



## **Cape Cod Commercial Hook Fishermen's Association**

### **Haddock Migration in New England Waters: Year 1 and Year 2 Analysis of Closed Area and Stock Boundaries**



**Final Report to the Northeast Consortium  
(Grant Numbers: 05-018 and PZ07030)**

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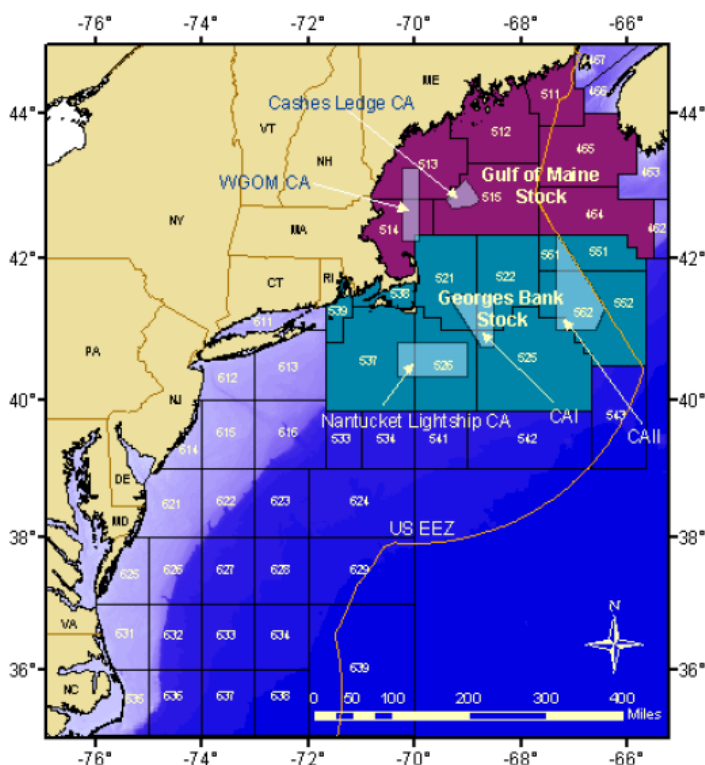


**Abstract:**

The Cape Cod Commercial Hook Fishermen's Association (CCCHFA) administered a cooperative mark-recapture tagging program in which 20,418 Atlantic haddock (*Melanogrammus aeglefinus*) were tagged and released throughout the U.S. range of the fish over approximately two years. Tag deployments were designed to provide information on fish movements between stock and sub-stock management units and across the boundaries of four areas closed year-round to groundfishing, except under certain special management programs. Fish were captured by commercial fishing vessels using hook and line gear (demersal longlines and rod and reel) and tagged using lime green t-bar anchor tags. The program featured several innovative design elements, including a close collaboration and infrastructure synthesis with the ongoing Northeast Regional Cod Tagging Program (NERCTP) and a custom-designed "scratch-off" cash lottery ticket as a reward for tag returns. Data management and returns infrastructure were performed by the Gulf of Maine Research Institute (GMRI) and scientific oversight was provided by NOAA Fisheries Northeast Fisheries Science Center (NEFSC). As of August 2009, there were 448 reported tag returns, a rate of approximately 2.2%. Preliminary results indicate that haddock move between the two U.S. stock areas, between the two Georges Bank sub-stocks, and between U.S. and Canadian waters. In addition, haddock do move across closed area boundaries. Program data are available to the public through an online GIS mapping server at [www.gmamapping.org/haddockmapping](http://www.gmamapping.org/haddockmapping).

## **Introduction:**

Haddock, *Melanogrammus aeglefinus* is a commercially exploited fish found in North Atlantic waters. There are two stocks in US Waters: Georges Bank (GB) and Gulf of Maine (GOM). (Figure 1) In addition to the two primary haddock management units, the GB stock consists of two sub-stocks, eastern and western, (Figure 2) which exhibit some morphological differences (Begg et al. 2001). The eastern GB stock is shared with Canada under the transboundary harvest sharing agreement, which was created in 2004.



**Figure 1: Gulf of Maine and Georges Bank stock areas (NEFSC, 2006)**

Stock sizes have fluctuated, but currently neither stock is overfished nor is overfishing occurring. (NEFSC, 2008) Fishing currently occurs year round using hook and line, gillnet and otter trawl. (NEFSC, 2006) Landings as well as stock size of the GB stock have and continue to be much greater than the GOM stock.

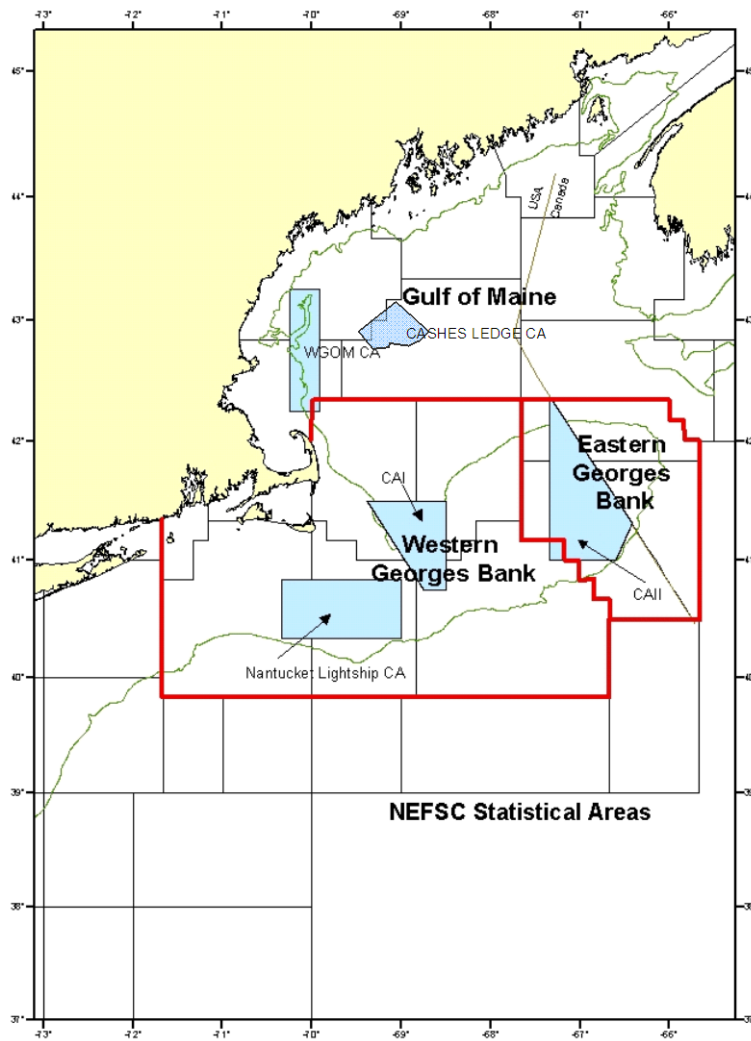
The 2007 GOM spawning stock biomass (SSB), 5,846 mt, is approximately 10 times greater than the estimated low in 1989 (553 mt), but still not as large as the 1979 estimate of 15,321 mt. Since 1987, GOM fish have been only caught by US fishermen. Population abundance has seen a similar increase with the current stock estimated to contain 9,472,000 fish.

In 2007, NEFSC estimated the GB SSB to be 315,976 mt. This is the greatest abundance of adult spawners since 1967. Fishermen saw GB haddock as an economic opportunity. Unfortunately, due to interactions with overfished stocks such as Georges Bank Atlantic Cod most fishermen were and continue to be unable to capitalize on the resource. Canadians are landing a majority of eastern Georges Bank haddock and evaluation of the interchange between the eastern versus western Georges Bank sub-stock issue is of critical relevance at this time because of the transboundary harvest sharing agreement.

Scientists have found that closed areas can be very important for a stock to rebuild, but specific information about fish movements into and out of these areas is often lacking, as is the case for haddock. There are four year-round closed areas in U.S. waters which are believed to have played a role in haddock rebuilding and in which haddock are found in substantial numbers: Georges Bank Closed Area I (CAI), Georges Bank Closed Area II (CAII), the Western Gulf of

Maine Closed Area (WGOM), and the Cashes Ledge Closed Area (CLCA). Information on haddock movement across these closed area boundaries is lacking. Recently groundfishermen have been granted carefully controlled opportunities to target haddock in two of these areas (CAI and CAII) through Special Access Programs (SAP). These SAP's present both a need and an opportunity for better information on haddock movements into and out of the closed areas.

Despite its importance to commercial fisheries and stock assessments, haddock movement rates within New England waters have not been studied since the 1950s. In particular, the interrelationship between the Georges Bank and Gulf of Maine management units has not been well studied, in part due to the long-term depletion of these stocks during the 1960s.



**Figure 2: Spatial definition of haddock management units in the Gulf of Maine and Georges Bank region along with locations of the western Gulf of Maine closed area (WGOM CA), Cashes Ledge Closed Area, Closed Area I (CA I) and Closed Area II (CA II).**

Knowledge of haddock movement rates between the Gulf of Maine and Georges Bank management units has potentially important implications for improving stock assessment and management. Determining the spatial definition of stocks is a critical first step in assessing stock status (NRC 1998a). In their review of New England groundfish stock assessments, the National Research Council recommended that the NEFSC “*improve the collection, analysis, and modeling of stock assessment data*” (NRC 1998b). This study directly addresses the issue of the interrelationship between the Gulf of Maine and Georges Bank haddock stocks and aligns with the Northeast Consortium priorities of investigating closed areas and fish habitats. Evaluation of the interchange between the eastern versus western Georges Bank sub-stock is of critical relevance at this time because of the transboundary harvest sharing agreement.

This tagging program was designed to deliver much needed information about the potential movements of haddock on Georges Bank and in the Gulf of Maine, providing insight on the relative importance of closed areas to stock recovery and fishery management.

The issue of how to use fishery and survey data to assess the haddock resource is important for analyses and interpretation of fishery impacts. If the reality were that there is substantial movement between the eastern and western and/or Georges Bank and Gulf of Maine units, then stock assessments would need to change to reflect the movement patterns. In particular, if substantial movements are documented between the Georges Bank and Gulf of Maine management units, then a combined model of the currently separate stocks would be warranted. The same would be true for the Canadian assessment. Allocation of harvest under the TRAC currently considers the eastern Georges Bank management unit separately from the western Georges Bank management unit. In addition, new biological reference points would have to be developed for any combination of existing stock units. At present, separate biological reference points exist for Georges Bank and the Gulf of Maine stocks.



**Figure 3: Tagged haddock on cradle board**

## **Project Objectives & Scientific Hypotheses:**

### ***Scientific Goals:***

- Document and improve understanding of current haddock distribution and movement patterns throughout Gulf of Maine and Georges Bank including pilot work to assess movement across closed area boundaries.
- Improve understanding of individual haddock growth rates through tag recaptures.
- Develop and maintain a database in collaboration with the Gulf of Maine Research Institute that builds upon an existing tagging infrastructure developed for the regional cooperative cod tagging program.
- Develop a collaborative haddock tagging program between fishermen and scientists that builds bridges and strengthens working relationships towards improved understanding of marine eco-systems.

### ***Social Goals:***

- Create supplemental income for fishermen while participating as partners in broad-scale data collection effort.
- Create formal mechanism for fishermen to contribute to science. This is key to building and maintaining support for the program and other efforts of government scientists.
- Overcome communication barriers over data collection and usage by developing relationships between fishermen and governmental scientists based on trust and mutual understanding.
- Acclimate fishermen to the concept of using fish sales as a means to match federal funds and augment cooperative research objectives. In this study fish sales on dedicated tagging trips will be used to ensure that tagging deployment targets are met.

### ***Objectives:***

- Conduct a sampling program to tag 21,000 haddock inside and outside of closed areas on Georges Bank and in the Gulf of Maine during a 24-month tagging period. Dedicated tagging trips will deploy 12,000 tags in inshore closed areas (CAI and WGOM). Non-dedicated tagging trips will deploy 9,000 tags in open areas and offshore closed areas (CAII and Cashes).
- Projected revenues from the sale of fish on dedicated tagging trips will be used to offset total costs of the program to NEC.
- Disperse funds to a wide diversity of vessels from numerous New England ports.
- Provide 100% of dedicated and non-dedicated trips with qualified tagging personnel, consisting of one of the following: Program Coordinator, CCCHFA or GMRI staff, NEFSC scientists, or trained fishermen “technicians.” These technicians will number at least 15, receive both classroom and on-water training, and act to improve the quality of data recorded.
- Manage field operations so that vessel crews participate in actual tagging operations in whichever way the technicians direct their efforts.

- Assign all fishermen the duty to record position, date, time, fish length, tag number, water depth, and water temperature for all recaptures.
- Enhance recapture return rates through outreach to the commercial and recreational fishing industries.
- Make every possible effort to minimize the mortality of the tagged haddock and any bycatch that may occur.
- Manage data so that participants, funders, managers, stakeholders, scientists and the public have access to movement and growth data through various tools including an online interactive mapping portal.

***Scientific Null Hypotheses for Testing:***

- 1) Movement of adult haddock between the Gulf of Maine and Georges Bank stocks is negligible.
- 2) Movement of adult haddock between the western and eastern Georges Bank substocks is negligible.

Hypothesis (1) is the basis for the current USA stock management units. Hypothesis (2) is the basis for the separate treatment of the eastern and western Georges Bank haddock substocks for the Transboundary Resource Sharing Agreement.



**Figure 4: Haddock being tagged**

**Participants**

*Scientific Partners (primary contacts)*

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**Table 1: Scientific Partners (other key personnel)**

<b>CCCHFA</b>	<b>GMRI</b>	<b>NEFSC</b>
Mel Sanderson	Sarah Whitford	Jon Brodziak
Sarah Gallo	Pat Foote	Azure Westwood
Eric Brazer		Stacy Kubis
Nat Mason	<b>Northern Geomantics</b>	Josh Moser
Paul Parker	Bill Duffy	Mike Palmer
		Laurel Col
		Liz Brooks

**Table 2: Fishing Vessel Participation (Vessel and captain)**

Alicia Ann- Greg Walinski	Rueby- Bill Chaprales	Yellow Bird- James Eldredge
Last Chance- Henry McCarthy	Seahound- Peter Taylor	William Gregory- Roger Horne
Lori B- Mike Leary	Sea Venture- Mike Pratt	Peggy B II- Ron Braun
Never Enough- Bruce Kaminski	Sea Win- Tom Luce	Tenacious- Eric Hesse
Fiona A- Brian Pearce	Sorry Charlie- Dan Shannon	Mattanza- Eric Hesse
Sandy B II- Bruce Bornstein	Sea Holly- Mark Leach	Special J- John Shusta

**Table 3: Industry Technicians**

Anne Magoon	Kenny Eldredge	Jerry Perry
John Kenneway	Renee Gagne	Katherine Fyfe
Mike Anderson	Nick Muto	Terry Pickard
Chip Foster	Ray Kane	Leo Maher
Pete Schimmel	Ethan Estey	Jerry Perry
Jeff Sampson	Chris Van Beeck	Rich Holden

### ***Student Participation & Volunteers***

Nichola Meserve completed a graduate summer internship between June and August 2005, working on the haddock tagging program. Nichola designed and acquired the outreach and reward materials (posters, scratch tickets, website language etc.), wrote the tagging manual, assisted with training, performed all data entry and approval, and sailed on numerous tagging cruises. Scott Donahue completed an undergraduate internship through which he contributed to the Haddock Tagging Project in summer 2006, assisting with tagging trips, data entry, and outreach. During the summer of 2007 Melissa Vasquez, Anthony Rafferty and Caitlin Luderer, graduate students from Duke University participated in the haddock tagging program through data entry and tagging. Jed Smythe from Davidson University participated on haddock tagging trips and data entry. Without the help of 6 dedicated citizen volunteers we would not have been able to complete such a large mailing in 2007. David Martins of SMAST and CCCHFA volunteer Jim Shyne provided assistance with the creation of Portuguese-language outreach materials and Dave provided invaluable assistance with outreach in New Bedford and Fairhaven, MA.

### **Methods**

#### ***Proposed Tag Deployment & Dispersal***

We set out to tag 21,000 haddock during a 24-month period from the time at which Exempted Fishing Permits were granted to participating vessels, using T-bar style mark-recapture (spaghetti) tags. About twice as many haddock were scheduled to be tagged on Georges Bank compared with the Gulf of Maine because there are more haddock on Georges Bank and also to ensure that a sufficient number of tags are deployed in the Gulf of Maine region. Of the total, (14,000) haddock were scheduled to be tagged on Georges Bank and (7,000) in the Gulf of Maine. In the Gulf of Maine, (5,000) haddock were scheduled to be tagged in closed areas and (2,000) will be tagged in open areas. On Georges Bank, (10,000) haddock will be tagged in closed areas and (4,000) in open areas. Twenty percent (20%) of the closed area tags were proposed to be tagged offshore (Cashes Ledge CA and GB CAII) and 80% of the closed area tags inshore (GB CAI and WGOM CA). Tags were proposed to be deployed equally among quarters of the year to the extent possible during the 24-month study period. This tag deployment plan was created in close consultation with NEFSC biologist Jon Brodziak and met his specifications for distribution of the tagged fish.

### ***Actual Tagging Location Deployment***

Tagging started in March 2005 and in total 20,418 fish were tagged (see table 1). Collaborating with commercial and charter boat fishermen, tags were deployed using two different methods: dedicated and non-dedicated trips. Inshore closed area fish were tagged during dedicated trips and open area or offshore closed area fish were tagged on non-dedicated trips. Trained technicians were deployed on all trips to ensure accurate tag deployment, fish measuring and data recording.

### ***Dedicated Trips***

On a dedicated tagging trip, the vessel sailed exclusively for the haddock tagging program at a fixed daily rate which accounted for proximity to shore, costs of setting baited hooks for haddock and fuel costs. Dedicated tagging trips targeted an average of 250 haddock per trip, tagging only the most vigorous haddock. Trained tagging technicians, NEFSC personnel, or senior program staff deployed tags on all dedicated haddock tagging trips. Legal and marketable bycatch was retained up to existing and applicable trip limits and EFP poundage caps, landed, and sold. The proceeds were pooled back into the research project.

### ***Non-Dedicated Trips***

On non-dedicated tagging trips, the program sought to capitalize on active commercial longline trips and other research programs as platforms for tagging. Following a similar program as developed by CCCHFA for its portions of the Northeast Regional Cod Tagging Project (NRCTP), the vessels were paid \$5.00 per tagged fish, with a variable but pre-set limit on daily deployments meant to ensure controlled distribution in line with program objectives. Only trained tagging technicians, NEFSC personnel, and senior program staff were permitted to deploy tags to maintain an increased level of scientific rigor.

<b>General Tagging Area</b>	<b>Proposed amount of tags to be deployed over 24 months</b>	<b>Total amount of tags deployed and approved over 24 months</b>
Georges Bank CAI	8,000	7,430
Georges Bank CAII	2,000	816
Georges Bank Open Area	4,000	6,802
Western Gulf of Maine Closed Area	4,000	3,977
Gulf of Maine Open Area	2,000	494
Cashes Ledge Closed Area	1,000	899
<b>Totals</b>	<b>21,000</b>	<b>20,418</b>

**Table 4: Proposed and Current Tag Deployment**

Tagging took place inside year-round closed areas between 2005 and 2007 with the successful acquisition and administration of two EFPs (DA-5736, DA-6093). The EFP's allowed dedicated trips to closed areas with the sale of bycatch under a system of caps on haddock catch, haddock landings, and cod bycatch. The investigators were able to meet the scheduled deployment targets for the Western Gulf of Maine Closed Area and Georges Bank Closed Area I without exceeding any of the EFP impact caps.

### ***Fish Revenue Utilization***

The year one and year two grants each included deliberate budget shortfalls of \$12,188, representing estimated fish revenues which were intended to supplement the NEC funding. All legal and marketable fish caught that were not tagged were landed and sold, with all associated revenue used towards the project budget. The fish-sales revenue was first used at a rate of 100% in order to meet the shortfall. Upon meeting the shortfall, 75% of subsequent revenues were returned to NEC for re-competition, and 25% were retained by the grantee for discretionary use within the project. In year one the budget shortfall was met and an additional \$18,577 was returned to the NEC. The shortfall was also met in year two with an additional \$975.05 sent back to the NEC for re-competition.

