



Fisheries and Oceans    Pêches et Océans  
Canada                      Canada

Canadian Stock Assessment Secretariat  
Research Document 98/24

Secrétariat canadien pour l'évaluation des stocks  
Document de recherche 98/24

Not to be cited without  
Permission of the authors<sup>1</sup>

Ne pas citer sans  
autorisation des auteurs<sup>1</sup>

Movement patterns of inshore cod in Subdivision 3Ps (southern Newfoundland)  
based on marked-recapture studies during 1996-97

by

G. L. Lawson, G. A. Rose  
Fisheries Conservation Chair  
Fisheries and Marine Institute of Memorial University  
P.O. Box 4920  
St. John's, Newfoundland  
A1C 5R3

and

J. Bratley  
Science Branch  
Department of Fisheries and Oceans  
P.O. Box 5667  
St. John's, Newfoundland  
A1C 5X1

<sup>1</sup> This series documents the scientific basis for the evaluation of fisheries resources in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

<sup>1</sup> La présente série documente les bases scientifiques des évaluations des ressources halieutiques du Canada. Elle traite des problèmes courants selon les échéanciers dictés. Les documents qu'elle contient ne doivent pas être considérés comme des énoncés définitifs sur les sujets traités, mais plutôt comme des rapports d'étape sur les études en cours.

Research documents are produced in the official language in which they are provided to the Secretariat.

Les documents de recherche sont publiés dans la langue officielle utilisée dans le manuscrit envoyé au secrétariat.

ISSN 1480-4883

Ottawa, 1998

Canada

## Abstract

We address movements of cod inhabiting inshore areas of subdivision 3Ps (southern Newfoundland) based on mark-recapture experiments during 1996 and 1997. Cod were tagged with spaghetti t-bar tags at thirteen locations in Placentia Bay and adjacent areas at times representing important stages in cod life history. Spawning cod tagged in the inner reaches of Placentia Bay during spring 1996 and 1997 moved outwards along both the East and West sides of Placentia Bay during spring and summer, although the movement continued farther out the bay on the East side. A portion of these East side migrants crossed the stock boundary between NAFO subdivision 3Ps and Div. 3L, and continued northward around the Avalon Peninsula. Smaller fish (<50 cm) tended to remain resident in the inner portions of Placentia Bay, and did not migrate as far as larger (>50 cm) individuals. Fish tagged at the mouth of Placentia Bay (Cape St. Mary's) did not move into the bay during spring and summer, but instead remained in the area or migrated into Div. 3L. Exchange of cod occurred between Fortune and Placentia Bays, but fish tagged in Fortune Bay were never recaptured farther west. No tagged cod were reported as recaptured from offshore areas in 3Ps or from the Gulf of St. Lawrence (3Pn4RS).

## Résumé

Nous avons examiné les déplacements de la morue des zones côtières de la sous-division 3Ps (sud de Terre-Neuve) en nous fondant sur les résultats d'essais par marquage-recapture réalisés en 1996 et 1997. Les morues ont été marquées à l'aide d'étiquettes spaghetti à barre en t en treize endroits de la baie Placentia et dans des zones voisines à des moments correspondant à des étapes importantes de leur cycle vital. Les géniteurs marqués dans le fond de la baie Placentia au cours du printemps de 1996 et 1997 se sont déplacés vers l'extérieur, le long des côtes est et ouest de la baie pendant le printemps et l'été, et ce déplacement s'est poursuivi, du côté est, vers l'extérieur de la baie. Une partie de ces poissons ont traversé la limite de l'aire du stock entre la sous-division 3Ps et la division 3L de l'OPANO et ont continué de se déplacer vers le nord, le long de la péninsule d'Avalon. Les poissons plus petits (< 50 cm) avaient tendance à demeurer dans le fond de la baie Placentia et ils ne se sont pas déplacés aussi loin que les poissons plus gros (> 50 cm). Les poissons marqués à l'embouchure de la baie Placentia (cap St. Mary's) ne se sont pas déplacés vers l'intérieur de la baie pendant le printemps et l'été; ils sont plutôt demeurés dans la même zone ou se sont déplacés vers la division 3L. Il y a eu échange de morues entre les baies Fortune et Placentia, mais les poissons marqués dans la baie Fortune n'ont jamais été recapturés plus à l'ouest. Aucune morue marquée n'a été recapturée dans les zones hauturières de 3Ps ou dans le golfe du Saint-Laurent (3Pn4RS).

## **Introduction**

Effective fisheries management requires knowledge of stock structure and fish seasonal movement patterns. There is evidence to suggest that several sub-stocks of cod exist within NAFO subdivision 3Ps, each displaying different migratory patterns (Templeman 1974; 1979; Lear 1984, 1988; Moguedet 1994; Taggart et al. 1995). In this paper we describe movement patterns of cod in Placentia Bay and adjacent areas based on mark-recapture experiments conducted in 1996 and 1997.

## **Methods**

The methodology is described in detail in Brattey and Cadigan (1998). Briefly, cod were tagged with spaghetti t-bar tags at various inshore sites in 3Ps and adjacent areas (southern 3L) during the summer and fall of 1996, as well as prior to and during the commercial fishery in 1997 (Fig. 1; Table 1). Tagging locations were selected to represent key stages in cod life history: particularly spawning, capelin feeding, and migrations. A wide range of sizes of cod were tagged (see Brattey and Cadigan 1998), but mean lengths tended to be slightly smaller at the more westerly tagging sites compared to the eastern and inner reaches of Placentia Bay (Table 1). Three of the tagging experiments in spring 1997 (9701, 9704, 9705) were performed on cod spawning aggregations.

## **Results**

Spring tagging experiments of 1997 on two spawning aggregations and an immature-dominated aggregation in the head of Placentia Bay (experiments 9701, 9702, 9704; Fig. 2) revealed a movement of cod out along both the East and West sides of the bay. No tags were returned from the West side of the bay farther South than  $43^{\circ} 47.2' N$  (approximately half-way out of the bay). Cod migrated all the way along the East side of the bay, with many tag returns from the mouth of the bay near Cape St. Mary's. This migration continued around the Cape into NAFO Division 3L and 5 tags were returned from sentinel fishers in southern 3L as far north as Bay de Verde; however, the lack of a full commercial fishery in 3L precluded quantifying the extent of this migration across the stock boundary. The outward movement from the head of the bay seems complete by late summer. Tags from cod of size less than 50 cm were returned mostly in the upper portions of the bay, with no returns farther out than half-way down the bay ( $43^{\circ} 47.2' N$ ; Fig. 3), suggesting that smaller cod were less migratory.

