PROGRESS REPORT FOR 2005

• PROJECT TITLE: Analyzing 19th-century Fisheries Records to Determine the Historical Abundance and Distribution of Gulf of Maine Cod

• PRINCIPLE INVESTIGATORS: W. Jeffrey Bolster (Department of History, UNH)

• OTHER RESEARCHERS: A.A. Rosenberg, A.B. Cooper, W.B. Leavenworth, M.G. McKenzie, K.E. Alexander, S. Claesson

• PERIOD AND AMOUNT OF AWARD: Initiation Date 2/1/04; Completion Date 1/31/06; $85,242/year (2 years)

• PUBLICATIONS:


Bolster, W.J. (submitted) “Opportunities in Marine Environmental History,” submitted to Environmental History.


Leavenworth, W.B.; Alexander, K.E; Smith, G., Brennan, S.; Claesson, S. (in prep., working
title) "Spatial Fishing Patterns in the Gulf of Maine, 1852-1865."

Rosenberg, A.A.; Bolster, W.J.; Leavenworth, W.B.; Alexander, K.E.; Cooper, A.B. (in prep., working title) “Inshore Migration Patterns of Gulf of Maine Cod and Hake, 1852-1865”


Bolster, W.J.; Rosenberg, A.A.; Leavenworth, W.B.; Cooper, A.B; Alexander, K.E. (in prep., working title) “Bait and Fish: The Relationship of Cod Catch and Sightings of Bait in the 19th-century Coastal Codfishery in the Gulf of Maine”


Alexander, K.E. (in prep., working title) “So Ends This Day: Personal Records of Life at Sea from 19th-Century New England Fishermen’s Logs”

Brennan, S. (in prep., working title) “Neighbors at Work: Demographics of Fishing in 19th-Century Maine Coastal Villages”

**PROFESSIONAL DEVELOPMENT:**

Graduates:


René Poulsen, Ph.D. in History awarded by the University of Southern Denmark in July 2005. Dissertation: *An Environmental History of North Sea Ling and Cod Fisheries, 1840-1914.*

Graduate Students:
Lesley Rains, MA, Ph.D. Candidate in History
Stefan Claesson, MA, Ph.D. Candidate in Natural Resources
Erika Washburn, MA, Ph.D. Candidate in Maritime History, University of Southern Denmark

Prospective Graduate Students:
Steve Brennan, MA, prospective Ph.D. student in History
Emily Klein, prospective Masters Candidate in Marine Ecology

Undergraduate Research Assistants:
Tristan Law, History
Renée Dunn, Resource Economics

Visiting Scholars:
Dr. Dmitry Lajus, Department of Ichthyology and Hydrobiology at St. Petersburg State University, Russia, Fulbright Scholar, 2006, working on collaborative topics comparing historic White and Barents Sea cod and salmon fisheries with those in the Gulf of Maine.

Dr. Julia Lajus, Department of History and Department of Marine Biology, European
University of St. Petersburg, Russia, received the Breuninger Fellowship in Environmental History, a prestigious National Award in Russia, to compare US and Russian Fish Commission and Fisheries Expositions in the late 19th century.

**OUTREACH IMPACTS:**

**Public or Professional Presentations:**
- "Retelling the History of New England and the Sea as if the Oceans Mattered," University of Connecticut, Avery Point, CT (W.J. Bolster) Mar 2005;
- "Retelling the History of New England and the Sea as if the Oceans Mattered," Cape Cod Museum of Natural History, Brewster, MA (W.J. Bolster) Apr 2005;
- "Opportunities in Marine Environmental History" New England Marine Environmental History Conference, Woods Hole, MA (W.J. Bolster) May 2005;

**Media Presentation:**
A Census of Marine Life press release for the *Frontiers* paper resulted in more than 20 news articles around the world. This work was reported on CNN, UPI, Reuters, CPI, MSNBC, the Washington Times, and the Kerala (India) Daily New, among others. [The last was particularly gratifying to the historians on this project because Gilbert Westin and Calvin Foster, schooner captains from Beverly, Massachusetts in the 1850s, were quoted in the Indian Newspaper as experts on the fishery.]