### ***Tagging Protocol***

Haddock were captured using commercial longline and rod and reel gear. Haddock were minimally handled assuring that the protective slime coat was not removed. Haddock were gently removed from the hook by the captain and either handed to a technician or placed in a live well. Captains and other personnel were trained on how to handle the haddock; specifically, they were trained not to touch the eyes or gills, and taught to disqualify any haddock that were severely injured during the capture or hook removal process. The technician screened the fish again, and ultimately decided whether or not to tag the haddock. If the technician thought that the fish would not survive they were placed in a live well for further assessment or rejected. All personnel handling fish were required to wear pre-moistened cotton gloves based on previous program's determination that this minimized slime loss. Custom designed cradle boards with integrated measuring sticks were used to record total fish length (i.e. to the tip of the tail). Two manuals were provided to technicians and have been previously submitted to NEC. They are also available upon request. In addition, an addendum to the Haddock Tagging Protocol was written upon implementation of new protocols developed to describe and record overall stamina and mouth injury condition indices of the haddock when they were tagged. Table 2 describes these indices and the complete addendum is also available upon request.

<b>Overall Stamina</b>	
S1	Alive, strong, much resistance to being handled
S2	Alive but moderate resistance to being handled
S3	Alive, but weak, showing little resistance to being handled
S4	Dead
<b>Mouth Injury</b>	
M1	No injury - normal hook entry, little or no blood
M2	Enlarged mouth injury, slit-like, moderate bleeding
M3	Severe mouth injury, lip ripped/twisted, jaw broken, profuse bleeding
M4	Catastrophic to fatal mouth injury, extending to most of face or head

**Table 5: Stamina & Mouth Condition Index**

Highly visible lime-green Hallprint T-bar tags which include a tag number, the program name, and a phone number and website address for reporting recaptured fish were deployed. On-board technicians and scientists recorded the following characteristics for every fish tagged: fishing location, date, time, gear, depth, water temperature, tagging personnel, tag number, fish length, spawning condition, sustainability and mouth characteristics. 25% of the fish were double tagged to determine tag retention rates. All data management protocols were closely modeled on those of the NRCTP- in effect those methods were simply duplicated in another example of the efficiency gained by working off the infrastructure of that program. Example datasheets can be found in the haddock tagging manual.



**Figure 5: Fish lengths at release were measured in total length (to the tip of the tail) as opposed to fork length since most reported recaptures could be expected to include total length.**

### ***Data Entry & Verification***

With relatively minor additions and modifications, the existing database infrastructure hosted by the Gulf of Maine Research Institute and developed for the Northeast Regional Cod Tagging Program (NRCTP) was modified to cater to the haddock tagging program's needs. A new component was built that allowed project partners to enter data from this program into a standardized tagging database integrated with a Geographic Information System (GIS). GMRI and Northern Geomatics developed a password protected, on-line data administration system that allows program partners to log on, add and download data and see the results displayed on the website. GMRI's Data Management and Quality Control Specialist validated that the data was properly entered and also inserted comments prior to displaying the information on the website. The data entry web portal can be viewed at [www.gmamapping.org/haddockdata](http://www.gmamapping.org/haddockdata).

### ***Public Data Viewing***

Like the NRCTP, this program was designed and developed to allow unprecedented access to the data by the public. The data entered provides input for an Internet Map Server (IMS) display. The interactive mapping website is fully populated and operational, and available to stakeholders and the public at [www.gmamapping.org/haddockmapping](http://www.gmamapping.org/haddockmapping). This site allows viewers to report recaptured haddock and view a variety of information about haddock that have been tagged and recaptured.

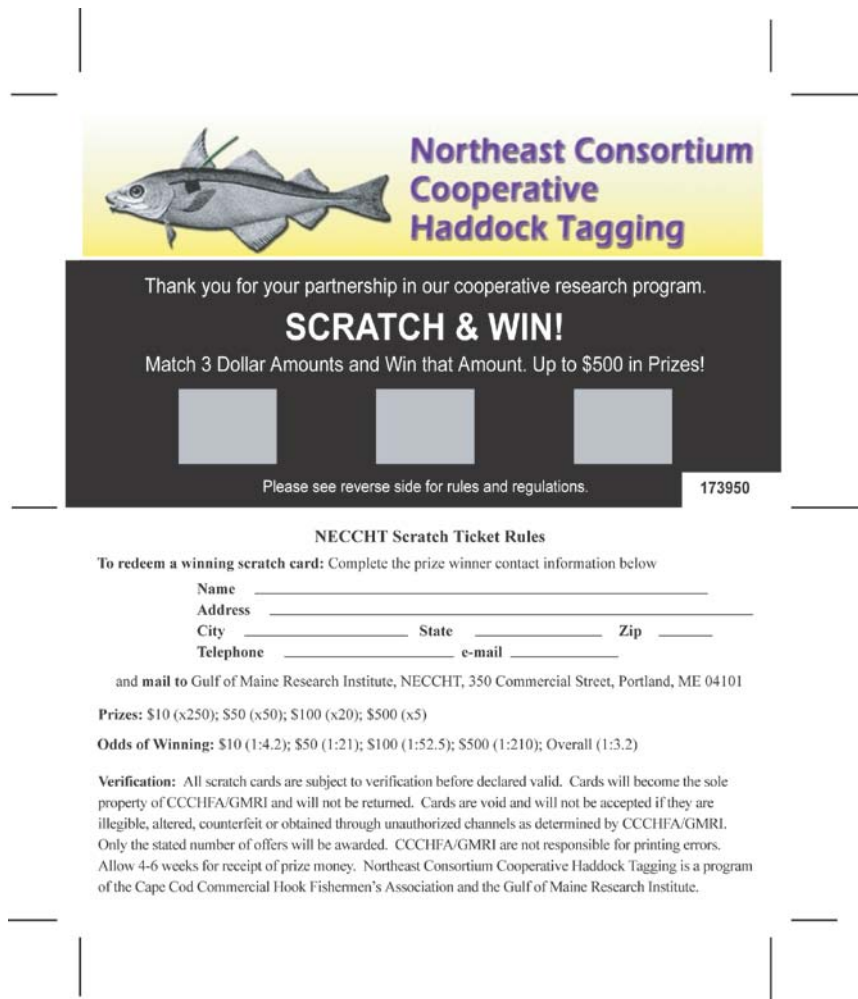
### ***Tag Returns***

Again, in an attempt to maximize efficiency and reduce costs, returns were managed by GMRI by piggybacking onto the existing NRCTP infrastructure. Fishermen reported recaptured tagged haddock in different methods. All tags in the Program include the same toll-free phone number as the Northeast Regional Cod Tagging Program, where U.S. and Canadian fishermen can call to report information. GMRI answers the toll-free calls during the day with an automated message after office hours. Fishermen also used the website to report tags or sent them directly to GMRI and CCCHFA.

GMRI's Data Management and Quality Control Specialists ensured that all tag returns were dealt with in a timely fashion and were quality controlled. Recaptured haddock were assigned an area of release and an area of capture based on the reported release and capture coordinates. The areas included the primary groundfish closed areas and open areas as defined by the stock boundary between Georges Bank and Gulf of Maine haddock stocks (Figure 2). In particular, the open area of Georges Bank was the region bounded on the north by 42.33°N and on the east and west by 70.00°W and 66.00°W. The open area of the Gulf of Maine was the region bounded on the south by 42.33°N (41.67°N in Cape Cod Bay) and on the west by 66.00°W. Haddock recaptures outside of the open and closed areas designated above were categorized as "Other", and included two recaptures in Canadian waters near the mouth or in the Bay of Fundy.

Within a few weeks of receiving a tag, a thank you letter showing where the fish was tagged and recaptured, along with other tagging and recapture data for the fish, was sent back to the fisherman. In addition to providing fishermen with timely information on individual fish movements via prompt follow-up mailings, innovative custom designed scratch-off cash lottery tickets were used as an incentive to further enhance the number of tag returns. The distribution of these items not only serves as a reward, but also serves to publicize the program. During the first year of the program one scratch off ticket was sent to each person that reported a recaptured tagged haddock. Due to low return rates we decided to boost the reward to two scratch-off tickets and sent a second ticket to anyone that already reported a recapture. GMRI has continued to answer phone calls, send rewards and enter returned tag information into the database despite an end in funding for the program. It is not known how long they are going to be able to continue this process and it is important to find a permanent location for program data and a host which can continue to receive, enter and respond to recaptured fish information.

**Figure 6: The program return reward, a scratch off cash lottery ticket (front and back view)**



## Outreach

Initial information packages were developed and distributed by CCCHFA prior to initial tagging. These included information about the program's goals and objectives, where tags should be sent, what data is needed in association with the returned tag, and self-addressed, stamped envelopes to return the tags. Envelopes were printed with headings prompting them to record the pertinent information (date, location, gear type, fish length, etc.). Having these on board fishing vessels increases the likelihood of tags being returned, and improves the quality of associated data.

CCCHFA maintains a homepage for the haddock tagging program on the organization's website ([www.ccchfa.org/tagging](http://www.ccchfa.org/tagging)) and also a prominent sidebar on all pages which publicizes the program and directs inquiries. The program staff also participated in regional communication with the other mark-recapture tagging programs (cod, YTF, scup etc.) on such group outreach efforts as NOAA Weather Radio announcements and informational tabling at events such as the New Bedford Working Waterfront Festival. An article about the program was featured in the April 2006 and March 2007 editions of Commercial Fisheries News. GMRI also hosts a webpage describing the program (<http://www.gmri.org/mini/index.asp?ID=21>).

Program posters were created in both English and Portuguese and were distributed throughout New England and maritime Canada on several occasions.

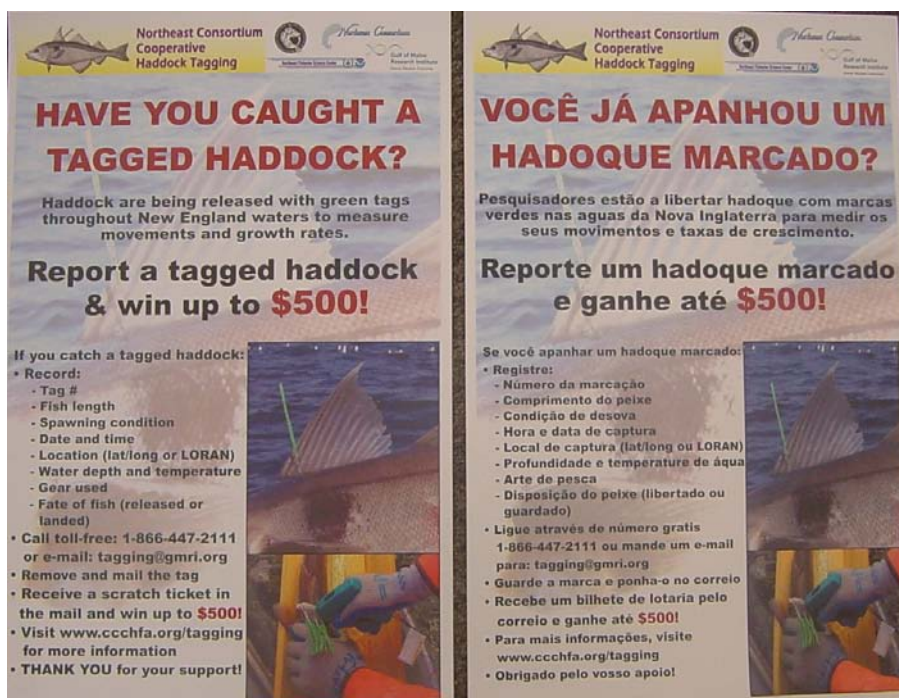


Figure 7: Two versions of the program poster

Two mass mailings were completed, the first one totaling over 500 pieces to American and Canadian Permit Holders and Processing Plants. The second mass mailing sent an informational newsletter, haddock tagging mini-data sheet and self addressed return envelope to over 5,000 individuals from the US and Canada.

GMRI kindly included regular updates and outreach messages for the haddock tagging program in its NRCTP mailings and newsletters as well.

CCCHFA ran earned and paid advertisements in U.S. and Canadian fishing press (commercial and recreational) on a regular basis throughout 2007 and 2008, including Commercial Fisheries News, The Navigator, etc

Program posters were created in both English and Portuguese and were distributed throughout New England and maritime Canada on several occasions.

Final summary reports were sent to fishermen who participated in the tagging program. The reports included:

- Summary table identifying where they tagged haddock and amount
- Map showing tagged and recaptured fish

### ***Changes from Proposed Work & Complications***

- Deployments in the Georges Bank Closed Areas fell short for a variety of reasons including permitting difficulties, poor haddock catches, and overabundances of dogfish. CAI tagging came very close to the target, falling short by approximately 500 fish out of the 8,000 targeted. CAII only achieved about 50% of the objective. These tags were instead deployed on non-dedicated trips to open areas of Georges adjacent to the closed areas.
- Year 1 and year 2 each had one trip scheduled to catch haddock in Closed Area II. Year I was unsuccessful and relied on Year 2 to catch and tag 2,000 fish. On the second trip technicians tagged over 700 fish. Further trips were not deployed due to a lack of vessel availability, permit coverage and the prohibitive cost of the trip. The remaining tags were deployed in areas adjacent to CAII using non-dedicated trips. Insurance reasons prevented technicians from sailing on these trips. In order to deploy tags captains and crew were trained in proper handling and tagging procedures and acted as technicians.
- Two trips to Cashes Ledge Closed Area were scheduled for year 2 since no tags were successfully deployed there in year 1. The first trip was not very successful (n= 45 deployments) but the second did very well, tagging 854 fish thus a total of 899 haddock were tagged in the CLCA
- Non-dedicated trips were scheduled to the Gulf of Maine Open Area during March and April 2006 when haddock are plentiful and dogfish are largely absent. Most of the haddock caught were greater than legal size and worth more to sell than to tag and release and since these were not dedicated trips few fish were tagged. Because few haddock were being tagged through this non-dedicated effort, dedicated trips were instead

scheduled for GOM open areas to tag all haddock and sell the legal size bycatch. These trips were unproductive catching mostly dogfish and damaged haddock eaten by dogfish. Although attempts were made using rod and reel as the primary method of capture to avoid the dogfish we were unable to meet the expected Gulf of Maine Open Area tag deployment targets.

- Securing International Animal Care and Use Committee Approval (IACUC) under new NEC guidelines was a major unanticipated task. Budget revisions were made to adjust for the extra time demands of this development.
- The year 2 Exempted Fishing Permit (EFP) application, its associated Environmental Assessment (EA), and negotiations over the various EFP impact caps were far more time-consuming than originally anticipated, and created a major drain on staff resources.
- Some tags were reported to have a brown growth on them making it difficult to identify that the fish were tagged. This may have lead to some recaptured tagged haddock not being reported.
- Returns were lower than expected all along. Although slow but steady progress has probably brought the program to a point at which enough returns have been reported to allow for useful analyses (n= 448 returns as of August 2009, for a return rate of approximately 2.2%), this falls short of the goal of approximately 5% (1,000 fish).
- This scenario was not unanticipated. In fact the original proposal describes the goal of 1,000 fish as “probably overly optimistic” and goes on to describe a variety of possible reasons why recapture and/or reporting rates might fall short, including lower than expected harvest rates, lack of reporting, and lack of effort inside closed areas.
- It is likely that all of these played a role in the lower than expected return rate. Capture or tagging induced mortality may have also been a contributing factor, since haddock are notoriously fragile fish.
- CCCHFA believes however, that lack of effective effort and thus overall U.S. catch is the primary cause of the low return rate. Specifically, overall under-utilization of the U.S. haddock Total Allowable Catch (TAC) and a lack of effort in closed areas resulted in lower than expected recapture rates.
- This project expected fishermen to harvest approximately 20% of the Georges Bank and GOM TAC each year. For 2008, only 5% of the overall US Georges Bank TAC and 35% of the GOM TAC was landed. Nearly every fishing year during which this project’s fish have been at large has featured premature closures of the EUSCA due to achievement of TAC’s on other species (i.e. cod or yellowtail flounder), thus preventing effort in important haddock fishing grounds including CAII.
- This theory would seem to be anecdotally confirmed by the fact that the majority of the Georges Bank recaptures that have been caught and reported by Canadian fishermen with very few reports coming from Americans. This in turn probably reflects higher harvest rates in Canadian waters. Also, the lack of recaptures inside CAII is noteworthy especially in light of the numerous recaptures just to the east of it in Canadian waters.

## Results & Conclusions

### *Accomplishments towards NECCHT Program Objectives to Date*

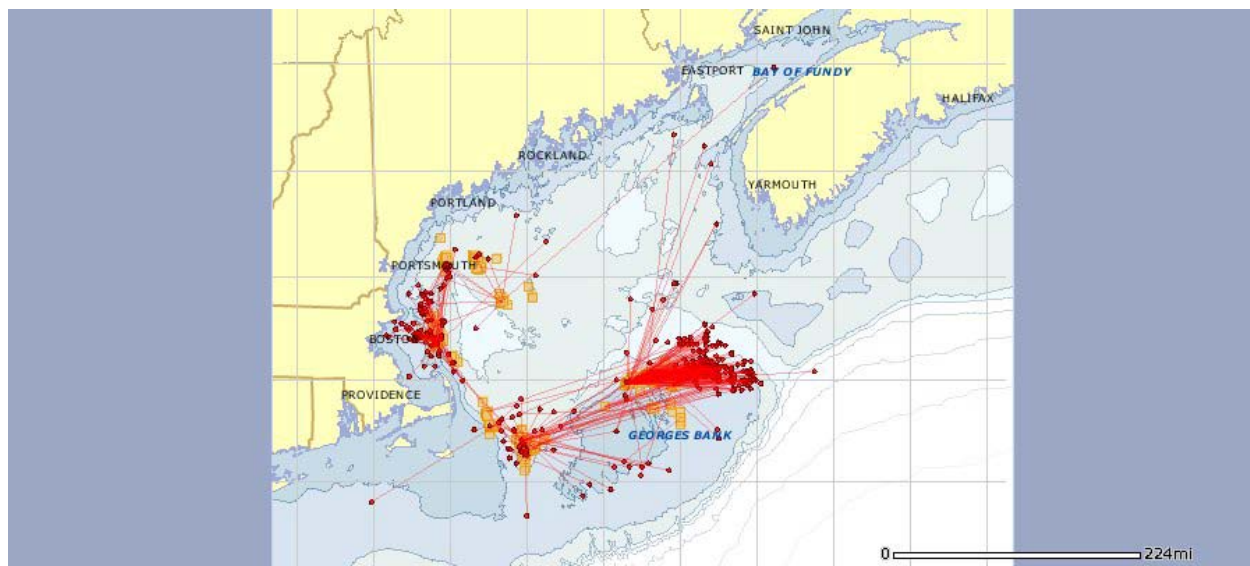
- Scientific Research Permits (SRP) were secured to cover CAI in March and April 2005 and 2006, to ensure that spawning fish would be tagged there and to cover ovary collection needs of the NEFSC (spawning months were excluded from the EFP's).
- Innovative incentives (scratch off lottery tickets) were researched, designed and acquired. United States Postal Service Money Orders were acquired and transferred to GMRI for fulfillment of the winning tickets. The following lists the number of reported scratch off ticket winners and the amount of money they won:

<b>No. of Winners</b>	<b>201</b>
<b>\$10 Winners</b>	<b>144</b>
<b>\$50 Winners</b>	<b>37</b>
<b>\$100 Winners</b>	<b>16</b>
<b>\$500 Winners</b>	<b>4</b>
<b>TOTAL \$\$</b>	<b>\$ 6890.00</b>

**Table 6: cash rewards paid out to date through scratch-off lottery ticket redemptions**

- Program graphics were designed by Dr. Tallack
- Informational brochures and posters designed, printed, laminated as necessary and distributed across the region to docks, auction houses, processors, marine supply stores, research institutes, fisheries organizations, and stakeholders.
- Two EFP applications and Environmental Assessments (EA) were prepared and submitted, triggering lengthy negotiation and revision processes. The sale of bycatch (including haddock not viable for tagging), upon which the project budget depended, was allowed under the EFP's. Both EFP's were successfully administered and monitored with final reporting to NMFS completed in May 2007.
- Letter of Understanding and Statement of Work between GMRI and CCCHFA was drafted and executed. GMRI submitted progress and final reports.
- Extensive classroom and on water training of tagging technicians took place
- International Animal Care and Use Committee Approval (IACUC) was granted for the haddock tagging protocol allowing year 2 tagging to initiate (06/13/2007). IACUC applications and approval required significantly more staff time than anticipated. Budget revisions were made to adjust for the extra time.
- Database was created and population of the database with >20,000 releases entered by CCCHFA was managed by GMRI. The database continues to be updated as more tagged fish are reported. Recapture reports are generated in real time. (see [www.gmamapping.org/haddockdata](http://www.gmamapping.org/haddockdata))
- Informational project homepage updated and operational (see [www.ccchfa.org/tagging](http://www.ccchfa.org/tagging))
- Online GIS mapping interface operational and regularly updated, allowing public access to program data in real time (see [www.gmamapping.org/haddockmapping](http://www.gmamapping.org/haddockmapping))
- Tag deployments are summarized by area as shown in Table 1. There were a total of 108 trips taken and 18 vessels participated in the program.

