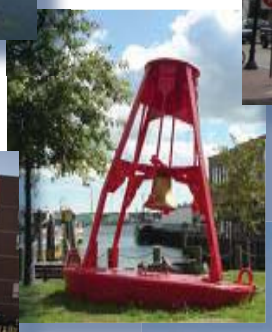
Portland Regency Hotel . Portland, ME USA



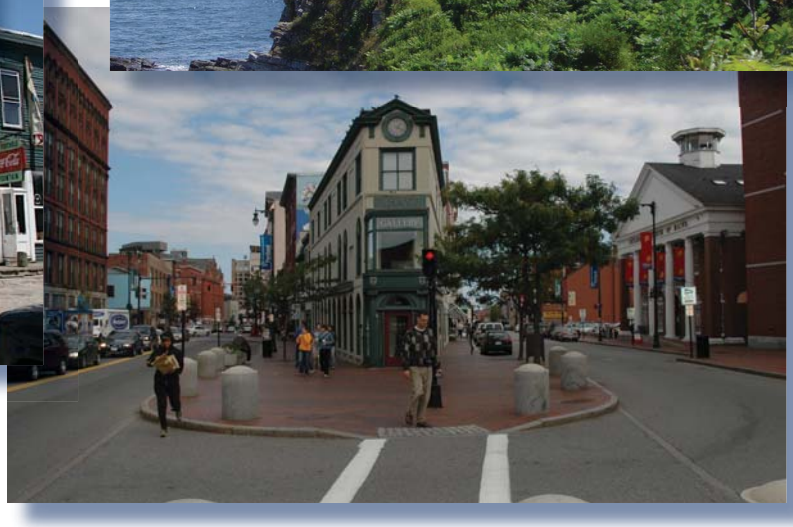

Northeast Consortium

NOAA National Oceanic and Atmospheric Administration U.S. Department of Commerce









Programme Designer and Editor
Laurinda Sousa Smith, Northeast Consortium
Ocean Process Analysis Laboratory, University of New Hampshire

Programme Cover Design
Kristi Donahue, Institute for the Study of Earth, Oceans and Space
University of New Hampshire

Photos provided by
Rachel Gallant Feeney, Chris Manning, Chris Glass, Claudio Estaban Gatica Molina, NOAA Fisheries, Portland Travel & Tourism

# Table of Contents

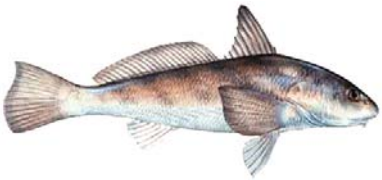
The codend is brought aboard a Chilean hake *(Merluccius gayi gayi)* trawler.
*Photo courtesy of Claudio Esteban Gatica Molina*

# HAKE 2010

## WELCOME TO THE SYMPOSIUM

INTERNATIONAL SYMPOSIUM
ON THE BIOLOGY, MANAGEMENT,
HARVESTING AND CONSERVATION OF HAKES

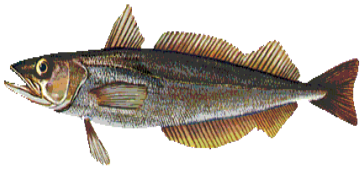
11-12 MAY 2010 - PORTLAND, MAINE USA



*Uropycis tenuis*

*Urophycis Chuss*

*Merluccius gayi gayi*



*Merluccius bilnearis*

*Merluccius merluccius*

### INTRODUCTION TO THE SYMPOSIUM

Welcome to Portland and to the International Symposium, Hake 2010: Biology, Management, Harvesting and Conservation of Hakes.

Hake species are important for the commercial fishing communities of the North-east U.S., and the North Atlantic; and as this symposium demonstrates, much of the worlds oceans. They are important not only as commercially exploited stocks but as vital elements of ecosystems both as predators and as prey. Even though the varied species have been the subject of scientific investigations for more than a century, there remains much to learn. Information on life history, ecology, harvest strategies, bycatch and discard, stock delineation and data available for stock assessment varies widely among hake species. Some of the primary fishery resources have been well studied, but others are considered data-poor.

The goal of this symposium is to synthesize the state of our knowledge regarding the biology, ecology and population dynamics of various hake species and to identify common patterns and themes. We will review management measures in place in different locations and will review the status of bycatch and discard including bycatch reduction and other conservation strategies related to sustainable fishing. Finally, we aim to make recommendations to guide future biological research, develop effective and selective harvest practices and strategies, and the advance hake stock assessments.

I consider it extremely appropriate that this meeting takes place here in Portland, Maine, a port city, as the name suggests, with a long and storied history of commercial fishing, seafood processing, shipping and shipbuilding. Portland continues to be a portal to the marine world with a vibrant fishing industry and more recently with a developing and increasingly influential, scientific research community.

The steering committee extends a very warm welcome to this special symposium. We thank you for all your many contributions and hope you enjoy your stay in the vibrant City of Portland.

Christopher Glass
On behalf of the Conveners and the Steering Committee

## Hake 2010 Steering Committee

Dr. Pingguo He, Chair - University of Massachusetts - Dartmouth

Dr. Christopher Glass, Chair - Northeast Consortium, University of New Hampshire

Dr. John Annala - Gulf of Maine Research Institute

Dr. Steven Cadrin - University of Massachusetts, Dartmouth & NOAA Fisheries

Capt. David Goethel - F/V Ellen Diane

Dr. Kenneth La Valley - NH Sea Grant College Program

Dr. David Pierce - Massachusetts Department of Marine Fisheries

Mr. Michael Pol - Massachusetts Department of Marine Fisheries

Ms. Laurinda Sousa Smith, Symposium Coordinator - Northeast Consortium

Special thanks to
Ms. Kathi Higgins, Research Assistant
Gulf of Maine Research Institute
for providing liaison with the Portland Regency

# Hake 2010 Keynote Speakers

## Dr. Tom Helser, Resource Ecologist - Alaska Fisheries Science Center, Seattle, WA

**After having received a Bachelor of Science degree in biology from the University of Wisconsin in 1982, Dr. Helser's career interest in fisheries was defined as a Peace Corps Volunteer in Nepal. Tom earned a Master of Science degree in Marine Fisheries from Auburn University in 1987 and a Ph.D. in Fisheries Oceanography from Louisiana State University in 1992, which subsequently lead to his career as a stock assessment scientist with NOAA Fisheries. Over the last 25 years he has conducted stock assessments and fisheries ecology studies on numerous marine and freshwater fish species, with major emphasis on hake stocks on both coasts of the U.S. His service to fisheries science has spanned both the academic and federal institutional arenas, holding Assistant and Adjunct Assistant Professorships and an appointment to Pacific Fishery Management Council's Scientific and Statistical Committee.**

**While Tom's research has been quite varied, the central theme is in quantitative modeling and statistical analysis and includes over 25 published, peer reviewed articles in bioeconomic modeling, stochastic population modeling, mixed effects models of life history parameters, and growth models using Bayesian hierarchical meta-analysis. He is currently the Program Director of the Age and Growth Laboratory in the Resource Ecology Division at the Alaska Fisheries Science Center in Seattle, WA. In addition to the production ageing of over 30,000 otoliths annually to support age structured stock assessments, the Program conducts studies in radiocarbon age validation, fisheries ecology using otolith microchemistry, and impacts of climate on fish growth.**

## Capt. David Goethel, Vessel Owner & Captain - F/V Ellen Diane, Hampton, NH

**As the owner-operator of the 44-foot day boat trawler, F/V Ellen Diane, Captain Goethel is involved in all aspects of a small fishing business. Over the past 30 years, David's fishing based activities include, but are not limited to serving as president of the Tri-Coastal Seafood Co-Op, a member of the Board of Directors of the New Hampshire Commercial Fisherman's Association and the Northeast Seafood Coalition. He has also served on the New England Fishery Management Council for the past five years and has served in the capacity as the Governor's appointee to the New Hampshire Shore Fisheries Commission. In addition, David has been invited to participate in numerous conferences both national and international on responsible fishing techniques and equitable management policies.**

**David's particular area of scientific interest is researching fish behavior in its relationship to fishing gear. To this end, David has participated in many gear studies focused on reducing bycatch of non-target species in trawl nets. His expertise also lies in the design and execution of tagging experiments with the goal toward a better understanding fish migratory patterns, spawning grounds and stock delineation. Over David's four decade fishing career he has successfully fished for all major Northwest Atlantic species using a myriad of gear types.**

# HAKE 2010 SYMPOSIUM ORGANIZING PARTNERS

## Northeast Consortium - Sponsor

The Northeast Consortium was created in 1999 to encourage and fund effective, equal partnerships among commercial fishermen, scientists, and other stakeholders to engage in collaborative research and monitoring projects in the Gulf of Maine and Georges Bank. The Northeast Consortium consists of four research institutions -- University of New Hampshire, University of Maine, Massachusetts Institute of Technology, and Woods Hole Oceanographic Institution -- working together to foster this initiative.

