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**The Status of White Hake (*Urophycis tenuis*, Mitchell)
in the Southern Gulf of St. Lawrence (NAFO Division 4T) in 1994**

by

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¹La présente série documente les bases scientifiques des évaluations des ressources halieutiques sur la côte Atlantique 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.

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

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1 - Summary Sheet

Year	1988	1989	1990	1991	1992	1993	1994	1995	Min.	Med.	Max.
Reference Level - 000's t	5.5	5.5	N/A	N/A	N/A	N/A	N/A	N/A			
TAC - 000's t	5.5	5.5	5.5	5.5	5.5	3.6	2.0	0.0	0.0 ¹	5.5 ¹	12.0 ¹
Reported Landings - 000's t	3.9	5.4	5.2	4.5	3.9	1.5 ²	0.9 ²		0.9 ³	5.4 ³	14.0 ³
Estimated Biomass - 000's t	15.7	13.9	12.9	12.1	7.7	4.1	3.8		3.8 ⁴	12.5 ⁴	30.9 ⁴
		¹ For 1982-1995		² Preliminary statistics		³ For 1960-1994		⁴ For 1971-1994			

Description of Fisheries (Landings): Landings peaked at 14,039 t in 1981 and have declined almost every year since to a historic low of 939 t in 1994. Since 1988 landings have been lower than the average for the period (1960-1994) which equals 5,670 t.

Target: TAC's have been set at levels approximating the $F_{0.1}$ mortality level.

Fishery Data: Fewer older white hake (i.e., age 6⁺ and 8⁺) have been caught since 1989. The modal age shifted from age 6 in 1988 and 1989 to age 5 from 1990-93. In 1994 the modal age changed to age 6, but this fishery is now dependent on only 2 to 3 year-classes (ages 4 - 6), compared to 5 to 6 year-classes in the years before 1989 and, as a result, it will be sensitive to annual fluctuations in recruitment.

Research Data: Results from the 1994 research vessel survey indicate that the abundance and biomass of white hake in NAFO division 4T continue to be at very low levels. The research vessel abundance index declined slightly from the 1993 level and is at its lowest level since 1972. The estimates of population abundance and biomass for 1994 decreased by almost 65% from 1991. An examination of the length composition of white hake caught during the 1994 survey showed that the abundance of larger white hake has continued to decline and that there are no indications of improved recruitment. Fewer white hake have been caught in the western part of the southern Gulf each year since 1991 suggesting that there has been a contraction of the geographic range in recent years.

Estimation of Stock Parameters: Trends in relative fishing mortality (F) at age were estimated using commercial and research survey data and the ratio of catch at age from the commercial fishery to the catch at age in the research survey. The research vessel abundance index data were also analyzed using a multiplicative model to obtain estimates of average total mortality (Z), using a model with age and yearclass as effects.

Assessment Results: The fishery for white hake in NAFO division 4T may be at its lowest level since the first quota was put in place in 1982. Both of the approaches used to estimate stock parameters (estimates of relative fishing mortality (F) and average total mortality (Z)) indicate that fishing mortality was high on the year-classes that supported the fishery (ages 4⁺) in the late 1980's and continued to increase in the early 1990's.

Ecological Considerations: A sampling program in the Miramichi estuary in the fall of 1994 found the by-catch of small white hake in the openwater fishery for smelt and tomcod to be considerable and suggestions for minimizing the by-catch were provided.

Future Prospects: A quantitative forecast is not possible. The catches of recent years appear to have resulted in a high rate of exploitation. Rebuilding of this resource will probably occur slowly given the current low abundance and indications of weak incoming recruitment.

Management Considerations: The minister of the DFO announced (Dec. 21, 1994) the closure of the fishery for white hake in NAFO 4T. He also announced the closure of directed fishing for white hake in NAFO 4RS, 3Pn and 4Vn (January to April). Concern has been expressed about the potential for continued exploitation of NAFO 4T white hake during their migration to and from NAFO 4Vn. Evidence suggests that any directed fishing for white hake in NAFO 4Vn before mid-June could result in mortality to white hake that originated in NAFO 4T. As well, fishing in late fall (late November and December) could have a similar impact.

2 - Abstract

The white hake resource in NAFO division 4T may be at its lowest level since the first quota was put in place in 1982. Frequent and in some areas almost continuous closures of the fishery undoubtedly contributed to the record low landings of 939 t in 1994 (nearly 85% below the average for the period 1960-94). In 1994 sixty-four percent of the landings were taken by longlines and less than fifteen percent were taken by mobile gears. Since 1988, the majority (90%) of the white hake landings in the southern Gulf have been taken from statistical unit areas occupied by the 'Strait' component of the stock (i.e., 4Tg, 4Th, 4Tj, 4Tl, 4Tm and 4Tn). Eighty-one percent of the landings of white hake were from unit area 4Tg alone in 1994.

Fewer older (i.e., age 6 and over) white hake have been caught since 1990 and the fishery was dependent on only 2 to 3 age groups in 1994, compared to five to six in the years before 1989, and as a result, it will be sensitive to annual fluctuations in recruitment.

Results from the 1994 research vessel survey indicate that the abundance and biomass of white hake in NAFO division 4T continue to be at very low levels. The research vessel abundance index declined slightly from the 1993 level and is at its lowest level since 1972. An examination of the length composition of white hake caught during the 1994 survey showed that the abundance of larger white hake has continued to decline and that there are no indications of improved recruitment. Very few hake were caught in the western part of the southern Gulf in 1994 and 1993 and there appears to have been a contraction of their geographic range in recent years.

A sampling program in the Miramichi estuary in the fall of 1994 found the by-catch of small white hake in the openwater fishery for smelt and tomcod to be considerable and suggestions for minimizing the by-catch were provided.

In response to recommendations made by the Fisheries Resource Conservation Council (F.R.C.C.) the minister of the Department of Fisheries and Oceans announced (Dec. 21, 1994) the closure of the fishery for white hake in NAFO 4T. He also announced conservation measures beyond the F.R.C.C. recommendations, including the closure of directed fishing for white hake in NAFO 4RS, 3Pn and 4Vn (January to April).

Considering the low abundance and indications of weak incoming recruitment, rebuilding of this stock will probably occur slowly.

3 - Résumé

La ressource de la merluche blanche dans la division 4T de l'OPANO pourrait être à son niveau le plus bas depuis l'introduction des premiers quotas en 1982. Des fermetures fréquentes et, dans certaines zones, la fermeture presque constante de la pêche ont sans doute contribué au faible débarquement record de 939 tonnes en 1994 (ce qui correspond à près de 85% au-dessous de la moyenne pour la période allant de 1960 à 1994). En 1994, soixante-quatre pour cent des débarquements ont été pris par des palangriers et moins de quinze pour cent des débarquements étaient attribuables aux engins mobiles. Depuis 1988, la majorité (90%) des débarquements de merluche blanche du sud du golfe ont été pêchés dans les zones de l'unité statistique occupées par la composante du stock «dite du détroit» (c.-à-d. 4Tg, 4Th, 4Tj, 4Tl, 4Tm et 4Tn). En 1994, quatre-vingt-un pour cent des débarquements de merluche blanche provenaient uniquement de l'unité 4Tg.

Depuis 1990, moins de merluches blanches plus âgées (de six ans et plus) ont été capturées et, en 1994, la pêche comprenait uniquement deux ou trois groupes d'âge, comparativement à cinq ou six avant 1989; la pêche sera donc très sensible aux fluctuations annuelles dans le recrutement.

Les résultats du relevé de recherche de 1994 indiquent que l'abondance et la biomasse de la merluche blanche dans la division 4T de l'OPANO demeurent à des niveaux très bas. L'indice d'abondance établi par le bateau de recherche a légèrement décliné par rapport au niveau de 1993; il se situe au plus bas depuis 1972. L'examen de la composition selon la longueur des prises de merluches blanches réalisées pendant le relevé de 1994 indique que les plus grosses merluches se font de plus en plus rares et qu'il n'y a aucun indice permettant de croire à une amélioration du recrutement. Très peu de merluches ont été prises dans la partie ouest du sud du golfe en 1994 et 1993, et on semble assister ces dernières années à un rétrécissement de leur aire de distribution.

Un programme d'échantillonnage dans l'estuaire de la Miramichi mené à l'automne de 1994 a permis de conclure que les prises accessoires de petites merluches blanches dans la pêche en eaux libres de l'éperlan et du poulamon étaient considérables, et l'on a par la suite fait des suggestions en vue de réduire les prises accessoires.

En réponse aux recommandations formulées par le Conseil pour la conservation des ressources halieutiques (CCRH), le ministre des Pêches et des Océans a annoncé, le 21 décembre 1994, la fermeture de la pêche de la merluche blanche dans la division 4T de l'OPANO. Il a également annoncé des mesures de conservation plus poussées que celles préconisées par le CCRH, y compris la fermeture de la pêche sélective de la merluche blanche dans les divisions 4RS, 3Pn et 4Vn de l'OPANO (de janvier à avril).

Compte tenu de la faible abondance de l'espèce et des indices laissant présager de faibles recrutements, la reconstitution de ce stock ne se fera probablement que lentement.

4 - Introduction

White hake (*Urophycis tenuis*, Mitchill) has historically been the third or fourth most important groundfish resource in the southern Gulf of St. Lawrence (NAFO division 4T - Figure 1).

Since 1960, the average annual catch of white hake in NAFO division 4T has been about 5,670 t (Table 1). This resource was not managed by a TAC (Total Allowable Catch) until the precautionary quota of 12,000 tonnes was placed upon this stock in 1981, for the 1982 season. Subsequent assessments (Clay et al. 1986; Clay 1987; Clay and Hurlbut 1988) suggested long term yields in the range of 5,000 to 6,000 tonnes. The TAC has subsequently been reduced on four occasions: to 9,400 t for 1987, to 5,500 t for 1988, to 3,600 t for 1993 and most recently to 2,000 t for 1994 (Table 1). This is the only fishery for this species within the NAFO convention area that is regulated by a TAC.

Hurlbut et al. (1994) investigated the magnitude of the landings of white hake in adjacent NAFO divisions and subareas (4R, 4S, 3Pn, 4Vn and 3Ps) and showed that the NAFO 4T landings (fixed and mobile) were consistently greater (frequently several times greater) than the combined landings in the adjacent NAFO divisions and subareas, however, this difference has diminished since 1990, especially for fixed gear catches.

This fishery usually does not commence until May when the last of the ice has dispersed. Landings traditionally peak between July and September and decline through October and November. The hake fishery is carried out mainly by small inshore vessels, and is strongly affected by weather and local market conditions. Both fixed (gillnets and longlines) and mobile gears (small otter trawlers (< 20m) and larger seiners) are used in the hake fishery. The majority of the fishery is conducted in the Northumberland Strait, on the western end of P.E.I., and between P.E.I. and Cape Breton Island.

Previously, the hake fishery in the southern Gulf was considered to be a by-catch fishery, however Clay and Hurlbut (1990) demonstrated that it tends to be a directed fishery, traditionally pursued during periods between other, more economically lucrative fisheries (i.e., lobster, scallop, tuna, etc.).

The combined evidence from a discriminant function analysis of morphometric and meristic characters (Hurlbut 1990; Hurlbut and Clay 1990A), seasonal and annual distributional studies (Clay 1991; Clay and Hurlbut 1989) and a tagging study (Kohler 1971) indicates that the management unit for white hake in NAFO division 4T is composed of two different stock components:

- (1) fish from the shallow inshore southern Gulf (depths \leq 200m), principally the Northumberland Strait area (the 'Strait' component) and
- (2) fish from along the Laurentian Channel in depths in excess of 200 m (the 'Channel' component).

Furthermore, recent analyses of data from surveys of the southern and northern Gulf indicate that the distribution of southern Gulf white hake extends beyond the limits of the NAFO division 4T management unit in winter (Morin and Hurlbut 1994). As a result of these uncertainties concerning stock definition and the adequacy of the NAFO division 4T management unit, a formal analytical assessment (SPA based) has not been conducted since 1989. The present document reviews the status of white hake in 1994.

5 - Description of Fisheries

A) Landings

With only a few exceptions, the annual landings of white hake in NAFO division 4T have declined every year from the high of 14,039 t in 1981 (Table 1 and Figure 2a).

The TAC was reduced from 3,600 t to 2,000 t for the 1994 fishing season. The provisional landings in 1994 were 939 t (Table 1 - Figure 2a), the lowest level in recorded landings for this resource (a difference of -83% from the average landings for the period 1960-94 which equals 5,670 t).

We allocated the NAFO division 4T landings (1988 - 1994) to the 'Strait' and 'Channel' stock components by the statistical unit areas (See Map - Figure 3) in which they were landed using the depth criteria (depths \leq 200 m Vs. depths $>$ 200 m) defined by Hurlbut (1990) and Hurlbut and Clay (1990A). Unit areas in the southern Gulf where the bottom depths were predominately less than 200 m were regarded as belonging to the 'Strait' component and those unit areas bordering the Laurentian Channel with depths predominately greater than 200 m were regarded as belonging to the 'Channel' component).

Since 1988, the majority (90%) of the white hake landings in the southern Gulf of St. Lawrence have been from the 'Strait' component of the stock (unit areas 4Tg, 4Th, 4Tj, 4Ti, 4Tm and 4Tn - Figure 4). In 1994, 81% of the total landings of white hake came from unit area 4Tg alone. From 1988 - 94, annual landings from the unit areas that encompass the 'Channel' component (unit areas 4Tf, 4Tk, 4To, 4Tp and 4Tq - Figure 4) have averaged 10% or less of the total landings, however, the landings for unit areas 4Tf and possibly 4Tk, probably include hake from the 'Strait' component that were caught while migrating through these unit areas, or were from the shallower parts (i.e., $<$ 200 m depth) of these unit areas.

Since 1960, gillnets have accounted for 30% of the landings of white hake, followed by bottom trawl (26%) (Table 1 and Figure 2b). Over the same time period, longlines and seines have accounted for

17% and 11% respectively. In 1994 however, 64% of the landings were taken by longlines and less than 15% were taken by mobile gears (Table 1 and Figure 2b). More than 60% of the landings of white hake were made during the months of July and August in 1994 (Table 2).

The landings of white hake in NAFO 4T were compared with the landings in adjacent NAFO divisions and areas (NAFO 3O, 3Pn, 3Ps, 4RS, 4W, 4Vn and 4Vs - see Figure 1). With the exception of 1986, the landings of white hake in NAFO 4T were greater than the combined landings in the other adjacent NAFO divisions and areas for the period 1985-1991 (Table 3 and Figure 5). Since 1992, the NAFO 4T landings have been less than the combined landings in the other adjacent divisions and areas.

From 1985-1992 there were no landings of white hake reported by foreign nations in NAFO 3Pn, 4S or 4T (Table 3). Foreign nations accounted for a significant proportion of the landings of white hake in NAFO 3O in the late 1980's, but their contribution to the landings in NAFO 3Ps, 4R, 4W, 4Vn and 4Vs has been minor since 1985.

In recent years, there have been reports of significant by-catches of white hake in the redfish and shrimp fisheries that occur along the Laurentian Channel. To investigate this possibility, the landings of white hake in the ZIFF (Zonal Interchange File Format) data files for 1985-94 were examined for trips in which the targeted or main species was redfish, shrimp or cod. (Table 4 and Figure 6).

In NAFO 4T, significant quantities of white hake were reported landed by vessels targeting cod each year. The quantity of white hake reported landed in the redfish fishery was variable, averaging 15 t per year and there were no landings of white hake reported by vessels targeting shrimp.

The reported by-catch of white hake in cod directed fisheries in the adjacent NAFO divisions and areas (NAFO 3O, 3Pn, 3Ps, 4RS, 4W, 4Vn and 4Vs) was also significant for most of the years examined. White hake were landed as by-catch in the redfish directed fishery in all of the adjacent NAFO divisions and areas, but the proportion has only recently increased significantly in NAFO 3Ps, 4Vn and 4Vs (to 102, 148 and 28 t respectively). The reported by-catch of white hake in the shrimp directed fishery was nonexistent or insignificant in the adjacent NAFO divisions and areas.

B) Management Measures Relevant to the White Hake Fishery

In addition to the introduction of Conservation Harvesting Plans, several significant changes to the fishery regulations were announced in 1993 that affected the fishery for white hake in 1993 and in 1994, including:

- the minimum mesh size was increased from 108 (diamond) to 120 mm (square mesh) for mobile gears (<14 m (45 feet)) fishing in the Northumberland Strait area
- the minimum mesh size for mobile gears used outside the Northumberland Strait was increased to 130 mm (square mesh)
- a regulation to control excessive dumping/discarding of groundfish at sea was introduced requiring fishing vessels to land all groundfish caught (with some species excluded)

Following the closure of the cod directed fishery (1/09/93), the minimum mesh size for mobile gears (<14 m (45 feet)) targeting hake in the Northumberland Strait was increased to 130 mm (square mesh). At the same time, the minimum mesh size for mobile gears fishing hake outside the Northumberland Strait, was increased to 145 mm (square mesh).

In 1994, the Department of Fisheries and Oceans (DFO) again required each fleet sector to submit a Conservation Harvesting Plan before beginning to fish. Each plan was required to address the following issues:

- Protection of small fish
- By-catch controls
- Catch monitoring
- Fishing effort
- Enforcement

Under the continuation of the cod moratorium in 1994, each fleet sector was required to limit their cod by-catch to no more than 10%. In consultation with industry, DFO developed and implemented a cod by-catch protocol, wherein, if a given fleet sector exceeded the by-catch limit of 10% in an area, the groundfish fishery would be closed for 10 consecutive days. The closure was then followed by a test fishery to determine if the cod by-catch level in the area was more or less than 10%.

To further minimize the harvesting of cod, DFO implemented restrictive fishing seasons for both the fixed and mobile gear sectors. The purpose of this management measure was to permit cod migration to be completed before opening the area to any other groundfish fishing activity. As well, the fishing season for mobile gear in the eastern portion of the Northumberland Strait was adjusted to open on July 15 to allow hake to spawn. The fishing seasons that were in effect in NAFO 4T in 1994 were as follows:

<u>DFO Fishing Area</u>	<u>Fixed Gear</u>	<u>Mobile Gear</u>
Gaspé and N.B. (4T3 to 4T6)	May 15 - Oct.15	May 1 - Nov. 1
Magdalen Is. (4T2)	May 15 - Jul. 1	May 1 - Nov. 15
Bay St. Lawrence (4T9)	May 20 - Nov. 1	May 15 - Nov.1
W. Northumberland Strait (4T7)	May 1 - Jul. 20 Sep.15 - Oct. 15	June 1 - Oct. 31
E. Northumberland Strait (4T8)	Jul. 1 - Oct. 20	July 15 - Oct. 31
Cheticamp (4T1)	Jul. 1 - Oct. 30	May 20 - Oct. 1
Northeast P.E.I. (4T2)	Jul. 1 - Oct. 20	May 15 - Oct. 1

(See map of fishing areas - Figure 7)

There were numerous closures for variable lengths of time in the fixed gear fishery (vessels < 65') for white hake in 1994 because of high cod by-catch:

<u>Closure Date</u>	<u>DFO Fishing Area</u>	<u>Opening Date</u>
6/07/94	4T1, 4T2	Not Re-opened
20/07/94	4T2, 4T5, 4T7	Not Re-opened
24/07/94	4T2	27/08/94
27/08/94	4T2	Not Re-opened
29/09/94	4T2	Not Re-opened

In addition to the cod by-catch protocol, DFO implemented a small fish protocol, in which, if a fleet sector exceeded 15% in number of "small" fish, the groundfish fishery would be closed (the target fish size agreed to by industry for white hake was 45 cm).