In addition, Rosenberg, Bolster and Leavenworth were interviewed for a documentary on overfishing to be completed in 2006 by an independent film producer. Alexander provided background information to Jean Michel Cousteau’s production company, which is researching a story on the National Marine Sanctuaries.

**Websites:**
- Gulf of Maine Cod Project: [www.fishhisstory.org](http://www.fishhisstory.org)
- HMAP: [www.hmapcoml.org](http://www.hmapcoml.org)

**Museum Exhibits:**
*From Abundance to Aquaculture: Changes in New England’s Fisheries,* (forthcoming) permanent exhibit to be displayed by the Seacoast Science Center, designed by G. Smith.

*All Hands Employed—An Alliance of the Past and Present for the Future of the Fisheries,* (in prep.) exhibit to be displayed at the National Archives and Records Administration, New England Regional Center, Waltham, MA, designed by G. Smith.

**Conference (Participation):**

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NSF Human and Social Dynamics Award Recipient Conference, Washington, DC, Sep 2005 (A.A. Rosenberg, K.E. Alexander)

Conference Papers:
“Historical Perspectives on Gulf of Maine Coastal Cod Fisheries,” Conference on the Gulf of Maine Cod Fishery, Island Institute, Rockland, ME (W.J. Bolster) Apr 2005;
“Opportunities in Marine Environmental History” New England Marine Environmental History Conference, Woods Hole, MA (W.J. Bolster) May 2005;
“Offshore Technology Changes and Their Impacts on Inshore Species around Cape Cod, 1860-1895,” Oceans Past Conference, Kolding, Denmark (M. MacKenzie, Sea Education Association), Oct 2005


*Other Support Received This Year:

Introduction:
**Project Objectives:** The project’s goals are to establish biological reference points and geographical distribution for the mid 19th-century cod population in the Gulf of Maine. Whenever possible, we will adapt modern fisheries stock assessment models and non-linear statistical methods to data from log books from the inshore codfishery, 1852-1866. The 19th century Gulf of Maine cod population will be compared to its modern counterparts today. These goals will be accomplished through these three objectives: 1) evaluation and retrieval of historic fisheries data from the logs, 2) database design and management, 3) metric derivation, mapping and biostatistical analysis, and 4) comparisons between the 19th century Gulf of Maine cod population and the modern cod population.

Analysis of the cod logs was substantially expanded in September 2004 when we received an NSF Human and Social Dynamics grant to examine knowledge systems, risk taking and decision making among 19th century New England codfishermen. NSF funds allowed us to make pdf copies of the logs in public collections, enabling in-house work on the same log by several researchers at the same time, reexamination of the logs, and eventual web-posting. Pdf files have greatly enhanced what we do with the logs and increased productivity. They facilitated collaborations such as contributing to the NOAA digital library and the Smithsonian Oceans Hall website, projects still in the planning stages. They also forced us to reexamine initial assumptions about the dataset in light of the variety of fishing patterns identified for inshore vessels. Fishing in the Gulf of Maine was quite different from fishing on the Scotian Shelf and other offshore grounds.

**Objective 1—Evaluation and Retrieval of Historic Fisheries Data from the Logs:** In order to analyze historic catch data with fisheries stock assessment models, the records must supply catch per day for each vessel over a geographically specific area, as well as parameters for that vessel such as size (tonnage) or number of men fishing. Since fishing logs acted as payrolls in the 19th-century, they provide the numbers of fish caught by each man per day for the entire season, from which catch/vessel-day is aggregated. Fishing agreements (the contract between the vessel’s management and the crew) provide the vessel tonnage and generally the weight of the catch in quintals (1 quintal = 112 lbs.), often at the end of each fare, or discrete trip during a season. While deepwater vessels made only one or two fares per season, Gulf of Maine vessels could make as many as 50 separate fares (Newburyport). Three or four fares per season were more representative, although most coastal fishing vessels made frequent trips in and out of port during each fare. By linking data in the fishing agreements and in the best of the logs, catch, fishing effort, and geographical position can often be derived for each day of the season. Using similar data, Gulf of Maine Cod Project researchers and analysts calculated the biomass of cod on the Scotian Shelf in 1852 from logbooks of the Beverly, Massachusetts, cod fleet (Rosenberg et al. 2005).

