
Tagging program fact sheets

Each of the Northeast fish mark-recapture programs was briefly described before the workshop in the form of a program fact sheet. These provided background information on the core components of each program and were expanded upon during the presentations delivered by the Principal Investigator (PI) for each program. The transcript in Annex I provides further detail shared during the presentations, in addition to documenting the interactive discussions which ensued.

I. Atlantic cod, *Gadus morhua*

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Scientific justification: Canadian and US stock assessments for Atlantic cod indicate considerable fluctuation in stock abundance and recruitment over the last 20 years. This recovering resource is regulated on a stock-by-stock basis, with varying management measures in place. Since the 1920s, a number of small-scale, independent tagging studies were conducted, but each varies considerably in spatial and geographic coverage, tagging technique, and the information collected. Furthermore, information was rarely shared between programs. The Northeast Regional Cod Tagging Program was initiated to study cod movements using a standardized technique on a region-wide scale, whilst simultaneously achieving international collaboration between fishermen and scientists. The data will compliment future stock assessments by providing current information on movement patterns and growth in the Gulf of Maine and neighboring waters.

Technical objectives (prioritized):

- 1) Identify the migration patterns of Atlantic cod throughout the Gulf of Maine and neighboring Canadian and US waters;
- 2) Identify the extent of mixing between cod in these water bodies;
- 3) Obtain in situ growth increment information;
- 4) Investigate the roles of temperature, depth and reproductive condition on migration and growth.

Tag specifications: Hallprint "TBA-2 tag" T-bar anchor tags. Two colors:

- 1) **Yellow tags:** 6-digit #####, NE COD TAGGING PROGRAM, 1-866-447-2111, www.codresearch.org; 10% are "double-tagged" to assess tag retention.
- 2) **Blue high-reward tags:** 6-digit H#####, NE COD TAGGING – HIGH REWARD \$\$, 1-866-447-2111, www.codresearch.org. Since May 2004, 10% of cod receive a high-reward tag.

Geographic extent: Gulf of Maine and neighboring waters in Maritime Canada: Georges Bank, Nantucket Shoals, Coxes Ledge, Cashes Ledge, Fippennies Ledge, nearshore Western Gulf of Maine, nearshore Downeast Maine, ledges around Jordan Basin, Browns Bank, Digby Neck & Bay of Fundy (see Figure 1).

Geographic stratification: Cod are targeted and tagged in the general tagging areas outlined (see Geographic extent), according to their availability; certain permanent and seasonal closed areas are also targeted. A “rule-of-thumb” cap is set at 5,000 fish per tagging area, per season. In some areas this cap is easily attainable; in other areas the program has struggled to locate and tag 5,000 cod.

Timeframe of releases: Tagging in 2003 (~46,000 releases), 2004 (currently ~45,000, projected total ~75,000 releases), and planned for 2005 (projected ~20,000 releases).

Seasonality of releases: Focus is on spring and fall, but in some areas tagging continues throughout the summer. Seasonality is partially determined by when fish are in the target release areas. Spawning fish are tagged when possible (spring), but numbers found by June 2004 had not been high: n=706 of the 55,758 checked for spawning condition from all data by that time.

Size of fish: The minimum tagging size is 36cm (legal minimum size is 56cm); all fish of 36cm or greater are tagged, if their condition is strong.

Method of initial capture: **1)** Commercial otter trawls (mesh sizes 5.5”, 6.0” and 6.5”) and relatively short tows (~20-30 min); **2)** commercial hook gear (handline, manual rod & reel, electronic rod & reel, long-line); **3)** recreational hook gear (handline, manual rod & reel); **4)** lobster traps (very few); and **5)** gillnet (one trip only).

Method of recapture and seasonality: Recaptures from year-round commercial fishery (trawl, hook and gillnet) with some seasonal geographic closures. Recaptures also from seasonal recreational fishery (hook) (spring – fall). Cod tagged in permanent closed areas are only recaptured if they move outside the closed area, are recaptured by recreational vessels or are recaptured during a tagging trip.

Reward system:

- 1) **Yellow tags:** 155,000 regular tags – incentive is a T-shirt, hat or mug. In addition, all individuals reporting a minimum of date, tag #, recapture location and fish length are entered into a monthly lottery (\$1,000) with 5 categories (thus, each reward = \$200).
- 2) **Blue tags:** 10,000 high-reward (\$100) tags; rewarded on receipt of tag only (began in year two).

Outreach methods: Distribution of laminated (bi-lingual: English and Portuguese) posters and information brochures. Mass-mailings (2x per year) to all multispecies permit holders, tag reporters, charter companies and processing plants (includes update letter, newsletter, flyer, mini-data sheets and SAEs). Regularly updated program website (www.codresearch.org), which gives viewers access to near real-time data via an interactive GIS mapping site (www.gmamapping.org/codmapping/). Press releases, message on NOAA weather radio, periodic TV coverage. Tag returns: toll free number (866-447-2111), prompt responses to tag returnees (letter with recapture report & map, and their reward). Annual meeting with scientists and fishermen, progress update meetings at regional industry meetings.

Data management: The data collected includes:

Trip & vessel

- Vessel name, Fed. permit # & Doc. #
- Gear type
- Trip #
- Names of Captain & crew
- Tagging Organization
- General tagging area
- Trip date range
- Total number of fish tagged
- Units of measure: Location, depth, temperature
- Haul #

Haul

- Date: at start • Time: start & end • Location: start & end • Water depth: start & end
- Water temperature: surface/bottom • Tagger: initials only • Number of fish tagged • Haul comments

Tagged fish

Vessel name, Trip#, Tagger (full name), Units of measure (cm/"), & Are you checking for spawning condition? (Y/N)

- Haul #
- Fish count
- Tag #(s) (skin-tag checkbox)
- Fish length
- Presence of milt/eggs?
- Fish comment
- Fate of fish: Released, floater, seagull, landed

Recaptures (during tagging trip)

- Haul #
- Fish count
- Tag #(s)
- Fish length
- Presence of milt/eggs?
- Fish comment
- Fate of fish: Released, floater, seagull, landed

Recaptures (general public)

- Tag #(s)
- Date
- Fish length
- Recapture location
- Depth
- Temperature
- Presence of milt/eggs?
- Fish comment
- Fate of fish: Released, floater, seagull, landed

Non-tagged cod

- Haul #
- Fish count
- Reason not tagged: undersized/poor condition
- Fish length
- Presence of milt/eggs?
- Fish comment

Data management of the NRCTP data is undertaken by GMRI, the contracted data “clearing house”. Each program partner enters their tag release data via a password protected, online, custom-made, relational database which has been developed in SQL Server. This online database avoided the need for software updates for the multiple program partners as the database evolved and increased in sophistication. Significant automated quality control (QC) tools are built into numerous fields allowing the data to be error checked as it is entered. Program partners then “submit” their data in order that GMRI can verify or “approve” it again, before committing it to the database. Recaptures are entered solely by GMRI, and again undergo a QC approval process.

Once committed, the data is accessible to the public through the online GIS mapping interface; data can be filtered to investigate different parameters. To date only partner organizations can download the raw data; the file format is a flat, tab-delimited file. In future months, after sufficient QC and data verification, the database will be downloadable as a complete, relational Access database.

Number of releases, by time and geographic area:

Organization	Release Area	Releases by June 04	% releases
DMR, II	Cashes, Fippennies, Platts	1,995	2.5%
	Offshore Downeast	2,027	2.5%
	Inshore Downeast	953	1.2%
	Central Inshore GOM	5,979	7.5%
	Jeffreys Ledge	2,213	2.8%
	Western GOM Inshore	230	0.3%
SMAST & CCCHFA	Georges Bank	16,547	20.8%
	Cape Cod/East of Chatham	11,900	15.0%
	Nantucket Shoals	17,798	22.4%
	Great South Channel	8,998	11.3%
DFO	Digby Neck (03)	5,260	6.6%
	Yarmouth - Cape Sable (02 & 03)	5,591	7.0%
Total		79,491	

Number of recaptures to date: By July 31, 2004, stakeholders had reported 1702 recaptured tagged cod (~2.0% of ~87,000 total releases to date). When added to the estimate of ~485 recaptures recorded during tagging trips, the return rate is ~2.5%. Physical tags have been received for 1,263 (74%) of the 1,702 recaptures reported by stakeholders.

- **Double-tagged fish:** 191 recaptures have been reported; little evidence of tag loss.
- **Re-releases:** 86 of recaptures reported were re-released (in addition to all recaptures from tagging trips if the fish is in good condition).
- **High-reward tags:** GMRI has processed 18 recaptures since May 2004 (~1.8% of high-reward tag releases by July 2004 (~996)), and 17 physical tags have been received by GMRI. (Note: high-reward tags were only released in year two).
- **Method of reporting:** Of the 1,702 recaptures reported, 60% came via mail (mini-data sheets), 28% by phone (1-866-447-2111), 9% via email (through www.codresearch.org), and 4% were reported in person.

Tag recaptures reported from March 2003 - July 2004; stakeholders reporting tags include Fishermen (F), Processors (P) and Observers (O). For recapture locations, see Figure 2.

	Release areas covered	Reported by			Totals	% of releases
		F	P	O		
DFO	Bay of Fundy, Browns Bank	146	260	9	415	7.1%
Isl. Inst.	Nearshore Maine & Jeffreys	19	4	1	24	1.6%
DMR	Cashes, Fippennies, Jordan Basin, Nearshore Maine, Jeffreys Ledge	280	48	47	375	2.2%
CCCHFA	Nantucket Shoals, Great South Channel, Chatham, Coxes Ledge, Stellwagen Bank	409	29	45	483	1.1%
SMAST	Georges Bank, Great South Channel	299	92	14	405	2.2%
Totals		1153	433	116	1702	2.1%
Totals with Recaptures from tagging trips					~2187	2.7%

Tag retention: 10% of fish tagged with yellow tags receive 2 tags; this will give a measure of tag retention. To date significant tag loss has not been indicated.