- Approved tag recaptures (n=448 as of August 2009) are presented graphically in relation to releases in Figure 3.
- Several iterations of a data analysis summary have been prepared by the NEFSC, most recently in September 2008. These reports are preliminary and not intended for publication but have been provided to the NEC as appendices to performance reports. They are available by contacting the project PI's. NEFSC revises and updates these summaries periodically.
- Year 2 fish revenues were realized in the amount of \$13,488.07. Of this total, \$12,188.00 was retained to offset a designed budget shortfall and balance the program budget. Under NEC contractual guidelines, an additional \$975.05 was returned to the NEC for re-competition for a total savings to the funder of \$13,163.05. The remaining \$325.02 is retained in the program budget for discretionary use by the investigators. Year 1 fish revenues resulted in a total of \$32,493.85 savings to the funder.



**Figure 8: Locations of Haddock Released and Recaptured  
(Releases in yellow and recaptures in red)**

### *Data*

Consistent with the structure of the program as originally envisioned and laid out in the Year 1 and Year 2 proposals, stock assessment and population dynamics biologists at NOAA Fisheries Northeast Fisheries Science Center periodically access the program data, which was collected under the overall program management of CCCHFA and is managed and warehoused by GMRI, and prepare data analysis summaries. These reports summarize and compile the data to date, and examine it relative to the program hypotheses and for other potential uses. They are prepared on an approximately annual basis, and several iterations are available, with others planned when possible in the future. The most recent summary completed by NEFSC provides a summary of available haddock tag-recapture data collected by the project through September 2008. A brief review of the major findings is presented below, and a full copy of the NEFSC summary is attached to this report as Appendix A.

***Brief Summary of Results from NEFSC Summary (September 2008):***

A total of 352 haddock tag-recapture records were verified. In comparison, a total of 20,418 tagged fish were reported to have been released. Of these, 20,405 fish have sufficient information for analysis. Based on the verified release data, the nominal tag-recapture rate from April 2005 through September 2008 was 2.2%.

***Additional Preliminary Results***

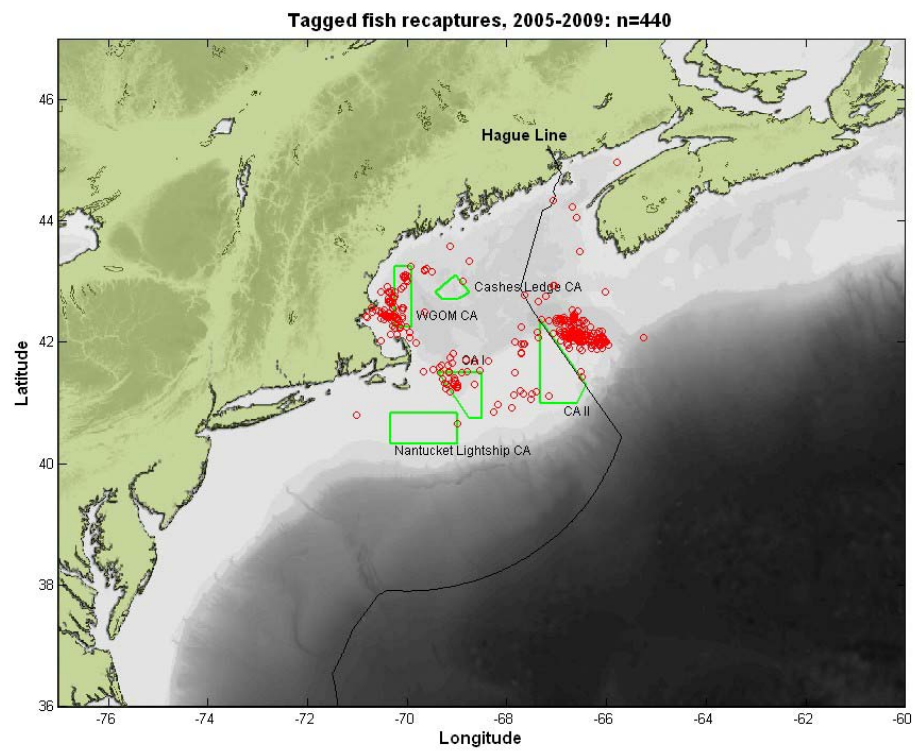
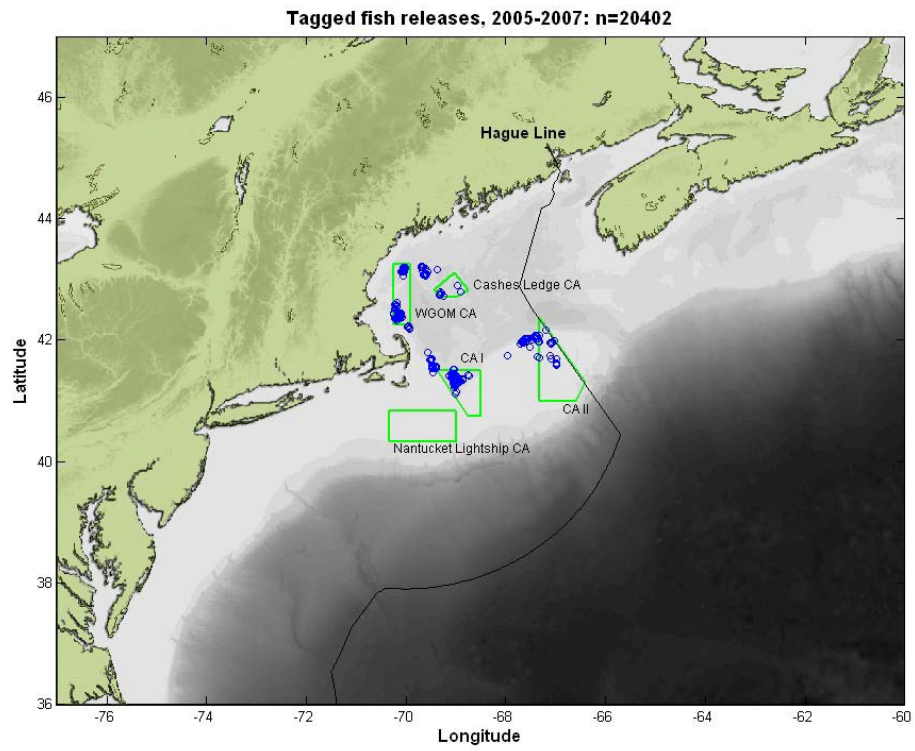
While the main source of project results, including for management purposes will continue to be the periodic summaries prepared by NEFSC, the project PI's may undertake future analyses as well. On the following two pages are some preliminary findings on observed movements and growth prepared by Dr. Tallack for this report. Please note that similar figures are available for each year of the program. Also note that minor differences, on the order of several to several dozen fish, may sometimes emerge between various analyses. These are to be expected and usually reflect different data "pulls" from the program database at different times, or different interpretations of the data by different analysts. They do not reflect raw data discrepancies.

In addition to these brief findings, Laurel Col of the NEFSC will present some preliminary findings and a poster at the 2009 meeting of the American Fisheries Society (AFS). This material will be available upon request.

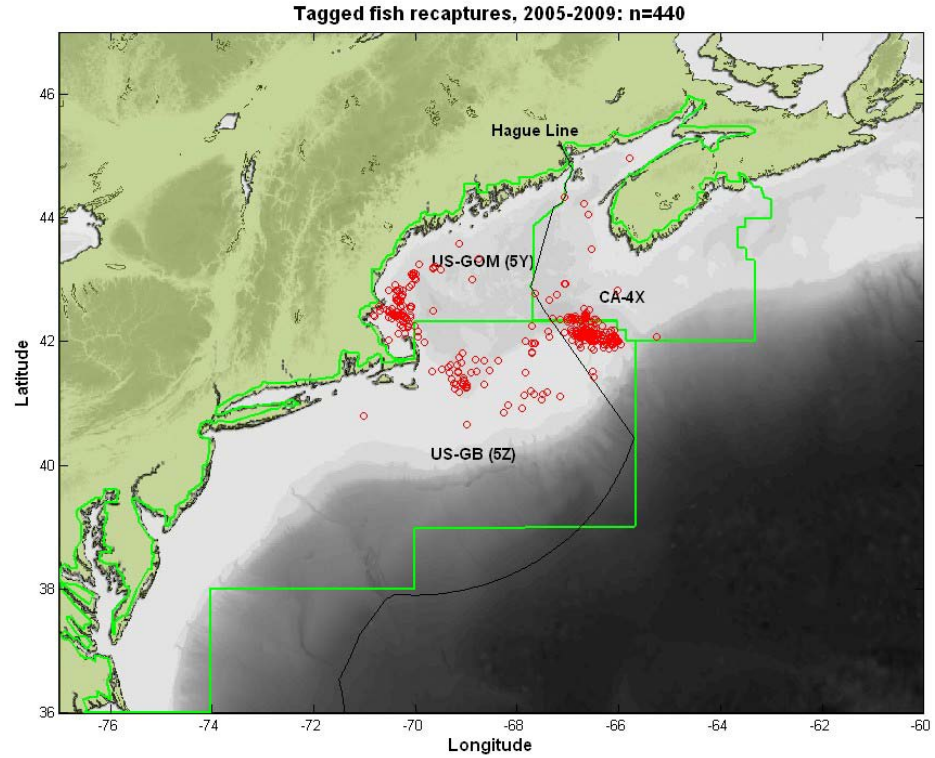
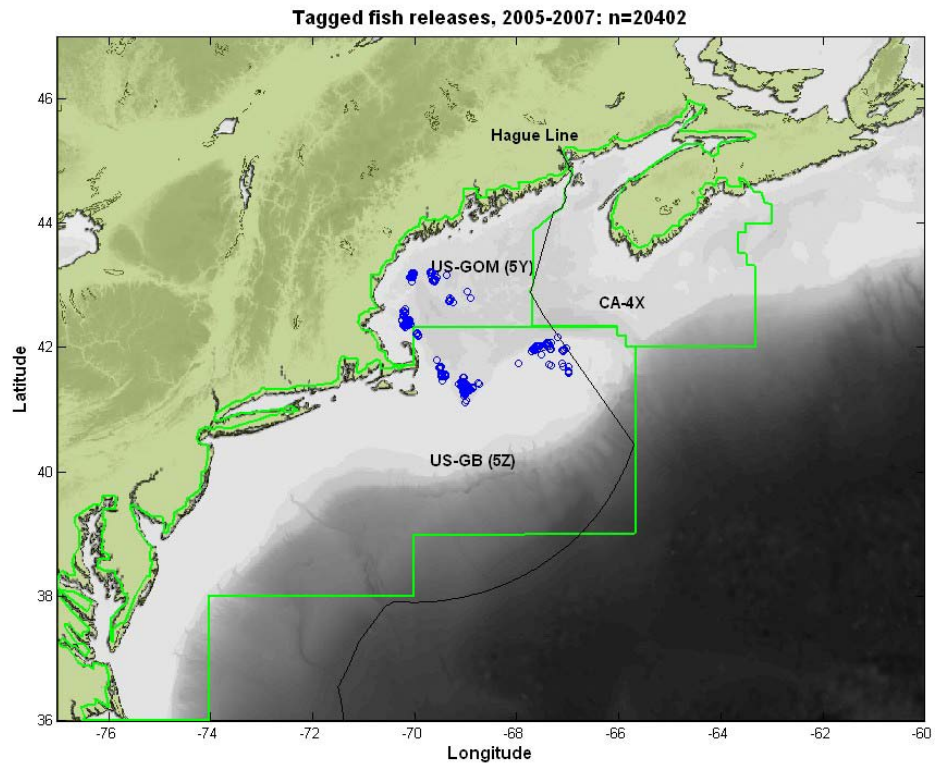
**Figure 9: A double-tagged haddock. 25% of the fish were double-tagged to allow for calculation of a tag retention rate**



**Figures 10 and 11: Total releases and recaptures by principal U.S. year-round closed areas**



Figures 12 and 13: Total releases and recaptures by principal U.S./Canada management areas



## **Preliminary Growth Analysis prepared by Dr. Tallack**

### **Introduction**

Tagging studies have been widely used for assessing fish growth for many species, including scombrids (Gillanders *et al.*, 2001; Laslett *et al.*, 2002; Ortiz de Zárate & Bertignac, 2002; Eveson *et al.*, 2004; Hallier & Gaertner, 2006), gadoids (Shackell *et al.*, 1997; Cote *et al.*, 1999; Righton *et al.*, 2006), serranids (Tranquilli & Childers, 1982; Welsh *et al.*, 2003), labrids (Welsford & Lyle, 2005) and elasmobranchs (Natanson *et al.*, 1999; Simpfendorfer *et al.*, 2000; Natanson *et al.*, 2002; Rodríguez-Cabello *et al.*, 2005).

GROTAG methodology (Francis, 1988) was recently applied to the Northeast Regional Cod Tagging Program (NRCTP) data to assess regional variation in haddock growth as evidenced by tagging data (Tallack, 2009). Though sample numbers are low, this analytical approach has now also been applied to the Northeast Consortium Cooperative Haddock Tagging Project (NECCHT), tag release and recovery data for the two US haddock management areas (5Y and 5Z) separately, and for the whole dataset combined.

### **Methods for growth analyses**

By June 2009, GMRI had received a total of 440 haddock recapture records. The data quality for each fish varied, but before undertaking growth analysis, certain data filters were applied. Only recaptures with tag #, recapture date, recapture location and fish length were used. These data were then filtered to omit any haddock reported with approximate dates, locations or fish lengths. Of these recaptures, all were included for assessments of measurement error ( $n=253$ ); however, to minimize the potential for a downward bias in growth estimate caused by short-term recaptures (i.e. DAL=0-30 days), actual growth assessments were undertaken on fish with 30 DAL as the minimum. After filtering for all these criteria, a total of 249 tagged haddock recaptures qualified for growth assessment across the whole region, ranging in size from 36–76 cm at initial capture (i.e. release) (Table 1, Figure 1). When analyzing each management area separately, only haddock which were both released and recaptured within the same management area were used; thus, 29 fish for GOM (5Y) and 151 fish for Georges Bank (5Z).

Length data were then analyzed using Francis's (1988) maximum likelihood GROTAG technique which fits a modified version of the von Bertalanffy growth curve (for full methodology, see Tallack, 2009). Growth trajectories were compiled from the length ( $L$ ) at initial capture (i.e. the release length) ( $L_1$ ), the time at release ( $T_1$ ), the time at final capture (i.e. recapture) ( $T_2$ ), the change in length ( $\Delta L$ ) from  $L_1$  to the length at final capture ( $L_2$ ), and the duration in years between release and recapture ( $\Delta T$ ).  $T_1$  and  $T_2$  were measured in years from the arbitrarily chosen point in time, March 20<sup>th</sup> 2005 (the date of the first tagged cod release).

After optimizing the GROTAG model, variability in growth estimates was assessed with bootstrap simulations of each spatial area's raw tagging dataset, thereby enabling the calculation of 95% confidence limits for the optimized GROTAG growth parameter estimates. Raw data quadruples ( $T_1$ ,  $T_2$ ,  $L_t$  and  $\Delta L$ ) for each spatial area (with  $n$  samples) were re-sampled (1000 iterations) with replacement to generate 1000 bootstrap data sets (with  $n$  samples) for each spatial area. The optimized GROTAG model was then applied to each of the 1000 bootstrap data sets to generate 1000 bootstrap-derived growth parameter estimates. For each spatial area, variability was subsequently quantified by calculating the 95% confidence limits for the 1000 estimates of each growth parameter ( $K$ ,  $L_\infty$ ,  $g\alpha$ ,  $g\beta$ ,  $v$ ,  $p$ ,  $u$ ,  $w$ ,  $s$  and  $m$ ).

### **Growth results**

Descriptive statistics for size at release and recapture of the haddock used in the growth analyses are presented in Table 1. Since recaptures constitute only ~2.2% of all haddock releases ( $n=440$ ), the data available for growth analyses is minimal ( $n=249$ ) after filtering for quality, particularly for the Gulf of Maine (5Y). Thus, it is acknowledged that the

Von Bertalanffy growth estimates presented here will be of minimal application, but they are reported nonetheless. It is also noted that observations of very large haddock are not represented in these data (i.e. there are few haddock over 75 cm) (Figure 1), and as such, the estimates of asymptotic growth ( $L_{\infty}$ ) are smaller than one might expect for this species (Table 2).

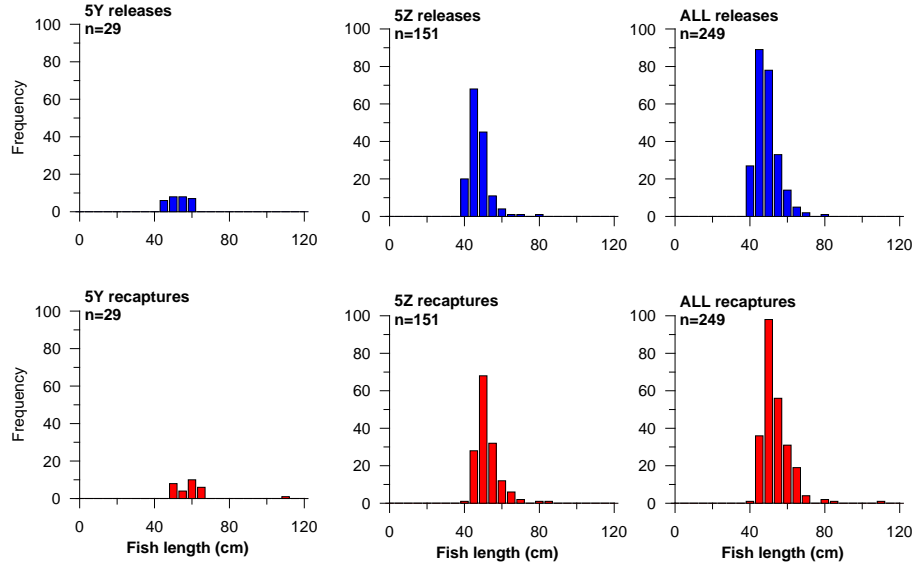
**Table 7: Descriptive statistics on the size at release and recapture of all haddock both released and recaptured in each management area (5Y and 5Z) and for the region as a whole (ALL).**

<b>Size at release</b>	<b>5Y</b>	<b>5Z</b>	<b>ALL</b>
n	29	151	249
Mean	50.88	45.32	46.81
St. Err.	0.93	0.46	0.39
Median	51.00	45.00	46.00
St. Dev.	5.02	5.62	6.15
Minimum	42.00	36.00	36.00
Maximum	60.00	76.00	76.00
Confidence Level (95.0%)	1.83	0.90	0.77
<b>Size at recapture</b>	<b>5Y</b>	<b>5Z</b>	<b>ALL</b>
n	29	151	249
Mean	56.74	49.72	51.31
St. Err.	2.05	0.50	0.47
Median	55.88	48.26	49.53
St. Dev.	11.04	6.09	7.45
Minimum	48.26	40.00	40.00
Maximum	107.95	80.01	107.95
Confidence Level (95.0%)	4.02	0.97	0.93

**Table 8: Von Bertalanffy estimates derived from applications of GROTAG to mark-recapture data, categorized by management area (5Y and 5Z) and for the region as a whole (ALL); mean estimates and 95% confidence limits (95% CL) represent 1000 bootstrapped simulations per area.**

VB Ps.	Management area 5Y				Management area 5Z				ALL			
	Data	Mean BS	95% CL		Data	Mean BS	95% CL		Data	Mean BS	95% CL	
<b>n</b>	29	1000			151	1000			249	1000		
$L_{\infty}$	63.08	62.15	60.41	- 63.89	69.31	70.87	69.42	- 72.31	73.00	77.64	76.61	- 78.67
<b>K</b>	0.24	0.29	0.29	- 0.31	0.12	0.11	0.10	- 0.11	0.14	0.12	0.12	- 0.13
$t_0$	-0.31	-0.02	-0.47	-0.51	-0.56	-0.65	-0.76	- -0.55	-0.46	-0.51		

**Figure 34: Size frequency distribution of haddock at RELEASE and RECAPTURE by management area (5Y and 5Z) and combined (ALL).**



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## **Conclusions**

Given the limited number of tag recaptures available and lack of information on fishing effort, reporting rates and haddock mortality rates, no attempt was made to estimate movement rates in this report. Nonetheless, a few simple conclusions can be drawn (excerpted from the NEFSC September 2008 data summary).

