^

Working Paper C.1

Gulf of Maine Research Institute
Science. Education. Community.

WP3A and WP3C

A description of tagging data from the Northeast Regional Cod Tagging Program (WP3A) and preliminary applications of weighting and mixing analysis (WP3C).

DRAFT REPORT:

Submitted to National Marine Fisheries Service,
Pre-GARM working group

PREPARED and SUBMITTED BY:

Shelly Tallack
Program Manager
Gulf of Maine Research Institute
207-228-1639, stallack@gmri.org

Date Submitted:
October 17th 2007

This information is distributed solely for the purpose of pre-dissemination peer review. It has not been formally disseminated by NOAA. It does not represent any final agency determination or policy.

Table of Contents

Table of Contents 2
Acknowledgements 3
Application of this data to the stock assessment 4
1. WP3A - Program background and description of data available to the GARM 5
1.1 Introduction & Background 5
1.2 Collaboration 5
1.3 Data description and characteristics 6
1.3.1 The study area 6
1.3.2 Tag releases 6
1.3.3 Data collected and entered into the online database 9
Trip/vessel information: 9
Haul information: 9
Tagged fish release information: 10
Tag recapture information: 10
Data download options: 10
1.3.4 Tag recaptures 12
1.3.5 Recapture data quality 12
1.3.6 Tag return rates 13
1.3.7 Fish size tagged and recaptured 15
1.3.8 Tag shedding 16
1.3.9 Tagging induced mortality 16
1.3.10 Spawning 16
2. WP3C - Movement and Growth analysis of relevance to the GARM 17
2.1 Analysis of raw movement data 17
2.2 Analysis of weighted movement data 20
2.2.1 Weighting of releases 20
2.2.2 Weighting of recaptures 21
Exploitation 21
Reporting rates 21
2.2.3 Resolution of analysis 21
2.2.4 Model outputs 22
2.2.5 Mixing rates summarized by Management area 26
2.2.6 Mixing rates summarized by Statistical square 28
2.3 Growth 30
Discussion 31
References 31
ANNEX 1 - The spatial scales used for analysis 32
ANNEX 2 – Analysis at Management Area resolution. 33
A. Release data pooled for 2003-2005 and recapture data pooled for 2003-2007. 33
B. Released and recaptured in 2003. 35
C. Released and recaptured in 2004. 37
D. Released and recaptured in 2005. 39
E. Cod released at 53cm (21”) or larger, data pooled for 2003-2007. 41
F. Cod released smaller than 53cm (21”), data pooled for 2003-2007. 43
ANNEX 3 - Analysis at Statistical Square resolution. 45
G. Release data pooled for 2003-2005 and recapture data pooled for 2003-2007. 45
H. Released and recaptured in 2003. 49
I. Released and recaptured in 2004. 53
J. Released and recaptured in 2005. 57

Acknowledgements

The Northeast Regional Cod Tagging Program has been a highly collaborative effort since its commencement in January 2003, and also during the earlier planning phases. In the interest of space, a complete list of Program Partners and collaborators has not been included here, but the following are particularly acknowledged for their input over time.

Within GMRI: Patricia Foote, Sarah Whitford, Laura Taylor-Singer, Don Perkins and John Annala.

Regional Program Coordinators: Don Clark (DFO), Ben Neal (Island Institute), Kevin Kelly and team (Maine DMR), Tom Rudolph (CCCHFA), and Rodney Rountree and team (SMAST).

Collaborating fishermen throughout the region: Over 250 fishermen actively participated in releasing tagged cod, in addition to ~30 tagging technicians, and ~1000 tag reporters (fishermen, fish processors and observers).

Analytical support: Mark Terceiro, Ralph Mayo, Loretta O'Brien Gary Shepherd and Tim Miller (Northeast Fisheries Science Center, Woods Hole, Massachusetts), Don Clark (Canada Department of Fisheries and Oceans, St. Andrews, New Brunswick, CA), Steven Cadrin (NOAA/CMER Director, School for Marine Sciences, UMASS, Dartmouth, Massachusetts) and Alistair Hobday (CSIRO & University of Tasmania, Hobart, Tasmania).

Database development: Bill Duffy, Tom Lynch, Stony Lohr, Jason Sardano, Cindy Eick (Northern Geomantics, Hallowell, Maine).

Application of this data to the stock assessment

During 2005, it was recognized that the Northeast Regional Cod Tagging Program's large, quality-controlled database had the potential for real management application, particularly with regard to stock identification through estimates of mixing and growth. Two core assumptions when defining a stock are that the stock is self-sustaining and that neighboring stocks exist in isolation.

As the bank of recapture data has increased, inter-annual trends have been demonstrated which have enabled a descriptive depiction of "passages of travel" for Atlantic cod in the Gulf of Maine region. These migration patterns appear to substantially violate both core stock definition assumptions, but this can only be verified through also producing a more quantitative output. Of the movements observed, some were anticipated; e.g. exchanges of fully recruited cod between the Bay of Fundy (Canada) and Georges Bank (US). However, a more surprising split in migration patterns has been observed where smaller cod appear to recruit from the Cape Cod nearshore waters and migrate either: 1) northwards into the inshore Gulf of Maine waters, or 2) eastwards out onto Georges Bank. This divergence in migration patterns is not currently accounted for in the current stock assessment models.

This report is specifically relevant to the following Terms of Reference for the GARM Data Meeting:

C. Tagging Data for Yellowtail Flounder, Cod, and Haddock.

1. Do results of tagging experiments support existing stock definitions for cod and yellowtail flounder?
2. Can migrations among stock areas be quantified?
3. Develop appropriate analytical models for estimation of migration and fishing mortality
5. Consider sources of uncertainty, particularly tag reporting rates, and commercial fishing effort.
6. Consider use of tagging data to "inform" stock assessment.

This report is formatted into two primary sections:

1) WP3A - Program background and description of cod tagging data available to the GARM.
2) WP3C - Movement and Growth analysis of relevance to the GARM.

1. WP3A - Program background and description of data available to the GARM

1.1 Introduction & Background

The Northeast Regional Cod Tagging Program (NRCTP), was initiated in 2003 as a large-scale, international collaborative tagging program which would extend throughout the international Gulf of Maine region. Since 2003, the Gulf of Maine Research Institute (GMRI) has managed a partnership of eight different research organizations and over 250 fishermen along the Northeast seaboard of the US and Canada. By June 2006, this large, internationally collaborative Program had achieved its original key objectives:

(1) Develop a collaborative cod tagging program between scientists and fishermen in the Gulf of Maine region, including Canada;

(2) Obtain and analyze data from T-bar tag recaptures to improve our understanding of cod distribution, movement and growth;

(3) Make the tagging data available to the public via an online GIS mapping interface; and

(4) Establish a preliminary understanding of cod movements and stock structure that will identify testable hypotheses for continuing tagging studies.

A final report for work and data collected from 2003-2006 is available online at: http://www.codresearch.org/GMRI_Final_Report_2003-2006.htm. GMRI's current goals are to deliver the Program's data to NOAA in a format which is applicable to future stock assessments. This includes:

(1) Undertaking relevant movement analysis to provide estimates of stock mixing and exchange;

(2) Consolidating and reformatting data from three additional recent 'historical' cod tagging studies (UNH, SMAST & DFO) into the NRCTP's database format for delivery to NOAA; these studies combined total 67,554 cod releases and 3,617 recaptures;

(3) Re-engaging stakeholder groups with the analysis progress and inviting their feedback over the course of two Industry-Science workshops.

1.2 Collaboration

The NRCTP has been collaborative from the outset with both stakeholder and scientist involvement and participation in defining the Program's objectives, methodology, in addition to reviewing the findings and providing feedback on future analyses. This level of collaboration has been achieved through a variety of local and regional meetings geared towards tagging training, program reviews and presentation of analyses. All major meetings and workshops have been documented and the summaries are available online as follows:

- Annual and semi-annual meeting summaries
http://www.codresearch.org/Updates_Meeting_summaries.htm;

- Proceedings from "A workshop to review and evaluate the design and utility of fish mark-recapture projects in the Northeast US"
http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0502/;

- Two-part Industry-Science Workshops (March and June 2007)
http://www.codresearch.org/IndustryScienceWorkshop.htm.

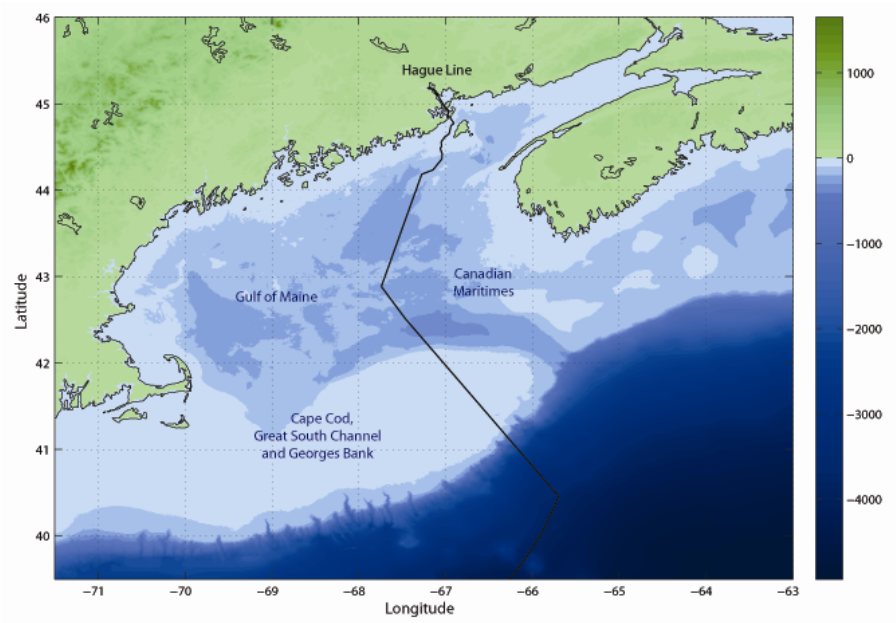
1.3 Data description and characteristics

Between April 2003 and July 2005 over 114,000 cod were T-bar tagged on over 100 commercial and recreational vessels, during dedicated tagging trips in both US and Canadian waters. By October 2007, recapture information has been received by GMRI for over 5% of the tagged cod releases. Following is further discussion on the nature of the tagging data available; additional detail is also available in GMRI's Final Report (http://www.codresearch.org/GMRI_Final_Report_2003-2006.htm) and in the database dictionary (available from GMRI).

1.3.1 The study area

The study area of the NRCTP includes the Gulf of Maine in addition to Southern New England Waters (Cape Cod, Great South Channel and Georges Bank) and the Canadian Maritimes, particularly Browns Bank and the Bay of Fundy (Figure 1). Each tagging organization targeted fishing grounds which have been traditionally considered key spawning and/or feeding grounds, or were for other reasons believed to be of interest with regard to the movement of Atlantic cod.

Figure 1: The study area for the NRCTP covered the Gulf of Maine and neighboring Southern New England and Canadian Maritime waters.



1.3.2 Tag releases

The original target for the NRCTP was to tag and release ~100,000 Atlantic cod throughout the study area, in key fishing and historical spawning areas as proposed by the New England Aquarium Final report (NEAQ, 2001) and as defined by each tagging organization in their respective contracts with the CRPP. By the end of July 2005, a total of 114,473 Atlantic cod had been released in total.

The tags applied in this study were Hallprint T-bar anchor tags (TBA-2) and three colors were deployed. Regular or 'low' reward (LR) tags were yellow and orange (from the earlier DFO study) and 'high' reward tags (HR) worth $100 were blue (Figure 2). A total of 18,305 (15.9%) cod were also double-tagged to enable the estimation of tag loss, or tag shedding. The distribution of these different tag types can be seen in Figure 3.

Figure 2: The Hallprint T-bar anchor tags deployed during this study; regular yellow tags, DFO orange tags and blue high-reward tags.

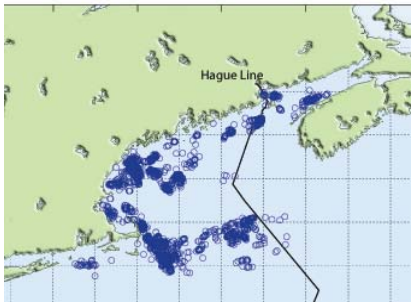
The primary tag release years were 2003 and 2004, with only 5.4% of the total being released in 2005 (Table 1). Of the fish tagged, 95.7% were tagged with yellow tags, 2.3% with DFO's orange tags and 1.9% with high-reward (blue) tags. The orange (DFO) tags were released by DMR and DFO in both US and Canadian waters to check for any difference in reporting rates of yellow versus orange tags by Americans and Canadians (since the orange tags had been associated with a different program and a different reward scheme which also no longer had funds to continue rewarding with incentives other than tag recapture reports).

Table 1: Tagged cod releases by calendar year.

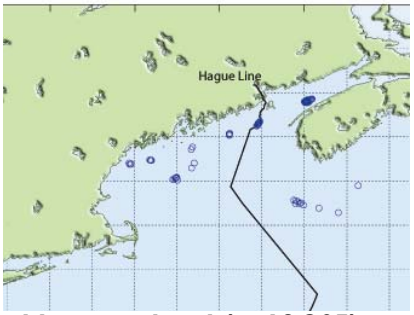
Tag type	2003	2004	2005
Single-tagged total	43,133	50,857	2,178
Double-tagged total	4,359	9,855	4,091
Single - yellow	40,672	49,131	1,667
Double – yellow	4,141	9,852	4,091
Single – orange (DFO)	2,461	0	0
Double – orange (DFO)	220	0	0
Low-reward tagged	47,492	58,983	5,758
High-reward tagged	0	1,729	511
Total releases	**47,492**	**60,712**	**6,269**
Grand total	**114,473**		

Figure 3: The distribution of cod tagged using (A) the regular yellow tags (n=109,554), (B) DFO's orange tags (n=2,681), (C) blue high-reward tags (n=2,240) and (D) double-tagged cod (n=18,305).

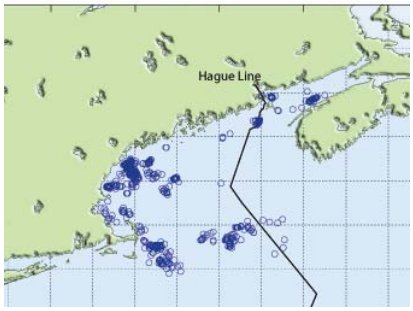
A) Yellow single-tagged cod (n=109,554)



B) DFO orange tagged cod (n=2,681)



C) Blue high-reward tagged cod (n=2,240)



D) Double-tagged cod (n=18,305)

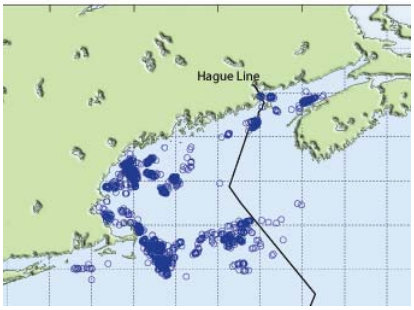


Table 2 presents the number of tagged cod released by stock Management Area (MA). Georges Bank (MA 5Z) received the most tags (n=80,230), followed by the Gulf of Maine area (MA 5Y) (n=25,515) and finally Canadian waters (MA 4X) (n=8,467). Table 3 presents the releases by year in terms of location, as categorized by the NAFO 3-digit Statistical Squares (SS). The top five statistical squares for cod releases (in order) were 521, 513, 561, 522 and 466.

Table 2: Tagged cod releases categorized by Stock Management Area.

Management Area	2003	2004	2005	Total
US-GOM (5Z)	10358	10930	4227	**25515**
US-GB (5Y)	30500	47730	2000	**80230**
CA (4X)	6408	2017	42	**8467**
Total	**47266**	**60677**	**6269**	**114212**

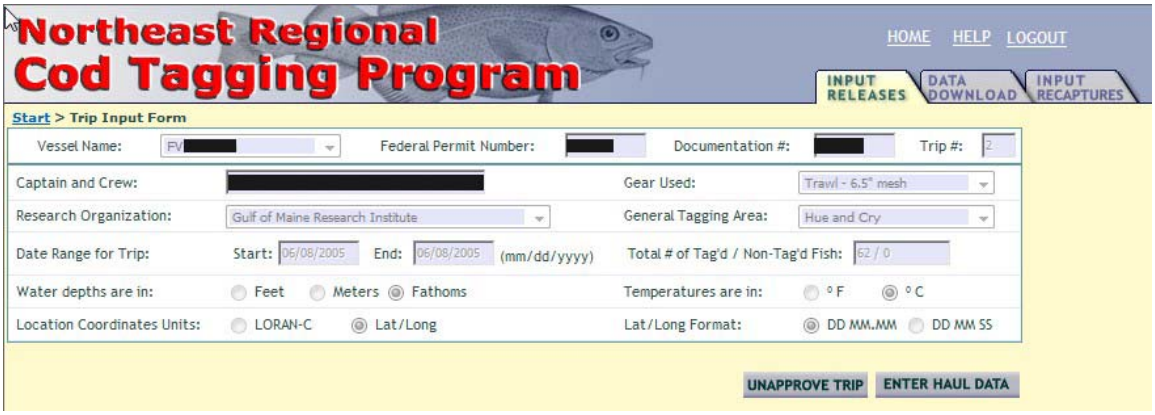
Table 3: Tagged cod releases categorized by NAFO 3-digit statistical squares (SS).