Tag-induced mortality: We currently have no data from which to quantify tag-induced mortality. However, use of live-wells during tagging trips indicates that some fish do not survive the fishing process (even before tagging), despite modifications to fishing techniques aimed at maximizing survivability. The tagging protocol developed recommends against tagging weak fish. The fate of the fish is noted on release and upon analysis, this will provide some indication of short-term post-tagging mortality. Very few instances of infection around the tagging site have been observed.

Analytical design: Estimate movement (and mortality) based on the number of tag returns by area and season, taking into account the reporting rate and fishing effort. Preliminary data analysis has focused on: size relationships, growth rate, distance and direction of movements, seasonal displacement, recapture reporting rate and method of reporting tags (implications for outreach efficacy).

Figure 1: Tagging locations for Atlantic cod targeted by each tagging organization: Canada Department of Fisheries and Oceans (DFO), Island Institute, Maine Department of Marine Resources (DMR), Cape Cod Commercial Hook Fishermen’s Association (CCCHFA) and the School for Marine Sciences and Technology (SMAST).

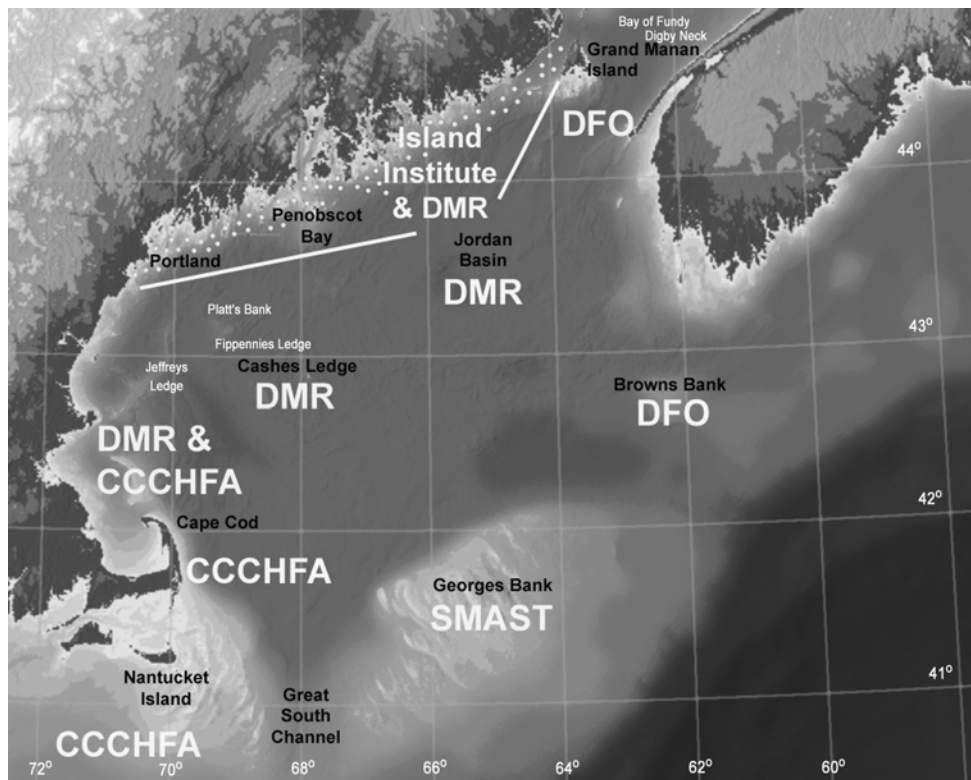
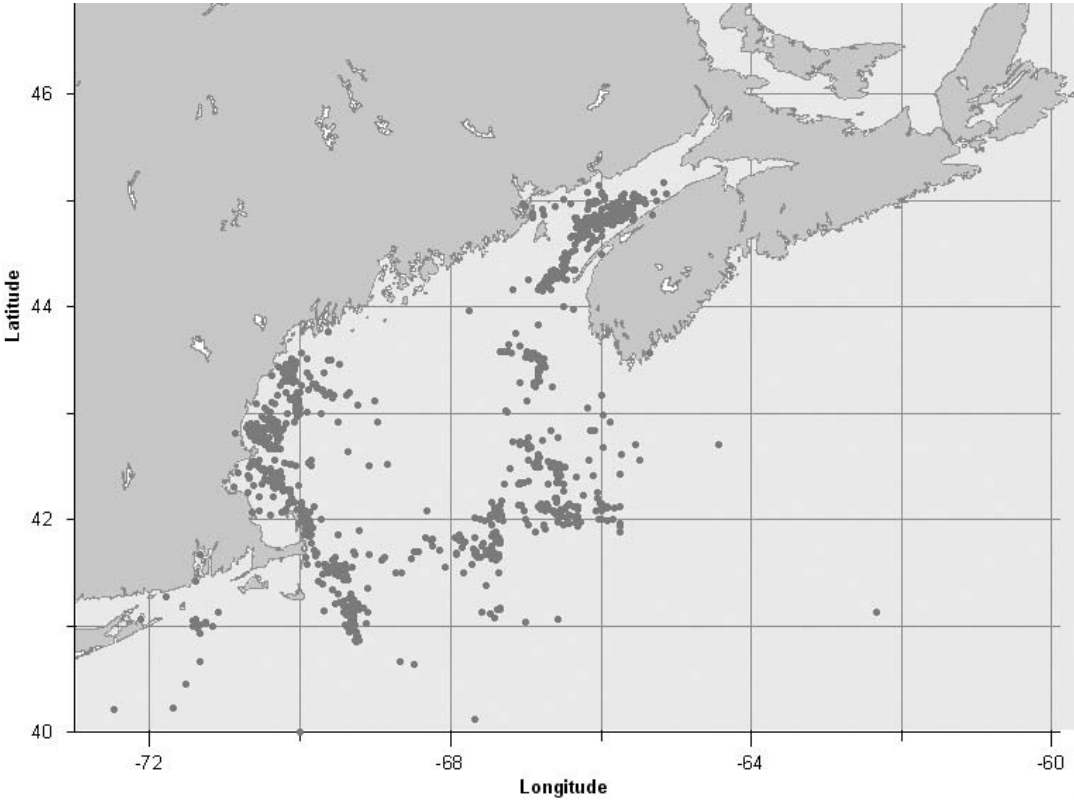


Figure 2: Recapture locations reported for the period March 2003 – August 2004 (n=1,605): recaptures are being reported from all major fishing grounds, though few have been reported from Downeast Maine waters.



2. Yellowtail flounder, *Limanda ferruginea*

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Technical objectives (prioritized):

- 1) Estimate movement among stock areas
- 2) Determine fishing mortality rates within stock areas
- 3) Growth increment observations

Scientific justification: All U.S. yellowtail resources are rebuilding from overfished conditions and there are considerable uncertainties in the conventional stock assessment methods (e.g., substantial retrospective bias). The most recent mark-recapture studies for yellowtail were from the 1950s, when stock conditions and potentially movement patterns were different. The tagging study is designed to complement current sources of information for yellowtail assessments and provide an independent estimate of fishing mortality.

Tag specifications:

- 1) **Peterson discs;** Floy Tag 7/8" round, fluorescent pink, labeled "cooperative-tagging.org, 5-digit tag #, \$1000 lottery (or \$100 reward), toll free 877-826-2612, provide tags & location and date." Most fish tagged blank on blind side, scales plucked from approximately 10%, labeled tags on blind side, "take some fish scales & return to 166 Water Street Woods Hole MA 02543."
- 2) **Data-storage tag;** Lotek LTD 1100, 32K memory, 8mm x 16mm x 27mm; time (dynamic storage & intervals), depth (+/- 0.04psi up to 735psi) & temperature (+/- 0.19° C), 3 year battery, labeled "tag#, Mail tag, date, location to 166 Water Street Woods Hole MA 02543". Oval disc tag labeled "cooperative-tagging.org, \$100 reward, toll free 877-826-2612."

Geographic extent: Three U.S. Stock areas: Cape Cod-Gulf of Maine, Georges Bank, southern New England-Mid Atlantic (see Figure 1).

Geographic stratification: Tag releases in 10 statistical reporting areas, proportional to relative abundance of yellowtail (according to NEFSC groundfish surveys).

Timeframe of releases: Tagging in 2003 (9475 releases), 2004 (projected 19,089 releases), and planned for 2005 (projected 5,000 releases).

Seasonality of releases: Nearly all releases during spawning season (May-August), some releases in autumn (820 of 28,564).

Size of fish: All legal-sized fish (>33cm), and some sub-legal sized-fish from low density tows in southern New England-Mid Atlantic.

Method of initial capture: Commercial otter trawls using large mesh (6") and relatively short tows (~30 min).

Method of recapture and seasonality: Recaptures from year-round commercial fishery with some seasonal geographic closures. The reward system involves:

- 30,000 lottery tags (\$1000) with quarterly drawings;
- 200 high-value (\$100) tags;
- \$100 reward for data-storage tags.

Outreach methods: Reward posters (in English and Portuguese), brochures, website (cooperative-tagging.org), annual letters to yellowtail fishermen, press releases, toll free number (877-826-2612), phone call and 'thank you' letter with map with details of the tagged fish and its movements to every fisherman who reports a recapture, annual meeting with scientists and fishermen, hats for leading tag returns and collaborators.

Data management: Tag release data are recorded on two data logs, the Captain's log and the tagger's log. The two logs are keypunched by technicians into two associated data tables that can be linked using 'date' and 'tow number' fields. Recapture information from phone calls or letters are recorded on recapture logs and keypunched by technicians to a table that can be linked by 'tag number.' The resulting database has three relational tables. Copies of the updated master database are routinely copied and sent to cooperating parties.