- Haddock migrate from US waters on eastern Georges Bank to Canadian waters.
- A few haddock migrate long distances across stock boundaries. The longest migration was 280 nautical miles. One fish tagged on northern Georges Bank traveled a minimum of 139 nautical miles to the northern Gulf of Maine and another tagged in a similar location traveled 142 nm to the mouth of the Bay of Fundy. Likewise, a haddock tagged in Cashes Ledge Closed Area traveled 203 nm into the Bay of Fundy. These fish were all of mature size (47-50 cm), they were released between the end of April and mid-July, and were captured between the end of July and mid-September, indicating that occasional large northern movements may occur after the spawning season. Another haddock tagged in Closed Area I traveled 84 nm to the Western Gulf of Maine Closed Area between mid-August and mid-September of 2005.
- Some haddock move from the Georges Bank stock area to the Gulf of Maine stock area and vice versa.
- Some haddock move from the Eastern Georges Bank management unit to the Western Georges Bank management unit and vice versa.
- Several haddock tagged inside of Closed Area I, Closed Area II, Cashes Ledge Closed Area, and the Western Gulf of Maine Closed Area were captured outside of the areas. This indicates that there is some spill-over of adult haddock from these closed areas. Conversely, there were a few instances of haddock moving from open areas to closed areas.
- The low number of recaptures could indicate that haddock do not survive the tagging process as well as other groundfish (i.e. high tagging-induced mortality rates); it could also reflect tag loss or low reporting rate. There are not sufficient data at present to evaluate the relative veracity of these factors.
- Haddock in the Georges Bank and Gulf of Maine regions constitute a metapopulation, i.e., consist of a group of spatially separated populations (of the same species) which interact at some level.

## **Partnerships**

This project supported and featured strong partnerships between scientists and fishermen. Technicians and scientists accompanied fishermen out at sea. This allowed program scientific staff to not only tag haddock, but also gain insight into normal fishing techniques. Fishermen have been integrally involved in the project from design through implementation, and had the opportunity to learn tagging techniques and data collection and recording skills. They have also participated enthusiastically in the financial model which minimizes permit related discards and returns revenue to the program.

Collaborating with Jon Brodziak, Laurel Col and others from the Northeast Fisheries Science Center, scientists have been deployed on tagging trips to collect valuable spawning information and deploy data tags. Working with Hunt Howell from the University of New Hampshire we were able to successfully receive IACUC Approval. The partnership with GMRI to piggyback on the existing cod tagging infrastructure has also been highly successful. Project partners remain in contact regarding periodic updates to the data summaries, data management, potential future analyses, and future plans for maintaining and/or de-commissioning the program infrastructure.

### **Impacts & Implications**

Because preliminary analyses are based on a limited number of returns, data from this study were not used in the 2008 NEFSC haddock benchmark assessment (GARM III). It is hoped that information from this study will be used in future assessments as well as management reviews on the appropriateness of the current stock management units and impacts of closed areas and closed area access. Currently, there are no advanced migration or growth analyses being completed, but further analysis may be completed in future months.

### **Related Projects**

This project would not have been possible without the data management and tag return infrastructure that was already in place at the Gulf of Maine Research Institute for the Northeast Cod Tagging Program.

This program provided ancillary support and research platform opportunities for NEFSC biologists to collect haddock ovaries for ongoing haddock fecundity studies.

An NEC grant program entitled “*Is Closed Area I Serving as a Refuge for Haddock? A Prototype Study of Fine-Scale Movement through the Use of Acoustic Tagging Techniques,*” managed by Graham Sherwood from the Gulf of Maine Research Institute, also took place and involved collaboration with this program. CCCHFA staff and fishermen provided logistical support, including the provision of NECCHT tags.

### **Presentations**

- Northeast Regional Mark Recapture Tagging Workshop (October 2004)
- New Bedford Working Waterfront Festival (September 2005)
- Maine Fishermen’s Forum (March 2006) Title: Collaborative Northeast Groundfish Tagging Program: Results and Applications.
- Tom Rudolph presented at Orleans Elementary School in March 2006, teaching students the importance of tagging projects and how to tag fish.
- Lara Slifka presented at the 2007 Ocean Quest Teacher Workshop, teaching teachers about cooperative research, focusing on the Haddock Tagging Program.
- Lara Slifka presented at Northeast Regional Tagging Symposium, October 2008

## **Published Reports & Papers**

- Advertisements were placed in the following publications detailing procedures for recording and reporting a tagged haddock.
  - Commercial Fisheries News
  - Fishermen's Voice
  - National Fisherman
  - The Portuguese Times
  - The Navigator
  - Working Waterfront/ Inter Island News
  - National Fisherman
- Commercial Fisheries News published an article about the project in the April 2006 and March 2007 issues.
- CCCHFA maintains a homepage for the haddock tagging program on the organization's website ([www.ccchfa.org/tagging](http://www.ccchfa.org/tagging)) and also a prominent sidebar on all pages which publicizes the program and directs inquiries.
- GMRI also hosts a webpage describing the program (<http://www.gmri.org/mini/index.asp?ID=21>).

## **Future Research**

While there are a number of ongoing or follow-up inquiries that would be valuable (continued tagging, capture and tagging mortality investigations, archival tagging, etc.) the most pressing need at this time is for program maintenance. Tagged fish are still being caught and reported, and this can be expected to continue for up to several more years. Premature closure of tagging response infrastructures is a chronic problem in fisheries research, particularly for contracted cooperative programs, which lack long-term government agency hosting, and which are particularly prone to erosion of hard-earned industry support in the event that nobody is "keeping the lights on."

GMRI has been receiving, recording and responding to returns despite a lack of funding for this work for much of the past year, but it is not known how long they are going to be able to continue this process and it is important to find a permanent location for program data and a host which can continue to receive, enter and respond to recaptured fish information. Program partners (CCCHFA, GMRI and NEFSC) have held some preliminary discussions about this issue, but no final plans have been made. There has been discussion of transferring the NERCTP (cod) database to the NEFSC, and once again the "piggyback" model may offer efficiencies: it should be relatively simple and inexpensive to transfer the haddock database at the same time.

Since NEC was the sponsor of this program, consultation with NEC regarding this potential outcome will be needed.

**Appendix A: NEFSC Data Summary Report from September 2008**

**Northeast Consortium Cooperative Haddock Tagging Project:  
Summary of Reported Haddock Tag Recaptures  
Through September, 2008**

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## Data

This report provides a summary of available haddock tag-recapture data collected by the Northeast Consortium Cooperative Haddock Tagging Project (Parker et al. 2004) through September 2008. Haddock were captured with longline gear. Each fish was held briefly in a cold water tank for observation. Haddock that exhibited abnormal swimming movements or “floaters” were not tagged. Healthy haddock were tagged with Hallprint T-bar tags similar to tags used in the Northeast Regional Haddock Tagging Program. The tag-recapture data reported here were downloaded from the Gulf of Maine Research Institute website (<http://www.gmamapping.org/haddockdata/>) on September 2, 2008 (Figure 1). A total of 352 haddock tag-recapture records were verified. In comparison, a total of 20,418 tagged fish were reported to have been released. Of these, 20,405 fish had sufficient information for analysis. Based on the verified release data, the nominal tag-recapture rate from April 2005 through September 2008 was 1.7%.

Recaptured haddock were assigned an area of release and an area of capture based on the reported release and capture coordinates. The areas included the primary groundfish closed areas (Table 1) as well as the areas outside of these closed areas (open areas) as defined by the stock boundary between Georges Bank and Gulf of Maine haddock stocks (Figure 2). In particular, the open area of Georges Bank was the region bounded on the north by 42.33°N and on the east and west by 70.00°W and 66.00°W. The open area of the Gulf of Maine was the region bounded on the south by 42.33°N (41.67°N in Cape Cod Bay) and on the west by 66.00°W. Haddock recaptures outside of the open and closed areas designated above were categorized as “Other”, and included two recaptures in Canadian waters near the mouth or in the Bay of Fundy (Table 2). Additionally, there were 11 haddock recaptures without location information.

## Results

### Actual Tag Releases by Area

The actual releases of tagged haddock were 97% of the planned release numbers (Table 3). Total releases in Closed Area II, the open area of the Gulf of Maine, and the Cashes Ledge Closed Area were below target due to logistical difficulties. There were higher releases in the Georges Bank open areas due to opportunistic tagging on non-dedicated tagging trips (Parker et al. 2004). Overall, the project goal of deploying roughly 20,000 tags was achieved.

All release areas generated recaptures including Closed Area I, Closed Area II, the Western Gulf of Maine Closed Area, Cashes Ledge Closed Area, and the open areas of Georges Bank and the Gulf of Maine (Table 2). Recaptures were reported in all areas except for Nantucket Lightship and Cashes Ledge Closed Areas.

### Closed Area I Releases

There were 52 recaptures of haddock released in Closed Area I (Tables 2 and 3, Figure 2). This was about 0.7% of total releases in Closed Area I. Of these, ten were recaptured in Closed Area I (19%), one was recaptured in Closed Area II (2%), one was recaptured

in the Western Gulf of Maine Closed Area (2%), two were recaptured in the open area of the Gulf of Maine (4%), and 35 were recaptured in the open area on Georges Bank (67%). The vast majority of haddock released in Closed Area I were recaptured on Georges Bank. Nevertheless, there was evidence that some fish move from Closed Area I to the Gulf of Maine stock area. There was also evidence of haddock spill-over from closed areas to open areas on Georges Bank as well as in the Gulf of Maine.

#### Closed Area II Releases

About 2.8% of haddock released in Closed Area II were reported to be recaptured. There were 31 recaptures of haddock released in Closed Area II (Tables 2 and 3, Figure 2). Of these, 29 fish were recaptured in the open area on Georges Bank (94%), and one was caught in the open area in the Gulf of Maine (3%).

#### Cashes Ledge Closed Area

There were 6 recaptures of haddock tagged in Cashes Ledge Closed Area (Tables 2 and 3, Figure 2). This represented about 12.8% of haddock released in the Cashes Ledge Closed Area. Of these, five occurred in the open area in the Gulf of Maine (83%), and one was recaptured outside of the US stock areas.

#### Western Gulf of Maine Closed Area Releases

A total of 87 recaptures of haddock tagged within the Western Gulf of Maine Closed Area have been reported (Tables 2 and 3, Figure 2). This represented about 2.1% of haddock released in the Western Gulf of Maine Closed Area. Of these, 25 fish were also recaptured in the Western Gulf of Maine Closed Area (29%), 54 were recaptured in the open area of the Gulf of Maine (62%), and seven were recaptured in the open area on Georges Bank (8%). While most fish tagged in the Western Gulf of Maine Closed Area were recaptured in the Gulf of Maine, there was evidence that some haddock moved from the Gulf of Maine to Georges Bank.

#### Georges Bank Open Area Releases

There were 172 recaptures of haddock released in the open areas of Georges Bank (Tables 2 and 3, Figure 2). This was about 2.6% percent of the total releases in Georges Bank open areas. Of these, 137 recaptures also occurred in the open area on Georges Bank (80%), including Canadian waters. There were also two recaptures in Closed Area I (1%), 26 in the open areas of the Gulf of Maine (15%), and one outside of the US stock areas. Thus, although the vast majority of haddock released in the open area on Georges Bank were also recaptured there, these data show that some haddock move to closed areas of Georges Bank and from Georges Bank to the Gulf of Maine.

#### Gulf of Maine Open Area Releases

There were four recaptures of haddock released in the open areas in the Gulf of Maine (Tables 2 and 3, Figure 2), and all of these recaptures also occurred in the open areas in the Gulf of Maine. This represented about 0.3% of the total releases in Gulf of Maine open areas.

### Movement between Georges Bank and the Gulf of Maine Region

The recapture locations of a total of 339 haddock tagged and recaptured in either the Georges Bank or the Gulf of Maine regions were analyzed (Table 4). Of the 244 haddock tagged on Georges Bank, 214 fish (88%) were recaptured on Georges Bank and 30 fish (12%) were recaptured in the Gulf of Maine. Similarly, of the 95 haddock tagged in the Gulf of Maine, 88 fish (93%) were recaptured in the Gulf of Maine while 7 fish (7%) were recaptured on Georges Bank. Contingency table analysis indicates that the hypothesis that release and recapture distributions were independent would be rejected at the  $\alpha=0.05$  confidence level ( $X = 194.21 \gg \chi^2(0.95,1) = 3.84$ ). Thus, the release and recapture distributions were not statistically independent in the Georges Bank and Gulf of Maine regions which suggests regional heterogeneity in one or more processes affecting reported tag recaptures.

The available tag-recapture data also indicate that some haddock move between Georges Bank and the Gulf of Maine. Further, if fishing effort and reporting rates were homogeneous in time and space, the available data would suggest that the probability of individual fish movement between regions may be on the order of 10% per year. This is a crude approximation and the assumption of homogeneous effort is not likely met since recent average fishing mortality during 2005-2007 differed between the Georges Bank ( $F_{AVG}=0.26$ , unweighted average of ages 5-8, Brooks et al. (2008)) and the Gulf of Maine ( $F_{AVG}=0.36$ , unweighted average of ages 6-8, Palmer et al. (2008)) regions. Overall, the application of finer scale analyses using an appropriately modified tag-recapture model (e.g., Miller and Andersen (2008)) would be necessary to directly estimate movement rates.

### Movement between the Eastern and Western Georges Bank Management Units

Reported recapture locations of 234 haddock tagged in either the Eastern or Western Georges Bank management units and subsequently recovered and reported were analyzed (Table 5). Of the 142 haddock tagged on Eastern Georges Bank, 116 fish (82%) were recaptured on Eastern Georges Bank, 4 fish (3%) were recaptured on Western Georges Bank, and 22 fish (15%) were not recaptured on Georges Bank. Similarly, there were 92 haddock tagged on Western Georges Bank and recaptured. Of these, 47 fish (51%) were recaptured on Eastern Georges Bank, 29 fish (32%) were recaptured on Western Georges Bank, and 16 fish (17%) were not recaptured on Georges Bank. Contingency table analysis indicates that the hypothesis that release and recapture distributions were independent would be rejected at the  $\alpha=0.05$  confidence level ( $X = 133.26 \gg \chi^2(0.95,2) = 5.99$ ). Thus, the release and recapture distributions were not statistically independent in the Eastern and Western Georges Bank regions which suggests regional heterogeneity in one or more processes affecting reported tag recaptures. The available tag-recapture data indicate movement occurs between the Eastern and Western Georges Bank management units and also show that some tagged fish moved from inside to outside of these units.

### Length Frequency Distribution at Release of Recaptured Haddock

The length at release of the recaptured haddock (Figure 3) ranged from 37 cm to 76 cm (15-30 in). The mean length at release of the recaptured haddock was 49 cm (19 in) with

a coefficient of variation (CV) of 15%. Overall, most of the recaptured fish would be considered to be scrod haddock in comparison to large market category haddock.

#### Distribution of Numbers of Days at Large Before Recapture

The number of days at large before recapture ranged from 4 to 930 days (Figure 4). The mean length of time before recapture was 275 days, with a median of 228 nm and a CV of 80%. Overall, 75% of the recaptures were reported within 418 days.

#### Distribution of Minimum Distance Traveled

The minimum distance traveled by recaptured haddock ranged from 0.5 to 203.2 nautical miles (Figure 5). Here the minimum distance traveled is the haversine great-circle straight line distance between the release and recapture sites. The mean distance traveled was 40 nm, with a median of 37 nm and a CV of 75%. Overall, 75% of recaptured fish were caught within 50 nm of their release site.

#### Distribution of Percent Growth between Release and Recapture

The percent growth between release and recapture ranged from 0% to +112% in length (Figure 6). This percentage was calculated as the difference between the reported recapture and release lengths divided by the reported release length. Forty percent of the recaptures (n=141) were excluded due to inaccurate or missing recapture length measurements. Overall, the percent growth averaged 9%. Although the percent growth is subject to measurement error in the field, especially for the length at recapture, the data suggests that growth in length was relatively slow, on average, during time at large. However, growth rates need to be further examined by stock area, time-at-large, season, and length at release. We would particularly expect that smaller fish would have greater growth rates than larger fish.

#### Distribution of the Average Minimum Distance Traveled Per Day

The minimum distance traveled per day of recaptured haddock ranged from 0.00065 nm/day to 12.8 nm/day (Figure 7). The mean minimum distance traveled per day for all tagged haddock was 0.6 nautical miles with a CV of 201%, with 95% of the recaptures traveling less than 2.1 nm/day. However, actual distance traveled per day is likely greater, and the calculated minimum distance per day metric is likely biased by time-at-large, especially considering possible seasonal movements.

#### Distribution of the Angle of Movement from Release to Recapture Site

The angle of movement from release site to recapture site ranged from 1° to 359° relative to due East (Figure 8). The median angle of movement was roughly 138°, i.e., approximately northwest. The 75<sup>th</sup> quantile for the angle of movement was equal to 239°, indicating that the angles of movement were fairly equally distributed directionally. However, the distribution seems to be bimodal (Figure 8) with one peak movement angle to the northwest (120°-150°) as well as one to the east (around 360°). These may correspond to mean movements in the Gulf of Maine and Georges Bank respectively (Figure 2). Again, angle of movement could be confounded by seasonal movements as well as the location of the release sites to closed areas with reduced fishing effort and recapture rates.

## Conclusions

Given the limited number of tag recaptures available and lack of information on fishing effort, reporting rates and haddock mortality rates, no attempt was made to estimate movement rates in this report. Nonetheless, a few simple conclusions can be drawn:

- Haddock migrate from US waters on eastern Georges Bank to Canadian waters.
- A few haddock migrate long distances across stock boundaries. One fish tagged on northern Georges Bank traveled a minimum of 139 nautical miles to the northern Gulf of Maine and another tagged in a similar location traveled 142 nm to the mouth of the Bay of Fundy. Likewise, a haddock tagged in Cashes Ledge Closed Area traveled 203 nm into the Bay of Fundy. These fish were all of mature size (47-50 cm), they were released between the end of April and mid-July, and were captured between the end of July and mid-September, indicating that occasional large northern movements may occur after the spawning season. Another haddock tagged in Closed Area I traveled 84 nm to the Western Gulf of Maine Closed Area between mid-August and mid-September of 2005.
- Some haddock move from the Georges Bank stock area to the Gulf of Maine stock area and vice versa.
- Some haddock move from the Eastern Georges Bank management unit to the Western Georges Bank management unit and vice versa.
- Several haddock tagged inside of Closed Area I, Closed Area II, Cashes Ledge Closed Area, and the Western Gulf of Maine Closed Area were captured outside of the areas. This indicates that there is some spill-over of adult haddock from these closed areas. Conversely, there were a few instances of haddock moving from open areas to closed areas.
- The low number of recaptures could indicate that haddock do not survive the tagging process as well as other groundfish (i.e. high tagging-induced mortality rates); it could also reflect tag loss or low reporting rate. There are not sufficient data at present to evaluate the relative veracity of these factors.
- Haddock in the Georges Bank and Gulf of Maine regions constitute a metapopulation, i.e., consist of a group of spatially separated populations (of the same species) which interact at some level.

## References

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Parker, P., Tallack, S., and Brodziak, J. 2004. Haddock migration in New England waters: Analysis of movements between stocks and closed areas. Northeast Consortium, 142 Morse Hall, 8 College Road, Durham NH 03824.

Table 1. Points defining the boundaries of NEFMC Groundfish Closed Areas: Closed Area I (CA I), Closed Area II (CA II), Nantucket Lightship Closed Area (NAN), Western Gulf of Maine Closed Area (WGOM), and Cashes Ledge Closed Area (Cashes CA).

	Point Number	Longitude		Latitude	
		Deg	Min	Deg	Min
CA I	1	69	22.8	41	30
	2	68	30	41	30
	3	68	30	40	45
	4	68	45	40	45
CA II	1	67	19.5	42	21.7
	2	66	25.5	41	19.2
	3	66	36	41	0
	4	67	20	41	0
NAN	1	70	20	40	50
	2	69	0	40	50
	3	69	0	40	20
	4	70	20	40	20
WGOM	1	70	15	43	15
	2	69	55	43	15
	3	69	55	42	15
	4	70	15	42	15
Cashes CA	1	69	26	42	49.5
	2	69	02	43	07
	3	68	46	42	49.5
	4	68	50.5	42	46.5
	5	68	58.5	42	43.5
	6	69	17.5	42	42.5

Table 2. Frequency of reported recaptures of tagged haddock by release area and recapture area.