The spring 1997 tagging experiment on the spawning aggregation off Cape St. Mary's (experiment 9705; Fig. 4) was on larger cod than those tagged in the head of Placentia Bay (Table 1). The majority of tag returns were from close to the tagging site itself, with one return from Conception Bay in summer (3L), and three from the upper portions of Placentia Bay in the fall. These results indicate that cod in the spawning aggregation did not migrate into the inner Bay during spring and summer. Some fish remained in the general area of the tagging site, whereas others migrated across the stock boundary into

3L. The number of returns during fall was low, due to lower landings in the commercial fishery, but the location of these tag returns suggests a movement of cod back into the inner portion of the Bay during fall.

Tagging experiments on cod in Fortune Bay during the late fall of 1996 (experiments 9628, 9641-9643; Fig. 5) indicated some movement of cod from Fortune Bay around the Burin Peninsula into the western and inner portions of Placentia Bay. None of the cod tagged in Fortune Bay were reported as recaptured from areas further west.

Tagging on Oderin Bank on the western side of Placentia Bay in early summer 1997 (9706; Fig. 6) generated only 10 returns with recapture positions, with two from the tip of the Burin Peninsula and three from inner Fortune Bay. Cod tagged off the tip of the Burin Peninsula in summer 1997 (9708; Fig. 7) showed returns very close to the tagging site, and two from inner Fortune Bay. None of these cod were recaptured east of the tagging location.

A single tagging experiment conducted at the head of Placentia Bay in summer 1996 (experiment 9604; Fig. 8) gave returns mostly near the tagging location, but with a few from the outer reaches of the Bay on both the western and eastern sides as well as from Fortune Bay. Most of the recaptures received during spring, when the commercial fishery reopened, were from areas west of the tagging site. In contrast, spring and summer recaptures were mostly from close to the tagging site or from the eastern side of Placentia Bay. A small number of cod (84) tagged at Little Paradise on the western side of Placentia Bay gave returns only from the vicinity of the tagging site and inner bay (Fig. 9).

## Conclusions

There exists an outwards migration of a portion of the cod that spawn in the head of Placentia Bay in the spring, along both sides of the bay. Some fish remain fairly localised in the upper portion of the bay, but other cod migrate along the bay's eastern shore and into NAFO Div. 3L. We speculate that these migrants return to 3Ps in the fall. Larger cod appear to migrate farther, with smaller fish remaining in the upper reaches of the bay. Due to the lack of a commercial fishery in 3L, the proportion of Placentia Bay cod which leave 3Ps and migrate into 3L remains difficult to determine.

There is an exchange of cod between Fortune and Placentia Bays. We speculate that some Fortune Bay cod move into the western and inner portions of Placentia Bay in the summer, returning to Fortune Bay by late fall. These individuals, however, remain within 3Ps all year, and do not move farther west than Fortune Bay. No cod tagged in Placentia Bay, Fortune Bay, or southern 3L appeared to migrate to offshore areas of 3Ps or to the Gulf of St. Lawrence during the course of the study.

The short temporal scale of the 1997 commercial 3Ps fishery, combined with a tendency to intense fishing pressure on very localised areas, led to patchy tag returns. This made interpretation of movement patterns outside the commercial fishing period difficult.

## Acknowledgments

We thank T. Brown, M. Chapman, C. Cull, S. Fraser, S. Gauthier, C. George, E. Gifford, D. Maddock, J. Maddock, S. Moulton, T. Paddle, D. Porter, D. Robichaud, and G. Ruttgaizer for conducting field work; captains and crew of the CCGS Shamook, MV Innovation, and MV Mares; staff of the commercial sampling section who assisted in recovery of tags; and the fishers who assisted with tagging operations. Daniel Briand kindly assisted with advertising and recovery of tags from fishers on St. Pierre and Miquelon. We are also grateful to local fisheries officers and plant managers who assisted with advertising the cod tagging program, and fishers and plant workers who returned cod tags. Funding was provided through the Fisheries Conservation Chair and the DFO Strategic Research Program. G.L.L. was supported by a post-graduate scholarship from NSERC.

## References

- Bratney, J., and N. Cadigan. 1998. Exploitation rates and population size of cod in Placentia Bay, Subdivision 3Ps: estimates from a new mark-recapture study. Canadian Stock Assessment SCR document 98/20.
- Lear, W.H. 1984. Results of tagging of Atlantic cod on St. Pierre Bank during February, 1980. NAFO SCR document 84/IV/25. 4p.
- Lear, W.H. 1988. Migrations of Atlantic cod of NAFO Division 3Ps. NAFO SCR document 88/73. 8p.
- Moguedet, P. 1994. Cod migrations in the Gulf of St. Lawrence and south areas off Newfoundland. NAFO Scientific Council Studies 22: 71-84.
- Taggart, C.T., P. Penney, N. Barrowman, and C. George. 1995. The 1954-1993 Newfoundland cod-tagging database: statistical summaries and spatial-temporal distributions. Can. Tech. Rep. Fish. Aquat. Sci. 2042: 441p.
- Templeman, W.T. 1974. Migrations and intermingling of Atlantic cod (Gadus morhua) stocks of the Newfoundland area. J. Fish. Res. Bd. Can. 31: 1073-1092.
- Templeman, W.T. 1979. Migrations and intermingling of stocks of Atlantic cod, Gadus morhua, of the Newfoundland and adjacent areas from tagging in 1962-66. ICNAF Res. Bull. 14: 5-50.

Table 1. Summary of details for cod tagging experiments conducted off the south coast of Newfoundland (NAFO Subdiv. 3Ps) and adjacent areas (southern 3L) during 1996 and 1997.