Number of releases, by time and geographic area: (see Figure 1 for geographic depiction of statistical areas).

Area	Statistical Yellowtail		2003	2004	Total	% releases
	area	resource	releases	releases	releases	
Western Gulf of Maine	513	7%	15	1,468	1,483	5%
Mass Bays	514	13%	2,104	1,395	3,499	12%
East of Cape Cod	521	10%	2,282	66	2,348	8%
Cultivator	522	3%	724	765	1,489	5%
Southwest Part Georges	525	12%	140	4,005	4,145	15%
Northern Edge Georges	561	1%	428	446	874	3%
Closed Area II	562	43%	2,962	9,169	12,131	42%
Lightship Area	526	3%	125	605	730	3%
Southern New England	537	4%	430	368	798	3%
Mid Atlantic	613	3%	225	736	961	3%
Block Island	539	1%	40	66	106	0%
Total		100%	9,475	19,089	28,564	100%

Number of recaptures to date: As of June 20 2004, tags from 655 recaptured fish were reported (approximately 7% of 2003 releases) (Figure 2). Nineteen \$100 tags were returned (17%).

Release Area	Recapture Area					Total
	Gulf of Maine	Cape Cod	Georges Bank	S.New England	Mid Atlantic	
Gulf of Maine	0	1	0	0	0	1
Cape Cod	1	384	9	2	0	396
Georges Bank	0	6	248	0	0	254
S.New England	0	0	1	0	0	1
Mid Atlantic	0	0	0	0	0	0

Tag retention: Long-term holding study in progress (no tags lost over 3 months).

Tag-induced mortality: Short-term holding experiments suggest some mortality, possibly due to transport from fishing grounds to Woods Hole. Cage studies proposed for 2005.

Analytical design: Estimate movement and mortality according to the observed number of tag returns by area and season, accounting for tag-induced mortality and reporting rate. The model has flexible spatiotemporal resolution, so that stock areas can be analyzed by stock areas annually, or by statistical areas seasonally if the number of tag returns supports such detail.

Figure 1: Statistical areas corresponding to releases of tagged yellowtail flounder.

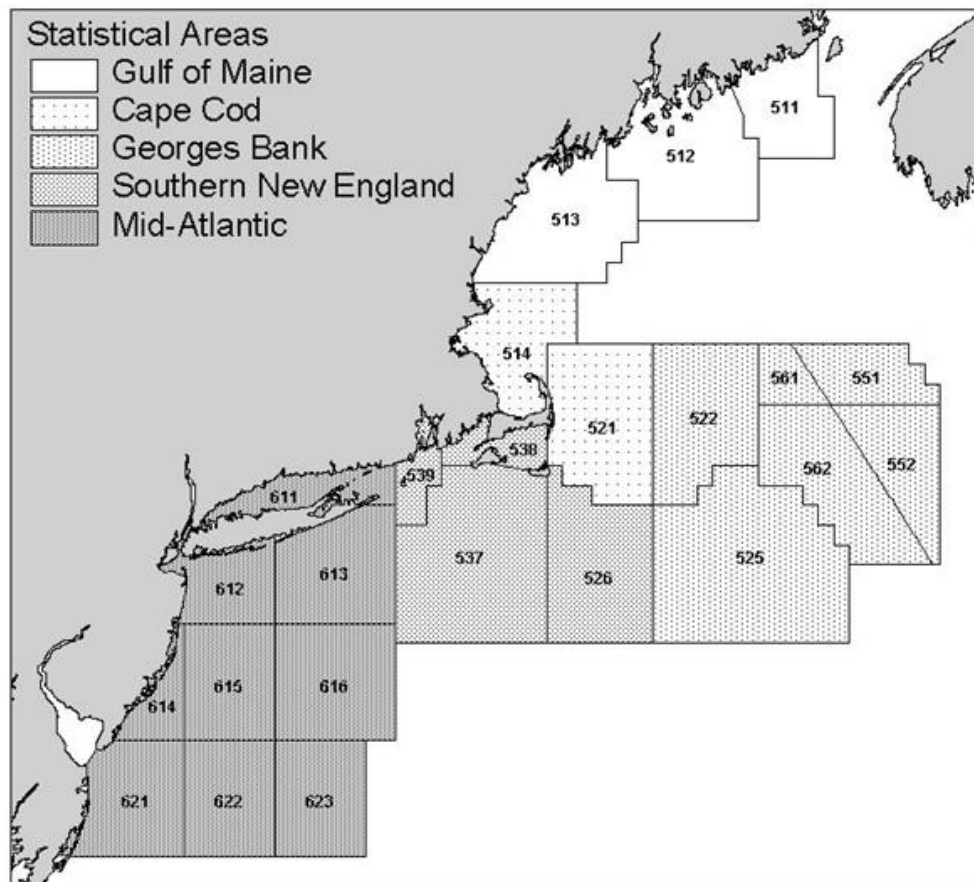
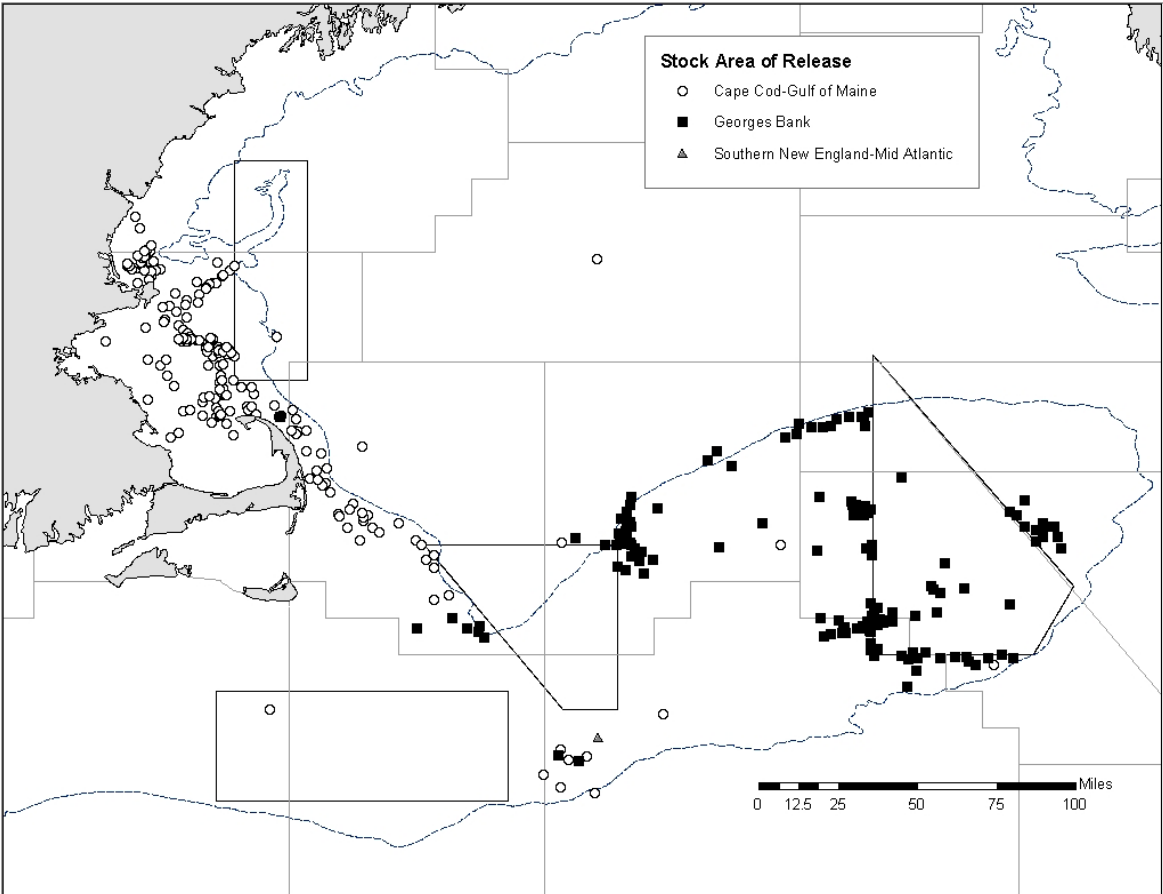


Figure 2: Recapture locations of tagged yellowtail flounder.



3. Black sea bass, *Centropristis striata*

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Scientific justification: Black sea bass are managed as a single unit stock by the Mid-Atlantic Fisheries Management Council. Stock status has been based on trends in indices from the NMFS spring bottom trawl survey. It was recommended during a 1998 review of the assessment that alternative methods, such as tagging, be considered as a means of evaluating exploitation rate of the stock relative to biological reference points. In addition, management of sea bass as a unit stock has been questioned by user groups. A tagging project was seen as a way to evaluate the validity of the one stock approach to management.

Technical objectives (prioritized):

- 1) Estimate **exploitation rate** of the northern stock of black sea bass.
- 2) Identify the **seasonal migration** pattern throughout the stock.
- 3) Exam the extent of **mixing** among regional components of the stock.

Tag specifications: Floy internal anchor tags, model FM 84

- 1) Orange tags – 6-digit tag #, telephone number, “REWARD” (information is reversed on other side of tag with tag # at end of the tag). Internal tab has tag #, “Reward” on one side, NMFS Woods Hole, Telephone number on the other side.
- 2) Red tags – 6-digit tag #, telephone number, “\$100 REWARD” (information is reversed on other side of tag with tag # at end of the tag). Internal tab has tag #, “\$100 Reward” on one side, NMFS Woods Hole, Telephone number on the other side.
- 3) Data-storage tag - Lotek LTD 1100, 32K memory, 8mm x 16mm x 27mm; time (dynamic storage & intervals), depth (+/- 0.04psi up to 735psi) & temperature (+/- 0.19° C), 3 year battery, labeled “tag#, Mail tag, date, location to 166 Water Street Woods Hole MA 02543”. Oval disc tag labeled “cooperative-tagging.org, \$100 reward, toll free 877-826-2612.”