As mentioned earlier, the TAC for white hake in NAFO 4T in 1994 was reduced from 3,600 t to 2,000 t, by recommendation of the Fisheries Resource Conservation Council (F.R.C.C.).

On June 23, 1994 the minister of the Department of Fisheries and Oceans announced the opening of the recreational and subsistence groundfish fisheries. The conservation measures introduced included a daily bag limit of 10 groundfish and a fishing season from June 24 to October 30. A survey was subsequently conducted which determined that less than 50 t of hake was landed in the recreational fishery in the southern Gulf.

C) Descriptions from Industry of the Fisheries for White Hake in 1994

In November 1994, personnel from the Dept. of Fisheries and Oceans, Science Branch, Gulf Region, made presentations at public meetings in Grande-Rivière, Québec, Shippagan, N.B., Charlottetown, P.E.I., Chéticamp, N.S. and Cap-aux-Meules in the Magdalen Islands on the groundfish stocks of the southern Gulf of St. Lawrence. The purpose of these meetings was to obtain views from fishers and fishing industry on the status of the various groundfish stocks in the southern Gulf in 1994. A record of all of the comments and discussions regarding white hake at these meetings is contained in Appendix 1.

Relative to the meetings in Charlottetown and Chéticamp, there were few opinions or comments expressed concerning white hake at the meetings in Grande-Rivière, Shippagan and Cap-aux-Meules. Nevertheless, at all three of these meetings, participants indicated that the abundance of white hake has declined.

By far the most discussion concerning white hake occurred at the meeting in Chéticamp, where several participants expressed scepticism with the results of the September (1994) abundance survey and indicated that there was an abundance of white hake in the area, especially in St. Georges Bay, in 1994. Several fishers commented on the increased catch of white hake in lobster traps early in the summer and there was a report of the capture of juvenile hake by scallopers in the Pictou area during the fall.

Several participants indicated that hake directed fishing effort (both fixed and mobile) was limited due to cod by-catch restrictions and stressed that the reduced catch of hake was not the result of a decline in stock abundance. Concern was also expressed about recent increased effort directed at white hake in 4Vn during the winter, where catches have been unregulated.

As in Chéticamp, several participants at the Charlottetown meeting commented on the impact of the cod by-catch restrictions and closures on the amount of fishing effort directed at white hake. It was noted that the large number of closures made it difficult to comment on the abundance of hake, especially on the north and west coasts of the island, but there seemed to be a consensus that hake were abundant off the east coast of P.E.I. There was a report that many small hake were caught in fishing gear set for silversides and eels in the early fall.

In order to clarify the opinions expressed at the Charlottetown meeting concerning the white hake fishery off P.E.I. in 1994, several fishers were contacted in February 1995. These discussions left little doubt that the cod moratorium had influenced the landings of hake on P.E.I. in 1994. With the directed fishery for cod closed in 1994, there was relatively little effort in the groundfish ITQ fleet based on P.E.I. Furthermore, the mobile competitive fleet, which is able to fish within the Northumberland Strait proper and thus have access to those grounds where hake might be taken more cleanly, were affected by a series of closures triggered by excess cod by-catches in some zones.

The fixed gear fleet along the north shore (4T2), a fleet which commonly harvests a mix of hake and cod, was heavily impacted by closures due to cod by-catch. The fixed gear fishery in zones 4T5, 4T7 and 4T8 was less impacted by such closures and in 4T8, in particular, fishers seemed to be able to avoid fishing those grounds where cod traditionally congregate, thereby preventing a shutdown.

The net result of these factors is that considerable effort which would, under normal circumstances, have produced hake landings as by-catch or as part of a mixed landing, did not occur in 1994.

Nevertheless, fishers in many parts of P.E.I. indicated that they felt the hake resource was not in good condition and that fish were less abundant than in previous years. In the western North Shore area (Alberton - Tignish), fishers reported that the amount of hake in the mixed catch decreased sharply. Along the rest of the North Shore, fishers reported that cod were prevalent in the shallow inshore grounds (inside 8 fms) where hake would normally have been prevalent.

In south-eastern P.E.I., the situation was less clear. Some fishers reported that catches of hake on the grounds where they regularly fish were as good (several claim better) as in recent years. In particular, there were reports of good catches of hake by both mobile and fixed gears in certain locations in 4T8 by both P.E.I. and Gulf N.S. fishers in October. However, other fishers in the same general area described a general decrease in the overall abundance of hake and reported that grounds which at one time produced good hake catches did not do so in 1994.

A number of fishers were of the view that the increased abundance of dogfish in the Gulf in recent years has affected the hake resource. Many felt that as the dogfish move into an area, they 'chase' the other commercial species away. Several speculated that dogfish might be feeding on small hake, and thereby be a contributing factor to the general decline in recruitment in this stock through the 1980's and 90's and still others regarded seals as a possible predator of juvenile hake.

Some additional information on the hake fishery off Gulf Nova Scotia was obtained from field staff from the DFO Antigonish office. They reported that many fishers had remarked on the unusual abundance of hake in lobster traps in June. Several fishers had commented on the smaller catches and larger size of hake captured in fixed and mobile gear with the increased mesh size required in 1994. Some fishers had indicated that small hake were not present on the traditional fishing grounds and that the larger hake seemed to be mixed with cod farther out on the fishing grounds, and therefore effectively unavailable.

Markets for hake were apparently excellent in the Gulf Nova Scotia area throughout the fishing season with prices ranging from 35 to 50 cents per pound (average 45 cents).

The Gulf Groundfish Index Fisher Program was introduced in 1990, primarily to obtain catch and effort information from inshore groundfish fishers that traditionally have not been required to maintain logbooks. Volunteers in this program maintain a daily logbook of their groundfish catch and effort and are contacted periodically throughout the fishing season, by phone, to obtain their views on the fishery.

In 1994, 53 fishers volunteered to participate in this program, of which 36 (68%) actually fished and submitted log records. At the end of the fishing season (Nov. 1994), all of the volunteers were contacted by phone and asked for their responses to a questionnaire concerning the 1994 groundfish fishery (a subset of the relevant questions that were asked on this questionnaire is contained in Appendix 2).

Twelve of the respondents to the questionnaire had directed for white hake in 1994. Nine of these twelve respondents indicated that closures of the fishery had not reduced the amount of time that they had spent fishing for groundfish but 3 indicated that it had. Eight of the respondents reported the same amount of or more fishing effort in 1994, while four indicated less effort than in the past (i.e. 1984-1993). Four of the respondents described the abundance of hake in 1994 as average and 3 described it as better than average. On the same question, three of the respondents described the abundance of hake in 1994 as less than average and two described it as the lowest or minimum. When asked to describe the size of hake in 1994, 5 respondents categorized them as small, 5 described them as average and two said that they were larger.

When asked to compare the 1994 groundfish fishery to the 1993 fishery, 2 respondents described it as somewhat better and 4 described it as about the same. On the same question, 3 respondents described the 1994 groundfish fishery as somewhat worse and 2 described it as worse.

When asked to relate the 1994 fishing season to all of their years of experience in the groundfish fishery, 2 described it as somewhat better and 4 described it as about the same or average. On the same question, 3 respondents described the 1994 groundfish fishery as somewhat worse and 3 respondents described it as the worst in their longterm experience (experience in the groundfish fishery for these 12 respondents ranged from 7 - 38 years (average 18)).

6 - Target

The target corresponds to an exploitation rate at the $F_{0.1}$ level. The TAC has been reduced on four occasions since the precautionary quota of 12,000 tonnes was placed upon this resource in 1982: to 9,400 t in 1987, to 5,500 t in 1988, to 3,600 t in 1993 and most recently to 2,000 t in 1994.

7 - Fishery Data

A) Commercial Samples and Age Determination

Commercial port samples of NAFO division 4T white hake were obtained according to previously established protocols (Clay et al. 1985; Clay and Hurlbut 1989; Clay and Clay 1991). In 1994, DFO port samplers collected 16 length frequency samples (2,651 fish measured) and 747 otoliths, of which 729 provided acceptable age estimates. Fifteen of the 16 commercial white hake samples obtained from NAFO division 4T in 1994 were obtained from unit area 4Tg which is occupied by the 'Strait' component. The one sample obtained from unit area 4Tf (the 'Channel' component) consisted of 212 fish measured for length and 60 otoliths.

Quality control tests were conducted during the entire period of ageing calibration and age determination, after every 200 to 250 otoliths that were read. These tests involve the ageing of two randomly selected trays (50 otoliths per tray) from the reference collection. Recently assigned ages are

accepted if the agreement on both trays exceeds 75% (otherwise the ages are discarded and the reader recalibrates with otoliths from the reference collection). In 1994, agreement with the reference age ranged from 54% (during initial calibration) to 93% with a mean of 79%.

B) *Catch, Weight and Length at Age in 1994*

Low sampling intensity in 1994 allowed for separation of the aged samples into only two gear groupings (age/length keys) (Table 5). There were no samples obtained from otter trawlers in 1994. As in previous assessments of this resource, catches from otter trawls and seines were combined because they were considered comparable, as were catches from gillnets and longlines. Four combinations of time and gear were selected for the length frequency data from the available samples for 1994 (Table 5).

The catch-at-age, weight-at-age and length-at-age were calculated for each key for 1994 (Tables 6 to 8) using the AGELEN program (Ver 3.21) for sexes combined. The estimated catch in numbers-at-age for each key was added together to obtain the annual total catch-at-age and a weighted average (by numbers in each age group) was calculated for the weights- and lengths-at-age. As well, the catch-at-age, weight-at-age and length-at-age were re-calculated for 1991, to comply with the finalized NAFO landings statistics.

In 1993 and 1994 the largest fish at-age were those obtained from gillnets and seines (Tables 8 and 9 (Note: there were no samples obtained from otter trawls in 1994)). For seines, this difference probably reflects the increase in mesh size that occurred in 1993. In 1994 the mean length and weight-at-age of hake caught by longline was considerably less than that for hake sampled from any of the other fishing gears, especially for hake sampled after July.

Comparing the catch-at-age for 1994 with that for previous years (Table 10 and Figure 8), it is evident that fewer older fish (i.e., age 6+) have been caught since 1989. The modal age shifted from age 6 in 1988 and 1989 to age 5 from 1990-93. In 1994 the modal age changed to age 6, but this fishery is now dependent on only 2 to 3 year-classes (ages 4 - 6) and, as a result, it will be sensitive to annual fluctuations in recruitment. Aside from minor differences in the numbers at ages 4 and 5, the re-calculated catch-at-age for 1991 changed very little from that reported in the last assessment of this resource (Table 10).

C) *Catch Rates From Index Fishers*

The Groundfish Index Fisher Program was established in 1990 to obtain catch rate information from inshore groundfish fishers. Since its start, 50 to 58 fishers have volunteered to participate in this program each year, about one quarter of which are considered to fish at least part-time for white hake. The catch rates for eight of the index fishers who targeted and caught white hake in 1994 are shown in Figure 9.

The trends in the catch rates for these eight fishers are highly variable and difficult to characterize except for the following:

- the catch rate series for the two otter trawlers show a marked decrease in 1993 and 1994
- three of the four catch rate series for gillnetters exhibit an increase in 1994, with two of them being pronounced
- the catch rate series for one of the longliners was stable from 1992-94 while the other showed an increase in 1994 from 1993.

8 - Research Data

A) *Fall Groundfish Survey of 1994*

Research vessel surveys have been conducted every autumn since 1971 in the southern Gulf of St. Lawrence, to provide an index of groundfish stock abundance. A stratified random survey design was initially adopted and has been maintained, except for the period 1984-1987, when randomly chosen fixed stations were surveyed. The surveys are conducted in the month of September before groundfish commence their migration out of the Gulf. Survey procedures and protocols are standardized and are documented in Hurlbut and Clay (1990B). The survey strata for the fall groundfish abundance survey are shown in Figure 10.

In 1992, the Alfred Needler replaced the Lady Hammond as the survey vessel for the annual resource survey. In early August 1992, before the replacement, a comparative fishing experiment was conducted between the two vessels. Results from this analysis indicated that there was no significant difference in the efficiencies of the two vessels for catching white hake (Nielsen 1994).

During the 1994 survey (N210), 186 valid sets were made of which 160 were made in NAFO Div. 4T.

i) Geographic Distribution

The distribution of white hake catches during the 1994 survey was generally similar to the pattern observed in previous years (Figure 11) with concentrations occurring in warmer water either in shallow inshore areas or in deep water along the Laurentian Channel. White hake have seldom been caught in the shallow, central zone adjacent to the Magdalen Islands. Fewer white hake have been caught in the western part of the southern Gulf each year since 1991 suggesting that there has been a contraction of the geographic range in recent years.

ii) Length Frequency Distribution of Survey Catches

Length frequencies were produced for the entire series of abundance surveys of the southern Gulf conducted since 1971 (Figure 12). With the exception of 1990, when the modal length was only 33 cm, the modal length varied between 39-44 cm from 1986-93. In 1994, the modal length dropped to 31 cm. Examination of the length frequency for 1994 shows that the abundance of larger hake has continued to decline. In addition, there are no indications of improved recruitment (i.e., fish < 42 cm).

iii) Size at Age

The stratified mean catch per tow-at-age, mean weight-at-age and mean length-at-age were calculated for the entire series of abundance surveys of the southern Gulf conducted since 1971 (Tables 11 - 13) using the research vessel analysis (RVAN) programs (Clay 1989) written in SAS. Examination of these tables reveals the same reduction in abundance of larger hake evident in the survey length frequencies.

iv) Abundance Indices and Biomass Estimates

From 1971-1983, 10 to 13 fixed stations were surveyed every year during the annual stratified random survey of the southern Gulf. As mentioned above, during the annual abundance surveys of NAFO Div. 4T, conducted from 1984-87, the survey design was modified from randomly selected stations to fixed stations that were initially randomly chosen and successfully fished from 1981-1983. Furthermore, from 1984-1987, several stations were re-sampled or repeated up to a maximum of 10

times (the majority of stations were not repeated more than 2 to 3 times) after varying amounts of time. In 1988, an experiment was conducted in which catches were compared at stations that were fished both during the day and at night. An analysis was recently conducted of the validity and impacts of including the fixed and repeat stations on estimates of population abundance and biomass (Nielsen, 1995). The analysis resulted in a recommendation for including fixed stations in such analyses but cautioned against the inclusion of repeat sets for white hake because of the tendency for catches of hake to be higher for repeat sets.

Consequently, the research vessel stratified mean catch (numbers and weight) per tow, estimates of population abundance and biomass and associated variances were re-calculated for the entire series of abundance surveys of the southern Gulf conducted since 1971 including fixed stations and all locations that were fished from 1984-88 (Table 14). The most significant effect of these changes on the survey index for white hake (Figure 13) is the reduction of the index for the years 1984 and 1986-88.

The mean number of white hake caught per tow during the 1994 September groundfish survey declined slightly from the 1993 level to 3.3 fish/tow and is at its lowest level since 1972 (Table 14 and Figures 13-14). The estimates of population abundance and biomass for 1994 decreased by almost 65% from 1991.

The research vessel stratified mean catch per tow, estimates of population abundance and biomass and associated variances were also calculated for the 'Strait' and 'Channel' components (separately), using the depth criteria mentioned previously. Strata 403, 420-422, 432 and 433 were selected for analyses of the 'Strait' component and strata 415, 425 and 437-439 were selected for analyses of the 'Channel' component (Tables 15 and 16 and Figure 15).

This analysis revealed a substantial difference in the abundance of the two components from 1988-1992, with the 'Channel' component being significantly more abundant than the 'Strait' component in 1988, followed by a reversal for the years 1989-92. The abundance of white hake from the 'Strait' component declined to a minimum in 1993 but increased slightly in 1994. In contrast, the abundance of white hake from the 'Channel' component reached a minimum in 1994.

As mentioned earlier, scepticism was expressed concerning the results of the September (1994) abundance survey by representatives from the fishing industry who contended that white hake were abundant in the southeastern Gulf in 1994, especially in St. Georges Bay. To address this issue, the research vessel estimates of the mean catch per tow for the area in question (survey strata 403 and 433 - See Figure 10) were compiled and compared to the estimates for the remaining survey area and the whole survey area (Table 17 and Figure 16).

The results reveal the considerable significance of strata 403 and 433 in terms of the local abundance (density) of white hake and offers support for the contention by industry that hake were abundant in this area in 1994. Nevertheless, the following points must be borne in mind:

- Stratum 403 is the smallest stratum in the survey area for the southern Gulf. Because stations are allocated to strata in proportion to stratum area, the maximum number of trawl tows ever made in stratum 403 was 3 (only one tow was made in 1989). Consequently, abundance estimates for this stratum may have a higher variance since relatively few tows were made, as in 1989.
- The mean number of white hake caught per tow in strata 403 and 433 declined to its lowest level in 1993 but increased slightly in 1994 (to a level considerably less than the average for the period 1984-1994).
- The contention that white hake were abundant in the southeastern Gulf in 1994 is consistent with the results of the 1994 abundance survey which found concentrations of hake in St. Georges

Bay (stratum 403) and at the eastern end of Northumberland Strait (stratum 433) and in very few other places in the southern Gulf (Figure 11).

B) January 95 Survey of Cabot Strait

A groundfish survey was conducted in the Cabot Strait (NAFO division 4T to 4Vsb) from January 10-29, 1995 using the Alfred Needler. Station selection was non random (grid design), otherwise standard Gulf survey protocols were followed. The primary objective of this survey was to determine the distribution and relative abundance of groundfish species in the Cabot Strait area during winter (Chouinard 1995).

During the survey, 164 valid sets were completed. White hake catches were highest in areas 4Vn and 4Vs in waters deeper than 200 m (Figure 17). As in the January 1994 survey, only small catches were realized within the Gulf.

Examination of the length frequencies of white hake caught during the 1994 and 1995 January surveys (Figure 18) revealed modes at lengths that were considerably shorter (23 cm in 1994 and 25 cm in 1995) than the modes described previously for the 1994 annual survey of NAFO 4T. The origin of these small hake is uncertain.

9 - Estimation of Stock Parameters

A formal analytical assessment of this resource has not been conducted since 1989 due to the lack of a reliable index of abundance and because of uncertainties about stock structure and the adequacy of the NAFO 4T management unit.