Northeast Consortium . Institute for the Study of Earth, Oceans and Space
University of New Hampshire . 8 College Road, 142 Morse Hall . Durham, New Hampshire 03824 USA
www.northeastconsortium.org.

## National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS)

NOAA's Fisheries Service is the federal agency responsible for the stewardship of the nation's living marine resources and their habitats. NOAA fisheries manages, conserves and protects fish, shellfish, whales, dolphins, sea turles and other living creatures in the oceans.

As a world class science agency that serves the entire country, it is their mission to ensure healthy fisheries for the benefit of all Americans. Federally managed living marine resources provide an important source of food and recreation for the nation, as well as thousands of jobs and a traditional way of life for man y coastal communities. NMFS works to promote sustainable fisheries and to prevent the lost potential associated with overfishing, diminished resources and degraded habitats. They strive to balance competing public needs and interests in the use and enjoyment of our ocean and coastal resources. They carry out their stewardship responsibilities through scientific programs, including sustainable fisheries, protected species, seafood safety inspection, aquaculture, enforcement and habitat conservation.

NOAA Fisheries . National Marine Fisheries Service . Northeast Fisheries Science Center . 166 Water Street
Woods Hole, Massachusetts 02543 USA
www.nefsc.noaa.gov

## F/V Ellen Diane - David T. Goethel, Owner & Operator

The F/V Ellen Diane is a 44-foot day boat otter trawler based, owned and operated by Captain David T. Goethel, out of Hampton, New Hampshire. The Ellen Diane fishes for multispecies with multiple gear types in a successful small fishing business. The F/V Ellen Diane has been engaged in many collaborative research activities on species including, but not limited to whiting, Atlantic cod, shrimp (*Pandalus borealis)*, yellowtail flounder, and herring. The F/V Ellen Diane was the lead vessel on the Northeast Fisheries Science Center Yellowtail Flounder Tagging Study, in which New England fishermen and the NEFSC tagged over 45,000 yellowtail flounder in all three New England stock areas. Captain Goethel was instrumental in developing this study and the Gulf of Maine Cod Tagging study as well.

F/V Ellen Diane . Hampton, New Hampshire USA

## Massachusetts Division of Marine Fisheries

The Massachusetts Division of Marine Fisheries provides wealth and benefits to all citizens of Massachusetts by managing the Commonwealth's living marine resources and the sustainable harvesting of those resources by commercial and recreational fisheries, maintaining a diverse number of self-sustaining fish populations at healthy levels of abundance in balance with the ecosystem.

Massachusetts Division of Marine Fisheries . 251 Causeway Street, Suite 400
Boston, Massachusetts 02114 USA
www.mass.gov/dfwele/dmf/

## Gulf of Maine Research Institute

The Gulf of Maine Research Institute (GMRI) is a new genre of marine research and education institution - neutral, place-based in the Gulf of Maine bioregion, and strategically focused on emerging ecosystem stewardship challenges.

The Gulf of Maine Research Institute (GMRI) catalyzes community dialogue, interdisciplinary research, and science literacy to realize the natural and human potential of the Gulf of Maine bioregion. Our goal is to position the Gulf of Maine community to emerge at the forefront of a new era of maritime innovation, embracing creative strategies to harness the oceans productive capacity while sustaining the bioregion's vitality and character for future generations.

Our scientists partner with fishermen, environmentalists, and state and federal fishery managers to build knowledge of commercial fish species, critical habitats, fishing gear technology, and human behaviors to enable more effective fishery management in the Gulf of Maine. Our education programs engage students with the scientific method and encourage them to learn about Maines fresh and saltwater ecosystems. Our community programs help to identify emerging challenges and opportunities in New England fisheries and foster a climate of cooperation among a diverse mix of marine stakeholders.

Gulf of Maine Research Institute . 350 Commercial Street . Portland, Maine 04101 USA
www.gmri.org

## New Hampshire Sea Grant College Program
## University of New Hampshire

Operating under the guidelines of, and in partnership with, the National Sea Grant Program of the National Oceanic and Atmospheric Administration (NOAA) NH Sea Grant is a federally funded program of marine research, education and extension. These development and conservation of marine and coastal resources of New Hampshire, northern New England and the Nation.

New Hampshire Sea Grant College Program . Chase Ocean Engineering Laboratory
University of New Hampshire . 24 Colovos Road . Durham, New Hampshire 03824 USA
www.seagrant.unh.edu

## University of Massachusetts Dartmouth -- SMAST

The School for Marine Science and Technology (SMAST) is the marine campus of the University of Massachusetts Dartmouth. It is located in the historical city of New Bedford, America's premier fishing port. Scientists at SMAST have expertise in ocean modeling and monitoring, fisheries science and management, coastal systems science, ocean acoustics, biogeochemistry, remote sensing, and ocean engineering.

School for Marine Science and Technology . University of Massachusetts Dartmouth
706 Rodney French Boulevard . New Bedford, MA 02744-1221 USA
www.smast.umassd.edu

**Registration**

The Symposium Registration Desk will open in the Atlantic Room lobby beginning at 8 a.m. on Tuesday, 11 May. A message and announcement board will be located at the registration desk. The Symposium Coordinator's office area will be located in the registration area as well.

**Symposium Coordinator**

The Coordinator's office will be located at the registration area. Laurinda will be available to speakers and registrants throughout the Symposium to assist with any questions or concerns that may arise.

**Computer and Internet Access**

The Hyatt Regency is equipped with complimentary wireless internet service throughout the facility.

**Meals & Breaks**

A continental breakfast will be provided from 8 a.m. - 9 a.m. in the lobby of the Atlantic room on Days 1 and 2 of the Symposium. A lunch buffet will be provided from 12:30 - 1:30 p.m. in the lobby of the Atlantic room on Days 1 and 2 of the Symposium. Breaks are provided in the morning and in the afternoon. Breakfast, lunch and break refreshments are included in your registration.

**NOTE**: Dinner is not included in your Symposium registration. In addition to the hotel restaurant, Portland boasts many excellent restaurants. You may pick up a list of suggested eateries at the registration desk.

**Parking**

There is a $12 per night charge for overnight parking with unlimited access. There is street parking, which can be difficult to manage because of meters and availability. There are several public parking garages close by with an hourly or per day charge.

## Loading onto Presentation Computer

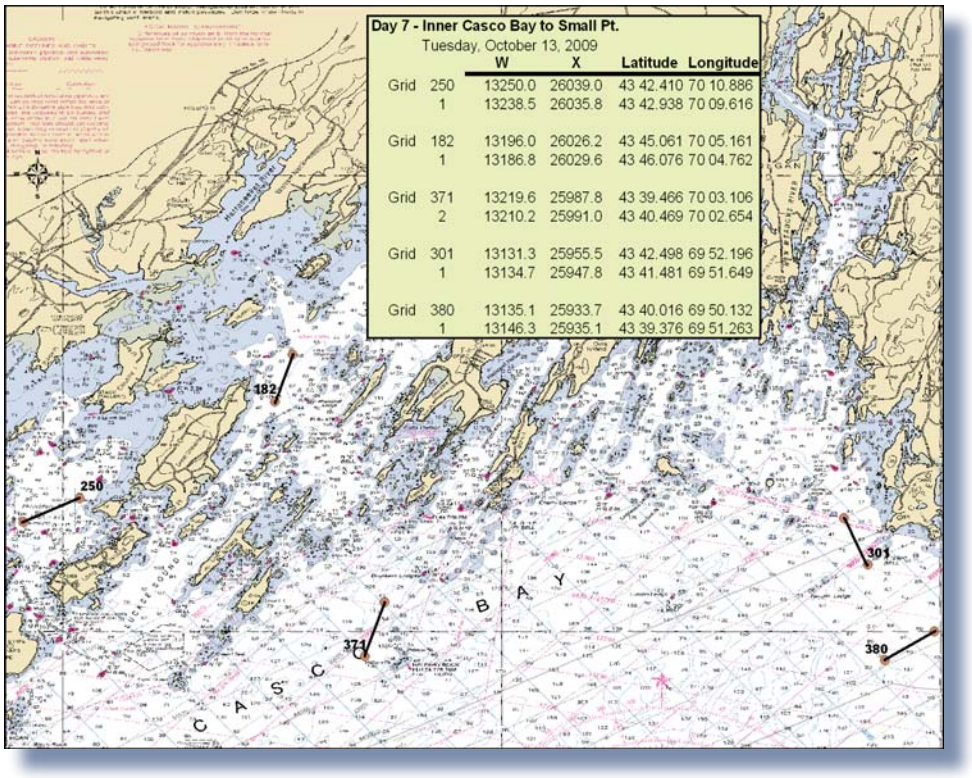
Please check with the Symposium Coordinator's office in the registration area located just outside the Atlantic room and have your presentation ready to load into and test on the Symposium computer **no later than 8 a.m. on Tuesday, 11 May.** The Coordinator will confirm your presentation time and direct you to the A/V presentation loading area. Do not load your presentation before checking in with the Symposium Coordinator. **Should there be a queue,** Audio Visual assistants will serve Day 1 speakers first and Day 2 speakers once all of Day 1 speakers' presentations have been loaded. If all presentations have not been loaded by the start of the days' programme, the Audio Visual assistants will be available again during the breaks for loading Day 2 presentations.

