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Exploitation and movements of Atlantic cod (*Gadus morhua*) in NAFO Divs. 3KL: further updates based on tag returns during 1995-2004

Exploitation et déplacements de la morue franche (*Gadus morhua*) dans les divisions 3KL de l'OPANO : nouvelles données fondées sur les morues marquées recapturées de 1995 à 2004

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ABSTRACT

During 1997-2002, a mark-recapture study was used to provide information on cod stock structure and migration patterns and estimates of exploitation for cod in the inshore of NAFO Divs. 3KL. However, the directed cod fishery in 2J+3KL was closed during 2003 and 2004 and reported landings of cod were reduced substantially. Most (82%) of the landings in 2003 (1,041 t) came from a fish-kill in Smith Sound in April, and almost all of the landings in 2004 (629 t) came from the winter flounder, *Pseudopleuronectes americanus* (Blackback flounder) fishery in July and August. These fisheries resulted in a total of 497 tag returns from 3KL in 2003 (with 418 from the fish kill in Smith Sound alone) and only 66 returns in 2004, substantially less than the annual totals for the preceding five years. We used these tag returns to estimate annual exploitation rates for 2003 and 2004, using methods described in our previous documents. Estimates of exploitation for 2003 for cod tagged in 3K or 3La were low (<5%), but were marginally higher (5-8%) for some groups of cod tagged in southern 3L (3Lq) due to recaptures in the neighbouring stock area where the directed cod fishery remains open. A notable result was the high 2003 estimates (10-24%) for 11 of 22 experiments that involved release of tagged cod in 3Lb during 1999-2002; most of the tag returns came from the fish kill in Smith Sound. This result indicates that the fish kill resulted in mortality of a substantial proportion of the cod that had been tagged in the local area in recent years. None of the tagged cod found during the fish kill had been in tagged in 3Ps or in 4RS3Pn. All of the estimates of exploitation for 2004 were low (<6%). Estimates of exploitation for the period 1997 to 2002 were also updated, but showed only minor differences from those reported in our previous analyses. These observations lend further support to our previous conclusion that there is a resident inshore component within the northern cod stock area. Tagging results from the period 1995-2004 indicate that this stock component largely remains within an area bounded by the 3Kd/3Ki border in the north and the 3Lb/3Lf border to the south. Southern 3L (3Lf/j/q) appears to be inhabited mainly by seasonal migrants from neighbouring 3Ps that return to that area during late fall and winter.

RÉSUMÉ

De 1997 à 2002, une étude de marquage-recapture a été réalisée pour obtenir de l'information sur la structure et les migrations des stocks de morue, ainsi que pour estimer l'exploitation de la morue dans les eaux côtières des divisions 3KL de l'OPANO. Toutefois, comme la pêche dirigée de la morue dans 2J et 3KL était fermée en 2003 et en 2004, les débarquements de morue déclarés ont baissé considérablement. La plupart (82 %) des morues débarquées en 2003 (1 041 t) provenaient d'une hécatombe de poissons qui s'est produite en avril dans le détroit Smith, tandis que presque tous les débarquements de 2004 (629 t) provenaient de la pêche à la plie rouge (*Pseudopleuronectes americanus*) en juillet et en août. Au total, 497 morues marquées ont été recapturées dans 3KL en 2003 (dont 418 provenaient de l'hécatombe du détroit Smith), et seulement 66 ont été recapturées en 2004, soit beaucoup moins que les totaux annuels des cinq années précédentes. Nous avons utilisé ces données de recaptures pour estimer les taux d'exploitation annuels de 2003 et de 2004 à l'aide des méthodes décrites dans nos documents antérieurs. Les estimations des taux d'exploitation de 2003 pour les morues marquées dans 3K ou 3La sont faibles (< 5 %), mais légèrement plus élevées (5 à 8 %) pour certains groupes de morues marquées dans le sud de la division 3L (3Lq) en raison des recaptures faites dans la zone de stock voisine où la pêche dirigée de la morue est restée ouverte. Résultat notable, les taux estimés pour 2003 sont élevés (10 à 24 %) pour 11 des 22 expériences de marquage de morues réalisées dans 3Lb de 1999 à 2002; la plupart des recaptures provenaient de l'hécatombe de poissons dans le détroit Smith. Ce résultat indique que l'hécatombe a touché une proportion considérable des morues marquées dans le secteur les années précédentes. Aucune des morues marquées recueillies lors de l'hécatombe n'avait été marquée dans 3Ps ou dans 4RS3Pn. Toutes les estimations du taux d'exploitation en 2004 sont faibles (< 6 %). Les taux d'exploitation estimés pour la période 1997-2002 ont été recalculés, mais cela n'a donné que des différences mineures par rapport aux taux calculés dans nos analyses antérieures. Ces observations corroborent notre conclusion antérieure selon laquelle le stock de morue du Nord comprend une composante côtière résidante. Les résultats de marquage-recapture pour la période 1995-2004 indiquent que cette composante du stock reste surtout dans une zone délimitée par la limite entre 3Kd et 3Ki au nord et la limite entre 3Lb et 3Lf au sud. La partie sud de 3L (3Lfjq) semble être peuplée surtout de morues qui y effectuent une migration saisonnière et retournent dans la sous-division 3Ps voisine à la fin de l'automne et à l'hiver.

INTRODUCTION

This document updates the results from a mark-recapture study of Atlantic cod (*Gadus morhua*) initiated during 1997 in NAFO Divs. 3KL and Subdiv. 3Ps. The purpose of the study is to provide information on movement patterns and stock structure of inshore cod and obtain estimates of exploitation rates on cod tagged in different inshore regions. Previous findings are reported in Brattey (1999, 2000), Brattey et al. (1999), Brattey and Healey (2003, 2004a), Brattey and Cadigan (2004), Cadigan and Brattey (1999a, b; 2000a, b; 2002; 2003a, b), Lawson and Rose (2000), and Lilly et al. (2001).

The directed cod fishery in NAFO Divs. 2J+3KL was closed during 2003 and 2004 and reported landings of cod (and hence tag returns) were reduced substantially compared to the 1998-2002 period. Tag returns received during 2003 and 2004 were used to estimate annual exploitation rates for those years and update our estimates for previous years. We also provide an updated synopsis of the spatial and temporal distribution of recaptures of tagged cod released in various regions of Divs. 3KL during 1997-2004. A fish kill in Smith Sound, Trinity Bay (Fig. 1) in spring 2003 provided a useful source of tag returns as harvesters were permitted to collect dead and dying cod as they rose to the surface; biological sampling of these landings (reported in Lilly et al. 2004) and information from tag returns reported herein provided useful new information about the origins of cod inhabiting Smith Sound in spring when the fishery would normally be closed. Historical cod tagging studies (prior to 1994) in the Newfoundland Region are summarized in Taggart (1997), Taggart et al. (1995), and Myers et al. (1996, 1997).

Materials and Methods

Cod for tagging were captured with various gears (mostly hand-line), measured (nearest cm) and tagged with one or two t-bar anchor tags inserted at the base of the first dorsal fin, and released. Prior to 1997 most cod were tagged with single red t-bar anchor tags and most of the tagging was done by sentinel fishermen. The exception was cod tagging in Trinity Bay in 1995 which was conducted by experienced technicians and involved yellow tags identical to those used from 1997 onwards. There was no commercial fishery in 3KL in 1995-1997 and the main source of tag returns was the recreational and/or sentinel fishery. Data from cod tagged prior to 1997 were used to illustrate cod movement patterns, but not for quantitative analyses as no estimates of tag loss or reporting rates were available for this time period.

Experienced technicians conducted the tagging from 1997 onwards. Only cod ≥45 cm fork length (FL) were tagged and each batch of cod typically consisted of individuals tagged with single or double tags. The tags were uniquely numbered and bore a return address as well as the value of the reward ($10 for one single, $20 for two singles, or $100 for high-reward). The tagging program was advertised extensively among those participating in the fishery. Details of the tagging experiments are summarized in Tables 1A and 1B. The number of cod tagged each year was variable, ranging from a low of only 118 in 1998 to a high of 8,420 in 1999. In 2003 only 472 cod were tagged and in 2004 only 932 were tagged, all in Smith Sound. The sizes of tagged cod ranged from 45 cm to about 115 cm, with mean lengths mostly in the 55-65 cm range. Since 1995,

tagging experiments have been conducted at various sites from Notre Dame Bay (3Kh/i) in the north to St. Mary's Bay (3Lq) in the south (Fig. 1).

Reported landings of cod from 3KL during the period 1998-2004 were extracted from the Statistics Branch catch database and are summarized to aid in the interpretation of tag returns. Landings for the adjacent management units (3Ps and 4RS+3Pn) are also given for the period 1997-2003. Final landings for these stocks for 2004 were not available, although the TAC's in the 2004-2005 management year were 15,000 t and 3,500 t, respectively

Estimation of exploitation rates

The methods used to estimate annual exploitation rates for each batch of tagged cod are identical to those described in Brattey and Healey (2004a) and are not repeated here. Updated estimates of tag loss were incorporated into the estimates, and these showed only minor changes and are also not given here. Reporting rate estimates for each year and region were calculated using methods described in Cadigan and Brattey (2003b) and are updated in Table 2. Note that in some years some tagged fish were released during the fishery and the first estimate of exploitation for these releases accounts for only a portion of the total exploitation in that year.

Many of the tagging experiments now have long (> 6 yrs) times at liberty and some of the earlier experiments likely have relatively few tagged cod still available for recapture, due to the combined effects of fishing, natural mortality, and tag loss. The remaining tagged cod from these experiments would also be typically >10 years old, given that they are usually at least age 4 at the time of tagging. The low numbers of tagged cod available for recapture from these older experiments sometimes caused computational difficulties, i.e. when a tag type was returned from an experiment where the estimated number of that tag type still available for recaptures was small, i.e. <1. To address this problem, during estimation we flagged the number of instances where the remaining numbers of cod tagged with a particular tag type declined to <1, and also flagged instances where more tagged cod were recaptured within a year than were estimated to be available. If such events occurred frequently and involved multiple recaptures across several experiments it could imply that the assumed rate of natural mortality, the estimated rate of tag loss, or estimated reporting rate was incorrect (too high). When more tags were received than were estimated to be available, for that experiment, tag type, and recapture year we have arbitrarily set the numbers available at zero and computed the exploitation rate; this results in a negative but minor bias in the estimate.

Results and Discussion

Spatial and temporal distribution of cod landings

Reported monthly landings of cod from the inshore of 3KL are summarized by statistical unit area for the period 1998-2004 (Table 3A, Fig 2.). The total allowable catches (TAC's) from 1998 to 2002 were 4,000 t, 9,000 t, 7,000 t, 5,600 t, and 5,600 t, respectively, and the directed fishery was closed in 2003 and 2004. The landings in 2003 (1,041 t) came mostly (82%) from 3Lb during April, when dead and dying cod appeared in Smith Sound and were harvested (see Lilly et al. 2004); the remaining landings in 2003 were mostly from the sentinel fishery. In 2004, reported landings of 629 t were taken mainly during the winter flounder fishery in July and August.

The spatial distribution of landings from the inshore of 3KL shows some distinct patterns (Fig. 2). Initially (1998-1999) highest landings came from adjacent areas in southern 3K and northern 3L, particularly Fogo-Twillingate (3Ki), Bonavista Bay (3La), and Trinity Bay (3Lb), but there was a rapid decline in the proportion of landings coming from all unit areas in 3K and a corresponding increase in 3Lb (Trinity Bay) during the 1998-2002 period. The large spike in landings in 3Lb in 2003 represents the fish kill in Smith Sound. Landings are consistently low further northward towards Notre Dame Bay (3Kh) and the White Bay-Northern Peninsula area (3Kd, 3Ka). Landings from southern 3L (i.e. Conception Bay southward, areas 3Lf, 3Lj, and 3Lq) tend to be much lower and more consistent over time in terms of a percentage of the total available. Reported annual landings from 2J and offshore landings from 2J+3KL (not shown) have been extremely small (< 50 t) throughout 1998-2004.

The reported landings from NAFO Subdiv. 3Ps in the post-moratorium period were substantially higher than those in 3KL, ranging from 9,700 t in 1997 to 25,000 t in 1999 (Table 3B). The spatial patterns in landings were broadly similar each year with highest landings (30-50% of the entire TAC) coming from Placentia Bay (3Psc), followed by the offshore region 3Psh.

Reported landings from the northern Gulf stock area, which includes the west coast of insular Newfoundland, are shown in Table 3C. The directed cod fishery in this area was open during 1997-2002 with TAC's ranging from 3,000 to 7,500 t, closed in 2003, and reopened in 2004 with a TAC of 3,500 t. Reported landings while the fishery was open have ranged from just over 3,000 t in 1998 to almost 7,000 t in 2001. The low landings in 2003 (276 t) came mostly from sentinel and by-catch fisheries.

Release of tagged cod

For each experiment, annual summaries of the numbers of tagged cod released and reported as recaptured up to the end of 2004 are given in Table 1A (1995 and 1996 experiments) and Table 1B (1997-2004 experiments). In total, 134 tagging experiments have been conducted since 1995, comprising over 37,000 tagged cod released at various locations from 3Kd in the north to 3Lq in the south. Most tagging has been conducted in 3La (Bonavista Bay) and 3Lb (Trinity Bay) and coverage has tended to vary among years. Relatively few cod (118) were tagged in 1998, whereas several thousand were tagged each year during 1999-2002. Mean lengths of tagged cod

have typically been in the range 50-65 cm, but average size has often been larger (>70 cm) for cod tagged in Smith Sound in 2001 and 2002.

Recaptures of tagged cod

All tagging experiments in 3KL that involved release of more than a few cod have resulted in some recaptures, and several hundred have been recaptured from some of the experiments with large numbers (>500) of releases, notably experiment numbers 1999-012, 2000-019, 2001-021, 2001-018. Between 1999 and 2003, the total number of recaptures each year from all experiments combined was >500 (see below). However, in 2004 when the reported landings of cod declined to only 629 t only 86 tags were returned (66 from 3KL) and most experiments had no recaptures.

Release Year	Nos. tagged	Number of reported recaptures (all areas)									
		1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
1995	2,774	18	39	23	48	40	22	15	9	13	1
1996	6,476		98	49	110	100	47	26	20	2	2
1997	3,451			35	136	190	85	38	27	13	1
1998	118				14	9	2	0	0	0	0
1999	8,268					840	377	243	125	68	14
2000	3,511						226	165	68	33	3
2001	5,963							581	404	141	23
2002	5,093								409	277	42
2003	472									1	0
2004	923										0
Totals	37,716	18	137	107	308	1179	759	1068	1062	548	86

The data above and in Tables 1A and 1B also show that some tagged cod are recaptured many years after release; for example, recaptures from experiments in 1995 have extended over a period of nine years after release (Table 1A), but in most experiments the majority of recaptures are typically taken within the first 3-4 years.

Exploitation rates

Estimates for 1997-2002

Annual estimates of exploitation rate for each batch of tagged cod (only for experiments where > 100 cod were tagged) are summarized and grouped by area of release in Table 4. Note that as described in our previous documents (Brattey and Healey 2003, 2004a) growth and length selectivity are not formally taken into account in this analyses; thus, the initial estimates for the year that fish are tagged pertain to cod >45 cm (approximately aged 4+), whereas estimates for subsequent years are for progressively older fish. Survivors from cod tagged in 1997 would be aged 11+ by 2004. In addition, the total landings have fluctuated since the fishery resumed, with

highest reported landings in 1999.

As described in the Methods section, the numbers of each tag type available for recapture within an experiment declined over time and was estimated to be <1 in some recapture year /tag types/experiment numbers; this occurred with respect to high reward tags in the following experiment numbers (and recapture years) listed in Table 4: 1999-026 (1999), 1999-031 (2001), and 2000-024 (2001). Such events are likely to occur infrequently due to chance alone, but could indicate overestimation of some of the parameters used in the estimation of exploitation rate. To date, these occurrences have not been sufficiently frequent to suggest that our estimates of tag loss or reporting rate, or assumed rate of natural mortality, were too high.

