

History of Marine Animal Populations Phase II: Working Description

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By

HMAP Steering Group:

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Executive Summary

HMAP is the historical component of the Census of Marine Life. HMAP's long-term aim is to improve our historical understanding of ecosystem change and our ecological understanding of man's role in changing marine ecosystems. After a consultation process involving several informed parties, a Steering Group for HMAP has been formed. This document contains HMAP-SG recommendations for the selection of an initial seven case studies for the further testing of key ecological hypotheses, and for a plan to build an institutional framework for the training of specialists in marine environmental history and historical ecology. Three universities are identified as a suitable basis for an institutional structure to support both the research initiatives and the expected disciplinary development. Schedules for institutional and disciplinary development and for research are included, along with a budget for the next two-years of HMAP.

Introduction

The History of Marine Animal Populations (HMAP) is the historical component of the 'Census of Marine Life' (CoML) program. It was initiated in the fall of 1999 based on the approach outlined in Holm, Smith and Starkey ("History of Marine Animal Populations: Testing Ecological Hypotheses"). Funding from the Sloan Foundation supported several modest research initiatives that constituted Phase I of HMAP. These initiatives focused on identifying ecosystems that were suitable for the development of improved understandings of the historic effect of humans on the marine environment, especially related to fisheries. The results of these studies were considered during a workshop held in February 2000 in Denmark. Then, historians and scientists established the aims, methods and scope of HMAP, identified several ecosystems as suitable for further HMAP studies, and discussed a research agenda for a ten-year HMAP effort, as described in the workshop report (Smith and Holm. 2000. "Workshop on History of Marine Animal Populations (H-MAP)").

The recommendations were reviewed by the Scientific Steering Committee for the Census of Marine Life and built into the draft Science Plan for the entire Census. Further consultations among workshop organizers and participants and other scientists and historians have resulted in further development of the research direction and plans, the overall scope of research, prioritization of the identified potential case studies, identification of other potential case studies to be evaluated, and identification of the need for the development of a sub-disciplines of Environmental History and Marine Ecology focused on the marine environment.

This synthesis has a rich potential. Ecologists need historical data to test key ecological hypotheses. Historians need to inform their analyses of the relationship of humans and the sea by improving their understanding of ecosystems. The long data time-series to be generated will be used to provide input to contemporary ecological modeling in order to characterize and visualize past ecosystems. Such visualizations and testing of ecological hypotheses will juxtapose and enhance the disciplines of history and ecology in seeking to explain long term changes in marine animal populations and their ecosystems, especially those changes resulting from man's activities.

The HMAP-SG has obtained funding from the Alfred P. Sloan Foundation to support Phase II of HMAP, which will build on the workshop recommendations and the CoML Science Plan to address the need for historical and ecological research within a fully developed institutional framework

HMAP Phase II

The HMAP Phase I workshop report identified the need for a strong central organization that would:

- maintain a focus on the hypotheses outlined, both within individual studies of specific ecosystems and among studies in different systems
- identify and design priority research projects
- facilitate the organization of research teams.

A Steering Group was formed, comprising a fisheries historian (Holm, Southern Denmark University, chair), a fisheries ecologist with strong paleoecology interests (Francis, University of Washington), two fisheries biologists (Rosenberg, University of New Hampshire, & Smith, Northeast Fisheries Science Center, Woods Hole MA) and a maritime historian (Starkey, University of Hull).

The CoML Scientific Steering Committee recommended at meetings in May and September 2000 that the HMAP Steering Group investigate the possibility for identifying 3-4 HMAP Centers. The Centers would form the core institutions in the further development both of the individual projects through the next 8-10 years and for the wider issues of developing collaboration between ecologists and historians in marine environmental history.

This document contains the recommendations of the Steering Group for HMAP Phase II regarding the scope of HMAP in the context of CoML, the formation of three HMAP Centers, the selection of seven initial research projects, and approaches for developing new research projects. It also details schedules relating to institution building (Appendix 1) and research projects (Appendix 2).

Scope and Methods of HMAP

The ecological hypotheses developed by HMAP Phase I (see Appendix 3) addressed a wide range of methodological, ecological and historical questions that could be addressed with historical and paleoecological data covering long time periods. The recommendation from most workshop participants was that it would be best to orient HMAP towards collecting and analyzing data from selected ecosystems specifically to test some of these hypotheses, rather than attempting a broad brush approach of also collecting historical data from a wider range of

ecosystems where in some cases archives have been degraded or were never established. Therefore, the workshop agreed that HMAP should focus on exploited ecosystems where sufficient historical data are likely to exist, and where current ecological understanding has been sufficiently developed to allow changes in ecosystem structure and function to be detected.