## Verbal Presentations - Time Allocation

To allow the sessions to run smoothly, and in fairness to other speakers, please be ready to present your paper at the appointed time, which will be confirmed when you check in with the Symposium Coordinator, and adhere strictly to the time allocated. Please take a seat at the front of the room during the session to which you are assigned for quick access to the podium when it is your time to speak. The schedule of presentations is listed on pages 9-12 of this programme.

## Discussion Panel Members

In the interest of time, please sit in the front of the room during the session to which you are assigned to the discussion panel. When the Chair of the session calls for the panel to come up, take the chair behind your name card. Please speak clearly into the microphone when called upon by the Moderator of the discussion and take direction from him. Remember to pay close attention to the Moderator throughout the panel discussion in the interest of covering as much ground and addressing as many issues as possible during the time allotted.




Courtesy of ME/NH Trawl Survey - Inner Casco Bay to Small Pt.

**Session 1 - Tuesday, 11 May, 9:10 - 15:10**
**BIOLOGY AND POPULATION DYNAMICS**
**Session Chair, Stephen Cadrin - SMAST & NOAA Fisheries** **Panel Discussion Moderator, John Annala - GMRI**

Information on life history and data available for stock assessment varies widely among hake species. Some of the primary fishery resources have been well studied, but others are more data-poor. The goal of the presentations and panel discussion in this session is to consider information on biology and population dynamics of various hake species and to identify common patterns and themes. The session is intended to guide future biological research and the advancement of hake stock assessments.

**Session 2a - Tuesday, 11 May, 15:40 - 16:40**
**Session 2b - Wednesday, 12 May, 8:35 - 10:00**
**STOCK DELINEATION, FOOD WEBS, AND HABITAT USE: WHO'S WHO, WHO EATS WHOM AND WHO LIVES WHERE?**
**Session Chair, Michael Pol - MA DMF** **Panel Discussion Moderator, Ken La Valley, NH Sea Grant**

Understanding or managing a marine ecosystem requires comprehending the relationships among the organisms within it. It requires the accurate grouping of the organisms into populations, stocks, and species; ecosystem relationships among groups of organisms are usually built on predation and can also be defined by habitat use. In this session, we contribute to ecosystem management of hakes by recognizing the importance of accurate definitions of hake stocks and species, then examining feeding variation among different stocks, while also considering variation in habitat use. The goal of the session and discussion is to further understanding of the relevance of stock and species definition as functional units to management of hakes and of ecosystem management, while considering the dynamic nature of ecosystems.

**Session 3 - Wednesday, 12 May, 10:30 - 15:10**
**FISHERIES, MANAGEMENT, BYCATCH AND CONSERVATION**
**Session Chair, Pingguo He - SMAST** **Panel Discussion Moderator, Chris Glass - Northeast Consortium**

Hake, in general, are fast swimmers with sharp teeth, and are important predators on a wide range of species. Some species aggregate in large numbers, while others undertake nocturnal movements through the water column. This combination of slim body form, variable distribution and differential aggregations poses many challenges for selective harvesting and management. This session and associated panel discussion will review and report on various hake fisheries, consider specific management measures including bycatch reduction and other conservation strategies related to these fisheries, and identify commonalities that will help guide future research topics and activities.

**Final Panel Discussion - Wednesday, 12 May, 15:30 - 16:10**
**TITLE**
**Moderator, Steve Cadrin – SMAST & NOAA Fisheries**

Symposia such as this provide an opportunity to assess the state of our global knowledge with respect to science, management and harvest strategies. Putting these issues into a global perspective and showcasing successful strategies, may help promote more effective management of these species both locally and regionally. A panel consisting of keynote speakers and fishing industry representatives will discuss the issues raised during each of the preceding sessions, and seek participation through question and dialogue with the audience. The goal of the open forum discussion is to arrive at consensus on future research and management needs and to formulate recommendations on next steps.

| *Tuesday, 11 May 2010* | | |
|---|---|---|
| **Time** | **Presentation** *(Abstract page)* | **Presenter/Room** |
| 8:00 | Registration Opens | Atlantic Room Lobby |
| 8:00 - 9:00 | Continental Breakfast | Atlantic Room |
| 9:00 | Welcome & Introductions | Chris Glass |
| **Session 1**<br>**Chair: Steve Cadrin**<br>**University of MA Dartmouth**<br>**NOAA Fisheries** | **Biology and Population Dynamics** | **Atlantic Room** |
| 9:10 | **Keynote Address: Tom Helser**<br>**Alaska Fisheries Science Center - Seattle, WA**<br>*A retrospective of the hake stocks off the Stlantic and Pacific coasts of the United States: Uncertainties and challenges facing assessment and management in a complex environment (pg. 13)* | Atlantic Room |
| 10:00 | Ted Ames<br>Penobscot East Resource Center<br>*White hake in the Gulf of Maine: Population structure insights from the 1920s (pg. 15)* | Ames |
| 10:20 | Claudio Esteban Gatica Molina, Rubén Alarcón-Muñoz, Aquiles Sepúlveda<br>Instituto de Investigación Pesquera, VIII Región<br>*Changes in the population structure of the stock of Chilean hake (Merluccius gayi gayi) associated with the combined effect of fishing and predation. (pg. 15)* | Gatica Molina |
| 10:40 | Sally Sherman, Keri Stepanek<br>Maine Department of Marine Resources<br>*Abundance and distribution trends for three species of hake along the Maine and New Hampshire coasts (pg. 16)* | Sherman |
| 11:00 | *Morning Break* | |
| 11:30 | Mark Szymanski<br>Massachusetts Division of Marine Fisheries<br>*Abundance trends for four species of hakes in coastal Massachusetts (pg. 16)* | Szymanski |
| 11:50 | Rosario Dominguez-Petit<br>Institute of Marine Research (CSIC) Vigo, Spain<br>*Temporal variability of European hake reproductive potential: Implications for management (pg. 16)* | Dominguez-Petit |
| 12:10 | Michele L. Traver, Katherine A. Sosebee and Larry Alade<br>NOAA Fisheries, National Marine Fisheries Service<br>Northeast Fisheries Science Center<br>*What the hake? Basic dynamics of offshire hake, Merluccius albidus (pg. 16)* | Traver |
| 12:30 - 13:30 | Lunch (provided) | Atlantic Room |
| 13:30 | Rubén Alarcón-Muñoz, Caudio Esteban Gatica Molina, Aquiles Sepúlveda<br>Instituto de Investigación Pesquera, VIII Región<br>*Inter-annual changes in the size at maturity of Chilean hake (Merluccius gayi gayi) in the south-central zone of Chile between 1997 and 2008 (pg. 17)* | Alarcón-Muñoz |

| *Tuesday, 11 May 2010* | | |
|---|---|---|
| **Time** | **Presentation** *(Abstract page)* | **Presenter/Room** |
| 13:50 | Katherine A. Sosebee, Christopher M. Legault<br>NOAA Fisheries, National Marine Fisheries Service<br>Northeast Fisheries Science Center<br>*Age date: To pool or not to pool? That is the question. (pg. 17)* | Sosebee |
| 14:10 | **Panel Discussion**<br>**Moderator: John Annala**<br>**Gulf of Maine Research Institute** | Atlantic Room |
| 15:10 | *Afternoon Break* | |
| **Session 2**<br>**Chair: Michael Pol**<br>**Massachusetts Division of Marine Fisheries** | **Stock Delineation, Food Webs, and Habitat Use: Who's Who, Who Eats Whom and Who Lives Where?** | Atlantic Room |
| 15:40 | Francis Juanes<br>University of Massachetts Amerherst<br>*Who is who in mixed hake fisheries: Identifying species by DNA markers (pg. 17)* | Juanes |
| 16:00 | Peter Straub, William Phoel, Tami Wolstenholme and Claire Coleman<br>Richard Stockton College<br>*Stock discrimination of silver hake in the Western North Atlantic by DNA microsatellite analysis (pg. 18)* | Phoel |
| 16:20 | David Stormer<br>University of Massachusetts Amherst<br>*Long-term trends in cannibalism between the northern and southern stocks of silver hake (Merluccius bilinearis) in the northwest Atlantic ocean (pg. 18)* | Stormer |