Estimates of exploitation for the period 1997 to 2002 are updated (Table 4) from those reported in Brattey and Healey (2003). The updated estimates show only minor differences from those reported previously, due to a combination of updated estimates of reporting rate (see Table 2) and tag loss rate, and inclusion of additional tags received since 2003. Briefly, the main findings concerning exploitation in 1997-2002 are as follows:

- During 1999, estimates of exploitation for cod tagged in 3K were extremely high (27-70%), but dropped dramatically during 2000 and 2001.

- Cod tagged in 3K in 2002 were quite heavily exploited (13-21%) and the fishery was already underway when these tagged cod were released.

- The catch in 3K dropped dramatically from about 3,500 t in 1999 to only 600 t in 2002.

- Recaptures of cod tagged in 3K during 1999 dropped dramatically over a three year period, whereas those tagged in regions further south continued to be recaptured for at least 4-5 years

- Among cod tagged in Bonavista Bay (3La), estimates of exploitation were also highest for 1999, ranging from 6-17%, with most values close to 15%. Most estimates of exploitation for subsequent years were lower.

- Among cod tagged in Trinity Bay (3Lb), estimates of exploitation for 1999 ranged from 3.5-13.2%, whereas in 2000 and 2001, most estimates were between 5 and 15%. The most notable finding was the apparent increase in exploitation during 2002, particularly for cod tagged in Smith Sound where five of the estimates exceeded 20%.

- Relatively small numbers of tagging experiments have been conducted in Conception Bay (3Lf) and along the eastern Avalon (3Lj) and most of the estimates have not exceeded 10%.

- Cod tagged in St. Mary's Bay (3Lq) were quite heavily exploited throughout 1999-2002, with 19 of 25 annual estimates exceeding 15%. A significant portion of the exploitation of these cod occurs in the neighbouring stock area, particularly in Placentia Bay (3Psc).

Estimates for 2003 and 2004

During 2003, the directed cod fishery in 2J+3KL was closed, except during a brief period in April when harvesters were permitted to collect dead and dying cod that floated to the surface during the fish-kill event in Smith Sound, Trinity Bay. In scientific terms, this event could reasonably be termed natural mortality. However, given that these fish were harvested and catch estimates were available we have included tag returns from these fish in our estimates of exploitation. The fish kill accounted for most (82%) of the 523 tags reported as recaptured within 3KL during 2003 and hence most of the exploitation; the remaining tags were reported from sentinel and by-catch fisheries.

The mortality event resulted in one or more tag returns from 41 of the experiments listed in Tables 1A and 1B; there were >10 tag returns from eleven of the experiments and these were tagged mostly in 3Lb but also in southern Bonavista Bay or near Cape Bonavista (see Fig.1). A notable finding was the large number of tag returns from specific experiments conducted during 2002. For example, 80 tags were recovered from 1612 cod tagged off Cape Bonavista during June 2002 (experiment 2002-015). Also, 71 tags were recovered from 981 cod tagged in Smith Sound in November 2002 (experiment 2002-023).

In terms of exploitation, most experiments with long times at liberty or relatively small numbers of releases (<200) did not result in tag returns in 2003, so the estimates of exploitation for many experiments for that year are zero (Table 4). In many experiments where tagged cod were released in 3K, northern 3La or 3Lf/j/q the estimates of exploitation were low, i.e. <5%, except among cod tagged in 3Lq where some values where higher (5-8%) due to exploitation from the directed fishery in neighbouring 3Ps. Estimates for cod tagged in southern Bonavista Bay or near Cape Bonavista were variable (0-13.6%). A notable result is the high exploitation estimates (10-24%) for many (11) of the 22 experiments where tagged cod were released in 3Lb during 1999-2002. This result indicates that the Smith Sound fish kill resulted in substantial mortality among several groups of cod tagged in the local area during recent years. The actual level of mortality may be higher than estimated and reported as exploitation in Table 4, given that additional tagged cod that died may have sunk and not been recovered. Limited bottom trawling in the vicinity of the fish kill, and video from a remote operated vehicle did not find substantial amounts of dead cod on the bottom or permit detailed estimation of the quantities involved, but some dead cod were observed so the many of the values are likely under-estimates.

In 2004, all of the estimates of exploitation are low (<6%) and examination of the data in Table 4 shows that most of the non-zero estimates come from experiments with relatively large numbers of releases (i.e. >400). With no directed fishery and limited cod landings, the likelihood of obtaining a single tag return is higher for experiments where larger numbers are available for capture so this result is not unexpected. Furthermore, most of the tag returns in 2004 came from cod tagged in 3La, 3Lb, or more rarely 3Ki and recaptured in those regions during the blackback flounder fishery, or from fish tagged in 3Lq (see Fig. 3G) which is adjacent to the active fishery in the neighbouring 3Ps stock area.

Spatial and temporal distribution of recaptures

Annual summaries of the distribution of recaptures, grouped by year and unit area of release, are given in Table 5 and for a subset of the experiments these are shown in a series of plots (Fig 3A-3I.). These tables and figures provide information on cod movement patterns and show where the exploitation of cod tagged in each unit area has taken place each year. Note that the Figs. 3A-3I depict only tag returns where the exact location of recapture (latitude/longitude) was provided, whereas in Table 4 all recaptures are reported and these are adjusted by regional reporting rates. Table 4 only includes experiments from 1997 onwards as no estimates of reporting rate were available for 1995-1996.

Cod were tagged in 3Kh only during 1996-1997 and most of the recaptures came from the local area with little evidence of southward movement; these tagged cod also disappeared rapidly with no recaptures after 1999 (Fig. 3A) . Cod tagged in 3Ki (Fig. 3B), 3La (Fig. 3C), and 3Lb (Fig. 3D) tended to generate a lot of recaptures within the area of release, but there was also considerable movement between 3Ki, 3La, and 3Lb. Most of the cod tagged in Trinity Bay were tagged in Smith Sound, and these tended to be recaptured northward in northwestern Trinity Bay, on both sides of the Bonavista Peninsula, and into Bonavista Bay (i.e. 3La) and in small numbers in 3K. The plots of recaptures from cod tagged in the inshore of northern 3L (3La, 3Lb) and inshore 3K (3Kh, 3Ki) and the data in Table 4 show that, even after several years at liberty, most cod tagged in this region at various times of year tend to remain in an area that extends from the 3Kd/3Kh border in the north to the 3Lb/3Lf border in the south. There were relatively few recaptures from areas south of the 3Lb-3Lf border. Recaptures of cod tagged in southern 3L (3Lf, 3Lj, and 3Lq, Figs. 3E-3G) indicate substantial movements into 3Psc and some movement to 3Psh, but little northward movement into 3La/b or the inshore of 3K.

Some cod tagged in 3Psc have been recaptured in 3L and more rarely in 3K, but most of the recoveries from outside the 3Ps stock boundary have come from unit areas in southern 3L, notably 3Lq/j/f (Fig. 3H). The percentages recaptured in southern 3L are generally small but these recaptures are observed in many experiments spanning several years (Table 4). Many of the more northerly recoveries were obtained during 1999 when the TAC in the inshore of 3KL was at a post-moratorium peak (8,400 t, Table 3B). Similarly, some cod tagged offshore in 3Ps (i.e. 3Psh, Fig. 3I) have been recaptured in southern 3L although the numbers have generally been small (<20). Recaptures from tagging further westward in 3Ps are not shown here as these have resulted in few or no recoveries from 3KL (see Brattey and Healey 2004a).

Many of the experiments depicted in Figs. 3A-3I as well as the data in Table 4 indicate that one or two tagged cod are sometimes recaptured considerable distances away from the tagging area, such as from 3K to 3Psc or vice versa; however, these generally represent a small fraction of the total releases and total recaptures. Dispersal of tagged cod away from release sites does not appear to increase with successive years at liberty; typically the tagged cod disperse the year they are tagged and show similar distributions of recaptures in successive years. Only one tagged cod has been recaptured in the offshore; this cod was 84 cm at release and was tagged in Smith Sound in November 1999; it was reported as recaptured in northern 3L (3Ld) during July 2000 in a gillnet, presumably set for turbot (*Reinhardtius hippoglossoides*).

The extent to which cod tagged in the inshore migrate to offshore areas is difficult to discern, but the limited data available suggest that the bulk of the cod inhabiting the coastal waters are inshore residents. Reported annual landings of cod from the offshore of 2J3KL have been low (<50 t per annum) since the mid-1990s and DFO trawl surveys have found few large fish (> 60 cm) and very low stock size in the offshore for several years (Lilly et al. 2003, 2004). However, if there is offshore migration of a sizeable portion of the cod inhabiting the inshore during summer, the high intensity of tagging (typically at least 1 tag for 10 t or less of reported landings) suggests that even small amounts of offshore by-catch should generate some tag returns. Also, there is no legal reason why fishers should not report the tags since at least a portion of the offshore by-catch is permitted in some fisheries. The available evidence therefore suggests that at present most of the catch is comprised of inshore residents.

Tag returns from the cod mortality event in Smith Sound

Colbourne et al. (2003) described the oceanographic conditions that led to the mortality of cod during an extreme cold-water event in Smith Sound, Trinity Bay, during April 2003. Dead and dying cod of a wide range of sizes floated to the surface of Smith Sound over a period of weeks and were harvested by local fishers. Most of the landings were processed at a local plant. A total of 418 tags were reported from this event, providing a new source of information during a time of year when the fishery would normally be closed. Most recaptures came from cod that had been tagged in the local area encompassing Smith Sound itself, off Cape Bonavista, and southern Bonavista Bay (Fig. 4). There were no tags from cod that had been tagged in 3Ps (from 62,700 tagged cod release since 1997). Previous work has shown that during summer some 3Ps cod migrate northward into 3L (see Lawson and Rose 2000; Brattey and Healey 2004a); however, the absence of cod tagged in 3Ps during the April fish-kill suggests that these cod return to 3Ps and do not over-winter in Smith Sound in significant numbers. Similarly, there were no tags from cod tagged in the northern Gulf stock area (3Pn4RS) although an extensive tagging program has been conducted in that region in recent years (Brattey and Healey 2004b).

The fish kill resulted in only two tags recovered from cod tagged outside the local area; one from Notre Dame Bay (tagged in 2002) and one from St. Mary's Bay (tagged in 2000). These were exceptions and there were several tagging experiments in 3K and northern Bonavista Bay as well as southern 3L (i.e. 3Lf, 3Lj, and 3Lq) that did not result in recoveries from the April 2003 fish-kill. The general absence of recoveries from most tagging experiments in southern 3L is consistent with our previous conclusion that most cod found in southern 3L during summer are seasonal migrants from 3Ps (Brattey and Healey 2003). The rarity of recoveries from prior tagging in 3K and northern Bonavista Bay may partly reflect the long times at liberty of most cod tagged in those regions; many cod in this area were tagged in 1999. When combined with a high exploitation rate (see Table 4), it is likely that relatively few of these tagged cod were still alive by the spring of 2003. There is also evidence that cod in 3K have experienced a higher rate of natural mortality which would further reduce the numbers available for subsequent recapture (Cadigan and Brattey 2003a).

Most of the tags from the fish kill came from cod tagged in 2001 and 2002 (see legend in Fig. 4), but the recoveries extended back to cod tagged in the local area in December 1995, i.e. over seven years prior to the event.

Overall, the new tag return information from the fish kill and general recaptures during 2003-2004 is consistent with previous findings, indicating that Smith Sound is an over-wintering area for cod that disperse mostly northward to northwestern Trinity Bay, Bonavista Bay, and inshore 3K during summer. There is no evidence of migrant cod from 3Ps cod over-wintering in Smith Sound, but recaptures in southern 3L in summer over successive years indicates a seasonal movement of some cod from 3Ps into this area with a return migration into 3Ps prior to winter.

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Table 1A. Annual summary of reported recaptures (all tag types combined) for cod tagged and released in the inshore of NAFO Divs. 3KL from 1995-1996 (AV=Avalon Peninsula, BB=Bonavista Bay, BBN=Bonavista Bay North, TB=Trinity Bay, CB=Conception Bay, NDB=Notre Dame Bay, BVP=Bay Verte Peninsula, NP=Northern Peninsula).

Expt.	Unit	Release date			Mean	Number	Reported recaptures										
number	area	First	Last	Tagging site	length (cm)	tagged	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	unk
1995001	3LB	18-Apr-95	25-Apr-95	Gooseberry Cove, TB	56.9	514	15	4	1	3	4	3	2	1	1	0	2
1995002	3LB	24-Apr-95	2-May-95	Smith Sound, TB	66.8	214	3	7	2	5	5	0	1	0	1	0	2
1995003	3LB	4-Dec-95	14-Dec-95	Smith Snd/NW & SW Arm, TB	56.1	2046	0	28	20	40	31	19	12	8	11	1	2
				Totals		2774	18	39	23	48	40	22	15	9	13	1	6

Expt.	Unit	Release date				Number	Reported recaptures									
number	area	First	Last	Tagging site		tagged	1996	1997	1998	1999	2000	2001	2002	2003	2004	unk
1996029	3KD	16-Sep-96	16-Sep-96	CONCHE NP	49.2	175	3	0	0	0	0	0	0	0	0	0
1996017	3KH	16-Jul-96	16-Jul-96	SHOE COVE NDB	50.2	52	2	0	1	1	0	0	0	0	0	0
1996018	3KH	17-Jul-96	17-Jul-96	MINGS BIGHT BVP	53.6	17	0	0	0	0	0	0	0	0	0	0
1996021	3KH	25-Jul-96	25-Jul-96	COACHMAN CV BVP	52.9	482	17	4	10	5	0	0	0	0	0	0
1996022	3KH	26-Jul-96	26-Jul-96	LA SCIE BVP	51.6	292	10	1	1	1	0	1	0	0	0	1
1996002	3KI	3-Jul-96	3-Jul-96	DEEP BAY - FOGO	51.2	374	8	5	6	7	1	0	0	0	0	0
1996005	3KI	10-Jul-96	10-Jul-96	ASPEN COVE FOGO	46.0	75	0	0	0	1	1	1	0	0	0	0
1996007	3KI	11-Jul-96	11-Jul-96	TOO GOOD ARM I	53.2	456	12	2	11	15	1	1	1	0	0	0
1996013	3KI	12-Jul-96	12-Jul-96	TWILLINGATE I	53.3	187	6	1	7	6	1	0	0	0	0	0
1996014	3KI	17-Sep-96	17-Sep-96	TWILLINGATE II	51.9	77	1	0	1	1	0	0	0	0	0	0
1996001	3LA	5-Jul-96	5-Jul-96	PLATE COVE 1 BB	50.1	702	11	4	16	18	8	4	1	0	1	1
1996016	3LA	16-Jul-96	16-Jul-96	BONAVISTA BB	54.5	337	3	3	4	8	5	8	10	0	1	1
1996019	3LA	18-Jul-96	18-Jul-96	CENTREVILLE BBN	45.6	218	3	3	4	4	3	2	0	0	0	0
1996003	3LB	5-Jul-96	5-Jul-96	HOPEALL TB	50.2	478	7	0	7	2	0	3	0	0	0	2
1996006	3LB	5-Jul-96	5-Jul-96	HEARTS CONT TB	53.4	291	6	3	2	1	4	0	0	0	0	0
1996023	3LB	23-Jul-96	23-Jul-96	SMITH SND II TB	52.1	208	1	2	8	6	9	1	4	1	0	1
1996020	3LF	18-Jul-96	18-Jul-96	BAY DE VERDE CB	38.5	2	0	0	0	0	0	0	0	0	0	0
1996026	3LF	15-Aug-96	15-Aug-96	PORT D GRAVE CB	53.6	117	0	0	2	0	0	0	0	0	0	0
1996008	3LJ	16-Jul-96	16-Jul-96	PETTY HBR I AV	58.4	185	0	2	6	2	0	2	0	0	0	0
1996009	3LJ	16-Jul-96	16-Jul-96	PETTY HBR 2 AV	54.4	7	0	0	0	0	0	0	0	0	0	0
1996010	3LJ	29-Jul-96	29-Jul-96	PETTY HBR 3 AV	56.9	9	0	0	0	0	0	0	0	0	0	0
1996011	3LJ	1-Aug-96	1-Aug-96	PETTY HBR 4 AV	55.2	16	0	0	0	0	1	0	0	0	0	0
1996012	3LJ	21-Aug-96	21-Aug-96	PETTY HBR 5 AV	62.2	55	1	1	0	2	0	0	0	1	0	0
1996024	3LJ	5-Aug-96	5-Aug-96	CALVERT AV	56.6	47	0	1	2	1	0	1	0	0	0	0
1996025	3LJ	6-Aug-96	6-Aug-96	FERRYLAND I AV	51.9	338	1	5	4	5	6	1	2	0	0	0
1996027	3LJ	20-Aug-96	20-Aug-96	PETTY HBR 6 AV	58.9	72	1	1	0	1	0	0	0	0	0	0
1996031	3LJ	28-Aug-96	28-Aug-96	PETTY HBR 7 AV	62.0	62	1	1	1	1	0	0	1	0	0	0
1996033	3LJ	2-Oct-96	2-Oct-96	PETTY HBR 8 AV	52.2	43	0	0	1	0	0	0	0	0	0	0
1996034	3LJ	3-Sep-96	3-Sep-96	PETTY HBR 9 AV	51.3	483	1	5	6	6	2	1	1	0	0	1
1996035	3LJ	19-Sep-96	19-Sep-96	PETTY HBR 10 AV	48.0	65	0	0	1	0	1	0	0	0	0	0
1996036	3LJ	3-Oct-96	3-Oct-96	PETTY HBR 11 AV	55.7	20	0	0	0	0	0	0	0	0	0	0
1996037	3LJ	16-Jul-96	16-Jul-96	PETTY HBR 12 AV	50.6	176	1	1	5	3	0	0	0	0	0	1
1996038	3LJ	6-Sep-96	6-Sep-96	PETTY HBR 13 AV	60.1	152	2	0	0	1	1	0	0	0	0	0
1996039	3LJ	10-Sep-96	10-Sep-96	PETTY HBR 14 AV	62.9	113	0	2	2	2	1	0	0	0	0	0
1996040	3LJ	12-Sep-96	12-Sep-96	PETTY HBR 15 AV	56.6	93	0	2	2	0	2	0	0	0	0	0
				Total		6476	98	49	110	100	47	26	20	2	2	8