A) Estimation of Mortality Rates

Sinclair et al. (1993) described a method for estimating trends in fishing mortality at length, using commercial and research vessel survey length frequency data. With this method, the ratio of catch at length (C_l) to the RV estimate (A_l) is used as a direct estimate of relative fishing mortality at length (R_l).

$$R_l = C_l/A_l$$

A variation of this method was used to estimate trends in fishing mortality at age (R_a) from the ratio of catch at age (C_a) to the RV estimate (A_a).

$$R_a = C_a/A_a$$

The research vessel abundance index data were also analyzed using a multiplicative model to obtain information on trends in total mortality, similar to that described by Sinclair (1992). The model with age and yearclass as effects was of the form:

$$\ln(C_{ij}) = \beta_0 + \beta_1 I + \beta_2 J + e$$

where: C_{ij} is the catch of hake (standardized to a 1.75 nautical mile tow) of age i of year j .

I = age category

J = year class category

Analyses used the GLM procedure of SAS (SAS Institute 1989). The research vessel time series was analyzed in successive 5 year blocks (i.e. 1984-89, 1985-90, etc.) and included ages 1 to 11.

Estimates of average total mortality (Z) for the respective periods were obtained by linear regression of the predicted values from the above model for ages 4 to 8 for the years 1984-94.

10 - Assessment Results

The results (Figure 20) indicate a trend of increasing fishing mortality on the year-classes that supported the fishery (ages 4+) from 1986-92, followed by a reduction in 1993 that is consistent with a reported reduction in fishing effort due to low prices. The trend of increasing fishing mortality on hake aged 6 and 7 in 1994 is contrary to expectations with the reported reductions in fishing effort that occurred due to the cod moratorium and associated closures in 1994.

From the multiplicative analysis, the estimated Z in the late 1980's was approximately 0.9 (Figure 21) but increased sharply in 1990 and has remained at a very high level (approximately 1.4) in the years since.

11 - Ecological Considerations

Concern has been expressed recently about the by-catch and mortality of small white hake in estuarine smelt fisheries in some areas of the southern Gulf, particularly the Miramichi estuary. Preliminary sampling in 1992 indicated that the by-catch of white hake in the "openwater" smelt fishery could be significant but the magnitude and extent of this type of mortality was unquantified (Hurlbut et al., 1994). To address this need, a sampling program was initiated in the fall of 1994.

Although there may have been more than 100 licensed smelt fishers in the Miramichi estuary in 1994 (statistical districts 70, 71 and 73), all of whom were eligible to participate in either the "openwater" or the ice fishery, the actual number of fishers that participated in the "openwater" fishery was around 10. These fishers were contacted and the four most active fishers were identified for subsequent sampling of their catches. The sampling protocol was as follows:

- for 15 days (Oct. 16 to Nov. 10, 1994) a sampler accompanied one of the four smelt fishers to their traps and observed and quantified any discarding of white hake or winter flounder (the sampler attempted to accompany and sample the catches of each of the four fishers on alternating days)
- when the catch was brought ashore and sorted all white hake and winter flounder were weighed and measured (subsampling was occasionally necessary for large catches)
- fishing effort information (i.e., the number of nets and "soak" time) and the quantity of white hake or winter flounder discarded were recorded
- each evening the other active smelt fishers were contacted by telephone and asked for their catches of white hake and winter flounder and associated fishing effort

During this program, sampling was conducted on smelt catches in which more than 3,100 kg of white hake were caught as by-catch (Table 18). The size range of the white hake that were sampled ranged from 8 to 40 cm corresponding to a potential age range of 0 to 3 years old (Figure 19).

Estimates of the minimum total daily catch of small white hake in the Miramichi estuary were made by combining the estimated number from the sampled catch of that day with estimates of the numbers caught by the other fishers that reported landings on the same day (the sampling ratio from the sampled catch was used to estimate the number caught in the catches that were not sampled). The estimated catches were corrected for the amount of time that the nets actually fished ("soak" time). It was estimated that the minimum number of white hake caught in the Miramichi estuary during the 15 day sampling period was of the order of 100,000-110,000 (14,000-15,000 kg).

According to the smelt fishers, 1994 was an unusual year in terms of their white hake by-catch. They claimed that the presence of white hake in the estuary is usually of a much shorter duration (i.e., a 'pulse' of fish lasting for the first two weeks of the season after which they disappear completely). This was not the case in 1994 as white hake were caught from the first day of the smelt season (Oct. 16) until the last day of sampling (Nov. 10), although the numbers decreased towards the end of sampling.

In the fall of 1994 the DFO enforced a regulation that required smelt fishers in the Miramichi estuary to sort and discard on site all groundfish (i.e., white hake and winter flounder) from their traps. It was the opinion of the contractor that conducted the sampling for this study that this was an unrealistic and ineffective way to limit the by-catch of white hake because it required an inordinate amount of time which could compromise the viability of the fishers efforts and also because of the extensive predation by birds that results. He suggested that the best solution to the problem of white hake by-catch in this fishery is to avoid catching them in the first place, since white hake represents nothing but a nuisance to the fishers. He discussed this concept with several of the smelt fishers in 1994 and concluded that a modification to the bottom of the nets that would keep white hake and winter flounder out of the nets entirely, while retaining smelt and tomcod was probably viable and was endorsed by several of the fishers.

12 - Future Prospects

The white hake resource in NAFO division 4T may be at its lowest level since the first quota was put in place in 1982. A quantitative forecast is not possible. The catches of recent years appear to have resulted in a high rate of exploitation. Considering the low abundance and indications of weak incoming recruitment, rebuilding of this stock will probably occur slowly.

13 - Management Considerations

After extensive consultations and meetings with industry, the Fisheries Resource Conservation Council (F.R.C.C.) recommended "that there be no directed fishing for NAFO 4T white hake in 1995 and that by-catches be kept to the lowest possible level". The council also recommended that "measures be taken to avoid catches of small hake in smelt and eel traps".

In response to the above recommendation, the minister of the Department of Fisheries and Oceans announced (Dec. 21, 1994) the closure of the fishery for white hake in NAFO 4T. He also announced conservation measures beyond the F.R.C.C. recommendations, including the closure of directed fishing for white hake in NAFO 4RS, 3Pn and 4Vn (January to April).

Concern has been expressed about the potential for continued exploitation of NAFO 4T white hake during their winter residency in and migration to and from NAFO 4Vn and possibly 3Pn. The evidence from six seasonal surveys conducted in the southeastern Gulf (Sept. 1986 - Sept. 1987) suggests that any directed fishing for white hake in NAFO 4Vn before mid-June could result in mortality to white hake that originated in NAFO 4T. As well, fishing in late fall (late November and December) could have a similar impact.

14 - Research Recommendations

1. Examine potential inverse relationship between hake and cod abundance off PEI.
2. Investigate changes in fishing effort relative to abundance.
3. Compare size frequencies for the 'Strait' and 'Channel' components.

4. Modes of small hake in the 4Vn survey seem to correspond to those for hake sampled from the Miramichi smelt fisheries. Could they be the same fish?
5. Are small white hake found inside scallop shells in the fall?
6. Do research vessel surveys using mobile gear(s) underestimate the abundance of hake? (Hake may be more abundant on hard bottom, where they are less vulnerable to the trawl).
7. Expand the sampling of by-catch from estuarine fisheries.

15 - Acknowledgements

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Table 1. Nominal landings (tonnes) of white hake from NAFO division 4T by gear, year and TAC (total allowable catch). All data from 1993 to 1994 are provisional.

<u>YEAR</u>	<u>TRAWL</u>	<u>SEINE</u>	<u>GILLNET</u>	<u>LINE</u>	<u>OTHER</u>	<u>TOTAL</u>	<u>TAC</u>
1960	479	21	3	1172	333	2008	
1961	1430	79	309	3498	7	5323	
1962	1141	97	889	4542	574	7244	
1963	1444	71	48	N/S	4987	6550	
1964	1508	82	N/S	1	4615	6206	
1965	N/S	N/S	N/S	N/S	N/S	4706	
1966	2267	205	375	1870	2307	7024	
1967	2295	128	809	948	2370	6550	
1968	795	84	1734	466	1182	4261	
1969	1030	50	1802	498	828	4208	
1970	1463	382	2149	385	1289	5668	
1971	1523	632	1622	702	1228	5707	
1972	1139	863	1190	1605	960	5757	
1973	2468	211	1265	1045	713	5702	
1974	1454	305	1098	345	414	3616	
1975	1574	306	1279	324	642	4125	
1976	1429	398	1147	183	601	3758	
1977	1227	408	1300	231	818	3984	
1978	1303	737	1829	456	500	4825	
1979	2826	912	3189	479	704	8110	
1980	3430	1615	4831	832	1715	12423	
1981	4733	1922	6174	799	411	14039	
1982	2885	994	4625	1027	245	9776	12000
1983	2141	906	2959	753	546	7305	12000
1984	1734	588	3789	865	74	7050	12000
1985	1639	1008	2480	799	88	6014	12000
1986	1094	898	1884	1068	4	4948	12000
1987	820	1505	2200	1847	0	6372	9400
1988	388	817	1923	748	11	3887	5500
1989	868	1689	1830	943	24	5354	5500
1990	771	1216	2022	1118	48	5175	5500
1991	1205	848	1292	1156	0	4501	5500
1992	955	926	914	1136	0	3931	5500
*1993	172	101	454	694	45	1465	3600
*1994	79	50	211	599	0	939	2000

1960 to 1994

AVERAGE	1477	602	1704	947	808	5672	
PERCENT	26	11	30	17	14		

1994

PERCENT	8	5	22	64	0		
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N/S = Gear Type Not Specified
 * = Provisional Statistics

**Table 2. Nominal landings (tonnes) of white hake from
NAFO division 4T in 1994 by gear and month.
All data are provisional statistics.**

<u>MONTH</u>	<u>TRAWL</u>	<u>SEINE</u>	<u>LINE</u>	<u>GILLNET</u>	<u>OTHER</u>	<u>TOTAL</u>
JANUARY	0.0	0.0	0.0	0.0	0.0	0.0
FEBRUARY	0.0	0.0	0.0	0.0	0.0	0.0
MARCH	0.0	0.0	0.0	0.0	0.0	0.0
APRIL	0.0	0.0	0.0	0.0	0.0	0.0
MAY	0.0	7.6	1.8	0.1	0.0	9.5
JUNE	6.0	8.7	3.4	2.0	0.0	20.1
JULY	24.4	4.7	105.9	120.6	0.0	255.6
AUGUST	16.5	0.8	257.9	57.7	0.0	332.9
SEPTEMBER	24.5	3.2	120.2	22.3	0.0	170.2
OCTOBER	7.5	24.0	110.2	8.3	0.0	150.0
NOVEMBER	0.0	0.5	0.0	0.0	0.0	0.5
DECEMBER	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	78.9	49.5	599.4	211.0	0.0	938.8
PERCENT	8.4	5.3	63.8	22.5	0.0	100.0

Total Canadian Landings of White Hake (tonnes) in Selected NAFO Div's., Areas and Subareas											
Year	3O	3Pn	3Ps	3Pu	4R	4S	4T	4Vn	4Vs	4Vu	4W
85	1672	63	1156	0	88	12	6014	345	526	0	1105
86	2169	57	1228	0	38	66	4948	372	518	0	1407
87	1731	92	1318	0	98	92	6372	586	743	0	1588
88	954	66	683	0	49	58	3887	333	378	0	789
89	1103	22	706	0	43	66	5354	293	476	0	938
90	1053	13	1441	0	34	48	5175	191	311	0	1237
91	960	44	1445	0	45	106	4501	172	301	0	1044
92	1647	80	1208	15	85	78	3931	158	304	0	809
93	966	243	681	51	127	55	1465	136	259	12	753
94	253	285	382	0	89	37	939	224	146	67	590

Total Foreign Landings of White Hake (tonnes) in Selected NAFO Div's., Areas and Subareas											
Year	3O	3Pn	3Ps	3Pu	4R	4S	4T	4Vn	4Vs	4Vu	4W
85	2835	0	0	0	0	0	0	1	16	0	4
86	1569	0	14	0	126	0	0	25	20	0	5
87	990	0	0	0	0	0	0	1	8	0	21
88	111	0	12	0	0	0	0	0	1	0	0
89	23	0	3	0	0	0	0	0	0	0	8
90	7	0	1	0	0	0	0	0	0	0	2
91	0	0	0	0	0	0	0	0	0	0	40
92	0	0	0	0	0	0	0	0	0	0	0
93	0	0	0	0	0	0	0	0	0	0	0
94	0	0	0	0	0	0	0	0	0	0	0

Total Canadian and Foreign Landings of White Hake (tonnes) in Selected NAFO Div's., Areas and Subareas											
Year	3O	3Pn	3Ps	3Pu	4R	4S	4T	4Vn	4Vs	4Vu	4W
85	4507	63	1156	0	88	12	6014	346	542	0	1109
86	3738	57	1242	0	164	66	4948	397	538	0	1412
87	2721	92	1318	0	98	92	6372	587	751	0	1609
88	1065	66	695	0	49	58	3887	333	379	0	789
89	1126	22	709	0	43	66	5354	293	476	0	946
90	1060	13	1442	0	34	48	5175	191	311	0	1239
91	960	44	1445	0	45	106	4501	172	301	0	1084
92	1647	80	1208	15	85	78	3931	158	304	0	809
93	966	243	681	51	127	55	1465	136	259	12	753
94	253	285	382	0	89	37	939	224	146	67	590

Table 3. Canadian Vs. Foreign landings of white hake in selected NAFO divisions, areas and subareas.

Canadian Landings of White Hake (tonnes) in the Cod Fishery in Selected NAFO Div's., Areas and Subareas											
Year	3O	3Pn	3Ps	3Pu	4R	4S	4T	4Vn	4Vs	4Vu	4W
85	103	50	43	0	42	8	879	44	93	0	13
86	61	37	103	0	14	14	596	35	114	0	40
87	97	32	288	0	37	50	1411	48	184	0	36
88	168	33	332	0	22	37	754	186	95	0	84
89	67	18	157	0	35	21	1108	194	174	0	108
90	116	13	138	0	23	20	1082	93	168	0	96
91	207	18	468	0	19	17	934	44	87	0	53
92	125	22	379	15	9	12	839	26	72	2	69
93	106	22	115	0	22	5	157	5	58	1	25
94	2	0	2	0	4	2	55	0	0	0	4

Canadian Landings of White Hake (tonnes) in the Redfish Fishery in Selected NAFO Div's., Areas and Subareas											
Year	3O	3Pn	3Ps	3Pu	4R	4S	4T	4Vn	4Vs	4Vu	4W
85	1	7	10	0	22	2	0	12	14	0	7
86	0	13	22	0	15	4	1	6	3	0	8
87	1	26	12	0	22	4	13	56	11	0	8
88	0	33	7	0	6	2	9	108	12	0	1
89	0	4	1	0	0	2	12	18	4	0	11
90	0	0	8	0	3	0	14	9	0	0	0
91	0	0	4	0	5	1	36	12	3	0	0
92	1	4	7	0	7	2	20	19	1	0	0
93	4	36	13	0	12	7	17	71	2	0	1
94	0	16	102	0	15	5	27	148	28	0	4

Canadian Landings of White Hake (tonnes) in the Shrimp Fishery in Selected NAFO Div's., Areas and Subareas											
Year	3O	3Pn	3Ps	3Pu	4R	4S	4T	4Vn	4Vs	4Vu	4W
85	0	0	0	0	3	1	0	0	0	0	0
86	0	0	0	0	3	4	0	0	0	0	0
87	0	0	0	0	5	9	0	0	0	0	0
88	0	0	0	0	0	3	0	0	0	0	0
89	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	2	0	0	0	0	0
91	0	0	0	0	0	0	0	0	0	0	0
92	0	0	0	0	0	3	0	0	0	0	0
93	0	0	0	0	0	0	0	0	0	0	0
94	0	0	0	0	0	0	0	0	0	0	0

Table 4. Canadian landings of White Hake in the cod, redfish and shrimp fisheries in selected NAFO Div's., areas and subareas.

Table 5. Keys selected for gear/time combinations and their groupings to produce age/length keys for 1994 with at least 400 fish ages (See below for explanation of abbreviations for gear types).

Key #	Fishery	Period	Sample Type	Sample Source	Sample # of Observations	Landings (t)
1	OTB/SNU	Jan. - Dec.	Age	All Gears OTB*/SNU/GN/LL Jan. - Dec.	729	128.4
			Length	SNU Jan. - Dec.	608	
2	GN	Jan. - Dec.	Age	GN/LL Jan. - Dec.	519	211.0
			Length	GN Jan. - Dec.	210	
3	LL	Jan. - Jul.	Age	GN/LL Jan. - Dec.	519	111.1
			Length	LL Jan. - Jul.	547	
4	LL	Aug. - Dec.	Age	GN/LL Jan. - Dec.	519	488.3
			Length	LL Aug. - Dec.	1286	

Gear Type Abbreviations

OTB = Otter Trawl SNU = Seine GN = Gillnet LL = Longline MISC = Miscellaneous

- OTB landings were combined with SNU because there were no samples obtained from OTB's in 1994.

Length/Weight Coefficients (sexes combined) from Mission N210 (Sept. 1994)

a = 0.005209 b = 3.092523

Table 6. Catch-at-age of white hake in NAFO division 4T as estimated from dockside sampling of the commercial fisheries in 1994. The four keys refer to the keys of Table 5.

<u>White Hake: Catch-Numbers-at-Age (000's)</u>						
AGE	KEY 1 (OTB [*] /SNU)	KEY 2 (GN)	KEY 3 (LL)	KEY 4 (LL)	SUM	VAR
1-2	0	0	0	0	0	0
3	0	0	0	22	22	121
4	2	1	6	109	118	2814
5	13	14	18	118	163	2657
6	29	52	23	79	183	648
7	14	25	10	30	79	87
8	4	8	4	9	25	7
9	1	1	1	2	5	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13-16	0	0	0	0	0	0
TOTALS:	63	101	62	369	595	
# IN L-F	608	210	547	1286		
# AGED	729	519	519	519		
MEAN AGE	6.18	6.29	5.83	5.06		

Table 7. Weight-at-age (kg) of white hake in NAFO division 4T as estimated from dockside sampling of the commercial fisheries in 1994. The four keys refer to the keys of Table 5.

<u>White Hake: Weight-at-Age (kg)</u>					
AGE	KEY 1 (OTB [*] /SNU)	KEY 2 (GN)	KEY 3 (LL)	KEY 4 (LL)	WEIGHTED AVE.WGT.
1					
2					
3			0.77	0.61	0.61
4	1.08	1.14	0.95	0.82	0.83
5	1.37	1.50	1.29	1.17	1.23
6	1.85	1.96	1.80	1.76	1.84
7	2.42	2.48	2.58	2.49	2.49
8	3.09	2.95	3.15	3.02	3.03
9	3.92	3.03	3.41	3.43	3.44
10	4.25	4.00			
11					
12					
13	9.55				
14					
15					
16					
MEAN (From Keys)	2.01	2.11	1.80	1.33	
# IN L-F	608	210	547	1286	
# AGED	729	519	519	519	
MEAN AGE	6.18	6.29	5.83	5.06	

Table 8. Length-at-age (cm) of white hake in NAFO division 4T as estimated from dockside sampling of the commercial fisheries in 1994. The four keys refer to the keys of Table 5.