| *Wednesday, 12 May 2010* | | |
|---|---|---|
| **Time** | **Presentation** *(Abstract page)* | **Presenter/Room** |
| 8:00 - 8:50 | Continental Breakfast | Atlantic Room |
| Session 2 (Continued)<br>Chair: Michael Pol<br>**Massachusetts Division of Marine Fisheries** | **Stock Delineation, Food Webs, and Habitat Use: Who's Who, Who Eats Whom and Who Lives Where?** | **Atlantic Room** |
| 8:50 | **Recap of Session 1 - Day 1** | Michael Pol |
| 9:00 | Mark Lazzari<br>Maine Department of Marine Resources<br>*Habitat variability in young-of-the-year white hake in Maine estuaries (pg. 18)* | Lazzari |
| 9:20 | Rosario Dominguez-Petit<br>Institute of Marine Research (CSIC) Vigo, Spain<br>*Estimation of consumption in European hake (Merluccius merluccius) using generalized simple bioenergetic model (pg. 19)* | Dominguez-Petit |
| 9:40 | **Panel Discussion**<br>**Moderator: Kenneth La Valley**<br>**NH Sea Grant College Program** | Atlantic Room |
| 10:20 | *Morning Break* | |
| **Session 3**<br>**Chair: Pingguo He**<br>**University of Massachusetts Dartmouth** | **Fisheries, Management, Bycatch and Conservation** | Atlantic Room |
| 10:50 | **Keynote Address: Capt. David Goethel**<br>**F/V Ellen Diane - Hampton, NH**<br>*Hake Fisheries off the Northeast Coast of the United States: A Fisherman's Perspective (pg. 14)* | Atlantic Room |
| 11:30 | Michael Pol<br>Massachusetts Division of Marine Fisheries<br>Northeast Fisheries Science Center<br>*Assessing the value of the Massachusetts silver hake trawl fishery (pg. 19)* | Pol |
| 11:50 | Henry Milliken<br>NOAA Fisheries - Northeast Fisheries Science Center<br>*Assessment of large mesh panels to reduce the flatfish bycatch in the small mesh bottom trawls used in the New England silver hake fishery (pg. 20)* | Milliken |
| 12:10 | Rubén Alarcón-Muñoz, Claudio Esteban Gatica Molina, Aquiles Sepúlveda<br>Instituto de Investigación Pesquera, VIII Región<br>*Trends in the landings of Chilean hake (Merluccius gayi gayi) in the south-central zone of Chile (pg. 20)* | Alarcón-Muñoz |
| 12:30 | Lunch (provided) | Atlantic Room |
| 13:30 | Rubén Alarcón-Muñoz, Claudio Esteban Gatica Molina, Aquiles Sepúlveda<br>Instituto de Investigación Pesquera, VIII Región<br>*Bycatch in the industrial fishery of Chilean hake (Merluccius gayi gayi) (pg. 20)* | Alarcón-Muñoz |

| *Wednesday, 12 May 2010* | | |
|---|---|---|
| **Time** | **Presentation (Abstract Page)** | **Presenter/Room** |
| 13:50 | David Chosid<br>Massachusetts Division of Marine Fisheries<br>*Video observations of a whiting net bycatch reduction device (pg. 21)* | Chosid |
| 14:10 | Elias Olafsson<br>Dantrawl, Inc.<br>*Alpha Mar Trawl Design (pg. 21)* | Olafsson |
| 14:30 | Sally Roman<br>University of Massachusetts Dartmouth, SMAST<br>*Review of fishermen collected data to investigate patterns in hake catches on Georges Bank (pg. 21)* | Roman |
| 14:50 | Andrew Applegate<br>New England Fishery Management Council<br>*Why open access management of small mesh hake fisheries has not failed - yet (pg. 22)* | Applegate |
| 15:10 | **Panel Discussion**<br>**Moderator: Chris Glass**<br>**Northeast Consortium**<br>**University of New Hampshire** | Atlantic Room |
| 15:50 | **Panel Discussion, Summary and Recommendations**<br>**Moderator: Steve Cadrin**<br>**University of Massachusetts Dartmouth**<br>**NOAA Fisheries** | Atlantic Room |
| 16:30 | **Closing Remarks** | Chris Glass |

# Hake 2010 Keynote Address

*Tuesday, 11 May 2010*

**Tom Helser, Resource Ecologist**
**National Marine Fisheries Service, Alaska Fisheries Science Center - Seattle, WA**

## *A retrospective of the hake stocks off the Atlantic and Pacific coasts of the United States: Uncertainties and challenges facing assessment and management in a complex environment*

**Abstract**

Hake stocks off the northeast and northwest coasts of the United States and Canada have been commercially exploited since the early 1950s and have been major contributors to the historic world-wide hake catches. During the last two decades annual production of U.S. hake catches have averaged approximately 300,000 metric tones with the dominant share coming from the coastal Pacific hake stock. Pacific hake (*Merluccius productus*), which supported both domestic and foreign fleets, occurs over the continental shelf with a number of localized sub populations found in coastal inland waters of Washington State and British Columbia Canada. In the northwest Atlantic two sympatric species occur, the commercially sought coastal silver hake (*Merluccius bilinearis*) and the offshore hake (*Merluccius albidus*), which due to its deep water distribution is generally unavailable to the fishery. Like many of the 12 world-wide species of hakes of the genus *Merluccius*, the U.S. hake species share common attributes in their biology, ecology and population dynamics which may be dictated by the production cycles and circulation patterns characteristic of northerly ecosystems. For instance, both species exhibit a migration pattern centered on spawning in one region followed by feasting in another, both are fast swimming ambush predators that take advantage of high euphausid production as young but transition to a piscid dominated diet with age, and both are known to exhibit highly variable, density-dependent related life history characteristics as population regulatory mechanisms. However, these species can be contrasted in many different ways related to specific adaptations within the unique ecosystems which they live, the diverse and changing fisheries targeting them, and the complexity of stock assessment tools and management structures that have emerged in an attempt to provide a sound scientific basis for setting catch limits. For instance, *M. productus* lives in a boundary current system dominated by strong seasonal upwelling and a poleward sub-surface current that serves as the driver behind a migratory pattern over a scale of thousands of miles that varies both as a function of age structure, population size and short term climate impacts. Upon this ecological mosaic, a diverse commercial fishery has developed, including foreign and joint-venture fleets in both the U.S and Canada, domestic trawler vessels making day trips, and a highly mobile fleet of massive floating processors and catcher-processors. Because of these complex spatial dynamics, fishery and fishery-independent catch rates have been highly variable and have provided a challenge to the assessment and management of this stock. This paper takes a retrospective and contemporary look at these two species, comparing and contrasting our current state of knowledge, highlighting uncertainties and identifying the complex challenges facing assessment and management.

# Hake 2010 Keynote Address

*Wednesday, 11 May 2010*

**David Goethel, Captain and Owner**
**F/V Ellen Diane - Hampton, NH**

## *Hake Fisheries off the Northeast Coast of the United States: A Fisherman's Perspective*

**Abstract**

The hake species occupy an important ecological niche as both predator and prey in the large marine ecosystem of the Northwest Atlantic. Yet despite their importance, they receive relatively little attention from science or management. The goal of this symposium is to bring scientists, management and fishermen together to exchange information and identify knowledge gaps that need to be filled to ensure the success of hake management in the future. The goal of this talk is to provide symposium participants with an overview, from a fisherman's perspective, of the three major hake species. The discussion will briefly touch on stock status, management, fishing gear, principal uses, local names, and interesting fact not usually found in textbooks or journals.

# Hake 2010 Abstracts

*(In order of scheduled appearance)*

## Session 1: Biology and Population Dynamics

### White hake in the Gulf of Maine: Population structure insights from the 1920s

Author: Ted Ames

This study provides insight into the historical population structure of white hake by deriving their distribution, seasonal movement patterns and the behavior of individual population components from relevant scientific literature, data, and surveys of fishermen during the 1920s, a period when stocks were more abundant. These derivations are consistent with current white hake populations in the GOM and with the presence of local spawning components. White hake (Urophysis tenuis) are part of an important but depleted fishery in the Gulf of Maine (GOM). Two population centers have been identified that contribute to the white hake caught along the coastal shelf of the GOM. One stock is centered on the Scotian Shelf in eastern GOM and the other is centered in the Georges Bank-Mid Atlantic Bight area. These stocks overlap within the GOM and there is evidence that hake spawn along the entire northern coastal shelf of the GOM. Understanding the population structure of these two overlapping stock components will be valuable for developing management strategies to rebuilding and making the fishery sustainable. The study relies on fishermen's ecological knowledge (FEK) of the 1920s to reconstruct white hake population structure and compares their observations with recent scientific reports and surveys. These comparisons reveal temporal changes in white hake distribution, behavior and population structure that have occurred that may be important to creating a sustainable fishery. The 1920s was a period when many commercial stocks were abundant and provides an opportunity to examine white hake population structure that includes their interactions with large numbers of other species while competing for habitat and prey in a robust, relatively intact marine ecosystem. During the 1920s, the primary fishing technology to catch white hake was fishermen using baited hooks. Handlines were deployed at night to catch the hake while they were feeding part way to the surface and/or tub trawls that placed hooks on the bottom. These were usually set before sunrise and hauled within a few hours and caused minimal damage to benthic habitats. Knowing that benthic habitats were still intact during the period allows the habitat preferences of white hake and related species to be derived from fishing data. Historical seasonal distribution and movements were compared to current distribution patterns in order to evaluate whether the disappearance of spawning components undetected by system-wide assessments had contributed to the current low white hake population levels. A brief discussion of historical population structure is included that compares white hake with Atlantic cod in the Gulf of Maine during the same period.