Table 1B. Annual summary of reported recaptures (all tag types combined) for cod tagged and released in the inshore of NAFO Divs. 3KL from 1997 onwards (BB=Bonavista Bay, BBN=Bonavista Bay North, TB=Trinity Bay, CB=Conception Bay, SMB St. Mary's Bay, NDB=Notre Dame Bay,TW=Twillingate, S. AV=southern Avalon Peninsula).

Expt.	Unit	Release date			Mean	Number	Reported recaptures								
number	area	First	Last	Tagging site	length (cm)	tagged	1997	1998	1999	2000	2001	2002	2003	2004	unk
1997-012	3KI	23-Jul-97	24-Jul-97	Aspen Cove	51.9	260	1	15	5	2	1	0	0	0	0
1997-009	3LA	9-Jul-97	10-Jul-97	Plate Cove BB	53.3	464	1	23	28	10	7	3	2	0	1
1997-010	3LA	12-Jun-97	12-Jun-97	Open Hall BB	61.8	314	0	11	15	9	3	4	4	0	1
1997-003	3LB	1-May-97	5-May-97	NW Arm TB	56.8	589	2	10	23	7	7	8	5	0	0
1997-011	3LJ	30-Jul-97	13-Aug-97	Ferryland, Avalon Pen.	62.2	86	5	2	4	4	0	0	0	0	0
1997-013	3LJ	5-Aug-97	5-Aug-97	Pouch Cove, Avalon Pen.	56.9	220	4	8	9	7	1	2	0	0	0
1997-007	3LQ	25-Jun-97	26-Jun-97	Riverhead, SMB	56.9	701	21	49	74	26	8	5	1	0	3
1997-014	3LQ	9-Oct-97	14-Oct-97	Colinet, SMB	53.8	618	1	16	22	17	9	2	0	1	0
					Totals	3252	35	134	180	82	36	24	12	1	5
1998-007	3KI	18-Jun-98	18_jun-98	SE FOGO	57.4	118	.	14	9	2	0	0	0	0	0
1999-022	3KH	22-Jun-99	22-Jun-99	JACKSONS CV NDB	67.3	3	.	.	0	0	0	0	0	0	0
1999-011	3KI	3-Jun-99	3-Jun-99	FOGO	61.2	122	.	.	22	3	1	0	0	0	0
1999-012	3KI	9-Jun-99	11-Jun-99	TOO GOOD ARM, TW	60.8	639	.	.	167	19	9	1	1	0	0
1999-020	3KI	15-Jun-99	15-Jun-99	LUMSDEN FOGO	62.3	10	.	.	3	0	0	0	0	0	0
1999-021	3KI	16-Jun-99	16-Jun-99	SUMMERFORD TW	56.3	3	.	.	1	0	0	0	0	0	0
1999-025	3KI	22-Jun-99	25-Jun-99	TOO GOOD ARM, TW	61.5	571	.	.	151	19	3	2	1	0	0
1999-026	3KI	6-Jul-99	7-Jul-99	TWILLINGATE	59.6	197	.	.	82	7	2	0	0	0	0
1999-034	3KI	22-Sep-99	22-Sep-99	LUMSDEN FOGO	51.9	101	.	.	0	1	4	0	0	0	0
1999-037	3KI	29-Sep-99	29-Sep-99	LADLE COVE	51.8	60	.	.	0	4	0	0	0	0	0
1999-008	3LA	4-May-99	5-May-99	PLATE COVE BB	62.3	309	.	.	28	9	6	3	1	0	0
1999-009	3LA	11-May-99	12-May-99	S. BONAVISTA BAY	63.2	80	.	.	11	6	3	0	1	0	0
1999-018	3LA	9-Jun-99	10-Jun-99	GREENSPOND BBN	56.7	242	.	.	13	7	3	0	0	1	0
1999-015	3LA	10-Jun-99	13-Jun-99	SANDY COVE BB	64.8	164	.	.	32	8	8	6	3	0	0
1999-016	3LA	10-Jun-99	13-Jun-99	SWALE ISLAND BB	61.2	372	.	.	31	15	9	3	2	0	0
1999-019	3LA	11-Jun-99	11-Jun-99	SILVER FOX ISLAND BBN	61.7	157	.	.	21	8	4	3	0	1	0
1999-017	3LA	11-Jun-99	12-Jun-99	BROOM CLOSE HD BB	63.7	305	.	.	13	7	1	0	0	0	0
1999-024	3LA	24-Jun-99	24-Jun-99	BONAVISTA BB	66.0	210	.	.	7	12	5	1	2	1	0
1999-033	3LA	21-Sep-99	21-Sep-99	WESLEYVILLE BBN	55.9	107	.	.	0	0	3	0	0	0	0
1999-041	3LA	22-Nov-99	22-Nov-99	HAPPY ADVENTURE BB	59.0	49	.	.	0	2	1	0	0	0	0
1999-007	3LB	27-Apr-99	4-May-99	SMITH SD TB	65.7	376	.	.	23	15	22	19	3	1	0
1999-010	3LB	28-May-99	28-May-99	SMITH SD TB	70.0	376	.	.	11	8	5	6	6	0	1
1999-013	3LB	7-Jun-99	8-Jun-99	NW ARM TB	62.7	224	.	.	16	6	11	6	2	1	0
1999-014	3LB	9-Jun-99	9-Jun-99	TRINITY TB	62.7	222	.	.	4	7	8	6	5	0	1
1999-028	3LB	6-Aug-99	6-Aug-99	NEW HARBOUR TB	48.5	486	.	.	38	19	11	4	1	0	2
1999-030	3LB	1-Sep-99	2-Sep-99	L. CATALINA TB	68.5	456	.	.	17	15	17	13	11	2	0
1999-035	3LB	21-Sep-99	21-Sep-99	L. CATALINA TB	64.0	203	.	.	5	2	5	4	0	0	0
1999-036	3LB	28-Sep-99	28-Sep-99	SMITH SND TB	62.4	16	.	.	0	1	0	1	0	0	0
1999-038	3LB	7-Oct-99	8-Oct-99	SMITH SND TB	62.8	142	.	.	0	13	6	6	0	0	0
1999-042	3LB	23-Nov-99	26-Nov-99	SMITH SND TB	68.8	514	.	.	0	32	22	13	15	2	0
1999-044	3LB	1-Dec-99	3-Dec-99	SMITH SND TB	70.4	476	.	.	0	34	24	13	8	1	1
1999-027	3LF	19-Jul-99	19-Jul-99	FOXTRAP CB	51.4	17	.	.	2	0	0	0	0	0	0
1999-029	3LF	25-Aug-99	25-Aug-99	KELLY'S ISLAND CB	55.4	177	.	.	12	7	4	0	0	0	0
1999-023	3LJ	28-Jun-99	28-Jun-99	FERRYLAND S. AV	61.1	21	.	.	7	1	1	0	0	1	0
1999-006	3LQ	7-May-99	10-May-99	ST. MARYS BAY	56.4	733	.	.	85	69	31	11	5	2	5
1999-031	3LQ	2-Sep-99	13-Sep-99	ST SHOTTS S. AV	61.9	280	.	.	38	21	14	4	0	0	4
					Total	8420	.	.	849	379	243	125	67	13	14

cont'd.

Table 1B. Cont'd.

Expt. number	Unit area	Release date First	Release date Last	Location	Mean length (cm)	Number tagged	Reported recaptures 2000	2001	2002	2003	2004	unk
2000-023	3KI	10-Aug-00	11-Aug-00	TOO GOOD ARM	57.3	252	10	11	0	0	0	0
2000-028	3KI	17-Aug-00	18-Aug-00	TOO GOOD ARM	55.0	145	9	3	0	0	0	0
2000-011	3LA	20-Apr-00	20-Apr-00	PLATE COVE BB	62.2	29	2	1	0	0	0	0
2000-016	3LA	26-May-00	26-May-00	RED COVE BB	75.7	24	2	1	1	0	0	1
2000-019	3LA	7-Jun-00	11-Jun-00	SOUTHERN BB	64.0	1032	90	45	10	2	0	0
2000-032	3LA	7-Sep-00	8-Sep-00	HAPPY ADVENTURE BB	48.8	8	0	0	0	0	0	0
2000-012	3LB	4-May-00	4-May-00	SMITH SND TB	69.3	69	5	4	0	2	0	0
2000-013	3LB	11-May-00	11-May-00	SMITH SND TB	81.6	45	3	3	0	0	0	1
2000-014	3LB	18-May-00	19-May-00	SMITH SND TB	71.2	333	22	18	20	11	0	0
2000-015	3LB	25-May-00	25-May-00	SMITH SND TB	67.4	273	11	8	8	3	0	1
2000-018	3LB	30-May-00	30-May-00	SMITH SND TB	68.6	315	10	15	5	7	0	1
2000-021	3LB	27-Jun-00	27-Jun-00	BONAVENTURE HD BB	88.0	213	11	9	3	2	0	0
2000-026	3LB	16-Aug-00	16-Aug-00	HOPEALL TB	51.4	16	0	0	0	0	0	0
2000-030	3LB	24-Aug-00	24-Aug-00	HOPEALL TB	51.9	32	0	0	1	0	0	0
2000-027	3LF	17-Aug-00	17-Aug-00	FOXTRAP CB	52.6	172	8	4	4	0	0	0
2000-029	3LF	23-Aug-00	23-Aug-00	FOXTRAP CB	55.4	50	1	1	1	0	1	0
2000-031	3LF	28-Aug-00	28-Aug-00	BAY DE VERDE CB	53.6	41	2	1	0	0	0	0
2000-017	3LG	27-May-00	27-May-00	OFFSHORE 3L	49.0	1	0	0	0	0	0	0
2000-022	3LJ	5-Jul-00	5-Jul-00	PETTY HARBOUR	60.3	28	1	3	0	0	1	0
2000-025	3LJ	15-Aug-00	15-Aug-00	PETTY HARBOUR	52.5	20	0	1	0	0	0	0
2000-020	3LQ	22-Jun-00	22-Jun-00	ST MARYS BAY	66.9	194	19	21	10	4	1	2
2000-024	3LQ	11-Aug-00	11-Aug-00	ST SHOTTS	61.5	122	20	14	4	0	0	4
					Total	3414	226	163	67	31	3	10
2001-019	3LA	18-Jun-01	27-Jun-01	OFF BONAVISTA	69.5	889	.	30	46	25	2	1
2001-021	3LA	20-Jun-01	22-Jun-01	PLATE COVE BB	69.2	1690	.	305	107	28	2	0
2001-012	3LB	15-May-01	17-May-01	SMITH SOUND 01	76.2	470	.	25	23	16	3	0
2001-015	3LB	29-May-01	1-Jun-01	SMITH SOUND 02	56.7	709	.	46	40	17	3	0
2001-016	3LB	29-May-01	1-Jun-01	SMITH SOUND 03	63.9	41	.	1	3	1	0	0
2001-017	3LB	6-Jun-01	6-Jun-01	SMITH SOUND 04	56.3	19	.	0	3	1	0	0
2001-020	3LB	28-Jun-01	28-Jun-01	WESTERN TB	72.7	142	.	7	11	3	0	1
2001-022	3LB	15-Jun-01	21-Jun-01	SMITH SOUND 05	71.9	48	.	3	3	2	0	0
2001-024	3LB	18-Jul-01	19-Jul-01	HOPEALL TB	55.2	65	.	9	4	1	0	0
2001-026	3LB	14-Nov-01	10-Dec-01	SMITH SOUND 06	64.3	993	.	0	98	35	8	0
2001-013	3LD/A/I	10-May-01	17-May-01	OFFSHORE 3L	50.4	16	.	0	0	0	0	0
2001-023	3LJ	12-Jul-01	12-Jul-01	PETTY HARBOUR	49.8	157	.	19	8	0	0	0
2001-014	3LQ	6-Jun-01	6-Jun-01	HOLYROOD POND	51.7	39	.	7	2	0	0	0
2001-018	3LQ	13-Jun-01	15-Jun-01	RIVERHEAD SMB	60.9	683	.	129	56	12	3	8
					Total	5961		581	404	141	21	10
2002-018	3KI	10-Jul-02	17-Jul-02	NEW WORLD ISLAND	53.4	590	.	.	65	0	6	0
2002-020	3KI	16-Jul-02	16-Jul-02	SUMMERFORD TW	49.4	40	.	.	3	0	0	0
2002-021	3KI	18-Jul-02	18-Jul-02	CLAM ROCKS TW	51.7	20	.	.	2	1	0	0
2002-022	3KI	25-Jul-02	26-Jul-02	NORTH FOGO ISLAND	49.7	100	.	.	7	0	0	0
2002-015	3LA	23-Jun-02	30-Jun-02	CAPE BONAVISTA	74.0	1612	.	.	140	97	8	0
2002-016	3LA	26-Jun-02	1-Jul-02	SOUTHERN BB	56.8	15	.	.	1	1	0	0
2002-019	3LA	16-Jul-02	25-Jul-02	SWALE ISLAND BB	63.4	108	.	.	15	1	0	1
2002-009	3LB	17-Apr-02	17-Apr-02	SMITH SOUND (LT)	72.1	65	.	.	2	0	0	0
2002-010	3LB	22-May-02	23-May-02	SMITH SOUND (HL)	66.2	913	.	.	109	51	10	0
2002-013	3LB	21-Jun-02	21-Jun-02	SMITH SOUND (OT)	72.0	152	.	.	23	6	1	0
2002-014	3LB	22-Jun-02	22-Jun-02	BONAVENTURE HEAD TB	64.3	4	.	.	1	0	0	0
2002-017	3LB	1-Jul-02	2-Jul-02	SPILLAR'S LEDGE TB	71.9	254	.	.	20	18	0	0
2002-023	3LB	31-Oct-02	14-Nov-02	SMITH SOUND (HL)	67.5	981	.	.	2	85	13	0
2002-011	3LQ	12-Jun-02	13-Jun-02	MALL BAY, SMB	54.6	148	.	.	18	10	2	0
					Total	5002			408	270	40	1
2003-001	3LB	9-Apr-03	9-Apr-03	SMITH SOUND (OT)	59.4	472			.	1	0	3
2004-001	3LB	1-Dec-04	2-Dec-04	SMITH SOUND (HL)	61.4	932					0	0

Table 2. The proportion of tags returned by year and region based on a high-reward tagging study described in Cadigan and Brattey (2003b). 3K_IN=NAFO unit areas 3Kd/h/i; 3L_INN=3La/b; 3L_INS=3Lf/j/q; 3Ps_PB=3Psc; 3Ps_FB=3Psb; 3Ps_BB=3Psa/d; OFF_SH=3Pse/f/g/h and Divs 3NO; 3PN_4RS=subdiv. 3Pn and Divs. 4R and 4S.