DFO Stat. area	Year & expt no.	Location	Dates	Gear	Depth (m)	No. cod tagged	Mean length (cm)
3Psa	9643	Hermitage, Hermitage Bay	7 Nov.	longline	100	147	57.8
3Psb	9628	Harbour Breton, Fortune Bay	23 Oct.	longline	137	188	55.2
	9641	Harbour Breton, Fortune Bay	6 Nov.	longline	137	139	54.5
	9642	Seal Cove, Fortune Bay	9 Oct.	longline	100	36	60.0
3Psa	9604	Little Hbr., NE Placentia Bay	27 Jun.-11 Jul	cod trap	18	990	55.1
	9630	Little Paradise, W Placentia Bay	9 Sept.	longline	60	84	58.9
	9701	Bar Haven, NW Placentia Bay	9-12 Apr.	handline	48-60	996	62.1
	9702	Clattice Hbr., W Placentia Bay	10 Apr.	handline	58-60	966	52.3
	9704	Bar Haven, NW Placentia Bay	17-18 May	handline	50	817	65.0
	9705	St. Bride's, SE Placentia Bay	25-28 May	handline	40	709	66.4

Cont'd:

Table 1. Cont'd.

DFO Stat.	Year &				Depth	No. cod	Mean
area	expt no.	Location	Dates	Gear	(m)	tagged	length (cm)
	9706	Oderin Bank, W Placentia Bay	24-26 Jun.	handline	40	963	58.9
	9708	Lord's Cove, SW Placentia Bay	25 Jun.-18 Jul.	trap/handline	18-40	793	53.5
	9715	Iona Islands, E Placentia Bay	6-8 Nov.	handline	30-50	778	61.3
3Lq	9707	Riverhead, E St. Mary's Bay	25-26 Jun.	cod trap	16	701	56.9
	9714	Colinet Is., St. Mary's Bay	10-14 Oct.	otter trawl	50	618	53.8

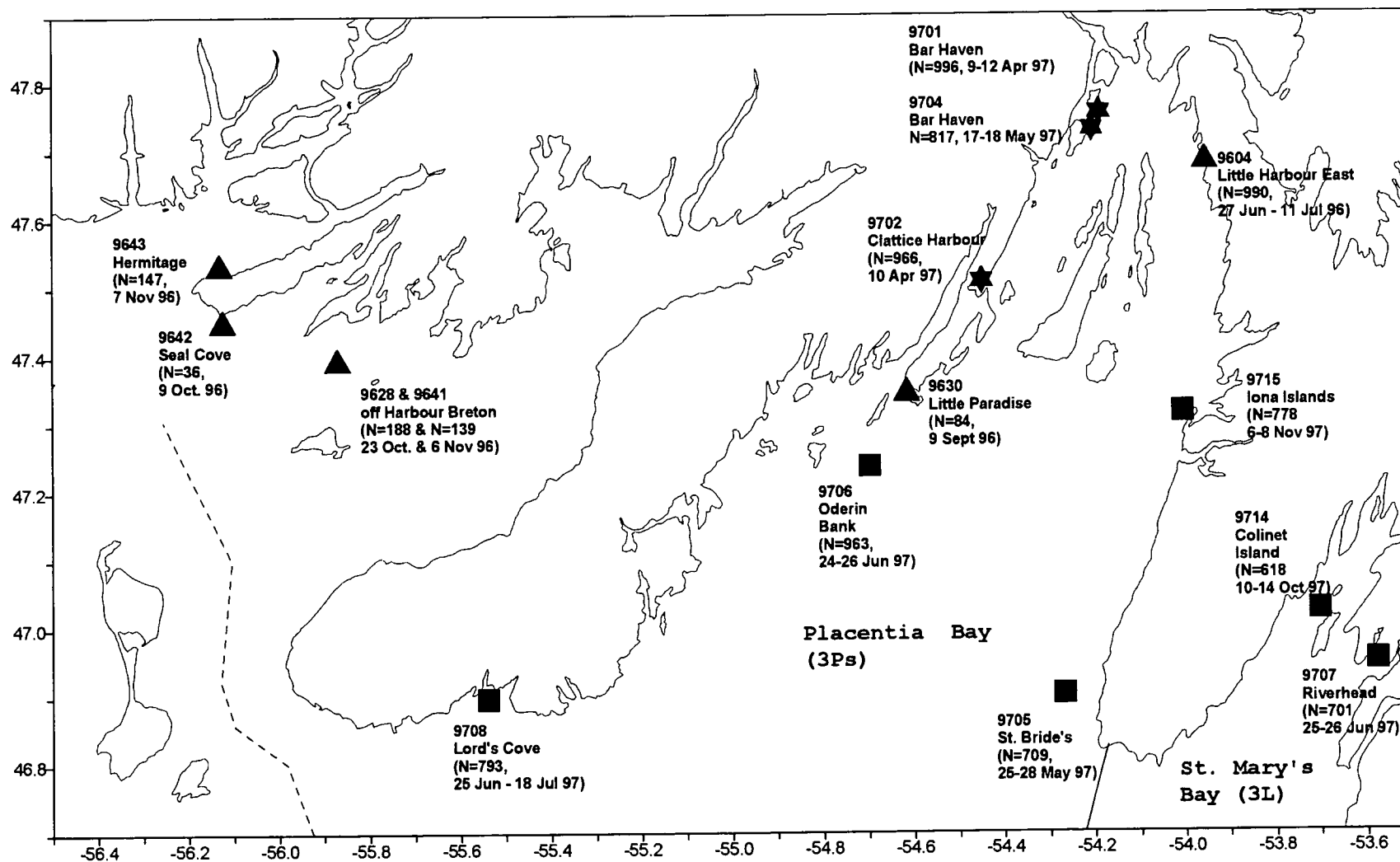


Fig 1. Numbers of cod tagged and released in Placentia Bay, Fortune Bay, and adjacent areas. Triangles=1996 taggings, stars=1997 taggings prior to reopening of the cod fishery, squares=1997 taggings after the fishery reopened. Dashed line=boundary of French economic zone.