*Contact: Ted Ames; e-mail: ted.ames7@gmail.com; phone: 207.367.2708*

### Changes in the population structure of the stock of Chilean hake (*Merluccius gayi gayi)* associated with the combined effect of fishing and predation

Authors: Claudio Esteban Gatica Molina, Rubén Alarcón-Muñoz, Aquiles Sepúlveda

The Chilean hake (Merluccius gayi gayi) is the main groundfish resource in the south-central zone of Chile. This species is probably the best documented among Chilean fishing resources. The factors associated with changes in abundance and population structure are debated among scientists and stakeholders. National catch statistics have been gathered since 1940 and it is possible to recognize different periods based on the trend in the landings. In periods of low catches, the landings were around 10,000 tons, while in periods of high catches the landings reached more than 130,000 tons. Biomass trends since 1992 showed a significant stock productivity until 2002-2003, supported by strong recruitments and population growth. During the most recent period of high abundance, landings increased from 62,000 t in 1992 to more than 100,000 t from 2001 to 2003. Then landings decreased, fluctuating around 50,000 t from 2005 to the present.

The depletion of the population has been associated with different factors, including predation by jumbo squid, cannibalism, overfishing and recruitment failure. Our analysis of the condition of the stock was based on indirect stock assessment models, acoustic assessment, analysis of growth and trophic interaction. We found that the current status of Chilean hake is the result of the combined effect of predation and high catch due to an incorrect determination of the status of the stock, mainly as a result of the overestimation of the acoustic biomass in 2002. Currently, the stock has a high percentage of juveniles less than 36 cm and a low percentage of adults. Furthermore, growth and size analyses indicate that the population structure has changed because individuals of the same age are smaller today than individuals used to be at the beginning of the period of high abundance. In summary, the population has lost the individuals with a high growth capacity due to fishing, jumbo squid predation and cannibalism.

*Contact: Claudio Esteban Gatica Molina; e-mail: cgatica@inpesca.cl; phone: 56.41.2920411*

**Abundance and distribution trends for three species of hake along the Maine and New Hampshire Coasts**

Authors: Sally Sherman and Keri Stepanek

The Maine-New Hampshire Inshore Trawl Survey was initiated in 2000 to fill a significant information gap on approximately two-thirds of the inshore portion of the Gulf of Maine. Now in its 10th year, the MENH Inshore Trawl Survey is the longest continuous time series on the approximately 80% of the U.S. Gulf of Maine's inshore waters where fishery independent stock assessment had been virtually absent. Conducted biannually, the survey completes 85-115 tows along the coastal waters off the coast of Maine and New Hampshire out to the 12 mile limit. Its overall goal is to provide a quantitative time-series on the distribution and relative abundance of benthic marine resources in these waters and is a successful collaboration between Maine's and New Hampshire's commercial fishermen and state resource scientists. The survey catches significant numbers of roughly 30 species of finfish and 10 invertebrate species. Spring and fall yearly abundance indices, seasonal catch at length data, bubble plots of species distribution, and maturity stage estimates are provided for three hake species, white hake, Urophysis tenuis, red hake, Urophysis chuss, and silver hake, Merluccius bilinearis.

*Contact: Sally Sherman; e-mail: sally.sherman@maine.gov; phone: 207.633.9503*

**Abundance trends for four species of hakes in coastal Massachusetts**

Author: Mark Szymanski

The Massachusetts Division of Marine Fisheries Resource Assessment Project has conducted a semi-annual standardized bottom trawl survey (Spring and Fall) for marine fish in Massachusetts' territorial waters since 1978. Survey data for our species of hakes: silver hake (Merluccius bilinearis), red hake (Urophycis chuss), white hake (Urophycis tenuis) and spotted hake (Urophycis regia) have been summarized to examine trends in their abundance and distribution. The most notable trend is the increase of spring spotted hake (Urophycis regia) catches since the mid 1990's. A more complete analysis of spotted hake observations might reveal a shift of spring spotted hake distribution into Massachusetts territorial waters potentially indicating environmental change.

*Contact: Mark Szymanski; e-mail: mark.szymanski@state.ma.us; phone: 508.990.2860 ext. 237*

**Temporal variability of European hake reproductive potential: Implications for management**

Author: Rosario Dominguez-Petit

European hake is one of the most important economic resources for South European fleets. Currently it is considered an overexploited stock and consequently, UE has implemented a recovery plan whose main criteria for judging the status of the stock is the spawning stock biomass (SSB). Maturity data are the basic information to estimate SSB as well as to define other reproductive aspects related to SSB like spawning season, spawning cycle, spawning fraction, etc. Egg Production (EP) is a proxy of the Stock Reproductive Potential (SRP). It is known that the egg relative contribution of large females to the SRP is higher than those of small ones. Under these circumstances, SSB is not the most accurate measure of SRP, because it does not take into account the size structure of the reproductive stock. Besides, recent tagging studies have demonstrated that European hake grows about two times faster than previously supposed what may alters perception of the stock status, particularly in the predictions. Currently this stock is assessed with and age-length based model.

The objective of the present study is to provide an index of SSB and EP for assessment purposes. With this aim, temporal variability of length based maturity parameters of female hake from the Southern Stock are analyzed as well as the size structure of the reproductive stock and its relation with recruitment dynamics. Annual L50 were estimated during the period 1982-2008. A model for the fecundity/length relationship is fitted in order to estimate annual EP for the period 1982-2008. This approach allows the analysis of temporal variations in SRP and stock/recruitment dynamics of the Southern hake. A comparison between both, SSB and EP are provided. Finally, the impact of shifting from SSB to EP as alternative SRP index for Southern hake management is discussed.

*Contact: Rosario Dominguez-Petit; e-mail: rosario@iim.csic.es; phone: +34986214466*

**What the hake? Basic dynamics of offshore hake,** ***Merluccius albidus***

Author: Michele L. Traver, Katherine A. Sosebee and Larry Alade

Little is known about the life history of offshore hake. The species is difficult to distinguish visually from silver hake, and this is problematic because the two hakes co occur in deep, outer continental shelf waters where the two species are commonly caught together. We investigated the spatial distribution, maturity, and length-weight relationship of offshore hake using NMFS survey data, commer-

cial landings records, and fishery observer data. We also estimated offshore hake landings and discards using the standardized bycatch reporting methodology (SBRM). Our work provides some of the basic assessment data needed to better characterize the status of this data-poor stock.

*Contact: Michele Traver; e-mail: michele.traver@noaa.gov; phone: 508.495.2195*

**Interannual changes in the size at maturity of Chilean hake *(Merluccius gayi gayi)* in the south-central zone of Chile between 1997 and 2008**

Authors: Rubén Alarcón-Muñoz, Claudio Esteban Gatica Molina, Aquiles Sepúlveda

The Chilean hake (Merluccius gayi gayi, Guichenot, 1848) is a demersal specie that show a wide distribution in the Chilean coast from Arica (18°30' S) to the Cheap Channel (47º08' S), over the continental platform and slope with a bathymetric range from 50 to 500 m. Also is the main groundfish resource in the south-central zone of Chile being exploited by an artisanal and industrial fleet.

Merluccius gayi gayi has an extended reproductive cycle being possible to find females sexually mature during all the year. Furthermore is a multiple spawner that present two spawning periods, the main between July and November (late winter and spring in the South Hemisphere), being September in average the maximum spawning time. The secondary occurs between March and April. Historically, the size at maturity in females of Chilean hake as been around 37 cm of total length (LT), but in the last decade was observed a progressive reduction in that population parameter.

The size at maturity of M. gayi gayi was estimated for the main spawning period between 1997 and 2008 using a logistic model fitted by maximum likelihood method implemented in Ad Model Builder program. Between 1997 and 2008, the mean size at maturity showed a reduction from 40 cm LT to 32 cm LT. Finally we found significant difference in the mean size at maturity in the periods 1992-2002 and 2003-2008. In the first period the mean size was 40 cm LT while in the most recent time it was 32 cm LT.

The stock assessment models for Chilean hake historically used a size at maturity equal to 37 cm of total length. We discuss the effect of the change of the maturity size on the spawning biomass estimates.