	Single tag reporting rates							
Region	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
3K_IN	0.76	0.76	0.76	0.76	1.00	0.76	0.76	0.76
3L_INN	0.76	0.76	0.76	0.76	1.00	0.76	0.76	0.76
3L_INS	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
OFF_SH	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
3Ps_PB	0.70	0.70	0.70	0.85	0.85	0.85	0.85	0.85
3Ps_FB	0.70	0.70	0.70	0.85	0.85	0.85	0.85	0.85
3Ps_BB	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
3PN_4RS	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53

	Double tag reporting rates							
Region	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
3K_IN	0.85	0.85	0.85	0.85	1.00	0.85	0.85	0.85
3L_INN	0.85	0.85	0.85	0.85	1.00	0.85	0.85	0.85
3L_INS	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
OFF_SH	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
3Ps_PB	0.80	0.80	0.80	0.91	0.91	0.91	0.91	0.91
3Ps_FB	0.80	0.80	0.80	0.91	0.91	0.91	0.91	0.91
3Ps_BB	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
3PN_4RS	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66

Table 3A. Reported landings of cod from inshore unit areas in NAFO Divs. 3KL during 1998-2004. Most of the landings in 3Lb during 2003 were from a fish kill in Smith Sound, Trinity Bay during April. Total reported offshore landings from 3KL have been < 50 t per annum.

Year	3Ka	3Kd	3Kh	3Ki	3La	3Lb	3Lf	3Lj	3Lq	Totals
1998	5	122	661	1,331	1,113	649	411	402	147	4,840
1999	24	205	1,100	2,299	1,462	1,686	702	698	268	8,444
2000	13	57	204	1,188	1,477	1,442	398	451	211	5,441
2001	27	184	440	1,117	1,546	2,042	592	486	434	6,868
2002	8	37	133	444	1,150	1,503	304	288	285	4,153
2003	4	6	14	32	74	853	19	11	28	1,041
2004	1	4	26	119	161	140	70	86	23	629

Table 3B. Reported landings of cod from unit areas in NAFO Subdiv. 3Ps during 1997-2004. (landings for 2004 are to 1 October as the fishery was still in progress).

Year	3Psa	3Psb	3Psc	3Psd	3Pse	3Psf	3Psg	3Psh	Totals
1997	1,191	1,791	4,956	256	110	90	0	1,314	9,708
1998	1,573	2,428	7,102	1,274	698	1,108	377	4,713	19,274
1999	2,697	3,206	11,654	873	360	2,856	804	2,109	24,558
2000	1,718	2,263	8,774	249	1,003	3,183	156	7,742	25,087
2001	1,273	2,398	5,853	343	262	1,404	120	3,349	15,002
2002	1,353	2,302	4,892	356	1,389	1,144	92	3,292	14,819
2003	1,328	2,536	4,825	234	1,401	1,358	171	3,408	15,261
2004	1,279	2,213	4,609	277	291	619	84	2,342	11,714

Table 3C. Reported landings of cod from unit areas in NAFO Subdiv. 3Pn and Divs. 4RS during 1997-2003.

Year	3PN	4Rd	4Rc	4Rb	4Ra	4Sv	4Sw	4Sxyz	Totals
1997	2,006	299	593	600	806	141	327	20	4,792
1998	870	636	281	367	387	61	476	33	3,111
1999	1,165	944	908	1,478	1,551	124	632	88	6,890
2000	1,478	800	728	1,439	1,215	180	660	140	6,640
2001	1,740	717	995	1,269	1,310	252	570	81	6,934
2002	1,713	591	795	1,377	1,172	123	686	69	6,526
2003	35	59	14	55	20	19	60	13	276

Table 4. Annual estimates of exploitation (harvest rate, in percent) by experiment for cod tagged in NAFO Divs. 3KL during 1997-2004. Recaptures were adjusted to account for tag reporting rates, tag loss and assumed natural mortality. Estimates for experiments where > 100 cod were tagged are shown (see text for details). Shaded cells represent partial estimates as fishery was already in progress.

Unit	Expt.	Release dates		Area of release	Number	Annual exploitation rate (% harvested)							
area	number	First	Last		tagged	1997	1998	1999	2000	2001	2002	2003	2004
3KI	1997012	23-Jul-97	24-Jul-97	ASPEN COVE	260	2.9	13.3	5.4	3.7	0.0	0.0	0.0	0.0
3KI	1998007	18-Jun-98	18_jun-98	SE FOGO	118		23.6	17.6	7.1	0.0	0.0	0.0	0.0
3KI	1999011	3-Jun-99	3-Jun-99	FOGO	122			26.7	6.5	3.2	0.0	0.0	0.0
3KI	1999012	9-Jun-99	11-Jun-99	TOO GOOD ARM	639			38.3	10.4	6.0	1.3	1.6	0.0
3KI	1999025	22-Jun-99	25-Jun-99	TOO GOOD ARM	571			37.9	10.0	1.7	1.4	1.8	0.0
3KI	1999026	6-Jul-99	7-Jul-99	TWILLINGATE	197			70.2	27.6	0.0	0.0	0.0	0.0
3KI	1999034	22-Sep-99	22-Sep-99	LUMSDEN FOGO	101			0.0	3.3	12.8	0.0	0.0	0.0
3KI	2000023	10-Aug-00	11-Aug-00	TOO GOOD ARM	252				8.5	9.9	0.0	0.0	0.0
3KI	2000028	17-Aug-00	18-Aug-00	TOO GOOD ARM	145				10.6	3.8	0.0	0.0	0.0
3KI	2002018	10-Jul-02	17-Jul-02	NEW WORLD ISLAND	590						20.5	0.0	4.5
3KI	2002022	25-Jul-02	26-Jul-02	NORTH FOGO ISLAND	100						12.7	0.0	0.0
3LA	1997009	9-Jul-97	10-Jul-97	PLATE COVE	464	0.7	16.0	24.2	7.7	8.4	14.7	6.6	0.0
3LA	1997010	12-Jun-97	12-Jun-97	OPEN HALL	314	0.0	7.0	11.8	10.4	4.4	12.9	13.4	0.0
3LA	1999008	4-May-99	5-May-99	PLATE COVE BB	309			13.8	7.4	5.6	5.9	2.6	0.0
3LA	1999015	10-Jun-99	13-Jun-99	SANDY COVE BB	164			12.8	10.7	5.1	0.0	0.0	0.0
3LA	1999016	10-Jun-99	13-Jun-99	SWALE ISLAND BB	372			13.7	5.6	5.7	7.5	4.3	0.0
3LA	1999017	11-Jun-99	12-Jun-99	BROOM CLOSE HD BB	305			16.5	12.4	8.8	5.3	4.5	0.0
3LA	1999018	9-Jun-99	10-Jun-99	GREENSPOND BBN	242			14.2	10.1	4.4	6.3	0.0	4.2
3LA	1999019	11-Jun-99	11-Jun-99	SILVER FOX ISLAND BBN	157			14.2	9.5	2.2	0.0	0.0	0.0
3LA	1999024	24-Jun-99	24-Jun-99	BONAVISTA BB	210			6.1	10.9	4.7	2.7	0.0	4.3
3LA	1999033	21-Sep-99	21-Sep-99	WESLEYVILLE BBN	107			0.0	0.0	8.4	0.0	0.0	0.0
3LA	2000019	7-Jun-00	11-Jun-00	SOUTHERN BB	1032				14.4	8.5	3.0	1.1	0.0
3LA	2001019	18-Jun-01	27-Jun-01	OFF BONAVISTA	889					4.4	11.6	8.6	1.0
3LA	2001021	20-Jun-01	22-Jun-01	PLATE COVE BB	1690					21.9	17.4	6.6	0.6
3LA	2002015	23-Jun-02	30-Jun-02	CAPE BONAVISTA	1612						13.3	13.6	1.9
3LA	2002019	16-Jul-02	25-Jul-02	SWALE ISLAND BB	108						27.8	3.2	0.0
3LB	1997003	1-May-97	5-May-97	NW Arm TB	589	0.5	2.8	10.7	3.8	3.9	8.0	7.8	0.0
3LB	1999007	27-Apr-99	4-May-99	SMITH SD TB	376			11.8	10.7	16.1	24.1	6.4	0.0
3LB	1999010	28-May-99	28-May-99	SMITH SD TB	376			9.5	7.7	4.7	13.0	20.4	0.0
3LB	1999013	7-Jun-99	8-Jun-99	NW ARM TB	224			11.9	6.5	13.0	12.4	6.1	4.2
3LB	1999014	9-Jun-99	9-Jun-99	TRINITY TB	222			3.2	8.0	8.8	11.8	13.1	0.0
3LB	1999028	6-Aug-99	6-Aug-99	NEW HARBOUR TB	486			13.1	11.2	6.5	4.6	1.5	0.0
3LB	1999030	1-Sep-99	2-Sep-99	L. CATALINA TB	456			8.0	7.1	10.1	14.7	14.9	6.0
3LB	1999035	21-Sep-99	21-Sep-99	L. CATALINA TB	203			4.4	3.4	6.7	9.1	0.0	0.0
3LB	1999038	7-Oct-99	8-Oct-99	SMITH SND TB	142			0.0	20.4	11.0	15.3	0.0	0.0
3LB	1999042	23-Nov-99	26-Nov-99	SMITH SND TB	514			0.0	15.3	12.7	10.6	24.1	5.9
3LB	1999044	1-Dec-99	3-Dec-99	SMITH SND TB	476			0.0	17.3	12.1	18.1	14.2	0.0
3LB	2000014	18-May-00	19-May-00	SMITH SND TB	333				11.8	9.4	21.4	16.1	0.0
3LB	2000015	25-May-00	25-May-00	SMITH SND TB	273				6.4	3.3	12.8	6.1	0.0
3LB	2000018	30-May-00	30-May-00	SMITH SND TB	315				5.2	9.3	5.3	9.1	0.0
3LB	2000021	27-Jun-00	27-Jun-00	BONAVENTURE HD BB	213				7.5	5.2	3.8	1.7	0.0
3LB	2001012	15-May-01	17-May-01	SMITH SOUND 01	470					6.7	11.7	11.0	3.1
3LB	2001015	29-May-01	1-Jun-01	SMITH SOUND 02	709					8.2	13.4	7.7	1.9
3LB	2001020	28-Jun-01	28-Jun-01	WESTERN TB	142					7.0	17.8	7.2	0.0
3LB	2001026	14-Nov-01	10-Dec-01	SMITH SOUND 06	993					0.0	23.6	13.3	4.9
3LB	2002010	22-May-02	23-May-02	SMITH SOUND (HL)	913						19.1	14.0	4.3
3LB	2002013	21-Jun-02	21-Jun-02	SMITH SOUND (OT)	152						23.8	9.6	2.1
3LB	2002017	1-Jul-02	2-Jul-02	SPILLAR'S LEDGE TB	254						14.1	19.7	0.0
3LB	2002023	31-Oct-02	14-Nov-02	SMITH SOUND (HL)	981						0.4	18.8	4.6
3LB	2003001	9-Apr-03	9-Apr-03	SMITH SOUND (OT)	472							1.4	0.0
3LB	2004001	1-Dec-04	2-Dec-04	SMITH SOUND (HL)	932								0.0
3LF	1999029	25-Aug-99	25-Aug-99	KELLY'S ISLAND CB	177			10.8	11.7	11.4	0.0	0.0	0.0
3LF	2000027	17-Aug-00	17-Aug-00	FOXTRAP CB	172				5.4	4.1	10.6	0.0	0.0
3LJ	1997013	5-Aug-97	5-Aug-97	POUCH COVE, AVALON PEN.	220	2.8	8.8	5.6	6.6	5.5	0.0	0.0	0.0
3LJ	2001023	12-Jul-01	12-Jul-01	PETTY HARBOUR	157					21.7	17.7	0.0	0.0
3LQ	1997007	25-Jun-97	26-Jun-97	RIVERHEAD, SMB	701	4.5	15.1	19.6	16.1	8.9	5.0	2.7	0.0
3LQ	1997014	9-Oct-97	14-Oct-97	COLINET, SMB	618	0.0	5.7	7.8	11.5	3.3	2.0	0.0	0.0
3LQ	1999006	7-May-99	10-May-99	ST. MARYS BAY	733			23.6	26.6	19.8	9.5	5.2	3.6
3LQ	1999031	2-Sep-99	13-Sep-99	ST SHOTTS S. AV	280			34.2	25.9	38.3	11.0	0.0	0.0
3LQ	2000020	22-Jun-00	22-Jun-00	ST MARYS BAY	194				10.9	25.6	21.4	7.9	5.5
3LQ	2000024	11-Aug-00	11-Aug-00	ST SHOTTS	122				36.3	50.0	29.6	0.0	0.0
3LQ	2001018	13-Jun-01	15-Jun-01	RIVERHEAD SMB	683					32.2	24.7	8.0	1.8

Table 5. Annual distribution of recaptures of cod tagged and released in various regions of NAFO Divs. 3KL and eastern Subdiv. 3Ps during 1997-2004. Recapture numbers were adjusted by region specific reporting rates estimated from a high reward tagging study. Shaded cells give the percentage recaptured in the area of release. Area 3PsOFF=3Ps/e/f/g/h.

Release area	Release year	Number tagged	Recapture year	Number recap'd	% of annual recaptures													
					3K	3LA	3LB	3LF	3LJ	3LQ	3NO	3Psa	3Psb	3Psc	3Psd	3PsOFF	4RS3Pn	UNK
3KD	1997	260	1997	1	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.	.	.	1998	19	59.1	40.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.	.	.	1999	7	40.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60.0
.	.	.	2000	3	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.	.	.	2001	1	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3KI	1998	118	1998	17	92.3	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.			1999	11	67.8	32.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.			2000	2	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3KI	1999	1703	1999	531	93.6	4.3	0.0	0.5	0.0	0.0	0.0	0.0	0.2	0.5	0.0	0.0	0.0	0.9
.			2000	67	73.6	18.4	3.4	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	2.8	0.0
.			2001	19	47.4	52.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.			2002	4	31.0	69.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.			2003	3	0.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3KI	2000	397	2000	24	94.5	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.			2001	14	85.7	7.1	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3KI	2002	750	2002	99	98.7	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.			2003	1	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.			2004	8	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

cont'd.