The focus of HMAP is toward ecosystems that have been subject to fishing. In addition to paleoecological data that accumulate under certain environmental conditions, HMAP will make use of written archives containing actual or surrogate data on landings and fishing effort and on fishing operations. Such data range from formal port or governmental or tax records, especially what has been termed the statistical era (since 1900) and the proto-statistical era (1850-1900), to less formal records of from fish markets and church records of tithes, which are more likely in the pre-statistical period (pre-1850). HMAP will also access fishery resource survey data where they exist, especially from research efforts that may have occurred early in the development of fisheries. These data sources will allow the development of both quantitative time series of fishery related indices as well as qualitative overviews of ecosystem features. In addition to such data relating to the animal populations, HMAP will also access historical data on environmental changes that are rapidly accumulating from a variety of research projects.

To synthesize such diverse information several different modeling approaches will be used. Statistical modeling of historical information will be used in exploratory data analyses to discern pattern through graphical methods and summary statistics, including geographical analysis. We recognize that in some cases data will not support quantitative modeling, but anticipate that useful conclusions may be drawn from more qualitative modeling. Formal evaluation of hypotheses may be possible for some systems. For example, testing hypotheses concerning the impacts of environmental changes on the Baltic Sea fish communities by comparing environmental and fish abundance based on data from tithing records. In addition to such statistical modeling, there is a clear need for extensive simulation work informed by the various historical and biological data sources. Approaches include the analysis of simulation models to determine sensitivity of results to hypotheses about alternative ecosystem structures, back-calculate possible ecosystem configurations based on observed patterns of removals., and simple mass balance models. Of course, analysis and modeling approaches will vary among the case studies because of differences in the types of data available, and multiple approaches will frequently be called for since different approaches potentially reveal pieces of the puzzle of what has happened to ecosystems over historical time.

HMAP Centers

The Steering Group has analyzed a range of institutional issues, including the configuration of relevant academic disciplines, the structure of university departments, and the differences in professional publication and reward patterns between history and science. With regard to the issue of academic disciplines, two main developments are anticipated. One is the promotion of a marine focus within the rapidly developing discipline of Environmental History. With few exceptions, Environmental History has addressed the effects of human activities in terrestrial systems, where they are more easily observed. We intend to draw this discipline into the marine situation, especially relating to fisheries. Second is the development of an historical perspective within Marine Ecology, focusing on environmental and ecological change, again especially in the context of fisheries. To foster interdisciplinary development, it is essential that the Centers be based at universities where there is strong institutional support for the development of

interdisciplinary and inter-institutional research programs. Following consultation both at the departmental and administrative level, the Steering Group is confident that the Universities of New Hampshire, Southern Denmark and Hull, UK, will provide ideal hosts for the three Centers. The strengths of these institutions for HMAP purposes are described in Appendix 4.

We will work with three HMAP Centers at UNH, SDU and UH. A joint call for MA and PhD students will be immediately issued, along with an invitation to students for an Interdisciplinary Summer School to be held in August 2001 in Esbjerg, Denmark. Strong interdisciplinary training programs will be developed at both the Masters and PhD levels. Students will be expected to develop primary skills in either environmental history or marine ecology, and a working knowledge of the other. To enhance the development and interchange of research methodologies, support for visiting faculty and graduate student exchanges will be provided. Involvement in professional society meetings will be encouraged and supported. Students and faculty associated with HMAP will be encouraged to participate in the International Summer School, modeled after the successful international summer school, titled "Fishing Matters," held in Denmark in 1998 (<http://www.fimus.dk/fishmatt.htm>).

Institutionally, HMAP will be structured around the three Centers, two responsible for regional and, as appropriate, international components of both historical and ecological research, and the other responsible for the processing and storage of both historical and ecological data in a consistent manner. The first two Centers are the Southern Denmark University (SDU) at Esbjerg and the University of New Hampshire (UNH) at Durham. SDU at Esbjerg is a new and growing campus that hosts the Center for Maritime and Regional History led by Poul Holm, recently of the Danish National Fisheries and Maritime Museum. UNH is an established university with two relevant interdisciplinary programs, one a PhD program in Natural Resources and the other a new Masters Program in Environmental Education. Dr. Andrew Rosenberg, recently of the US National Marine Fisheries Service, is Dean of College of Life Sciences and Agriculture, where these interdisciplinary programs are located.