**Accomplishments:** 92% of the extant logs have been assessed, and 600 logs from Penobscot, ME, Frenchman’s Bay, ME, Machias, ME, Beverly, MA, have been digitized. Logs from the Massachusetts Customs Districts of Beverly (701), Newburyport (233) and Barnstable (112), and the Maine Districts of Frenchman’s Bay (521), Machias (142), Deer Isle (45) have been evaluated for fishing location (1762 total). Although the fishing location has been determined for 8 logs from the Kennebunk District found last year at the Old Berwick Historical Society, most logs at Mystic Seaport (51) have not yet been examined, nor have the 93 logs at the Marblehead Historical Society. We have found 611 vessels fishing in the Gulf of
Maine full time and 161 part time so far. Since this survey includes the majority of logs, few vessel names will be added to this list. The logs show that 95% of Maine vessels fished exclusively in the Gulf of Maine, but only 31% of Massachusetts vessels fished there exclusively. Very few logs represent the Cape Ann coastal fishery.

Only about 30% of Frenchman’s Bay logs have detailed enough descriptions of the fishing grounds to establish the precise location of catch each day, although Machias logs are more descriptive. The deepwater Beverly fleet recorded daily latitude and longitude while underway, and occasionally made observations on the Scotian Shelf as well. Gulf of Maine skippers were much more laconic in their record keeping. While this surprised us at first, we soon came to realize that the inshore skippers may have treated fishing trips as we do the drive to work. Many went home for church, some to vote in local elections, to get in their hay. Most vessels docked into nearby ports during bad weather. Most fares were short, routine, and didn’t require diligent navigation. In Gulf of Maine logs for which catch can be easily geographic-referenced, captains occasionally noted the names of individual fishing grounds in daily entries, although more often locations at sea were identified by landmarks. Many vessels fished in one area for an entire fare, providing excellent geographic specificity.

Quantitative and qualitative data from the logs and fishing agreements from 456 Gulf of Maine vessels (Frenchman’s Bay and Machias, ME, and Newburyport, MA) and 46 deepwater vessels (Beverly and Newburyport, MA, and Kennebunkport, ME) have been entered in Daily Catch Record (DCR) databases. Each DCR corresponds to one log, or one vessel/season. It contains daily catch and location of that vessel throughout the season, as well as occasional observations on the fishing grounds, normalized for statistical analysis. Customs District Log (CDL) databases aggregate catch and vessel information from all the schooners licensed in that port each year, linking catch data from a log with vessel size from its corresponding fishing agreement. Fare Sheets, aggregating catch over each fare of one vessel in a single season, also derive from DCRs and allow catch per fare to be linked with the weight of fish caught during that fare, information occasionally, but not always, provided on the fishing agreement.

We hoped to correlate fishing strategies we observe with vessel size, homeport and fishing ground to create fishing profiles for Gulf of Maine codfishing vessels. These profiles could aid in estimating the fishing range and catch of vessels with no extant log. For schooners from deepwater fleets, vessel size and homeport are good indicators of fishing location. Small vessels under 35 tons generally fished inshore Gulf of Maine grounds, while schooners over 50 tons fished the grounds further from shore. The size of Massachusetts offshore schooners correlated well with fishing banks. Large schooners over 50 tons from Newburyport, MA, generally fished the Labrador. Very large schooners over 80 tons from Beverly, MA, generally fished the Grand Banks, while those ranging from 50 to 80 tons from Beverly fished the Scotian Shelf. For Massachusetts communities and the offshore banks, vessel tonnage is a good proxy for effort and fishing pattern. Catch and effort can be estimated for statistical models. We were surprised to find that this straightforward correlation was not true for Maine vessels licensed to fish for cod.

Vessel size influenced fishing patterns by limiting the safe operating range and carrying capacity of smaller vessels. Small boats fished in bays and estuaries close to sheltered harbors in case of a sudden storm. Since cargo capacity was limited, they unloaded catch every few days at a home base to be dried on fish flakes by a shoreman. Some appear to have worked as day fishermen, returning home most evenings. Many schooners over 40 tons fished east to
west parallel to the coast and farther out to sea. They were more seaworthy, could hold more cod, hence they could travel further from home, but they didn’t have to.