Table 5. Cont'd. (Distribution of recaptures)

Release area	Release year	Number tagged	Recapture year	Number recap'd	% of annual recaptures													
					3K	3LA	3LB	3LF	3LJ	3LQ	3NO	3PSA	3PSB	3PSC	3PSD	3PSOFF	4RS3PN	UNK
3LA	1997	778	1997	1	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.			1998	43	17.5	52.5	20.3	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	0.0	0.0	3.0
.			1999	54	30.8	48.1	13.6	0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	4.9
.			2000	23	15.3	52.3	21.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.5
.			2001	10	0.0	70.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0
.			2002	9	0.0	42.9	57.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.			2003	8	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3LA	1999	1995	1999	198	19.5	75.3	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.			2000	92	24.3	64.9	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9
.			2001	43	18.6	67.4	14.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.			2002	20	4.9	51.9	30.9	0.0	0.0	0.0	0.0	0.0	0.0	5.8	0.0	0.0	0.0	6.5
.			2003	11	0.0	44.4	55.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.			2004	4	32.3	0.0	32.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.4	0.0	0.0
3LA	2000	1093	2000	121	17.2	74.7	5.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	2.2
.			2001	47	2.1	83.0	12.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1
.			2002	14	9.4	90.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.			2003	3	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3LA	2001	2580	2001	336	20.9	70.9	6.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2
.			2002	192	5.3	76.8	17.3	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0
.			2003	68	0.0	15.0	85.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.			2004	5	26.6	73.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3LA	2002	1735	2002	198	1.2	83.0	15.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.			2003	127	1.0	9.9	86.2	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	1.0
.			2004	11	0.0	75.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3LB	1997	589	1997	2	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.			1998	11	0.0	0.0	87.5	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.0	0.0	0.0	0.0
.			1999	29	17.3	31.7	47.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5
.			2000	9	0.0	40.9	45.5	0.0	13.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.			2001	7	13.7	13.7	41.2	0.0	0.0	0.0	0.0	0.0	0.0	31.3	0.0	0.0	0.0	0.0
.			2002	10	0.0	48.4	51.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.			2003	7	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3LB	1999	3339	1999	146	1.8	13.8	79.7	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0	0.0	2.7
.			2000	189	8.7	33.3	50.4	3.9	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	2.5
.			2001	132	9.8	30.2	54.4	3.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.8
.			2002	116	0.0	46.0	48.5	1.1	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	3.4
.			2003	65	0.0	7.9	90.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
.			2004	9	0.0	27.6	43.6	0.0	0.0	0.0	0.0	0.0	0.0	13.0	0.0	15.9	0.0	0.0
3LB	2000	1296	2000	79	9.6	34.4	49.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.3
.			2001	58	5.2	29.4	60.6	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0
.			2002	48	0.0	38.1	55.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0
.			2003	33	0.0	4.0	91.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0
3LB	2001	2489	2001	91	3.3	41.8	53.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1
.			2002	235	1.4	36.0	60.1	1.1	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.4	0.0	0.4
.			2003	96	0.0	2.7	97.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.			2004	18	14.5	49.1	36.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3LB	2002	2369	2002	200	0.0	32.6	66.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3
.			2003	202	0.0	8.3	91.1	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.			2004	29	12.7	55.2	32.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3LB	2003	472	2003	1	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3LB	2004	923	2004	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

cont'd:

Table 5. Cont'd. (Distribution of recaptures)

Release area	Release year	Number tagged	Recapture year	Number recap'd	% of annual recaptures													
					3K	3LA	3LB	3LF	3LJ	3LQ	3NO	3PSA	3PSB	3PSC	3PSD	3PSOFF	4RS3PN	UNK
3LF	1999	194	1999	17	0.0	0.0	0.0	79.6	7.5	0.0	0.0	0.0	0.0	12.9	0.0	0.0	0.0	0.0
.			2000	9	15.3	0.0	15.3	44.2	0.0	0.0	0.0	0.0	0.0	25.3	0.0	0.0	0.0	0.0
.			2001	5	0.0	0.0	0.0	0.0	0.0	77.0	0.0	0.0	0.0	23.0	0.0	0.0	0.0	0.0
3LF	2000	263	2000	14	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.			2001	8	0.0	0.0	0.0	50.5	34.9	0.0	0.0	0.0	0.0	14.6	0.0	0.0	0.0	0.0
.			2002	6	0.0	0.0	40.9	40.9	0.0	0.0	0.0	0.0	0.0	18.3	0.0	0.0	0.0	0.0
.			2004	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
3LJ	1997	306	1997	11	0.0	0.0	12.0	0.0	78.8	0.0	0.0	0.0	0.0	9.2	0.0	0.0	0.0	0.0
.			1998	13	10.5	0.0	0.0	28.9	19.9	0.0	0.0	0.0	0.0	21.4	0.0	10.0	0.0	9.4
.			1999	17	0.0	0.0	20.2	0.0	15.0	0.0	0.0	0.0	0.0	56.1	0.0	8.7	0.0	0.0
.			2000	13	9.9	0.0	0.0	9.9	17.7	0.0	0.0	0.0	0.0	33.5	10.8	9.4	0.0	8.9
.			2001	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	100.0
.			2002	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
3LJ	1999	21	1999	9	0.0	0.0	11.3	0.0	44.4	0.0	0.0	0.0	0.0	44.3	0.0	0.0	0.0	0.0
.			2000	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
.			2001	1	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.			2004	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
3LJ	2000	48	2000	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
.			2001	5	0.0	0.0	0.0	28.2	0.0	0.0	0.0	0.0	0.0	71.8	0.0	0.0	0.0	0.0
3LJ	2001	157	2001	23	0.0	4.3	0.0	5.7	83.8	0.0	0.0	6.2	0.0	0.0	0.0	0.0	0.0	0.0
.			2002	10	0.0	0.0	0.0	0.0	76.0	0.0	0.0	0.0	0.0	11.3	0.0	0.0	0.0	12.7
3LQ	1997	1319	1997	28	0.0	0.0	0.0	13.4	8.3	4.2	0.0	0.0	0.0	74.1	0.0	0.0	0.0	0.0
.			1998	84	0.0	4.2	4.4	4.2	6.0	15.4	0.0	0.0	4.4	55.6	0.0	2.7	0.0	3.1
.			1999	122	1.0	1.1	3.9	1.0	0.0	4.6	0.0	1.0	7.2	75.0	0.0	2.3	0.0	2.9
.			2000	49	0.0	0.0	0.0	0.0	2.7	2.7	0.0	0.0	7.1	87.5	0.0	0.0	0.0	0.0
.			2001	19	5.2	15.7	5.2	0.0	0.0	0.0	0.0	0.0	0.0	59.5	0.0	7.5	0.0	6.9
.			2002	8	0.0	0.0	0.0	0.0	0.0	16.0	0.0	0.0	0.0	84.0	0.0	0.0	0.0	0.0
.			2003	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
.			2004	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
3LQ	1999	1013	1999	169	0.0	0.0	2.3	0.0	2.9	3.7	0.0	0.0	2.5	86.2	0.7	0.0	0.0	1.6
.			2000	105	0.0	0.0	2.4	0.0	3.6	7.4	0.0	0.0	1.1	85.5	0.0	0.0	0.0	0.0
.			2001	52	0.0	0.0	0.0	0.0	0.0	11.7	0.0	0.0	2.3	83.5	0.0	0.0	0.0	2.5
.			2002	18	0.0	0.0	0.0	0.0	7.4	7.4	0.0	0.0	0.0	77.2	0.0	8.1	0.0	0.0
.			2003	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
.			2004	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
3LQ	2000	316	2000	46	0.0	0.0	0.0	0.0	0.0	8.3	0.0	0.0	5.1	75.4	0.0	6.3	0.0	4.8
.			2001	42	0.0	2.4	0.0	0.0	6.3	6.3	0.0	3.4	2.8	66.2	3.4	9.2	0.0	0.0
.			2002	17	0.0	0.0	0.0	0.0	0.0	15.1	0.0	0.0	0.0	84.9	0.0	0.0	0.0	0.0
.			2003	5	0.0	0.0	26.1	0.0	0.0	0.0	0.0	0.0	0.0	45.3	0.0	28.6	0.0	0.0
.			2004	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
3LQ	2001	722	2001	165	0.6	0.0	2.4	2.8	0.8	46.8	0.0	0.0	0.7	44.5	0.0	0.0	0.0	1.4
.			2002	69	0.0	0.0	1.9	0.0	3.8	13.4	0.0	0.0	0.0	79.0	0.0	0.0	0.0	1.9
.			2003	14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	90.0	0.0	10.0	0.0	0.0
.			2004	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	64.1	0.0	0.0	0.0	35.9
3LQ	2002	148	2002	22	0.0	0.0	0.0	0.0	0.0	24.4	0.0	0.0	0.0	75.6	0.0	0.0	0.0	0.0
.			2003	12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
.			2004	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0

cont'd:

Table 5. Cont'd. (Distribution of recaptures)

Release area	Release year	Number tagged	Recapture year	Number recap'd	% of annual recaptures													
					3K	3LA	3LB	3LF	3LJ	3LQ	3NO	3PSA	3PSB	3PSC	3PSD	3PSOFF	4RS3PN	UNK
3PSC	1997	6028	1997	448	0.0	0.0	0.2	0.3	0.3	0.6	0.0	0.0	4.2	94.1	0.0	0.3	0.0	0.0
.			1998	481	0.0	0.0	0.7	1.2	4.2	0.9	0.6	0.3	12.9	75.3	0.6	1.4	0.4	1.5
.			1999	620	0.4	0.4	1.2	3.0	1.6	1.6	0.0	0.9	6.6	81.7	0.0	1.1	0.0	1.4
.			2000	260	0.4	1.0	0.5	0.0	0.9	1.0	0.0	1.4	6.6	80.7	0.0	5.6	0.7	1.3
.			2001	69	0.0	0.0	1.4	0.0	0.0	1.9	0.0	1.4	11.7	77.6	0.0	6.0	0.0	0.0
.			2002	23	0.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0	24.1	48.9	0.0	18.5	0.0	4.3
.			2003	10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.5	77.6	0.0	11.9	0.0	0.0
.			2004	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	50.0	0.0	0.0	0.0	0.0
3PSC	1998	5715	1998	495	0.0	0.0	0.6	2.1	4.5	1.2	0.0	0.2	1.0	89.5	0.0	0.0	0.0	0.8
.			1999	1134	0.3	0.4	2.2	2.3	1.8	1.3	0.0	0.2	4.2	84.8	0.0	0.8	0.0	1.6
.			2000	513	0.7	0.2	0.7	0.4	0.5	2.4	0.0	0.8	4.6	87.6	0.0	1.6	0.0	0.6
.			2001	156	1.3	0.6	0.0	0.8	1.5	4.7	0.0	0.0	3.5	83.7	0.0	3.2	0.0	0.6
.			2002	54	0.0	2.4	0.0	0.0	0.0	8.9	0.0	0.0	0.0	82.4	0.0	2.3	0.0	3.9
.			2003	26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.8	77.8	0.0	0.0	0.0	4.4
.			2004	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	79.7	0.0	0.0	0.0	20.3
3PSC	1999	4574	1999	656	0.0	0.0	0.8	0.4	0.8	0.6	0.0	0.0	0.8	96.4	0.0	0.0	0.0	0.2
.			2000	745	0.0	0.0	0.3	0.2	0.5	1.2	0.0	0.0	2.9	94.3	0.0	0.2	0.0	0.3
.			2001	273	0.0	0.4	0.4	0.8	1.0	3.8	0.0	0.0	2.1	87.7	0.0	2.6	0.0	1.2
.			2002	91	0.0	0.0	1.4	0.0	1.4	4.0	0.0	0.0	6.5	82.9	0.0	1.6	0.0	2.2
.			2003	28	0.0	0.0	0.0	0.0	0.0	4.7	0.0	0.0	0.0	91.7	0.0	3.6	0.0	0.0
.			2004	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.9	62.5	0.0	20.6	0.0	0.0
3PSC	2000	6190	2000	595	0.0	0.0	0.0	0.0	0.4	1.3	0.0	0.0	1.5	95.5	0.2	0.0	0.0	1.0
.			2001	795	0.0	0.0	0.4	0.8	1.0	4.9	0.0	0.2	1.3	89.8	0.0	1.0	0.0	0.6
.			2002	305	0.0	0.0	0.0	0.4	0.0	3.0	0.0	0.5	3.5	86.8	0.5	4.2	0.0	1.2
.			2003	119	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	2.0	92.4	0.0	3.5	0.0	0.9
.			2004	37	0.0	0.0	0.0	3.6	3.6	0.0	0.0	3.9	0.0	69.6	7.8	11.7	0.0	0.0
3PSC	2001	4323	2001	649	0.2	0.2	0.2	1.6	0.8	6.1	0.0	0.0	1.1	87.2	0.0	0.9	0.0	1.8
.			2002	487	0.3	0.3	0.3	0.5	0.5	0.8	0.0	0.6	1.0	92.8	0.0	1.5	0.0	1.4
.			2003	198	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	92.2	0.0	4.9	0.0	1.2
.			2004	43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	93.9	0.0	3.4	0.0	0.0
3PSC	2002	4902	2002	558	0.0	0.0	0.0	0.2	0.0	1.2	0.0	0.3	0.0	98.1	0.0	0.0	0.0	0.2
.			2003	632	0.0	0.0	0.0	0.2	0.0	0.4	0.0	0.0	2.0	96.0	0.0	1.1	0.0	0.4
.			2004	225	0.6	0.0	0.6	0.0	0.0	0.6	0.0	0.6	0.5	95.4	0.0	0.6	0.0	1.0
3PSC	2003	3426	2003	578	0.0	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.4	98.7	0.0	0.2	0.0	0.2
.			2004	471	0.0	0.0	0.2	0.3	0.2	0.3	0.0	0.4	1.0	97.2	0.0	0.4	0.0	0.0

cont'd:

Table 5. Cont'd. (Distribution of recaptures)

Release area	Release year	Number tagged	Recapture year	Number recap'd	% of annual recaptures													
					3K	3LA	3LB	3LF	3LJ	3LQ	3NO	3PSA	3PSB	3PSC	3PSD	3PSOFF	4RS3PN	UNK
3PSH	1998	1842	1998	30	0.0	0.0	0.0	3.3	0.0	0.0	4.8	0.0	0.0	22.4	0.0	69.5	0.0	0.0
.			1999	29	0.0	0.0	0.0	4.5	4.0	0.0	0.0	0.0	0.0	33.6	0.0	51.1	3.4	3.4
.			2000	19	0.0	0.0	0.0	0.0	5.3	0.0	0.0	0.0	6.2	23.8	0.0	57.2	0.0	7.6
.			2001	8	0.0	0.0	12.2	0.0	0.0	0.0	0.0	0.0	0.0	39.9	0.0	32.7	0.0	15.2
.			2002	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.0	0.0	48.9	0.0	28.1
.			2003	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
3PSH	1999	1808	1999	50	2.0	0.0	2.6	0.0	7.7	2.4	4.9	0.0	0.0	40.3	0.0	31.2	0.0	8.9
.			2000	58	0.0	0.0	0.0	4.5	0.0	2.3	2.5	0.0	0.0	21.9	5.0	44.8	0.0	19.1
.			2001	25	0.0	0.0	0.0	4.1	0.0	0.0	0.0	0.0	4.8	28.3	0.0	53.0	0.0	9.9
.			2002	17	0.0	0.0	0.0	0.0	0.0	0.0	8.4	0.0	0.0	41.4	0.0	31.2	0.0	19.1
.			2003	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.8	0.0	36.8	0.0	33.4
.			2004	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.8	35.4	45.8
3PSH	2000	1044	2000	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.0	0.0	0.0	55.0	0.0	0.0
.			2001	16	0.0	0.0	0.0	0.0	0.0	8.0	17.4	0.0	0.0	7.1	0.0	50.0	0.0	17.4
.			2002	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.3	0.0	56.7	0.0	0.0
.			2003	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
.			2004	3	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0
3PSH	2001	1144	2001	13	0.0	0.0	0.0	0.0	0.0	9.9	10.8	0.0	0.0	17.7	0.0	50.8	0.0	10.8
.			2002	17	0.0	0.0	0.0	0.0	5.8	0.0	0.0	0.0	0.0	19.4	0.0	49.9	0.0	24.9
.			2003	9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.1	0.0	44.7	0.0	28.1
.			2004	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.0	0.0	55.0	0.0	0.0
3PSH	2002	1509	2002	17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.3	0.0	66.7	0.0	12.1
.			2003	16	0.0	0.0	0.0	0.0	0.0	0.0	8.8	0.0	0.0	34.0	0.0	33.4	0.0	23.8
.			2004	12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.6	8.2	0.0	58.7	0.0	23.5
3PSH	2003	133	2003	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.0	0.0	31.5	0.0	31.5
.			2004	9	0.0	0.0	0.0	0.0	0.0	0.0	16.6	0.0	0.0	38.7	0.0	33.2	0.0	11.5
3PSH	2004	1747	2004	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0