In support of HMAP's data requirements, the third Center, the University of Hull (UH), will be responsible for managing and co-coordinating the computerization and archiving of the data collected for all components of HMAP, as well as conducting several of the initial case studies. UH hosts the Maritime Historical Studies Centre, led by David J. Starkey, Wilson Family Senior Lecturer in Maritime History. The Centre has strong computer science and data handling capabilities that have been proven in other historical studies. The data handling capabilities developed at UH will provide the primary data archiving (and hence access) point for HMAP participants. UH will also interface with the Ocean Biogeographical Information System (OBIS) to ensure efficient integration of the HMAP data into the larger CoML program.

Additionally, over the course of Phase II of HMAP, efforts will be made to identify a fourth institution where HMAP might be developed, preferably on the Pacific Rim, in Asia or in the Southern Hemisphere.

HMAP Research Plans

The Steering Group will co-ordinate the work of the three HMAP Centers as well as continuing to direct the individual HMAP research projects. The disciplinary and institutional breadth of the Steering Group will enable it to organize and direct the historical and ecological interdisciplinary research envisioned under HMAP. For each of the seven case studies, a Working Party will be appointed, which will report to the Steering Group. For the exploratory studies, the

Steering Group will oversee directly the historical source reviews. A prime focus of the Steering Group will be maintaining an interdisciplinary dialog to ensure that methodological differences are identified and addressed as they arise. In addition the Steering Group will ensure that the historical and ecological analyses within each project are integrated, and that expertise in a variety of ecological analysis and modeling methods is available within each project. To accomplish this, the Steering Group will meet regularly, and a substantial commitment of time by members is anticipated.

The research approach developed in Phase I was to identify large marine ecosystems where the ecology has been well studied and where complementary historical data on fisheries, and/or paleoecological records, are likely to exist. HMAP will pursue the seven case studies (see Appendix 3) that were identified based on the preliminary evaluations of HMAP Phase I as being most suitable. These are:

Northwest Atlantic	Gulf of Maine, Newfoundland-Grand Banks, Greenland cod fisheries
Southwest Pacific	Southeast Australian Shelf and Slope fisheries, New Zealand Shelf fisheries
White and Barents Seas	Russian and Norwegian herring, salmon and cod fisheries
Norwegian, North and Baltic Seas	Multinational cod, herring and plaice fisheries
Southwest African Shelf	Clupeid fisheries in continental boundary current systems
World Wide Whaling	Historical and 20 th Century whaling in all oceans
California Current	Clupeid fisheries in continental boundary current systems

Exploratory historical research similar to that in HMAP Phase I will be conducted to identify further case studies of other ecosystems that have not yet been adequately evaluated for HMAP purposes. Candidates include the Caribbean Sea, southeast Asian seas, the Mediterranean Sea and the Bering Sea. The keys to identifying suitable additional case studies will be identifying both adequate historical archives and paleoecological archives and the identification of personnel able and willing to conduct an initial review of historical sources relating to each region. We anticipate identifying some additional worthwhile studies, but recognize that the conditions suitable for an HMAP case study are difficult to meet.

Initial findings from the case studies will be presented at the second HMAP Workshop (the first was February 2000), scheduled to follow the International Summer School in August, 2001. The Steering Group will immediately thereafter review the results and make necessary adjustments to research plans. In addition, the Steering Group will develop plans for exploratory historical research to determine the feasibility of other case studies. The Steering Group will use the initial results available in the fall of 2001 to develop an Implementation Plan, as its part of the Census of Marine Life's long term plan. This will identify future research on both decadal and 3-5 year scales. In 2002, HMAP will continue to pursue the seven case studies, and findings in the form of draft scientific and historical papers will be presented for the third HMAP Workshop scheduled for August 2002. These will be finalized and submitted to journals by the end of 2002.

Communicating HMAP Plans and Results

To ensure that information on the progress of HMAP is disseminated widely, the Steering Group will formulate an outreach strategy in conjunction with the Census Secretariat at CORE. A variety of media, such as news releases, leaflets, posters and an HMAP website, will be used. The announcement in December 2000 of the HMAP Centers will be followed immediately by a global call for MA and PhD applicants for study grants. We expect to support 10-12 Masters and

3-4 Phd students annually in the three Centers. In March 2001 and 2002, the International Summer Schools to be held in August of those years will be widely advertised.