SS	2003	2004	2005	Total
461	0	0	0	**0**
462	6	0	0	**6**
463	0	0	0	**0**
464	83	0	0	**83**
465	0	0	0	**0**
466	3670	1225	14	**4909**
467	1020	628	14	**1662**
511	2085	336	0	**2421**
512	200	102	0	**302**
513	8065	8356	3980	**20401**
514	0	1453	247	**1700**
515	1586	812	0	**2398**
521	23039	34476	1087	**58602**
522	1875	3384	11	**5270**
525	597	3	0	**600**
526	729	403	0	**1132**
533	0	0	0	**0**
534	0	0	0	**0**
537	59	201	79	**339**
538	0	0	0	**0**
539	0	81	284	**365**
541	0	0	0	**0**
542	0	0	0	**0**
543	0	0	0	**0**
551	0	0	119	**119**
552	0	0	47	**47**
561	1635	8205	6	**9846**
562	2565	882	367	**3814**
611	0	0	0	**0**
612	0	0	0	**0**
613	0	0	0	**0**
614	0	0	0	**0**
615	0	0	0	**0**
616	0	0	0	**0**
621	0	0	0	**0**
622	0	0	0	**0**
623	0	0	0	**0**
624	0	0	0	**0**
Total	**47214**	**60677**	**6269**	**114212**

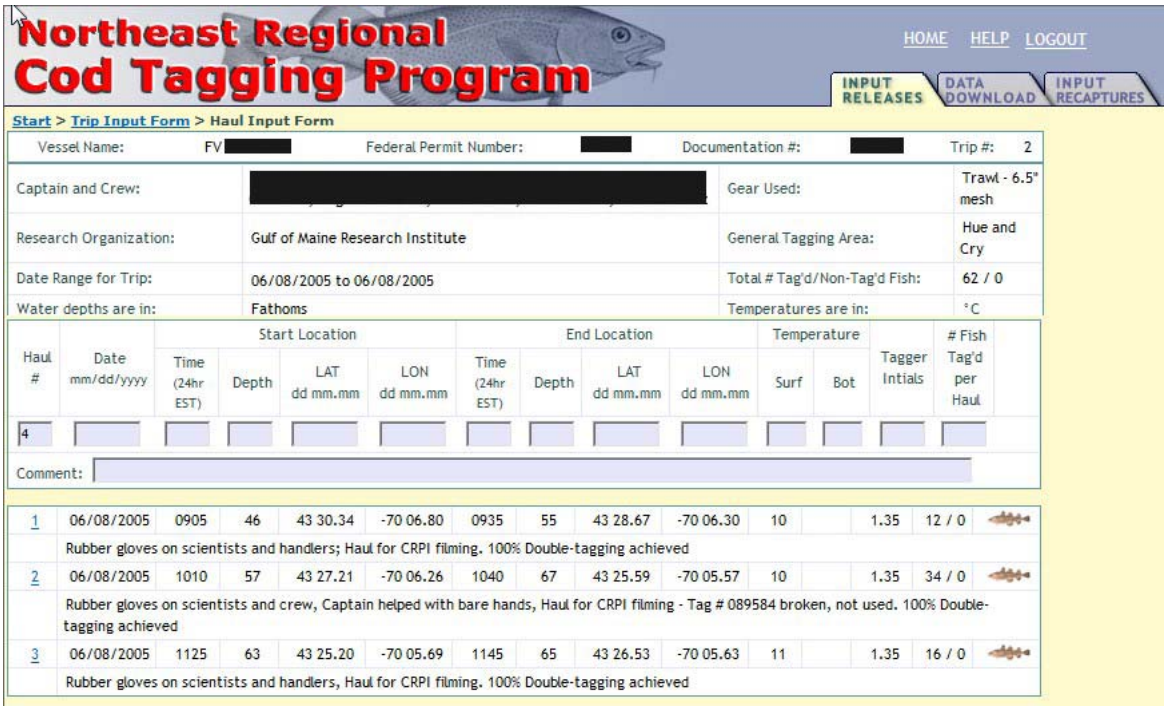
1.3.3 Data collected and entered into the online database

The data collected at release and recapture is exemplified via the following screenshots from the online database. Additional tables are also provided here to show the data available for fish/tag fate (Table 4), gear type used (Table 6) and closed/open status of tag release location (Table 5).

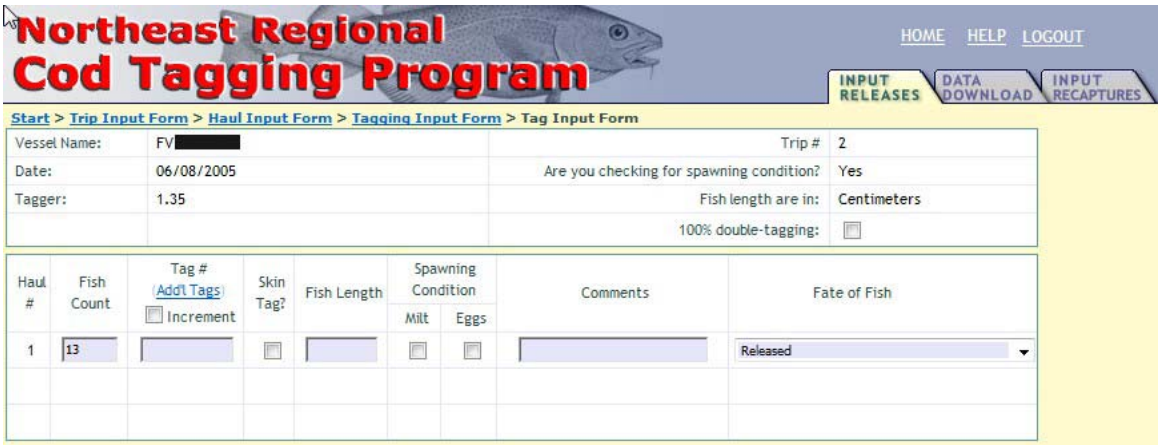
Trip/vessel information:



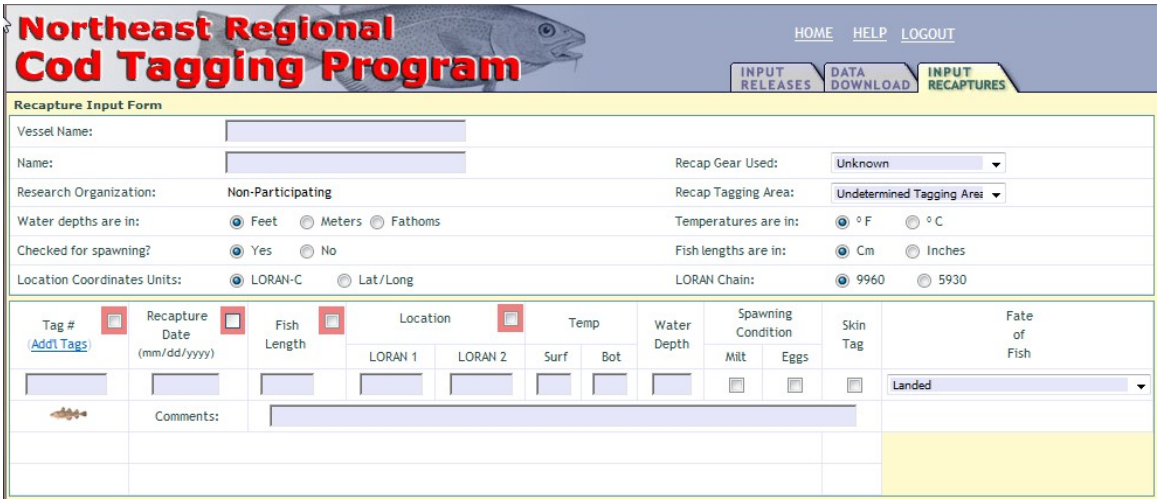
Haul information:



Tagged fish release information:



Tag recapture information:



Data download options:

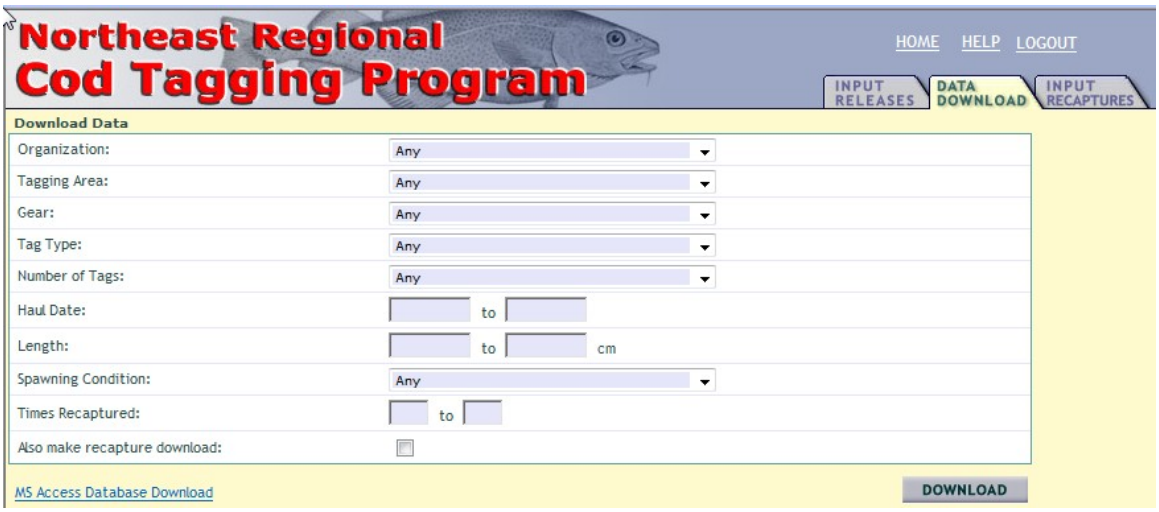


Table 4: Fish fates recorded at release and/or recapture.

FATE_ID	NAME
1	Landed
2	Released
3	Floater
9	Floater ?
13	Gutted
14	Dead
15	Re-released - no tag
16	Re-released - with old tag
17	Re-released - with old tag & new tag
18	Re-released - with new tag, old tag removed
19	Wrong species
20	Re-released - no tag - floater(?)
21	Re-released - with tag - floater(?)
22	Re-released - no tag - surface attack
23	Re-released - with tag - surface attack
24	Dissected
25	Surface attack
26	Unknown

Table 5: Closure area status recorded at tag release.

CLOSURE_AREA_ID	NAME
1	No Closure Area
2	Cashes CA
3	Western GOM CA
4	CA I
5	CA II
6	Nantucket Lightship CA

Table 6: Gear types recorded at release and/or recapture.

GEAR_CATEGORY_ID	NAME
1	Unknown
2	Hook
3	Trawl
4	Gillnet
5	Trap
6	Other

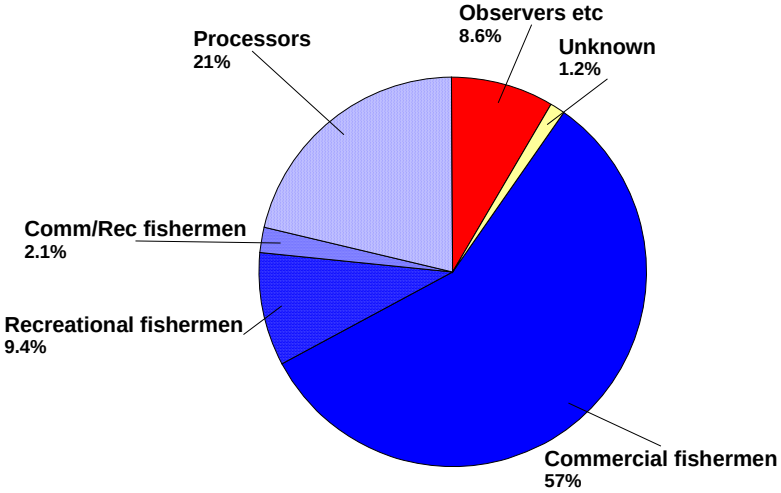
GEAR_ID	NAME	GEAR_CATEGORY_ID
1	Unknown	1
8	Hook & LL	2
25	Handgear	2
26	ERR	2
27	MRR	2
28	ERR/Handline	2
29	ERR/MRR	2
30	LL/Handgear	2
31	Handline	2
32	LL	2
33	Hook - Not specified	2
11	Trawl - 5" mesh	3
12	Trawl - 5.5" mesh	3
13	Trawl - 6" mesh	3
14	Trawl - 6.5" mesh	3
15	Trawl	3
20	Gillnet	4
16	Lobster Trap - Single	5
17	Lobster Trap - Multiple	5
18	Fish Trap - Single	5
19	Fish Trap - Multiple	5
34	Purse Seine	6
35	Scallop dredge	6

1.3.4 Tag recaptures

Two types of tag returns are referred to in this report: 1) NPO recaptures (from Non-Participating Organizations, i.e. not Program Partners), and 2) TO recaptures (Tagging Organization recaptures, i.e. tagged cod which have been recaptured during tagging trips). If a participating tagging vessel reported a tagged cod which was not caught during a tagging trip, this recapture is considered as an NPO recapture.

The majority (70%) of NPO recaptures have been reported by fishermen; specifically, commercial fishermen have reported 57% of all NPO recaptures, while charter vessel owners who also hold commercial permits (commercial/recreational fishermen) have reported 2% and recreational fishermen have reported an additional 9% (Figure 4). The remainder of NPO recaptures can be attributed to observers, port samplers and non-partner researchers (9%), and fish processing plants and markets have reported 21%. A small proportion of NPO recaptures (1%) were reported by individuals who did not divulge their occupation.

Figure 4: Tag reporting by source.



Recapture data presented comes from a total 752 vessels for which a vessel name was given; in addition, 1,139 tags were reported without vessel identification information. Gear type was recorded for 91.2% of the tag recaptures and is spread across gear categories as shown in Table 7.

Table 7: Releases and recaptures by gear type.

	Comm. Hook	Trawl	Gillnet	Trap	Other	Rec. Hook	Unknown
Releases	62540	51645	32	256	0	*	0
Recaptures (by release gear)	2711	3858	1	18	0	*	0
% **Recaptures** (by release gear)	**54.6%**	**45.1%**	**0.0%**	**0.2%**	**0.0%**	*	**0.0%**
Recaptures (by recapture gear)	1123	3384	865	26	3	668	519
% **Recaptures** (by recapture gear)	**17.0%**	**51.4%**	**13.1%**	**0.4%**	**0.0%**	**10.1%**	**7.9%**

* For releases, Recreational Hook gear is included in Commercial Hook gear

1.3.5 Recapture data quality

Recapture data are categorized for quality as "full", "approximate", "vague" or "none"; examples for each category are presented in Table 8. Overall the four key pieces of recapture information (tag #, date, fish length and location) are reported in "full" for a high proportion (78-100%) of recaptures reported, to the best of GMRI's knowledge (Table 9).

Table 8: Examples of recapture data quality (through June 2006).

	Data quality categories			
	Full	**Approx.**	**Vague**	**None**
Tag #	123456	n/a	n/a	n/a
Date	20th March 2004	First week of March 2004	Sometime in March 2004	No date given
Location	Lat/Lon	Lat/Lon app.	Georges Bank	None
Fish length	56cm	~56cm	Legal sized	None
Spawning noted	Eggs/milt/none	n/a	n/a	None
Water depth	50 fa	~50 fa	Pretty deep	None
Water temperature	56 deg	~56 deg	Cold!	None
Gear type	Hook	n/a	n/a	None

Table 9: Estimates of recapture data quality (through June 06).

n=5,236	Proportion of recaptures			
	Full	**Approx.**	**Vague**	**None**
Tag #	100.0%	-	-	-
Date	87.8%	4.6%	5.6%	2.0%
Location	78.2%	11.6%	1.1%	9.2%
Fish length	78.9%	4.4%	1.6%	15.1%
Spawning noted	10.1%	-	-	89.9%
Water depth	67.0%	4.3%	0.0%	28.7%
Water temperature	32.4%	0.7%	0.1%	66.9%
Gear type	91.6%	-	-	8.4%

1.3.6 Tag return rates

Tag returns are dependent on 1) fishermen's awareness of the program, 2) tag detection, 3) the geographic distribution of tagging effort relative to biomass and relative to fishing effort, and 4) compliance to report tags and good recapture information (this varies greatly from individual to individual). Tag returns also vary by season and for cod, the peak tag return periods have tended to be the summer and into the fall after peak recaptures in the spring and summer.

By October 2007, the returns for all tag types combined (NPOs and TOs) total at ~5.6% and GMRI continues to receive a reduced, but steady flow of tag recapture information (Table 10). The total proportion of high-reward tags returned is more than double (11.7%) that of low-reward (i.e. regular reward) tags (5.0%) and this data is used to calculate reporting rates by area (see page 21).

Table 10: The NPO tag returns for each year's releases, by tag type: Low-reward tags (LR) and High-reward (blue) tags (HR). A decay in tag returns is seen after about two years at large. Note that recaptures for 2007 represent just 9 months of the year.

Release year		**Recapture years**					
LR tags	**Releases**	**2003**	**2004**	**2005**	**2006**	**2007**	**Total**
2003	47492	1.8%	2.3%	0.9%	0.2%	0.1%	**5.3%**
2004	58983	0.0%	1.7%	1.9%	0.7%	0.2%	**4.5%**
2005	5758	0.0%	0.0%	4.2%	3.2%	0.5%	**7.9%**
Total	**112233**	**0.8%**	**1.8%**	**1.6%**	**0.6%**	**0.2%**	**5.0%**
HR tags	**Releases**	**2003**	**2004**	**2005**	**2006**	**2007**	**Total**
2003	0	-	-	-	-	-	**-**
2004	1729	0.0%	4.5%	4.1%	1.7%	0.1%	**10.4%**
2005	511	0.0%	0.0%	10.0%	4.7%	1.2%	**15.9%**
Total	**2240**	**0.0%**	**3.4%**	**5.4%**	**2.4%**	**0.4%**	**11.7%**

Return rates are calculated from those fish which have been both released and recaptured in the same area so that the rate is relative to the number of tagged releases. Differences in NPO return rates by Stock Management Area are apparent (Table 11). The highest return rates are seen for fish released in 4X with a total return rate of 9.6% by Oct 2007; this is ~2 times higher than 5Y (4.9%) and ~3 times higher than 5Z (2.9%). Recaptures from fish released in 5Y are ~2 times higher than for cod released and recaptured in 5Z.

Analysis of return rates on a finer resolution (Table 12) (e.g. General Fishing Areas as defined in ANNEX 1), shows which areas most strongly impact the return rates observed for the Management Areas. [**Note:** low return rates may be due to reporting compliance issues, but may also be caused by emigration, mortality or lack of tag detection.]

Table 11: Return rates (LR tags) for Stock Management Areas between March 2003 and October 2007.

Management Areas	Total releases	Recaptures reported from this area (released anywhere)	Releases which have been recaptured (recaptured anywhere)	Recaptures both released and recaptured in this area	% Recaptures both released and recaptured in this area	Overall return rate
US-GOM (5Z)	**24324**	1558	1449	**1194**	82.4%	4.9%
US-GB (5Y)	**79386**	2448	3249	**2339**	72.0%	2.9%
CA (4X)	**8267**	999	895	**793**	88.6%	9.6%

Table 12: Reporting rates for General Fishing Areas between March 2003 and October 2007.

General Areas	Total releases	Recaptures reported from this area (released anywhere)	Releases which have been recaptured (recaptured anywhere)	Recaptures both released and recaptured in this area	% Recaptures both released and recaptured in this area	Overall return rate
Bay of Fundy	6939	691	809	603	74.54%	8.69%
CA GOM	78	171	0	0	-	-
George's Basin	1	144	0	0	-	-
Brown's Bank	5	14	0	0	-	-
CA Eastern Waters	6	10	0	0	-	-
Georges Bank	18902	799	973	626	64.34%	3.31%
Cape Cod & Great South Channel	55982	1058	2107	1004	47.65%	1.79%
Downeast Maine	2479	25	124	9	7.26%	0.36%
Inshore GOM	18576	964	1221	852	69.78%	4.59%
Wilkinson Basin	1558	487	69	47	68.12%	3.02%
Central GOM	3374	149	133	48	36.09%	1.42%
Jordan Basin	10	20	0	0	-	-
W. Cape Cod & Coxes	5626	437	209	102	48.80%	1.81%
S. New England	705	96	41	38	92.68%	5.39%

1.3.7 Fish size tagged and recaptured

The NRCTP tagged fish across a size range of 28-134cm; the target minimum was 38cm and no maximum was set. The size-frequency distributions of cod tagged varied by stock management area; the largest fish were tagged in the Gulf of Maine (Area 5Y) with a modal size of 66cm, and the smallest fish were tagged in Georges Bank (Area 5Z) with a modal size of 48cm.