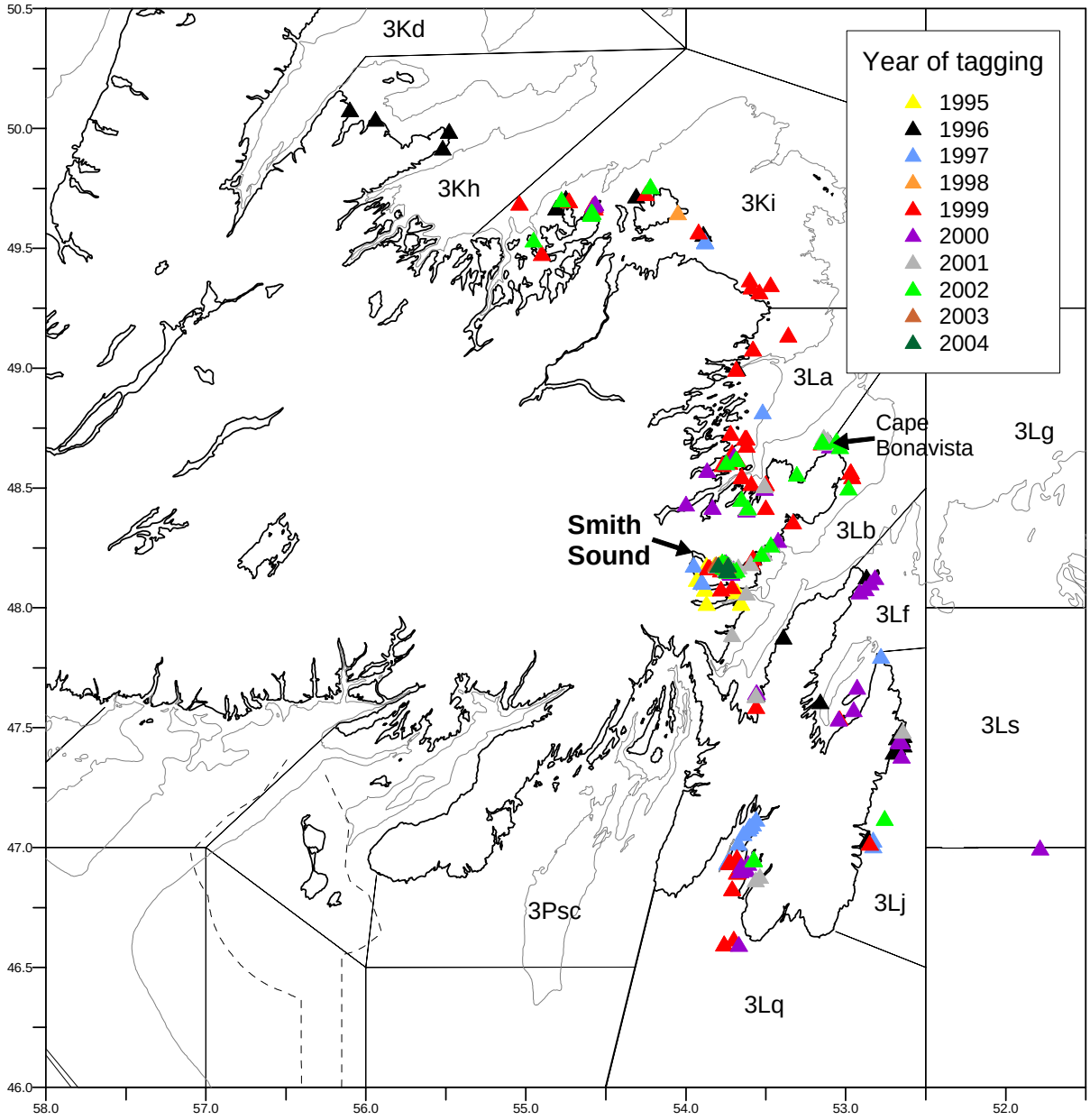

Fig. 1. Locations where cod were tagged off eastern Newfoundland (NAFO Divs. 3KL) during 1995-2004. Boundaries of statistical unit areas (solid line), the 200 m depth contour (grey line), and the French economic zone surrounding Saint Pierre and Miquelon (dashed line) are also shown.

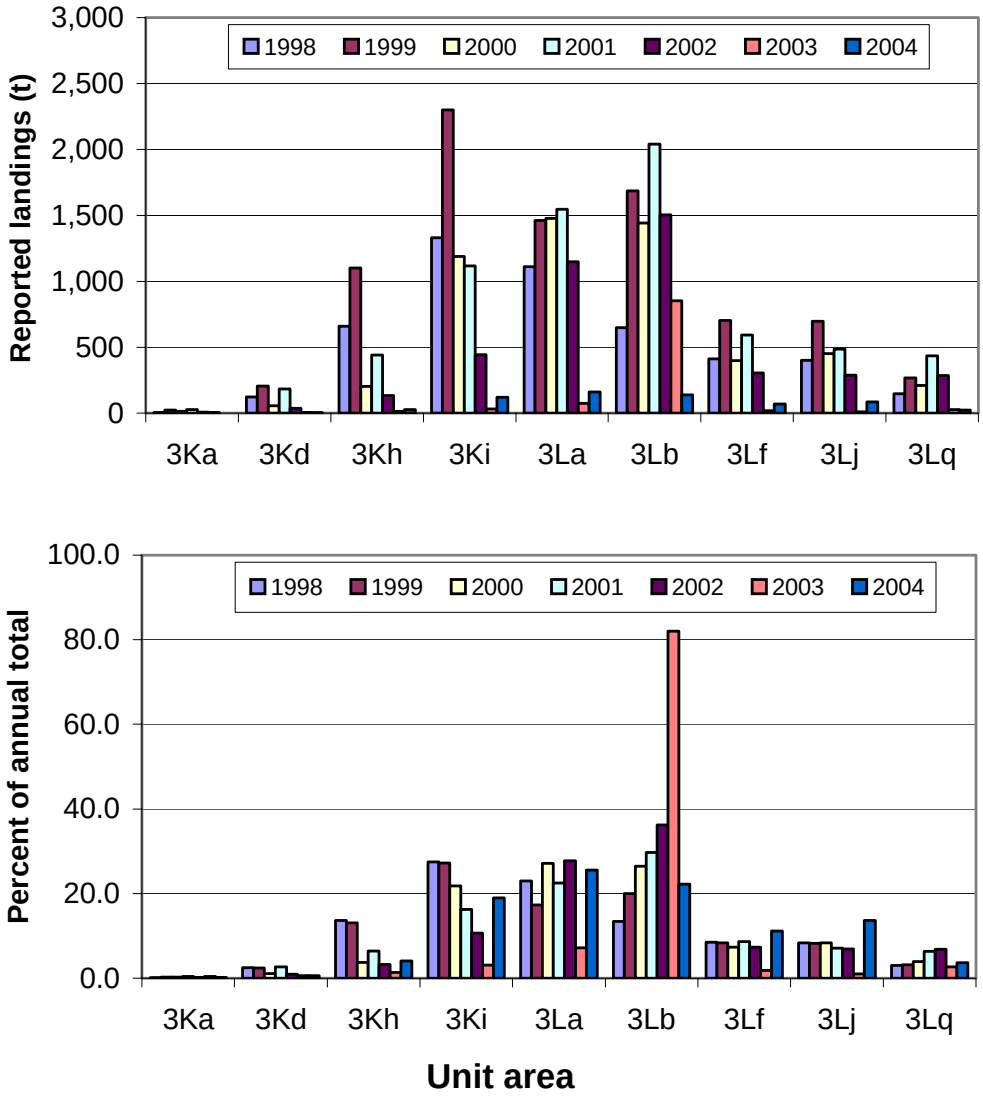

Fig. 2. Distribution of cod landings (t) along the inshore (north to south) of NAFO Divs. 3KL during 1998-2004. Reported offshore landings have been low (< 50 t) throughout 1998-2004.

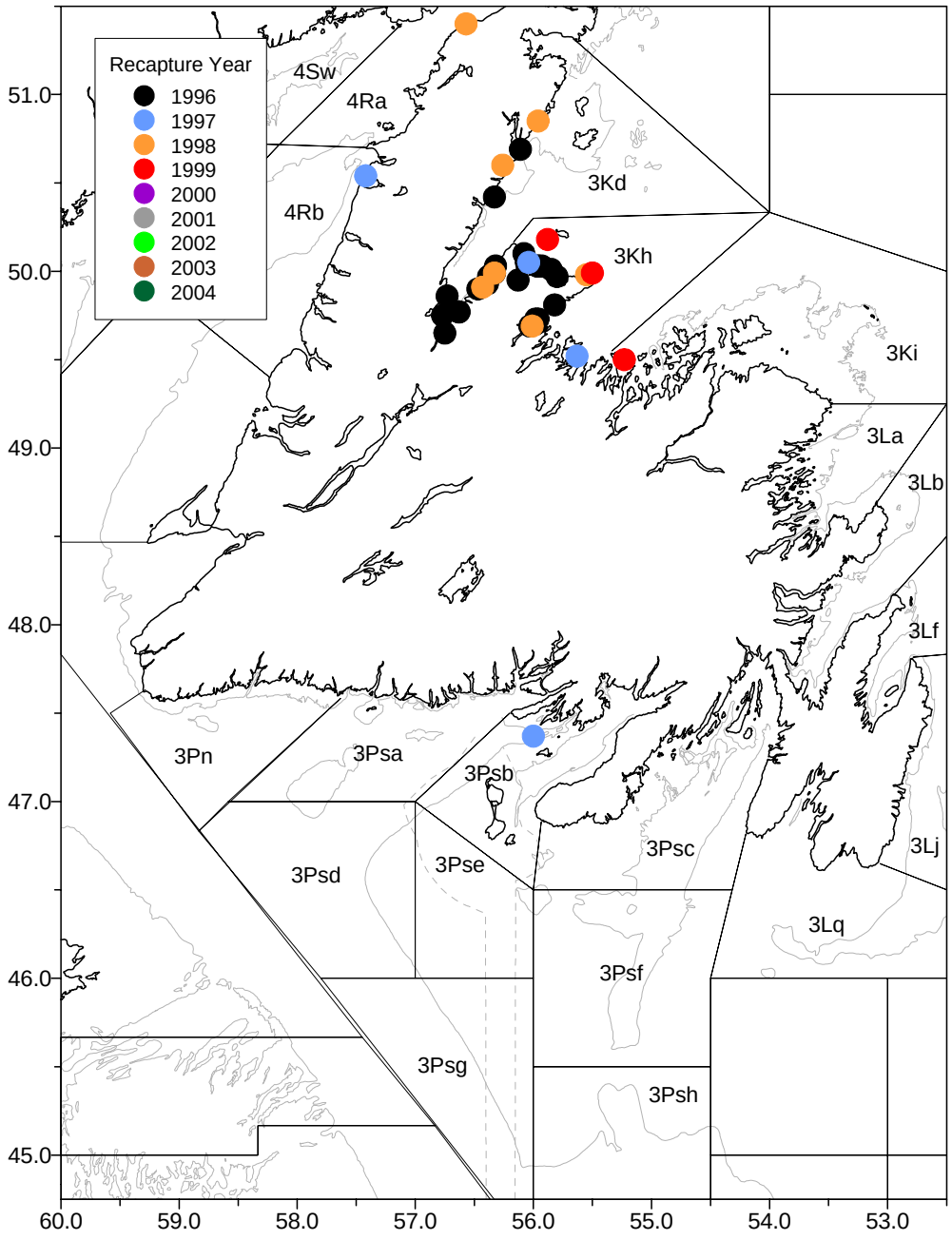

Fig. 3A. Reported recapture positions for cod tagged and released in 3Kh (Notre Dame Bay) during 1996-1997 (43 recaptures). Boundaries of statistical unit areas (solid lines), the 200 m depth contour (grey line) and French economic zone surrounding Saint Pierre and Miquelon (dashed line) are also shown.

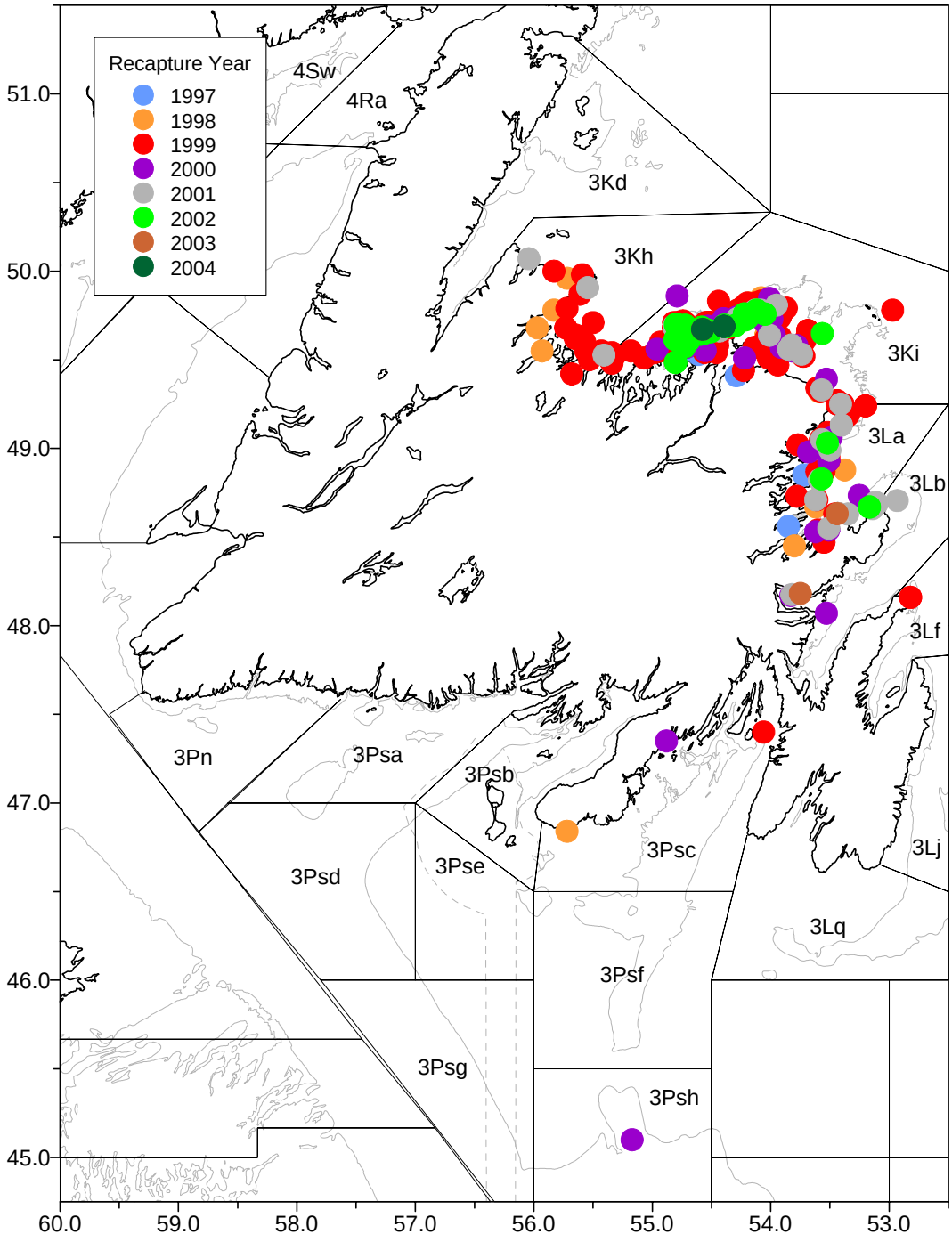

Fig. 3B. Reported recapture positions for cod tagged and released in 3Ki (Fogo - Twillingate) during 1997-2000 and 2002 (634 recaptures). Boundaries of statistical unit areas (solid lines), the 200 m depth contour (grey line) and French economic zone surrounding Saint Pierre and Miquelon (dashed line) are also shown.