Results of HMAP research projects will be published in the primary literature of both environmental history and marine ecology. HMAP participants will be expected to present research results in the 2001 and 2002 Workshops, and to publish results in peer reviewed history and ecology journals. HMAP participants will also organize sessions at meetings of history and marine ecology professional societies, and the Steering Group plans to organize a symposium under the auspices of the International Council for the Exploration of the Seas (ICES). Support will also be provided to enable HMAP participants to present both research plans and results at selected institutions to inform the academic research community of the work being done.

The historical data developed by HMAP research projects will be developed by the University of Hull for use by the Ocean Biogeographical Information Systems that will handle all of the Census data. Structures that are tailored to the needs of historical data will be developed, especially to facilitate easy access to long time series of fisheries and related data. These data will be documented in data monographs and data bases will be made available on the World Wide Web.

In the longer term, HMAP will lay a basis for fundamentally redefining our understanding of man's relationship to and affect on marine ecosystem over historical time. To convey this deeper perspective, HMAP will produce discipline-defining proceedings volumes, (for example, the first will be the results of the first HMAP Workshop, "Exploited Seas: Directions for Environmental History"), and scholarly and specialists monographs. Books are envisioned which would be accessible to both the academic community and to the interested public. In addition, HMAP will approach broad-based media outlets such as National Geographic Society about developing materials for the general public.

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**Appendix 1. History of Marine Animal Populations Schedule of Activities for 2001 and 2002,
and some activities which can be anticipated in 2003.**

(Activities anticipated but not included in available funds shown in SMALL CAPITAL LETTERS)

Month	2001	2002	2003
(Dec 2000)	Sloan Foundation announces 3 HMAP Centers SG advertises Intl. Grad. Student Opportunity		
January	Sloan transfers funds to UNH UNH transfers institution building funds SG transfers funds for Proj 1, 2a, 3, 4b, 5, 6a, 7	SG proposes Amer. History Assoc panel for 2003 mtg	HMAP Panel: Amer. History Assoc. mtg.
February	SG: Select graduate students	SG: Select graduate students Graduate Student Exchanges	HMAP Session: Am. Assoc. Adv. Sci. HMAP Session Am. Soc. of Env. Hist.
March	SG advertises Intl. Summer School-II Holm & Smith publish <i>Exploited Seas</i> UNH recruiting visiting faculty with modeling expertise	SG advertises Intl. Summer School-III HMAP Panel: Am. Soc. Of Env. History SG: proposes HMAP Panel for ASEH 2003	SG ADVERTISES INTL. SUMMER SCHOOL-IV
April	SG proposes Am. Soc. Of Env. Hist. Panel for 2002 UNH hosts Dunfee Env. History Conf.		SDU: 1 PHD FINISHES
May	SDU: mtg of instructors of Intl. Summer School-II	UNH: mtg of instructors of Intl. Summer School-III	SDU: MTG. OF INSTRUCTORS OF INTL. SUMMER SCHOOL-IV
July	Graduate students start (UNH, UH, SDU) UNH: Visiting faculty start Holm: HMAP presented to Nordic Hist. Congress HMAP Panel: Anglo-Amer. Hist. "The Sea"	Graduate students start (UNH, UH, SDU) UH: History-OBIS project begins HMAP Panel: Amer.-British History Conference	First MS students finish. Second MS students continue 3 PhD students continue
August	Intl. Summer School-II (13-23, SDU) HMAP Workshop-II (24-25, SDU) SG mtg (27-28, SDU): review of progress, new initiatives & implementation plan drafting Graduate Student Exchanges	Intl. Summer School-III (12-22, UNH) HMAP Workshop-III (23-24, UNH) SG mtg (26-27, UNH): planning for HMAP Phase III	INTL. SUMMER SCHOOL-IV (11-21, SDU) HMAP WORKSHOP-IV (22-23, SDU) SG MTG (25-26, SDU)
September	SG: Project funds to PIs for Projects 2b,4b, 6b, 8 Holm: HMAP presented to Europ. Soc. for Env. Hist.	HMAP Session at ICES Statutory Meeting	
October	SG: Presents Implementation Plan to CoML SSC Holm: HMAP presented to IABO / IPASO SG: proposes ICES HMAP session for 2002		
December	SG: proposes History-OBIS project SG: advertises Intl. Grad. Student Opportunity	SG ADVERTISES INTL. GRAD. STUDENT OPPORTUNITY	