Return rates calculated for tagged cod categorized by release size in 10cm bins (Table 13) show the return rate is positively related to the size at release until the larger cod sizes (Figure 5) and this difference in return rates is significant (χ^2=669.698, d.f.=8, p<0.001). Possible explanations for this pattern include:

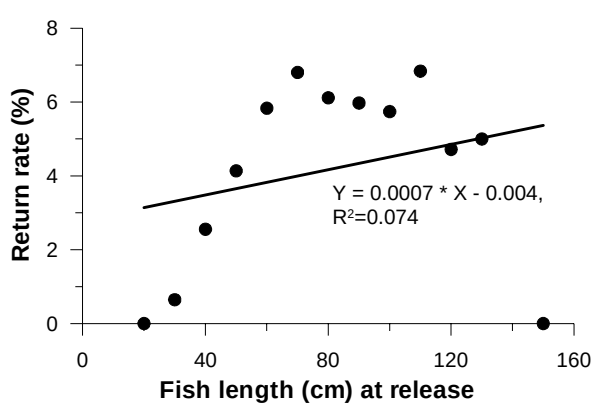
- Poor survivability of small fish tagged;
- Catchability effects;
- Fishing effort – fishermen are likely to focus on fishing grounds where they expect the catch to be of legal size.

Table 13: Chi-square analysis on recapture rates of LR tagged fish grouped by release size: larger fish are significantly more likely to be reported (χ^2=669.698, d.f.=8, p<0.001).

Release size (cm)	No. Releases	No. Observed Recaptures	Observed return rate	No. Expected recaptures	Chi-result
20-29*	*	*	*	*	*
30-39*	*	*	*	*	*
20-49*	19852	501	2.52%	1018	262.322*
50-59	37088	1511	4.07%	1901	80.106
60-69	28026	1700	6.07%	1437	48.251
70-79	17760	1311	7.38%	910	176.233
80-89	7228	518	7.17%	371	58.691
90-99	2980	226	7.58%	153	35.109
100-109	958	62	6.47%	49	3.383
110-119	351	28	7.98%	18	5.565
120-159*	127	6	4.72%	7	0.040*
130-139*	*	*	*	*	*
140-149*	*	*	*	*	*
150-159*	*	*	*	*	*
Totals	**114370**	**5583**	**4.9%**		**669.698**

* = Chi-result reflects data pooled with adjacent groups until a minimum of 5 observations per cell is seen

Figure 5: The relationship between the size at release and recapture rates for tagged cod.



1.3.8 Tag shedding

By July 2005, a total of 18,305 cod had been "double-tagged" in order to enable an estimate of tag loss/shedding. The current estimate for the proportion of tagged cod which have lost or shed a tag is ~15% across all tag types. This result has been obtained by calculating the proportion of double-tagged cod which have been recaptured with only one tag reported. If this shedding rate is representative of the 96,168 single-tagged cod which the NRCTP has tagged (yellow, orange and blue tags combined) and released, then ~15% of single-tagged cod may also have lost their only tag. Thus, the total number of single-tagged cod likely to have remained in the sample for recapture becomes ~81,166; i.e. a reduction of ~15,000 fish. This shedding rate estimate is applied during the mixing/weighting analysis (see page 20).

1.3.9 Tagging induced mortality

The NRCTP did not have funds available to initiate a tag-induced mortality study, though the need for this was discussed often during the first two years of the Program. Attempts to secure additional funding for this were not successful and as a result the Program's estimates of tag-induced mortality come from: 1) the literature from other tagging studies on cod, and 2) a small number of samples from the current study which were studied as part of a juvenile mortality assessment from hook gear (undertaken by CCCHFA). An averaged tagging-induced mortality rate of 9% is applied during the mixing/weighting analysis (see page 20).

1.3.10 Spawning

Out of a total of 114,473 tagged cod, very few spawning fish were observed despite fishing on spawning grounds during anticipated spawning periods (which vary by region). By July 2005, milt or eggs had been observed for 1,374 releases, and by June 2006, 63 of these fish had been recaptured. It is unlikely that this data alone will tell us much about the spawning migrations of cod throughout the region.

In recaptures, spawning information has been noted in 9% of NPO recaptures. Of these fish, ~6% have been noted as extruding milt and ~3% have been noted for eggs; ~1% have indicated that spawning was not evident. Varying degrees of detail are provided, but spawning information from NPOs is subjective and not always reliable.

2. WP3C - Movement and Growth analysis of relevance to the GARM

During 2005, it was recognized that this Program's large, quality-controlled database had the potential for real management application, particularly with regard to stock identification. Two core assumptions when defining a stock are that the stock is self-sustaining and that neighboring stocks exist in isolation.

As the bank of recapture data has increased, inter-annual trends have been demonstrated which have enabled a descriptive depiction of "passages of travel" for Atlantic cod in the Gulf of Maine region. These migration patterns appear to substantially violate both core stock definition assumptions, but this can only be verified through also producing a more quantitative output.

Of the movements observed, some were anticipated; e.g. exchanges of fully recruited cod between the Bay of Fundy (Canada) and Georges Bank (US). However, a more surprising split in migration patterns has been observed where smaller cod appear to recruit from the Cape Cod nearshore waters and migrate either: 1) northwards into the inshore Gulf of Maine waters, or 2) eastwards out onto Georges Bank. This divergence in migration patterns is not currently accounted for in the current stock assessment models.

Analysis to date has taken two approaches: 1) analysis of raw data with the aim of improving our understanding of how Atlantic cod are migrating throughout the Gulf of Maine region, and 2) analysis of weighted data with the aim of providing estimates of emigration, immigration and net exchange between stock management/assessment areas.

2.1 Analysis of raw movement data

A regional snapshot of the movements seen to date is presented in Figure 6. This figure, in its raw, un-weighted and unfiltered state is highly vulnerable to misinterpretation. Some key factors to consider when interpreting movement patterns and migrations include: release season, fish size, and time at large in addition to the number of recaptures relative to the number of releases, biomass estimates for each location and also fishing effort.

Movement analysis on raw data initially focused on descriptive visualization of cod movements in terms of:

- Displacement & distance traveled
- Direction of travel
- Size effects
- Differences between release locations
- Seasonal effects
- Identification of homing movements

These analyses indicate exchanges between the different areas which appear to be related to spawning behavior, maturation and environmental conditions. Through these analyses, it has been possible to generate a descriptive/qualitative depiction of the migration corridors or "passages of travel" for cod in the Gulf of Maine region (Figure 7).

Figure 6: An overview of the movement indicated to date, from >6,500 recaptures (http://www.gmamapping.org/codmapping).

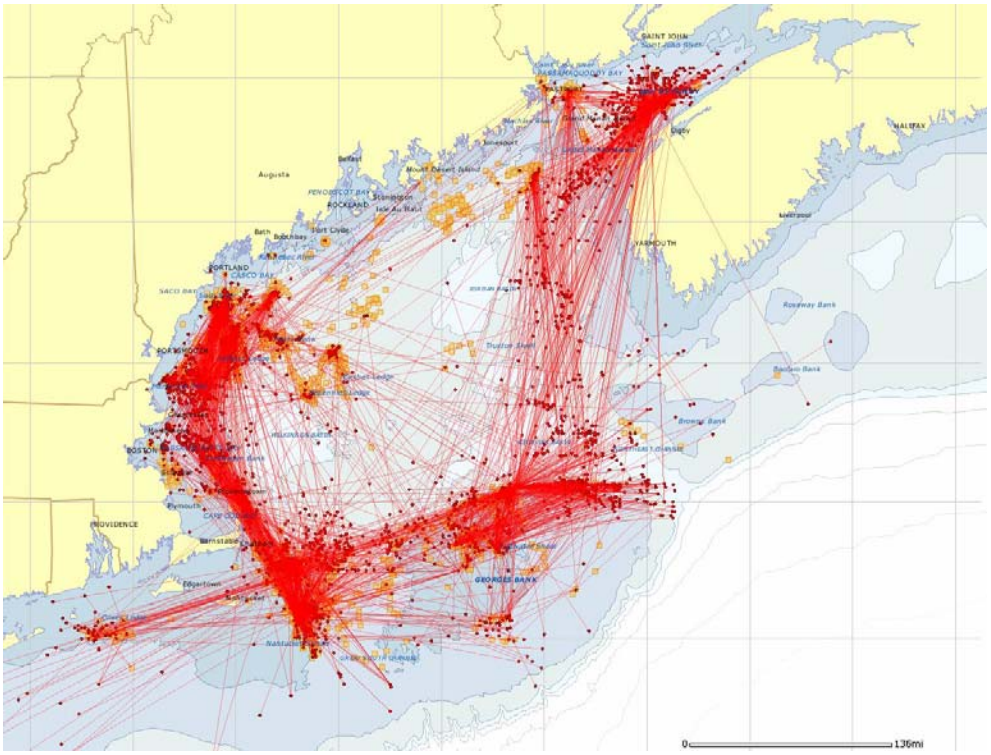
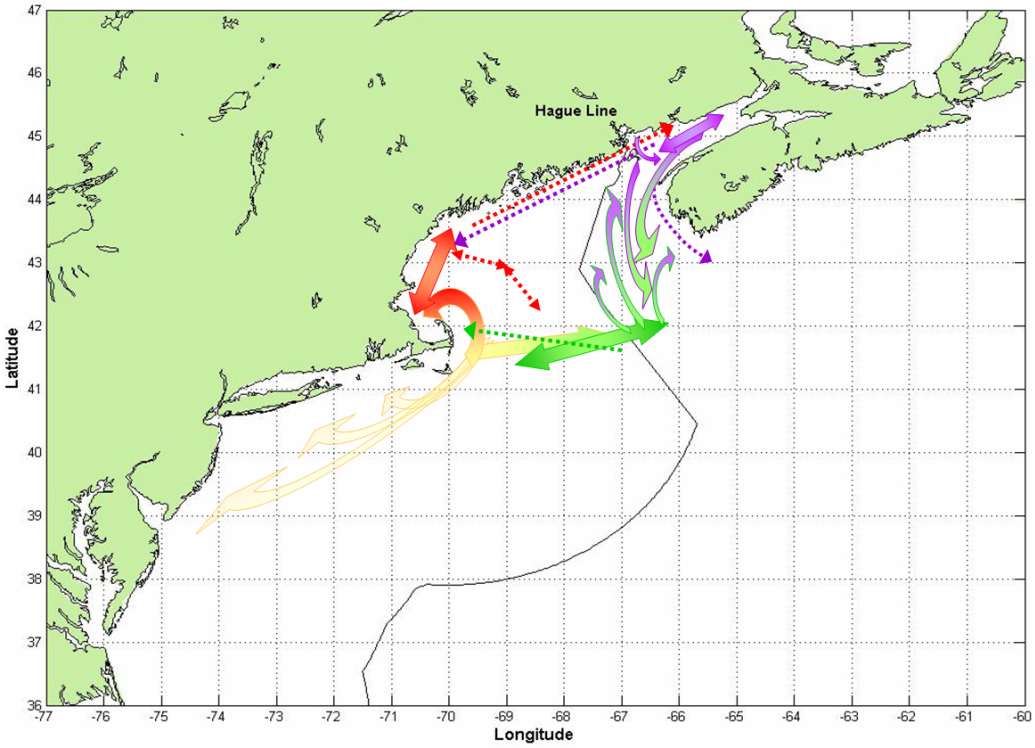


Figure 7: The proposed "passages of travel" for Atlantic cod movement based on analysis of raw mark-recapture data collected between 2003 and 2007. The area of prime concern is the Cape Cod area which apparently feeds both Georges Bank and the Western Gulf of Maine, but is currently considered as 5Z stock.



2.2 Analysis of weighted movement data

Providing estimates of exchange rates of cod between management areas was not an original goal for the NRCTP, and as such, considerable effort has been invested in developing a weighting method which can correct for all potential biases on the quantification and interpretation of the movements observed. A depiction of weighting needs is summarized in Figure 8.

For tag releases potential biases include: biomass present in a release area, tag loss/shedding and tag-induced mortality estimates and how these impact the expected number of recaptures. For tag recaptures, potential biases include: fishing effort and landings by tagging area, in addition to reporting rates by gear type and by tagging area.

The tailor-made weighting method being applied is based on methods described by Hunt et al (1999). The model has evolved into a complex weighting procedure with five different weighting outputs (Table 14).

Figure 8: The components which are involved in weighting tag releases and tag recaptures for the NRCTP data.

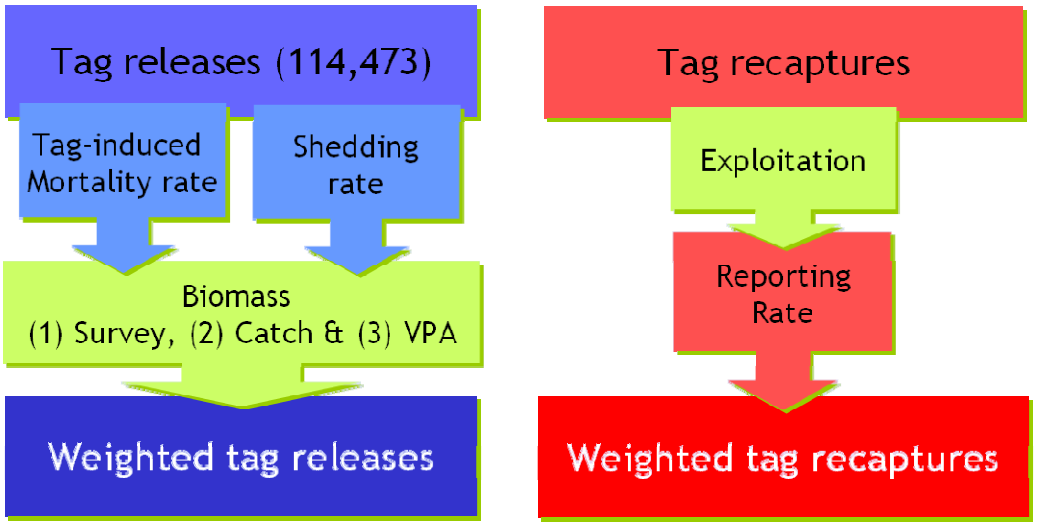


Table 14: The five different weighting scenarios.

Weighting Scenario	Releases	Recaptures
RAW (Unweighted observations)	-	-
RAW (Weighted recaptures only)	-	F* and RR
Weighted - Survey (Biomass*)	Swept area biomass	F* and RR
Weighted - Fishing (Catch)	Catch/VPA F	F* and RR
Weighted - VPA (Biomass)	VPA biomass	F* and RR

* = VPA derived F (instantaneous fishing mortality)

2.2.1 Weighting of releases

Tag releases are first 'corrected' by removing from the sample the estimated numbers of fish which will have likely shed their tag, or may have died during the tagging process (see page 16). For either of these fates, these fish are effectively removed from the sample since they are unlikely to be recaptured and reported.

Since the NRCTP did not structure its release quantities relative to the estimated biomass in a given tagging area, the tag releases must also be weighted to take into account relative cod abundance. It

was decided to proceed with three different estimates of biomass: one based on fishery-independent data (i.e. the groundfish survey), one based on fishery-dependent data (i.e. landings data) and one which combines both data types (i.e. VPA biomass estimates). From Table 14 it is seen that these three biomass weighting methods are also compared with outputs from (1) unweighted (raw) movement observations and (2) movement observations weighted just using the recapture weighting component of the model.

2.2.2 Weighting of recaptures

Weighting of recaptures is a complex process which has been confounded by trying to account for geographic variation in both exploitation and reporting rates, including differences between tag types and gear types.

Exploitation

To incorporate fishing pressure in a given area, VPA derived F values (instantaneous fishing mortality) are used to calculate an exploitation weighting factor; this is then applied to the recaptures in that same area.

Reporting rates

The difference in return rates for different tag types was summarized in Table 10. Essentially, it appears that high-reward (blue) tags are more than twice as likely to be reported than regular (low-reward, i.e. yellow) tags. This difference in return rate provides a calibration which enables the calculation of a reporting rate (RR) for a given area, year or gear type. By way of example, using the Program-wide return rates of 5% (LR tags) and 11.9% (HR tags), and if we assume that 100% of HR tags are reported when detected, then 42% of LR tags recaptured are reported (Equation 1).

Equation 1

$$\left(\frac{5\%}{11.9\%}\right) * 100\% = 42\%$$

High-reward tags were only released from May 2004 onwards; consequently, for 2003 recaptures, an extrapolated reporting rate has been applied which is based on the return rates of HR tags from May 2004 onwards.

Reporting rates were found to vary considerably between areas and between years (see Table 10 and reporting rate Tables in ANNEX 2 and ANNEX 3). Most notable is the considerably higher return rate of tags from 2005 releases, despite this being the year of fewest tagged cod releases [this is likely to be both an area and gear effect since these releases were focused on the Inshore Western Gulf of Maine which is exposed to considerable fishing effort both commercially and recreationally].

Reporting rates are calculated by gear type (Trawl, Commercial Hook, Recreational Hook, Gillnet, Trap) and overall (all gears totaled, including unidentified gears). These reporting rates enable calculations of expected recaptures by gear type for each area. However, for actual movement estimates, it was decided to use only the 'Overall (gear not specified)' reporting rate to estimate mixing, since this includes recaptures from individuals who did not specify the recapture gear used.

2.2.3 Resolution of analysis

The mixing analysis is run on a variety of subsets of data which are filtered by: fish size, tagging year and different geographical scales, including Management Areas and the finer resolution NAFO Statistical Squares (see Annex 1). The need for analysis at finer spatial resolutions was highlighted by the divergent migration patterns identified during the analysis of raw data, with the Cape Cod area (521) being of particular concern (Figure 7).

Recommendation: As the analytical resolution is increased (spatially, temporally, or by filtering out specific fish, e.g. by size) the sample numbers tend to decrease to the point where undertaking this analysis becomes difficult. Specifically, recapture numbers (particularly of high-reward tags) are too low to generate reliable reporting rates; consequently, estimates of expected recaptures and

associated movements are challenged. The recommendation is therefore to apply the analysis on the data pooled across all years, particularly if it is being analyzed at Statistical Square resolution.

2.2.4 Model outputs

Model outputs include matrices showing cod residency, emigration, and immigration. From these matrices, estimates of net exchange between stock areas can be calculated. Examples of these outputs are presented in Table 15 through Table 19.