Geographic extent: Massachusetts to North Carolina

Geographic stratification: Tag releases are stratified by state, with the release numbers in approximate proportion to reported commercial landings.

Timeframe of releases: Releases made in September 2002, May 2003, September 2003 and September 2004. Approximately 3,000 releases per season.

Seasonality of releases: Last two weeks of September (or May). Tagging has been extended into the first week of October if weather delays were encountered (hurricanes, etc.).

Size of fish: Minimum length of fish tagged was approximately 27cm (minimum legal size = 28 cm), although on occasion smaller fish were included. Below 25 cm the size of the tag appears to be too large. All fish above 27 cm were tagged if condition permitted.

Method of initial capture: Captures were made using black sea bass pots operated by commercial fishermen, commercial hook and line gear, or recreational hook and line catches from volunteer fishermen on chartered party boats.

Method of recapture and seasonality: Recaptures have come from recreational fishermen on private or charter boats, commercial hook and line fishermen, commercial sea bass pots or otter trawls.

Reward system: Each orange tag returned with information was rewarded with an embroidered baseball hat (“Cooperative Tagging Program” and a sea bass). Each red tag reported and sent to NMFS, Woods Hole was rewarded with a \$100 check.

Outreach methods: Information about the tagging project was distributed to the press via a NEFSC press release. Individual letters were sent to permitted commercial fishermen and recreational fishing clubs (who also received a small poster). Posters were distributed to bait and tackle shops in ports where tagging trips were conducted. A website was developed which gives viewers updated information on the project including maps of general release and recapture locations. Information about the individual tagged fish is included in a letter sent to people reporting a recaptured tag. Also inclusion of volunteer fishermen in the release program increases general knowledge of the program.

Data management: Release data is entered into an Excel spreadsheet and contains information on: release date (month, day, year), vessel, port, site location (latitude and longitude), gear type, water depth, water temperature, tag number, tag type, tagger name, recorder name and comments. Recapture information entered into the spreadsheet includes: date (month, day, year), tag number, tag type, fish length, length unit, length quality code, fate of tag, fate of fish (disposition), number of times recaptured, reason for release, recapture site, recapture coordinates, coordinate precision code, NMFS statistical area, port, gear type, industry code (recreational, charter, etc.), target species, vessel name, reporter name, address, telephone number, tag condition, comments.

Entered data is transferred to a SAS database and release/recapture files are merged by tag number. Automated auditing of the merged file includes comparisons of dates and lengths before and after recapture and estimation of distance traveled compared to time at large. The SAS data file is updated regularly with the addition of new data and backed up daily as part of the Center data management practices. Specific release and recapture location coordinates are considered confidential information.

Number of releases, by time and geographic area: (September 2004 releases incomplete; see Figure 1 for release locations; red tags are high-reward tags).

State	September 2002		May 2003		September 2003		September 2004	
	Orange	Red	Orange	Red	Orange	Red	Orange	Red
MA - NY	1606	137	131	7	1153	80	779	39
NJ - DE	518	33	726	42	685	87	501	26
MD-NC	1354	142	1503	34	1203	129	1207	59
Total	3478	312	2360	83	3041	296	2487	124

Number of recaptures to date: The following summary includes all recaptures regardless of tag fate (removed or re-released); red tags are high-reward tags (see Figure 2 for recapture locations).

Area	Orange tag Recaptures	Red tag Recaptures	Total
MA - NY	422	48	470
NJ - DE	527	42	569
MD-NC	512	49	561
Total	1461 (13%)	139 (17%)	1600 (73%)

Tag retention: Three independent studies done holding tagged fish in aquariums. First study held 9 fish for 3-9 months with no tag losses. A second study held 31 fish 10-12 months with 3 tags lost and a third study held 30 fish for 27 days with 4 tags lost. Overall the tag loss rate was 10.1%.

Tag-induced mortality: In the three tag retention studies conducted no tag-induced mortality was observed.

Analytical design: The initial estimate of exploitation rate using tag return data was made using a Petersen model, modified to account for tag reporting and tag loss. In addition, an instantaneous rate model was fit based on expected probabilities of tag recapture. Details of the analysis and results are available in NEFSC Lab Reference Document 04-10 '39th Northeast Regional Stock Assessment Workshop (39th SAW) Assessment Summary Report & Assessment Report'.

Figure 1: Release locations from September 2002 – September 2003.

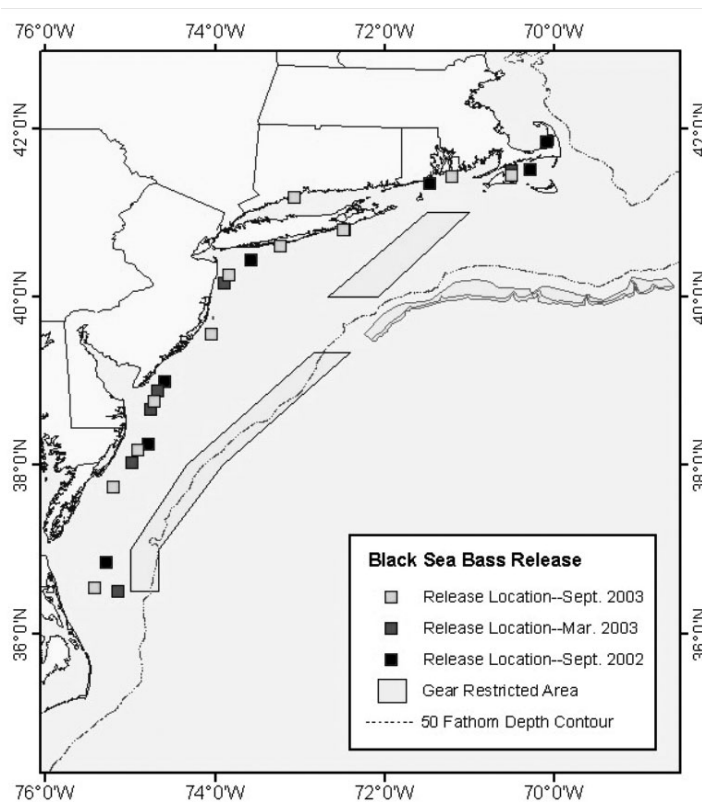
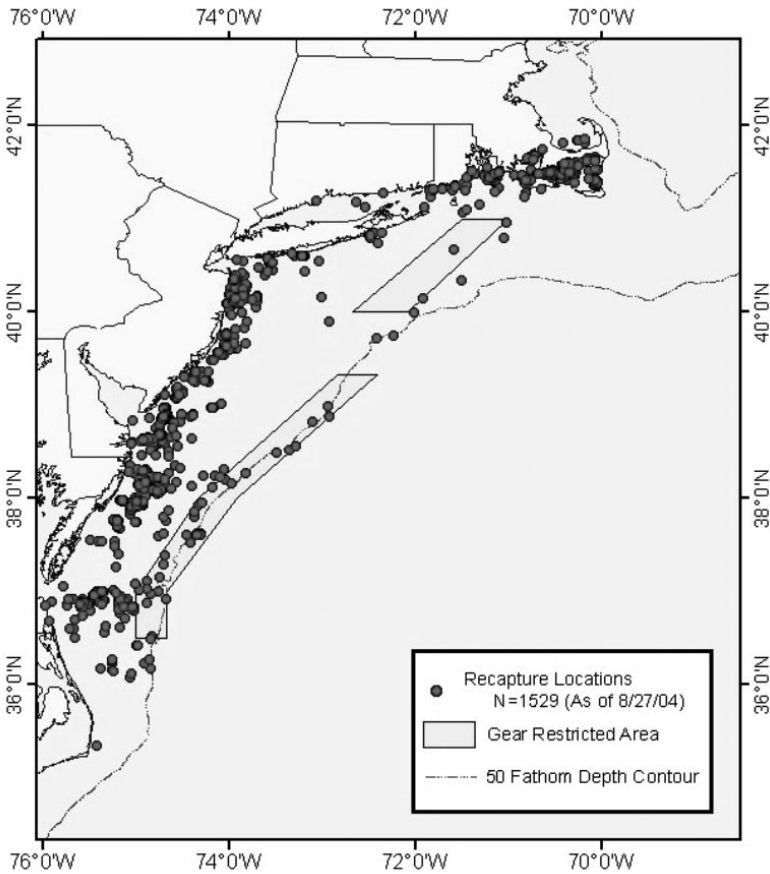


Figure 2: Recapture locations for reported by August 27 2004.



4. Atlantic shark species excluding dogfishes

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Technical objectives (prioritized):

- 1) Investigate spatial and temporal variation in the distribution and migratory patterns of coastal and pelagic Atlantic shark species at various life history stages;
- 2) Delineate nursery and pupping areas and seasonal residence time;
- 3) Obtain individual migration, growth rates and longevity data;
- 4) Validate and verify age determination methods;
- 5) Determine stock identification and the degree of mixing between stocks;
- 6) Identify fine-scale factors influencing distribution, behavior, and growth including sea surface temperature and salinity;
- 7) Determine survival estimates; and
- 8) Promote conservation through catch and release.

Scientific justification: The National Marine Fisheries Service Cooperative Shark Tagging Program (CSTP) is a multi-decadal program that is part of continuing research directed to the study of the biology of large Atlantic Sharks to obtain information for rational resource management. Many shark species have wide ranging distributions, frequently traverse national boundaries, and are exploited by multinational fisheries. Their wide geographic range has made it difficult to gather basic data on distribution, movement patterns, and life histories that are essential to management.