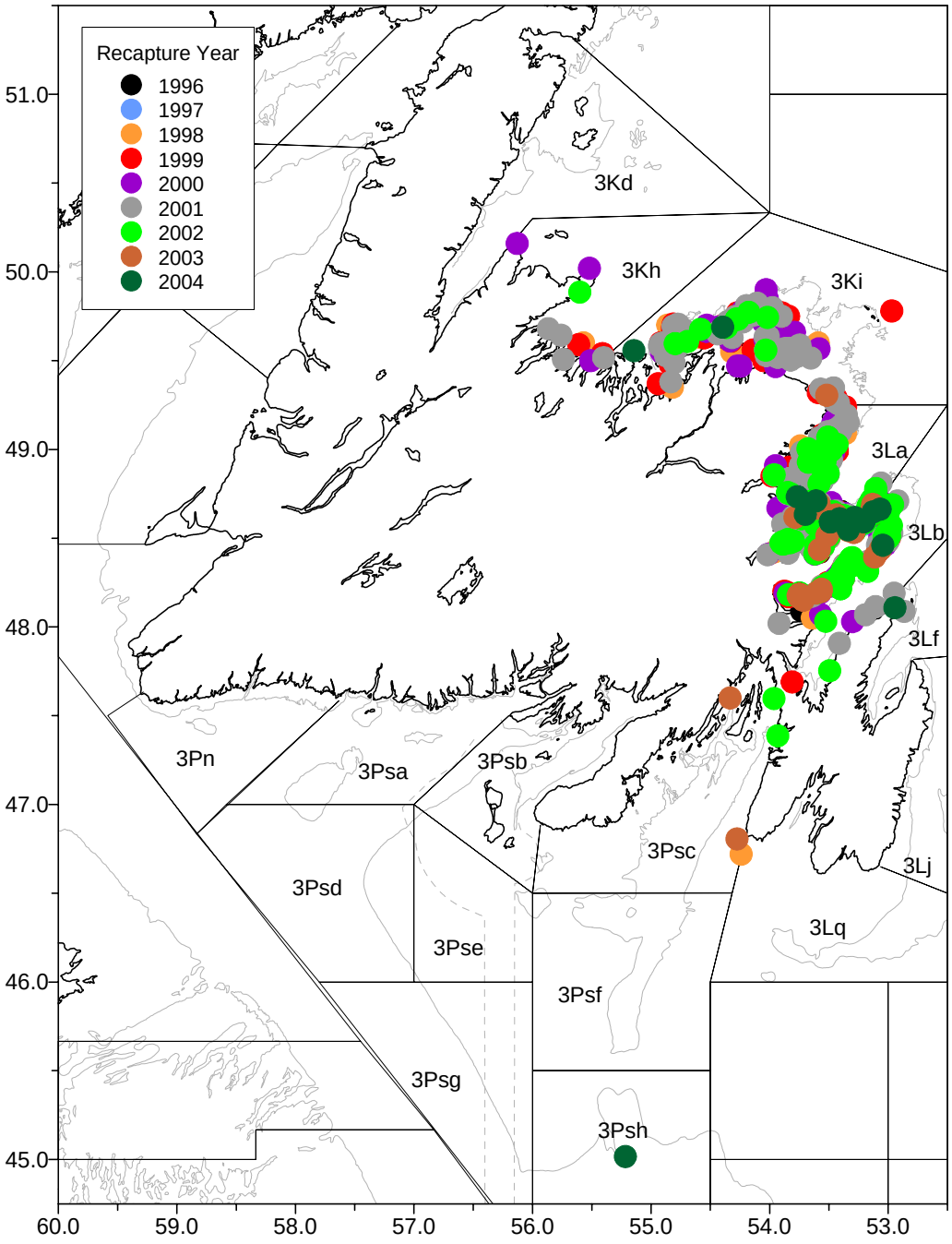

Fig 3C. Reported recapture positions for cod tagged and released in 3La (Bonavista Bay) during 1996-2002 (>1,300 recaptures). Boundaries of statistical unit areas (solid lines), 200 m depth contour (grey lines), and French economic zone surrounding St. Pierre and Miquelon (dashed line) are also shown.

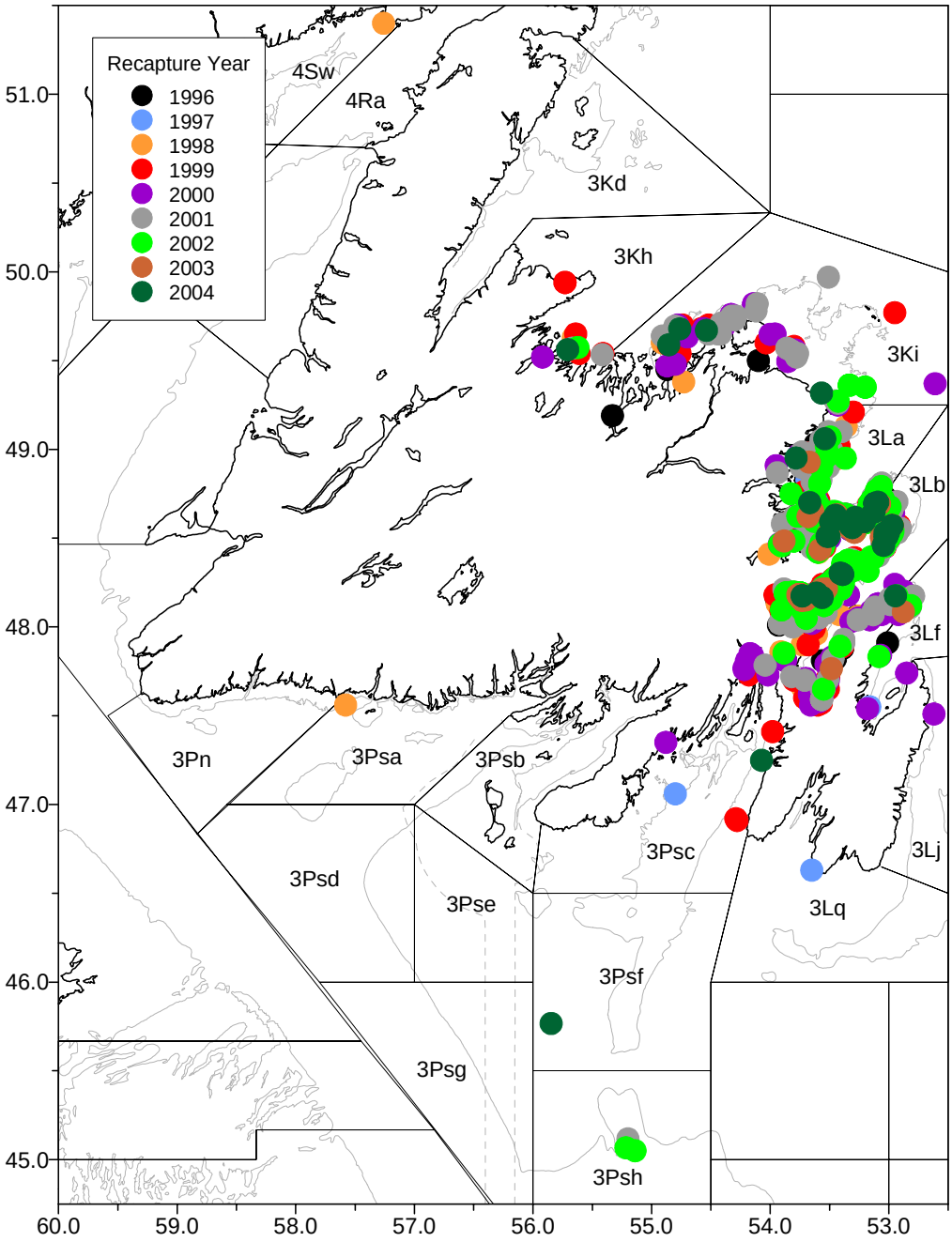

Fig. 3D. Reported recapture positions for cod tagged and released in 3Lb (Trinity Bay) during 1996-2004 (>1,500 recaptures). Boundaries of statistical unit areas (solid lines), the 200 m depth contour (grey line) and French economic zone surrounding St. Pierre and Miquelon (dashed line) are also shown.

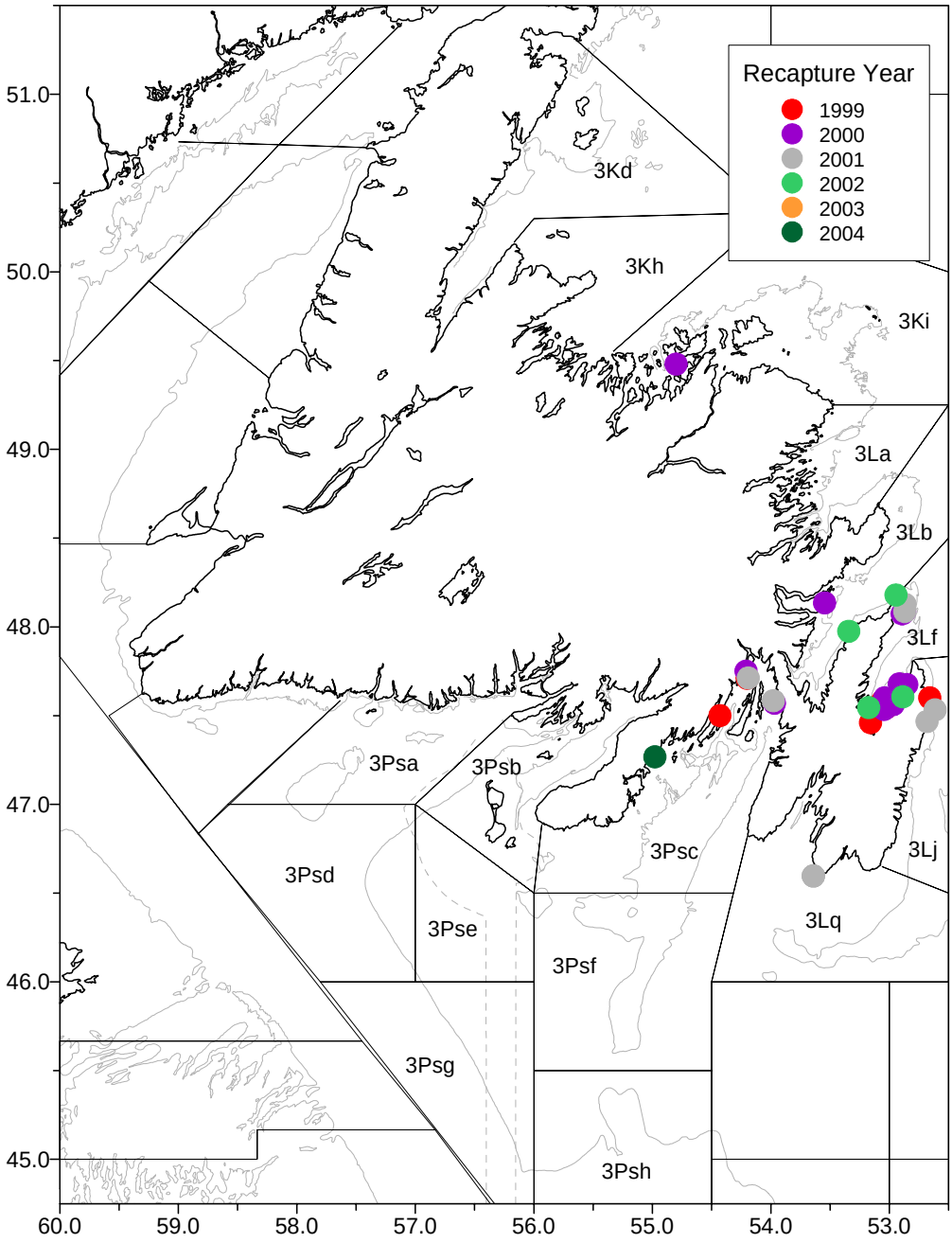

Fig. 3E. Reported recapture positions for cod tagged and released in 3Lf (Conception Bay) during 1999-2000 (46 recaptures). Boundaries of statistical unit areas (solid lines), 200 m depth contour (grey lines), and French economic zone surrounding St. Pierre and Miquelon (dashed line) are also shown.

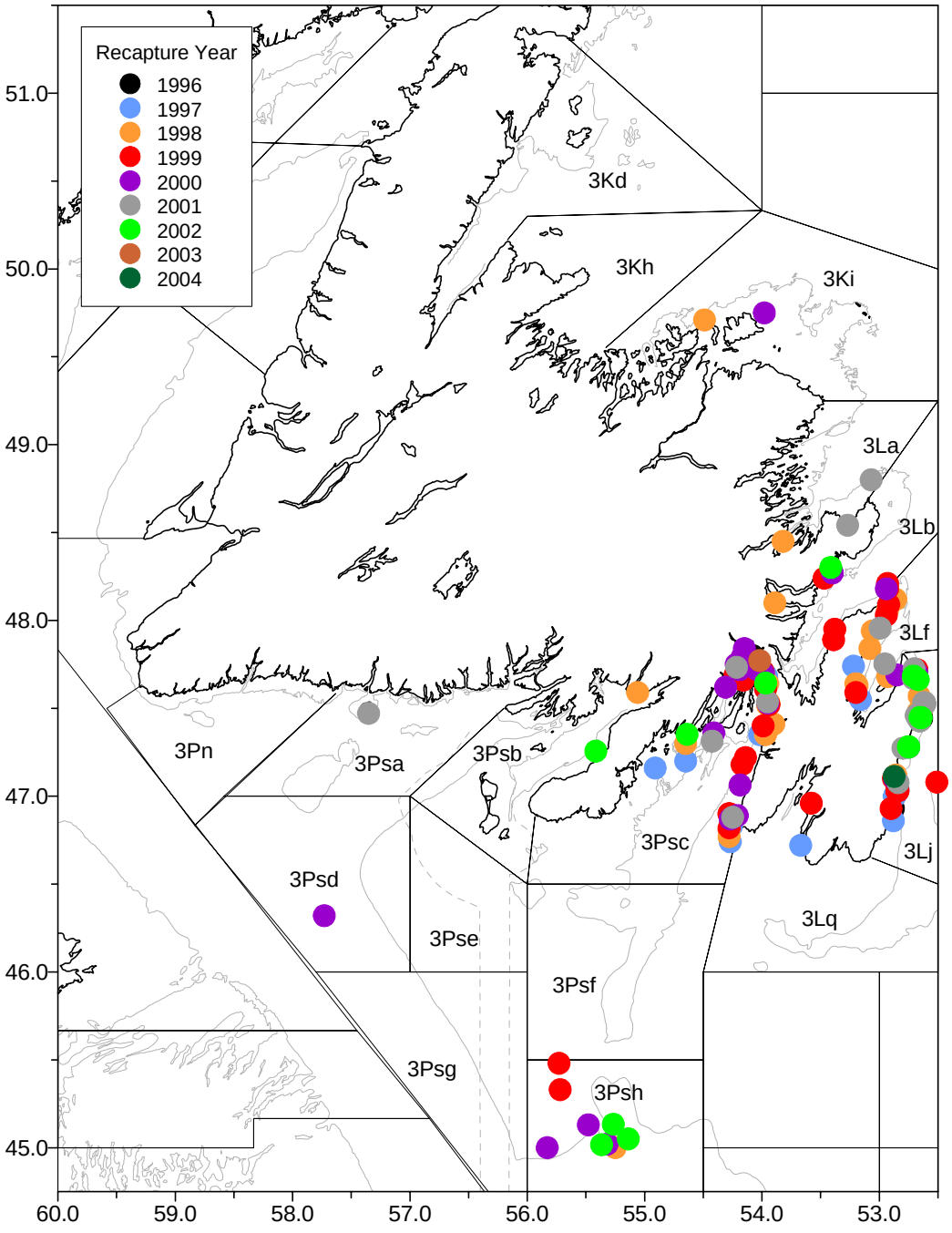

Fig 3F. Reported recapture positions for cod tagged and released in 3Lj (Eastern Avalon) during 1996-2004 (158 recaptures). Boundaries of statistical unit areas (solid lines), 200 m depth contour (grey lines), and French economic zone surrounding St. Pierre and Miquelon (dashed line) are also shown.