Actual model outputs are presented for the following filtered datasets as follows:

Management Area resolution:	
2003-2007 pooled data	Annex 2 - Table 26 through Table 29
2003 data	Annex 2 - Table 30 through Table 33
2004 data	Annex 2 - Table 34 through Table 37
2005 data	Annex 2 - Table 38 through Table 41
2003-2007 pooled data (cod released at 53cm+)	Annex 2 - Table 42 through Table 45
2003-2007 pooled data (cod released at <53cm)	Annex 2 - Table 46 through Table 49
Statistical Square resolution:	
2003-2007 pooled data	Annex 3 - Table 50 through Table 53
2003 data	Annex 3 - Table 54 through Table 57
2004 data	Annex 3 - Table 58 through Table 61
2005 data	Annex 3 - Table 62 through Table 65

Table 15: Example: The RELEASE weighting process (releases pooled for 2003-2005). The actual tag releases (RAW (Low Reward only)) are corrected for tagging-induced mortality and tag shedding (RAW (LR) less tag losses) and are standardized and 're-distributed' by three different cod biomass estimates (Survey biomass, Fishing (total catch) and VPA biomass estimates) to enable three standardized assessments of fish movements.

RELEASES (#s)					Re-distribution of releases after weighting		
	RAW (all tags)	RAW (High Reward only)	RAW (Low Reward only)	RAW (LR) less tag losses	Survey (Biomass)	Fishing (Catch)	VPA (Biomass)
5Y-GOM	25515	1191	24324	19604	28293	7438	6688
5Z-GB	80230	844	79386	63004	48510	69428	79204
4X	8467	200	8267	6502	12308	12244	3218
Total	**114212**	**2235**	**111977**	**89110**	**89110**	**89110**	**89110**

RELEASES (%s)					Re-distribution of releases after weighting		
	RAW (all tags)	RAW (High Reward only)	RAW (Low Reward only)	RAW (LR) less tag losses	Survey (Biomass)	Fishing (Catch)	VPA (Biomass)
5Y-GOM	22.3%	53.3%	21.7%	22.0%	31.8%	8.3%	7.5%
5Z-GB	70.2%	37.8%	70.9%	70.7%	54.4%	77.9%	88.9%
4X	7.4%	8.9%	7.4%	7.3%	13.8%	13.7%	3.6%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table 16: Example: The RECAPTURE weighting process (pre-movement estimation). Raw recaptures pooled (2003-2007) and weighted by a VPA F derived exploitation weighting factor, then raised by the reporting rate (RR) to give an overall Expected Recaptures for raw, unweighted release data.

RECAPTURES (#s)					Expected Recaptures
	Observed HR tags (RAW)	Observed LR tags (RAW)	Weighted by VPA F	Raised by RR only (RAW)	Weighted (VPA F) & Raised by RR
5Y-GOM	162	1326	1018	1944	1658
5Z-GB	48	2373	3047	3224	4201
4X	41	830	903	1182	1346
Total	**251**	**4529**	**4969**	**6350**	**7205**

RECAPTURES (%s)					Expected Recaptures
	Observed HR tags (RAW)	Observed LR tags (RAW)	Weighted by VPA F	Raised by RR only (RAW)	Weighted (VPA F) & Raised by RR
5Y-GOM	64.5%	29.3%	20.5%	30.6%	23.0%
5Z-GB	19.1%	52.4%	61.3%	50.8%	58.3%
4X	16.3%	18.3%	18.2%	18.6%	18.7%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table 17: Example: The reporting rates for each management area, by gear (data pooled 2003-2007) and raised to expected recaptures by gear for each area. This output is generated each time, but for movement estimates, it is only the 'Overall (gear not specified)' reporting rate which is used to estimate mixing since this enables inclusion of recaptures from individuals who did not specify the recapture gear used.

RECAPTURES BY GEAR (#s) - RAW

	Trawl	Comm Hook	Rec Hook	Gillnet	Trap	Gears totaled	Overall (gear not specified)
5Y-GOM	508	47	346	260	9	1170	1194
5Z-GB	1046	675	188	370	9	2288	2339
4X	697	25	1	28	0	751	793
Total	2251	747	535	658	18	4209	4326

REPORTING RATES BY GEAR (%s) - corrected by HR tag returns

	Trawl	Comm Hook	Rec Hook	Gillnet	Trap	Gears totaled	Overall (gear not specified)
5Y-GOM	41.2%	22.1%	46.5%	26.0%	0.0%	36.7%	37.2%
5Z-GB	54.2%	63.6%	10.2%	47.9%	0.0%	40.9%	62.1%
4X	48.8%	59.5%	23.5%	66.6%	0.0%	49.5%	51.0%
Total	39.0%	65.9%	8.2%	22.8%	0.0%	33.4%	37.0%

RECAPTURES BY GEAR (#s) - Expected, raised by RR

	Trawl	Comm Hook	Rec Hook	Gillnet	Trap	Gears totaled	Overall (gear not specified)
5Y-GOM	807	84	531	452	9	1883	1944
5Z-GB	1525	921	357	563	9	3374	3224
4X	1054	35	2	37	0	1128	1182
Total	3386	1040	890	1052	18	6386	6350

RECAPTURES BY GEAR (%s) - RAW

	Trawl	Comm Hook	Rec Hook	Gillnet	Trap	Gears totaled	Overall (gear not specified)
5Y-GOM	22.6%	6.3%	64.7%	39.5%	50.0%	27.8%	27.6%
5Z-GB	46.5%	90.4%	35.1%	56.2%	50.0%	54.4%	54.1%
4X	31.0%	3.3%	0.2%	4.3%	0.0%	17.8%	18.3%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

RECAPTURES BY GEAR (%s) - Expected, raised by RR

	Trawl	Comm Hook	Rec Hook	Gillnet	Trap	Gears totaled	Overall (gear not specified)
5Y-GOM	23.8%	8.0%	59.7%	43.0%	50.0%	29.5%	30.6%
5Z-GB	45.0%	88.6%	40.1%	53.5%	50.0%	52.8%	50.8%
4X	31.1%	3.4%	0.2%	3.5%	0.0%	17.7%	18.6%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 18: Example: The effect of incorporating RECAPTURE weighting (by VPA F and reporting rate) into movement estimates (data pooled for 2003-2007 recaptures). RAW observed recaptures/movements into other management areas, compared with raw observed recaptures weighted on the recapture end by VPA F and reporting rate (A). [Neither matrix involves weighting of releases]. Values highlighted on the diagonal represent the resident fish.

	Tag release areas			
RAW - unweighted	GOM-5Y	GB-5Z	4X	Total
GOM-5Y	1326	352	20	1698
GB-5Z	74	2373	43	2490
4X	35	175	830	1040
Total	1435	2900	893	5228

	Tag release areas			
A) RAW - weighted recaptures	GOM-5Y	GB-5Z	4X	Total
GOM-5Y	1658	440	25	2123
GB-5Z	131	4201	76	4408
4X	57	284	1346	1686
Total	1846	4925	1447	8217

Table 19: Example: the effect of incorporating both RELEASE weighting (by Survey, Fishery & VPA biomass) & RECAPTURE weighting (by VPA F and reporting rate) into movement and mixing estimates (data pooled for 2003-2007 recaptures). RAW, unweighted data versus, RAW recapture weighted data (A) and data weighted also by tag releases using the Survey biomass method (B), the Fishery data method (C) and the VPA biomass method (D). Values highlighted on the diagonal represent the resident fish.

	Tag release areas				
RAW - unweighted recaptures	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	92%	12%	2%	14%	11%
GB-5Z	5%	82%	5%	10%	
4X	2%	6%	93%	8%	
% Emigration (Loss)	8%	18%	7%	89%	Ave residency
Net movement	7%	8%	1%		
A) RAW - weighted recaptures	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	90%	9%	2%	11%	11%
GB-5Z	7%	85%	5%	12%	
4X	3%	6%	93%	9%	
% Emigration (Loss)	10%	15%	7%	89%	Ave residency
Net movement	0%	2%	2%		
B) Survey weighted	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	87%	6%	3%	9%	14%
GB-5Z	12%	93%	18%	29%	
4X	1%	2%	79%	3%	
% Emigration (Loss)	13%	7%	21%	86%	Ave residency
Net movement	4%	22%	18%		
C) Catch weighted	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	56%	1%	1%	2%	24%
GB-5Z	41%	98%	24%	65%	
4X	3%	1%	75%	4%	
% Emigration (Loss)	44%	2%	25%	76%	Ave residency
Net movement	42%	63%	21%		
D) VPA weighted	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	96%	47%	2%	49%	29%
GB-5Z	0%	18%	0%	1%	
4X	4%	34%	98%	38%	
% Emigration (Loss)	4%	82%	2%	71%	Ave residency
Net movement	45%	81%	36%		

2.2.5 Mixing rates summarized by Management area

Detailed descriptions of each output will not be given in this report, but results for Management Area resolution are presented in ANNEX 2. The overall trends observed are as follows:

- **Estimates of net mixing** throughout the region are presented in Table 20 and range from 3-29%. Similar estimates are produced using the Survey weighted method and the weighting of recaptures only. The estimates from the Fishery and VPA methods indicate higher net movement in all datasets except 2005; the VPA scenario consistently provides the highest estimates of net movement throughout the region.
- **Estimates of average 'residency'** (effectively the opposite of net movement) are presented in Table 21. Regional estimates of residency range from 52-91% with the lowest residencies being produced by the VPA weighting scenario.
- **Estimates of emigration and immigration between management areas** are provided in Table 22. These values have been averaged across weighting scenarios, but are available for each weighting scenario (Table 19, ANNEX 2, and at the finer resolution scale of Statistical Square analysis in ANNEX 3).
- **Exchange between 5Y and 5Z:** Considerable exchange occurs between 5Y and 5Z. Overall, the immigration into 5Y from 5Z is higher than the emigration from 5Y to 5Z. This is particularly evident in fish released smaller than 53cm where 24.0% have moved into 5Y from 5Z compared with only 9.2% moving from 5Y to 5Z (this finding is strongly influenced by small fish moving from 521/Cape Cod waters up into 514/513). The only exception is for larger fish (released >53cm) where almost 15% have moved from 5Y to 5Z in comparison to only ~12% from 5Z to 5Y.
- **Exchange between 5Z and 4X:** When all size classes are grouped, the exchanges between 5Z and 4X are comparable (10.7% and 11.8%). However, when analyzing by fish size, it appears that few (2.6%) small fish from 5Z (i.e. predominantly released in 521) have been recaptured in 4X, while small fish from 4X (released in 466/467) are recaptured in 5Z at an averaged rate of 12.6%. For the legal fish (released >53cm) fewer fish from 4X are recaptured in 5Z (10.6%) relative to legal fish released in 5Z and being recaptured in 4X (15.1%).
- **Exchange between 5Y and 4X:** Overall, it appears that there is least exchange between 5Y and 4X in either direction; values range from 0-3.3%.

Table 20: Net mixing estimates for the region as a whole, from each dataset analyzed on the Management Area resolution; estimates are presented for five weighting scenarios. For more detail, see ANNEX 2.

Weighting scenario	2003-2007	2003-2007 (53cm+)	2003-2007 (<53cm)	2003	2004	2005
Raw-unweighted	10.9%	10.9%	10.4%	9.0%	7.3%	12.0%
Recapture weighted only	10.6%	10.9%	9.1%	9.4%	6.9%	17.6%
Survey	13.8%	13.1%	12.8%	8.6%	10.5%	11.1%
Fishery	23.8%	23.2%	18.8%	13.6%	18.5%	3.1%
VPA	29.2%	29.8%	28.2%	29.8%	25.3%	47.2%

Table 21: Average 'residence' estimates for the region as a whole, from each dataset analyzed on the Management Area resolution; estimates are presented for five weighting scenarios. For more detail, see ANNEX 2.

Weighting scenario	2003-2007	2003-2007 (53cm+)	2003-2007 (<53cm)	2003	2004	2005
Raw-unweighted	89.1%	89.1%	89.6%	91.0%	92.7%	88.0%
Recapture weighted only	89.4%	89.1%	90.9%	90.6%	93.1%	82.4%
Survey	86.2%	86.9%	87.2%	91.4%	89.5%	88.9%
Fishery	76.2%	76.8%	81.2%	86.4%	81.5%	96.9%
VPA	70.8%	70.2%	71.8%	70.2%	74.7%	52.8%

Table 22: Movements between Management Areas for each different dataset analyzed; movements are averaged across weighting scenarios. For each method's results, see ANNEX 2.

5Y - Movements averaged across weighting scenarios						
Direction	**2003-2007**	**2003-2007 (53cm+)**	**2003-2007 (<53cm)**	**2003**	**2004**	**2005**
From 5Z	15.8%	11.9%	24.0%	10.2%	12.1%	33.2%
To 5Z	15.1%	14.9%	9.2%	8.7%	9.5%	0.0%
From 4X	1.9%	1.8%	2.5%	1.6%	2.3%	-
To 4X	2.8%	3.3%	0.8%	2.2%	0.3%	0.0%

5Z - Movements averaged across weighting scenarios						
Direction	**2003-2007**	**2003-2007 (53cm+)**	**2003-2007 (<53cm)**	**2003**	**2004**	**2005**
From 5Y	15.1%	14.9%	9.2%	8.7%	9.5%	0.0%
To 5Y	15.8%	11.9%	24.0%	10.2%	12.1%	33.2%
From 4X	11.8%	10.6%	12.6%	4.8%	11.5%	-
To 4X	10.7%	15.1%	2.6%	18.6%	10.1%	6.4%

4X - Movements averaged across weighting scenarios						
Direction	**2003-2007**	**2003-2007 (53cm+)**	**2003-2007 (<53cm)**	**2003**	**2004**	**2005**
From 5Y	2.8%	3.3%	0.8%	2.2%	0.3%	0.0%
To 5Y	1.9%	1.8%	2.5%	1.6%	2.3%	-
From 5Z	10.7%	15.1%	2.6%	18.6%	10.1%	6.4%
To 5Z	11.8%	10.6%	12.6%	4.8%	11.5%	-

2.2.6 *Mixing rates summarized by Statistical square*

Detailed descriptions of each output will not be given in this report. Trying to work with filtered datasets at this analytical resolution proved challenging since too few recaptures were then available in many squares to enable calculations. Thus, only data pooled for 2003-2007 will be referred to here. For outputs for 2003, 2004 and 2005 separately, the reader is referred to ANNEX 3. The overall trends observed are as follows:

- **Estimates of net mixing** are higher (~89-92%) when undertaking analysis at this scale since the likelihood that fish will move in and out of these smaller analysis polygons/areas is higher (Table 23).
- **Estimates of average 'residency'** are lower (~8-10%) at this scale of analysis since it is easier for a cod to be recaptured outside of its release location when the polygon areas are smaller.
- **Estimates of emigration and immigration between statistical squares** are presented in ANNEX 3 for ten of the predominant fishing squares (and also squares for which most reliable reporting rates were possible based on HR tag recaptures).
- From the raw-unweighted data it appears that statistical squares 466, 467, 513 and 514 show the highest residency, or recapture in a neighboring square within the same management area. Area 521 shows considerably lower residency (~66%) and ~18% of these fish emigrate into 5Y. The lowest residency is seen for fish released on Georges Bank in areas 522, 551, 552, 561 and 562, though few fish which leave these areas are caught within 5Y.
- Once weighting is applied, some estimates become impossible owing to lack of high-reward recaptures in certain squares, This said, the overall message appears to be similar, with the majority of 4X fish (466 & 467) staying within 4X, and the majority of 5Y fish (513 & 514) staying within 5Y. However, the relative proportions of fish moving from 521 (Cape Cod area) to the 5Y stock become very high (~55-80% shared between 513 and 514). Of the Georges Bank releases (522, 561 and 562) a high amount of fish released in 522 appear to stay in 522 or move eastwards on Georges Bank (to 561 and 562). For the fish released on the eastern end of Georges Bank (561 and 562) the primary movements are either westwards (to 522 and 521) or northwards (to 466 and 467).

Table 23: Estimates of net mixing and residency for the region as a whole for 2003-2007 (data pooled), analyzed on the Statistical Square resolution; estimates are presented for five weighting scenarios. For more detail, see ANNEX 3.

Weighting scenario	Net mixing	Average residency
Raw-unweighted	86.1%	13.9%
Recapture weighted only	91.7%	8.3%
Survey	89.5%	10.5%
Fishery	89.2%	10.8%
VPA	89.3%	10.7%

Table 24: Mixing estimates for ten core statistical squares for five weighting scenarios; data is 2003-2005 releases and 2003-2007 recaptures. "Recaptured elsewhere" means cod were recaptured in statistical squares other than the ten presented here.