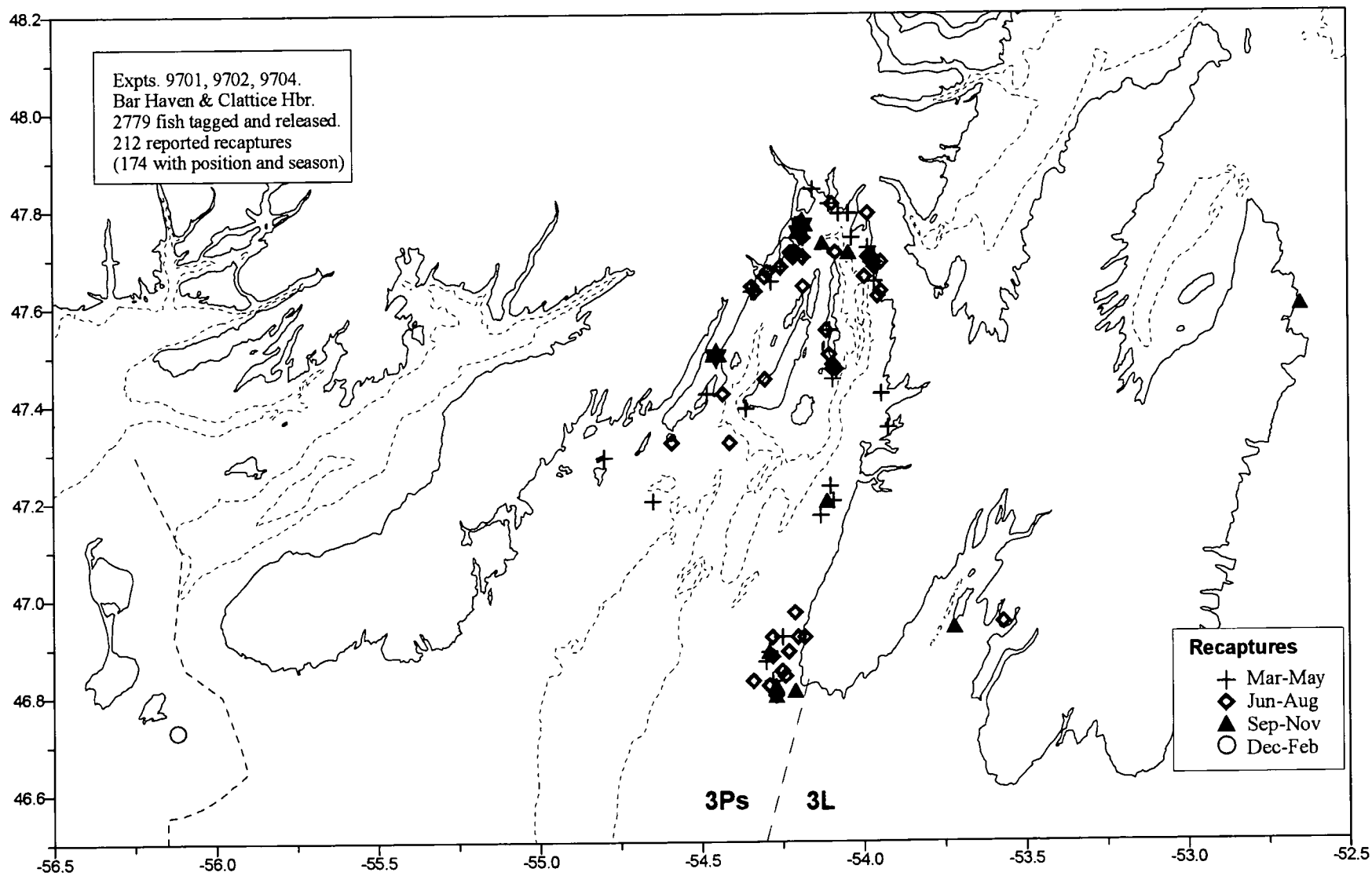


Fig. 2. Reported recapture positions by season for cod tagged at three sites (stars) at the head of Placentia Bay during April-May 1997.