NEC Cooperative Haddock Tagging Project Recapture Results as of 2-Sept-2008

The FREQ Procedure

RELEASE_AREA	RECAPTURE_AREA	Frequency	Percent
Closed Area I	Closed Area I	10	2.84
Closed Area I	Closed Area II	1	0.28
Closed Area I	Other	0	0.00
Closed Area I	Georges Bank Open	35	9.94
Closed Area I	Gulf of Maine Open	2	0.57
Closed Area I	No Recapture Location	3	0.85
Closed Area I	WGOM Closed Area	1	0.28
Closed Area II	Closed Area I	0	0.00
Closed Area II	Closed Area II	0	0.00
Closed Area II	Other	0	0.00
Closed Area II	Georges Bank Open	29	8.24
Closed Area II	Gulf of Maine Open	1	0.28
Closed Area II	No Recapture Location	1	0.28
Closed Area II	WGOM Closed Area	0	0.00
Cashes Ledge Closed Area	Closed Area I	0	0.00
Cashes Ledge Closed Area	Closed Area II	0	0.00
Cashes Ledge Closed Area	Other	1	0.28
Cashes Ledge Closed Area	Georges Bank Open	0	0.00
Cashes Ledge Closed Area	Gulf of Maine Open	5	1.42
Cashes Ledge Closed Area	No Recapture Location	0	0.00
Cashes Ledge Closed Area	WGOM Closed Area	0	0.00
Georges Bank Open	Closed Area I	2	0.57
Georges Bank Open	Closed Area II	0	0.00
Georges Bank Open	Other	1	0.28
Georges Bank Open	Georges Bank Open	137	38.92
Georges Bank Open	Gulf of Maine Open	26	7.39
Georges Bank Open	No Recapture Location	6	1.70
Georges Bank Open	WGOM Closed Area	0	0.00
Gulf of Maine Open	Closed Area I	0	0.00
Gulf of Maine Open	Closed Area II	0	0.00
Gulf of Maine Open	Other	0	0.00
Gulf of Maine Open	Georges Bank Open	0	0.00
Gulf of Maine Open	Gulf of Maine Open	4	1.14
Gulf of Maine Open	No Recapture Location	0	0.00
Gulf of Maine Open	WGOM Closed Area	0	0.00
WGOM Closed Area	Closed Area I	0	0.00
WGOM Closed Area	Closed Area II	0	0.00
WGOM Closed Area	Other	0	0.00
WGOM Closed Area	Georges Bank Open	7	1.99
WGOM Closed Area	Gulf of Maine Open	54	15.34
WGOM Closed Area	No Recapture Location	1	0.28
WGOM Closed Area	WGOM Closed Area	25	7.10

Table 3. Summary of haddock tagged and released by area as well as frequency and percent composition of reported recaptures by release area and recapture area.

**Number of Haddock Tagged and Released by Area**

Release Area	Planned Releases	Number Released	Total Recaptured	Percent Recaptured
Closed Area I	8000	7316	52	0.7%
Closed Area II	2000	1091	31	2.8%
WGOM Closed Area	4000	4092	87	2.1%
Cashes Ledge Closed Area	1000	47	6	12.8%
Georges Bank Open	4000	6718	172	2.6%
Gulf of Maine Open	2000	1188	4	0.3%
<b>Total Releases</b>	<b>21000</b>	<b>20452</b>	<b>352</b>	<b>1.7%</b>

**Number of Haddock Recaptured by Release Area**

Release Area	Recapture Area								Total	Percent of Total
	Closed Area I	Closed Area II	WGOM Closed Area	Cashes Ledge Close Area	Georges Bank Open	Gulf of Maine Open	Other or Unknown			
Closed Area I	10	1	1	0	35	2	3	52	14.8%	
Closed Area II	0	0	0	0	29	1	1	31	8.8%	
WGOM Closed Area	0	0	25	0	7	54	1	87	24.7%	
Cashes Ledge Closed Area	0	0	0	0	0	5	1	6	1.7%	
Georges Bank Open	2	0	0	0	137	26	7	172	48.9%	
Gulf of Maine Open	0	0	0	0	0	4	0	4	1.1%	
<b>Total Recaptured</b>	<b>12</b>	<b>1</b>	<b>26</b>	<b>0</b>	<b>208</b>	<b>92</b>	<b>13</b>	<b>352</b>	<b>100%</b>	
<b>Percent of Total</b>	<b>3.4%</b>	<b>0.3%</b>	<b>7.4%</b>	<b>0.0%</b>	<b>59.1%</b>	<b>26.1%</b>	<b>3.7%</b>	<b>100%</b>		

**Percent Composition by Release Area**

Release Area	Recapture Area								Total
	Closed Area I	Closed Area II	WGOM Closed Area	Cashes Ledge Close Area	Georges Bank Open	Gulf of Maine Open	Other or Unknown		
Closed Area I	19.2%	1.9%	1.9%	0%	67.3%	3.8%	5.8%	100%	
Closed Area II	0%	0%	0%	0%	93.5%	3.2%	3.2%	100%	
WGOM Closed Area	0%	0%	28.7%	0%	8.0%	62.1%	1.1%	100%	
Cashes Ledge Closed Area	0%	0%	0%	0%	0.0%	83.3%	16.7%	100%	
Georges Bank Open	1.2%	0%	0%	0%	79.7%	15.1%	4.1%	100%	
Gulf of Maine Open	0%	0%	0%	0%	0%	100.0%	0.0%	100%	

**Percent Composition by Recapture Area**

Release Area	Recapture Area							
	Closed Area I	Closed Area II	WGOM Closed Area	Cashes Ledge Close Area	Georges Bank Open	Gulf of Maine Open	Other or Unknown	
Closed Area I	83.3%	100.0%	3.8%	na	16.8%	2.2%	23.1%	
Closed Area II	0%	0%	0%	na	13.9%	1.1%	7.7%	
WGOM Closed Area	0%	0%	96.2%	na	3.4%	58.7%	7.7%	
Cashes Ledge Closed Area	0%	0%	0%	na	0%	5.4%	7.7%	
Georges Bank Open	16.7%	0%	0%	na	65.9%	28.3%	53.8%	
Gulf of Maine Open	0%	0%	0%	na	0%	4.3%	0.0%	
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>na</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	

Table 4. Summary of haddock tagged and recaptured by region (Georges Bank or Gulf of Maine) and fishery area (Open or Closed).

**Percent of Haddock Recaptured by Release Region**

Release Region	Recapture Region				Total	Percent of Total
	Georges Bank Open	Georges Bank Closed	Gulf of Maine Open	Gulf of Maine Closed		
Georges Bank Open	137	2	26	0	165	49%
Georges Bank Closed	64	11	3	1	79	23%
Gulf of Maine Open	0	0	4	0	4	3%
Gulf of Maine Closed	7	0	59	25	91	25%
Total	208	13	92	26	339	100%
Percent of Total	61%	4%	27%	8%	100%	

**Percent of Haddock Recaptured by Release Region**

Release Region	Recapture Region				Total
	Georges Bank Open	Georges Bank Closed	Gulf of Maine Open	Gulf of Maine Closed	
Georges Bank Open	83%	1%	16%	0%	100%
Georges Bank Closed	81%	14%	4%	1%	100%
Gulf of Maine Open	0%	0%	100%	0%	100%
Gulf of Maine Closed	8%	0%	65%	27%	100%

Table 5. Summary of haddock tagged on Georges Bank and recaptured by Georges Bank management unit (Eastern Georges Bank, Western Georges Bank or Not on Georges Bank/Unknown Area).

**Recaptures of Haddock Tagged on Georges Bank by Management Unit**

Release Region	Recapture Region			Total
	Eastern Georges Bank	Western Georges Bank	Not Recaptured on Georges Bank	
Eastern Georges Bank	116	4	22	142
Western Georges Bank	47	29	16	92
Total	163	33	38	234

**Percent Recaptures of Haddock Tagged on Georges Bank by Management Unit**

Release Region	Recapture Region			Total
	Eastern Georges Bank	Western Georges Bank	Not Recaptured on Georges Bank or Unknown Area	
Eastern Georges Bank	82%	3%	15%	100%
Western Georges Bank	51%	32%	17%	100%

Figure 1. Haddock tagging project recaptured fish (n=355) as of September 8, 2008 as plotted from GMRI website. Orange squares show deployment locations of tagged haddock. Red circles show recapture locations and red lines show the minimum distance between deployment and recapture.

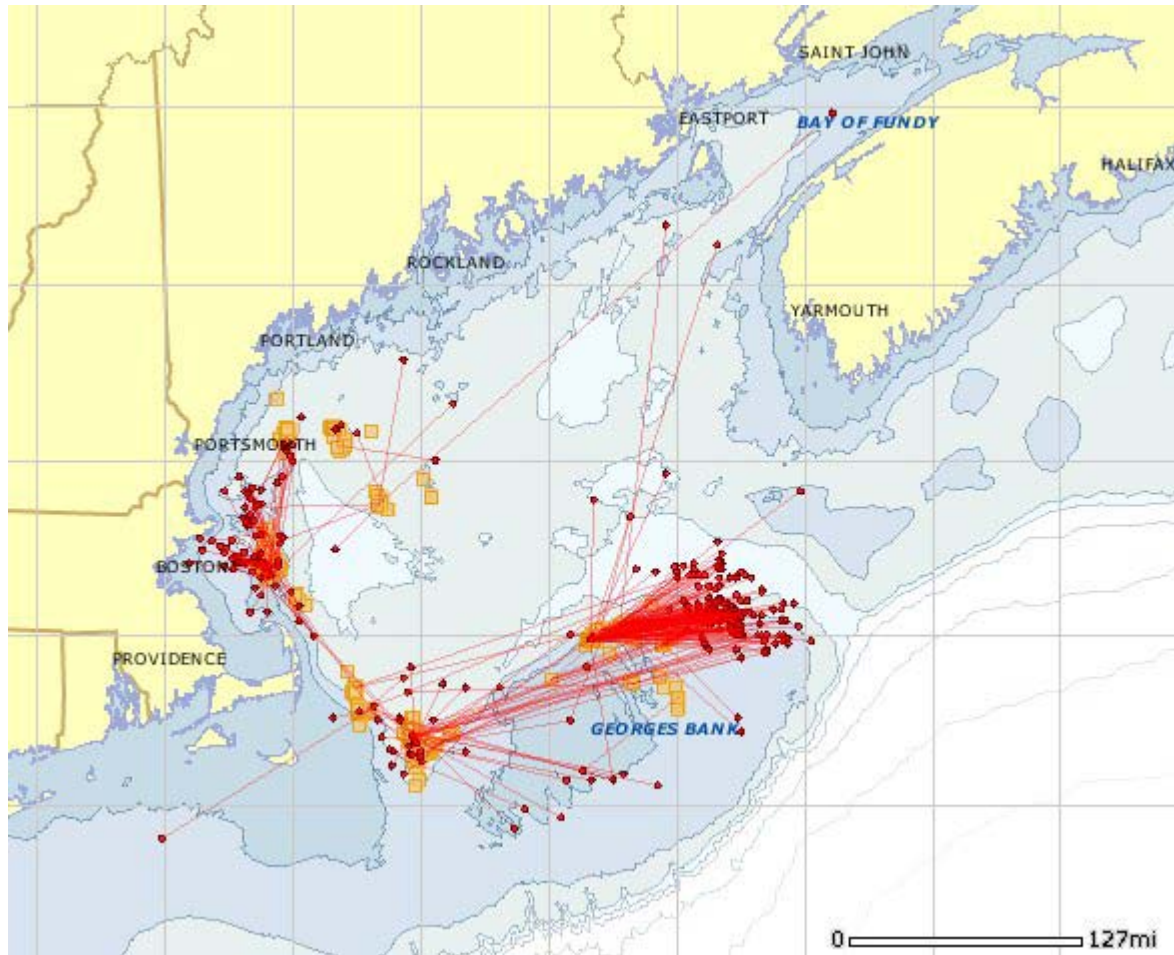


Figure 2. Plot of release and recapture locations of haddock tagged during the Northeast Consortium Cooperative Haddock Tagging Project reported through September 2, 2008 in relation to Georges Bank and Gulf of Maine haddock stock boundary (solid black line) to the west of the Hague line (light tan line).

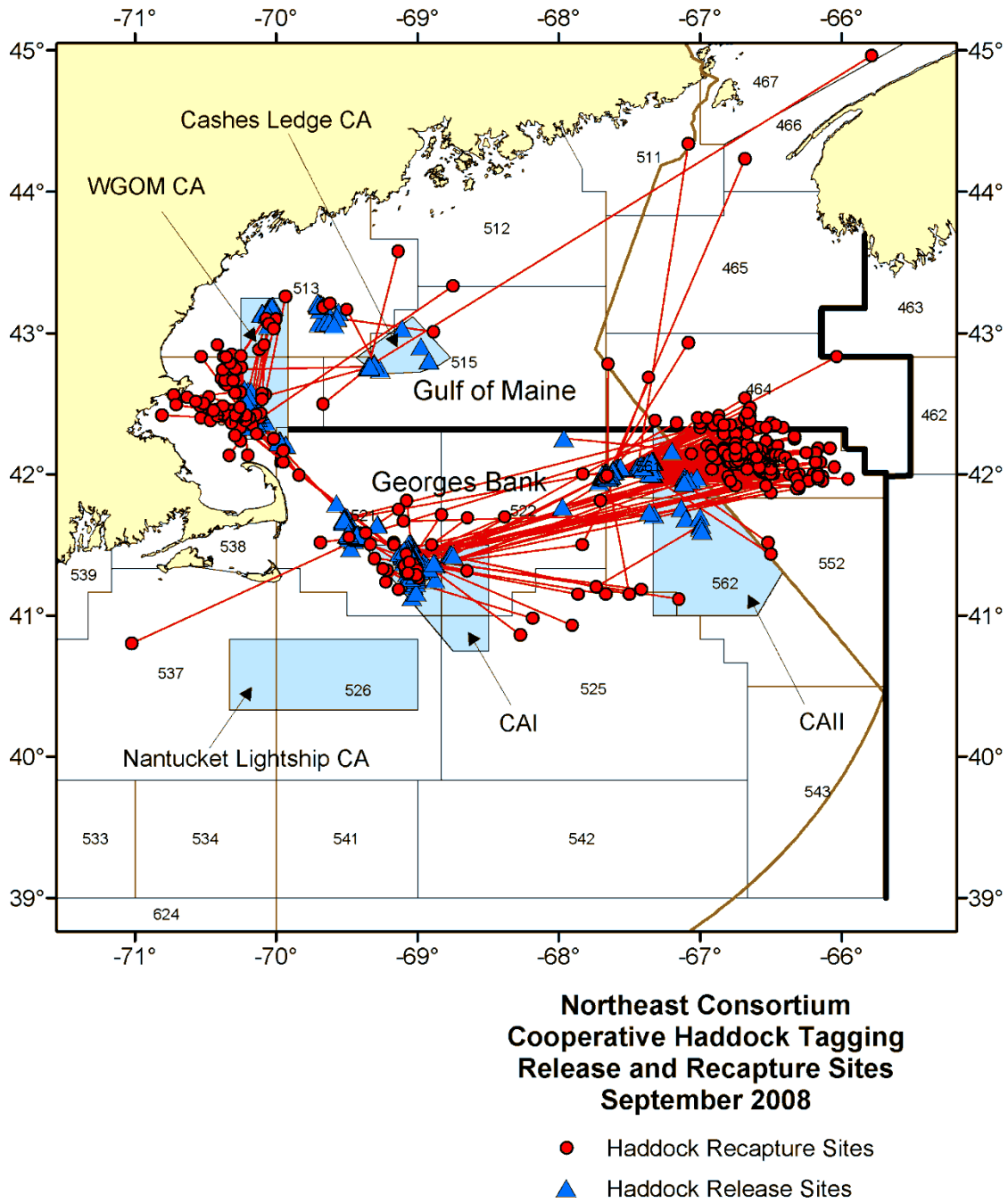


Figure 3. Length Frequency of Recaptured Haddock on Release from Northeast Consortium Cooperative Haddock Tagging September 2008

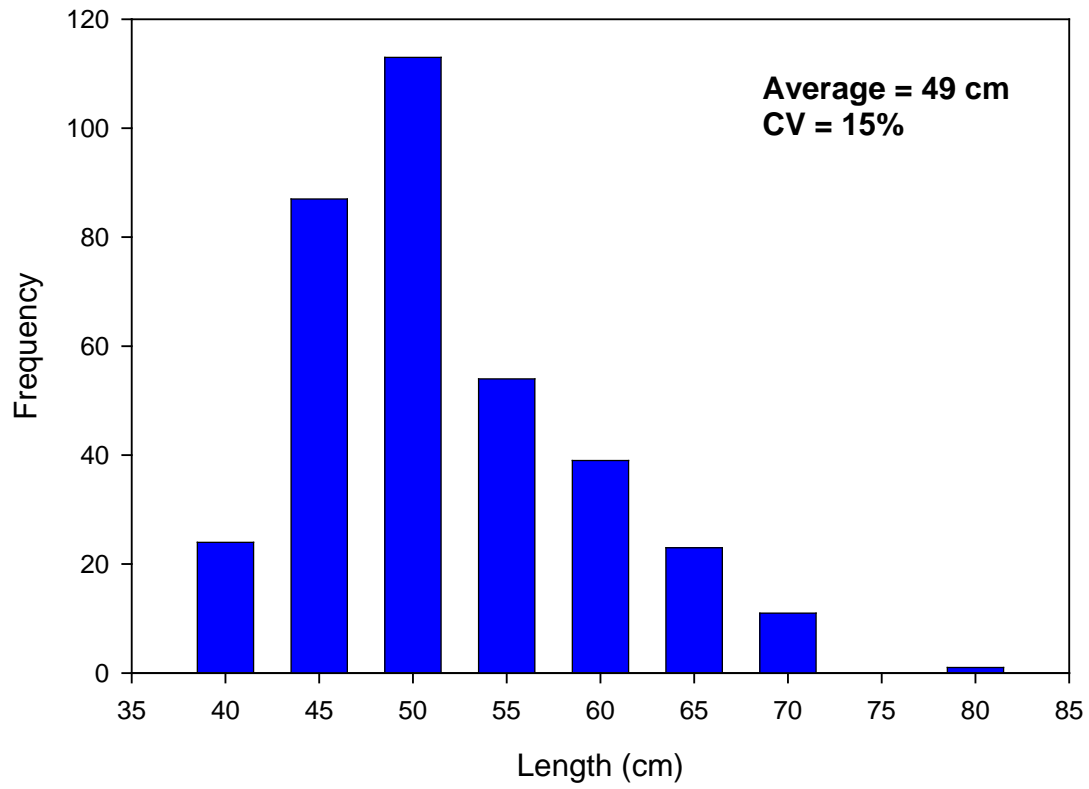


Figure 4. Haddock Days at Large from Northeast Consortium Cooperative Haddock Tagging, September 2008

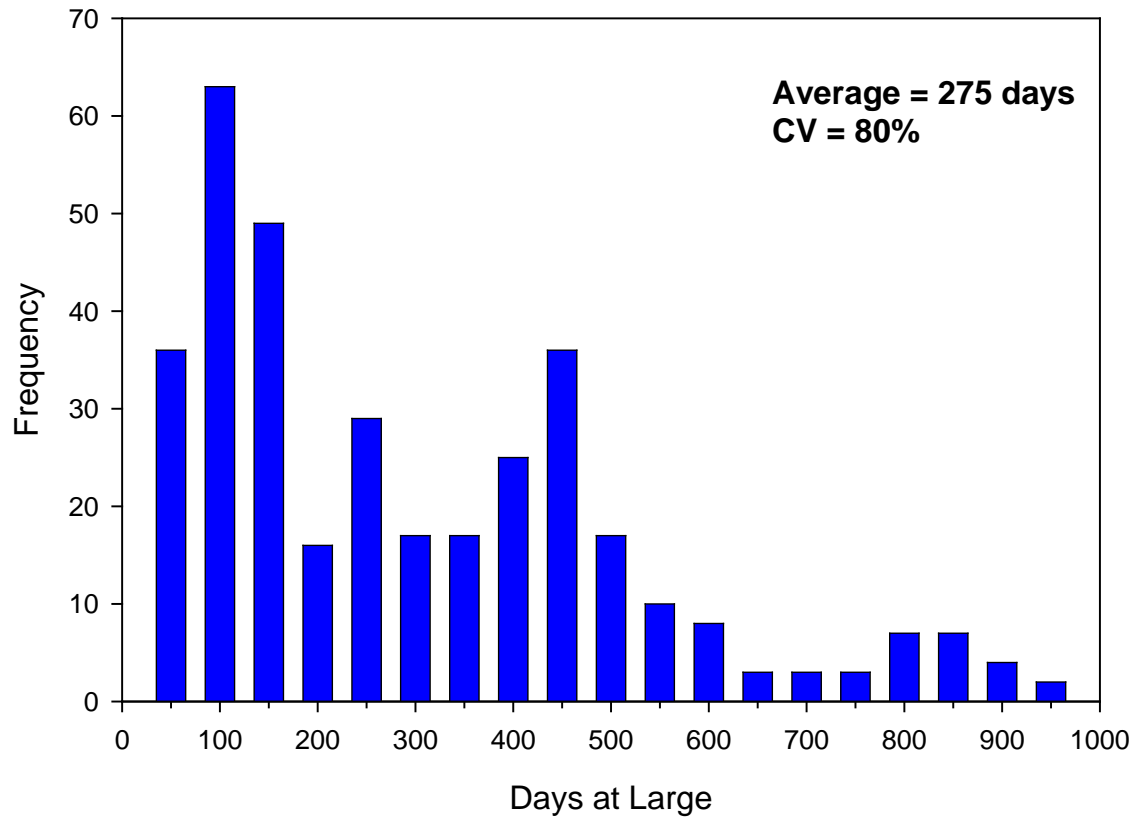


Figure 5. Minimum Distance Traveled by Haddock from Northeast Consortium Cooperative Haddock Tagging, September 2008