	Tag release areas									
RAW - unweighted	466	467	513	514	521	522	551	552	561	562
466	56.2%	34.6%	0.2%	0.0%	0.2%	2.3%	0.0%	0.0%	1.4%	1.2%
467	30.7%	20.2%	0.1%	0.0%	0.0%	1.8%	20.0%	0.0%	1.2%	2.9%
513	0.7%	3.8%	70.3%	16.7%	1.5%	0.5%	0.0%	0.0%	0.8%	0.0%
514	0.0%	1.9%	24.5%	79.5%	16.3%	0.9%	0.0%	0.0%	0.2%	0.0%
521	0.0%	1.0%	2.2%	1.3%	66.8%	3.6%	20.0%	0.0%	4.5%	0.0%
522	0.7%	2.9%	1.0%	1.3%	4.6%	19.9%	0.0%	0.0%	9.7%	8.2%
551	2.1%	1.9%	0.2%	0.0%	1.0%	38.9%	20.0%	0.0%	33.0%	35.9%
552	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
561	0.1%	0.0%	0.0%	0.0%	0.7%	7.7%	0.0%	0.0%	25.7%	12.9%
562	0.0%	0.0%	0.1%	0.0%	0.2%	3.2%	0.0%	0.0%	6.3%	21.8%
Recaptured elsewhere	10%	34%	1%	1%	9%	21%	40%	100%	17%	17%

	Tag release areas									
A) RAW - weighted recaptures	466	467	513	514	521	522	551	552	561	562
466	83.1%	43.9%	0.2%	0.0%	0.6%	3.8%	0.0%	0.0%	3.3%	2.9%
467										
513	1.5%	6.9%	76.1%	19.8%	8.0%	1.1%	0.0%	0.0%	2.7%	0.0%
514	0.0%	2.9%	22.0%	78.1%	73.0%	1.8%	0.0%	0.0%	0.6%	0.0%
521										
522	0.9%	3.1%	0.7%	0.9%	14.8%	28.4%	0.0%	0.0%	19.3%	17.2%
551	1.9%	1.5%	0.1%	0.0%	2.3%	41.0%	24.6%	0.0%	48.3%	55.2%
552	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
561										
562										
Recaptured elsewhere	13%	42%	1%	1%	1%	24%	75%	100%	26%	25%

	Tag release areas									
B) Survey weighted	466	467	513	514	521	522	551	552	561	562
466	97.5%	81.5%	0.3%	0.0%	3.7%	20.7%	0.0%		21.8%	26.2%
467										
513	1.6%	12.0%	98.2%	88.9%	45.7%	5.5%	0.0%		16.5%	0.0%
514	0.0%	0.1%	0.5%	5.7%	6.7%	0.1%	0.0%		0.1%	0.0%
521										
522	0.5%	2.7%	0.4%	2.0%	42.2%	71.7%	0.0%		59.0%	72.2%
551	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	100.0%		0.1%	0.2%
552	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%
561										
562										
Recaptured elsewhere	0%	4%	1%	3%	2%	2%	0%	100%	2%	1%

	Tag release areas									
C) Fishery weighted	466	467	513	514	521	522	551	552	561	562
466	88.2%	43.7%	0.1%	0.0%	2.1%	13.7%	0.0%		15.2%	21.6%
467										
513	2.8%	12.4%	97.9%	82.4%	49.4%	7.0%	0.0%		22.1%	0.0%
514	0.0%	0.2%	1.2%	13.9%	19.3%	0.5%	0.0%		0.2%	0.0%
521										
522	0.5%	1.7%	0.3%	1.1%	27.5%	54.8%	0.0%		47.4%	68.7%
551	0.0%	0.0%	0.0%	0.0%	0.2%	3.1%	100.0%		4.7%	8.7%
552	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%		0.0%	0.0%
561										
562										
Recaptured elsewhere	8%	42%	0%	3%	1%	21%	0%	100%	10%	1%

	Tag release areas									
D) VPA weighted	466	467	513	514	521	522	551	552	561	562
466	96.6%	74.2%	0.6%	0.0%	9.2%	38.1%	0.0%		35.7%	50.7%
467										
513	0.6%	4.2%	96.4%	82.5%	43.5%	3.9%	0.0%		10.3%	0.0%
514	0.0%	0.0%	0.4%	4.3%	5.3%	0.1%	0.0%		0.0%	0.0%
521										
522	0.2%	0.8%	0.4%	1.7%	36.4%	45.8%	0.0%		33.4%	48.4%
551	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	100.0%		0.1%	0.3%
552	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%
561										
562										
Recaptured elsewhere	3%	21%	2%	11%	6%	12%	0%	100%	20%	1%

2.3 Growth

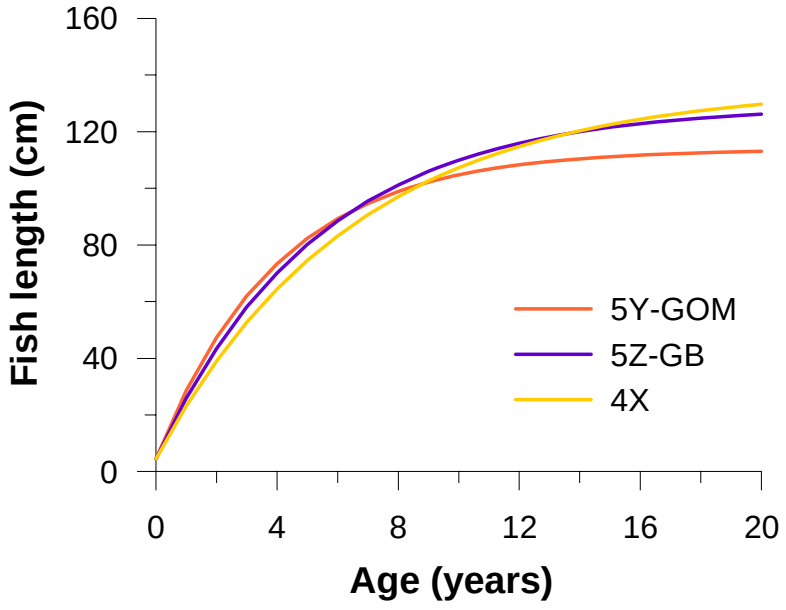
Analysis of the growth information has so far focused on visualization and looking at the relationships between:

- **Days at liberty and total growth:** Total growth increases the longer the tagged cod is at large (this is to be expected);
- **Release size and growth rate (cm/day):** Growth rate decreases with increasing fish size (this is to be expected since younger fish typically grow at a faster rate than older fish).
- **Regional variation in growth:** More recently, analysis has incorporated the sub-setting of data by release region; findings by management area only will be presented here.
- **Estimates of growth rates using GROTAG (Francis, 1988):** Findings to date using this method are presented as supplementary data (Table 25 & Figure 9). Future work will attempt to incorporate gear selectivity into the growth rate estimates, likely using the Taylor *et al.* (2005) method.

Table 25: GROTAG estimates of growth parameters by Management Area from NRCTP tagging data.

GROTAG Output		5Y	5Z	4X
Sample size	***n***	1148	1793	592
Von Bertalanffy growth parameters				
Asymptotic length (cm)	***L∞***	114	129	136
Growth rate	***K***	0.249	0.187	0.152
Time (years) when size = 0cm	***t0***	-0.162	-0.189	-0.221

Figure 9: GROTAG generated growth curves by Management Area from NRCTP tagging data.



Discussion

The first section of this paper (WP3A) has described the vast cod tagging dataset available to the GARM. GMRI is also in the process of collating three additional datasets from three recent, independent cod tagging studies (UNH, SMAST and DFO). It is recommended that future analysis also incorporate the movements observed within these three other datasets, since this will expand the longevity of the dataset, while also providing release and recapture data from both areas and seasons which may not have been sampled during the NRCTP.

The second section of this paper (WP3C) has presented contemporary "passages of travel" in a qualitative, descriptive manner, based on the analysis of raw movement data. The pattern proposed suggests that the Cape Cod area is an area which requires further attention since it appears to be source of fish for both 5Y and 5Z stocks to a greater level than currently catered for in past stock assessments.

This section then provided a detailed overview of a weighting approach for quantifying cod movements across the three stock areas. This complex, tailor-made weighting model has been developed in a collaborative manner with NEFSC staff and GMRI. The value of this model has yet to be determined, but it is evident that pooling the data across the study may be the most effective way forwards to ensure that sample sizes are sufficient in any given area to yield the most accurate estimates of mixing possible.

In recent months, the NEFSC has also begun applying a "finite-state continuous-time approach" (FSCTA) model to the NRCTP dataset. An accompanying working paper (WP3D) has been submitted for inclusion in this GARM meeting ("Estimating instantaneous rates of regional migration and mortality from conventional tagging data", Tim Miller, (NEFSC).

A small amount of growth analysis has also been undertaken, with the aim of providing a supplementary source of growth information for comparison with NEFSC estimates. Tagging data may be particularly useful for attempts at providing an estimate of growth for the 521/Cape Cod region in light of the number of releases which were deployed in this area.

References

Andersen, P. K., Borgen, Ø., Gill, R. D., and Keiding, N. (1993). Statistical models based on counting processes. Springer-Verlag, New York.

Francis, R.I.C.C., 1988. Maximum likelihood estimation of growth and growth variability from tagging data. New Zealand Journal of Marine and Freshwater Research, 22, 42-51.

Gillanders, B.M., Ferrell, D.J., and Andrew, N.L., 2001. Estimates of movement and life-history parameters of yellowtail kingfish (*Seriola lalandi*): how useful are data from a cooperative tagging programme? Marine and Freshwater Research, 52, 179–192.

Hunt, J.J., Stobo, W.T. & Almeida, F., (1999). Movement of Atlantic cod, *Gadus morhua*, tagged in the Gulf of Maine area. *Fishery Bulletin*, **97**: 842-860.

Mayo, R.K., Thunberg, S.E., Wigley, S.E., and Cadrin, S.X., 2002. The 2001 assessment of the Gulf of Maine Atlantic cod stock. Woods Hole Laboratory Ref. Doc., 02-02.

Miller, T. J. and Andersen, P. K. (in press). A finite-state continuous-time approach for inferring regional migration and mortality rates from conventional and archival tagging experiments. Biometrics.

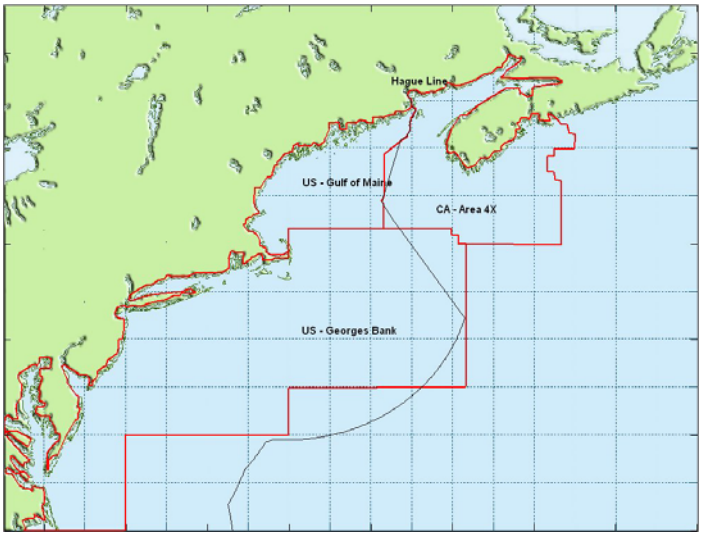
Natanson, L.J., Mello, J.J., and Campana, S.E., 2002. Validated age and growth of the porbeagle shark (*Lamna nasus*) in the western North Atlantic Ocean. Fisheries Bulletin, 100, 266-288.

Simpfendorfer, C., A., Chidlow, J., McAuley, R., and Unsworth, P., 2000. Age and growth of the whiskery shark, *Furgaleus macki*, from southwestern Australia. Environmental Biology of Fishes, 58, 335-343.

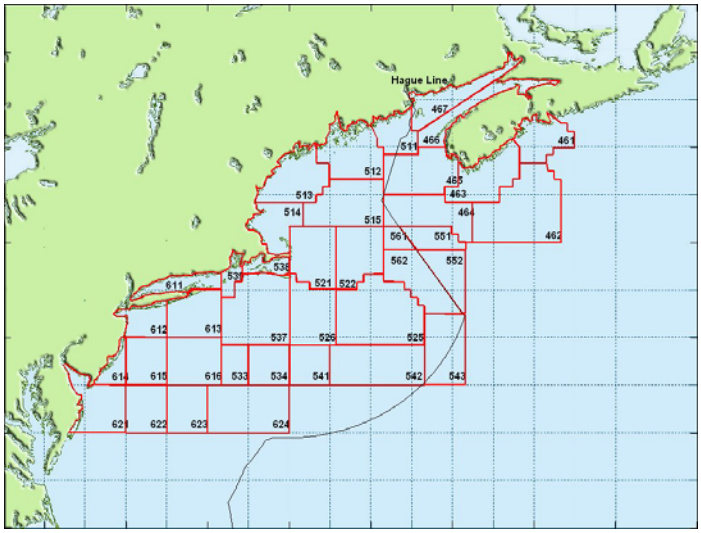
Taylor, N., G., Walters, C., J. & Martell, S., J.D., (2005). A new likelihood for simultaneously estimating von Bertalanffy growth parameters, gear selectivity, and natural and fishing mortality. *Canadian Journal of Fisheries and Aquatic Sciences*, **62**: 215-223.

ANNEX I - The spatial scales used for analysis

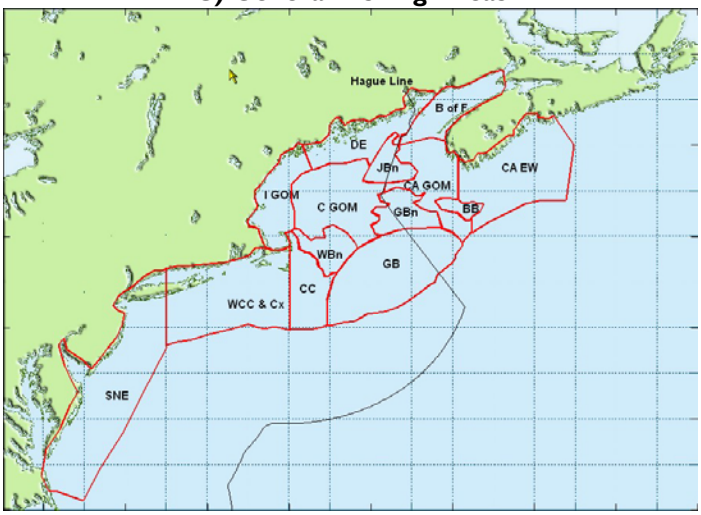
A) Management Areas



B) NAFO Statistical Squares



C) General Fishing Areas



ANNEX 2 – Analysis at Management Area resolution.

A. Release data pooled for 2003-2005 and recapture data pooled for 2003-2007.

Table 26: Weighting of RELEASES (Releases pooled for 2003-2005).

RELEASES (#s)					Re-distribution of releases after weighting		
	RAW (all tags)	RAW (High Reward only)	RAW (Low Reward only)	RAW (LR) less tag losses	Survey (Biomass)	Fishing (Catch)	VPA (Biomass)
5Y-GOM	25515	1191	24324	19604	28293	7438	6688
5Z-GB	80230	844	79386	63004	48510	69428	79204
4X	8467	200	8267	6502	12308	12244	3218
Total	**114212**	**2235**	**111977**	**89110**	**89110**	**89110**	**89110**
RELEASES (%s)					Re-distribution of releases after weighting		
	RAW (all tags)	RAW (High Reward only)	RAW (Low Reward only)	RAW (LR) less tag losses	Survey (Biomass)	Fishing (Catch)	VPA (Biomass)
5Y-GOM	22.3%	53.3%	21.7%	22.0%	31.8%	8.3%	7.5%
5Z-GB	70.2%	37.8%	70.9%	70.7%	54.4%	77.9%	88.9%
4X	7.4%	8.9%	7.4%	7.3%	13.8%	13.7%	3.6%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table 27: Reporting rates for each management area, by gear (data pooled for 2003-2007).

REPORTING RATES BY GEAR (%s) - corrected by HR tag returns							
	Trawl	Comm Hook	Rec Hook	Gillnet	Trap	Gears totaled	Overall (gear not specified)
5Y-GOM	41.2%	22.1%	46.5%	26.0%	0.0%	36.7%	37.2%
5Z-GB	54.2%	63.6%	10.2%	47.9%	0.0%	40.9%	62.1%
4X	48.8%	59.5%	23.5%	66.6%	0.0%	49.5%	51.0%
Total	**39.0%**	**65.9%**	**8.2%**	**22.8%**	**0.0%**	**33.4%**	**37.0%**

Table 28: RAW 2003-2007 observed recaptures/movements into other management areas, compared with raw observed recaptures weighted on the recapture end by VPA F and reporting rate (A). [Neither matrix involves weighting of releases]. Values highlighted on the diagonal represent the resident fish.

	Tag release areas			
RAW - unweighted	GOM-5Y	GB-5Z	4X	Total
GOM-5Y	1326	352	20	1698
GB-5Z	74	2373	43	2490
4X	35	175	830	1040
Total	1435	2900	893	5228

	Tag release areas			
A) RAW - weighted recaptures	GOM-5Y	GB-5Z	4X	Total
GOM-5Y	1658	440	25	2123
GB-5Z	131	4201	76	4408
4X	57	284	1346	1686
Total	1846	4925	1447	8217

Table 29: Movement and mixing estimates for pooled 2003-2007 data: RAW, unweighted data versus, RAW recapture weighted data (A) and data weighted also by tag releases using the Survey biomass method (B), the Fishery data method (C) and the VPA biomass method (D). Values highlighted on the diagonal represent the resident fish.

	Tag release areas				
RAW - unweighted recaptures	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	92%	12%	2%	14%	11%
GB-5Z	5%	82%	5%	10%	
4X	2%	6%	93%	8%	
% Emigration (Loss)	8%	18%	7%	89%	Ave residency
Net movement	7%	8%	1%		
A) RAW - weighted recaptures	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	90%	9%	2%	11%	11%
GB-5Z	7%	85%	5%	12%	
4X	3%	6%	93%	9%	
% Emigration (Loss)	10%	15%	7%	89%	Ave residency
Net movement	0%	2%	2%		
B) Survey weighted	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	87%	6%	3%	9%	14%
GB-5Z	12%	93%	18%	29%	
4X	1%	2%	79%	3%	
% Emigration (Loss)	13%	7%	21%	86%	Ave residency
Net movement	4%	22%	18%		
C) Catch weighted	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	56%	1%	1%	2%	24%
GB-5Z	41%	98%	24%	65%	
4X	3%	1%	75%	4%	
% Emigration (Loss)	44%	2%	25%	76%	Ave residency
Net movement	42%	63%	21%		
D) VPA weighted	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	96%	47%	2%	49%	29%
GB-5Z	0%	18%	0%	1%	
4X	4%	34%	98%	38%	
% Emigration (Loss)	4%	82%	2%	71%	Ave residency
Net movement	45%	81%	36%		

B. Released and recaptured in 2003.

Table 30: Weighting of RELEASES (2003).

RELEASES (#s)					Re-distribution of releases after weighting		
	RAW (all tags)	RAW (High Reward only)	RAW (Low Reward only)	RAW (LR) less tag losses	Survey (Biomass)	Fishing (Catch)	VPA (Biomass)
5Y-GOM	10358	1191	10358	8149	11796	3666	2942
5Z-GB	30500	844	30500	23969	20225	28039	32789
4X	6408	200	6408	5035	5131	5448	1422
Total	**47266**	**2235**	**47266**	**37153**	**37153**	**37153**	**37153**
RELEASES (%s)					Re-distribution of releases after weighting		
	RAW (all tags)	RAW (High Reward only)	RAW (Low Reward only)	RAW (LR) less tag losses	Survey (Biomass)	Fishing (Catch)	VPA (Biomass)
5Y-GOM	21.9%	53.3%	21.9%	21.9%	31.8%	9.9%	7.9%
5Z-GB	64.5%	37.8%	64.5%	64.5%	54.4%	75.5%	88.3%
4X	13.6%	8.9%	13.6%	13.6%	13.8%	14.7%	3.8%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table 31: Reporting rates for each management area, by gear (2003); facilitated using extrapolated high-reward return rates from May 2004 onwards, since no high reward tags were released in 2003 and thus, a reporting rate could not have been calculated otherwise.

REPORTING RATES BY GEAR (%s) - corrected by HR tag returns							
	Trawl	Comm Hook	Rec Hook	Gillnet	Trap	Gears totaled	Overall (gear not specified)
5Y-GOM	14.8%	4.5%	11.0%	7.9%	0.0%	11.2%	11.4%
5Z-GB	20.2%	23.5%	2.6%	11.2%	0.0%	13.4%	22.1%
4X	20.9%	46.1%	3.0%	18.4%	0.0%	21.0%	22.8%
Total	**18.9%**	**24.1%**	**80.1%**	**6.0%**	**0.0%**	**13.2%**	**15.2%**

Table 32: RAW 2003 observed recaptures/movements into other management areas, compared with raw observed recaptures weighted on the recapture end by VPA F and reporting rate (A). [Neither matrix involves weighting of releases]. Values highlighted on the diagonal represent the resident fish.