Tag specifications: The two principal tags in use are a fin tag (Jumbo Rototag) and a dart tag ("M" tag). The rototag is a two piece, plastic cattle ear tag which is inserted through the first dorsal fin. These tags are primarily used by biologists on small sharks in the nursery areas. The "M" tag is composed of a stainless steel dart head, monofilament line, and a plexiglass capsule containing a vinyl plastic legend with return instructions printed in English, Spanish, French, Japanese and Norwegian. These dart tags, in use since 1965, are implanted in the back musculature near the base of the first dorsal fin and are the predominant tags used by cooperative taggers.

Geographic extent: North Atlantic Ocean, Gulf of Mexico, Mediterranean Sea.

Geographic stratification: Sharks are tagged throughout the areas outlined in the geographic extent, but primarily in the Northwestern North Atlantic. Recaptures occur throughout the geographic area.

Timeframe of releases: The CSTP began in 1962 with 38 releases. Since that time the program has averaged over 4300 releases a year, for a total of 181,915.

Seasonality of releases: Year round. The majority of the releases occur in the waters off the Northeast United States from late spring through fall.

Size of fish: Neonate size and greater are tagged.

Method of initial capture: Anglers using rod and reel accomplish the majority of the tagging for all species combined. Biologists, NMFS fisheries observers, and commercial fishermen using primarily longlines, handlines, and nets (gill, trawl) account for the remainder.

Method of recapture and seasonality: Commercial fishermen using longlines and net gear, and rod and reel recreational anglers are responsible for the majority of the recaptures, which occur year round.

Reward system: Initially, a five dollar reward was sent as an incentive for returning tags; since 1988, a hat with an embroidered logo has been used.

Outreach methods: Numbered tags are sent to volunteer participants on self-addressed return post cards for recording tagging information (date, location, gear, size and sex of shark), along with a tagging needle, tagging instructions, an *Anglers Guide to Sharks of the Northeastern United States*, and current management information. Annual newsletter sent to all participants prior to 1999. Program website <http://na.nefsc.noaa.gov/sharks/index.html>. Prompt responses to tag returnees (letter with recapture report, and their reward). Staff frequently travel to fishing centers and to fishermen's forums to publicize the shark tagging program and educate constituents on shark conservation and the benefits of tag and release.

Data management: CSTP release and recapture data are maintained in fixed column unit record files. Since the Program has been in existence for over 40 years, we have lived through various computer systems and database management programs. Early on, it was decided to retain data in flat ASCII files, which can then be imported into a variety of statistical and GIS programs for display and analysis. This has avoided many problems in data conversion when the current popular database system is abandoned in favor of a new type.

Release data are recorded by the tagger on postage paid tag event cards and mailed to the laboratory. The cards are checked for accuracy, and database numerical codes are written directly on the card. Copies of the tag cards are sent offsite for data input. Recapture data are received by mail, email, phone, or in person. Onsite staff complete a recapture event card for each recapture and directly input coded data. The resulting release and recapture files are proofread against the original data, run through quality control and mapping programs, and archived with previous years data for subsequent analysis. The original tag cards, recapture event cards, and associated original recapture information (letters, emails, etc.) are all stored onsite in file cabinets.

Number of releases, by time and geographic area: Between 1962-2003, more than 181,000 sharks of 52 species have been tagged. Eighty-six percent of the tags are represented by eight species: blue shark, *Prionace glauca*; sandbar shark, *Carcharhinus plumbeus*; tiger shark, *Galeocerdo cuvier*; dusky shark, *C. obscurus*; shortfin mako, *Isurus oxyrinchus*; blacktip shark, *C. limbatus*; Atlantic sharpnose shark, *Rhizoprionodon terraenovae*; and scalloped hammerhead, *Sphyrna lewini*. The number of sharks tagged varies from 1 for the scoophead (*S. media*) to 97,843 for the blue shark.

Number of recaptures to date: Through 2003, 10,826 sharks of 33 species have been recaptured. Numbers of recaptures by species range from 1 for the Greenland shark (*Somniosus microcephalus*) to

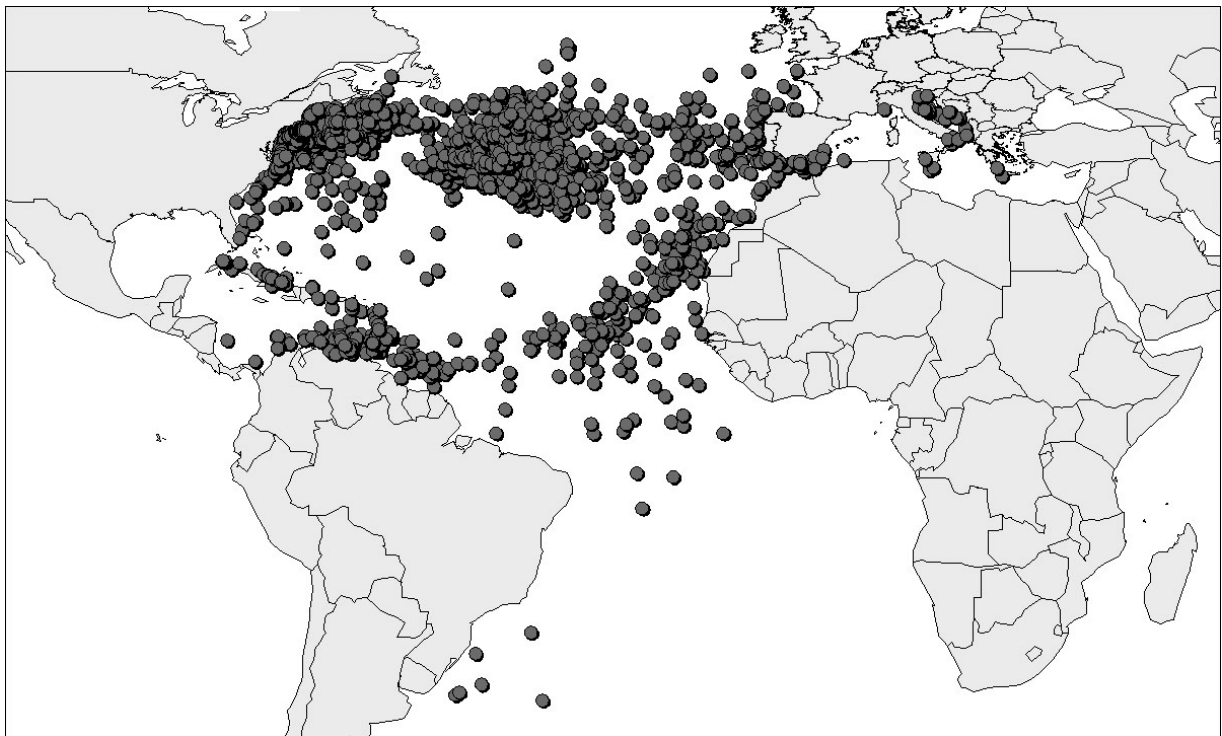
6,261 for the blue shark. Eighty-eight percent of the recaptures are made up of seven species: blue shark; sandbar shark; shortfin mako; tiger shark; lemon shark, *Negaprion brevirostris*; blacktip shark; and dusky shark. The rate of recapture ranges from 1.3% for the oceanic whitetip shark (*C. longimanus*) to 12.0% for the shortfin mako.

Tag retention: No data to estimate tag retention rate.

Tag-induced mortality: No data to estimate tag-induced mortality but post release survival studies show no mortalities and rapid recovery from the catch, tag, and release process for many shark species.

Analytical design: Analysis to date includes general migration patterns, extent of range, and growth information for multiple species. More recent analysis in progress is stock identity and survival estimates for some species.

Figure 1: Blue shark recapture locations from the Cooperative Shark Tagging Program



5. Atlantic Striped Bass, *Morone saxatilis*

Prepared by: Tina McCrobie, United States Fish and Wildlife Service

Principal investigators:

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The Cooperative Striped Bass Tagging Program is currently executed in a partnership comprised of three federal and 10 state agencies to allow continued adaptive management of this species. Tagging is conducted during various State/Federal research projects. In addition to the 13 federal and state agencies, there have been 10 other cooperating agencies since the tagging began in 1985. Overall, a larger number of personnel have worked on this program to date.

Technical objectives (prioritized):

- 1) Estimate survival and fishing mortality rates for Atlantic striped bass.
- 2) Examine movements, migration, and the nature of commercial/recreational fisheries for striped bass.
- 3) Characterize the distribution of striped bass harvest and discards by type of recapturing fisher and gear, for use in the striped bass virtual population analysis.

Scientific justification: Atlantic striped bass are an important resource to recreational fishermen, commercial harvesters, and their dependent communities coast wide. Declines in abundance during the late 1970's and early 1980's resulted in the enactment of the Atlantic Striped Bass Conservation Act of 1984. A component of the Act, The Emergency Striped Bass Study, led to the implementation of the striped bass tagging study, which is overseen by the U.S Fish and Wildlife Service.

Management of the species is coordinated through the Atlantic States Marine Fisheries Commission (A.S.M.F.C.), a consortium of the Atlantic coast states including the National Marine Fisheries Service and the U.S. Fish and Wildlife Service. The A.S.M.F.C. fisheries management plan specifies target and threshold values for both fishing mortality and female spawning stock biomass. Annual stock assessments compare current reference point estimates to target values, and provide advice to the A.S.M.F.C. striped bass Management Board on recommended actions.

The tagging study provides independent estimates of fishing mortality on coastal mixed stock aggregations of striped bass as well as on spawning aggregations of striped bass from the Hudson River, Delaware River, and the Chesapeake Bay. In addition, tag recovery data is used to characterize discards in the commercial fishery by gear type.