<u>White Hake: Length-at-Age (cm)</u>						WEIGHTED AVE. LT.
AGE	KEY 1 (OTB*/SNU)	KEY 2 (GN)	KEY 3 (LL)	KEY 4 (LL)		
1						
2						
3				47.00	43.56	43.56
4	52.30	53.22	50.20	47.81		48.05
5	56.44	58.10	55.26	53.53		54.35
6	62.19	63.39	61.62	61.08		61.98
7	67.76	68.36	69.24	68.49		68.41
8	73.20	72.26	73.75	72.74		72.82
9	78.79	73.04	75.72	75.88		75.86
10	81.56	80.00				
11						
12						
13	106.00					
14						
15						
16						
MEAN	63.19	64.66	60.79	47.01		
(From Keys)						
# IN L-F	608	210	547	1286		
# AGED	729	519	519	519		
MEAN AGE	6.18	6.29	5.83	5.06		

Table 9. Length-at-age (cm) of white hake in NAFO division 4T estimated from dockside sampling of the commercial fisheries in 1993.

<u>White Hake: Length-at-Age (cm)</u>							WEIGHTED AVE.LT.
AGE	KEY 1 (OTB)	KEY 2 (SNU)	KEY 3 (GN)	KEY 4 (GN)	KEY 5 (LL)	KEY 6 (LL)	
1							
2							
3	48.97	54.00	42.69	42.33	46.80	41.06	42.02
4	52.22	55.57	49.52	47.42	50.20	49.52	49.61
5	54.53	57.45	58.27	54.18	53.24	53.72	54.46
6	59.71	60.94	65.94	61.32	57.50	61.81	61.82
7	63.44	64.54	67.68	64.22	58.97	66.48	65.84
8	69.82	69.76	73.08	71.64	93.19	74.97	74.62
9	66.54	70.15	74.74	68.68	62.47	76.72	73.98
10		70.00	77.89	70.00		77.74	76.67
11		78.68	78.36	79.84	96.00	80.04	83.59
12	77.00	77.00	77.00			83.44	81.47
13							
14							
15							
16						112.00	
MEAN	55.79	59.60	62.04	52.40	53.53	54.44	
(from keys)							
# IN L-F	221	137	878	631	107	3427	
# AGED	708	708	622	622	622	622	
MEAN AGE	5.13	5.54	5.79	4.74	4.85	4.97	

Table 10. Commercial fishery catch (numbers - 1,000's) at age for white hake in NAFO division 4T.

Catch-at-age: NAFO 4T hake

Age :	70	71	72	73	74	75	76	77	78	79	80	81
3 :	86	84	91	80	49	56	81	86	79	90	91	66
4 :	708	715	633	499	250	214	298	332	354	470	452	427
5 :	798	798	747	664	380	390	433	471	579	833	1028	1075
6 :	456	448	485	461	297	344	333	361	545	972	1661	1976
7 :	373	378	403	454	313	380	291	302	345	672	1196	1391
8 :	144	144	165	191	136	171	132	136	172	315	540	604
9 :	74	77	84	108	78	99	67	66	61	101	137	154
10 :	42	43	44	50	33	42	28	29	26	47	75	94
11 :	12	14	12	13	8	8	5	5	4	8	7	4
12 :	7	8	8	9	5	7	9	8	8	11	6	1
13-14 :	3	3	4	4	3	3	2	2	2	4	5	8

Age :	82	83	84	85	86	87	88	89	90	91*	92	93
3 :	5	57	58	64	2	30	0	11	34	28	128	77
4 :	113	128	319	216	204	531	39	114	604	427	988	304
5 :	546	595	787	608	496	1357	476	574	1170	925	1002	390
6 :	1136	787	788	592	477	900	648	810	992	887	534	213
7 :	1104	609	542	391	330	411	513	689	427	556	260	85
8 :	551	398	275	227	233	149	109	224	80	87	58	27
9 :	149	233	142	108	77	68	15	76	18	16	25	10
10 :	79	71	69	51	45	18	6	11	8	6	11	1
11 :	21	5	22	16	21	4	2	13	2	2	4	2
12 :	9	4	16	18	14	2	1	5	1	2	0	1
13-14 :	9	1	7	12	9	3	1	6	1	1	1	0

Age : 94 91 (From Previous Assessment)

3 :	22	29
4 :	118	437
5 :	163	935
6 :	183	884
7 :	79	554
8 :	25	86
9 :	5	16
10 :	0	6
11 :	0	2
12 :	0	1
13-14 :	0	1

91* - After NAFO landings were finalized in 1995

Table 11. Stratified mean catch per tow (numbers) at age for White Hake caught during research vessel surveys of the southern Gulf of St. Lawrence (NAFO Div. 4T).

Survey	P091	P106	P122	P143	P157	P172	P188	P204	P229	P244	P260	P278
Year	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
age 0												
age 1	0.04	0.03	0.03	0.11	0.34	0.33	0.02	0.06		0.01	0.05	0.06
age 2	0.54	0.18	0.29	1.64	3.45	3.05	0.30	2.15	0.28	0.27	0.46	0.27
age 3	0.96	0.18	0.58	1.71	2.17	2.07	1.27	1.50	2.04	0.98	1.11	0.61
age 4	0.45	0.27	1.77	2.44	1.06	0.90	1.78	2.52	2.08	1.86	2.47	0.97
age 5	0.48	0.28	1.94	1.85	0.64	0.52	0.58	2.01	1.82	2.38	3.15	0.77
age 6	0.11	0.27	0.73	1.39	0.34	0.25	0.18	0.98	1.28	0.92	2.39	0.70
age 7	0.11	0.09	0.29	0.89	0.14	0.08	0.17	0.30	0.48	0.45	1.45	0.30
age 8	0.02	0.12	0.07	0.21	0.04	0.02	0.04	0.03	0.13	0.23	0.47	0.13
age 9	0.03	0.16	0.04	0.06			0.05	0.02	0.02	0.09	0.23	0.02
age 10	0.03	0.06	0.03	0.15	0.02	0.02	0.01	0.07	0.03	0.10	0.01	0.04
age 11	0.03	0.06	0.02	0.14	0.04	0.03	0.02		0.04	0.02	0.02	
age 12		0.02	0.03	0.08			0.03	0.04	0.06	0.01	0.01	
age 13		0.01									0.04	
age 14			0.01	0.02			0.02				0.02	
age 15									0.02			
age 16						0.00						
Totals:	2.80	1.72	5.83	10.67	8.24	7.27	4.46	9.67	8.25	7.33	11.88	3.86

Survey	P296	P312	P327	H159	H179	H192	H204	H219	H232	N178	N192	N210
Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
age 0		0.01	0.16	0.31		0.01	0.41	0.52	0.13	0.09	0.35	0.22
age 1	0.09	0.05	0.10	0.24	0.05	0.17	1.08	0.75	0.55	0.34	0.29	0.18
age 2	0.81	0.47	0.64	1.70	0.54	1.63	2.11	2.33	2.03	1.41	0.67	0.81
age 3	0.81	1.10	2.34	2.60	1.72	2.67	4.38	2.45	2.81	2.61	0.56	0.71
age 4	0.80	1.38	2.86	4.15	2.13	3.05	2.20	1.67	1.79	2.12	0.95	0.86
age 5	0.44	1.11	0.95	2.53	1.45	2.10	1.48	1.58	1.26	0.60	0.69	0.38
age 6	0.28	0.53	0.66	0.90	0.69	0.60	0.71	0.51	0.61	0.13	0.20	0.12
age 7	0.14	0.24	0.53	0.41	0.19	0.26	0.23	0.33	0.21	0.06	0.05	0.03
age 8	0.07	0.17	0.32	0.20	0.06	0.04	0.03	0.07	0.06	0.01	0.03	0.02
age 9	0.07	0.05	0.23	0.11	0.02	0.01	0.03	0.02	0.01		0.02	
age 10	0.01	0.06	0.05	0.04	0.03	0.02	0.02	0.07	0.02		0.01	
age 11		0.01	0.01	0.04			0.01		0.02			
age 12		0.01	0.04	0.03	0.02							
age 13			0.02	0.02								
age 14			0.02									
age 15			0.01									
age 16												
Totals:	3.52	5.19	8.93	13.26	6.89	10.56	12.68	10.29	9.50	7.36	3.83	3.33

**Research Vessels: E.E. Prince from 1971-85 (P)
Lady Hammond from 1986-91 (H)
Alfred Needler from 1992-94 (N)**

Table 12. Mean weight (g) at age for White Hake caught during research vessel surveys of the southern Gulf of St. Lawrence (NAFO Div. 4T).

Survey	P091	P106	P122	P143	P157	P172	P188	P204	P229	P244	P260	P278
Year	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
age 0												
age 1	119.2	156.9	237.0	184.2	260.8	245.0	90.8	208.6		216.2	59.9	85.9
age 2	331.6	321.1	283.9	241.8	300.5	299.4	299.9	296.6	336.2	408.9	242.1	335.3
age 3	476.0	698.4	666.1	438.8	424.6	433.2	497.4	466.4	482.4	547.2	466.3	596.6
age 4	730.9	657.3	1059.6	952.8	898.4	860.6	683.8	1011.5	861.5	1007.9	865.5	1004.4
age 5	1292.0	1627.7	1303.0	1388.8	1341.5	1322.9	1266.2	1568.6	1454.8	1403.9	1316.8	1325.0
age 6	1795.4	2352.5	1809.0	2082.1	1669.6	1652.8	1555.1	2100.4	1896.0	1870.3	1735.1	1748.2
age 7	2076.6	2433.3	2245.7	2190.0	2481.2	2495.7	1711.0	2479.9	2279.8	2494.2	2098.8	2326.1
age 8	2067.3	2688.9	4662.5	4577.0	2730.0	2784.2	2356.9	3283.9	2424.0	3068.9	2740.4	2903.4
age 9	2604.0	2870.4	4482.1	3357.0			3873.2	2456.3	3219.0	3300.1	2929.4	3079.2
age 10	2566.2	6150.8	3605.2	3800.7	3404.0	3192.7	2125.9	2128.7	2774.5	5396.7	3275.8	3593.3
age 11	8249.1	3264.8	5201.4	5554.4	2730.0	4975.4	9530.9		5005.9	4129.3	10905.9	
age 12		2820.0	2820.0	2820.0			3777.7	7546.3	2789.6	9530.9	3275.8	
age 13		4129.3									8692.0	
age 14			3654.8	3718.5			2456.3				10905.9	
age 15										3219.0		
age 16						10434.0						

Survey	P296	P312	P327	H159	H179	H192	H204	H219	H232	N178	N192	N210
Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
age 0		63.9	10.5	18.7		35.2	47.2	28.6	66.8	74.7	36.6	48
age 1	157.7	140.2	69.8	144.5	113.1	92.6	86.1	71.1	180.9	154.5	145.5	134.8
age 2	328.0	286.1	217.8	246.0	184.2	235.6	216.0	221.3	261.9	290.4	270.6	249.7
age 3	600.4	570.9	413.1	465.4	424.7	415.2	436.4	354.3	463.2	453.4	403.7	512.7
age 4	1076.7	921.3	750.6	774.9	676.2	706.8	617.7	639.6	664.7	629.9	623.9	808.5
age 5	1846.5	1500.1	1310.5	1255.7	1193.9	1087.9	1066.6	998.5	1052.7	958.7	847.8	1134.5
age 6	2067.6	2053.9	1905.4	1968.1	2026.8	1805.2	1631.6	1457.8	1545.4	1494.9	1316.0	1661.4
age 7	3020.2	2673.8	2608.2	2863.6	3019.7	2758.5	2387.8	2075.0	2146.4	1985.8	1109.3	2330.3
age 8	3731.6	3217.8	3509.7	3399.2	3921.7	3816.2	3477.3	3539.9	3710.9	3126.4	1248.3	3130.1
age 9	3881.4	2933.1	4950.5	4600.6	6792.8	5858.7	5471.3	4103.3	4338.0		3839.6	
age 10	5727.5	6078.9	3999.1	6516.6	6628.2	8730.8	6986.1		6593.3		4755.3	
age 11		4246.4	7492.4	7426.2	8230.6		9342.2		7148.6			
age 12		6345.4	10262.3	7933.2								
age 13			8908.1	10304.3								
age 14			10807.9									
age 15			12160.2									
age 16												

**Research Vessels: E.E. Prince from 1971-85 (P)
Lady Hammond from 1986-91 (H)
Alfred Needler from 1992-94 (N)**

Table 13. Mean length (cm) at age for White Hake caught during research vessel surveys of the southern Gulf of St. Lawrence (NAFO Div. 4T).

Survey	P091	P106	P122	P143	P157	P172	P188	P204	P229	P244	P260	P278
Year	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
age 0												
age 1	25.4	28.0	29.4	26.4	32.5	31.8	23.4	29.5		31.0	20.8	23.3
age 2	35.0	34.3	33.2	31.3	34.1	34.1	33.6	33.6	34.8	37.0	32.5	35.7
age 3	38.9	44.6	42.2	37.7	37.7	38.0	39.6	38.6	38.6	40.9	40.0	43.0
age 4	45.3	43.0	50.9	48.9	48.0	47.5	44.1	49.8	47.2	49.9	49.0	51.3
age 5	54.1	57.9	54.4	55.2	54.6	54.4	53.3	57.3	55.8	55.6	56.2	56.3
age 6	59.9	65.6	60.2	63.3	59.0	58.7	57.1	63.1	60.8	60.9	61.5	61.7
age 7	62.3	66.0	64.8	64.4	67.0	67.1	59.3	66.3	64.7	66.5	65.2	67.4
age 8	62.8	68.6	80.4	80.4	69.2	69.6	65.7	72.4	65.5	70.6	70.5	72.7
age 9	67.9	67.7	79.2	73.9			75.9	67.0	73.0	72.2	72.2	73.4
age 10	67.9	86.8	74.9	76.3	74.2	72.7	64.0	63.7	67.4	83.1	76.0	76.3
age 11	98.4	73.2	85.0	86.8	69.2	80.3	103.0		83.9	79.0	112.0	
age 12		70.0	70.0	70.0			75.8	95.6	69.7	103.0	76.0	
age 13		79.0									103.1	
age 14			76.0	76.4			67.0				112.0	
age 15										73.0		
age 16						106.0						

Survey	P296	P312	P327	H159	H179	H192	H204	H219	H232	N178	N192	N210
Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
age 0		22.0	12.0	13.2		17.4	19.2	15.6	20.0	22.0	16.2	18.5
age 1	27.8	27.0	21.7	26.7	26.1	23.3	23.0	20.9	29.2	27.5	26.8	26.4
age 2	35.5	33.7	31.4	32.0	30.3	32.4	30.9	31.3	33.0	34.3	33.1	32.5
age 3	42.8	42.2	37.6	39.0	39.4	38.7	39.1	36.4	39.8	39.9	37.9	41.0
age 4	52.5	48.7	45.9	46.0	45.3	45.8	43.7	44.4	44.8	44.4	44.0	47.5
age 5	62.6	56.8	54.4	53.7	54.0	52.2	52.0	51.4	52.0	51.1	48.7	53.0
age 6	65.2	62.6	61.5	62.1	63.5	61.3	59.7	58.2	58.9	59.2	56.1	60.0
age 7	73.8	67.6	67.5	69.7	72.1	70.2	67.4	65.2	65.6	65.1	53.1	66.9
age 8	78.4	71.7	73.4	73.4	77.4	77.3	76.2	77.9	78.2	76.0	55.5	73.6
age 9	80.2	70.0	81.5	80.0	92.7	88.6	88.3	82.0	83.0		80.2	
age 10	91.0	84.7	76.8	90.1	92.0	100.6	95.6		95.0		87.0	
age 11		79.0	93.9	94.3	98.4		105.0		97.4			
age 12		87.0	103.0	96.0								
age 13			99.0	106.0								
age 14			105.0									
age 15			108.0									
age 16												

**Research Vessels: E.E. Prince from 1971-85 (P)
Lady Hammond from 1986-91 (H)
Alfred Needler from 1992-94 (N)**

Table 14. Research vessel estimates of mean catch per tow (numbers and weight), population numbers and population biomass for White Hake in NAFO Div. 4T.

Year	Stratified Mean Number Per Tow	Variance	Stratified Mean Wt. (kg.) Per Tow	Variance	Estimated Population Numbers (000's) in NAFO 4T	Variance	Estimated Population Biomass (t) in NAFO 4T	Variance
1971	2.80	1.20	2.33	0.52	4838	3583318	4028	1552919
1972	1.73	0.23	3.24	1.59	2996	695312	5596	4758931
1973	5.83	17.46	7.60	28.98	10090	52212572	13134	86660015
1974	10.68	21.55	14.10	45.49	18470	64458299	24385	136048571
1975	8.26	15.57	5.11	1.60	14283	46551665	8837	4790655
1976	7.27	8.84	4.49	1.28	12576	26440912	7771	3823445
1977	4.47	1.59	3.77	0.84	7727	4745806	6515	2515284
1978	9.68	10.85	10.25	8.36	15711	28584269	16637	22038177
1979	8.28	6.95	9.97	8.94	14326	20794088	17243	26741492
1980	7.37	1.28	10.25	2.57	12747	3826823	17732	7688792
1981	11.88	13.55	17.89	33.68	20551	40514792	30937	100721146
1982	3.86	1.62	5.23	3.70	6677	4840525	9052	11080178
1983	3.58	0.39	4.11	0.40	6092	1130786	6989	1158737
1984	5.19	1.32	6.10	1.42	9375	4306370	11024	4633180
1985	8.87	7.30	10.22	10.71	16020	23834443	18465	34963326
1986	13.26	6.74	13.86	5.41	23954	21992371	25038	17639143
1987	6.88	2.02	7.38	2.29	12437	6590507	13326	7482536
1988	10.64	5.39	8.85	2.35	18915	17058956	15739	7429573
1989	12.66	6.73	7.86	1.70	22386	21049577	13906	5307029
1990	10.22	4.11	7.11	1.27	18469	13401710	12851	4157881
1991	9.50	9.83	6.82	3.03	16799	30732460	12065	9470256
1992	7.35	6.68	4.26	1.71	13280	21800402	7691	5577398
1993	3.90	0.78	2.29	0.32	7053	2531365	4140	1052272
1994	3.33	0.74	2.13	0.28	5892	2321388	3758	863747

Table 15. Research vessel estimates of mean catch per tow (numbers and weight), population numbers and population biomass for the "Strait" Component (Strata 403, 420, 421, 422, 432 and 433).