*Contact: Rubén Alarcón-Muñoz; e-mail: ralarco@inpesca.cl; phone: +56-41-2920410*

**Age Data: To pool or not to pool? That is the question.**

Authors: Katherine A. Sosebee and Christopher M. Legault

The white hake stock assessment is currently conducted using a forward-projecting age structured model (ASAP). We explored the potential degree of bias in the white hake assessment results when pooled age-length keys are used. Using data from 1982-2000, we ran the ASAP model with fishery catch numbers at age and research survey numbers at age derived using (a) semi-annual age-length keys and (b) age-length keys pooled over years by half year. Additional simulations were conducted to evaluate the potential bias when length data are allocated to age groups using a constant von Bertalanffy growth equation vs. using a pooled age-length key. Another set of simulations examined the use of a pooled age-length key to derive recruitment indices. Overall, our simulation results indicate that using a pooled age-length key in a stock assessment may be appropriate in some data poor situations.

*Contact: Katherine Sosebee; e-mail: katherine.sosebee@noaa.gov; phone: 508.495.2372*

## Session 2: Stock Delineation, Food Webs, and Habitat Use: Who's who, who eats whom and who lives where?

**Who is who in mixed hake fisheries: identifying species by DNA markers**

Author: Francis Juanes

Genetics is useful for species identification. Methods and techniques using DNA range from easy-and-cheap to expensive protocols requiring sophisticated equipment. Here we use species-specific genetic markers (single nucleotide polymorphisms or SNPs) to describe recent cases of species misidentification which may lead to inaccurate estimates of stock size and adversely affect sustainable hake fisheries management in the Atlantic Ocean. North American hakes and African hakes show evidence of erroneous mislabelling that may obscure underreported exploitation of some species (offshore hake and South African hake in North America and Africa respectively) caught together with other hake fisheries targeted in each region. A severe bottleneck signature in the genetic pattern of deep-water Cape hake suggests that mixed fisheries are inadvertently overexploiting one hake species of the two simultaneously captured in South African and Namibian waters.

*Contact: Frances Juanes; e-mail: juanes@nrc.umass.edu; phone: 413.545.4358*

**Stock discrimination of silver hake in the Western North Atlantic by DNA microsatellite analysis**

Authors: Peter Straub, William Phoel, Tami Wolstanholme and Claire Coleman

The Silver hake, Merluccius bilinearis, fishery has been managed in the USA as two separate stocks, northern and southern, along their distribution throughout the western North Atlantic. The USA stocks are generally recognized as Gulf of Maine and Northern Georges Bank as the northern stock and Southern Georges Bank and the Mid Atlantic Bight as the southern stock. In this study, 93 adults were collected from 5 locations: the Mid-Atlantic Bight (MAB), South Georges Bank (SGB), North Georges Bank (NGB), the Gulf of Maine (GOM), and the Canadian Scotian Shelf (CAN). In addition, thirty-two Mid Atlantic Bight (MAB) juvenile were also collected. Three microsatellites loci, UEA-WO1, UAE- Hk3b and Hk20, were evaluated in 125 silver hake samples by fluorescent capillary electrophoresis after PCR amplification to determine the alleles present within the population. Allele data was compiled for analysis of allele frequency and distance-based frequency using PowerMarker. Genetic structure analysis of the alleles exhibited in the subpopulations revealed an overall of 0.0099 indicating a very low level of inbreeding within subgroups; this is consistent with many marine fish. Genetic distance measures between subgroups were used to generate and test phylogenetic trees in Phylip. Consensus trees were drawn following bootstrap analysis (1000 trees) that supported a separate node for Mid Atlantic Bight (adults and juveniles) at 85.7%. Based on this limited analysis it was concluded that there is limited differentiation between the current divisions of stocks and that the only group exhibiting weak structure was the most southern Mid Atlantic Bight sub group. This calls into question the present southern stock aggregation of the Southern Georges Bank with the MAB.

*Contact: Peter Straub; e-mail: pete.straub@stockton.edu; phone: 609.652.4556*

**Long-term trends in cannibalism between the northern and southern stocks of silver hake *(Merluccius bilinearis)* in the northwest Atlantic ocean**

Author: David Stormer

Cannibalism is an interesting phenomenon that has been reported in a variety of fishes including silver hake (Merluccius bilinearis). It is believed that cannibalism is a mechanism through which an individual can reduce its competition while at the same time increasing growth rate and fecundity. Besides geographically differences in the two stocks, the northern and southern stocks of silver hake also differ in their feeding habits including incidences of cannibalism. In this study we examined diet data for silver hake obtained from the semi-annual bottom trawl survey conducted by the Northeast Fisheries Science Center (NEFSC) to determine whether cannibalism had increased from 1973 to 2006. We also compared sizes of silver hake (predator) that were cannibals vs. non-cannibals, and cannibalized prey vs. non-cannibalized prey. Over the entire time period, the percent cannibalism by weight for the northern stock and southern stock were similar ($P > 0.10$) and ranged from 0 – 38% (mean = 13.8 %WC), and 2.2 – 27.2% (mean = 11.9%WC) respectively. For the northern stock of silver hake, linear regression showed that year accounted for 53 % of the variation observed in %WC ($P < 0.0001$). Year accounted for 10% of the variation in %WC in the southern stock ($P = 0.06$). After combining %WC for the northern and southern stock year explained 61% of variation observed ($P < 0.001$). However, correlation analysis revealed no relationship in %WC between the northern and southern stocks over the time period ($P > 0.50$). A comparison of the slope coefficients indicated that the contribution by weight of cannibalized prey to the diet of silver hake increased at a greater rate for the northern stock versus the southern stock ($P < 0.001$). Prey sizes of cannibals and non-cannibals were similar ($P > 0.10$), and ranged from 5 – 300 mm (mean TL = 102 mm), and 1 – 390 mm (mean TL = 105 mm) respectively. Prey length: predator length ratios were also similar between cannibals and non-cannibals ($P > 0.30$). Overall, cannibalism (%WC) in silver hake has increased in both stocks from 1973 to 2006, but at a greater rate in the northern stock. The lack of a yearly relationship in %WC between the two stocks could be the result of temporally and spatially explicit differences in prey abundance. The proportion by weight of conspecifics in the diet of silver hake reported here indicates the potential for intense intra-specific interactions, with implications for stock production and regulation of population dynamics.

*Contact: David Stormer; e-mail: dstormer@nrc.umass.edu; phone: 334.329.9174*

**Habitate variability in young-of-the-year white hake in Maine estuaries**

Author: Mark Lazzari

The Magnuson-Stevens Fishery Conservation and Management Act defines Essential fish habitat (EFH) as "the waters and substrate necessary to fish for spawning, breeding, feeding, and growth to maturity" and the protection of nursery areas has become a key element in US Federal fisheries management. Distribution and abundance by habitat for age-0, young-of-the-year (YOY) white hake, Urophycis tenuis, were compared for 28 Maine estuaries to help define essential fish habitat for this life history stage. The Maine coast was divided into three broad geographic zones based upon geological features and sampled over five consecutive years; during April – November of 2000 in the Mid-coast, in 2001 and 2002 along the Southwest coast and in 2003 and 2004 along the Eastern Maine

coast. One beam trawl (2.0 m width, 3 mm mesh) sample was collected in one to four habitats in estuaries: eelgrass (Zostera marina), kelp (Laminaria longicruris), drift algae (Gracilaria sp.) and unvegetated sand/mud. Fish were sampled every two weeks, April-November 2000 – 2004. Abundance of YOY white hake was greatest in Mid-coast estuaries between Casco and Penobscot Bays and was significantly lower in Southwest estuaries. Abundance was similar across all three SAV (submerged aquatic vegetation) habitats in Mid-coast estuaries in 2000. In the other years, YOY were found in higher abundance in algae and eelgrass or eelgrass and kelp relative to sand habitat. A Logistic regression model based on nearshore habitat characteristics was developed to predict the distribution of this species along the three broad geological zones of the Maine coast with the physical and biological variables most important in discriminating between habitats with and without individual fish identified. This Logistic regression model correctly classified YOY white hake 80.5% of the time based on the year, zone, the physical habitat variables (temperature, salinity, depth) and the presence-absence of submerged aquatic vegetation (algae, eelgrass, kelp). YOY white hake were five times more likely to be found in eelgrass and kelp; and three times more likely to occur in algae than sand areas. These results indicate that the type of habitat most important to YOY white hake varies among estuaries along the Maine coast, but EFH for this species and life stage is related to the presence of SAV in shallow waters.