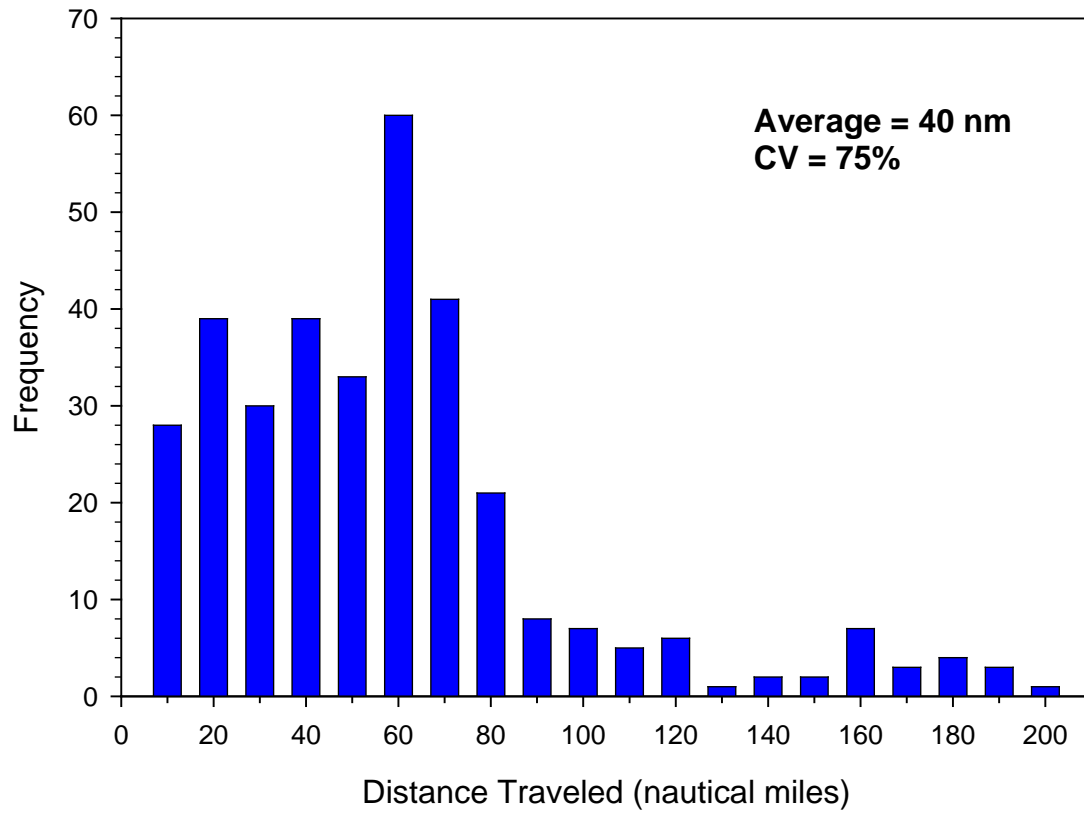


Figure 6. Haddock Percent Growth at Large from Northeast Consortium Cooperative Haddock Tagging September 2008

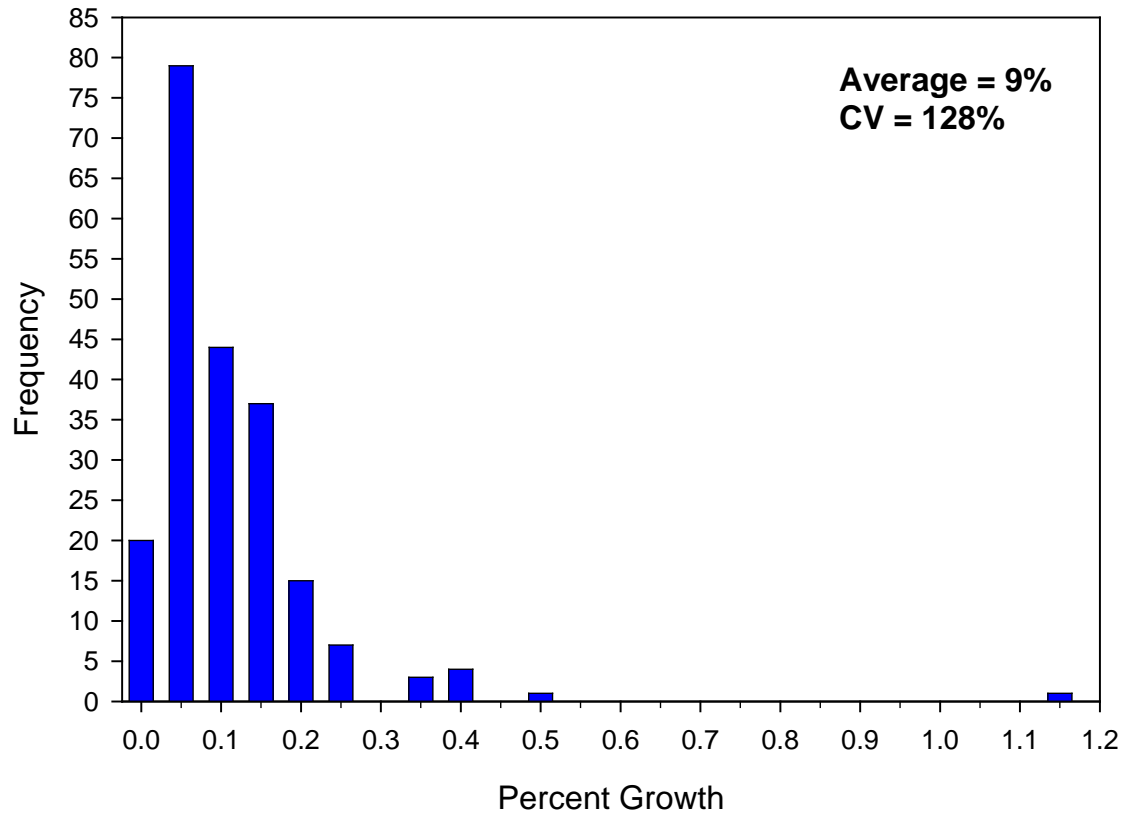


Figure 7. Haddock Mean Distance Traveled per Day at Large from Northeast Consortium Cooperative Haddock Tagging, September 2008

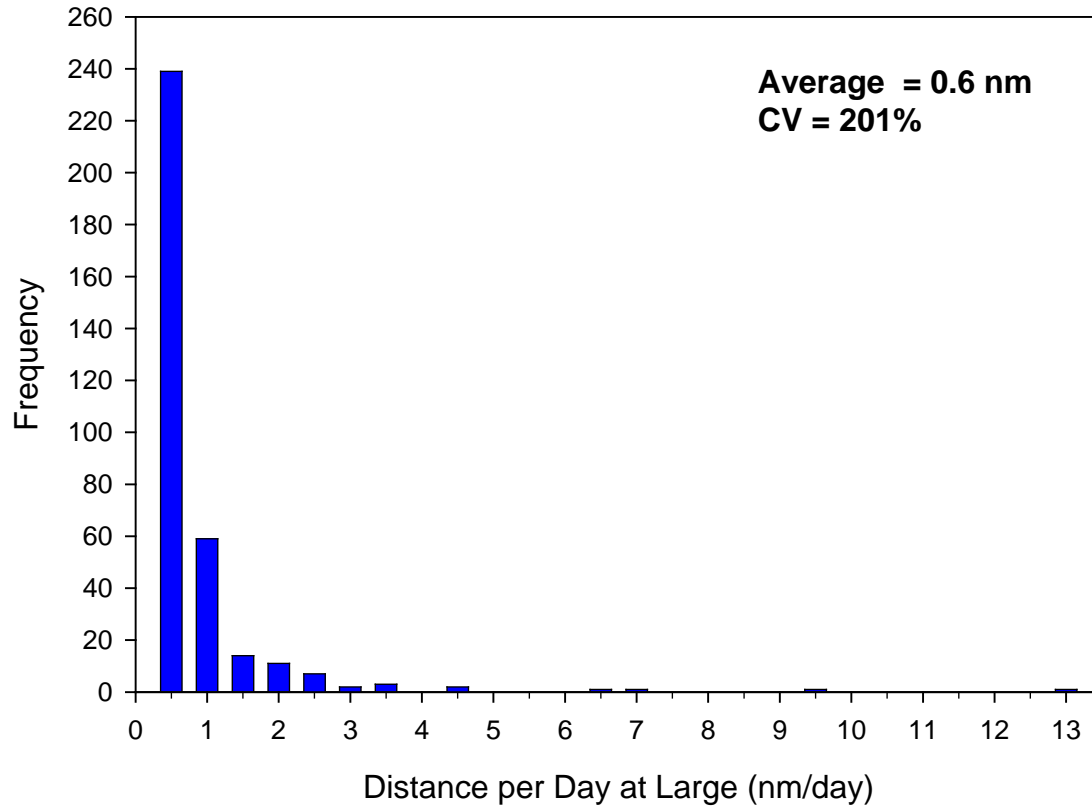
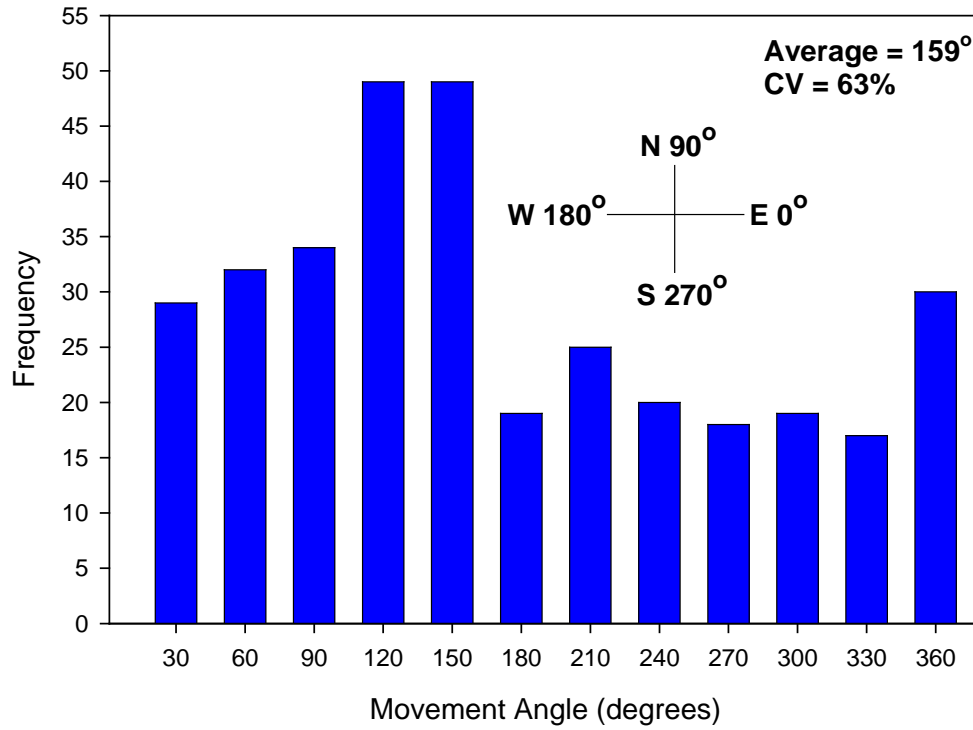


Figure 8. Movement Angle of Haddock at Large from Northeast Consortium Cooperative Haddock Tagging, September 2008



Appendix. Northeast Consortium Cooperative Haddock Tagging Project tag-recapture data through September 2, 2008.

Obs	FISHID	RELEASE AREA	RELEASE		RECAPTURE AREA	RECAPTURE		DAL	DISTANCE	RELEASE DATE	RECAPTURE DATE
			LAT	LON		LAT	LON		TRAVELED NM		
1	113630	GB Open	42.0512	67.4426	GB Open	42.1333	66.8333	63	37.2	7/15/2005	9/15/2005
2	113633	GB Open	42.0489	67.4252	GB Open	42.1833	66.1667	370	76.8	7/15/2005	7/20/2006
3	113634	GB Open	42.0489	67.4252	GB Open	42.2833	66.8333	46	40.3	7/15/2005	8/30/2005
4	113641	GB Open	42.0489	67.4252	GB Open	42.2	66.5	4	57.2	7/15/2005	7/19/2005
5	113643	GB Open	42.0489	67.4252	GB Open	42.0833	66.5833	26	51.1	7/15/2005	8/10/2005
6	113650	GB Open	42.0489	67.4252	GB Open	42.1167	66.6	427	50.3	7/15/2005	9/15/2006
7	113652	GB Open	42.0489	67.4252	GB Open	42.15	66.1833	11	75.5	7/15/2005	7/26/2005
8	113683	GB Open	42.0489	67.4299	GB Open	42.1333	66.6667	63	46.7	7/15/2005	9/16/2005
9	113685	GB Open	42.0489	67.4299	GB Open	42.1333	66.8	384	38.8	7/15/2005	8/3/2006
10	113710	GB Open	42.0479	67.4346	GB Open	42.2667	66.7	466	47.5	7/15/2005	10/24/2006
11	113725	GB Open	42.0479	67.4346	GB Open	42.2	66.45	20	60.6	7/15/2005	8/4/2005
12	113727	GB Open	42.0479	67.4346	GB Open	42.3333	66.6667	110	51.4	7/15/2005	11/2/2005
13	113732	GB Open	42.0491	67.44	GB Open	42.1333	66.5833	27	52.1	7/15/2005	8/11/2005
14	113741	GB Open	42.0491	67.44	GOM Open	44.3417	67.0833	62	188.9	7/15/2005	9/15/2005
15	113742	GB Open	42.0491	67.44	GB Open	42.15	66.25	16	72.1	7/15/2005	7/31/2005
16	113743	GB Open	42.0491	67.44	GB Open	42.1167	66.55	12	53.9	7/15/2005	7/27/2005
17	113751	GB Open	42.0467	67.4402	GB Open	42.1167	66.6	123	51.1	7/15/2005	11/15/2005
18	113762	GB Open	42.0467	67.4402	GB Open	42.1333	66.4667	6	59.2	7/15/2005	7/21/2005
19	113770	GB Open	42.0467	67.4402	GB Open	41.4333	66.5	333	75.7	7/15/2005	6/13/2006
20	113774	GB Open	42.0467	67.4402	GB Open	42.15	66.75	430	42.5	7/15/2005	9/18/2006
21	113817	GB Open	42.0613	67.3907	GB Open	42.2	66.95	44	29.0	7/16/2005	8/28/2005
22	113820	GB Open	42.0613	67.3907	GB Open	41.9833	66.1333	547	76.6	7/16/2005	1/13/2007
23	113843	GB Open	42.062	67.4	GB Open	42.1167	66.6	431	48.7	7/16/2005	9/19/2006
24	113866	GB Open	42.0588	67.4074	GB Open	42.25	66.3333	36	66.5	7/16/2005	8/20/2005
25	113868	GB Open	42.0588	67.4074	GB Open	42.2333	66.5333	18	54.5	7/16/2005	8/2/2005
26	113882	GB Open	42.0602	67.4195	GOM Open	42.35	66.8667	83	40.4	7/16/2005	10/6/2005
27	113885	GB Open	42.0602	67.4195	GOM Open	42.3497	66.9028	138	38.6	7/16/2005	11/30/2005
28	113981	Closed Area I	41.3658	68.8697	GB Open	41.8667	66.5	503	148.0	7/29/2005	12/14/2006
29	113999	Closed Area I	41.3658	68.8697	GB Open	42	66.4833	549	152.2	7/29/2005	1/29/2007
30	114082	Closed Area I	41.3658	68.8697	GB Open	42	66.3667	524	158.8	7/29/2005	1/4/2007

Obs	FISHID	RELEASE AREA	RELEASE	RELEASE	RECAPTURE AREA	RECAPTURE	RECAPTURE	DAL	DISTANCE	RELEASE	RECAPTURE
			LAT	LON		LAT	LON		TRAVELED	DATE	DATE
31	114088	Closed Area I	41.3658	68.8697	GB Open	42.3333	67	365	136.7	7/29/2005	7/29/2006
32	114115	Closed Area I	41.3658	68.8697	Closed Area I	41.3668	69.0345	501	9.9	7/29/2005	12/12/2006
33	114153	Closed Area I	41.3658	68.8697	Closed Area I	41.2618	68.9927	83	11.1	7/29/2005	10/20/2005
34	114169	Closed Area I	41.3658	68.8697	GB Open	41.5	67.8333	43	63.2	7/29/2005	9/10/2005
35	114285	Closed Area I	41.3678	68.9521	GB Open	41.4033	69.305	76	21.0	7/30/2005	10/14/2005
36	114300	Closed Area I	41.3678	68.9521	GB Open	41.5017	68.9	131	10.2	7/30/2005	12/8/2005
37	114320	Closed Area I	41.3654	68.9578	GOM Open	42.3667	67.1667	751	134.0	7/30/2005	8/20/2007
38	114357	Closed Area I	41.3576	68.9612	GB Open	41.5833	69.3667	73	29.6	7/30/2005	10/11/2005
39	114388	GB Open	41.5552	69.4238	GB Open	41.5172	69.6859	49	16.0	8/2/2005	9/19/2005
40	114456	Closed Area I	41.2139	69.0273	Closed Area I	41.3199	69.2137	215	13.4	4/6/2005	11/6/2005
41	114548	Closed Area I	41.231	69.009	GB Open	40.9783	68.185	37	53.9	4/6/2005	5/12/2005
42	114610	Closed Area I	41.2559	69.0106	GB Open	41.329	69.2448	214	14.6	4/6/2005	11/6/2005
43	114707	Closed Area I	41.2725	69.0117	Closed Area I	41.319	69.0028	214	3.0	4/6/2005	11/6/2005
44	114752	Closed Area I	41.2667	69.0444	Closed Area I	41.4335	69.0808	308	11.3	4/6/2005	2/8/2006
45	114950	GB Open	42.0342	67.3943	GB Open	42.1	66.5	375	56.0	7/20/2005	7/29/2006
46	115022	GB Open	42.0342	67.3943	GB Open	42.3333	66.5833	48	55.6	7/20/2005	9/5/2005
47	115052	GB Open	42.0342	67.3943	GB Open	42.0833	66.8	560	37.9	7/20/2005	1/30/2007
48	115225	Closed Area I	41.3171	68.9756	WGOM CA	42.3333	70.25	42	110.9	8/11/2005	9/22/2005
49	115330	Closed Area I	41.2964	69.0192	Closed Area I	41.3043	69.0846	795	4.0	8/11/2005	10/14/2007
50	115395	Closed Area I	41.2903	69.0532	GB Open	42.1167	66.6	349	161.7	8/11/2005	7/26/2006
51	115567	Closed Area I	41.3756	69.0923	GB Open	42	66.3	137	175.1	9/9/2005	1/23/2006
52	115711	Closed Area I	41.4027	69.0725	Closed Area I	41.3167	68.65	98	26.9	9/9/2005	12/16/2005
53	116173	Closed Area I	41.2866	69.0108	GB Open	42.1333	66.7333	418	152.7	9/28/2005	11/20/2006
54	116597	Closed Area I	41.4083	69.0446	GB Open	41.696	68.3826	198	46.3	11/19/2005	6/4/2006
55	117045	Closed Area I	41.4223	69.041	GB Open	42	66.3333	431	169.2	11/19/2005	1/23/2007
56	117054	Closed Area I	41.4223	69.041	GB Open	42	66.2	434	177.0	11/19/2005	1/26/2007
57	117070	Closed Area I	41.4223	69.041	GB Open	41.9	66.3	55	169.1	11/19/2005	1/12/2006
58	117650	GB Open	41.6839	69.4957	GB Open	42.2	66.6667	237	175.3	11/28/2005	7/22/2006
59	117653	GB Open	41.6839	69.4957	No Recap Loc	.	.	573	.	11/28/2005	6/23/2007
60	117750	GB Open	41.6922	69.4967	GB Open	42.3333	67	262	158.7	11/28/2005	8/17/2006
61	117817	GB Open	41.5479	69.4021	GB Open	40.8029	71.0223	920	114.2	12/5/2005	6/12/2008
62	117821	GB Open	41.5479	69.4021	No Recap Loc	.	.	930	.	12/5/2005	6/22/2008