Year	Stratified Mean Number Per Tow	Variance	Stratified Mean Wt. (kg.) Per Tow	Variance	Estimated Population Numbers (000's) for "Strait" Comp.	Variance	Estimated Population Biomass (t) for "Strait" Comp.	Variance
1984	8.64	25.37	11.85	26.80	2890	2842004	3967	3002462
1985	17.78	114.93	11.96	7.99	5952	12874653	4002	895574
1986	38.61	263.76	36.23	240.66	12922	29546651	12125	26959043
1987	18.69	144.68	16.53	130.82	6077	15292467	5374	13827623
1988	15.47	35.68	11.25	18.20	4745	3358539	3451	1713074
1989	46.41	157.22	22.36	25.83	15532	17612182	7485	2893357
1990	33.23	99.27	15.55	17.71	11121	11119903	5204	1984085
1991	36.36	269.27	22.16	76.19	12168	30164381	7417	8534517
1992	29.00	189.59	15.68	47.80	9705	21237889	5249	5354791
1993	5.67	2.07	3.76	0.78	1899	231667	1258	86960
1994	12.51	17.09	8.21	6.56	4186	1914096	2747	734925

Table 16. Research vessel estimates of mean catch per tow (numbers and weight), population numbers and population biomass for the "Channel" Component (Strata 415, 425, 437, 438 and 439).

Year	Stratified Mean Number Per Tow	Variance	Stratified Mean Wt. (kg.) Per Tow	Variance	Estimated Population Numbers (000's) for "Channel" Comp.	Variance	Estimated Population Biomass (t) for "Channel" Comp.	Variance
1984	27.58	51.68	28.99	38.16	5634	2157091	5922	1592714
1985	23.23	92.48	22.61	76.98	4746	3860476	4620	3213507
1986	74.27	762.60	65.41	257.14	15173	31833010	13363	10733773
1987	41.95	155.53	50.83	97.37	8571	6492258	10386	4064504
1988	80.67	273.63	73.84	174.60	16482	11422049	15086	7288252
1989	28.70	81.01	22.47	46.04	5864	3381403	4590	1921916
1990	30.35	52.70	26.95	32.08	6200	2199699	5506	1339279
1991	17.73	9.23	12.21	3.82	3623	385487	2496	159563
1992	16.05	13.26	10.23	4.96	3280	553644	2090	206946
1993	19.76	47.01	11.89	22.75	4038	1962490	2429	949542
1994	7.93	9.71	4.42	3.01	1621	405295	902	125552

Research Vessels: E.E. Prince from 1971-85
 Lady Hammond from 1986-91
 Alfred Needler from 1992-94

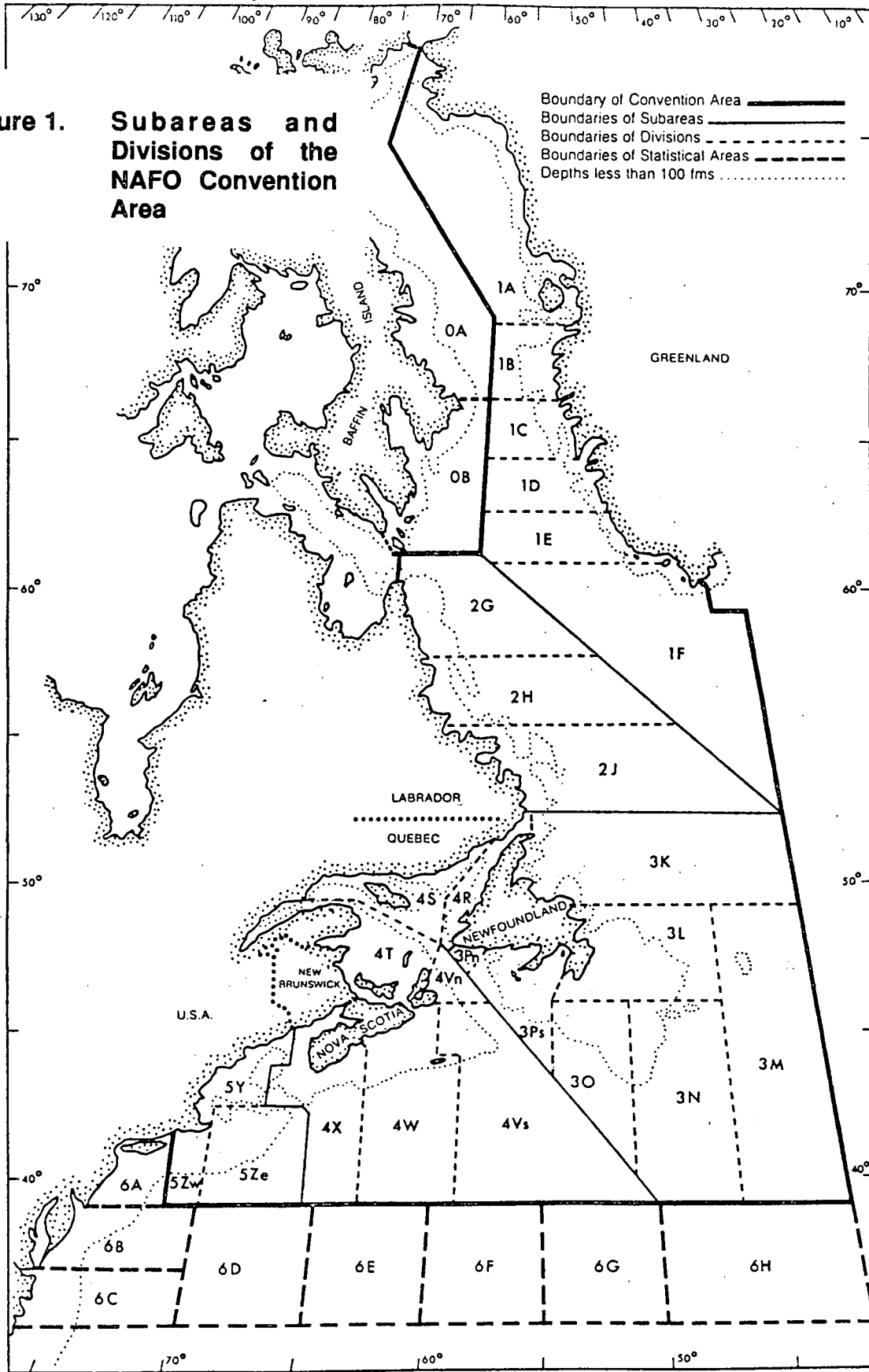
Table 17. Research vessel estimates of the mean catch per tow (numbers) for strata 403 and 433 (separated and combined) and the "rest" of the survey area.

Year	Mean No./Tow Strat. 403 (St. Georges Bay)	Mean No./Tow Strat. 433 East North. Strait	Mean No./Tow Strat. 403+433 (Combined Areas)	Mean No./Tow "Rest" of NAFO 4T	Mean No./Tow All of NAFO 4T (Total Survey Area)
1984	6.93	20.31	19.15	4.28	5.19
1985	26.67	46.75	45.01	6.52	8.87
1986	65.11	61.93	62.21	10.08	13.26
1987	21.58	36.14	34.88	5.06	6.88
1988	58.58	17.98	21.51	9.93	10.64
1989	532.66	81.68	120.85	5.62	12.66
1990	186.67	52.34	64.01	6.72	10.22
1991	80.27	77.93	78.13	5.04	9.50
1992	131.57	75.68	80.53	2.59	7.35
1993	79.93	5.16	11.65	3.40	3.90
1994	23.16	33.40	32.51	1.43	3.33

Table 18. Summary of the White Hake By-Catch Sampling Conducted in the Miramichi Smelt Fishery in the fall of 1994.

SAMPLE NUMBER	DATE (ddmmyy)	FISHER'S NAME	ESTIMATED TOTAL NUMBER CAUGHT	# OF WHITE HAKE MEASURED IN LEN. FREQ.	WHITE HAKE CATCH (kg)	WHITE HAKE SAMPLE WT. (kg)	NUMBER OF NETS FISHED
1	16/10/94	FISHER 1	384	299	59	46	6
2	24/10/94	FISHER 1	2043	274	261	35	8
3	25/10/94	FISHER 3	1869	441	284	67	6
4	26/10/94	FISHER 2	5950	227	865	33	8
5	27/10/94	FISHER 1	306	306	15	15	9
6	28/10/94	FISHER 4	5	n/a	1	1	5
7	31/10/94	FISHER 2	909	208	153	35	12
8	01/11/94	FISHER 3	76	76	16	16	3
9	02/11/94	FISHER 1	884	357	99	40	14
10	03/11/94	FISHER 2	1508	193	250	32	8
11	04/11/94	FISHER 1	1678	257	235	36	16
12	07/11/94	FISHER 2	4505	306	633	43	8
13	08/11/94	FISHER 1	0	0	0	0	0
14	09/11/94	FISHER 1	1150	311	122	33	9
15	10/11/94	FISHER 2	1068	267	124	31	4
TOTALS:			22335	3522	3117	463	116

Figure 1. Subareas and Divisions of the NAFO Convention Area



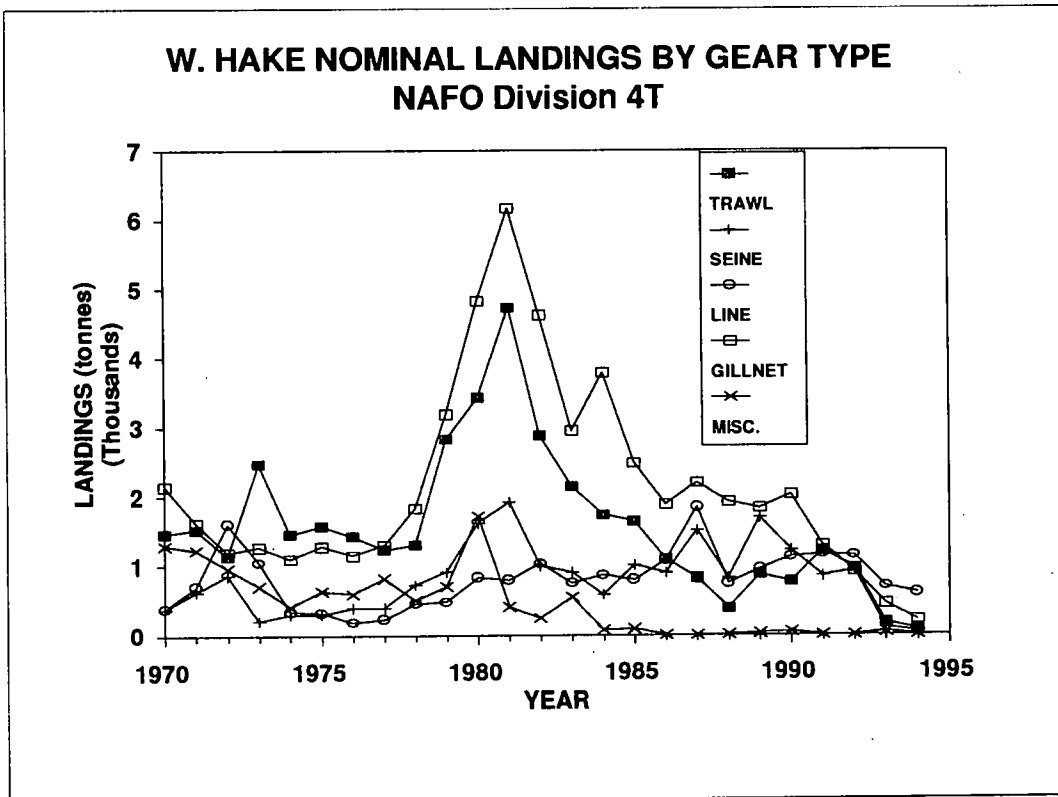
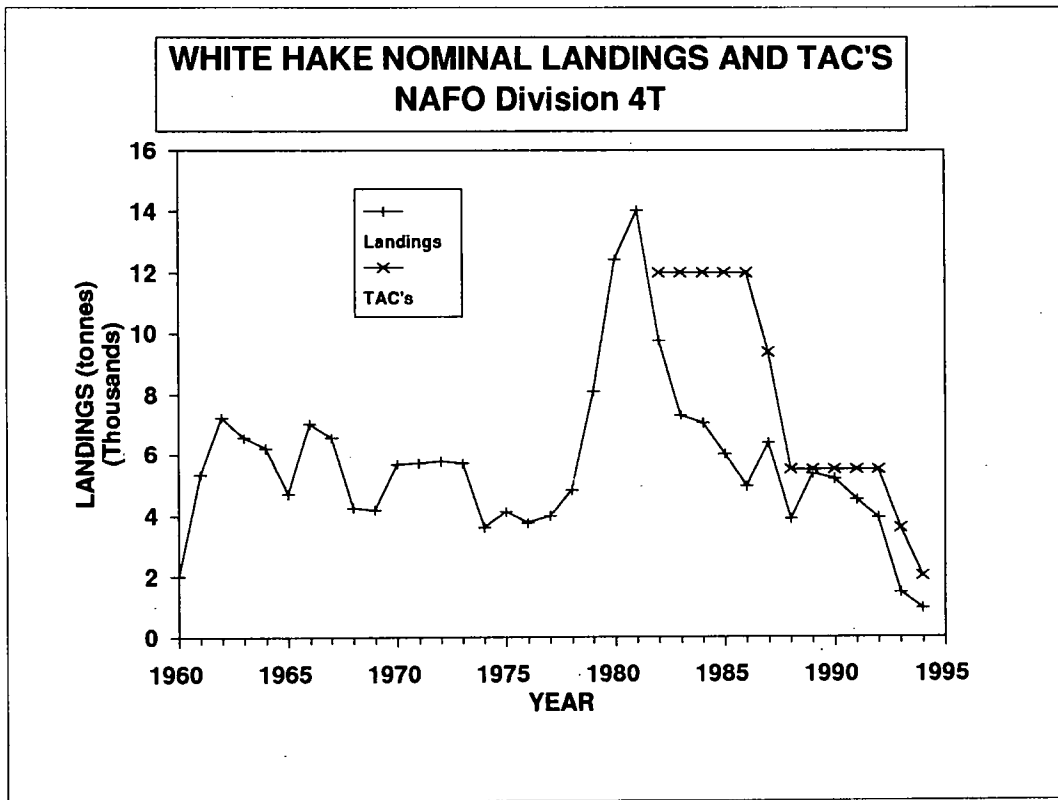


Figure 2 a. Nominal landings and TAC's for white hake in NAFO Division 4T.
 b. Nominal landings by gear category for white hake in NAFO Division 4T.