	Tag release areas			
RAW - unweighted	GOM-5Y	GB-5Z	4X	Total
GOM-5Y	152	28	5	185
GB-5Z	6	316	7	329
4X	3	38	275	316
Total	161	382	287	830

	Tag release areas			
A) RAW - weighted recaptures	GOM-5Y	GB-5Z	4X	Total
GOM-5Y	249	46	8	303
GB-5Z	11	556	12	579
4X	6	80	582	669
Total	266	682	602	1550

Table 33: Movement and mixing estimates for 2003 data: RAW, unweighted data versus, RAW recapture weighted data (A) and data weighted also by tag releases using the Survey biomass method (B), the Fishery data method (C) and the VPA biomass method (D). Values highlighted on the diagonal represent the resident fish.

	Tag release areas				
RAW - unweighted recaptures	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	94%	7%	2%	9%	9%
GB-5Z	4%	83%	2%	6%	
4X	2%	10%	96%	12%	
% Emigration (Loss)	6%	17%	4%	91%	Ave residency
Net movement	3%	11%	8%		
A) RAW - weighted recaptures	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	94%	7%	1%	8%	9%
GB-5Z	4%	81%	2%	6%	
4X	2%	12%	97%	14%	
% Emigration (Loss)	6%	19%	3%	91%	Ave residency
Net movement	2%	13%	11%		
B) Survey weighted	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	92%	4%	3%	7%	9%
GB-5Z	7%	92%	7%	14%	
4X	1%	3%	90%	4%	
% Emigration (Loss)	8%	8%	10%	91%	Ave residency
Net movement	0%	6%	6%		
C) Catch weighted	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	73%	1%	1%	2%	14%
GB-5Z	24%	96%	10%	34%	
4X	3%	3%	89%	5%	
% Emigration (Loss)	27%	4%	11%	86%	Ave residency
Net movement	25%	30%	5%		
D) VPA weighted	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	97%	28%	1%	30%	30%
GB-5Z	0%	15%	0%	0%	
4X	3%	57%	99%	59%	
% Emigration (Loss)	3%	85%	1%	70%	Ave residency
Net movement	27%	85%	58%		

C. Released and recaptured in 2004.

Table 34: Weighting of RELEASES (2004).

RELEASES (#s)					Re-distribution of releases after weighting		
	RAW (all tags)	RAW (High Reward only)	RAW (Low Reward only)	RAW (LR) less tag losses	Survey (Biomass)	Fishing (Catch)	VPA (Biomass)
5Y-GOM	10930	773	10157	8067	14905	2963	3205
5Z-GB	47730	754	46976	37443	25556	37324	41977
4X	2017	197	1820	1435	6484	6658	1763
Total	**60677**	**1724**	**58953**	**46945**	**46945**	**46945**	**46945**
RELEASES (%s)					Re-distribution of releases after weighting		
	RAW (all tags)	RAW (High Reward only)	RAW (Low Reward only)	RAW (LR) less tag losses	Survey (Biomass)	Fishing (Catch)	VPA (Biomass)
5Y-GOM	18.0%	44.8%	17.2%	17.2%	31.8%	6.3%	6.8%
5Z-GB	78.7%	43.7%	79.7%	79.8%	54.4%	79.5%	89.4%
4X	3.3%	11.4%	3.1%	3.1%	13.8%	14.2%	3.8%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table 35: Reporting rates for each management area, by gear (2004).

REPORTING RATES BY GEAR (%s) - corrected by HR tag returns							
	Trawl	Comm Hook	Rec Hook	Gillnet	Trap	Gears totaled	Overall (gear not specified)
5Y-GOM	67.5%	81.5%	93.2%	82.6%	0.0%	77.9%	79.7%
5Z-GB	93.7%	131.2%	19.6%	17.4%	0.0%	56.2%	138.2%
4X	159.3%	74.3%	-	118.3%	0.0%	153.6%	165.4%
Total	**52.4%**	**168.1%**	**8.4%**	**31.7%**	**0.0%**	**54.4%**	**67.8%**

Table 36: RAW 2004 observed recaptures/movements into other management areas, compared with raw observed recaptures weighted on the recapture end by VPA F and reporting rate (A). [Neither matrix involves weighting of releases]. Values highlighted on the diagonal represent the resident fish.

	Tag release areas			
RAW - unweighted	GOM-5Y	GB-5Z	4X	Total
GOM-5Y	175	35	2	212
GB-5Z	5	494	4	503
4X	1	53	163	217
Total	181	582	169	932
	Tag release areas			
A) RAW - weighted recaptures	GOM-5Y	GB-5Z	4X	Total
GOM-5Y	140	28	2	170
GB-5Z	5	461	4	469
4X	0	22	67	90
Total	145	511	73	729

Table 37: Movement and mixing estimates for 2004 data: RAW, unweighted data versus, RAW recapture weighted data (A) and data weighted also by tag releases using the Survey biomass method (B), the Fishery data method (C) and the VPA biomass method (D). Values highlighted on the diagonal represent the resident fish.

	Tag release areas				
RAW - unweighted recaptures	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	97%	6%	1%	7%	7%
GB-5Z	3%	85%	2%	5%	
4X	1%	9%	96%	10%	
% Emigration (Loss)	3%	15%	4%	93%	Ave residency
Net movement	4%	10%	6%		
A) RAW - weighted recaptures	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	97%	5%	2%	8%	7%
GB-5Z	3%	90%	5%	8%	
4X	0%	4%	93%	5%	
% Emigration (Loss)	3%	10%	7%	93%	Ave residency
Net movement	4%	1%	3%		
B) Survey weighted	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	94%	3%	4%	8%	11%
GB-5Z	5%	95%	17%	23%	
4X	0%	1%	79%	1%	
% Emigration (Loss)	6%	5%	21%	89%	Ave residency
Net movement	2%	18%	20%		
C) Catch weighted	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	70%	0%	1%	1%	18%
GB-5Z	29%	99%	24%	53%	
4X	0%	1%	76%	1%	
% Emigration (Loss)	30%	1%	24%	82%	Ave residency
Net movement	29%	52%	23%		
D) VPA weighted	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	100%	39%	2%	41%	25%
GB-5Z	0%	27%	0%	0%	
4X	0%	34%	98%	34%	
% Emigration (Loss)	0%	73%	2%	75%	Ave residency
Net movement	41%	73%	32%		

D. Released and recaptured in 2005.

Table 38: Weighting of RELEASES (2005).

RELEASES (#s)					Re-distribution of releases after weighting		
	RAW (all tags)	RAW (High Reward only)	RAW (Low Reward only)	RAW (LR) less tag losses	Survey (Biomass)	Fishing (Catch)	VPA (Biomass)
5Y-GOM	4227	418	3809	3387	1591	476	399
5Z-GB	2000	90	1910	1593	2729	3992	4470
4X	42	3	39	32	692	544	144
Total	**6269**	**511**	**5758**	**5012**	**5012**	**5012**	**5012**
RELEASES (%s)					Re-distribution of releases after weighting		
	RAW (all tags)	RAW (High Reward only)	RAW (Low Reward only)	RAW (LR) less tag losses	Survey (Biomass)	Fishing (Catch)	VPA (Biomass)
5Y-GOM	67.4%	81.8%	66.2%	67.6%	31.8%	9.5%	8.0%
5Z-GB	31.9%	17.6%	33.2%	31.8%	54.4%	79.7%	89.2%
4X	0.7%	0.6%	0.7%	0.6%	13.8%	10.9%	2.9%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table 39: Reporting rates for each management area, by gear (2005).

REPORTING RATES BY GEAR (%s) - corrected by HR tag returns							
	Trawl	Comm Hook	Rec Hook	Gillnet	Trap	Gears totaled	Overall (gear not specified)
5Y-GOM	58.3%	36.3%	78.4%	28.6%	0.0%	52.8%	53.4%
5Z-GB	144.6%	165.2%	35.9%	126.0%	0.0%	118.3%	158.4%
4X	87.9%	49.5%	-	28.7%	0.0%	80.8%	82.1%
Total	**111.2%**	**162.5%**	**10.7%**	**63.3%**	**0.0%**	**92.8%**	**100.7%**

Table 40: RAW 2005 observed recaptures/movements into other management areas, compared with raw observed recaptures weighted on the recapture end by VPA F and reporting rate (A). [Neither matrix involves weighting of releases]. Values highlighted on the diagonal represent the resident fish.

	Tag release areas			
RAW - unweighted	GOM-5Y	GB-5Z	4X	Total
GOM-5Y	184	9	0	193
GB-5Z	0	35	0	35
4X	0	2	0	2
Total	184	46	0	230

	Tag release areas			
A) RAW - weighted recaptures	GOM-5Y	GB-5Z	4X	Total
GOM-5Y	218	11	0	228
GB-5Z	0	23	0	23
4X	0	2	0	2
Total	218	36	0	254

Table 41: Movement and mixing estimates for 2005 data: RAW, unweighted data versus, RAW recapture weighted data (A) and data weighted also by tag releases using the Survey biomass method (B), the Fishery data method (C) and the VPA biomass method (D). Values highlighted on the diagonal represent the resident fish.

	Tag release areas				
RAW - unweighted recaptures	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	100%	20%		20%	12%
GB-5Z	0%	76%		0%	
4X	0%	4%		4%	
% Emigration (Loss)	0%	24%	0%	88%	Ave residency
Net movement	20%	24%	4%		
A) RAW - weighted recaptures	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	100%	29%		29%	18%
GB-5Z	0%	65%		0%	
4X	0%	6%		6%	
% Emigration (Loss)	0%	35%	0%	82%	Ave residency
Net movement	29%	35%	6%		
B) Survey weighted	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	100%	21%		21%	11%
GB-5Z	0%	78%		0%	
4X	0%	2%		2%	
% Emigration (Loss)	0%	22%	0%	89%	Ave residency
Net movement	21%	22%	2%		
C) Catch weighted	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	100%	5%		5%	3%
GB-5Z	0%	94%		0%	
4X	0%	1%		1%	
% Emigration (Loss)	0%	6%	0%	97%	Ave residency
Net movement	5%	6%	1%		
D) VPA weighted	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	100%	78%		78%	47%
GB-5Z	0%	6%		0%	
4X	0%	17%		17%	
% Emigration (Loss)	0%	94%	0%	53%	Ave residency
Net movement	78%	94%	17%		

E. Cod released at 53cm (21") or larger, data pooled for 2003-2007.

Table 42: Weighting of 53cm+ RELEASES (2003-2005).

RELEASES (#s)					Re-distribution of releases after weighting		
	RAW (all tags)	RAW (High Reward only)	RAW (Low Reward only)	RAW (LR) less tag losses	Survey (Biomass)	Fishing (Catch)	VPA (Biomass)
5Y-GOM	21596	1023	20573	16576	16696	4389	3947
5Z-GB	40026	668	39358	31417	28626	40970	46739
4X	6001	167	5834	4592	7263	7225	1899
Total	**67623**	**1858**	**65765**	**52585**	**52585**	**52585**	**52585**
RELEASES (%s)					Re-distribution of releases after weighting		
	RAW (all tags)	RAW (High Reward only)	RAW (Low Reward only)	RAW (LR) less tag losses	Survey (Biomass)	Fishing (Catch)	VPA (Biomass)
5Y-GOM	31.9%	55.1%	31.3%	31.5%	31.8%	8.3%	7.5%
5Z-GB	59.2%	36.0%	59.8%	59.7%	54.4%	77.9%	88.9%
4X	8.9%	9.0%	8.9%	8.7%	13.8%	13.7%	3.6%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table 43: Reporting rates for each management area (released 53cm+, 2003-2005, recaptured 2003-2007).

REPORTING RATES BY GEAR (%s) - corrected by HR tag returns	
	Overall (gear not specified)
5Y-GOM	34.7%
5Z-GB	72.0%
4X	53.4%
Total	**41.8%**

Table 44: RAW 2003-2007 (released 53cm+) observed recaptures/movements into other management areas, compared with raw observed recaptures weighted on the recapture end by VPA F and reporting rate (A). [Neither matrix involves weighting of releases]. Values highlighted on the diagonal represent the resident fish.

	Tag release areas			
RAW - unweighted	GOM-5Y	GB-5Z	4X	Total
GOM-5Y	1010	167	14	1191
GB-5Z	61	1532	30	1623
4X	33	160	626	819
Total	1104	1859	670	3633
	Tag release areas			
A) RAW - weighted recaptures	GOM-5Y	GB-5Z	4X	Total
GOM-5Y	1282	212	18	1512
GB-5Z	100	2518	49	2668
4X	53	255	999	1307
Total	1435	2986	1066	5487

Table 45: Movement and mixing estimates for 2003-2007 (released 53cm+) data: RAW, unweighted data versus, RAW recapture weighted data (A) and data weighted also by tag releases using the Survey biomass method (B), the Fishery data method (C) and the VPA biomass method (D). Values highlighted on the diagonal represent the resident fish.

	Tag release areas				
RAW - unweighted recaptures	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	91%	9%	2%	11%	11%
GB-5Z	6%	82%	4%	10%	
4X	3%	9%	93%	12%	
% Emigration (Loss)	9%	18%	7%	89%	Ave residency
Net movement	3%	8%	5%		
A) RAW - weighted recaptures	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	89%	7%	2%	9%	11%
GB-5Z	7%	84%	5%	12%	
4X	4%	9%	94%	12%	
% Emigration (Loss)	11%	16%	6%	89%	Ave residency
Net movement	2%	4%	6%		
B) Survey weighted	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	87%	5%	3%	8%	13%
GB-5Z	12%	93%	16%	27%	
4X	2%	2%	81%	4%	
% Emigration (Loss)	13%	7%	19%	87%	Ave residency
Net movement	5%	20%	15%		
C) Catch weighted	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	56%	1%	1%	2%	23%
GB-5Z	41%	97%	22%	62%	
4X	4%	2%	77%	6%	
% Emigration (Loss)	44%	3%	23%	77%	Ave residency
Net movement	43%	60%	17%		
D) VPA weighted	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	95%	35%	2%	37%	30%
GB-5Z	0%	17%	0%	0%	
4X	4%	48%	98%	52%	
% Emigration (Loss)	5%	83%	2%	70%	Ave residency
Net movement	32%	83%	50%		

F. Cod released smaller than 53cm (21"), data pooled for 2003-2007.

Table 46: Weighting of <53cm RELEASES (2003-2005).

RELEASES (#s)					Re-distribution of releases after weighting		
	RAW (all tags)	RAW (High Reward only)	RAW (Low Reward only)	RAW (LR) less tag losses	Survey (Biomass)	Fishing (Catch)	VPA (Biomass)
5Y-GOM	3877	164	3713	2998	11572	3042	2736
5Z-GB	40150	174	39976	31545	19841	28397	32396
4X	2459	33	2426	1905	5034	5008	1316
Total	**46486**	**371**	**46115**	**36448**	**36448**	**36448**	**36448**
RELEASES (%s)					Re-distribution of releases after weighting		
	RAW (all tags)	RAW (High Reward only)	RAW (Low Reward only)	RAW (LR) less tag losses	Survey (Biomass)	Fishing (Catch)	VPA (Biomass)
5Y-GOM	8.3%	44.2%	8.1%	8.2%	31.8%	8.3%	7.5%
5Z-GB	86.4%	46.9%	86.7%	86.5%	54.4%	77.9%	88.9%
4X	5.3%	8.9%	5.3%	5.2%	13.8%	13.7%	3.6%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table 47: Reporting rates for each management area (released <53cm, 2003-2005, recaptured 2003-2007).

REPORTING RATES BY GEAR (%s) - corrected by HR tag returns	
	Overall (gear not specified)
5Y-GOM	61.0%
5Z-GB	86.1%
4X	55.6%
Total	**45.1%**

Table 48: RAW 2003-2007 (released <53cm) observed recaptures/movements into other management areas, compared with raw observed recaptures weighted on the recapture end by VPA F and reporting rate (A). [Neither matrix involves weighting of releases]. Values highlighted on the diagonal represent the resident fish.

	Tag release areas			
RAW - unweighted	GOM-5Y	GB-5Z	4X	Total
GOM-5Y	173	173	6	352
GB-5Z	5	807	11	823
4X	1	12	166	179
Total	179	992	183	1354
	Tag release areas			
A) RAW - weighted recaptures	GOM-5Y	GB-5Z	4X	Total
GOM-5Y	185	185	6	376
GB-5Z	7	1181	16	1204
4X	2	19	261	281
Total	194	1384	283	1861

Table 49: Movement and mixing estimates for 2003-2007 (released <53cm) data: RAW, unweighted data versus, RAW recapture weighted data (A) and data weighted also by tag releases using the Survey biomass method (B), the Fishery data method (C) and the VPA biomass method (D). Values highlighted on the diagonal represent the resident fish.

	Tag release areas				
RAW - unweighted recaptures	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	97%	17%	3%	21%	10%
GB-5Z	3%	81%	6%	9%	
4X	1%	1%	91%	2%	
% Emigration (Loss)	3%	19%	9%	90%	Ave residency
Net movement	17%	10%	8%		
A) RAW - weighted recaptures	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	95%	13%	2%	16%	9%
GB-5Z	4%	85%	6%	9%	
4X	1%	1%	92%	2%	
% Emigration (Loss)	5%	15%	8%	91%	Ave residency
Net movement	11%	5%	6%		
B) Survey weighted	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	93%	8%	4%	13%	13%
GB-5Z	6%	91%	19%	25%	
4X	0%	0%	77%	1%	
% Emigration (Loss)	7%	9%	23%	87%	Ave residency
Net movement	6%	16%	22%		
C) Catch weighted	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	72%	2%	1%	3%	19%
GB-5Z	27%	98%	26%	52%	
4X	1%	0%	73%	1%	
% Emigration (Loss)	28%	2%	27%	81%	Ave residency
Net movement	25%	50%	25%		
D) VPA weighted	GOM-5Y	GB-5Z	4X	% Immigration (gain)	Net mixing
GOM-5Y	99%	73%	2%	75%	28%
GB-5Z	0%	19%	0%	0%	
4X	1%	8%	98%	9%	
% Emigration (Loss)	1%	81%	2%	72%	Ave residency
Net movement	74%	81%	7%		

ANNEX 3 - Analysis at Statistical Square resolution.

G. Release data pooled for 2003-2005 and recapture data pooled for 2003-2007.

Table 50: Weighting of RELEASES (Releases pooled for 2003-2005).