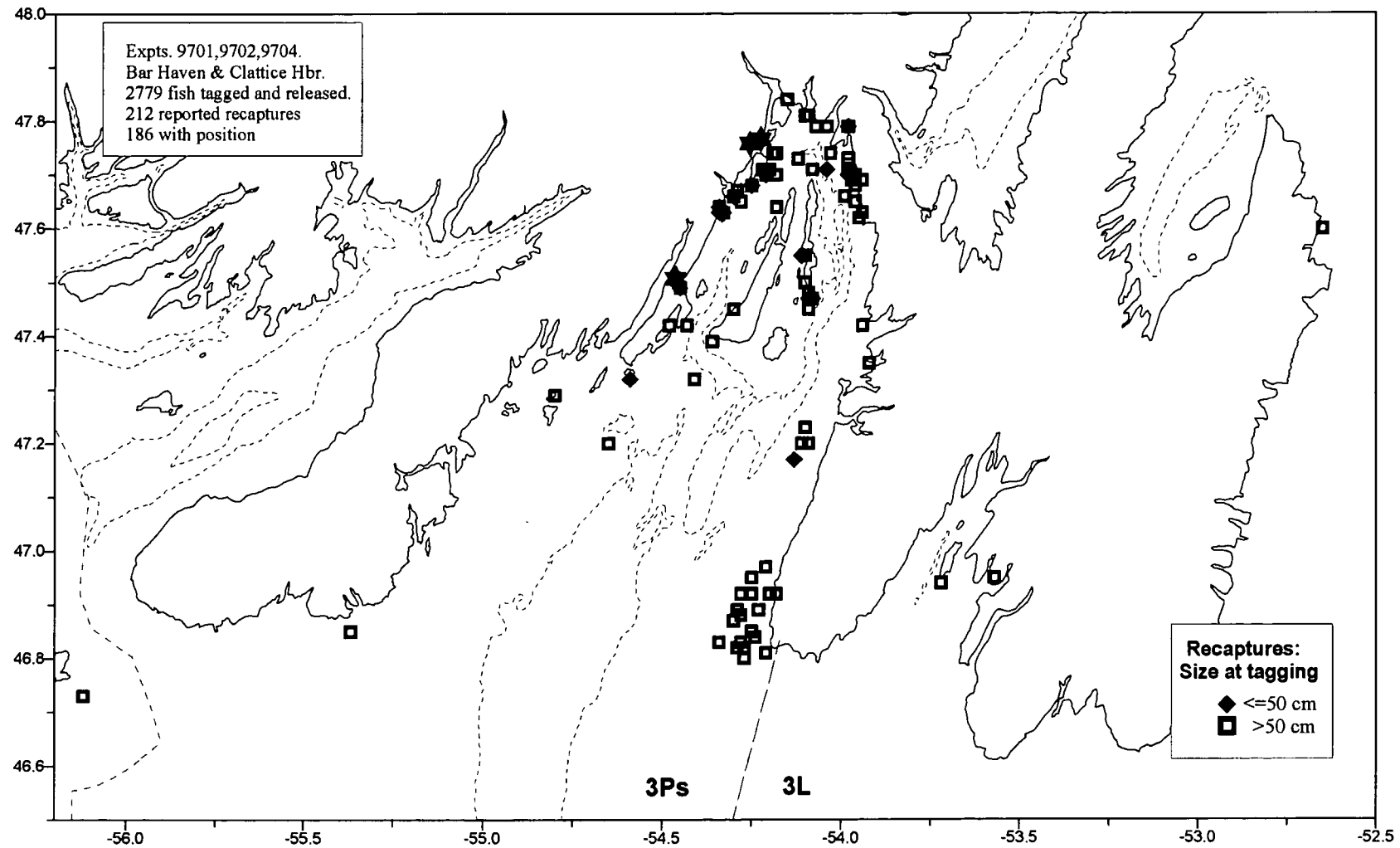


Fig. 3. Reported recapture by size group for cod tagged at three sites (stars) at the head of Placentia Bay during April-May 1997.

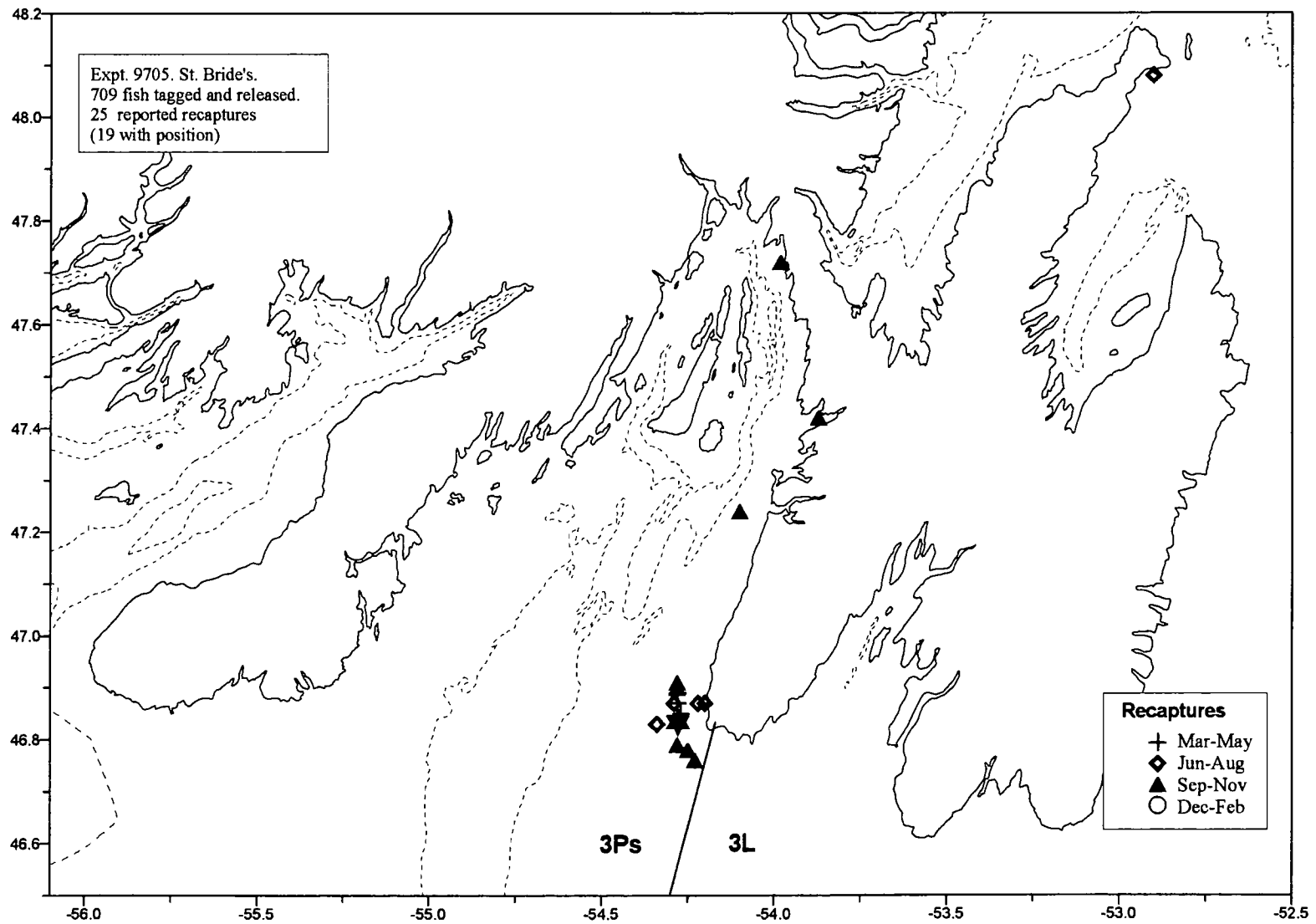


Fig. 4. Reported recapture positions by season for cod tagged off St. Bride's (star) on May 25-28, 1997.