*Contact: Mark Lazzari; e-mail: mark.lazzari@maine.gov; phone: 207.633.9569*

**Estimation of consumption in European hake *(Merluccius merluccius)* using generalized simple bioenergetic model**

Author: Rosario Dominguez-Petit

A generalized simple bioenergetic model was used to estimate consumption of European hake in both north- and southern stocks for the period 1994-2008. Consumption in biomass was estimated from weight-at-age data and growth parameters and then converted to energy intake in kJ using the prey-preference by size in percentage obtained from stomach contents and the energy-prey conversion factors. The energy consumption in kJ was then estimated for each year and for a range of hake between 1 and 75 cm. The consumptions from bioenergetic models were adjusted to the observed consumption from stomach content and then fitted to the theoretical maximum possible consumption model. Results showed that from the simple bioenergetic analyses smaller hake consumes slightly lower energy, while for individuals larger than 60 cm the model shows a greater consumption. For northern stock the estimated consumption for an individual hake of 50 cm shows an important variation with high values at the beginning of the time series (above 25000 kJ), although with a clear and sharp decreasing trend. In the last period consumption considerably fluctuated with a minimum of 21600 kJ in 1998 and a maximum of 30000 kJ in 2001. The source of variation in annual consumption was studied correlating the values with several indices of potential preys (anchovy, blue whiting and horse mackerel). The best fit was obtained with the survey indices of horse mackerel 0-group which showed a similar trend in abundance. Horse mackerel catch in number-at-age-0 showed a correlation of 0.89 with estimated total consumption from bioenergetic model and a correlation of 0.78 with the m0 parameter in the maximum possible consumption model. For the southern stock, consumption shows an important variation with values at the beginning of the time series around 25000 kJ, decreasing until 1997, then a sharp increase in consumption is observed in 1998, 1999 and 2000, followed with a clear and sharp decreasing trend, until reach the minimum in 2002. In this case the best fit was obtained with the survey indices of blue whiting abundance which showed a similar trend in abundance as consumption with a correlation of 0.79 with estimated total consumption from bioenergetic model and a correlation of 0.81 with the m0 parameter in the maximum possible consumption model. These results indicate that growth in hake is very much dependent on young horse mackerel for northern stock and on blue whiting for southern stock, which is coincident with preferred preys observed in stomach content demonstrating the validity of this method to estimate consumption from weight-at-age data.

*Contact: Rosario Dominguez-Petit; e-mail: rosario@iim.csic.es; phone: +34986214466*

## Session 3: Fisheries, Management, Bycatch and Conservation

**Assessing the value of the Massachusetts silver hake trawl fishery**

Author: Michael Pol

The importance of silver hake Merluccius bilinearis is hidden by its small size and relatively low market value. More than two decades of creative study and development by Massachusetts fishermen, Division of Marine Fisheries (DMF) managers and DMF biologists demonstrate that the Massachusetts silver hake trawl fishery may be on the leading edge of fisheries and should serve as an instructive example for solutions that apply to “big” fisheries. Examples of: collaborative partnership; gear development, implementation, and continued innovation; data collection; and collaborative fleet behavior, pioneered or developed during the last 20 years suggest that this “small” fishery has a “big” impact.

*Contact: Michael Pol; e-mail: mike.pol@state.ma.us; phone: 508.990.0449*

**Assessment of large mesh panels to reduce the flatfish bycatch in the small mesh bottom trawls used in the New England silver hake fishery**

Author: Henry Milliken

Fishermen must use small mesh bottom trawls to capture certain species of fish that cannot be retained by standard groundfish mesh sizes. These fisheries are subject to bycatch limits when these trawls are used in areas where regulated species reside. Bycatch of regulated flatfish in the small mesh bottom trawl fishery for silver hake Merluccius bilinearis in the Northwest Atlantic is a concern of management because the silver hake are captured in areas where juvenile regulated flatfish are common. An evaluation of flatfish and silver hake behaviors by using low light underwater cameras suggested that the two species could be separated within the mouth of a bottom trawl. Using the alternate tow method, four different large mesh panels positioned in the lower belly of the trawl were separately evaluated, and one proved effective at reducing flatfish bycatch while not reducing the catch of silver hake. A large mesh panel constructed of 40.6-cm (16-in) stretched mesh, diamond shaped using 1.6-mm (0.06-in) diameter, orange-colored nylon twine in the lower belly resulted in a 73% reduction in flatfish catch, while not affecting the catch of silver hake.

*Contact: Henry Milliken; e-mail: henry.milliken@noaa.gov; phone: 508.495.2294*

**Trends in the landings of Chilean hake** *(Merluccius gayi gayi)* **in the south-central zone of Chile**

**Authors: Rubén Alarcón-Muñoz, Claudio Esteban Gatica Molina, Aquiles Sepúlveda**

The Chilean hake (Merluccius gayi gayi, Guichenot, 1848) is a demersal specie that show a wide distribution in the Chilean coast, being from Arica (18°30' S) to the Cheap Channel (47º08' S) over the continental platform and slope from 50 to 500 m depth approximately.

The Chilean hake fishery is the oldest fishing activity developed in Chile that started at the end of the 1940 decade with landings that reached near to 10 thousands tons and showed a sustained growth to reach almost 90 thousands tons at middle of the Fifties. After that, we observed a period of stability with landings that fluctuated around 80 thousands tons until the end of the 1960 decade. During the Sixties the Chilean hake landings showed high fluctuations to reach in 1968 the historical maximum landing (128 thousands tons) that were not associated to an increasing of the fishing effort but rather to an increase of the availability of the resource. In the Seventies a strong declination in the landings was observed until reach a new stabilization period but with low levels of landings. During this second period of stability (1975 – 1985) the landings fluctuated around 30 thousands tons.

From the middle of the Eighties until to 2001 the Chilean hake fishery began a new growth phase until reaching a second historical maximum (121 thousands tons). Finally, from 2003 until 2009 a drastically decreasing of the landings was observed reaching landings near to 43 thousands tons in 2007 and a slight increase in 2008 -2009.

In the Chilean hake fishery participates two fleets, an artisanal fleet and an industrial fleet. From 1992 to 1999 the industrial fleet landed in average 80% of the total landings decreasing from 2000 to 2003 when a modification in the fishing law gave a constant participation of the captures of 65%. The landing trends of the industrial and the artisanal fleet from 1992 to 2009 is also analyzed.

*Contact: Rubén Alarcón-Muñoz; e-mail: ralarco@inpesca.cl; phone: +56-41-2920411*

**Bycatch in the industrial fishery of Chilean hake** *(Merluccius gayi gayi)*

Authors: **Rubén Alarcón-Muñoz, Claudio Esteban Gatica Molina, Aquiles Sepúlveda**

*The fishery of Chilean hake (Merluccius gayi gayi) is the main bottom trawl fishery realized in Chile. In this fishery like in others demersal fisheries many different species are incidentally captured together to hake. Those species constitute the by-catch of the Chilean hake. According the Chilean fishing law, the by-catch is part of the capture constituted by different species that are captured by a technological effect of the fishing gears oriented to an specific specie, in this case, Chilean hake. The by-catch can be explained by two factors: (1) the kind of fishing gears used to catch the objective specie is not totally selective, and (2) the species show some ecological relationships in a specific area.*

*In Chile, surveys financed by the government to assess the biomass of Chilean hake between 1995 and 2007 indicate that the by-catch in the Chilean hake fishery are constitutes for 95 species, that according to its importance in weight, can be grouped in five classes: (1) bony fish (Osteichtyes), (2) cartilaginous fish (Chondrichthyes), (3) crustaceans (Crustacea), (4) cephalopods (Cephalopoda), and (5) other invertebrates. Nevertheless, in the industrial captures between 2001 and 2007 just 42 species were identified as part of the by-catch, being also grouped in same classes that the surveys. The main specie of the by-catch in the industrial captures was jumbo squid (Dosidicus gigas).*

*The diversity and importance in number of species and in weight of the by-catch in the Chilean hake fishery is annually analyzed between 2001 and 2007. Also, the species composition of the by-catch of Chilean hake fishery is compared with biomass surveys.*

*Contact: Rubén Alarcón-Muñoz; e-mail: ralarco@inpesca.cl; phone: +56-41-2920411*

**Video Observations of a whiting net bycatch reduction device**

Author: David Chosid

The northern whiting Merluccius bilinearis (silver hake) stock in the Gulf of Maine generally exceeds its biomass targets and landings have been at a historical low. This fishery has traditionally been an important source of income for small trawlers in ports from Maine to Massachusetts. Spiny dogfish Squalus acanthias, an abundant bycatch, can prevent or hinder exploitation of this healthy stock. This species needs to be kept out of whiting nets to reduce bycatch mortality and to prevent damage to the catch due to the abrasive skin of dogfish. Also, bycatch levels of spiny dogfish may become especially critical once accountability measures are put into place in 2010; high discards of dogfish could close groundfish fisheries if bycatch allowances are exceeded. Furthermore, discarding of spiny dogfish is a time-consuming process.
Our collaboration of fishermen and biologists tested excluder grates with 50 mm (~ 2 inches) spacing to eliminate spiny dogfish in a raised-footrope whiting trawl net. Designs were varied by color (black or white), and upward or downward exclusion (through a top or bottom escape vent). Video showing the behaviors of whiting, dogfish, and other species' interacting with and around the grate were reviewed. Results based on observations and catch quantities indicate an overall excellent reduction of dogfish while allowing for commercial harvests of whiting and Atlantic herring Clupea harengus. Industry acceptance of a grate can provide cost benefits for fisherman and protection for managed bycatch.