**Appendix 2: HMAP Schedule for Research Projects
for 2001 and 2002**

Project	SubProject	2001		2002		
		Jan.	July	Jan.	July	Dec.
1. NW Atlantic		>	-----	-----	Ms	S <
2. SW Pacific	2a. Aust.	>	-----	Ms	S <	
	2b. NZ		>	-----	Rep	<
3. White & Barents		>	^	-----	Ms	S <
4. North-Norwegian-Baltic	4a. Baltic	>	-----	-----	Ms	S <
	4b. N-N		>	-----	Rep	<
5. SW African Shelf		>	-----	Ms	S <	
6. World Whaling	6a. 20 th C	>	-----	-----	Rep	<
	6b. Pre-1900		>	-----	Ms	S <
7. California Current		>	^	-----	Ms	S <
8. Evaluate Sources			>	-----	Reps	<

Key to Symbols

- > Begin work
- ^ Evaluate progress, decide if continue
- Continue research
- < End of project funding
- Ms draft ms completed
- S ms submitted for publication
- Rep(s) progress reports

Appendix 3: Specifics of Seven Case Studies

Seven case studies are defined, incorporating one or more large marine ecosystems, in order to address selected ecological and historical hypotheses developed in the HMAP I workshop report (attachment 2). These areas are grouped into case studies based on geography, nature of fisheries, and nature of historical archives:

1. Northwest Atlantic
2. Southwest Pacific
3. White and Barents Seas
4. Norwegian, North and Baltic Seas
5. Southwest African Shelf
6. World Whaling
7. California Current

For each case study, an HMAP Steering Group contact, and working party leader are identified, along with the institutions that will undertake the proposed work. The large marine ecosystems to be studied are identified by name and sequence number (see attachment 1). The new work to be done is identified briefly, and the specific products to be obtained in HMAP Phase II are defined.

1. Northwest Atlantic

Steering Group contact: David J. Starkey

Working party Leader: David J. Starkey

Institutions: UH, UNH, University of Greenland, Dalhousie University, Memorial University in Newfoundland, NOAA, Canadian Division of Fisheries and Oceans

Ecosystems: Newfoundland Shelf (9), Scotian Shelf (8), NE US Continental Shelf (7), W. Greenland Shelf (10)

Status: HMAP I agreed on the feasibility of studies in the Western North Atlantic, with highest priority for the Newfoundland Shelf and Grand Banks fishery. Recent developments in west Greenland have confirmed that this study would be profitable (Vinnie Andersen personal communication). The fisheries statistics of the twentieth century are relatively complete, and the full state of nineteenth-century data needs to be evaluated. Developing pre-1930s fishery data sources will allow optimum use of the extensive contemporary fishery and survey data in the NE US Continental Shelf system.

New work: Assemble Colonial Office data from London archives, identify, seek access, and collect data from Portuguese and Spanish printed and documentary sources. Mid-1800s Gulf of Maine records will be identified and evaluated. Evaluate and supplement extant fisheries statistics from west Greenland with archival records.

2. Southwest Pacific

Steering Group contact: Tim Smith

Working Party leader: Tim Smith (Leader)

Institutions: UNH, CSIRO (Hobart), Murdoch University (Perth), EcoQuest New Zealand partners

Ecosystems: Southeast Australian Shelf (unnumbered), New Zealand Shelf (40)

Status: HMAP I identified the potential of archival records for trawl fisheries surveys and fisheries statistics conducted since the beginning of commercial fishing early in the 20th Century. Subsequently, extensive archeological studies of Maori subsistence fisheries have been identified.

New Work: Historical archives for the Australian fishery and for the scientific research conducted in the 20th Century will be utilized in order to evaluate the impact on the species composition since the beginning of commercial fisheries. The potential for a study using historical and archeological data on Maori fisheries prior to the beginning of (and linking with) the development of commercial fisheries will be evaluated.

3. White & Barents Seas

Steering Group contacts: Poul Holm and David J. Starkey

Working Party leader: Julia Lajus

Institutions: European University of St Petersburg, Russian Academy of Science (St. Petersburg, Moscow, Archangel), Universities of Bergen and Tromsø

Ecosystems: Barents Sea (19), White Sea (unnumbered)

Status: HMAP I identified the potential value of the Russian archives especially for the herring and salmon fisheries of the White and Barents Sea. Subsequent evaluation has suggested the potential for a study of these species and cod in Norwegian and Russian fisheries in the Barents Sea.