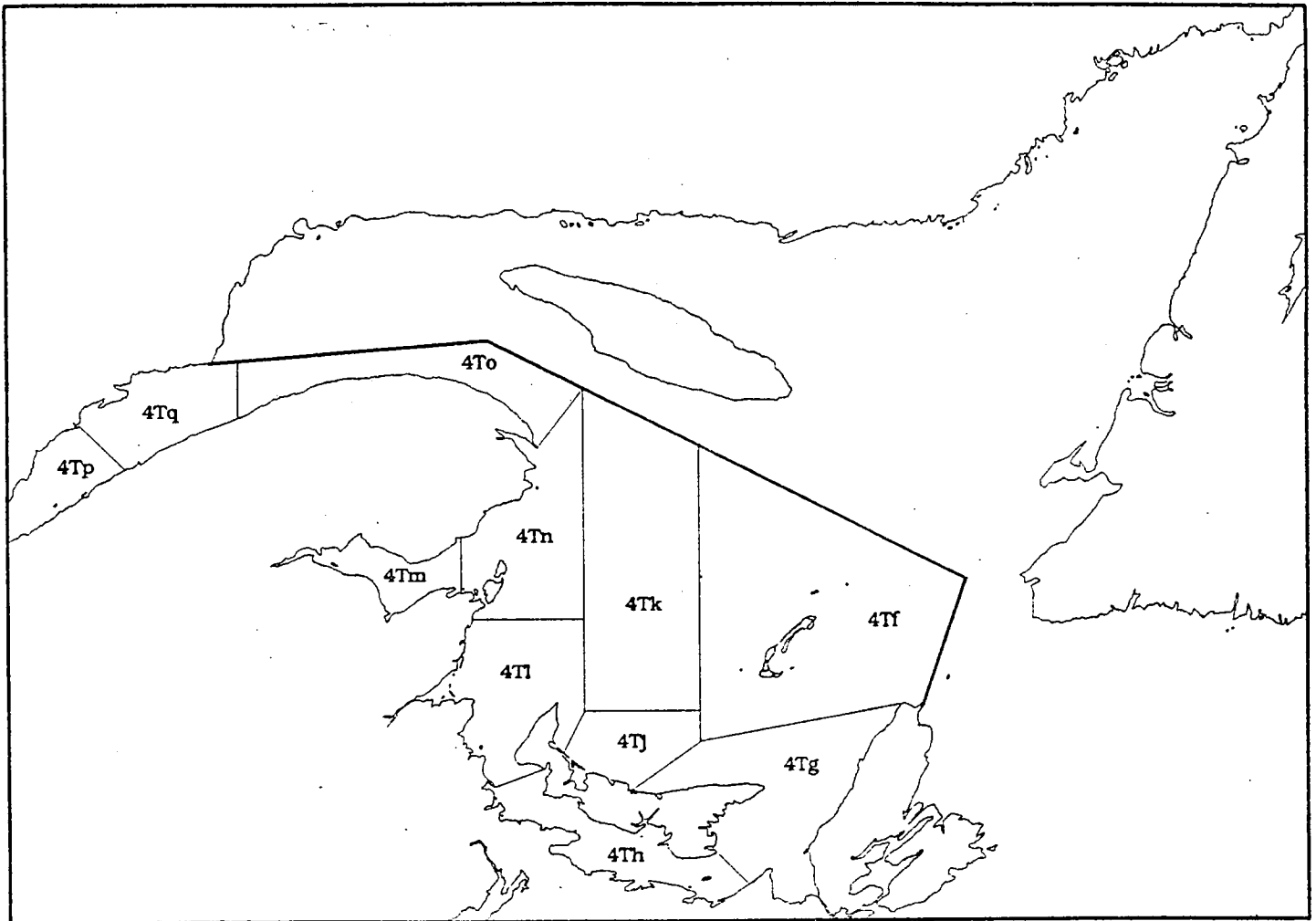


Figure 3 .Canadian Statistical Unit Areas within NAFO Div. 4T

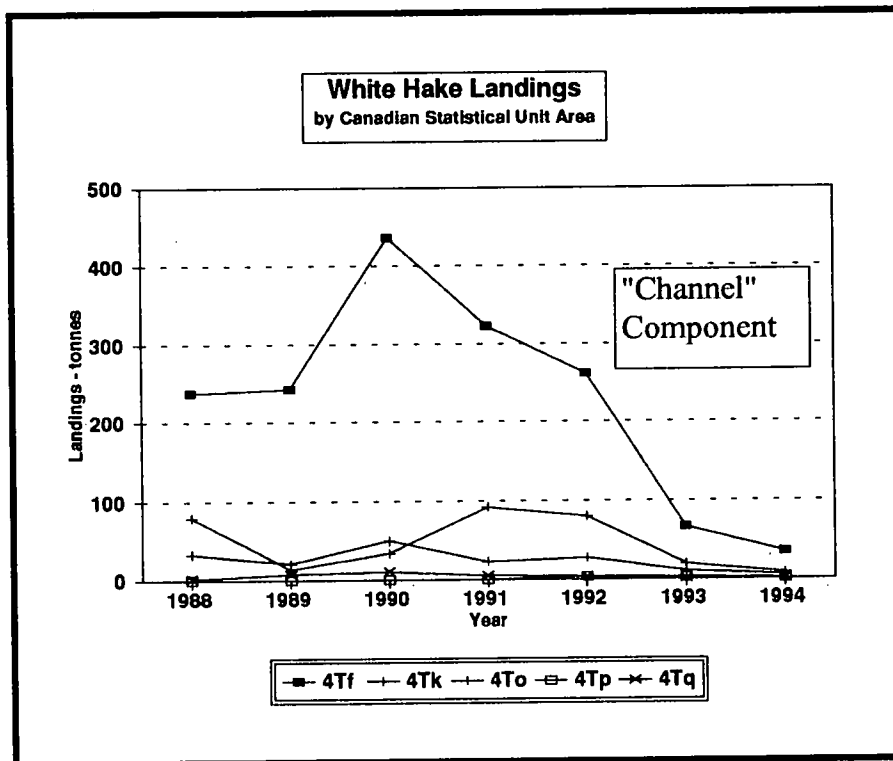
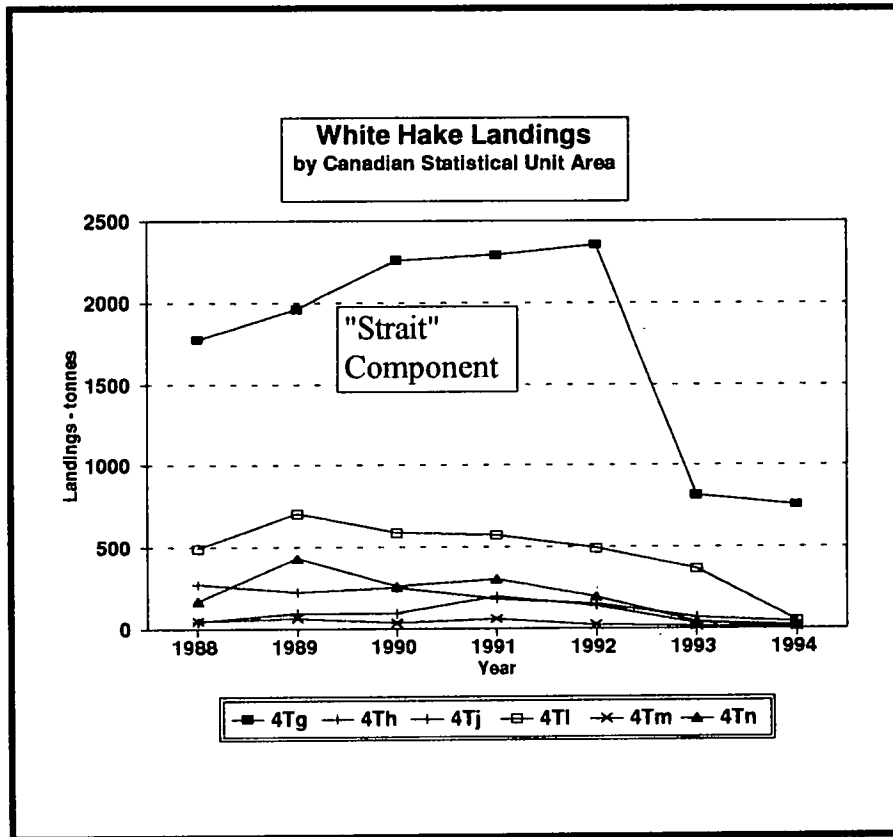


Figure 4. Landings of white hake by statistical unit area in NAFO Division 4T: 1988-94.

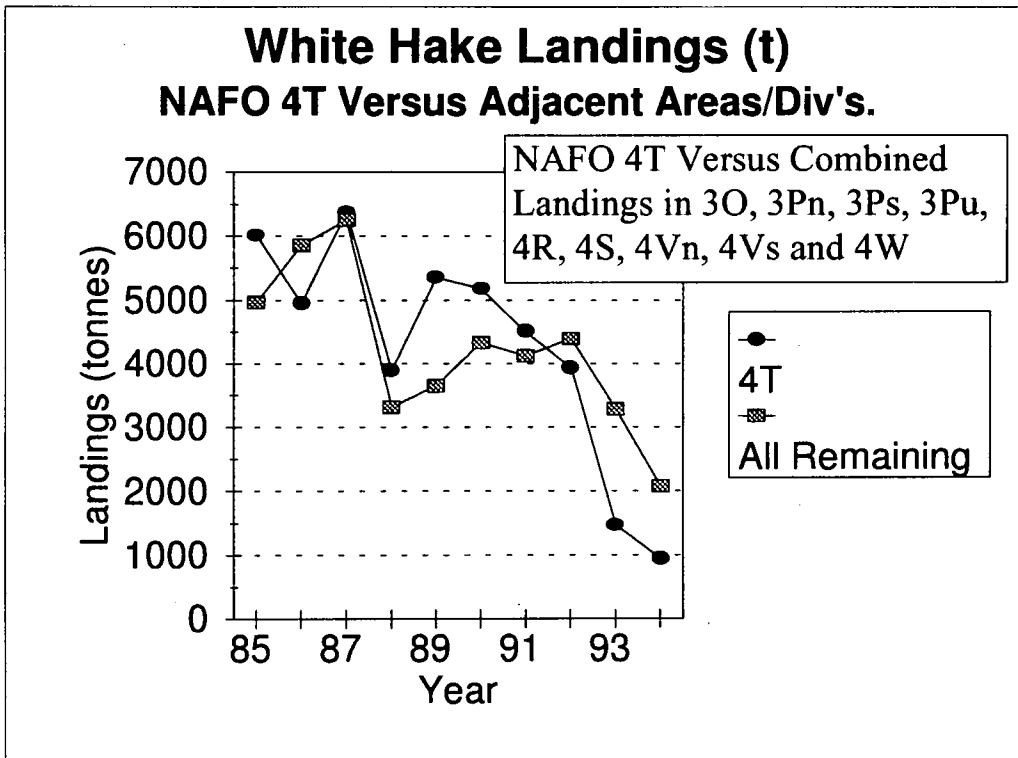


Figure 5. Comparison of landings of White Hake in NAFO 4T with the landings in adjacent NAFO areas and divisions.

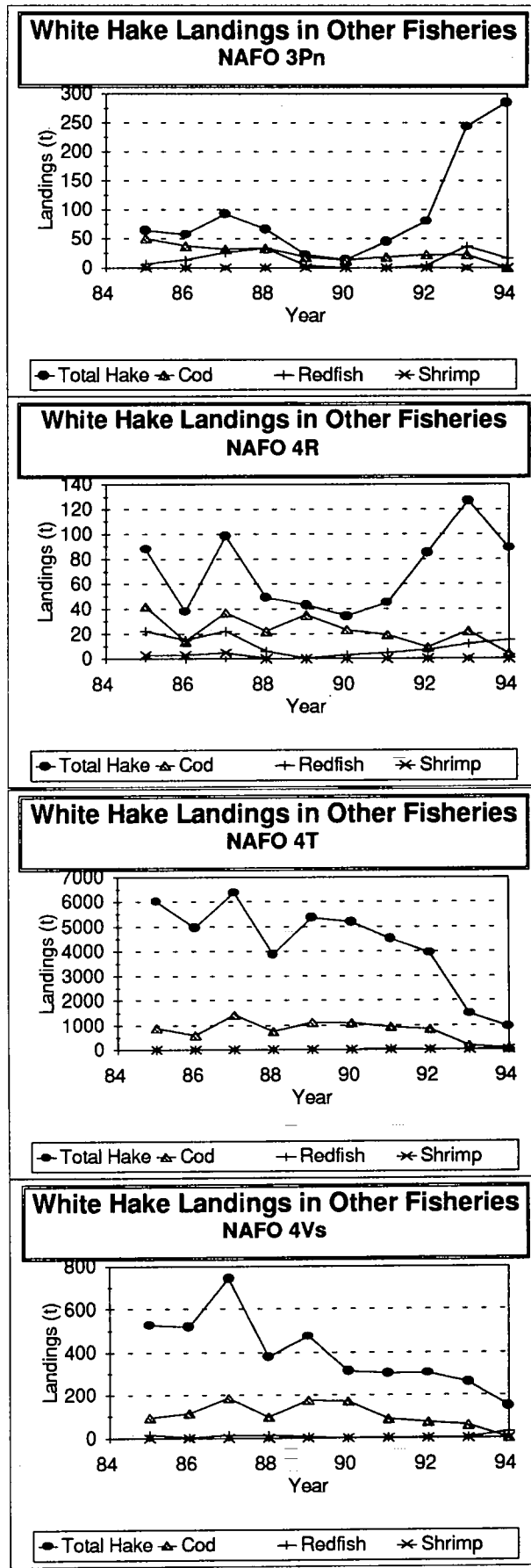
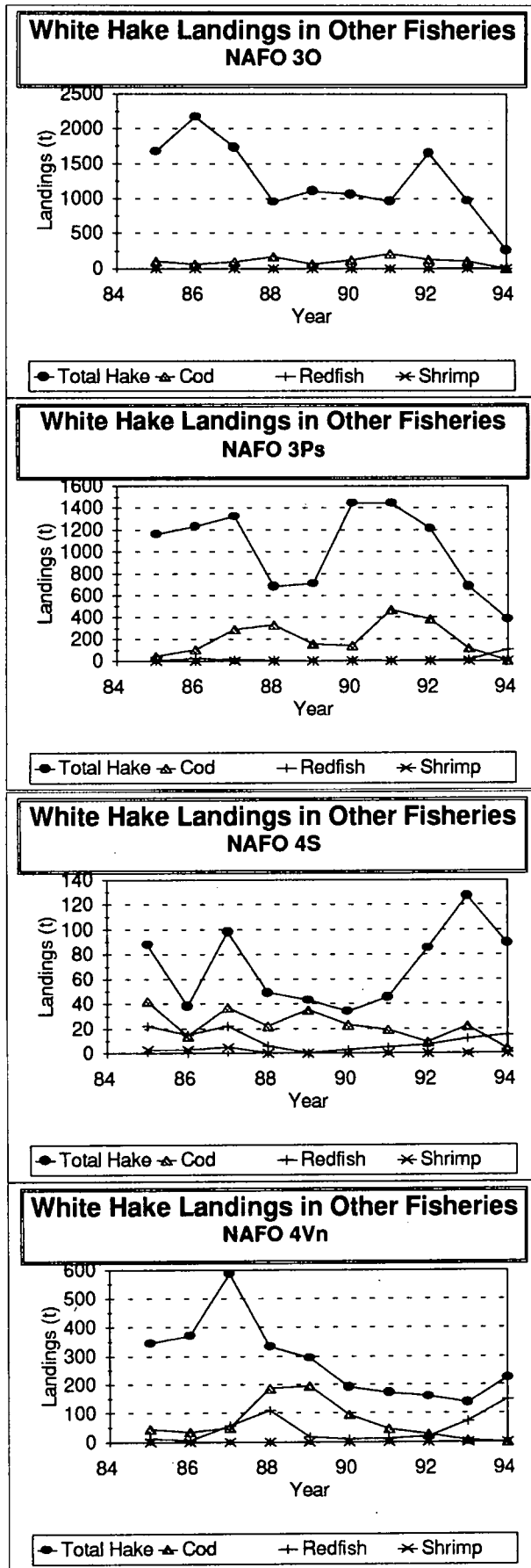


Figure 6. Landings of White Hake in the Cod, Redfish and Shrimp Directed Fisheries in NAFO 30, 3Pn, 3Ps, 4R, 4S, 4T, 4Vn and 4Vs.

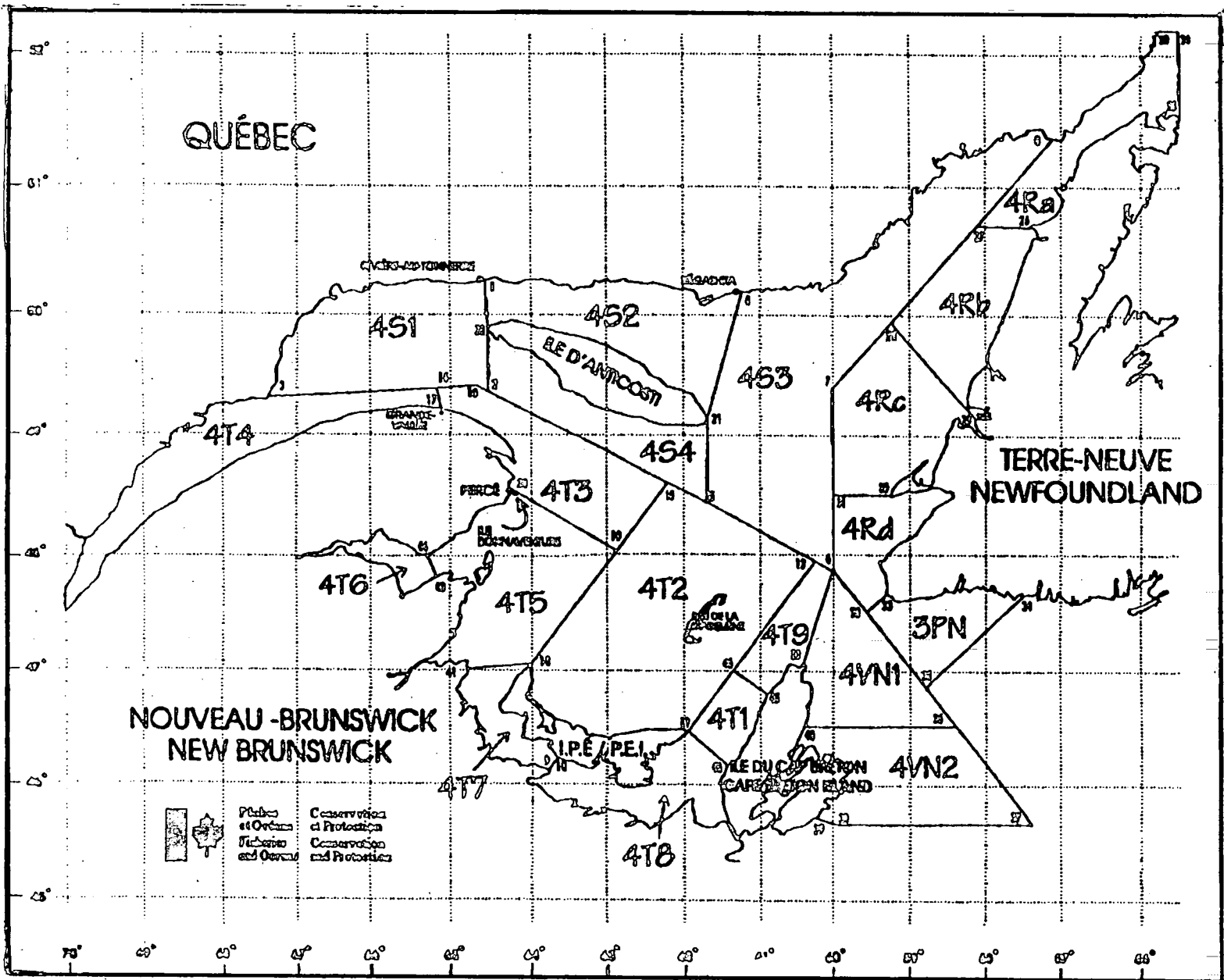


Figure 7. Map of the Gulf of St. Lawrence showing the groundfish fishing areas used by DFO Fisheries Management to manage small fish and by-catch in 1994.

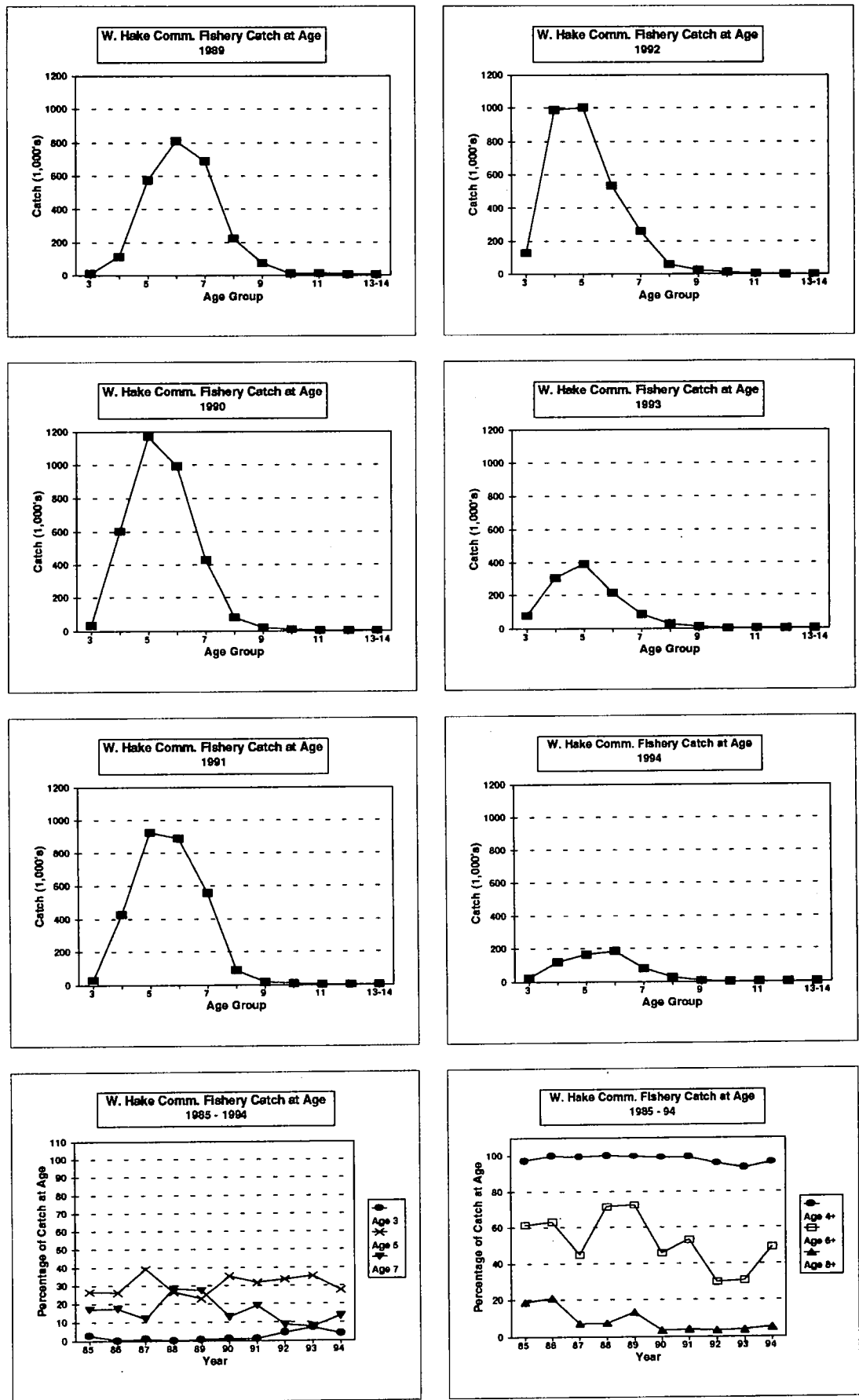


Figure 8. White hake commercial fishery catch-at-age: 1989-94. The two bottom figures show the age composition (%) for 1985-94.