Tag specifications: Floy internal anchor tag. Legend printed on both streamer (pink) and anchor (international orange).

Streamer legend: "REWARD PH: 1-800-448-8322" (tag number) #####
"IF UNDERSIZE CUT OFF TAG – RELEASE FISH"

Anchor legend: "USFWS 177 ADMIRAL COCHRANE DR. ANNAPOLIS, MD 21401
1-800-448-8322"
"REWARD U.S. FISH & WILDLIFE SERVICE"
"TAG NUMBER #####"

Geographic extent: Along the Atlantic coast from Maritime Canada to the northern portion of Florida, inland to major barriers impassable to fish.

Geographic stratification: Tags are released during a variety of coastal research efforts from Massachusetts to North Carolina. In addition, striped bass are tagged in the major spawning reaches of the Hudson River, Delaware River, and in the Chesapeake Bay.

Timeframe of releases: Tagging of Manning State Fish Hatchery striped bass began in November 1985; projects have since released tagged striped bass annually.

Seasonality of releases: Coastal tagging programs occur mainly during the Fall, although some tags are released in parts of the coast throughout the year. Tagging in the major spawning reaches occurs mainly during Spring.

Size of fish: Minimum size of fish tagged is about 100 mm, although some programs do not tag fish below 457 mm. Fish of these sizes or greater may be tagged if their condition is suitable according to the tagging protocol guidelines.

Method of initial capture: A variety of gears are used for initial capture including hook and line, seine, gill net, trawl, pound net, and electro-shocking.

Method of recapture and seasonality: Recaptures are reported from many types of gears, and many types of fishers. Recaptures follow a seasonal pattern of coastal migration north in the Summer, returning South in the Fall. Also evident in the recovery pattern is the distribution of fishing effort throughout the year.

Reward system: The U.S. Fish and Wildlife Service provides a variety of rewards to individuals who report recaptures. Rewards include a baseball cap, a hat pin/lapel pin, or five dollars.

Outreach methods: Plastic and laminated posters identifying various species in the U.S.F.W.S. tagging program are distributed and displayed at fishing access sites, etc., throughout the Atlantic coast.

Data management: Recapture and release data is stored into a Microsoft Access database at the Maryland Fishery Resources Office(MFRO), U.S. Fish & Wildlife Service (FWS), Annapolis, MD. The database consists of three major parts: 1) tag release data entry program, 2) tag recapture data entry program, and 3) an error checking and import program.

The tag release data entry program is used by cooperating state agencies and other members participating in the FWS striped bass tagging program. The system consolidates reporting of striped bass into a single system and provides a standard system for entering data regarding the release of tag striped bass. Following the data entry, the information is saved in the proper format (Microsoft Access 2000), which then is sent to the central database at the MFRO. An agency has a choice of using this program or providing a Microsoft Access file containing the same information.

Recapture information from a tagged striped bass is coded with an agency code according to which agency tagged and released the fish, along with a NOAA code for the location of the recapture site. After coding, the data forms are entered into the database at the MFRO using a tag recapture data entry program also operated in Microsoft Access.

The striped bass error checking and import program is designed to serve as a means of gathering, error checking, and importing striped bass release data that has been sent from cooperating agencies. This data is divided into three separate tables: batch data, individual data, and other tag data. After the database containing the release data is opened by the program, each of these sections goes through an error checking by the program. After all errors have been corrected, the data is imported into the tagging database.

Release and recapture data contained in the central database is sent in various formats upon request from a cooperating agency.

Number of releases, by time and geographic area: Through July, 2004 a total of 426,576 striped bass have been tagged and released.

Number of recaptures to date: A total of 75,930 recaptures (18% of releases) have been reported through July, 2004.

Tag retention: Tag retention studies were conducted comparing various tag types, including the internal anchor tag (Dunning et. al., 1987). Tag loss, evaluated by a number of investigators is believed to be low, ranging from 0% (Goshorn et. al. 1998) , to 2% (Dunning et. al. 1987), and 2.6% (Sprankle et. al. 1996).

Tag-induced mortality: Estimates of tag-induced mortality are low (0% Goshorn et. al. 1998; 1.3% Rugolo and Lange 1993) and no adjustment is made in the analysis.

Analytical design: The A.S.M.F.C. Striped bass Technical Committee, Tag Working Group, follows a standard protocol for estimating survival and fishing mortality from tag releases and recaptures. Currently the Tag Working group is using Program MARK software, available on the World Wide Web at www.cnr.colostate.edu/~gwhite/mark/mark.htm. Readers are encouraged to contact the A.S.M.F.C. species coordinator for striped bass to obtain copies of the Tag Working Group's recent report which details the analysis protocol at www.asmfc.org.

6. Atlantic herring, *Clupea harengus*

Prepared by: Kohl Kanwit, Maine Department of Marine Resources

Principal investigators:

Kohl Kanwit, Maine Department of Marine Resources (DMR), West Boothbay, ME

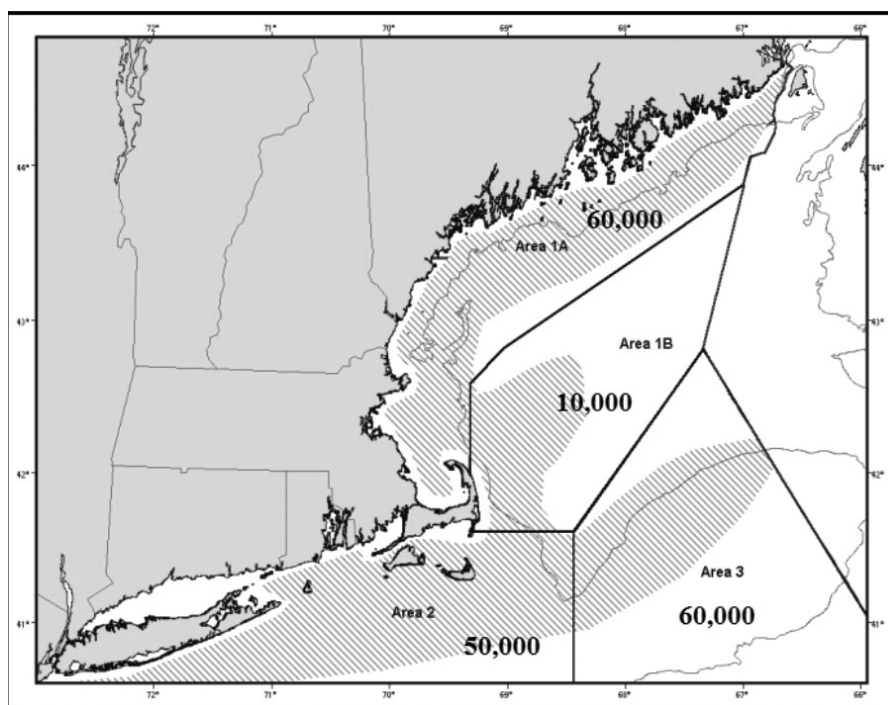
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Technical objectives (prioritized):

- 1) Determine migration and seasonal movement patterns in the Gulf of Maine and southern New England.
- 2) Determine seasonal intermixing rates of spawning groups in the three existing federal management areas.

Scientific justification: Under the current Fishery Management Plans (FMP), assumptions of stock intermixing play an important role in the allocation of the resource. The New England Fishery Management Council (NEFMC) and the Atlantic States Marine Fishery Commission (ASMFC) both employ stock mixing ratios based on 20-30 year old tagging data to determine annual Total Allowable Catch (TAC) values in each of the management areas (Figure 1). Although past and present stock assessment models estimate biomass for the entire herring complex, the inshore stock component is considered the limiting factor. In recognition of this and the general uncertainty regarding the status of the inshore stock, a risk assessment approach to determining the TACs is being proposed through Amendment I to the NEFMC Atlantic herring FMP. This tagging project is capable of contributing current data to the risk assessment process by updating stock intermixing rates and migration patterns. This information will contribute to scientifically based determinations of the area TACs and result in better management of the herring fishery.

Figure 1: Atlantic herring distribution in US waters with management areas and associated TACs (in metric tons).



Tag specifications:

- 1) Hallprint T-bar anchor tags, pink: ##### \$1000 LOTTERY 207-633-9535; PO Box 8 Boothbay, ME 04575
- 2) Floy T-bar anchor tags, yellow: ##### ME DMR

Geographic extent:

Currently: The inshore Gulf of Maine and southern New England.

Proposed: We have secured funding to expand the tagging project in 2005 to include Georges Bank and the extent of the winter feeding grounds in the mid-Atlantic.

Geographic stratification: The Atlantic herring tagging project employs a stratified sampling design based on releasing marked herring in proportion to their geographic and seasonal abundance in the Gulf of Maine and southern New England. Regional estimates of abundance were obtained from the TRAC final report and represent the most current information on stock biomass inshore and offshore. An analysis of the stock complex using hydroacoustic results, trawl survey data and prior assessments suggest that the inshore component contributes between 10-15% of the total spawning stock biomass. Therefore, this project will target a release ratio of 1000 marked offshore herring to every 150 marked inshore Gulf of Maine herring during the summer feeding/spawning temporal stratum when the stocks are assumed to be segregated. Releases in southern New England will be proportional to the total tagging effort in the inshore and offshore areas. This target is based on the assumption that both stock components utilize Area 2 during the winter feeding temporal stratum. Realistically this project can only hope to tag half of the optimal targets on Georges Bank and in southern New England, resulting in a total release of 64,500 fish. However, it is anticipated that this reduction can be corrected for in the later analysis of tag returns.

Timeframe of releases: Tagging began in 2003, continued in 2004 and is planned for 2005.

Seasonality of releases: The four temporal strata identified for this study are: spring migration (April-June), summer feeding/spawning (July-September), fall migration (October-December), and winter feeding (January-March).