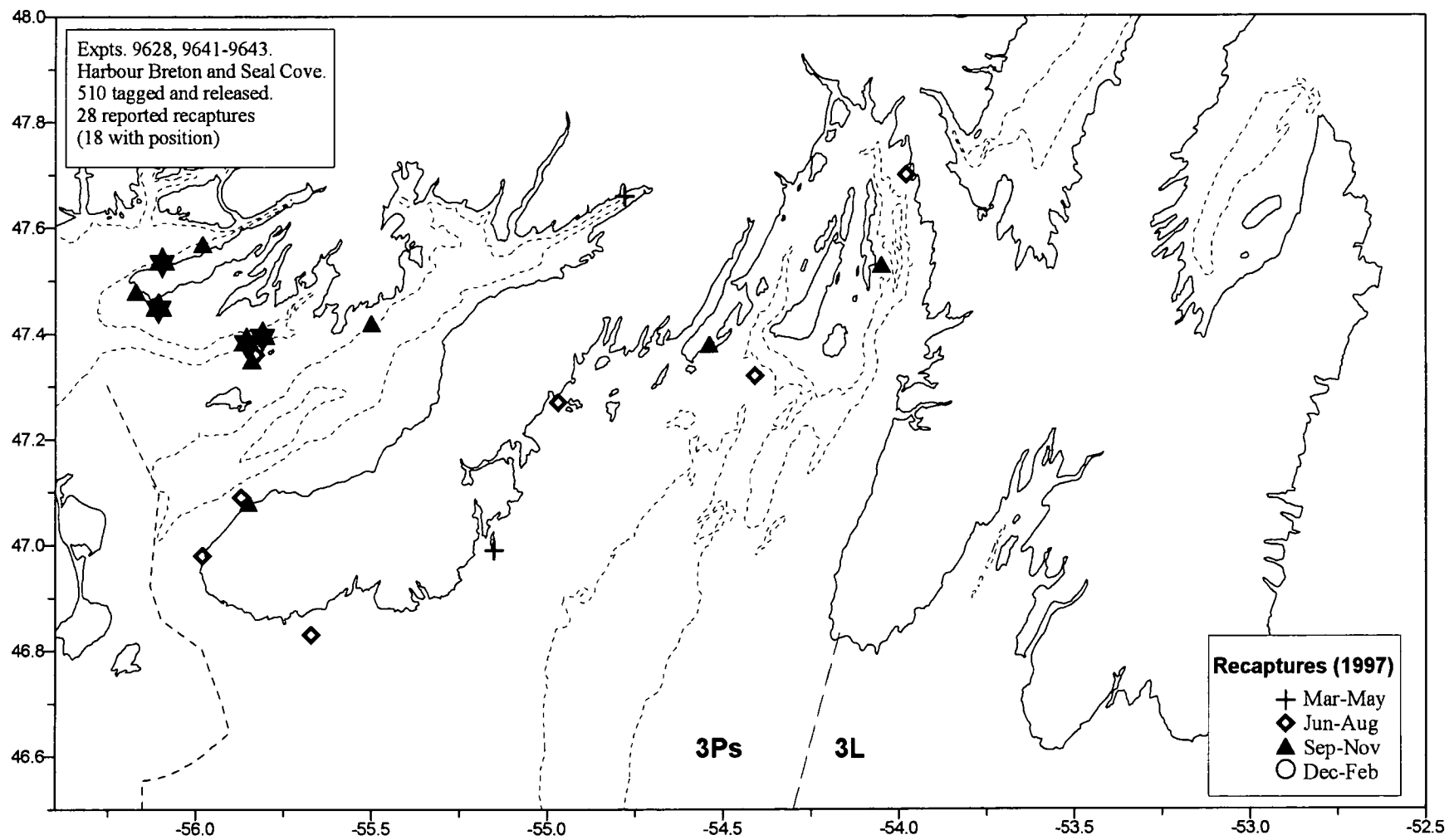


Fig. 5. Reported recapture positions by season for cod tagged at four sites (stars) in Fortune Bay and Hermitage Bay during October-November 1996.

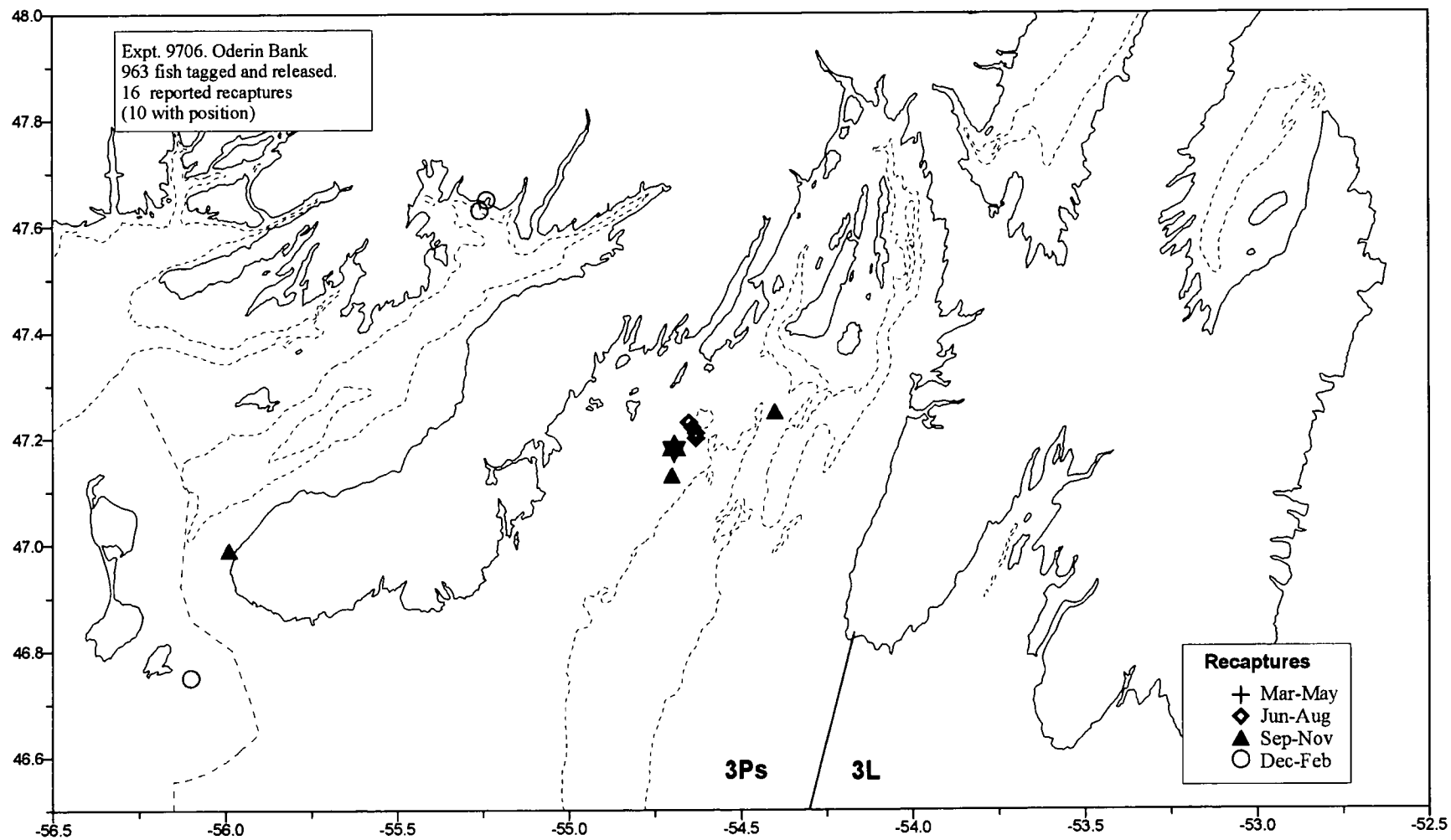


Fig. 6. Reported recapture positions for cod tagged on Oderin Bank (star) on 24-26 June, 1997.