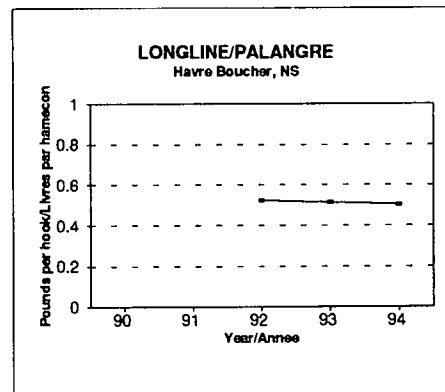
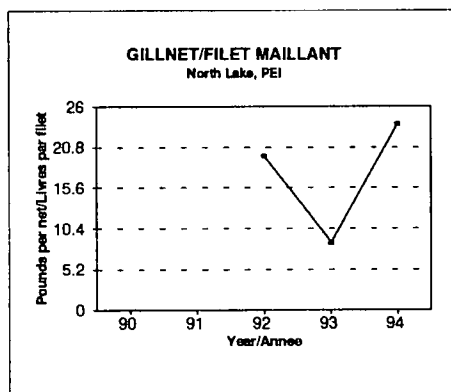
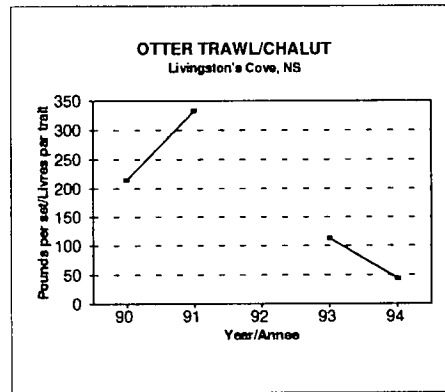
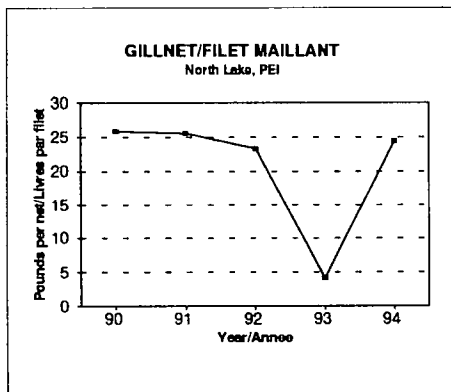
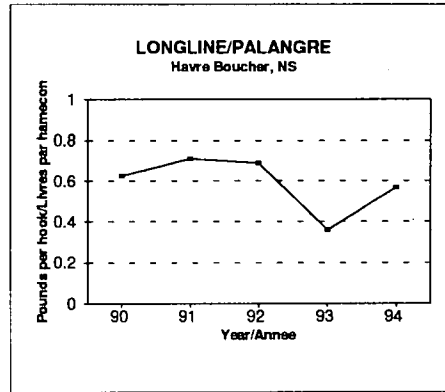
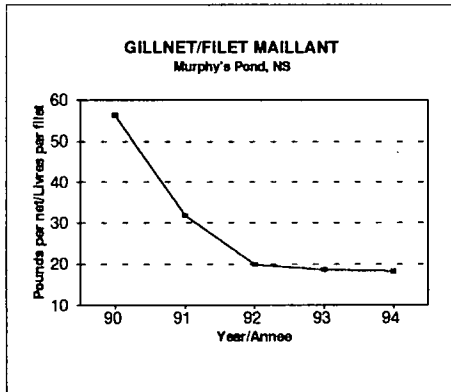
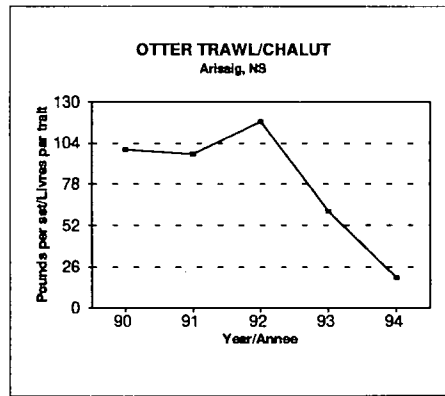
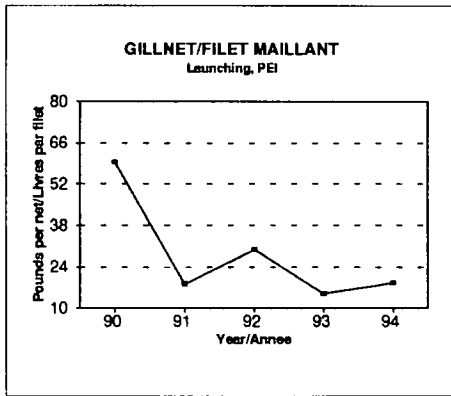


Fig. 9. Catch rates for white hake from eight index fishers that submitted logs during 1990-94. 41

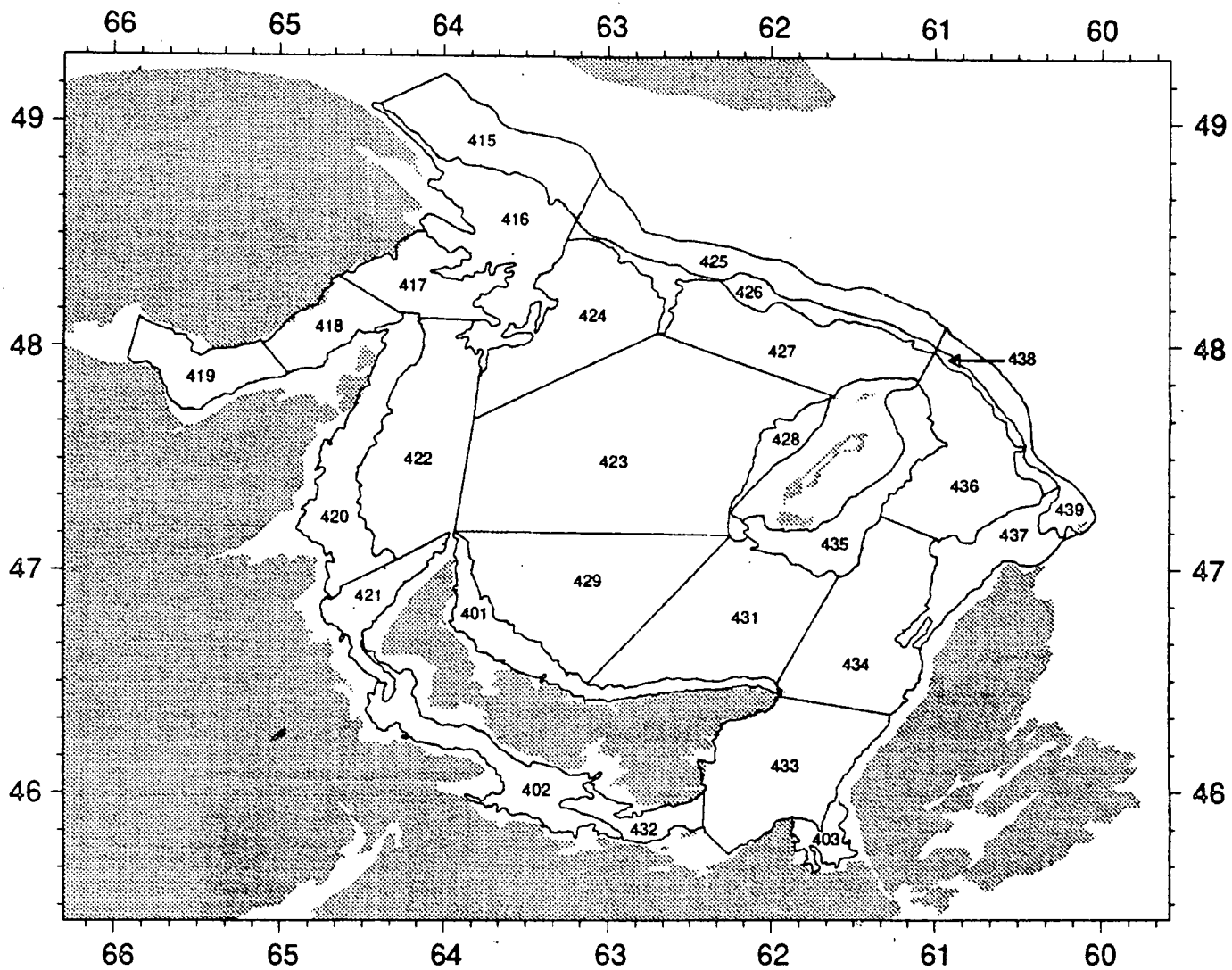


Figure 10. Survey strata for the annual groundfish survey of the southern Gulf of St. Lawrence.

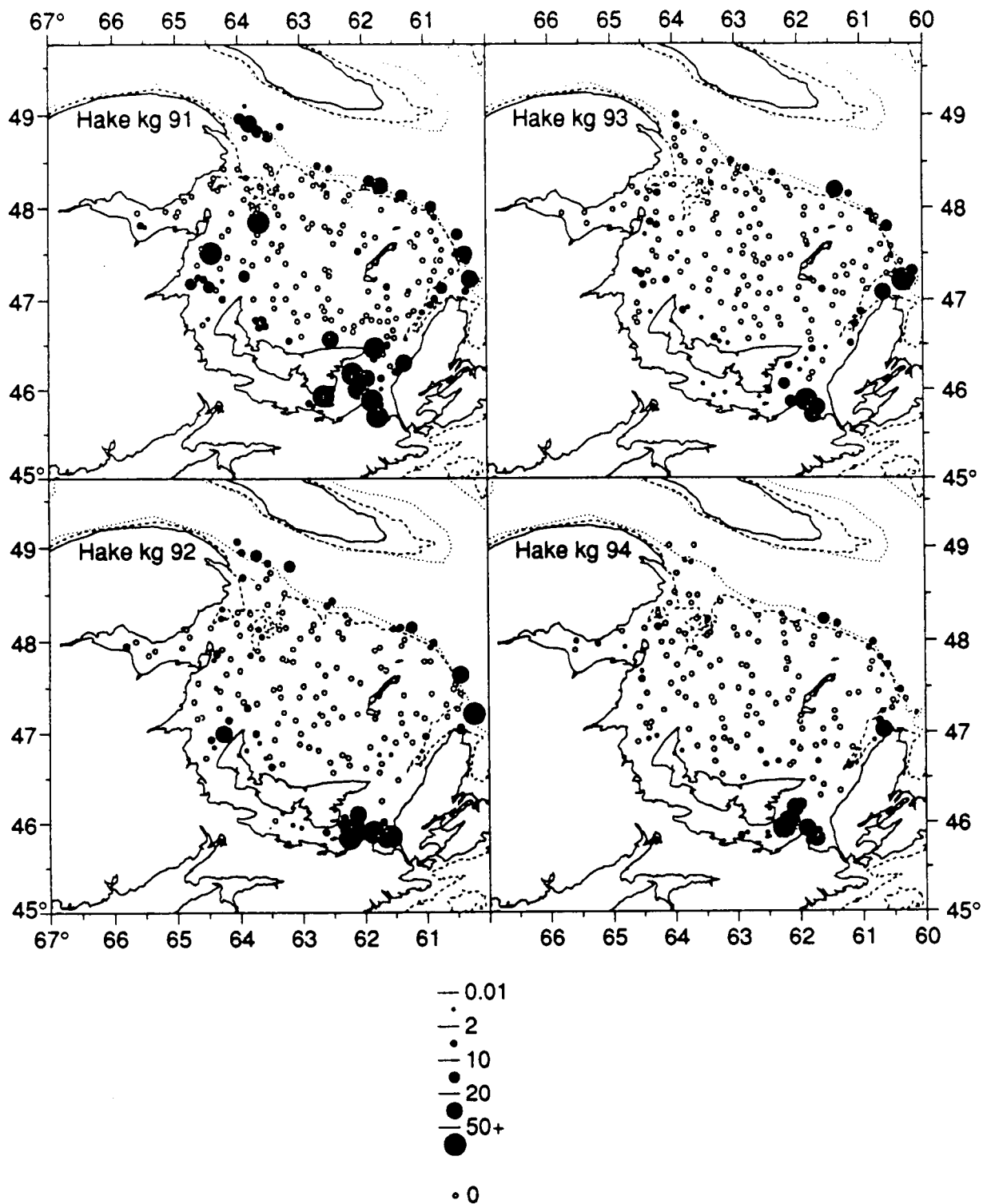


Figure 11. Distribution of catches (kg/standard tow) of white hake during annual (September) groundfish surveys of the southern Gulf of St. Lawrence (NAFO Div. 4T) from 1991-94.

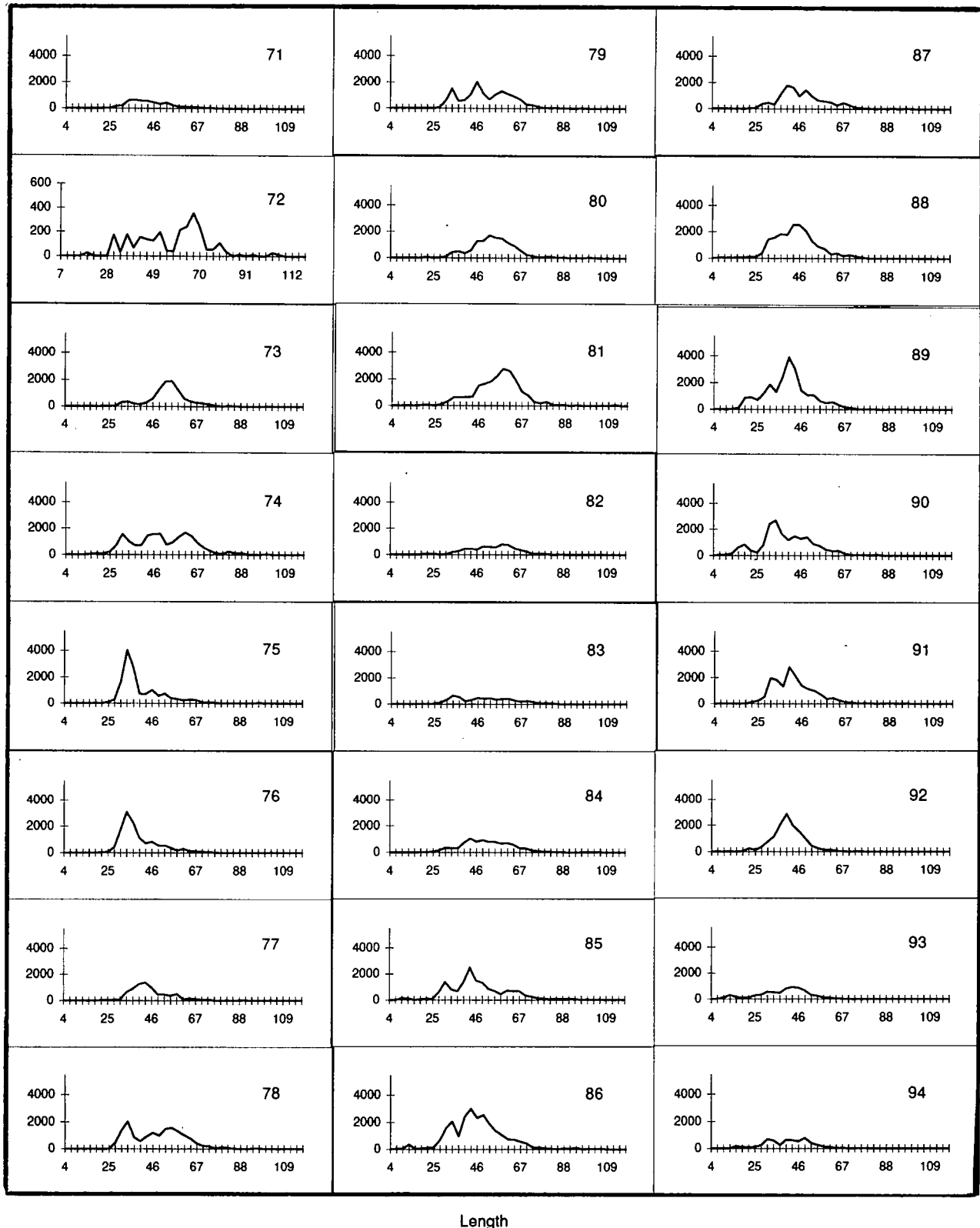


Figure 12. Annual length frequencies for NAFO 4T white hake from September groundfish surveys of the southern Gulf of St. Lawrence (Strata 415 - 439 for 1971 - 83 and Strata 401 - 439 for 1984 - 94).

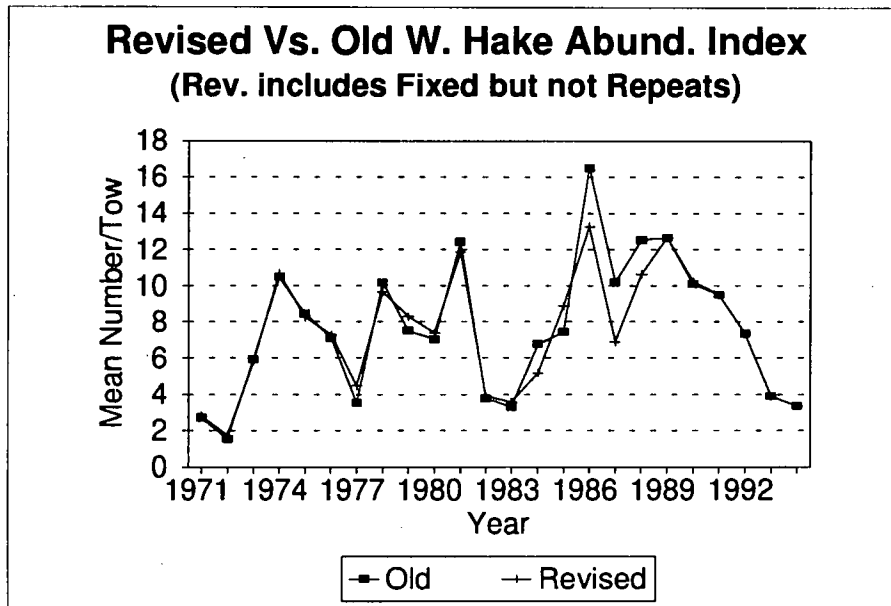


Figure 13. Comparison of Revised and Old Abundance Indices for NAFO Div. 4T White Hake.