The major focus of this study is on tagging pre-spawning (stage 4+) herring in the Gulf of Maine and Georges Bank during the summer feeding/spawning temporal stratum and tagging in the southern New England stratum during the winter feeding period. This approach will provide information on the potential mixing of Gulf of Maine and Georges Bank herring on the winter feeding grounds, identify stocks (including Canadian stocks) of herring that use winter feeding areas off southern New England, and identify any spawning site fidelity that may occur. Tagging will not occur in all of the defined temporal strata because returns from the migrating periods (spring migration and fall migration) have limited value to understanding the parameters of interest. Funding and resources are limited so tagging events will focus on only the most important temporal strata while attempting to cover the widest possible range of spatial strata.

Size of fish: The focus of the project will be on age 3+ fish capable of spawning in the year of marking. Generally age 3+ fish are 23 cm and above.

Method of initial capture: Herring are captured with an aquarium codend attached to a mid-water trawl net during charter trips. The specific depths and durations of the tows depend on fishing conditions. Regulated seawater flow is introduced into the holding tank of the aquarium codend after each set is hauled back. Tagging occurs directly from the holding tank to minimize handling of the herring. In order to reduce scale loss, tagging personnel use bare hands to handle the fish during the tag application procedure. All herring are selected for fitness and only tagged if they have in excess of 80% scale coverage.

Herring are also obtained for tagging using purse seines during commercial fishing trips. Generally the herring school near the boat after about 1/2 of the net is dried back and can be caught with a dip net. They are quickly transferred to a modified Xactix tote with a continual supply of fresh seawater. The fish are tagged directly from the holding tank in the same manner as described above.

Method of recapture and seasonality: Tagged herring are continually recovered through the commercial fishery. Tag returns come from both the food processing and bait sectors. Tags are traced to the catch vessel with a high degree of accuracy using mandatory dealer and vessel trip reports. The geographic extent of recoveries depends on the fishing effort and its relationship to the seasonal distribution of herring.

Reward system: There is a herring industry sponsored reward system with three annual drawings (1 for \$1,000 and 2 for \$500). The drawing is held at the Maine Fisherman's Forum in March.

Outreach methods: Posters and tag return forms are mailed annually to all herring and lobster dealers. Posters are also hung at prominent waterfront locations. Annual informational sessions are held at the Maine Fisherman's Forum. Thank you letters and maps are sent to all tag returnees. T-shirts are distributed to all cooperating captains and crews of commercial fishing vessels. We have also established a web site that provides downloadable posters/return forms and project information (http://www.state.me.us/dmr/rm/herring/herring_project.htm)

Data management: Herring tagging data are stored in a Microsoft Access Database. This database includes the following linked tables: TRIP, SET, TAG, SAMPLE, BYCATCH, and RETURN. These tables can be easily queried to obtain program information. Quality controls and defaults can be employed to insure data accuracy. We are currently developing data entry forms.

Number of releases, by time and geographic area:

Strata	2003	2004	Total
Eastern Gulf of Maine (EGOM)	6450	6925	13375
Southern New England (SNE)	4536	5875	10411
Western Gulf of Maine (WGOM)	8825	5850	14675
Total	19811	18650	38461

Number of recaptures to date:

Year	Release area	Recapture area							Total
		EGOM	WGOM	MA	NB	NS	SNE	UNK	
2003	EGOM	15	5	0	4	3	1	0	28
	SNE	2	2	1	5	6	2	2	20
	WGOM	2	4	0	2	1	3	0	12
2004	EGOM	3	0	0	0	0	0	3	6
	SNE	0	0	0	1	0	3	1	5
	WGOM	0	3	0	0	0	0	5	8
Total		22	14	1	12	10	9	11	79

Tag retention: Attempting holding studies using a sea-pen. Past trials using wet lab facilities at Maine DMR have failed.

Tag-induced mortality: Same as above.

Analytical design: Estimate movement and migration using vector analysis. Estimate stock intermixing by using mixing models and adjusting for effort.

7. Atlantic Salmon, *Salmo salar*

Prepared by: Edward Hastings, Northeast Fisheries Science Center, Orono

Principal investigators:

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Fred Trasko , United States Fish and Wildlife Service (USFWS), Green Lake National Fish Hatchery, Ellsworth, ME	(207)667-9531 Fredrick_Trasko@fws.gov
Chris Legault , Northeast Fisheries Science Center (NEFSC), Woods Hole, MA	(508) 495-2025 chris.legault@noaa.gov

Technical objectives (prioritized):

- 1) Identify patterns in post-smolt growth of returning Atlantic salmon in relation to prevailing near-shore oceanographic conditions immediately following release.
- 2) Evaluate time of emigration, smolt size distributions, seasonal distributions and relative proportions in relation to stocking date and location of emigrating stocked and naturally-reared smolts using a lower river smolt-trapping program.

Scientific justification: Declining marine survival has been implicated in the worldwide decline of Atlantic salmon stocks. Hatchery enhancement programs play an important role in Atlantic salmon restoration efforts in the Penobscot River. Adult returns to the Penobscot River were 779 and 1023 returning adults in 2002 and 2003, respectively, representing less than 10% of the adult escapement objectives for the system. Adult returns from hatchery stocked age 1+ smolts are critical to maintaining suitable returns of sea-run broodstock for future restoration efforts. Although ocean conditions affecting Atlantic salmon survival are largely beyond management control, stock enhancement programs can exert some control over the time that hatchery produced smolts encounter both in-river and nearshore marine environmental conditions. A better understanding of the interaction of in-river and nearshore marine environmental conditions in relation to smolt and post-smolt growth and survival would improve models used to assess Atlantic salmon and provide valuable information for restoration efforts.

Tag specifications: Visible Implant Elastomer (VIE), four fluorescent colors (red, green, pink, orange), applied in the adipose eyelid. <http://www.nmt.us/index.htm>. Secondary mark – adipose clip.

Geographic extent: From the Gulf of Maine and neighboring waters to Newfoundland and West Greenland.

Geographic stratification: Atlantic salmon smolts are tagged at a USFWS hatchery then released at four locations (~24,000 fish per location) in the Penobscot River. The release locations are Mattawamkeag (142km), Milo (120km), Howland (99km), and the West Enfield smolt ponds (101km).

Timeframe of releases: Tagged release for the Penobscot River were in 2000 (166,064 releases), 2001 (173,047 releases), 2002 (172,519 releases), 2003 (197,242 releases), 2004 (196,890 releases),

and planned for 2005 (projected 200,000). Along with the Penobscot, smolts were tagged for the Dennys River (2001-04: 212,504 fish tagged) and the Pleasant River (2003 – 04: 10,629 fish tagged).

Seasonality of releases: Releases occur in the spring during the smolt emigration (April and May).

Size of fish: Fish greater than 15cm (6”).

Method of initial capture: Hatchery fish used. Marking occurs at hatchery prior to release in rivers.

Method of recapture and seasonality: **1)** Eight-foot rotary screw traps in river, **2)** a Norwegian designed pelagic trawl towed at the surface with a specially-designed aluminum “aquarium” cod end, making 30 minute sets at a trawling speed of approximately 4.0 knots in estuary (Sampling locations shown on Figure 1), **3)** Sampling of West Greenland Atlantic salmon catch (August and September), and **4)** recovery at the Veazie fishway adult trap (May – November) in conjunction with ASC at the head of tide (Veazie Dam) of the Penobscot River.

Reward system: None, assistance by other agencies.

Outreach methods: Presentations at local salmon clubs, watershed councils and research forums. Added to ICES NASWG release tables that document all marking programs in North America and Europe.

Data management: The data collected in the tagging program is part of a larger salmon database that is maintained in Microsoft Access. This larger database is called MaineSalmon and contains a number of conventions that allow data to be entered and accessed by a number of different agencies (National Marine Fisheries Service, US Fish and Wildlife Service, and Maine Atlantic Salmon Commission) while maintaining a consistent naming and reference system. In-river observations are geo-referenced to river kilometer and separate databases on tagging, aging, electrofishing, etc. can be cross-referenced.

Number of releases, by time and geographic area:

Penobscot Release Group	2000 Releases	2001 Releases	2002 Releases	2003 Releases	2004 Releases	Total Releases	% Releases
Mattawmkeag – early	24,619	24,557	24,614	24,619	24,638	123,047	13.6%
Mattawmkeag - late	24,671	24,513	24,685	24,685	24,511	123,065	13.6%
Milo – early	24,958	24,202	24,666	24,681	24,569	123,076	13.6%
Milo – late	25,226	26,614	24,696	49,298	49,270	175,104	19.3%
Howland – early	25,122	24,398	24,576	24,692	24,663	123,451	13.6%
Howland – late	24,783	24,418	24,663	24,610	24,576	123,050	13.6%
West Enfield – Smolt Ponds	16,685	24,345	24,619	24,657	24,663	114,969	12.7%
Total	166,064	173,047	172,519	197,242	196,890	905,762	100%

Number of recaptures to date: Tag captures are reported from emigration smolt trapping using rotary screw traps (RST) and post-smolt trawls (PST), and returning adults of one sea winter (1sw) and multiple sea winter (msw) fish from a fish way trap. For the adult return data the 2000, 2001 and 2002 release cohorts were used for the one sea winter fish and the 2000 and 2001 release cohorts used for multiple sea winter fish.