In Frenchman’s Bay, the Customs District best represented for coastal fishing, very large vessels, some over 100 tons, fished inshore grounds alongside very small vessels, some under 10 tons. For instance, the AGENORA, 104 tons out of Surry, caught 8275 cod – over 40% of its total catch that year – near Duck Island just south of Mt. Desert. In fact, the AGENORA fished in the same locations as the 22 ton JAMES MONROE out of Tremont. Some vessels, regardless of size, did not appear to venture more than 30 miles from their homeport. Many did not venture out of sight of land on a clear day. This meant that tonnage is not an adequate proxy by itself for fishing strategy for Frenchman’s Bay vessels. While safety at sea limited the geographic range of small fishing vessels, no easy correlation exists for the larger ones. Furthermore, landings do not correlate to vessel size either. Some small vessels caught more cod in a season than large vessels did. For instance, the 12 ton boat NYMPH with a crew of 3 out of Cranberry Isles caught 15819 cod in 1862, while the 88.9 ton OLIVE BRANCH with a crew of 9 from Tremont only brought home 4122 cod that year. Vessels that caught less than 20,000 cod averaged 43.25 tons, with a standard deviation of 21.47. Vessels that caught over 20,000 cod, however, averaged just 58.25 tons, with a standard deviation of 25.48. For this inshore fishery, we found that tonnage cannot be used to estimate catch, effort or fishing location for vessels without logs. A cohesive population of vessels cannot be defined by physical parameters alone.

Objective 2-Database Design and Management: Database management is key to the success of this project. CDL, DCR, Fare Sheet databases have been developed that aggregate data from logs and fishing agreement to facilitate calculations over different chronological segments of the fishing season, but managing and integrating those databases have been increasingly more time consuming as the quantity of data increases and quality improves. An offshoot of HMAP, the Gulf of Maine Cod Project will eventually provide completed datasets on all the New England fisheries we examine to the HMAP Database, University of Hull, UK, which is linked to OBIS. The HMAP Database is currently undergoing reconfiguring in MYSQL, an agile open access platform facilitating the relational organization of complicated datasets. We investigated MYSQL and found that it offers the robust structure necessary to manage and integrate our rapidly expanding datasets, to link existing databases with new files from related projects (Tegner, Stellwagen, NSF), and to merge easily with OBIS.

Accomplishments: The MYSQL database, hosted at www.fishhistory.org, has undergone several evolutionary cycles as our understanding of the datasets matures. Not only can catch be aggregated and correlated per day, per fare, per season and for geographic location, but it can be correlated with the abundance of baitfish, as well as with demographic files pertaining to the NSF funded study, such as captain, fisherman, surname, age, village, profession, property ownership, etc. MYSQL has just recently allowed us to retire the CDL database. A template derived from the DCR database loads easily into MYSQL, which then aggregates daily catch to furnish the seasonal data originally stored in the CDL. Observations and comments from the original CDL survey are being transferred to MYSQL as metadata for individual logs. The Fare Sheet estimates the average size of cod within a season, and facilitates mapping the size cohorts. Data entry continues, using DCR templates. CDL, DCR, and Fare Sheet databases are maintained as backups for the online system.
The Fishing Ground prototype database easily aggregated catch spatially. Unfortunately, we found that locations in Gulf of Maine logs often referred to ranges and bearings on observed landmarks, not named fishing grounds [G. B. Goode 1887; W. Rich 1929] as mapped in the GIS dataset, or with coordinates as Scotian Shelf skippers provided. In addition, fishermen often named grounds after islands or other landmarks close by. Rich locates “Duck Island Grounds” near Boone Island, but the “Duck Island Grounds” the Frenchman’s Bay fishermen referred to is the one near Mt. Desert. This pales in comparison to the problem of “Long Island Grounds,” of which there are 3, and “Middle Grounds,” of which there are 4. Catch aggregated quite well by season and day, but Goode’s and Rich’s named fishing grounds failed to describe all vessel positions given in the logs.