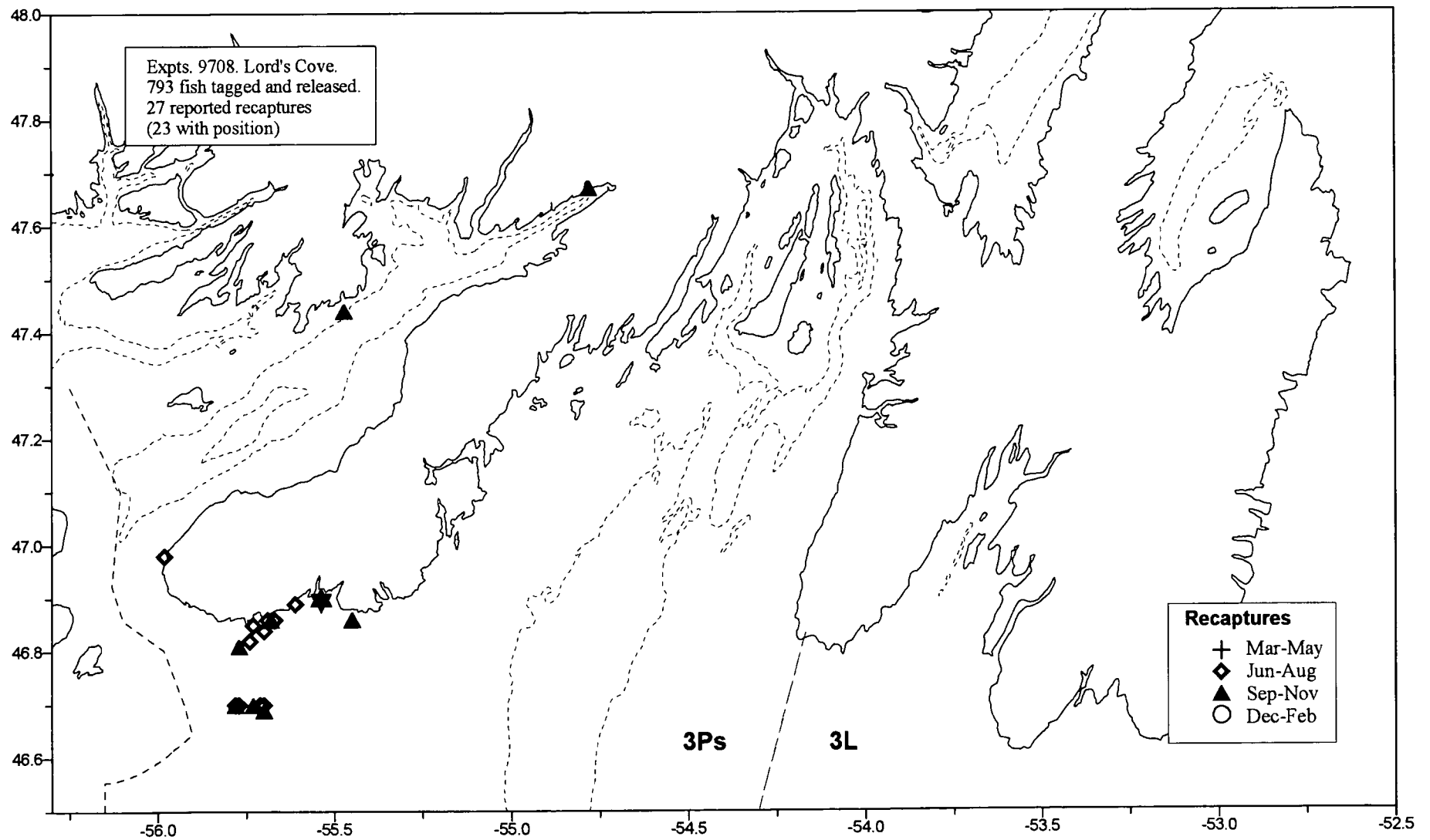


Fig. 7. Reported recapture positions for cod tagged off Lord's Cove (star) during June 24 - July 11, 1997.