Obs	FISHID	RELEASE AREA	RELEASE	RELEASE	RECAPTURE AREA	RECAPTURE	RECAPTURE	DAL	DISTANCE	RELEASE	RECAPTURE
			LAT	LON		LAT	LON		TRAVELED	DATE	DATE
63	117908	GB Open	41.5601	69.4112	Closed Area I	41.3501	69.0946	359	26.1	12/5/2005	11/29/2006
64	117946	GB Open	41.5612	69.4084	GB Open	41.15	67.5	876	119.6	12/5/2005	4/29/2008
65	117963	GB Open	41.5579	69.4192	GOM Open	42.4167	66.65	736	180.2	12/5/2005	12/11/2007
66	117996	Closed Area I	41.4215	69.0303	No Recap Loc	.	.	381	.	12/18/2005	1/2/2007
67	118447	Closed Area I	41.4194	69.0414	GB Open	42	66.1667	418	179.1	12/18/2005	2/8/2007
68	118758	GB Open	41.5732	69.4851	GB Open	41.15	67.5	867	123.2	1/6/2006	5/21/2008
69	119015	WGOM CA	42.427	70.1038	WGOM CA	43.0833	70.0667	824	52.4	1/13/2006	4/16/2008
70	119027	WGOM CA	42.427	70.1038	GOM Open	42.8167	70.35	337	33.6	1/13/2006	12/16/2006
71	119055	WGOM CA	42.427	70.1038	GOM Open	42.5486	70.4753	169	23.2	1/13/2006	7/1/2006
72	119072	Closed Area I	41.4052	69.0573	GB Open	41.5167	69.1667	298	10.1	1/17/2006	11/11/2006
73	119089	Closed Area I	41.4052	69.0573	GB Open	41.1833	67.4167	828	100.4	1/17/2006	4/24/2008
74	119144	WGOM CA	42.427	70.1038	GOM Open	43.2583	69.9333	834	67.6	1/13/2006	4/26/2008
75	119185	WGOM CA	42.4438	70.1355	WGOM CA	42.5833	70.25	578	13.6	1/13/2006	8/14/2007
76	119299	WGOM CA	42.5915	70.198	WGOM CA	43.1042	70.072	172	42.5	1/17/2006	7/7/2006
77	119303	WGOM CA	42.5915	70.198	GOM Open	42.6654	70.3646	418	11.2	1/17/2006	3/10/2007
78	119330	WGOM CA	42.5915	70.198	GOM Open	42.6796	70.3876	673	13.0	1/17/2006	11/20/2007
79	119335	WGOM CA	42.5915	70.198	GOM Open	42.5467	70.6317	55	25.9	1/17/2006	3/12/2006
80	119370	WGOM CA	42.5915	70.198	GOM Open	42.65	70.3667	72	10.7	1/17/2006	3/29/2006
81	119402	WGOM CA	42.5915	70.198	GOM Open	42.4515	70.2991	407	12.8	1/17/2006	2/27/2007
82	119431	WGOM CA	42.5507	70.1766	GOM Open	42.697	70.3317	417	13.9	1/17/2006	3/9/2007
83	119595	WGOM CA	42.6011	70.2212	GOM Open	42.575	70.29	242	4.5	1/17/2006	9/16/2006
84	119596	WGOM CA	42.6011	70.2212	No Recap Loc	.	.	431	.	1/17/2006	3/24/2007
85	119661	GB Open	41.569	69.3982	GB Open	41.75	69.1333	768	21.3	12/28/2005	2/3/2008
86	119736	WGOM CA	42.4435	70.1553	GB Open	42.1667	69.95	286	25.0	1/24/2006	11/5/2006
87	119977	WGOM CA	42.4435	70.1553	WGOM CA	42.4253	70.2469	394	7.6	1/24/2006	2/21/2007
88	120139	WGOM CA	42.3912	70.1604	GB Open	42.0833	69.95	99	27.9	1/28/2006	5/6/2006
89	120387	WGOM CA	42.4006	70.1299	WGOM CA	42.4175	70.2248	141	7.3	1/28/2006	6/18/2006
90	120396	WGOM CA	42.4006	70.1299	GOM Open	42.4151	70.2783	828	10.5	1/28/2006	5/5/2008
91	120485	WGOM CA	42.4006	70.1299	GOM Open	42.7377	70.2895	426	28.5	1/28/2006	3/30/2007
92	120518	WGOM CA	42.4006	70.1299	GOM Open	42.7593	70.2717	309	29.8	1/28/2006	12/3/2006
93	120591	WGOM CA	42.4006	70.1299	WGOM CA	42.4	70.1167	132	1.4	1/28/2006	6/9/2006
94	120598	WGOM CA	42.4006	70.1299	GOM Open	42.4443	70.4731	365	22.3	1/28/2006	1/28/2007

Obs	FISHID	RELEASE AREA	RELEASE		RECAPTURE AREA	RECAPTURE		DAL	DISTANCE	RELEASE DATE	RECAPTURE DATE
			LAT	LON		LAT	LON		TRAVELED NM		
95	120713	WGOM CA	42.588	70.174	GOM Open	42.6345	70.3484	726	9.2	1/20/2006	1/15/2008
96	120806	WGOM CA	42.588	70.174	GOM Open	42.8317	70.3733	234	20.1	1/20/2006	9/10/2006
97	120828	WGOM CA	42.3375	70.1475	GOM Open	42.4274	70.2787	793	8.8	1/29/2006	3/31/2008
98	120849	WGOM CA	42.3375	70.1475	GOM Open	42.4167	70.3667	105	12.9	1/29/2006	5/13/2006
99	120859	WGOM CA	42.3375	70.1475	WGOM CA	42.35	70.1667	543	0.7	1/29/2006	7/25/2007
100	120923	WGOM CA	42.3375	70.1475	GOM Open	42.4327	70.4343	125	17.2	1/29/2006	6/2/2006
101	120969	WGOM CA	42.347	70.1362	WGOM CA	42.25	70.0167	62	12.7	1/29/2006	3/31/2006
102	121032	WGOM CA	42.347	70.1362	GOM Open	42.4553	70.4501	423	19.1	1/29/2006	3/27/2007
103	121034	WGOM CA	42.347	70.1362	GOM Open	42.4809	70.5377	347	24.8	1/29/2006	1/10/2007
104	121177	Closed Area I	41.3564	68.9371	GB Open	41.5538	69.4842	260	37.7	2/2/2006	10/19/2006
105	121200	Closed Area I	41.3564	68.9371	GB Open	41.15	67.6667	80	77.1	2/2/2006	4/22/2006
106	121213	Closed Area I	41.3564	68.9371	Closed Area I	41.5	69.1667	242	19.3	2/2/2006	10/1/2006
107	121359	Closed Area I	41.3493	68.9637	No Recap Loc	.	.	827	.	2/2/2006	5/8/2008
108	121388	WGOM CA	42.3618	70.177	GOM Open	42.2333	70.25	821	12.4	2/2/2006	5/2/2008
109	121442	WGOM CA	42.3618	70.177	WGOM CA	42.4317	70.1122	549	6.4	2/2/2006	8/4/2007
110	121461	WGOM CA	42.3618	70.177	WGOM CA	42.2837	70.1374	130	8.5	2/2/2006	6/11/2006
111	121466	WGOM CA	42.3618	70.177	GOM Open	42.5625	70.725	491	35.3	2/2/2006	6/7/2007
112	121485	WGOM CA	42.3618	70.177	GB Open	41.995	69.8367	132	37.8	2/2/2006	6/13/2006
113	121488	WGOM CA	42.3618	70.177	WGOM CA	42.422	70.1401	6	4.7	2/2/2006	2/8/2006
114	121536	WGOM CA	42.3618	70.177	GOM Open	42.4328	70.4181	866	14.2	2/2/2006	6/16/2008
115	121563	WGOM CA	42.3618	70.177	GB Open	42.0833	69.95	347	28.1	2/2/2006	1/14/2007
116	121572	WGOM CA	42.3618	70.177	GOM Open	42.4578	70.4235	364	15.3	2/2/2006	1/31/2007
117	121604	WGOM CA	42.3618	70.177	GOM Open	42.8333	70.5333	168	42.2	2/2/2006	7/19/2006
118	121669	WGOM CA	42.3618	70.177	WGOM CA	42.5667	70.075	241	16.7	2/2/2006	9/30/2006
119	121704	WGOM CA	42.3618	70.177	GOM Open	42.5031	70.5163	57	21.9	2/2/2006	3/30/2006
120	121723	WGOM CA	42.3808	70.1803	GOM Open	42.4543	70.3008	52	7.9	2/2/2006	3/25/2006
121	121770	WGOM CA	42.3808	70.1803	WGOM CA	42.3972	70.1867	199	0.4	2/2/2006	8/19/2006
122	121793	WGOM CA	42.3808	70.1803	GOM Open	42.4244	70.3843	826	11.7	2/2/2006	5/7/2008
123	121853	WGOM CA	42.3808	70.1803	WGOM CA	43.1	70	140	58.4	2/2/2006	6/21/2006
124	121863	WGOM CA	42.3808	70.1803	GOM Open	42.5169	70.5673	355	24.5	2/2/2006	1/22/2007
125	122030	Closed Area I	41.3564	68.9371	GB Open	40.8636	68.271	84	54.6	2/2/2006	4/26/2006
126	122035	Closed Area I	41.3564	68.9371	GB Open	41.1486	67.863	81	65.6	2/2/2006	4/23/2006

Obs	FISHID	RELEASE AREA	RELEASE		RECAPTURE AREA	RECAPTURE		DAL	DISTANCE	RELEASE DATE	RECAPTURE DATE
			LAT	LON		LAT	LON		TRAVELED NM		
127	122242	Closed Area II	41.644	66.9886	GB Open	41.2041	67.7345	102	56.8	1/29/2006	5/11/2006
128	122255	Closed Area II	41.7133	67.3237	GB Open	41.95	66.2333	372	68.6	1/29/2006	2/5/2007
129	122259	Closed Area II	41.7133	67.3237	GB Open	41.6667	69.1	640	106.4	1/29/2006	10/31/2007
130	122263	Closed Area II	41.7133	67.3237	GB Open	41.9167	66.5333	318	50.6	1/29/2006	12/13/2006
131	122270	Closed Area II	41.7133	67.3237	GB Open	41.8142	67.7031	866	23.6	1/29/2006	6/13/2008
132	122287	GOM Open	43.1077	69.5722	GOM Open	43.0098	68.8848	490	44.6	3/13/2006	7/16/2007
133	122317	GOM Open	43.0683	69.6935	GOM Open	43.1928	69.6617	572	8.7	3/13/2006	10/6/2007
134	122421	WGOM CA	42.422	70.1401	WGOM CA	42.4253	70.2469	378	7.9	2/8/2006	2/21/2007
135	122470	WGOM CA	42.422	70.1401	GB Open	41.995	69.8367	125	36.9	2/8/2006	6/13/2006
136	122583	WGOM CA	42.422	70.1401	WGOM CA	42.5733	70.1017	180	14.0	2/8/2006	8/7/2006
137	122603	WGOM CA	42.3957	70.2245	WGOM CA	42.3833	70.2167	250	0.8	2/8/2006	10/16/2006
138	122608	WGOM CA	42.3957	70.2245	GB Open	41.995	69.8367	125	38.1	2/8/2006	6/13/2006
139	122622	WGOM CA	42.3957	70.2245	WGOM CA	42.4169	70.2152	50	3.3	2/8/2006	3/30/2006
140	122625	WGOM CA	42.3957	70.2245	GOM Open	42.1333	70.2	452	19.7	2/8/2006	5/6/2007
141	122722	GB Open	41.77	67.9701	GOM Open	42.54	66.6825	88	100.8	5/6/2006	8/2/2006
142	122756	GB Open	41.77	67.9701	GB Open	42.0667	66.55	550	89.5	5/6/2006	11/7/2007
143	122783	GB Open	41.77	67.9701	GB Open	42.1333	66.5	525	94.0	5/6/2006	10/13/2007
144	122840	GB Open	41.77	67.9701	GB Open	42.1958	66.6942	578	85.1	5/6/2006	12/5/2007
145	122927	GB Open	42.0083	67.67	GB Open	42.2	66.6667	71	62.6	5/17/2006	7/27/2006
146	122976	GB Open	42.0067	67.6717	GB Open	42.15	66.75	108	56.9	5/17/2006	9/2/2006
147	122985	GB Open	42.0067	67.6717	GOM Open	42.4	66.6667	132	68.9	5/17/2006	9/26/2006
148	123012	GB Open	42.0067	67.6733	GB Open	42.0833	66.7667	149	55.0	5/17/2006	10/13/2006
149	123036	GB Open	41.9883	67.6683	GB Open	41.9762	67.6759	711	0.5	5/18/2006	4/27/2008
150	123038	GB Open	41.9883	67.6683	GB Open	42.1167	66.6	108	65.2	5/18/2006	9/2/2006
151	123055	GB Open	41.9883	67.6683	GB Open	42.0167	66.5667	466	66.3	5/18/2006	8/26/2007
152	123067	GB Open	41.9883	67.6683	GB Open	42.1167	66.5333	460	69.2	5/18/2006	8/20/2007
153	123109	GB Open	41.9967	67.68	GB Open	42	66.5333	476	68.7	5/18/2006	9/5/2007
154	123114	GB Open	41.9967	67.68	GB Open	42.0167	66.5333	217	68.8	5/18/2006	12/20/2006
155	123136	GB Open	41.9967	67.6833	GB Open	42.1167	66.6	487	65.8	5/18/2006	9/16/2007
156	123141	GB Open	41.9967	67.6833	No Recap Loc	.	.	242	.	5/18/2006	1/14/2007
157	123153	GB Open	41.9967	67.6833	GB Open	42.1167	66.75	413	56.9	5/18/2006	7/4/2007
158	123181	GB Open	41.9967	67.685	GB Open	42.1167	66.6667	100	61.7	5/18/2006	8/25/2006

Obs	FISHID	RELEASE AREA	RELEASE		RECAPTURE AREA	RECAPTURE		DAL	DISTANCE	RELEASE DATE	RECAPTURE DATE
			LAT	LON		LAT	LON		TRAVELED NM		
159	123240	GB Open	41.9967	67.69	GB Open	42.1167	66.7833	55	55.4	5/18/2006	7/12/2006
160	123248	GB Open	41.9967	67.69	GB Open	42.15	66.55	104	69.7	5/18/2006	8/30/2006
161	123262	GB Open	41.9967	67.6917	GB Open	41.9833	66.8	755	53.6	5/18/2006	6/11/2008
162	123285	GB Open	41.9762	67.6759	GB Open	42.0333	66.5	455	70.8	5/24/2006	8/21/2007
163	123289	GB Open	41.9762	67.6759	GB Open	42.0833	66.55	428	68.2	5/24/2006	7/25/2007
164	123299	GB Open	41.9762	67.6759	GB Open	42.0833	66.5167	436	70.2	5/24/2006	8/2/2007
165	123329	GB Open	41.9762	67.6759	GOM Open	42.3833	67.3167	447	39.4	5/24/2006	8/13/2007
166	123360	GB Open	41.9762	67.6759	GOM Open	42.3833	66.6667	116	69.0	5/24/2006	9/16/2006
167	123364	GB Open	41.9762	67.6759	GB Open	41.9899	67.6579	372	1.5	5/24/2006	5/30/2007
168	123369	GB Open	41.9762	67.6759	GB Open	42.3333	66.4167	516	81.0	5/24/2006	10/21/2007
169	123376	GB Open	41.9762	67.6759	GOM Open	42.9333	67.0833	189	85.5	5/24/2006	11/28/2006
170	123382	GB Open	41.9762	67.6759	GB Open	42.1333	66.7333	420	58.1	5/24/2006	7/17/2007
171	123387	GB Open	41.9762	67.6759	GOM Open	42.3667	67	438	51.4	5/24/2006	8/4/2007
172	123406	GB Open	41.9866	67.6532	GB Open	42.05	66.05	62	96.5	5/24/2006	7/25/2006
173	123417	GB Open	41.9866	67.6532	No Recap Loc	.	.	655	.	5/24/2006	3/9/2008
174	123423	GB Open	41.9866	67.6532	GOM Open	42.4167	66.6667	480	68.7	5/24/2006	9/16/2007
175	123428	GB Open	41.9866	67.6532	GB Open	42.0333	66.55	445	66.4	5/24/2006	8/12/2007
176	123433	GB Open	41.9866	67.6532	GB Open	42.2833	66.75	186	59.3	5/24/2006	11/26/2006
177	123438	GB Open	41.9866	67.6532	GB Open	41.95	66.1333	627	91.4	5/24/2006	2/10/2008
178	123485	GB Open	41.9865	67.66	GB Open	42.1167	66.6	780	64.6	5/24/2006	7/12/2008
179	123545	GB Open	41.9873	67.6701	No Recap Loc	.	.	691	.	5/24/2006	4/14/2008
180	123577	GB Open	41.9873	67.6701	GB Open	42.0833	66.7333	413	56.8	5/24/2006	7/11/2007
181	123595	GB Open	41.9893	67.6762	GB Open	42.1833	66.8333	96	53.0	5/24/2006	8/28/2006
182	123638	Closed Area II	42.0015	67.3284	No Recap Loc	.	.	105	.	5/31/2006	9/13/2006
183	123691	Closed Area II	42.0015	67.3284	GB Open	42.0833	66.55	54	47.1	5/31/2006	7/24/2006
184	123721	GB Open	42.0045	67.3353	GB Open	42.0667	66.7333	412	36.3	5/31/2006	7/17/2007
185	123761	GB Open	42.0045	67.3353	GB Open	42.0833	66.75	764	35.6	5/31/2006	7/3/2008
186	123797	GB Open	42.0045	67.3353	GOM Open	42.35	66.7833	509	44.1	5/31/2006	10/22/2007
187	123799	GB Open	42.0045	67.3353	GB Open	42.0833	66.6833	421	39.5	5/31/2006	7/26/2007
188	123803	GB Open	42.0045	67.3353	GB Open	42.1167	66.8333	97	31.6	5/31/2006	9/5/2006
189	123818	GB Open	42.0045	67.3353	GB Open	42.0833	66.15	589	71.2	5/31/2006	1/10/2008
190	123962	Closed Area II	42.0289	67.325	GB Open	42.0215	66.5495	405	47.6	6/1/2006	7/10/2007

Obs	FISHID	RELEASE AREA	RELEASE		RECAPTURE AREA	RECAPTURE		DAL	DISTANCE	RELEASE DATE	RECAPTURE DATE
			LAT	LON		LAT	LON		TRAVELED NM		
191	123967	Closed Area II	42.0289	67.325	GB Open	41.9667	65.95	71	83.8	6/1/2006	8/10/2006
192	124017	GB Open	42.044	67.3496	GOM Open	42.4333	66.6667	477	52.6	6/1/2006	9/20/2007
193	124041	GB Open	42.044	67.3496	GB Open	42.0833	66.6833	390	40.5	6/1/2006	6/25/2007
194	124065	GB Open	42.0564	67.393	GB Open	42.1333	66.5833	29	48.6	6/6/2006	7/5/2006
195	124067	GB Open	42.0564	67.393	GOM Open	42.4	67.0167	446	36.6	6/6/2006	8/26/2007
196	124082	GB Open	42.0531	67.3928	GB Open	42	66.5	419	53.3	6/6/2006	7/30/2007
197	124099	GB Open	42.0531	67.3928	GB Open	42.1667	66.5667	121	50.3	6/6/2006	10/5/2006
198	124100	GB Open	42.0531	67.3928	GB Open	42.1	66.5333	22	51.5	6/6/2006	6/28/2006
199	124142	GB Open	42.0524	67.3959	GB Open	41.9	66.3167	235	65.4	6/6/2006	1/27/2007
200	124144	GB Open	42.0524	67.3959	GB Open	42.1	66.75	411	38.7	6/6/2006	7/22/2007
201	124219	GB Open	42.0524	67.3959	GB Open	42.1167	66.6	105	47.6	6/6/2006	9/19/2006
202	124225	GB Open	42.0524	67.3959	GB Open	42.1	66.6167	400	46.5	6/6/2006	7/11/2007
203	124246	GB Open	42.0518	67.3991	GB Open	41.9899	67.6579	377	16.6	6/6/2006	6/18/2007
204	124708	WGOM CA	43.172	70.0393	GOM Open	42.67	70.3608	152	42.6	10/8/2006	3/9/2007
205	124763	Closed Area II	41.9823	67.1064	GB Open	42.1085	66.8797	227	17.8	11/18/2006	7/3/2007
206	124788	Closed Area II	41.9823	67.1064	GB Open	42.0667	66.35	446	46.3	11/18/2006	2/7/2008
207	124807	Closed Area II	41.9676	67.0913	GB Open	42.1333	66.8167	385	22.1	11/18/2006	12/8/2007
208	124820	Closed Area II	41.9676	67.0913	GB Open	42.0898	66.653	248	28.6	11/18/2006	7/24/2007
209	124822	Closed Area II	41.9676	67.0913	GB Open	42.0833	66.75	217	23.1	11/18/2006	6/23/2007
210	124917	Closed Area II	41.959	67.0611	GB Open	42.0667	66.5167	282	34.0	11/18/2006	8/27/2007
211	125001	Closed Area II	41.9627	67.1057	GB Open	42.1333	66.6333	300	32.3	11/19/2006	9/15/2007
212	125003	Closed Area II	41.9627	67.1057	GB Open	41.9667	66.1667	72	56.7	11/19/2006	1/30/2007
213	125047	Closed Area II	41.9627	67.1057	GB Open	42.1333	66.5833	288	35.0	11/19/2006	9/3/2007
214	125081	Closed Area II	41.9627	67.1057	GB Open	42.1167	66.6	253	33.5	11/19/2006	7/30/2007
215	125122	Closed Area II	41.9627	67.1057	GB Open	42.1333	66.5833	242	35.0	11/19/2006	7/19/2007
216	125131	Closed Area II	41.9627	67.1057	GB Open	42.1333	66.4667	266	41.4	11/19/2006	8/12/2007
217	125159	Closed Area II	41.9568	67.0878	GB Open	42.1333	66.7333	225	26.8	11/19/2006	7/2/2007
218	125161	Closed Area II	41.9568	67.0878	GB Open	42.1167	66.6	287	33.0	11/19/2006	9/2/2007
219	125274	Closed Area I	41.3949	69.0436	GB Open	42.1167	66.7	154	152.3	1/18/2007	6/20/2007
220	125295	Closed Area I	41.3966	69.0416	GB Open	41.715	68.83	413	28.5	1/18/2007	3/5/2008
221	125367	Closed Area I	41.3979	69.0395	GB Open	41.6917	68.6467	383	33.3	1/18/2007	2/5/2008
222	125414	Closed Area I	41.4275	69.0792	GB Open	40.9282	67.9062	349	79.7	1/22/2007	1/5/2008