New work: Snapshots of the fisheries statistics for three sets of selected years, ca 1600, 1800, 1900, will be gathered from the Russian archives, and used to assess the potential for the creation of long time series in the White Sea. The potential for a study of the Barents Sea fisheries will be evaluated.

4. Norwegian, North, & Baltic Seas

Steering Group contact: Poul Holm and David J. Starkey

Working Party leader: Maibritt Bager

Institutions: SDU, UH, Danish, Swedish, German, Estonian, Latvian, Lithuanian, Finnish and Polish Fisheries Research Institutes, University of Bergen

Ecosystems: Norwegian Sea (20), North Sea (21) and Baltic Sea (22)

Status: HMAP I agreed that the Baltic Sea would be a good candidate for HMAP analysis, and outlined steps that needed to be taken to develop an integrated study in this politically diverse region. The Norwegian and North Seas were not reviewed, but these have been better studied and therefore it is anticipated that sufficient ecological and historical information will be available.

New work: The vast national archives will be systematically sampled, and data generated for a testing of selected ecological hypotheses. The potential for application of paleoarchival methods to the Gotland Deep will be evaluated. The potential for an application of the Baltic methodology for the North and Norwegian Seas will be evaluated.

5. Southwest African Shelf

Steering Group contact: Bob Francis

Working Party leader: Lance van Sittert

Institutions: University of Cape Town, Baltic Sea Research Institute, University of Washington

Ecosystems: Benguela Current (29)

Status: HMAP I identified the potential for further study of this system, in comparison to three other major continental boundary currents, to determine the causes of the dramatic changes in productivity (regime shifts) on the decadal to centennial scale in eastern boundary currents are due to physical forcing.

New work: The state of historical archives, paleoarchives and terrestrial archeology will be evaluated. An overview essay will review published material and synthesize the new work on historical archives.

6. World Whaling

Steering Group contact: Tim Smith and David J. Starkey

Working Party leader: Tim Smith

Institutions: UNH, UH, IWC Cambridge, Georgia Tech

Ecosystems: All of the world's oceans.

Status: HMAP I identified the need for considering whale fisheries as a separate unit because of the nature of whale populations utilizing entire ocean basins and the nature of the whale fisheries and associated archival data. Due to the importance of this group of animals in all the world oceans and the major changes in their abundance due to whaling, a comprehensive study was recommended.

New work: The study will be designed as a test case for H-OBIS with the first task to prepare twentieth century catch records held by the IWC for input to OBIS. The archives for pre-twentieth-century whaling operations will be systematically evaluated, and their suitability for further analysis will be determined. Further, existing estimates of historical catches and fishing effort for humpback, right and gray whales will be evaluated and archived.

7. California Current

Steering Group contact: Bob Francis

Working Party leader: Bob Francis

Institutions: University of Washington, University of California San Diego, Pacific Marine Environmental Laboratory Monterey, Scripps Institute of Oceanography

Ecosystems: California Current (3)

Status: HMAP I demonstrated the potential of the information from the paleoecological records of the California Current for testing ecological hypotheses.

New work: Data that have been extracted from bottom samples throughout the region will be compared and used to describe ecosystem structure and stability.

Appendix 3, Attachment 1: Large Marine Ecosystems by name and sequence number, as defined in http://www.edc.uri.edu/lme/clickable_map.htm. See that site for location and specific biological, fisheries and historical information. Two areas proposed for study are not yet defined as Large Marine Ecosystem, the South East Australian shelf/slope system and the White Sea.

1	E. Bering Sea	27	Canary Current
2	G. of Alaska	28	Guinea Current
3	California Current	29	Benguela Current
4	G. of California	30	Agulhas Current
5	G. of Mexico	31	Somali Coastal Current
6	SE US Cont. Shelf	32	Arabian Sea
7	NE US Cont. Shelf	33	Red Sea
8	Scotian Shelf	34	Bay of Bengal
9	Newfoundland Shelf	35	South China Sea
10	W. Greenland Shelf	36	Sulu-Celebes Seas
11	Insular Pacific-Hawaiian	37	Indonesian Seas
12	Caribbean Sea	38	N Australian Shelf
13	Humboldt Current	39	Great Barrier Reef
14	Patagonian Shelf	40	New Zealand Shelf
15	Brazil Current	41	East China Sea
16	NE Brazil Shelf	42	Yellow Sea
17	E. Greenland Shelf	43	Kuroshio Current
18	Iceland Shelf	44	Sea of Japan
19	Barents Sea	45	Oyashio Current
20	Norwegian Shelf	46	Sea of Okhotsk
21	North Sea	47	W Bering Sea
22	Baltic Sea	48	Faroe Plateau
23	Celtic-Biscay Shelf	49	Antarctic
24	Iberian Coastal	50	Pacific Central Am. Continent
25	Mediterranean Sea		
26	Black Sea		

Appendix 3, Attachment 2: Ecological and Historical Hypotheses Identified in H-MAP I
 (Smith, T.D. and P. Holm. 2000. Workshop on History of Marine Animals (H-MAP).<http://www.fimus.dk/hmaprepo.htm>).