*Contact: David Chosid; e-mail: david.chosid@state.ma.us; phone: 508.990.0449*

**Alpha Mar Trawl**

Author: Elias Olafsson

In order to effectively harvest the existing resources we have available to us, limit or eliminate the incidental catch of unwanted species and increase the relative efficiency of the platforms harvesting our resources, we must set aside our traditional approaches to trawl design and open ourselves to new design concepts. These new concepts will improve our ability to effectively harvest our resources while we confront the issues facing the industry today.
To date, traditional 'mesh' trawls have been relatively effective in harvesting the resources made available to our industry. Yet, the current climate compels us to consider a bigger picture than solely catching the fish. Modern trawl designs must confront other dilemmas such as fuel consumption, incidental catch and the economic viability of smaller platforms. By analyzing the core principals of the traditional trawl we are able to develop a new philosophy of design which utilizes the trawl as part of a system including the vessel, trawl doors and rigging. We can focus on maximizing the efficiencies and control within the system and subsequently make a vessel more efficient in its harvesting of the resource.
With this in mind, Dantrawl has recently finalized development of a new design concept, the Alpha Mar. The Alpha Mar design eliminates the use of meshes typically associated with front ends in traditional midwater trawls. Further, the design utilizes the power of the trawl doors to create greater control further back in the trawls. These elements combine to increase the efficiency of the design, reduce fuel consumption and allow smaller platforms to tow larger trawls. In the long term, it is our hope that we can also take advantage of the increased efficiency of this new design concept to tackle related incidental catch issues in specific fisheries.
The Alpha Mar design will be deployed into the Pacific Hake fisheries on the West Coast during the upcoming 2010 season.

*Contact: Elias Olafsson; e-mail: elias@dantrawl.com; phone: 206.789.8840*

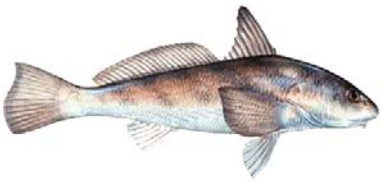
**Review of fishermen collected data to investigate patterns in hake catches on Georges Bank**

Author: Sally Roman

The University of Massachusetts, Dartmouth School for Marine Science and Technology (SMAST) has managed a study fleet fishing out of the port of New Bedford, Massachusetts since 2000. The SMAST study fleet collects effort, catch, and biological data on the haul level from a selection of commercial offshore otter trawl vessels targeting groundfish. Project objectives include: 1) obtaining fisheries data with high spatial and temporal resolution and 2) involving the fishing industry in the collection of fisheries data and management of the resources. Although hake species are not directly targeted by study fleet vessels, white hake (Urophycis tenuis) and red hake (Urophycis chuss) are captured in the mixed species groundfish fishery. Large white hake are retained by vessels for sale and all other hake are discarded. A review of hake catch data was completed to examine study fleet catch of hake including trends in catch rates and spatial distribution of catches. Data from 2000 to 2009 were queried from the study fleet database for hake species. Study fleet ves-

sels do not report white or red hake as separate species because of misidentification that can occur with small white hake and red hake. However, all retained hake are believed to be white hake because of their size, observations by SMAST technicians, and comments from participating vessels. The number of trips and hauls observed per year varied because of funding, and fishing effort. The study fleet caught a total of 167, 229 lbs of hake including 152, 566 lbs of retained white hake and 14, 663 lbs of discarded red/white hake. Catch of hake by study fleet vessels has declined since 2000 with a slight increase in 2003. Monitoring of commercial hake catch can provide insight on the abundance and the spatial distribution of these species. For example, even though hake catch has remained consistent on the western edge of Georges Bank for the entire time series, hake catch have increased in southern areas in recent years.

*Contact: Sally Roman; e-mail: sroman@umassd.edu; phone: 508.910.6379*



*Uropycis tenuis*

*Urophycis Chuss*

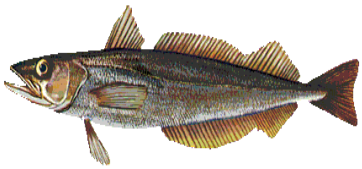
*Merluccius gayi gayi*

**Why open access management of small mesh hake fisheries has not failed - yet**

Author: Andrew Applegate

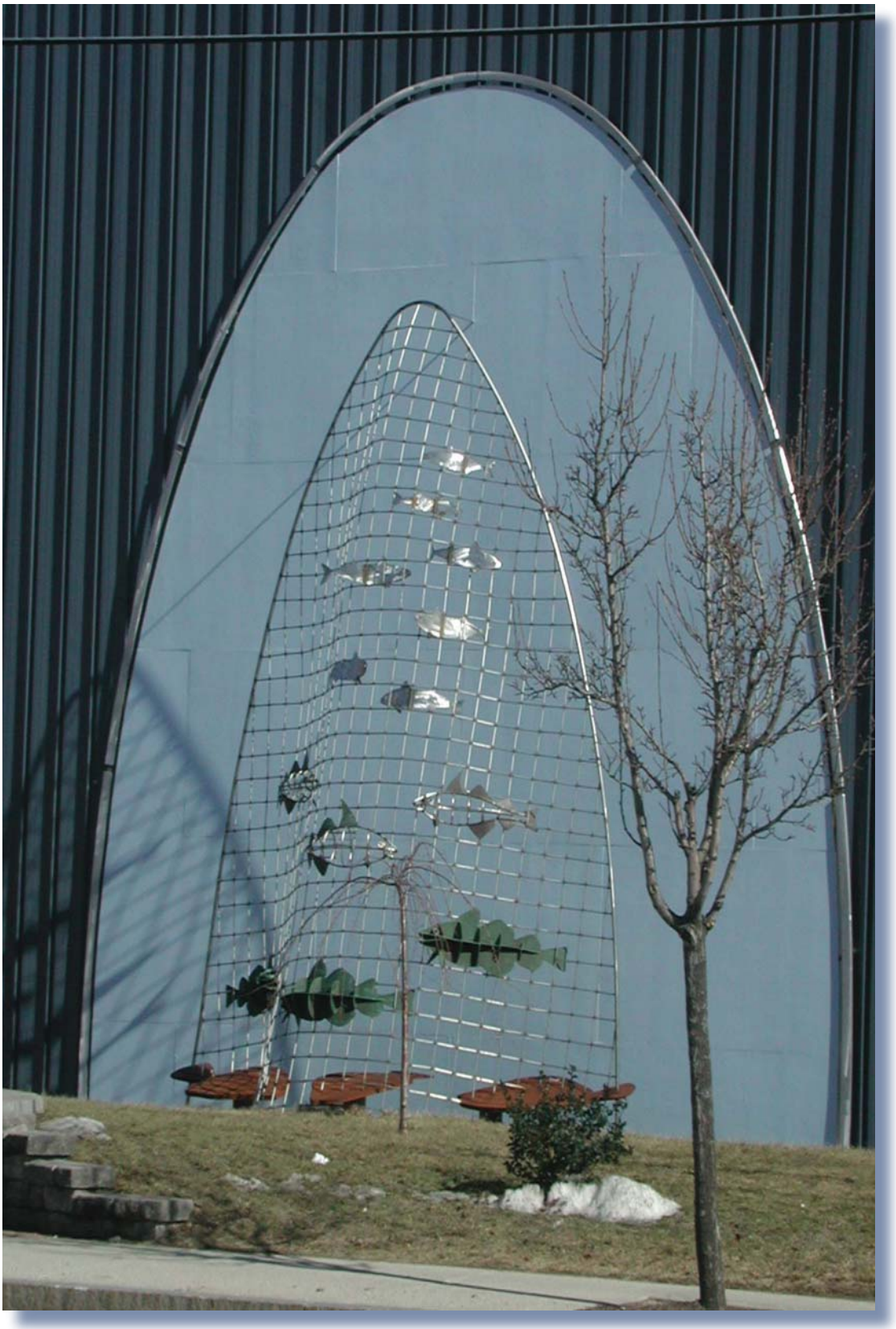
Since 1987, the small mesh hake fisheries, targeting silver hake (Merluccius bilinearis), offshore hake (Merluccius albidus), and red hake (Urophycis chuss) has been regulated by the Northeast Multispecies Fishery Management Plan using open access permits, restricted fishing areas, minimum mesh restrictions, and mesh-specific possession limits. The history of the fishery in the Northwest Atlantic is reviewed before and since multispecies management was implemented; to explain why despite open access, the fishery has remained somewhat muted in comparison to other trawl fisheries. Potential future management of the fishery is discussed, including the possible application of annual catch limits (ACLs) and multispecies sector management policy.

*Contact: Andrew Applegate; e-mail: aapplegate@nefmc.org; phone: 978.465.0492 ext. 17*



*Merluccius bilnearis*

*Merluccius merluccius*



Northeast Consortium

UNIVERSITY of NEW HAMPSHIRE

NOAA