Obs	FISHID	RELEASE AREA	RELEASE	RELEASE	RECAPTURE AREA	RECAPTURE	RECAPTURE	DAL	DISTANCE	RELEASE	RECAPTURE
			LAT	LON		LAT	LON		TRAVELED	DATE	DATE
223	125526	Closed Area II	41.9329	67.1137	GOM Open	42.4	66.6833	299	44.4	11/20/2006	9/14/2007
224	125540	Closed Area II	41.9329	67.1137	GB Open	42.0833	66.55	248	35.5	11/20/2006	7/25/2007
225	125564	Closed Area II	41.9329	67.1137	GB Open	42	66.5	280	37.2	11/20/2006	8/26/2007
226	125644	Closed Area II	41.9329	67.1137	GB Open	41.5173	66.5193	215	50.1	11/20/2006	6/22/2007
227	125724	Closed Area II	41.9425	67.1085	GB Open	42.1333	66.4333	306	42.9	11/20/2006	9/22/2007
228	125740	Closed Area II	41.9425	67.1085	GB Open	42.0333	66.9167	608	12.9	11/20/2006	7/20/2008
229	126176	Closed Area I	41.429	69.0579	Closed Area I	41.3767	69.0567	339	2.7	1/14/2007	12/19/2007
230	126360	Closed Area I	41.4263	69.0822	No Recap Loc	.	.	260	.	12/22/2006	9/7/2007
231	126369	Closed Area I	41.4263	69.0822	Closed Area I	41.2871	69.008	305	10.6	12/22/2006	10/22/2007
232	126455	Closed Area I	41.4447	69.1217	GOM Open	42.4232	70.3563	229	108.8	12/22/2006	8/7/2007
233	126493	Closed Area I	41.4177	69.0897	GB Open	42.1333	66.6667	238	156.5	12/22/2006	8/16/2007
234	127138	Closed Area I	41.4216	69.0459	GB Open	42.0667	66.7667	155	146.1	1/22/2007	6/25/2007
235	127234	Closed Area I	41.4237	68.7424	GB Open	41.1833	69.1333	176	30.3	1/14/2007	7/9/2007
236	127660	Closed Area I	41.4256	69.0462	GB Open	41.2353	69.2234	561	19.6	1/18/2007	7/31/2008
237	127982	Closed Area I	41.4701	69.0648	GB Open	42.0667	66.55	188	159.0	1/25/2007	7/31/2007
238	128333	Closed Area I	41.4135	69.0427	Closed Area II	41.1167	67.15	437	117.5	2/28/2007	5/9/2008
239	128538	Closed Area I	41.4145	69.0371	GB Open	41.815	69.075	367	30.8	2/28/2007	2/29/2008
240	128557	Closed Area I	41.4145	69.0371	GB Open	42.0833	66.1833	347	180.4	2/28/2007	2/9/2008
241	128900	WGOM CA	42.4008	70.1493	GOM Open	42.4923	70.7078	431	35.9	3/12/2007	5/15/2008
242	128984	WGOM CA	42.3833	70.1563	GOM Open	42.1333	70.3333	460	22.9	3/12/2007	6/13/2008
243	128994	WGOM CA	42.3833	70.1563	WGOM CA	43.0667	70.05	153	56.6	3/12/2007	8/11/2007
244	129014	GB Open	41.9925	67.661	Closed Area I	41.3	69.0667	162	100.8	5/10/2007	10/19/2007
245	129038	WGOM CA	42.3399	70.1992	GOM Open	42.4	70.5333	80	21.3	3/24/2007	6/11/2007
246	129056	WGOM CA	42.3399	70.1992	WGOM CA	42.7603	70.2453	235	35.4	3/24/2007	11/13/2007
247	129078	WGOM CA	42.3399	70.1992	GOM Open	42.3667	70.3167	363	8.1	3/24/2007	3/20/2008
248	129087	WGOM CA	42.3399	70.1992	GOM Open	42.4707	70.2585	296	12.3	3/24/2007	1/13/2008
249	129119	WGOM CA	42.3399	70.1992	GOM Open	42.2748	70.2928	438	7.3	3/24/2007	6/3/2008
250	129142	WGOM CA	42.3399	70.1992	GOM Open	42.4823	70.379	365	16.8	3/24/2007	3/22/2008
251	129153	WGOM CA	42.3399	70.1992	GOM Open	42.7462	70.2872	230	34.6	3/24/2007	11/8/2007
252	129164	WGOM CA	42.3399	70.1992	GOM Open	43.3333	68.75	84	119.5	3/24/2007	6/15/2007
253	129166	WGOM CA	42.3399	70.1992	GOM Open	42.4272	70.4515	64	17.5	3/24/2007	5/26/2007
254	129220	WGOM CA	42.3399	70.1992	GOM Open	42.3833	70.4667	63	17.1	3/24/2007	5/25/2007

Obs	FISHID	RELEASE AREA	RELEASE	RELEASE	RECAPTURE AREA	RECAPTURE	RECAPTURE	DAL	DISTANCE	RELEASE DATE	RECAPTURE DATE
			LAT	LON		LAT	LON		TRAVELED		
255	129227	WGOM CA	42.3399	70.1992	WGOM CA	42.8824	70.1226	141	45.4	3/24/2007	8/11/2007
256	129235	WGOM CA	42.3399	70.1992	GOM Open	42.4274	70.2787	374	9.7	3/24/2007	3/31/2008
257	129247	WGOM CA	42.3399	70.1992	WGOM CA	42.9167	70.0833	94	48.5	3/24/2007	6/25/2007
258	129250	WGOM CA	42.3399	70.1992	GOM Open	42.4179	70.2897	299	9.4	3/24/2007	1/16/2008
259	129281	WGOM CA	42.3584	70.2176	GOM Open	42.475	70.2536	372	10.8	3/24/2007	3/29/2008
260	129378	WGOM CA	42.3584	70.2176	GOM Open	42.9167	70.4167	75	48.1	3/24/2007	6/6/2007
261	129470	WGOM CA	42.3847	70.152	GOM Open	42.6619	70.3054	295	25.5	3/24/2007	1/12/2008
262	129488	WGOM CA	42.3847	70.152	GOM Open	42.85	70.3167	149	40.2	3/24/2007	8/19/2007
263	129518	WGOM CA	42.3847	70.152	GB Open	41.5032	69.3333	481	85.2	3/24/2007	7/16/2008
264	129531	WGOM CA	42.3847	70.152	GOM Open	42.4181	70.8089	264	40.3	3/24/2007	12/12/2007
265	129541	WGOM CA	42.3847	70.152	GOM Open	42.85	70.3167	462	40.2	3/24/2007	6/27/2008
266	129678	GB Open	42.0445	67.5739	GB Open	42.0333	66.5833	138	59.3	4/11/2007	8/27/2007
267	129729	GB Open	42.0431	67.58	GB Open	42.1167	66.6	111	59.1	4/11/2007	7/31/2007
268	129733	GB Open	42.0418	67.5861	GB Open	42.15	66.7167	123	52.9	4/11/2007	8/12/2007
269	129773	GB Open	42.0418	67.5861	GB Open	42.1167	66.6	134	59.5	4/11/2007	8/23/2007
270	129778	GB Open	42.0398	67.5953	GB Open	42.0833	66.6667	134	55.6	4/11/2007	8/23/2007
271	129807	GB Open	42.0398	67.5953	GB Open	42.1433	67.06	61	33.1	4/11/2007	6/11/2007
272	129847	GB Open	42.0458	67.5678	GB Open	41.5	67.8333	404	45.9	4/11/2007	5/19/2008
273	129870	GB Open	42.0504	67.5618	GB Open	42.1167	66.7167	124	51.0	4/11/2007	8/13/2007
274	129956	Cashes CA	42.762	69.347	GOM Open	43.5813	69.135	81	68.6	4/28/2007	7/18/2007
275	130075	Cashes CA	42.762	69.347	GOM Open	42.7383	70.3775	103	63.1	4/28/2007	8/9/2007
276	130181	Cashes CA	42.7884	69.3029	GOM Open	43.1667	69.5	469	34.3	4/28/2007	8/9/2008
277	130213	WGOM CA	42.5113	70.2092	GOM Open	42.7881	70.3235	169	25.0	3/12/2007	8/27/2007
278	130301	WGOM CA	42.3695	70.1418	GOM Open	42.4167	70.4167	72	17.6	3/21/2007	6/1/2007
279	130518	Cashes CA	42.7668	69.3446	Other	44.9667	65.7833	452	281.0	4/29/2007	7/23/2008
280	130559	Cashes CA	42.7597	69.3384	GOM Open	42.4509	70.4465	35	71.9	4/29/2007	6/2/2007
281	130907	Cashes CA	42.7658	69.3323	GOM Open	42.5	69.6667	321	29.4	4/29/2007	3/15/2008
282	130931	WGOM CA	42.3399	70.1992	WGOM CA	43.0333	70.0167	47	58.5	3/24/2007	5/9/2007
283	130937	WGOM CA	42.3728	70.2298	WGOM CA	42.5333	70.1	466	16.1	3/24/2007	7/1/2008
284	130952	WGOM CA	42.3728	70.2298	GOM Open	42.83	70.355	136	39.1	3/24/2007	8/6/2007
285	131003	GB Open	41.9879	67.667	No Recap Loc	.	.	85	.	6/9/2007	9/1/2007
286	131111	GB Open	41.9912	67.6671	GB Open	42.05	66.5833	37	65.2	6/9/2007	7/16/2007

Obs	FISHID	RELEASE AREA	RELEASE	RELEASE	RECAPTURE AREA	RECAPTURE	RECAPTURE	DAL	DISTANCE	RELEASE	RECAPTURE
			LAT	LON		LAT	LON		TRAVELED	DATE	DATE
287	131178	Closed Area II	42.0947	67.3254	GB Open	42.0833	66.7833	25	32.5	6/8/2007	7/2/2007
288	131301	GB Open	42.0778	67.3721	GB Open	42.3333	66.5333	138	55.1	6/8/2007	10/23/2007
289	131424	GB Open	41.9958	67.6611	GOM Open	42.3667	66.5	106	76.4	7/2/2007	10/15/2007
290	131644	GB Open	41.9949	67.6467	GB Open	41.9667	66.3167	201	79.9	6/19/2007	1/5/2008
291	131719	GB Open	41.9958	67.6611	GB Open	42.1833	66.6	94	65.5	7/1/2007	10/2/2007
292	131825	GB Open	41.9958	67.6611	GB Open	42.0333	66.5	41	69.5	7/1/2007	8/10/2007
293	131983	GB Open	41.9945	67.6672	GB Open	42.2167	66.75	80	58.1	7/1/2007	9/19/2007
294	132048	GB Open	41.9945	67.6672	GB Open	42.0833	66.6833	25	59.4	7/1/2007	7/26/2007
295	132095	GB Open	41.9939	67.6702	GB Open	42.1833	66.7	95	60.5	7/1/2007	10/4/2007
296	132164	GB Open	41.9991	67.6612	GB Open	42.2167	66.6667	94	62.5	7/1/2007	10/3/2007
297	132176	GB Open	41.9991	67.6612	GB Open	42.1667	66.9167	87	47.0	7/1/2007	9/26/2007
298	132310	GB Open	41.9898	67.6273	GOM Open	42.8333	66.0333	57	117.9	6/9/2007	8/5/2007
299	132341	GB Open	41.9898	67.6273	GB Open	42.15	66.6167	73	61.7	6/9/2007	8/21/2007
300	132355	GB Open	41.9898	67.6273	GOM Open	42.4167	66.8667	79	57.5	6/9/2007	8/27/2007
301	132363	GB Open	41.9898	67.6273	GB Open	41.9167	66.75	382	52.2	6/9/2007	6/25/2008
302	132382	GB Open	41.9898	67.6273	GOM Open	42.35	66.4667	110	75.4	6/9/2007	9/27/2007
303	132386	GB Open	41.9898	67.6273	GB Open	42.0833	66.75	29	52.7	6/9/2007	7/8/2007
304	132390	GB Open	41.9898	67.6273	GOM Open	42.6858	67.3638	75	59.7	6/9/2007	8/23/2007
305	132463	GB Open	41.9898	67.6273	GB Open	42.1667	66.8333	124	49.5	6/9/2007	10/11/2007
306	132468	GB Open	41.9898	67.6273	GB Open	42.1833	66.0833	124	93.6	6/9/2007	10/11/2007
307	132484	GB Open	41.9898	67.6273	GOM Open	42.3833	66.8667	59	55.9	6/9/2007	8/7/2007
308	132502	GB Open	41.9898	67.6273	GB Open	42.1167	66.6	132	62.1	6/9/2007	10/19/2007
309	132655	GB Open	41.9898	67.6273	GB Open	42.1167	66.7333	66	54.2	6/9/2007	8/14/2007
310	132672	GB Open	41.9898	67.6273	GB Open	42.1333	66.6833	100	57.5	6/9/2007	9/17/2007
311	132691	GB Open	41.9898	67.6273	GB Open	42.0019	67.8307	110	13.2	6/9/2007	9/27/2007
312	132752	GB Open	41.9872	67.6548	GOM Open	42.3833	66.65	84	70.4	6/24/2007	9/16/2007
313	132771	GB Open	41.9872	67.6548	GB Open	42.0833	66.75	26	56.5	6/24/2007	7/20/2007
314	132795	GB Open	41.9872	67.6548	GB Open	42.1	66.7	34	59.7	6/24/2007	7/28/2007
315	132815	GB Open	41.9872	67.6548	GOM Open	42.35	66.8333	83	59.5	6/24/2007	9/15/2007
316	132843	GB Open	41.9872	67.6548	GB Open	42	66.1667	228	90.7	6/24/2007	2/7/2008
317	132884	GB Open	41.9872	67.6548	GB Open	41.95	66.7833	99	53.6	6/24/2007	10/1/2007
318	132975	GB Open	41.9872	67.6548	GOM Open	42.7833	67.65	82	66.5	6/24/2007	9/14/2007

Obs	FISHID	RELEASE AREA	RELEASE		RECAPTURE		DAL	DISTANCE		RELEASE DATE	RECAPTURE DATE
			LAT	LON	RECAPTURE AREA	LAT		LON	TRAVELED		
319	133007	GB Open	41.9872	67.6548	GB Open	42.1333	66.9167	119	47.6	6/24/2007	10/21/2007
320	133023	GB Open	41.9872	67.6548	GB Open	42.1333	66.7	26	60.2	6/24/2007	7/20/2007
321	133089	GB Open	41.9872	67.6548	GB Open	41.15	67.5	342	65.9	6/24/2007	5/31/2008
322	133096	GB Open	41.9872	67.6548	GB Open	41.9833	66.1667	230	90.7	6/24/2007	2/9/2008
323	133123	GB Open	41.9872	67.6548	GOM Open	42.471	66.646	427	74.3	6/24/2007	8/24/2008
324	133191	GB Open	41.9872	67.6548	GB Open	42.0333	66.5	47	70.9	6/24/2007	8/10/2007
325	133200	GB Open	41.9872	67.6548	GB Open	42.1	66.7333	398	57.7	6/24/2007	7/26/2008
326	133304	GB Open	41.9872	67.6548	GB Open	42.0833	66.1833	230	90.2	6/24/2007	2/9/2008
327	133339	GB Open	41.9872	67.6548	GOM Open	42.4333	66.6667	83	71.6	6/24/2007	9/15/2007
328	133368	GB Open	41.9872	67.6548	Other	44.2333	66.6833	30	195.6	6/24/2007	7/24/2007
329	133410	GB Open	41.9872	67.6548	GB Open	42.1167	66.6	427	65.8	6/24/2007	8/24/2008
330	133411	GB Open	41.9872	67.6548	GB Open	41.9167	66.3	204	82.8	6/24/2007	1/14/2008
331	133510	GB Open	41.9899	67.6579	GB Open	42.1167	66.6	145	65.2	6/18/2007	11/10/2007
332	133515	GB Open	41.9899	67.6579	GB Open	42.1833	66.6333	30	64.5	6/18/2007	7/18/2007
333	133516	GB Open	41.9899	67.6579	GB Open	42.1333	66.7333	56	57.7	6/18/2007	8/13/2007
334	133523	GB Open	41.9899	67.6579	GB Open	42.1167	66.6	52	65.2	6/18/2007	8/9/2007
335	133531	GB Open	41.9899	67.6579	GB Open	42.2667	66.3333	77	83.7	6/18/2007	9/3/2007
336	133537	GB Open	41.9899	67.6579	GB Open	42.3333	66.5333	127	74.2	6/18/2007	10/23/2007
337	133630	GB Open	41.9899	67.6579	GB Open	42.2833	66.6667	145	65.3	6/18/2007	11/10/2007
338	133646	GB Open	41.9899	67.6579	GB Open	42.0333	66.6667	83	60.3	6/18/2007	9/9/2007
339	133708	GB Open	41.9899	67.6579	GB Open	42.1333	66.8	58	53.8	6/18/2007	8/15/2007
340	133730	GB Open	41.9899	67.6579	GB Open	42.05	66.5	88	70.4	6/18/2007	9/14/2007
341	133769	GB Open	41.9899	67.6579	GB Open	42.0333	66.5	44	70.3	6/18/2007	8/1/2007
342	133863	WGOM CA	43.14	70.0561	WGOM CA	42.8378	70.2482	305	27.3	10/21/2006	8/22/2007
343	133981	Closed Area II	42.0904	67.3309	GB Open	42.1167	66.6	38	43.9	6/18/2007	7/26/2007
344	134020	GB Open	42.0903	67.3344	GB Open	42.15	66.7	91	38.5	6/18/2007	9/17/2007
345	134023	GB Open	42.0903	67.3344	GB Open	42.1333	66.75	112	35.4	6/18/2007	10/8/2007
346	134045	GB Open	42.0907	67.3389	GB Open	42.1167	66.4	44	56.4	6/18/2007	8/1/2007
347	134054	GB Open	42.0907	67.3389	GOM Open	42.4	66.95	51	35.1	6/18/2007	8/8/2007
348	134099	GB Open	42.0907	67.3389	GB Open	42.1833	66.75	105	36.3	6/18/2007	10/1/2007
349	134129	GB Open	42.0907	67.3389	GB Open	42.0667	66.35	234	59.3	6/18/2007	2/7/2008
350	134164	GB Open	42.2562	67.9607	GB Open	42.1167	66.6	130	64.0	6/19/2007	10/26/2007
351	134448	GOM Open	43.1967	69.6636	GOM Open	43.1833	69.6667	376	1.1	7/22/2007	8/1/2008
352	134471	GOM Open	43.1992	69.6781	GOM Open	43.2105	69.6222	217	3.3	9/2/2007	4/5/2008