We had to develop a method of mapping vessel position based on sailing knowledge and dead reckoning. Fortunately, W.B. Leavenworth sailed those waters for 40 years in a Friendship sloop and other traditional schooners. With the rest of the Gulf of Maine team, he identified a set of zones where vessels were most likely to fish based on the context of the logs. Each fishing zone contains named fishing grounds. In this way, a set of nested locations has been developed. The smallest division is the named fishing ground, like Martin’s Ground in Frenchman’s Bay. MYSQL Place Names can aggregate catch on Martin’s Ground, within the Frenchman’s Bay fishing zone, in the Southern Bay of Fundy area, or within the region stretching from Monhegan to Grand Manan. The Monhegan to Grand Manan region appears to encompass the range of all but a handful of Frenchman’s Bay, Machias and Penobscot vessels. Best of all, the fishing zones appear to conform to patterns of movement the fishermen employed year after year. Although we had laboriously to reassign daily locations to all the logs completed earlier, the fishing zones have greatly facilitated interpreting the logs and aggregating catch on a sliding spatial scale.

Objective 3-Metric Derivation, Mapping and Biostatistical Analysis: Our Scotian Shelf study has shown that 19th-century New England fishing logs provide high quality data suitable for geo-spatial modeling. Because vessels fished frequently at anchor and captains knew the fishing grounds intimately, geographic resolution is higher than that usually found in modern distribution analyses of cod. The system of inadvertent bureaucratic checks and balances that insured the validity of offshore data seemed to work differently within the mixed economy and communitarian society in small coastal Maine villages. This explains the variety of fishing patterns we observed, and complicates data analysis.

Accomplishments-Metric Derivation: Currently, we aggregate catch in terms of vessel tonnage, number of men, year, fare, day, spatial location [fishing ground, zone, area, region], and weight of catch for each Customs District. A variety of metrics relate these data quantitatively and qualitatively. For instance, we can investigate the relationship of the average age of fishermen to catch, vessel size and fishing grounds. Census data showed that some vessels were captained by boys as young as 17. Often, however, the boy’s father or uncle—the agent or owner of the vessel—shipped aboard as a fisherman. Clearly, young captains were put in charge to learn the ropes, but identifying how decisions were made becomes more complicated.

Here is an example. The Grant family of Blue Hill Bay [Frenchman’s Bay Customs District] schooner captains consisted of Francis, Larkin, Osman, Jasper, Joseph and Thomas. All fished in the same fishing zones. Moses Grant, the patriarch of the family and its
wealthiest member, sailed as a fisherman in 1861 and 1862. In 1861, the 35 ton HOLBROOK, [Joseph Grant, master, age 46; Moses and Osman fishing] landed 22,588 cod in 83 days fishing for $1497. In 1862, the 92 ton FLORIDA, [Osman Grant, master, age 19; Moses fishing] landed 12922 cod in 49 days fishing for $1560. The FLORIDA caught fewer cod than the HOLBROOK, but its fishermen worked half as hard and made up the monetary difference with the bounty payment. The economic strategy of this family was not to maximize profit by fishing as hard as possible, but to meet a target income of around $1500. The Grants invested in a larger vessel not to catch more fish, but to increase their subsidy [a bounty for cod fishing amounting to $4.00/ton of vessel to be divided between the owners and crew, and paid out from 1792 to 1866]. This is “bounty catching” – FLORIDA clearly fished for cod, but only caught fish on 41% of the 120 days required by law. That’s a 28% reduction in effort expended compared to the HOLBROOK.

Fisheries stock assessment models assume that fishing effort is equal. In the Maine coastal fishery in the 19th-century, fishing effort varied according to economic motive. Some fished to maximize profit, others to reach a target income with the least effort. We need to find a way to model these data that accounts for the economic motives of the fishermen. Sociological variables may help explain these complicated metrics.

Catch is less ambiguous. Last spring we identified the region within which Penobscot, Frenchman’s Bay and Machias vessels fished: Monhegan to Grand Manan. The aggregated weight of catch for the Frenchman’s Bay alone, fishing between Monhegan and Grand Manan in 1861, comes to approximately 48,000 quintals of dried fish [1 quintal = 112 lbs.]. Converted to live weight, this comes to over 11,000mt, landed by 215 Frenchman’s Bay boats and schooners in 1861. When the MYSQL databases are completed we anticipate summarizing and comparing data across fishing grounds and Customs Districts.