RELEASES (#s)					Re-distribution of releases after weighting		
	RAW (all tags)	RAW (High Reward only)	RAW (Low Reward only)	RAW (LR) less tag losses	Survey (Biomass)	Fishing (Catch)	VPA (Biomass)
461	0	0	0	0	-	-	-
462	6	0	6	5	22	5020	1495
463	0	0	0	0	-	-	-
464	83	0	83	64	1890	8567	3490
465	0	0	0	0	-	-	-
466	4909	126	4783	3759	819	3319	343
467	1662	63	1599	1259	1665	2756	430
511	2421	33	2388	1880	3559	541	275
512	302	6	296	231	191	302	8
513	20401	1025	19376	15655	3662	7726	4011
514	1700	84	1616	1327	19195	15279	25521
515	2398	56	2342	1844	653	1705	199
521	58602	401	58201	46156	947	21726	16526
522	5270	295	4975	4134	1928	6764	2331
525	600	0	600	472	3882	5089	5078
526	1132	16	1116	877	205	859	38
533	0	0	0	0	-	-	-
534	0	0	0	0	-	-	-
537	339	0	339	266	18	1653	148
538	0	0	0	0	-	-	-
539	365	0	365	286	427	92	2
541	0	0	0	0	-	-	-
542	0	0	0	0	-	-	-
543	0	0	0	0	-	-	-
551	119	12	107	84	41198	3510	27670
552	47	5	42	33	2950	100	181
561	9846	50	9796	7659	2784	824	84
562	3814	65	3749	2961	2957	3121	1124
611	0	0	0	0	-	-	-
612	0	0	0	0	-	-	-
613	0	0	0	0	-	-	-
614	0	0	0	0	-	-	-
615	0	0	0	0	-	-	-
616	0	0	0	0	-	-	-
621	0	0	0	0	-	-	-
622	0	0	0	0	-	-	-
623	0	0	0	0	-	-	-
624	0	0	0	0	-	-	-
Total	**114016**	**2237**	**111779**	**88954**	**88954**	**88954**	**88954**

Table 51: Reporting rates for each statistical square, by gear (data pooled for 2003-2007).

REPORTING RATES BY GEAR (%s) - corrected by HR tag returns							
	Trawl	Comm Hook	Rec Hook	Gillnet	Trap	Gears totaled	Overall (gear not specified)
461	-	-	-	-	-	-	-
462	-	-	-	-	-	-	-
463	-	-	-	-	-	-	-
464	-	-	-	-	-	-	-
465	-	-	-	-	-	-	-
466	59.1%	31.1%	-	7.8%	-	54.4%	55.2%
467	23.2%	-	-	-	-	23.2%	23.2%
511	17.1%	-	-	-	-	51.3%	15.2%
512	-	-	-	-	-	-	-
513	40.1%	53.2%	46.5%	31.7%	-	39.9%	40.3%
514	68.5%	24.5%	53.8%	39.2%	-	52.9%	45.7%
515	18.8%	0.0%	23.5%	-	-	12.3%	14.1%
521	48.5%	60.1%	6.7%	26.5%	-	30.0%	46.4%
522	53.8%	56.6%	-	-	-	53.9%	59.3%
525	-	-	-	-	-	-	-
526	17.8%	-	-	-	-	17.8%	15.8%
533	-	-	-	-	-	-	-
534	-	-	-	-	-	-	-
537	-	-	-	-	-	-	-
538	-	-	-	-	-	-	-
539	-	-	-	-	-	-	-
541	-	-	-	-	-	-	-
542	-	-	-	-	-	-	-
543	-	-	-	-	-	-	-
551	-	112.9%	-	-	-	112.9%	123.2%
552	-	-	-	-	-	-	-
561	59.6%	5.2%	-	-	-	34.2%	64.1%
562	21.4%	-	-	-	-	21.4%	19.0%
611	-	-	-	-	-	-	-
612	-	-	-	-	-	-	-
613	-	-	-	-	-	-	-
614	-	-	-	-	-	-	-
615	-	-	-	-	-	-	-
616	-	-	-	-	-	-	-
621	-	-	-	-	-	-	-
622	-	-	-	-	-	-	-
623	-	-	-	-	-	-	-
624	-	-	-	-	-	-	-
Total	**33.2%**	**87.1%**	**8.5%**	**25.8%**	**0.0%**	**31.4%**	**33.8%**

Table 52: RAW 2003-2007 observed recaptures/movements into other statistical squares. Since 21 of these squares did not have releases, all future presentation of this data will focus on cells with more relevant data.

	Tag release areas																																						
	461	462	463	464	465	466	467	511	512	513	514	515	521	522	525	526	533	534	537	538	539	541	542	543	551	552	561	562	611	612	613	614	615	616	621	622	623	624	Total
461	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
462	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	5
463	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	11
464	0	0	0	0	0	19	11	21	0	3	0	5	3	33	2	0	0	0	0	0	0	0	0	0	0	0	55	18	0	0	0	0	0	0	0	0	0	0	170
465	0	0	0	0	0	34	14	30	0	1	0	1	1	3	0	0	0	0	0	0	0	0	0	0	2	1	9	3	0	0	0	0	0	0	0	0	0	0	99
466	0	0	0	0	0	401	36	14	0	3	0	1	3	5	0	0	0	0	0	0	0	0	0	0	0	0	7	2	0	0	0	0	0	0	0	0	0	0	472
467	0	0	0	0	0	219	21	4	0	1	0	0	0	4	0	0	0	0	0	0	0	0	0	0	1	0	6	5	0	0	0	0	0	0	0	0	0	0	261
511	0	0	0	0	0	10	9	3	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	25
512	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3
513	0	0	0	0	0	5	4	2	8	879	13	15	28	1	1	1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	961
514	0	0	0	0	0	0	2	2	4	307	62	13	308	2	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	702
515	0	0	0	0	0	0	0	0	0	11	1	12	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
521	0	0	0	0	0	0	1	0	0	27	1	6	1260	8	1	24	0	0	2	0	0	0	0	0	1	0	22	0	0	0	0	0	0	0	0	0	0	0	1353
522	0	0	0	0	0	5	3	1	0	13	1	15	87	44	2	2	0	0	0	0	0	0	0	0	0	0	48	14	0	0	0	0	0	0	0	0	0	0	235
525	0	0	0	0	0	0	0	0	0	1	0	1	37	5	2	2	0	0	0	0	0	0	0	0	0	0	10	7	0	0	0	0	0	0	0	0	0	0	65
526	0	0	0	0	0	0	0	0	0	1	0	0	52	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	57
533	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
534	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
537	0	0	0	0	0	0	0	0	0	0	0	0	22	0	0	0	0	0	10	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39
538	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
539	0	0	0	0	0	0	0	0	0	0	0	0	23	0	0	1	0	0	6	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44
541	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
542	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
543	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
551	0	0	0	0	0	15	2	5	0	3	0	1	18	86	17	0	0	0	1	0	0	0	0	0	1	0	163	61	0	0	0	0	0	0	0	0	0	0	373
552	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
561	0	0	0	0	0	1	0	3	0	0	0	1	14	17	1	0	0	0	0	0	0	0	0	0	0	0	127	22	0	0	0	0	0	0	0	0	0	0	186
562	0	0	0	0	0	0	0	0	0	1	0	0	4	7	1	1	0	0	0	0	0	0	0	0	0	0	31	37	0	0	0	0	0	0	0	0	0	0	82
611	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
612	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
613	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
614	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
615	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
616	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
621	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
622	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
623	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
624	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	714	104	85	13	1251	78	71	1885	221	28	33	0	0	19	0	22	0	0	0	5	1	494	170	0	0	0	0	0	0	0	0	0	0	5194

Table 53: Movement and mixing estimates for pooled 2003-2007 data: RAW, unweighted data versus, RAW recapture weighted data (A) and data weighted also by tag releases using the Survey biomass method (B), the Fishery data method (C) and the VPA biomass method (D). Values highlighted on the diagonal represent the resident fish.

	Tag release areas									
RAW - unweighted	466	467	513	514	521	522	551	552	561	562
466	56.2%	34.6%	0.2%	0.0%	0.2%	2.3%	0.0%	0.0%	1.4%	1.2%
467	30.7%	20.2%	0.1%	0.0%	0.0%	1.8%	20.0%	0.0%	1.2%	2.9%
513	0.7%	3.8%	70.3%	16.7%	1.5%	0.5%	0.0%	0.0%	0.8%	0.0%
514	0.0%	1.9%	24.5%	79.5%	16.3%	0.9%	0.0%	0.0%	0.2%	0.0%
521	0.0%	1.0%	2.2%	1.3%	66.8%	3.6%	20.0%	0.0%	4.5%	0.0%
522	0.7%	2.9%	1.0%	1.3%	4.6%	19.9%	0.0%	0.0%	9.7%	8.2%
551	2.1%	1.9%	0.2%	0.0%	1.0%	38.9%	20.0%	0.0%	33.0%	35.9%
552	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
561	0.1%	0.0%	0.0%	0.0%	0.7%	7.7%	0.0%	0.0%	25.7%	12.9%
562	0.0%	0.0%	0.1%	0.0%	0.2%	3.2%	0.0%	0.0%	6.3%	21.8%
Recaptured elsewhere	10%	34%	1%	1%	9%	21%	40%	100%	17%	17%

	Tag release areas									
A) RAW - weighted recaptures	466	467	513	514	521	522	551	552	561	562
466	83.1%	43.9%	0.2%	0.0%	0.6%	3.8%	0.0%	0.0%	3.3%	2.9%
467										
513	1.5%	6.9%	76.1%	19.8%	8.0%	1.1%	0.0%	0.0%	2.7%	0.0%
514	0.0%	2.9%	22.0%	78.1%	73.0%	1.8%	0.0%	0.0%	0.6%	0.0%
521										
522	0.9%	3.1%	0.7%	0.9%	14.8%	28.4%	0.0%	0.0%	19.3%	17.2%
551	1.9%	1.5%	0.1%	0.0%	2.3%	41.0%	24.6%	0.0%	48.3%	55.2%
552	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
561										
562										
Recaptured elsewhere	13%	42%	1%	1%	1%	24%	75%	100%	26%	25%

	Tag release areas									
B) Survey weighted	466	467	513	514	521	522	551	552	561	562
466	97.5%	81.5%	0.3%	0.0%	3.7%	20.7%	0.0%		21.8%	26.2%
467										
513	1.6%	12.0%	98.2%	88.9%	45.7%	5.5%	0.0%		16.5%	0.0%
514	0.0%	0.1%	0.5%	5.7%	6.7%	0.1%	0.0%		0.1%	0.0%
521										
522	0.5%	2.7%	0.4%	2.0%	42.2%	71.7%	0.0%		59.0%	72.2%
551	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	100.0%		0.1%	0.2%
552	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%
561										
562										
Recaptured elsewhere	0%	4%	1%	3%	2%	2%	0%	100%	2%	1%

	Tag release areas									
C) Fishery weighted	466	467	513	514	521	522	551	552	561	562
466	88.2%	43.7%	0.1%	0.0%	2.1%	13.7%	0.0%		15.2%	21.6%
467										
513	2.8%	12.4%	97.9%	82.4%	49.4%	7.0%	0.0%		22.1%	0.0%
514	0.0%	0.2%	1.2%	13.9%	19.3%	0.5%	0.0%		0.2%	0.0%
521										
522	0.5%	1.7%	0.3%	1.1%	27.5%	54.8%	0.0%		47.4%	68.7%
551	0.0%	0.0%	0.0%	0.0%	0.2%	3.1%	100.0%		4.7%	8.7%
552	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%		0.0%	0.0%
561										
562										
Recaptured elsewhere	8%	42%	0%	3%	1%	21%	0%	100%	10%	1%

	Tag release areas									
D) VPA weighted	466	467	513	514	521	522	551	552	561	562
466	96.6%	74.2%	0.6%	0.0%	9.2%	38.1%	0.0%		35.7%	50.7%
467										
513	0.6%	4.2%	96.4%	82.5%	43.5%	3.9%	0.0%		10.3%	0.0%
514	0.0%	0.0%	0.4%	4.3%	5.3%	0.1%	0.0%		0.0%	0.0%
521										
522	0.2%	0.8%	0.4%	1.7%	36.4%	45.8%	0.0%		33.4%	48.4%
551	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	100.0%		0.1%	0.3%
552	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%
561										
562										
Recaptured elsewhere	3%	21%	2%	11%	6%	12%	0%	100%	20%	1%

H. Released and recaptured in 2003.

Table 54: Weighting of RELEASES (2003).

RELEASES (#s)					Re-distribution of releases after weighting		
	RAW (all tags)	RAW (High Reward only)	RAW (Low Reward only)	RAW (LR) less tag losses	Survey (Biomass)	Fishing (Catch)	VPA (Biomass)
461	0	0	0	0	-	-	-
462	6	0	6	5	9	1990	557
463	0	0	0	0	-	-	-
464	83	0	83	64	788	3265	1242
465	0	0	0	0	-	-	-
466	3670	126	3670	2881	342	1789	215
467	1020	63	1020	803	695	1230	193
511	2085	33	2085	1641	1485	279	119
512	200	6	200	156	80	115	3
513	8065	1025	8065	6345	1528	3610	1908
514	0	84	0	0	-	-	-
515	1586	56	1586	1248	273	925	120
521	23039	401	23039	18118	395	8405	6121
522	1875	295	1875	1476	804	2433	795
525	597	0	597	470	1620	1968	1997
526	729	16	729	573	85	423	22
533	0	0	0	0	-	-	-
534	0	0	0	0	-	-	-
537	59	0	59	46	7	262	9
538	0	0	0	0	-	-	-
539	0	0	0	0	-	-	-
541	0	0	0	0	-	-	-
542	0	0	0	0	-	-	-
543	0	0	0	0	-	-	-
551	0	12	0	0	-	-	-
552	0	5	0	0	-	-	-
561	1635	50	1635	1281	1162	530	45
562	2565	65	2565	2004	1234	1406	521
611	0	0	0	0	-	-	-
612	0	0	0	0	-	-	-
613	0	0	0	0	-	-	-
614	0	0	0	0	-	-	-
615	0	0	0	0	-	-	-
616	0	0	0	0	-	-	-
621	0	0	0	0	-	-	-
622	0	0	0	0	-	-	-
623	0	0	0	0	-	-	-
624	0	0	0	0	-	-	-
Total	**47214**	**2237**	**47214**	**37112**	**10506**	**28632**	**13866**

Table 55: Reporting rates for each statistical square, by gear (2003); facilitated using extrapolated high-reward return rates from May 2004 onwards, since no high reward tags were released in 2003 and thus, a reporting rate could not have been calculated otherwise.

REPORTING RATES BY GEAR (%s) - corrected by HR tag returns							
	Trawl	Comm Hook	Rec Hook	Gillnet	Trap	Gears totaled	Overall (gear not specified)
461	-	-	-	-	-	-	-
462	-	-	-	-	-	-	-
463	-	-	-	-	-	-	-
464	-	-	-	-	-	-	-
465	-	-	-	-	-	-	-
466	30.4%	30.4%	-	3.4%	0.0%	28.9%	31.2%
467	4.0%	-	-	-	-	4.0%	4.0%
511	3.2%	-	-	-	-	3.2%	3.2%
512	-	-	-	-	-	-	-
513	16.2%	18.7%	13.4%	8.5%	0.0%	13.2%	13.6%
514	-	-	-	-	-	-	-
515	13.9%	0.0%	-	-	-	6.9%	6.9%
521	12.7%	21.9%	1.8%	6.4%	0.0%	7.4%	15.1%
522	34.8%	-	-	-	-	34.8%	42.5%
525	-	-	-	-	-	-	-
526	-	-	-	-	-	-	-
533	-	-	-	-	-	-	-
534	-	-	-	-	-	-	-
537	-	-	-	-	-	-	-
538	-	-	-	-	-	-	-
539	-	-	-	-	-	-	-
541	-	-	-	-	-	-	-
542	-	-	-	-	-	-	-
543	-	-	-	-	-	-	-
551	-	-	-	-	-	-	-
552	-	-	-	-	-	-	-
561	3.0%	-	-	-	-	3.0%	3.0%
562	5.2%	-	-	-	-	5.2%	5.2%
611	-	-	-	-	-	-	-
612	-	-	-	-	-	-	-
613	-	-	-	-	-	-	-
614	-	-	-	-	-	-	-
615	-	-	-	-	-	-	-
616	-	-	-	-	-	-	-
621	-	-	-	-	-	-	-
622	-	-	-	-	-	-	-
623	-	-	-	-	-	-	-
624	-	-	-	-	-	-	-
Total	**14.9%**	**35.4%**	**99.4%**	**6.1%**	**0.0%**	**11.5%**	**13.5%**

Table 56: RAW 2003 observed recaptures/movements into other statistical squares. Since 25 of these squares did not have releases, all future presentation of this data will focus on cells with more relevant data.

	Tag release areas																																							
	461	462	463	464	465	466	467	511	512	513	514	515	521	522	525	526	533	534	537	538	539	541	542	543	551	552	561	562	611	612	613	614	615	616	621	622	623	624	Total
461	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
462	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2
463	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
464	0	0	0	0	0	1	0	2	0	0	0	0	0	12	1	0	0	0	0	0	0	0	0	0	0	0	9	4	0	0	0	0	0	0	0	0	0	0	29
465	0	0	0	0	0	5	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
466	0	0	0	0	0	166	0	8	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	177
467	0	0	0	0	0	89	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	97
511	0	0	0	0	0	3	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
512	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
513	0	0	0	0	0	1	0	1	3	109	0	4	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	121
514	0	0	0	0	0	0	0	0	0	31	0	1	23	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	56
515	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
521	0	0	0	0	0	0	0	0	0	2	0	1	159	1	0	7	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	172
522	0	0	0	0	0	1	0	0	0	1	0	1	3	11	1	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	21
525	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	5
526	0	0	0	0	0	0	0	0	0	0	0	0	11	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
533	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
534	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
537	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
538	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
539	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
541	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
542	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
543	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
551	0	0	0	0	0	5	0	1	0	1	0	0	1	18	7	0	0	0	0	0	0	0	0	0	0	0	12	23	0	0	0	0	0	0	0	0	0	0	68
552	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
561	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	1	10	0	0	0	0	0	0	0	0	0	0	14
562	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	1	0	0	0	0	0	0	0	0	0	0	4	22	0	0	0	0	0	0	0	0	0	0	31
611	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
612	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
613	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
614	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
615	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
616	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
621	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
622	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
623	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
624	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	272	2	14	3	145	0	11	201	56	15	8	0	0	2	0	0	0	0	0	0	0	30	68	0	0	0	0	0	0	0	0	0	0	827

Table 57: Movement and mixing estimates for 2003 data: RAW, unweighted data versus, RAW recapture weighted data (A) and data weighted also by tag releases using the Survey biomass method (B), the Fishery data method (C) and the VPA biomass method (D). Values highlighted on the diagonal represent the resident fish.