1 Historical records can be used to infer fish population and community structure, after accounting for anthropogenic factors.

1.2 Records from light exploitation can be interpreted as sampling the population
 1.2 Records from heavy exploitation can be interpreted as measuring the effect of harvest

2 Anthropogenic changes in fishery patterns include:

2.1 Changes in socio-economic-political-demographic factors (e.g. price, markets, subsidies & taxation, food preferences, transportation economy, access to fishing grounds)

2.2 Changes in technology (e.g. improvements in fish finding, navigation and catching technology, vessels, processing technology)

2.3 Changes in numbers of vessels and individuals in the fishery

2.4 Changes in knowledge (e.g. accumulated experience, knowledge transfer, traditional knowledge, scientific knowledge)

3 Environmental forcing causes changes in abundance and/or spatial distribution

3.1 Highest amplitude variability at lower frequency (red noise spectrum)

3.1.1 Centennial climate shifts (e.g. cooling of Greenland, mini-Ice Age)

3.2 Widest spatial coherence occurs at lower frequencies

3.2.1 Inter-annual fluctuations are local (e.g. reflected in year_class strength)

3.2.2 Decadal shifts are ocean basin wide (e.g. North Atlantic Oscillation, North Pacific Oscillation)

3.3 Changes in patterns of environmental forcing (e.g. saline intrusions to Baltic)

3.4 Episodic events (e.g. Limfjord breaching, volcanos)

4 Fishing mortality has significant impacts on population abundance and/or spatial distribution

4.1 Direct changes:

4.1.1 Decreases in abundance

4.1.2 Contractions in spatial distribution

4.1.3 Changes in age and size composition (e.g. changes in average size, changes in fish quality)

4.2 Indirect changes in species composition:

4.2.1 Switches in abundances of competing species (e.g. skates & flatfish North Sea; capelin-herring Iceland)

4.2.2 Declines in predator's 'carrying capacity' due to harvest of prey (e.g. cod-capelin in Barents Sea)

4.2.3 Changes in prey abundance due to changes in harvesting of a predator (e.g. Antarctic krill surplus, trophic cascading in Baltic)

5 Changes in energy flows across trophic structure due to environmental change or fishing mortality:

5.1 Predator switching prey (e.g. Pacific hake distribution and hence predation on forage fish)

5.2 Changes in pathways from primary to secondary production (e.g. +/- microbial loop)

5.3 Relative abundance of demersal and pelagic species groups switches (e.g. Georges Bank, North Sea)

5.4 Increases in invertebrate abundance (e.g. salps, squid, crabs, lobsters)

5.5 Habitat change due to fishing or coastal and other development (e.g. NW Australia shelf)

5.6 Changes in energy flows due to pollutant loading (e.g. Chesapeake Bay, Southern Seas, PCBs, heavy metals, sub-lethal effects)

5.7 Megafauna structures marine communities (turtles, walrus, whales)

6 Diversity of marine animals has declined due to exploitation and habitat loss.

6.1 Changes in genetic diversity (e.g. DNA analyses of preserved specimens)

6.2 Changes in population richness (e.g. loss of discrete spawning stocks of Atlantic herring, loss of substocks)

6.3 Changes in species richness (number of species in the community)

6.4 Introductions and invasions of species (hatcheries, starfish, zebra mussels)

Appendix 4: HMAP Institutions

Southern Denmark University

Lead: Prof. Poul Holm

PhD Student:

Maibritt Bager (Danish marine resources, 1570-1720)

Research Assistants:

Bo Poulsen (twentieth-century Danish fisheries statistics)

Anne Lif Lund Jacobsen (historical GIS)

HMAP Projects:

White and Barents Sea

Norwegian, North and Baltic Seas

HMAP Responsibilities:

Overall HMAP coordination

Institutional Programs:

Master's and Ph.D. degrees in History, Biology, Environmental Economics

Institutional Summary:

SDU has faculty engaged in the teaching and research of marine environmental history, marine ecology, environmental archaeology, environmental economics and modeling.