**Mapping:** The award of a Mia Tegner grant in May, 2004, allowed Stefan Claesson to geo-reference charts of fishing grounds identified by name in G. B. Goode’s *Fisheries and Fishery Industries of the United States*, sec. III (1888), Walter Rich’s *Fishing Grounds of the Gulf of Maine* (1929), and unidentified spawning grounds in Ted Ames “Atlantic Cod Stock Structure in the Gulf of Maine” (2004). These charts were based on locations and names provided by experienced fishermen in the late 19th- and early 20th-centuries. They offer the closest physical representation of banks and grounds known to fishermen in the 1850s and 1860s. Each chart from a particular source was geo-referenced by its navigational coordinates, lined up and overlapped. The outlines of the fishing banks and grounds were rasterized and centroids plotted that correspond to the names of the grounds. Fishing grounds from one source constitute one layer. Additional layers superimposed on outlines of the Northwest Atlantic coast include: a metadata layer with catch and other geographic distribution data from Goode, bathymetry, LMEs, NAFO zones, fishing ground names, names and locations of ports, and contemporary nautical charts with depth contours.

Mapping individual vessel catch per day and course tracks began with the Scotian Shelf fishery because some of those data correlated to navigational coordinates. We are working to convert log locations on the Gulf of Maine coast to fishing zones to map catch per day with greater spatial resolution.

**Biostatistical Analysis:** Inconsistent CPUE due to different economic agendas causes problems in using fisheries stock assessment models to analyze these data. We may not be
able to resolve this modeling issue for the 19th-century Gulf of Maine codfishery. However, known distribution of catch and effort over the fishing zones per day and season is forthcoming.

In a meeting in Durham last February, Captain Ted Ames speculated that no fishermen in his right mind would spurn hake and only take cod. We countered that, to be eligible for the bounty, a vessel must fish only for cod during a 120 day season. Fishing for hake and filing for the cod bounty would violate the law. In addition, hake brought less money than cod. Income maximizers would naturally target the most expensive fish. However, we have found 7 logs containing evidence that the vessels fished for hake. Catch tallies appear to have been kept for each species, but we will have to reexamine all the data in light of this evidence.

To a much greater extent than in the offshore fisheries, Gulf of Maine captains observed and noted the relationship between baitfish like herring (spelled phonetically “herron”) and menhaden (“pogies”) and cod. Many logs contain descriptions of observed estimates of “bate” and “fish” (meaning cod). Signs of baitfish were important to fishermen for two reasons. First, most of the Maine inshore fleet caught their own bait whenever they could. Alternately, they dug clams, or bought bait from the weirs lining the rivers and bays. Catching or digging bait cut costs. Secondly, fishermen appear to relate the abundance of bait to the abundance of cod and alter fishing strategy accordingly. These data will allow us to plot the spatial location (presence/absence) of baitfish as well as cod in the region day to day over a season. Kate Magness’s study of regulation highlighted the fact that Gulf of Maine fishermen were the first to demand scientific investigation of declining fisheries in the 1860s. They feared that declining “river fish” would eventually cause a decrease in the abundance of cod inshore. The relationship between bait and cod in these logs from the mid 19th-century may tell us how the abundance of cod related to the abundance of prey species inshore, and how fishermen understood the marine ecosystem.

CONCLUSION: After two years the Gulf of Maine Inshore Cod Project has made significant progress in spite of rejecting old assumptions and refining methodology. Greater knowledge of fishing patterns has improved our understanding of coastal Maine cod fishing in the mid 19th-century, but it has also generated unexpected questions. Nevertheless, data recovery is ongoing and analysis poised to begin. The landings that have been recovered so far are significant. The 11,000 mt of cod caught by 215 Frenchman’s Bay vessels within 40 miles of shore between Monhegan to Grand Manan in 1861 are more than were landed by all vessels in the entire Gulf of Maine in 1998, 1999, and 2000. Catch alone shows that this area supported a much more important fishery than has heretofore been acknowledged. Between 1852 and 1866 cod were extraordinarily abundant along the coast between Monhegan and Grand Manan, a region almost devoid of cod today. Frenchman’s Bay, Blue Hill Bay and Penobscot Bay supported enormous primary production that fishermen understood and valued.