	Tag release areas									
RAW - unweighted	466	467	513	514	521	522	551	552	561	562
466	61.0%	0.0%	0.0%		0.0%	1.8%			3.3%	1.5%
467	32.7%	100.0%	0.0%		0.0%	5.4%			3.3%	2.9%
513	0.4%	0.0%	75.2%		1.0%	0.0%			0.0%	0.0%
514	0.0%	0.0%	21.4%		11.4%	1.8%			0.0%	0.0%
521	0.0%	0.0%	1.4%		79.1%	1.8%			6.7%	0.0%
522	0.4%	0.0%	0.7%		1.5%	19.6%			0.0%	4.4%
551	1.8%	0.0%	0.7%		0.5%	32.1%			40.0%	33.8%
552	0.0%	0.0%	0.0%		0.0%	0.0%			0.0%	0.0%
561	0.0%	0.0%	0.0%		0.0%	3.6%			3.3%	14.7%
562	0.0%	0.0%	0.0%		0.0%	5.4%			13.3%	32.4%
Recaptured elsewhere	4%	0%	1%	100%	6%	29%	100%	100%	30%	10%

	Tag release areas									
A) RAW - weighted recaptures	466	467	513	514	521	522	551	552	561	562
466	90.6%		0.0%		0.0%	2.7%			4.3%	3.1%
467										
513	0.7%		77.7%		8.0%	0.0%			0.0%	0.0%
514	0.0%		21.2%		88.4%	3.5%			0.0%	0.0%
521										
522										
551	3.3%		0.6%		3.6%	59.4%			62.5%	86.3%
552	0.0%		0.0%		0.0%	0.0%			0.0%	0.0%
561										
562										
Recaptured elsewhere	5%	100%	1%	100%	0%	34%	100%	100%	33%	11%

	Tag release areas									
B) Survey weighted	466	467	513	514	521	522	551	552	561	562
466	99.3%		0.0%		0.0%	78.7%			93.0%	96.8%
467										
513	0.4%		100.0%		100.0%	0.0%			0.0%	0.0%
514										
521										
522										
551										
552										
561										
562										
Recaptured elsewhere	0%	100%	0%	100%	0%	21%	100%	100%	7%	3%

	Tag release areas									
C) Fishery weighted	466	467	513	514	521	522	551	552	561	562
466	91.3%		0.0%		0.0%	17.0%			91.3%	96.0%
467										
513	0.8%		100.0%		100.0%	0.0%			0.0%	0.0%
514										
521										
522										
551										
552										
561										
562										
Recaptured elsewhere	8%	100%	0%	100%	0%	83%	100%	100%	9%	4%

	Tag release areas									
D) VPA weighted	466	467	513	514	521	522	551	552	561	562
466	97.4%		0.0%		0.0%	42.0%			97.1%	98.7%
467										
513	0.2%		100.0%		100.0%	0.0%			0.0%	0.0%
514										
521										
522										
551										
552										
561										
562										
Recaptured elsewhere	2%	100%	0%	100%	0%	58%	100%	100%	3%	1%

I. Released and recaptured in 2004.

Table 58: Weighting of RELEASES (2004).

RELEASES (#s)					Re-distribution of releases after weighting		
	RAW (all tags)	RAW (High Reward only)	RAW (Low Reward only)	RAW (LR) less tag losses	Survey (Biomass)	Fishing (Catch)	VPA (Biomass)
461	0	0	0	0	-	-	-
462	0	0	0	0	-	-	-
463	0	0	0	0	-	-	-
464	0	0	0	0	-	-	-
465	0	0	0	0	-	-	-
466	1225	2	1101	868	431	2322	299
467	628	1	566	446	877	1952	347
511	336	0	303	239	1874	310	154
512	102	0	96	75	101	187	5
513	8356	394	7725	6125	1928	3457	1771
514	1453	24	1393	1124	10108	6469	11647
515	812	0	756	596	344	701	77
521	34476	35	34110	27122	499	12643	10663
522	3384	1	3090	2649	1015	2943	928
525	3	0	3	2	2044	1857	1844
526	403	0	387	304	108	209	7
533	0	0	0	0	-	-	-
534	0	0	0	0	-	-	-
537	201	0	201	157	9	1855	355
538	0	0	0	0	-	-	-
539	81	0	81	64	225	62	1
541	0	0	0	0	-	-	-
542	0	0	0	0	-	-	-
543	0	0	0	0	-	-	-
551	0	12	0	0	-	-	-
552	0	5	0	0	-	-	-
561	8205	1	8156	6374	1466	538	50
562	882	36	853	696	1557	2497	960
611	0	0	0	0	-	-	-
612	0	0	0	0	-	-	-
613	0	0	0	0	-	-	-
614	0	0	0	0	-	-	-
615	0	0	0	0	-	-	-
616	0	0	0	0	-	-	-
621	0	0	0	0	-	-	-
622	0	0	0	0	-	-	-
623	0	0	0	0	-	-	-
624	0	0	0	0	-	-	-
Total	**60547**	**511**	**58821**	**46842**	**22587**	**38001**	**29107**

Table 59: Reporting rates for each statistical square, by gear (2004).

REPORTING RATES BY GEAR (%s) - corrected by HR tag returns							
	Trawl	Comm Hook	Rec Hook	Gillnet	Trap	Gears totaled	Overall (gear not specified)
461	-	-	-	-	-	-	-
462	-	-	-	-	-	-	-
463	-	-	-	-	-	-	-
464	-	-	-	-	-	-	-
465	-	-	-	-	-	-	-
466	2.8%	0.5%	-	0.8%	0.0%	2.6%	6.6%
467	1.4%	-	-	-	-	1.4%	1.4%
511	-	-	-	-	-	-	-
512	-	-	-	-	-	-	-
513	31.7%	29.1%	52.2%	52.7%	0.0%	39.8%	21.3%
514	-	-	17.3%	5.0%	0.0%	15.7%	8.3%
515	-	-	-	-	-	-	-
521	0.3%	11.6%	1.0%	0.5%	0.0%	0.9%	3.1%
522	0.0%	-	-	-	-	0.0%	0.1%
525	-	-	-	-	-	-	-
526	-	-	-	-	-	-	-
533	-	-	-	-	-	-	-
534	-	-	-	-	-	-	-
537	-	-	-	-	-	-	-
538	-	-	-	-	-	-	-
539	-	-	-	-	-	-	-
541	-	-	-	-	-	-	-
542	-	-	-	-	-	-	-
543	-	-	-	-	-	-	-
551	-	-	-	-	-	-	-
552	-	-	-	-	-	-	-
561	1.3%	-	-	-	-	1.3%	0.1%
562	13.3%	-	-	-	-	13.3%	27.5%
611	-	-	-	-	-	-	-
612	-	-	-	-	-	-	-
613	-	-	-	-	-	-	-
614	-	-	-	-	-	-	-
615	-	-	-	-	-	-	-
616	-	-	-	-	-	-	-
621	-	-	-	-	-	-	-
622	-	-	-	-	-	-	-
623	-	-	-	-	-	-	-
624	-	-	-	-	-	-	-
Total	**6.7%**	**42.1%**	**8.9%**	**5.1%**	**0.0%**	**8.4%**	**8.8%**

Table 60: RAW 2004 observed recaptures/movements into other statistical squares. Since 25 of these squares did not have releases, all future presentation of this data will focus on cells with more relevant data.

	Tag release areas																																						
	461	462	463	464	465	466	467	511	512	513	514	515	521	522	525	526	533	534	537	538	539	541	542	543	551	552	561	562	611	612	613	614	615	616	621	622	623	624	Total
461	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
462	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
463	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
464	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	29	0	0	0	0	0	0	0	0	0	0	0	33
465	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	9
466	0	0	0	0	0	96	4	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	107
467	0	0	0	0	0	52	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	58
511	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	6
512	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
513	0	0	0	0	0	0	1	0	0	111	3	2	5	1	0	1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	128
514	0	0	0	0	0	0	0	0	0	43	15	0	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	81
515	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
521	0	0	0	0	0	0	0	0	0	3	1	1	219	2	0	2	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	241
522	0	0	0	0	0	0	0	0	0	0	0	0	6	4	0	0	0	0	0	0	0	0	0	0	0	0	11	2	0	0	0	0	0	0	0	0	0	0	23
525	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	8
526	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
533	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
534	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
537	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
538	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
539	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
541	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
542	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
543	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
551	0	0	0	0	0	2	1	1	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	75	13	0	0	0	0	0	0	0	0	0	0	102
552	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
561	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	92	1	0	0	0	0	0	0	0	0	0	0	93
562	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0	0	0	0	0	0	0	21
611	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
612	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
613	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
614	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
615	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
616	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
621	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
622	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
623	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
624	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	154	12	1	0	159	19	3	264	22	0	3	0	0	2	0	4	0	0	0	0	0	269	16	0	0	0	0	0	0	0	0	0	0	928

Table 61: Movement and mixing estimates for pooled 2004 data: RAW, unweighted data versus, RAW recapture weighted data (A) and data weighted also by tag releases using the Survey biomass method (B), the Fishery data method (C) and the VPA biomass method (D). Values highlighted on the diagonal represent the resident fish.

	Tag release areas									
RAW - unweighted	466	467	513	514	521	522	551	552	561	562
466	62.3%	33.3%	0.6%	0.0%	0.0%	4.5%			1.9%	0.0%
467	33.8%	25.0%	0.0%	0.0%	0.0%	0.0%			1.1%	0.0%
513	0.0%	8.3%	69.8%	15.8%	1.9%	4.5%			1.5%	0.0%
514	0.0%	0.0%	27.0%	78.9%	8.7%	0.0%			0.0%	0.0%
521	0.0%	0.0%	1.9%	5.3%	83.0%	9.1%			4.8%	0.0%
522	0.0%	0.0%	0.0%	0.0%	2.3%	18.2%			4.1%	12.5%
551	1.3%	8.3%	0.0%	0.0%	0.0%	45.5%			27.9%	81.3%
552	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			0.0%	0.0%
561	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			34.2%	6.3%
562	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			7.8%	0.0%
Recaptured elsewhere	3%	25%	1%	0%	4%	18%	100%	100%	17%	0%

	Tag release areas									
A) RAW - weighted recaptures	466	467	513	514	521	522	551	552	561	562
466										
467										
513										
514	0.0%	0.0%	97.7%	100.0%	100.0%	0.0%			0.0%	0.0%
521										
522										
551	23.5%	14.1%	0.0%	0.0%	0.0%	67.0%			60.8%	100.0%
552	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			0.0%	0.0%
561										
562										
Recaptured elsewhere	77%	86%	2%	0%	0%	33%	100%	100%	39%	0%

	Tag release areas									
B) Survey weighted	466	467	513	514	521	522	551	552	561	562
466										
467										
513										
514	0.0%	0.0%	73.1%	100.0%	100.0%				0.0%	
521										
522										
551										
552										
561										
562										
Recaptured elsewhere	100%	100%	27%	0%	0%	100%	100%	100%	100%	100%

	Tag release areas									
C) Fishery weighted	466	467	513	514	521	522	551	552	561	562
466										
467										
513										
514	0.0%	0.0%	89.7%	100.0%	100.0%				0.0%	
521										
522										
551										
552										
561										
562										
Recaptured elsewhere	100%	100%	10%	0%	0%	100%	100%	100%	100%	100%

	Tag release areas									
D) VPA weighted	466	467	513	514	521	522	551	552	561	562
466										
467										
513										
514	0.0%	0.0%	34.6%	100.0%	100.0%				0.0%	
521										
522										
551										
552										
561										
562										
Recaptured elsewhere	100%	100%	65%	0%	0%	100%	100%	100%	100%	100%

J. Released and recaptured in 2005.

Table 62: Weighting of RELEASES (2005).

RELEASES (#s)					Re-distribution of releases after weighting		
	RAW (all tags)	RAW (High Reward only)	RAW (Low Reward only)	RAW (LR) less tag losses	Survey (Biomass)	Fishing (Catch)	VPA (Biomass)
461	0	0	0	0	-	-	-
462	0	0	0	0	-	-	-
463	0	0	0	0	-	-	-
464	0	0	0	0	-	-	-
465	0	0	0	0	-	-	-
466	14	2	12	9	46	124	10
467	14	1	13	10	94	96	13
511	0	0	0	0	-	-	-
512	0	0	0	0	-	-	-
513	3980	394	3586	3184	206	481	252
514	247	24	223	203	1079	910	1468
515	0	0	0	0	-	-	-
521	1087	35	1052	916	53	1281	964
522	11	1	10	9	108	424	147
525	0	0	0	0	-	-	-
526	0	0	0	0	-	-	-
533	0	0	0	0	-	-	-
534	0	0	0	0	-	-	-
537	79	0	79	62	1	149	20
538	0	0	0	0	-	-	-
539	284	0	284	222	24	7	0
541	0	0	0	0	-	-	-
542	0	0	0	0	-	-	-
543	0	0	0	0	-	-	-
551	119	12	107	84	2315	154	1423
552	47	5	42	33	166	4	9
561	6	1	5	5	156	15	3
562	367	36	331	261	166	105	38
611	0	0	0	0	-	-	-
612	0	0	0	0	-	-	-
613	0	0	0	0	-	-	-
614	0	0	0	0	-	-	-
615	0	0	0	0	-	-	-
616	0	0	0	0	-	-	-
621	0	0	0	0	-	-	-
622	0	0	0	0	-	-	-
623	0	0	0	0	-	-	-
624	0	0	0	0	-	-	-
Total	**6255**	**511**	**5744**	**4999**	**4415**	**3750**	**4349**

Table 63: Reporting rates for each statistical square, by gear (2005).

REPORTING RATES BY GEAR (%s) - corrected by HR tag returns							
	Trawl	Comm Hook	Rec Hook	Gillnet	Trap	Gears totaled	Overall (gear not specified)
461	-	-	-	-	-	-	-
462	-	-	-	-	-	-	-
463	-	-	-	-	-	-	-
464	-	-	-	-	-	-	-
465	-	-	-	-	-	-	-
466	110.9%	-	-	0.0%	0.0%	88.7%	88.7%
467	60.7%	-	-	-	-	60.7%	60.7%
511	-	-	-	-	-	-	-
512	-	-	-	-	-	-	-
513	50.9%	57.4%	77.2%	36.2%	0.0%	54.7%	54.9%
514	45.7%	97.1%	59.5%	60.3%	0.0%	60.3%	67.1%
515	-	-	-	-	-	-	-
521	119.4%	136.0%	21.3%	75.4%	0.0%	84.4%	112.5%
522	170.0%	90.2%	-	-	-	163.1%	178.5%
525	-	-	-	-	-	-	-
526	-	-	-	-	-	-	-
533	-	-	-	-	-	-	-
534	-	-	-	-	-	-	-
537	-	-	-	-	-	-	-
538	-	-	-	-	-	-	-
539	-	-	-	-	-	-	-
541	-	-	-	-	-	-	-
542	-	-	-	-	-	-	-
543	-	-	-	-	-	-	-
551	-	-	-	-	-	-	-
552	-	-	-	-	-	-	-
561	174.1%	180.5%	-	-	-	176.0%	160.3%
562	-	-	-	-	-	-	100.5%
611	-	-	-	-	-	-	-
612	-	-	-	-	-	-	-
613	-	-	-	-	-	-	-
614	-	-	-	-	-	-	-
615	-	-	-	-	-	-	-
616	-	-	-	-	-	-	-
621	-	-	-	-	-	-	-
622	-	-	-	-	-	-	-
623	-	-	-	-	-	-	-
624	-	-	-	-	-	-	-
Total	**87.9%**	**215.0%**	**11.2%**	**77.2%**	**0.0%**	**86.9%**	**93.1%**

Table 64: RAW 2005 observed recaptures/movements into other statistical squares. Since 29 of these squares did not have releases, all future presentation of this data will focus on cells with more relevant data.

	Tag release areas																																						
	461	462	463	464	465	466	467	511	512	513	514	515	521	522	525	526	533	534	537	538	539	541	542	543	551	552	561	562	611	612	613	614	615	616	621	622	623	624	Total
461	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
462	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
463	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
464	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
465	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
466	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
467	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
511	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
512	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
513	0	0	0	0	0	0	0	0	0	147	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	152
514	0	0	0	0	0	0	0	0	0	29	3	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41
515	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
521	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	15
522	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
525	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3
526	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
533	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
534	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
537	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
538	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
539	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
541	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
542	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
543	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
551	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	4
552	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
561	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
562	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
611	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
612	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
613	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
614	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
615	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
616	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
621	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
622	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
623	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
624	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	176	8	0	26	1	0	0	0	0	2	0	7	0	0	0	2	1	0	7	0	0	0	0	0	0	0	0	0	0	230

Table 65: Movement and mixing estimates for pooled 2005 data: RAW, unweighted data versus, RAW recapture weighted data (A) and data weighted also by tag releases using the Survey biomass method (B), the Fishery data method (C) and the VPA biomass method (D). Values highlighted on the diagonal represent the resident fish.

	Tag release areas									
RAW - unweighted	466	467	513	514	521	522	551	552	561	562
466			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		0.0%
467			0.0%	0.0%	0.0%	0.0%	50.0%	0.0%		0.0%
513			83.5%	62.5%	0.0%	0.0%	0.0%	0.0%		0.0%
514			16.5%	37.5%	34.6%	0.0%	0.0%	0.0%		0.0%
521			0.0%	0.0%	53.8%	0.0%	50.0%	0.0%		0.0%
522			0.0%	0.0%	7.7%	100.0%	0.0%	0.0%		0.0%
551			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		57.1%
552			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		0.0%
561			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		0.0%
562			0.0%	0.0%	3.8%	0.0%	0.0%	0.0%		0.0%
Recaptured elsewhere	100%	100%	0%	0%	0%	0%	0%	100%	100%	43%

	Tag release areas									
A) RAW - weighted recaptures	466	467	513	514	521	522	551	552	561	562
466										
467										
513										
514			100.0%	100.0%	100.0%			0.0%		0.0%
521										
522										
551			0.0%	0.0%	0.0%			0.0%		100.0%
552			0.0%	0.0%	0.0%			0.0%		0.0%
561										
562										
Recaptured elsewhere	100%	100%	0%	0%	0%	100%	100%	100%	100%	0%

	Tag release areas									
B) Survey weighted	466	467	513	514	521	522	551	552	561	562
466										
467										
513										
514			100.0%	100.0%	100.0%					0.0%
521										
522										
551			0.0%	0.0%	0.0%					100.0%
552			0.0%	0.0%	0.0%					0.0%
561										
562										
Recaptured elsewhere	100%	100%	0%	0%	0%	100%	100%	100%	100%	0%

	Tag release areas									
C) Fishery weighted	466	467	513	514	521	522	551	552	561	562
466										
467										
513										
514			100.0%	100.0%	100.0%					0.0%
521										
522										
551			0.0%	0.0%	0.0%					100.0%
552			0.0%	0.0%	0.0%					0.0%
561										
562										
Recaptured elsewhere	100%	100%	0%	0%	0%	100%	100%	100%	100%	0%

	Tag release areas									
D) VPA weighted	466	467	513	514	521	522	551	552	561	562
466										
467										
513										
514			100.0%	100.0%	100.0%					0.0%
521										
522										
551			0.0%	0.0%	0.0%					100.0%
552			0.0%	0.0%	0.0%					0.0%
561										
562										
Recaptured elsewhere	100%	100%	0%	0%	0%	100%	100%	100%	100%	0%