1. The Centre for Maritime and Regional History, led by Prof Holm at SDU-Esbjerg (www.sdu.dk/esbjerg), is a research unit of 6 permanent and four temporary staff specializing in marine environmental history, maritime history and integrated coastal zone management research.

2. The Department of History and Civilization at SDU-Odense and Esbjerg has faculty working with environmental history: Prof Nye (American environmental history), Assoc Prof Tønnes Bekker-Nielsen (Ancient Mediterranean fisheries), Assoc Prof Jan Hjarnø (environmental archaeology, New Zealand and Greenland).

2. The Department of Biology at SDU-Odense has an Ecology section lead by Prof Canfield with capabilities needed for HMAP studies. The Department has developed a course in biological science for humanities students.

3. Department of Environmental Economics lead by Prof Vestergaard at SDU-Esbjerg has strong emphasis in fisheries economics and modeling.

The Centre for Maritime and Regional History has strong interdisciplinary connections with other institutions: CMRH works with senior scientist Brian MacKenzie of the Danish Institute of Fisheries Research in Copenhagen (Baltic cod), senior scientist Daniel Conley of the National Environmental Research Institute, Department of Marine Ecology and Microbiology, (paleoecology), and senior scientist Jesper Madsen, National Environmental Research Institute, Department of Coastal Zone Ecology.

University of New Hampshire

Lead: Prof. Andrew A. Rosenberg, Dean of Life Sciences and Agriculture; Fisheries Biology

Faculty: Prof. Jeffrey Bolster, Maritime History
Prof. Lawrence Hamilton, Sociology of Maritime Communities
Assoc. Prof. Mimi Becker, Natural Resources and Environmental Conservation
Assoc. Prof. Kurk Dorsey, Environmental History
Assoc. Prof. Michael Lesser, Marine Ecology
Assoc. Prof. Bill McDowell, Natural Resources

Adjunct Faculty: Dr. Tim Smith, Fisheries Biology

HMAP Projects:

- NW Atlantic, especially Gulf of Maine
- SW Pacific
- SW African Shelf
- California Current

HMAP Responsibilities:

- Overall fiscal coordination

Institutional Programs:

- Interdisciplinary Ph.D. program in Natural Resources
- Interdisciplinary M.A. program in Environmental Education
- Master's and Ph.D. degrees in Natural Resources, Zoology, History, Sociology

UNH (www.unh.edu) has faculty interested in HMAP who are engaged in teaching and research in marine ecology and fisheries, environmental and maritime history, environmental conservation and maritime social anthropology. Several ongoing programs at UNH can be used as fora and catalysts:

- International Research Opportunities Program (IROP) provides advanced research opportunities for students.

- Natural Resources Department has an interdisciplinary doctoral program that has bridged disciplinary boundaries between sciences and humanities.

- The EcoQuest Program provides students from several universities in the US marine environmental field study opportunities in New Zealand.

University of Hull

Lead:	Dr David J. Starkey
Staff:	Dr Richard Gorski, Maritime History, Database Design
Honorary Research Fellows:	Dr Robb Robinson, Fisheries History Dr Neil Ashcroft, Fisheries History, Data Handling Dr Michael Haines, Fisheries History, Data Handling
PhD Students:	Michaela Barnard, Business History, UK Fisheries Roger Mumby-Croft, Industrial Relations, UK Fisheries
MA Students:	Martin Wilcox, Labour in the Trawl Fisheries Angus Smith, Hull Trawling, 1960s
HMAP Projects:	NW Atlantic World Whaling
HMAP Responsibilities:	Data handling and archiving for all HMAP projects Liaison & Collaboration with OBIS

The Institution:

The Maritime Historical Studies Centre (MHSC) (Director, David J Starkey) is located in Blaydes House, an eighteenth-century merchant's house recently renovated and equipped to provide the office space and data handling facilities to undertake major research investigations. Its mission is to provide high quality undergraduate and postgraduate teaching programmes in the field of maritime history, and to develop into a centre of research excellence of international standing.

The MHSC forms part of the Department of History, one of the University of Hull's most distinguished academic units. It has developed inter-departmental, interdisciplinary links with colleagues and research units in other parts of the University of Hull, notably in the Wetland Archaeology Unit, the Coastal and Estuarine Studies Centre, and the Biological Sciences Department. The MHSC benefits from the technical support of the University's Computing Centre, and the services provided by the administrative departments.