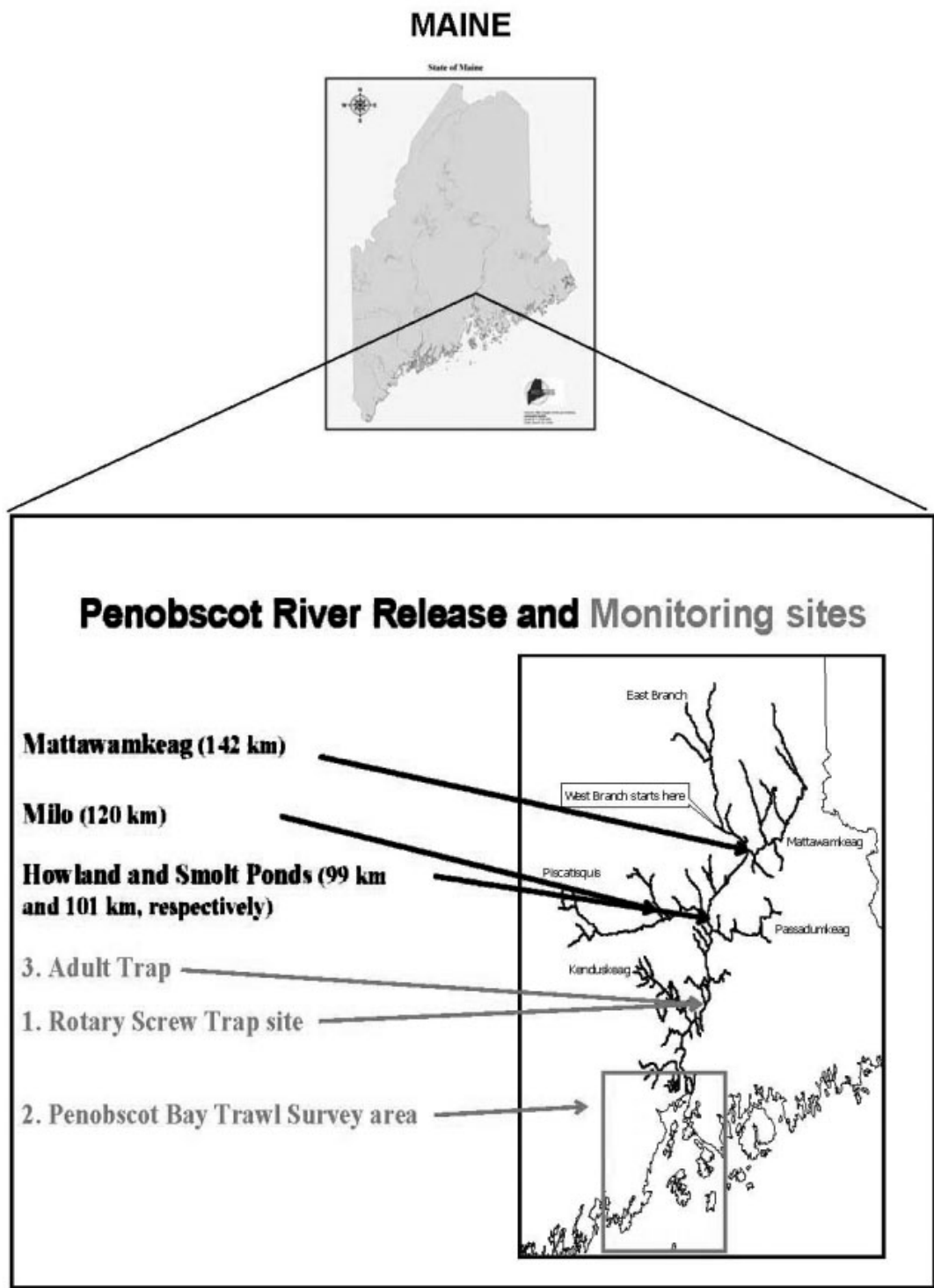
Penobscot Release Group	Emigration Capture				Adult Return Capture	
	2000 – 04 RST (2000 – 04 Cohort)	% of Releases	2001 – 04 PST (2001 – 04 Cohort)	% of Releases	2001 – 03 Adult Trap 1sw/msw/total (1sw: 00 – 02 cohort, msw: 01 and 02 cohort)	% of Releases 1sw/msw
Mattawmkeag – early	210	.17	98	.10	27 / 35 / 62	.04 / .07
Mattawmkeag - late	386	.31	129	.13	19 / 22 / 41	.02 / .04
Milo – early	242	.20	170	.17	30 / 33 / 63	.04 / .07
Milo – late	392	.22	233	.16	14 / 21 / 35	.02 / .04
Howland – early	230	.19	90	.09	45 / 56 / 101	.06 / .11
Howland – late	305	.25	211	.21	13 / 37 / 50	.02 / .08
West Enfield – Smolt Ponds	224	.19	90	.09	18 / 37 / 55	.03 / .09
Total	1989		1021		166/241/407	

Tag retention: Short term tag retention (2 – 20 days after tagging): 98.4% - 98.6%. Long term tag retention (multiple sea winter fish): 79% - 91%. High VIE tag retention/visualization rates have been reported in previous salmonid studies (Kincaid and Calkins 1992; Bryanand Ney 1994; Fitzgerald et al. 2004; Mourning et al. 1994; Niva 1995; Frenette and Bryant 1996; Zerrenner et al.1997; Catalano et al. 2001).

Tag-induced mortality: There has been low tag induced mortality (< 0.02%) over the past three years, some mortalities may be due to the handling of a large number of fish.

Analytical design: Three by two block design with three location blocks and two temporal blocks (early and late). A 7th group is spatially similar to low river release but can migrate volitionally from riverside holding ponds.

Figure 1: Sampling locations in Maine.



8. Atlantic haddock, *Melanogrammus aeglefinus*

Prepared by: Tom Rudolph, Cape Cod Commercial Hook Fishermen's Association

Principal investigators:

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Shelly M.L. Tallack , Gulf of Maine Research Institute (GMRI), Portland, ME	(207) 772-2321 stallack@gmri.org

Technical objectives (prioritized):

- 1) Document and improve understanding of current haddock distribution and movement patterns throughout Gulf of Maine and Georges Bank including pilot work to assess movement between management units and across closed area boundaries.
- 2) Develop a tagging program and related database that builds upon and integrates into the existing centralized infrastructure of the Northeast Regional Cod Tagging Program at the Gulf of Maine Research Institute.

Scientific justification: Ongoing haddock recovery is the most promising news in New England groundfish management, but despite its historical and future importance in our commercial fisheries, movement rates and patterns have not been studied since the 1950's. In particular, movement rates between the Georges Bank and Gulf of Maine management units have not been examined. Furthermore, the apparent importance of closed areas in this recovery invites further analysis of haddock movement in relation to the boundaries. This tagging program is designed to complement current sources of information and contribute to haddock stock assessments.

Tag specifications: Hallprint internal T-Bar anchor tags with program title, toll free return telephone, and website address.

Geographic extent: Two U.S stock areas- Georges Bank (GB) and Gulf of Maine (GOM).

Geographic stratification:

Management Area	Closed Area Deployments	Open Area Deployments	Total Deployments
Georges Bank	5,000	2,000	7,000
Gulf of Maine	2,500	1,000	3,500
Total	7,500	3,000	10,500

Timeframe of releases: Releases are planned for a 12 month period from March 2005 through February 2006.

Seasonality of releases: To the extent possible, deployed equally by quarters throughout the 12 month study period.

Size of fish: Mix of legal (19"+) and sub legal (<19") haddock, predominantly legal, with a minimum size of approximately 14".

Method of initial capture: Commercial demersal longline.

Method of recapture and seasonality: Recaptures from year-round commercial fishery with some seasonal geographic closures and probable Special Access Programs (SAPs) which allow for limited commercial effort in closed areas at certain times.

Reward system: Incentives, likely T-shirts, provided for individuals returning tags.

Outreach methods: Information packages with return envelopes, thank you letters with tagging and recapture information, Toll free telephone number at GMRI functional in US and Canada, website.

Data management: Existing infrastructure at the Gulf of Maine Research Institute for the Northeast Regional Cod Tagging Program (NRCTP) will be used to archive haddock release and recovery data. Considerable time and expense has been invested to date in the development of the NRCTP's online database and GIS mapping interface. However, with relatively minor additions and modifications, the database would also cater to the needs of the proposed study.

The current tagging system allows data to be entered into a standardized tagging database integrated with a Geographic Information System (GIS) after GMRI's Data Management and Quality Control Specialist validates them. This information provides input for the IMS map display. GMRI and Northern Geomatics have 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 after data verification by GMRI. Resources have been allocated to allow for program enhancements to the current cod tagging database by Northern Geomatics to allow for haddock data to be integrated.

Number of releases, by time and geographic area: This program has not yet entered operational period.

Number of recaptures to date: This program has not yet entered operational period.

Tag retention: There are currently no plans to study tag retention within this program.

Tag-induced mortality: There are currently no plans to study tag induced mortality within this program.

Analytical design: Tag recovery data will be analyzed to determine the probability of movement between areas. If tag recaptures indicate movement from one stock area to another, posterior probabilities of haddock movement rates will be estimated using appropriate binomial or multinomial models with uninformative beta or Dirichlet priors and the WINBUGS software for Bayesian data analysis (Congdon, 2001). This approach will provide confidence intervals for movement rates that are easily interpretable by fishery managers. An alternative analysis will be conducted using the MARK software program for analysis of marked individuals with movements among multiple strata (MARK available at: <http://www.cnr.colorstate.edu/~gwhite/mark/mark.htm>). A likelihood-based model of haddock movement rates may also be developed to estimate movement rates if sufficient tag recoveries occur. Model structure will follow standard approaches to account for population dynamics and differences in fishing effort among areas (Hilborn, 1990; McGarvey and Feenstra, 2002).

The average direction and magnitude of haddock movements will be conducted using GIS mapping and spatial analyses to estimate density. These maps and associated analyses will be used to create graphs that show the direction and magnitude of haddock movements to stakeholders in the fishery management process.

Study Area: The study area is presented in Figure I.

Figure I. 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).