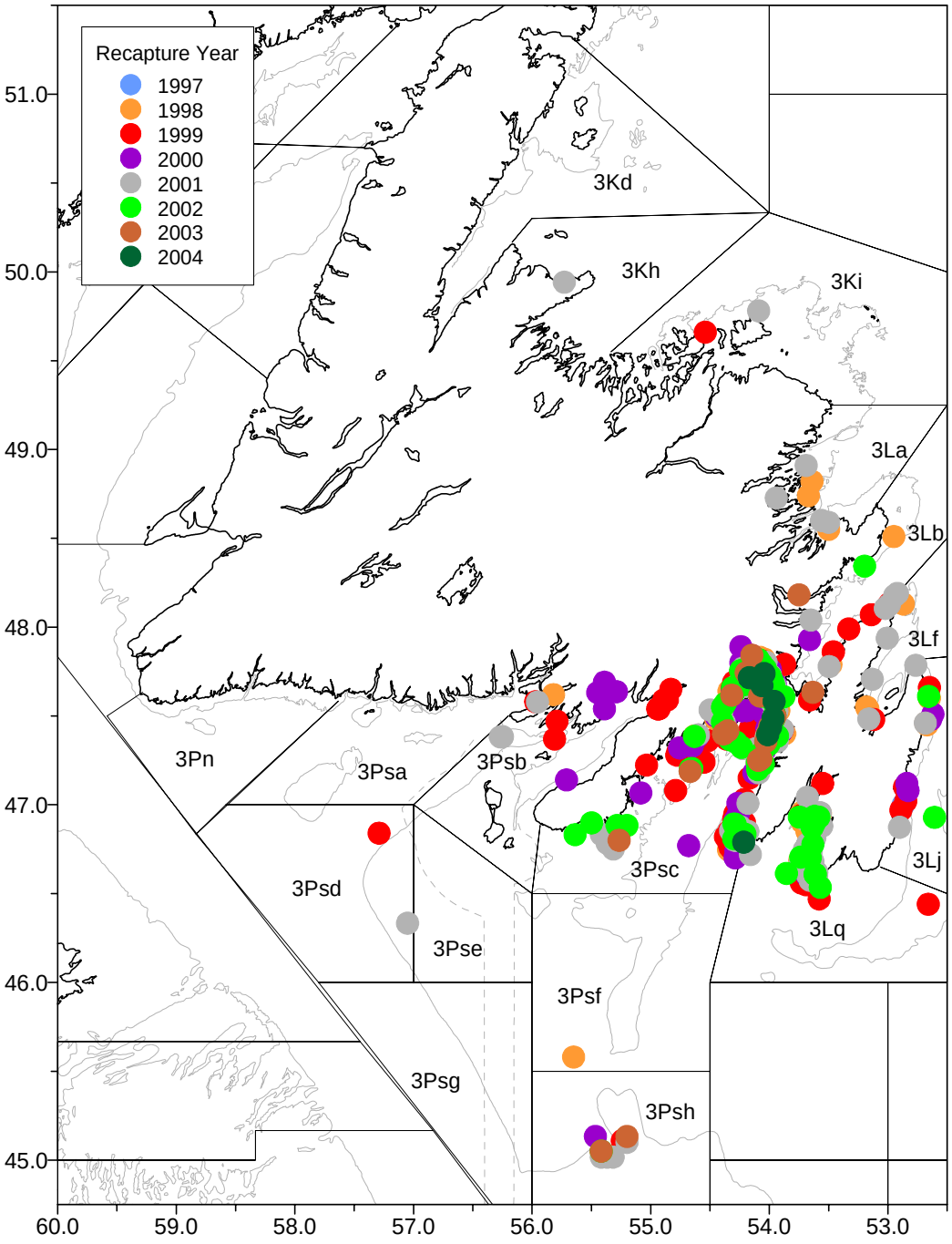

Fig 3G. Reported recapture positions for cod tagged and released in 3Lq (St. Mary's Bay) during 1997-2004 (717 recaptures). Boundaries of statistical unit areas (solid lines), 200 m depth contour (grey lines), and French economic zone surrounding St. Pierre and Miquelon (dashed line) are also shown.

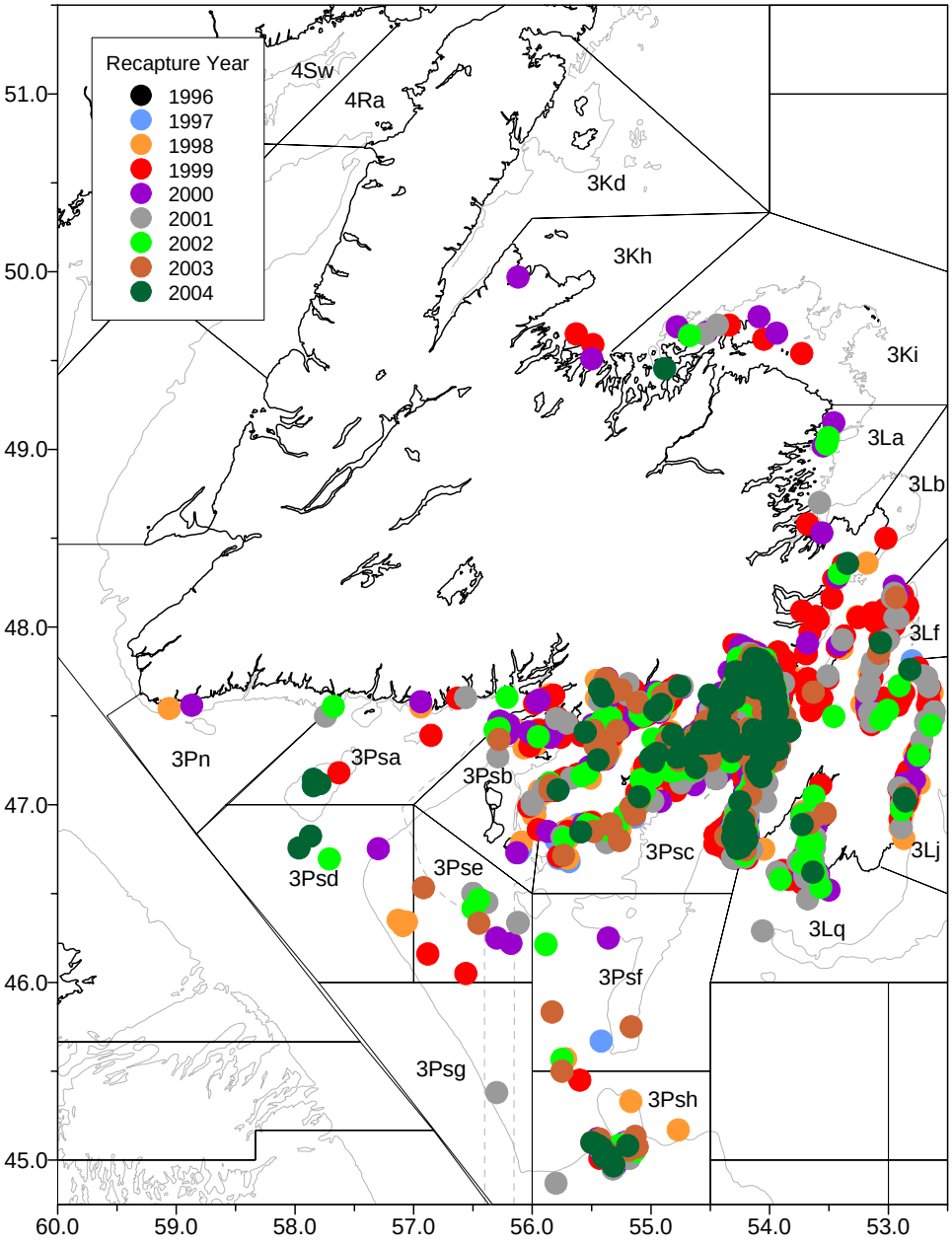

Fig. 3H. Reported recapture positions for cod tagged and released in 3Psc (Placentia Bay) during 1996-2004 (>8,490 recaptures). Boundaries of statistical unit areas (solid lines), the 200 m depth contour (grey line) and French economic zone surrounding St. Pierre and Miquelon (dashed line) are also shown.

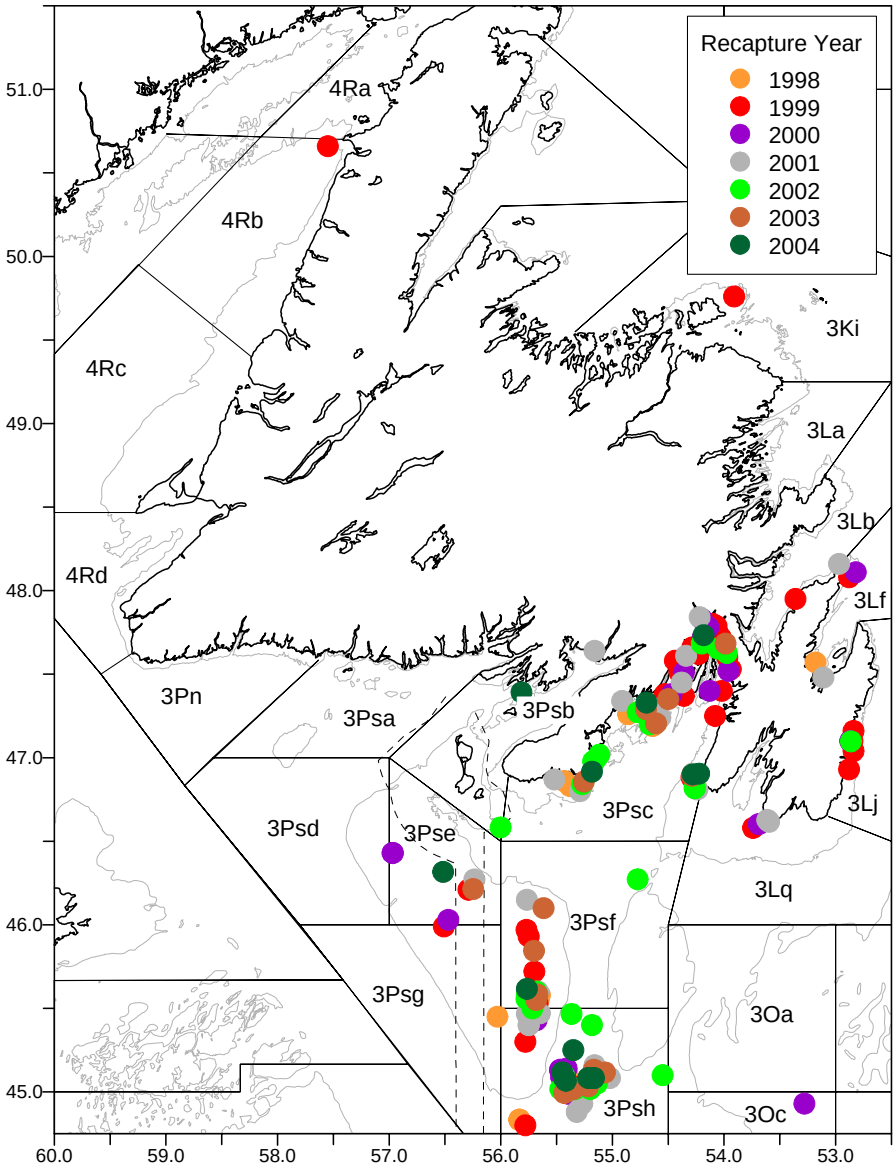

Fig 3I. Reported recapture positions for cod tagged and released in 3Psh (Halibut Channel) during 1998-2004 (222 recaptures). Boundaries of statistical unit areas (solid lines), 200 m depth contour (grey lines), and French economic zone surrounding St. Pierre and Miquelon (dashed line) are also shown.

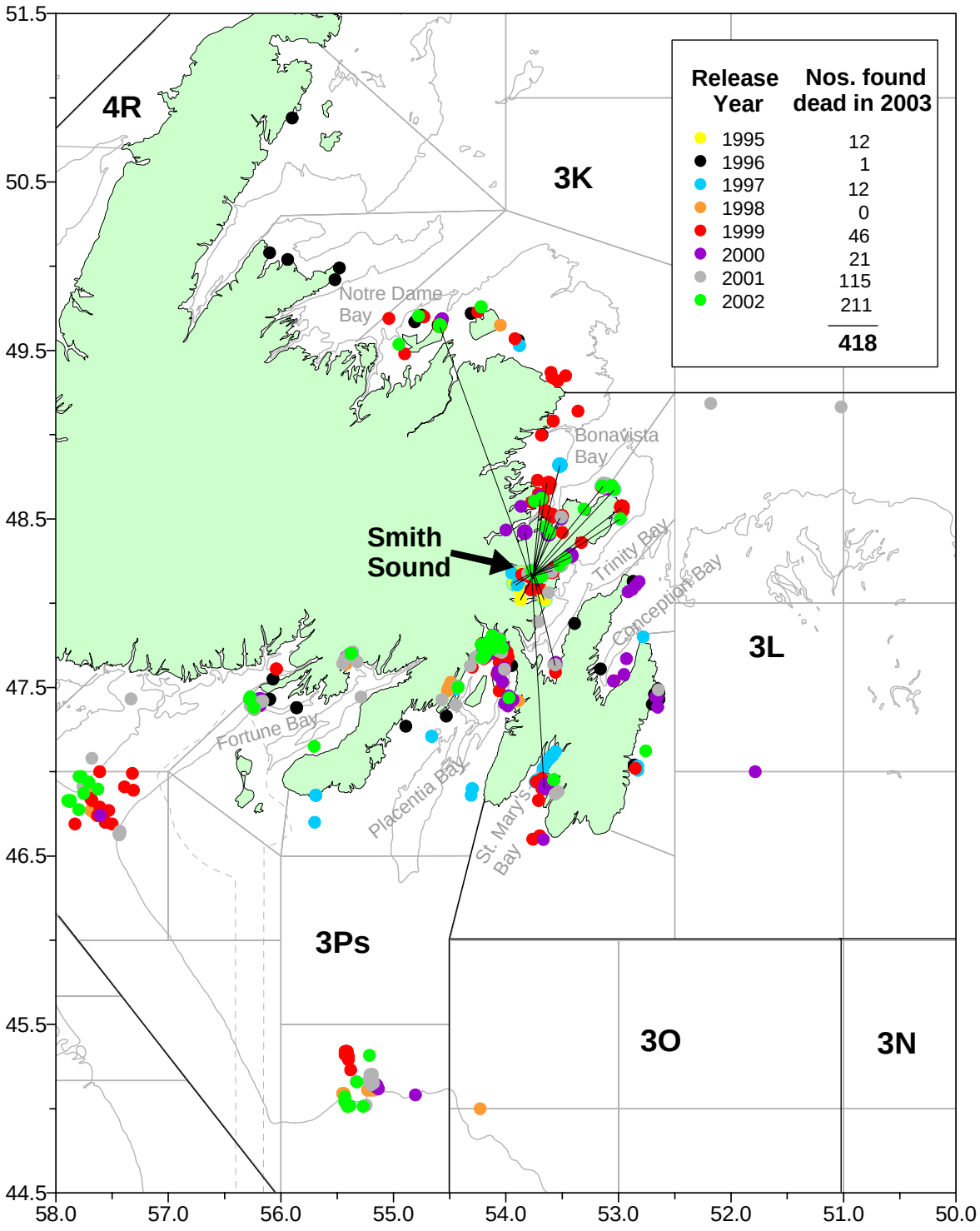

Fig. 4. Release sites of tagged cod off Newfoundland during 1995-2002. Symbols connected by lines to Smith Sound indicate sites from which at least one tagged cod was subsequently found dead in the April 2003 Smith Sound mortality event. See text for details.