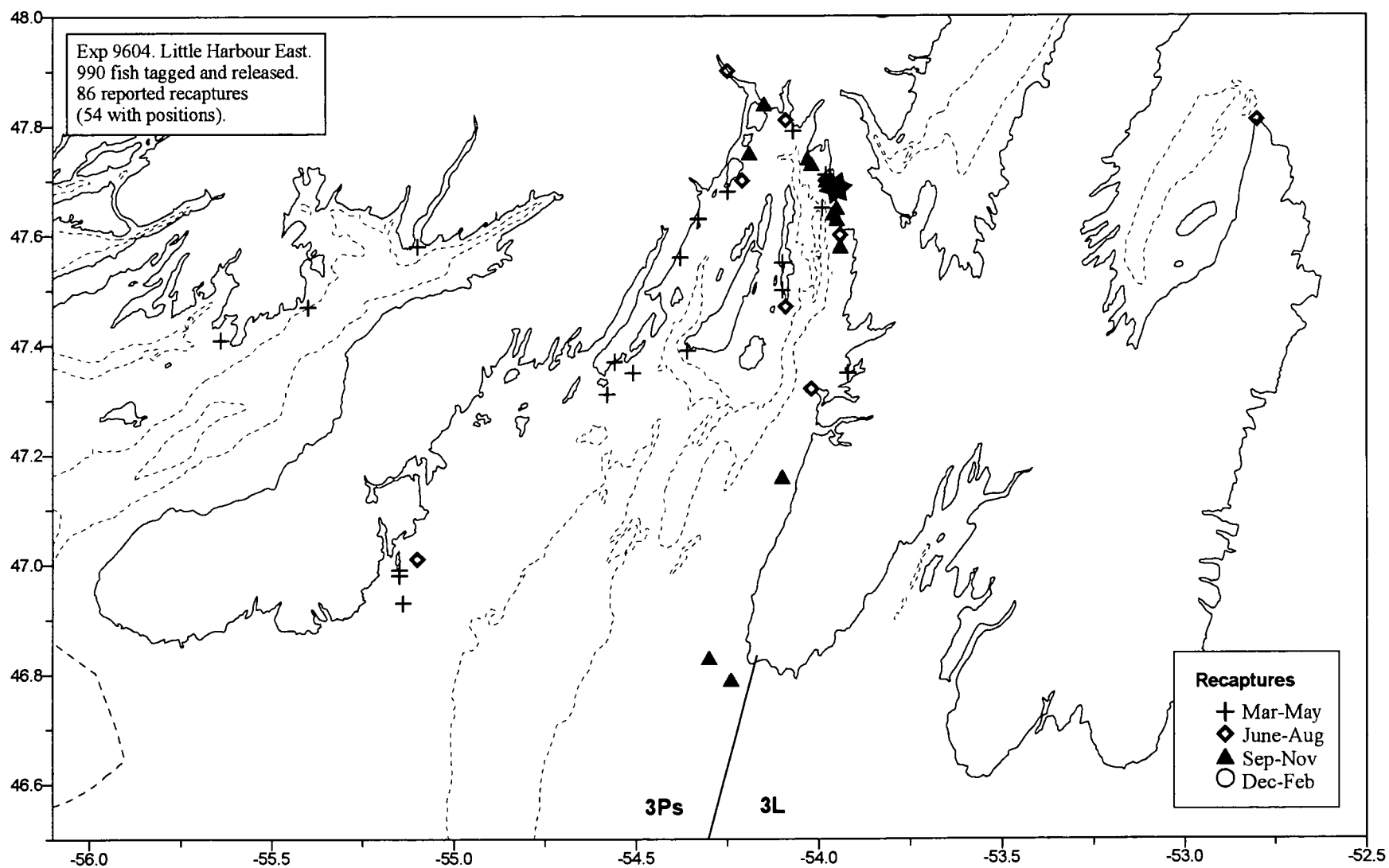


Fig. 8. Reported recapture positions by season for cod tagged at Little Harbour East (star) during June-July 1996.

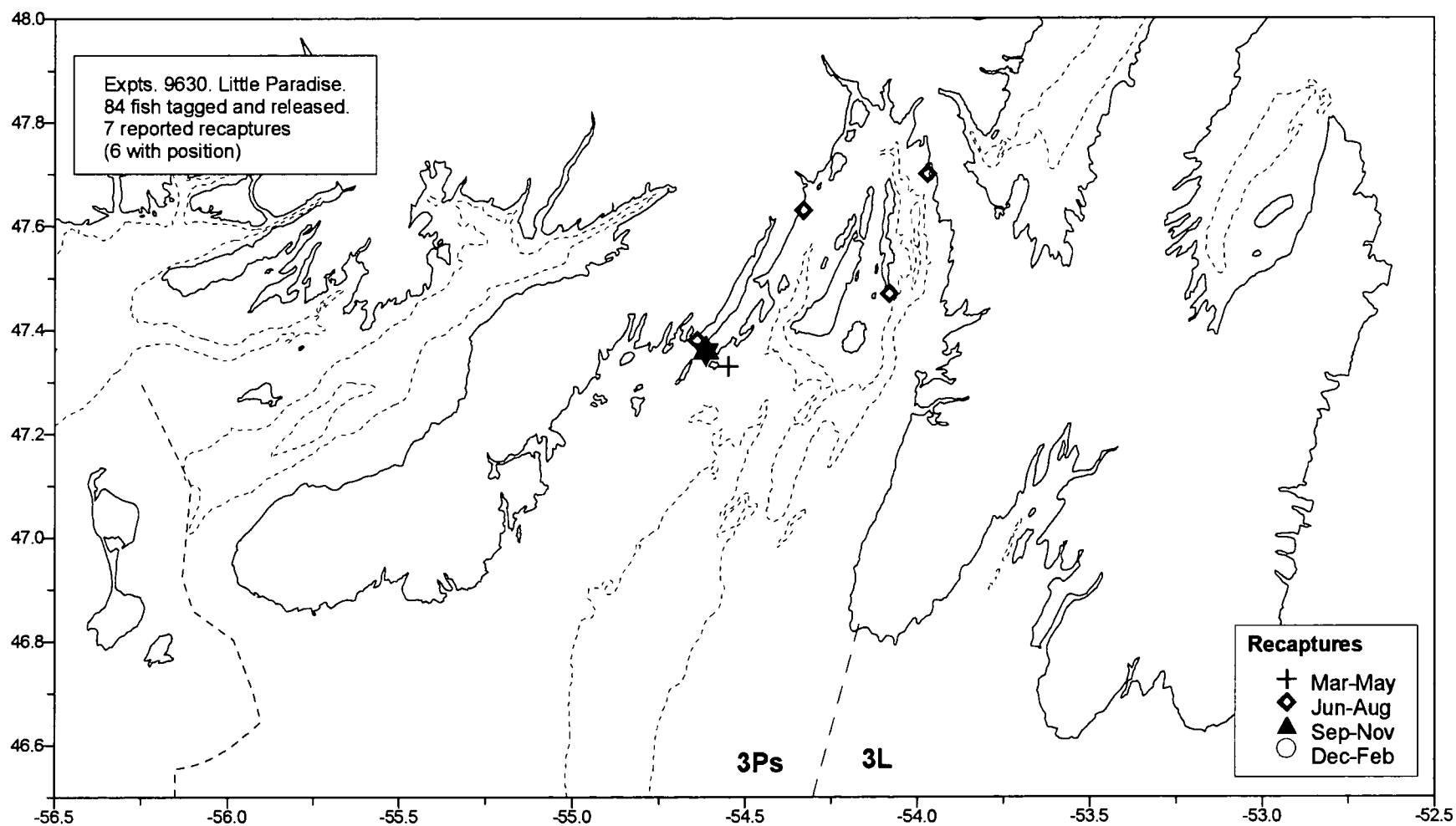


Fig. 9. Reported recapture positions by season for cod tagged off Little Paradise (star) during 9 September 1996.