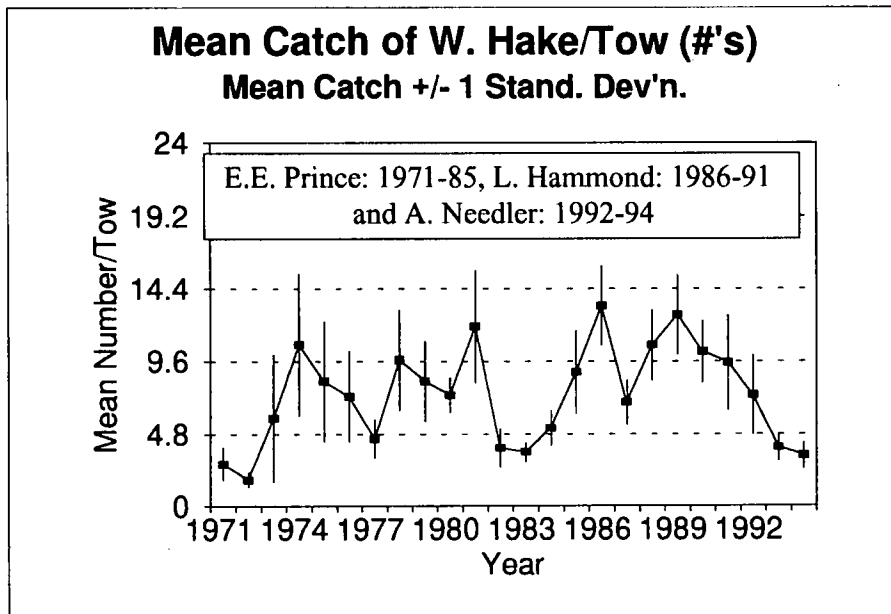


Figure 14. Research vessel mean numbers per tow for NAFO Div. 4T White Hake.

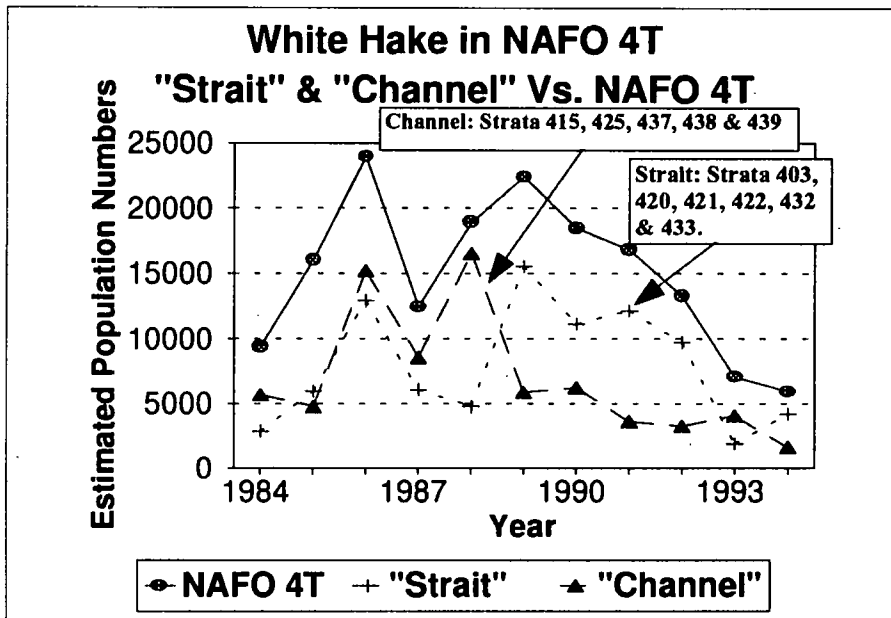


Figure 15. Comparison of research vessel abundance estimates for the 'Strait' and 'Channel' stock components.

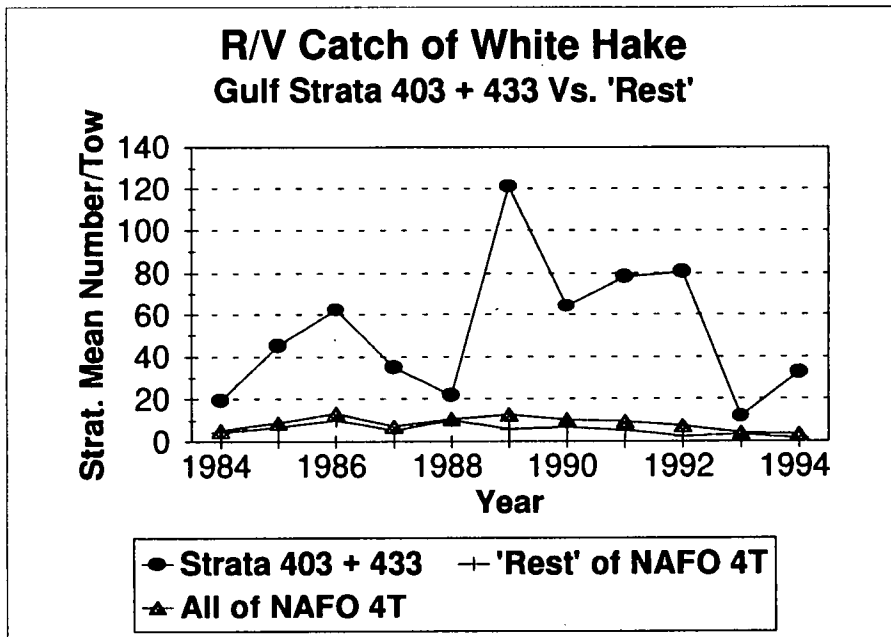


Figure 16. Comparison of research vessel mean catch per tow estimates for two strata in the southeastern Gulf (403 + 433) with the entire southern Gulf survey area.

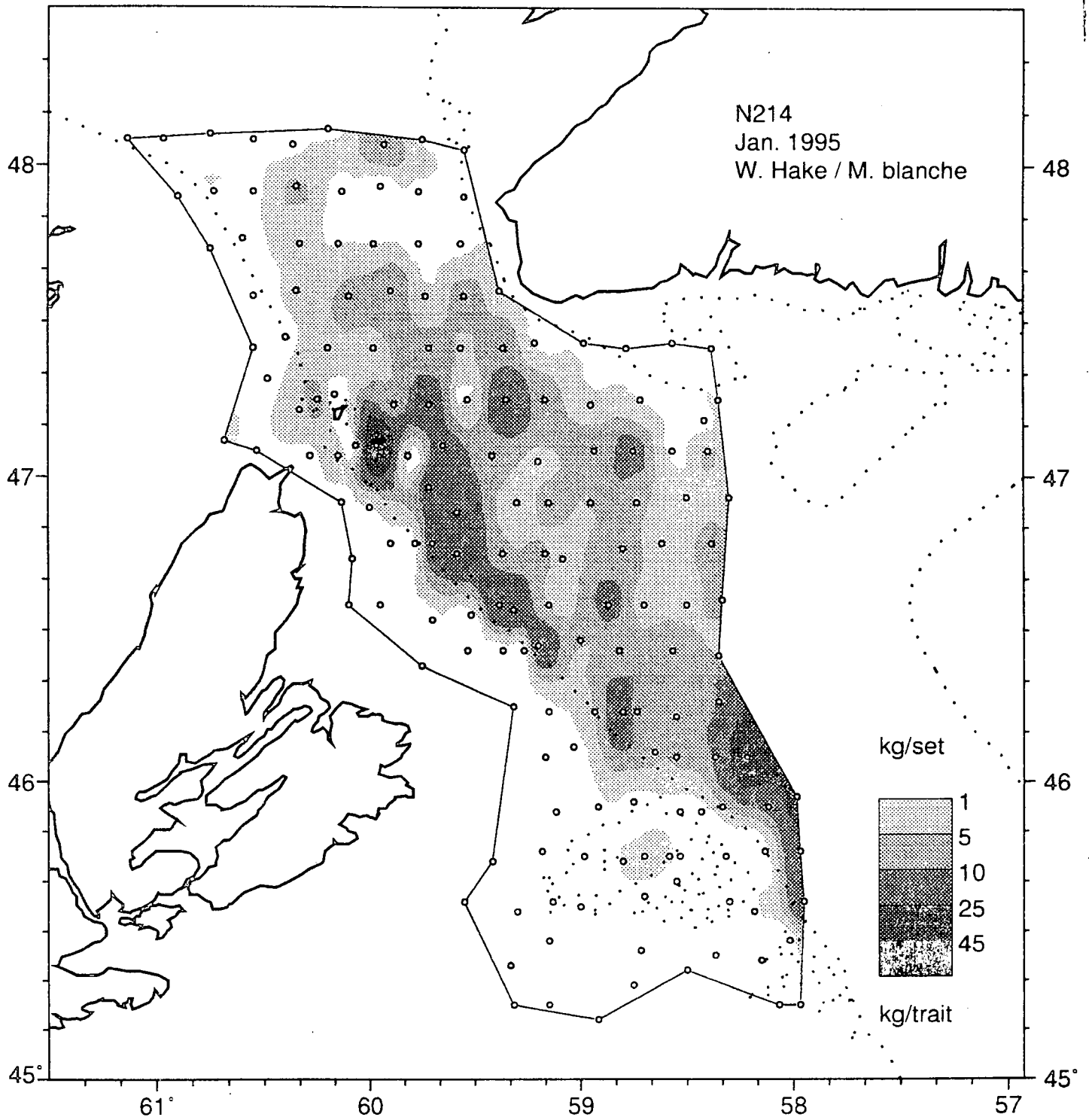


Figure 17. Distribution of catches (kg/standard tow) of white hake during the January 10-29, 1995 groundfish survey of the Cabot Strait area (open circles indicate set locations and the dotted lines represent the 200 m depth contour).

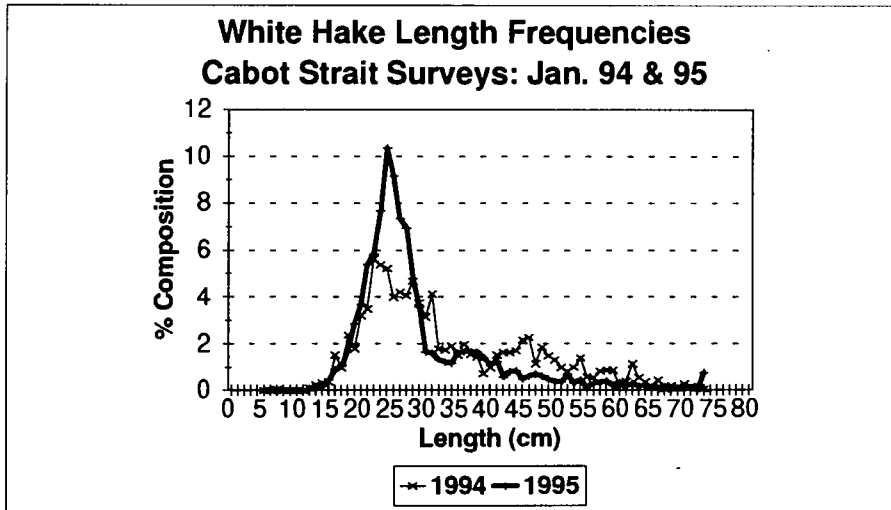


Figure 18. Length frequencies for white hake caught during surveys of Cabot Strait in January 1994 and 1995.

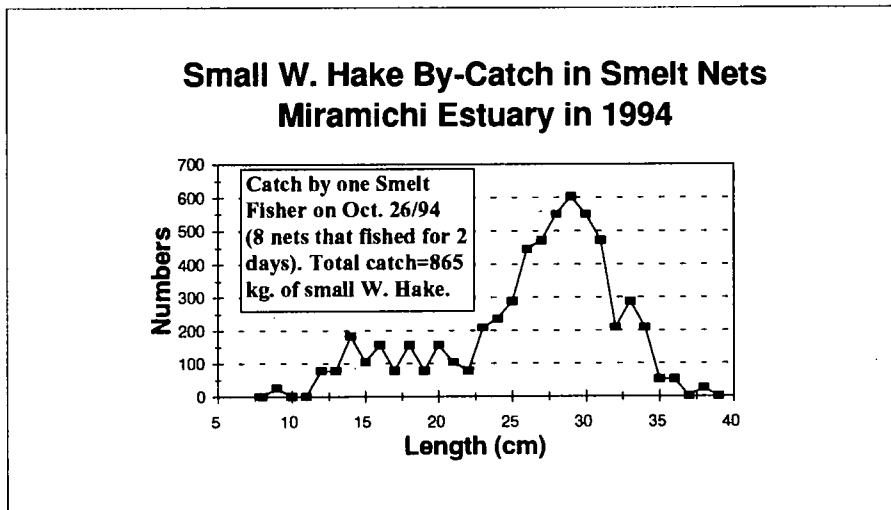


Figure 19. Length frequencies for small white hake caught as by-catch by one smelt fisher in the Miramichi Estuary in 1994.

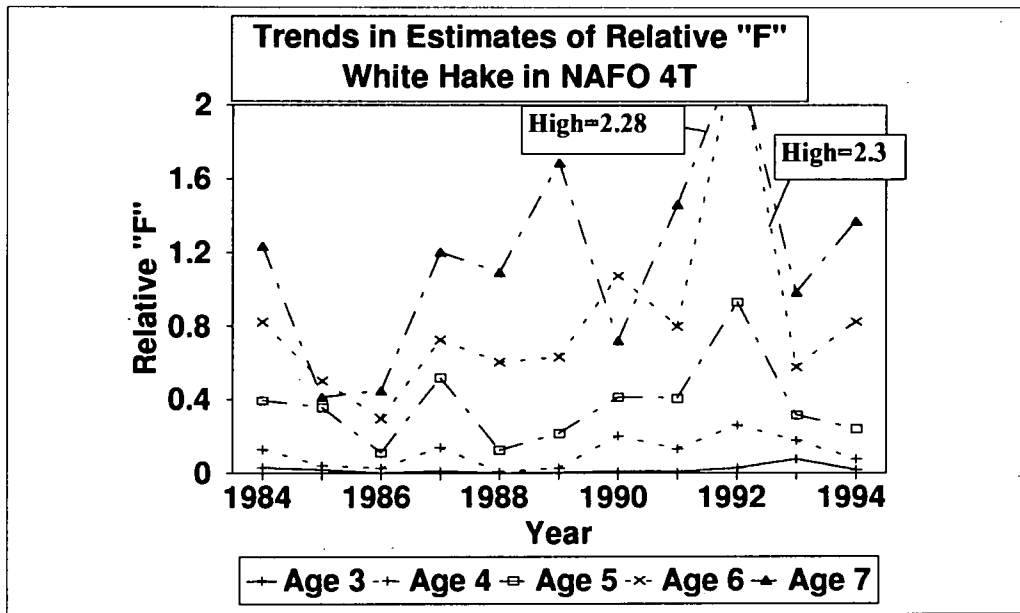


Figure 20. Trends in estimates of relative fishing mortality (F): 1984-94.

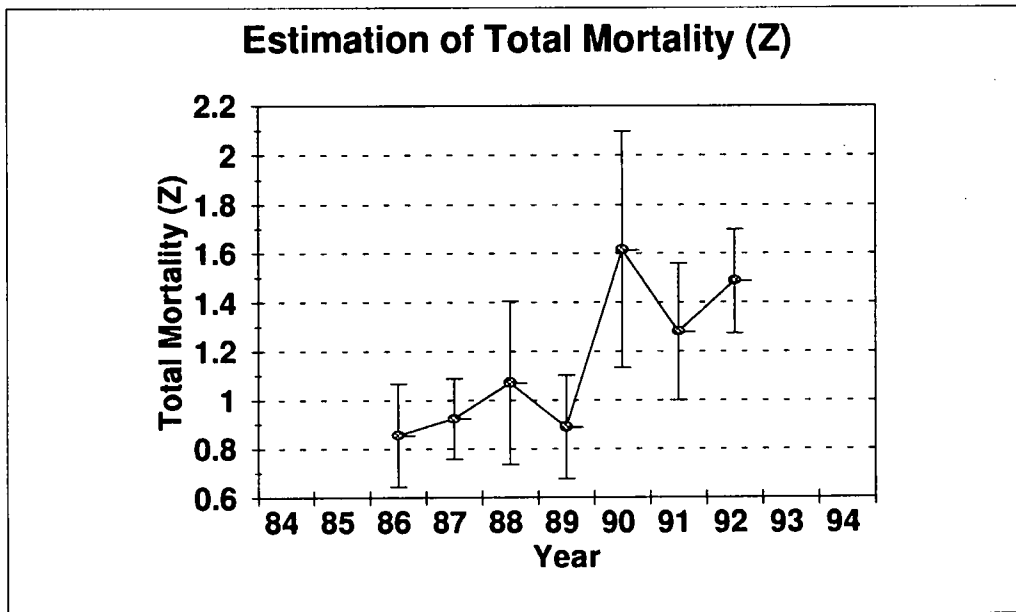


Figure 21. Total mortality (Z) estimates from analyses of R/V data. Z was estimated for ages 4-8 (See text for details). Error bars give 2 standard errors of the estimated slopes.

Personnel from the Dept. of Fisheries and Oceans, Science Branch, Gulf Region presented an overview of the data on the groundfish stocks of the southern Gulf of St. Lawrence collected during 1994 including a summary of catches and the preliminary results of the September Groundfish survey. The objective of the meeting was to obtain views from fishers and fishing industry on the status of the various groundfish stocks. The following represents a summary of the main points made during the five workshops regarding white hake.

Science Workshop
Centre Spécialisé des Pêches, Grande-Rivière, Québec
November 15, 1994

White Hake

- fishers reported a large decline in the abundance of this species.
- hake used to be caught as a by-catch in the redfish fishery along the edge of the Laurentian Channel but this has decreased recently
- small hake are found along the edge of the Laurentian Channel
- in winter, hake are found in deeper waters than cod

Science Workshop
Centre Marin, Shippagan, N.B.
November 16, 1994

White Hake

- White hake is not fished a lot and it was described by fishers as a by-catch fishery.
- One fisherman described hake as a once abundant resource that has declined for reasons that are not clearly understood. He pleaded for an increased research effort on this resource.

Science Workshop
Wandlynn Inn, Charlottetown, P.E.I.
November 23, 1994

White Hake

- Many hake landings from East PEI were missing
- By-catch restrictions for cod in the hake fishery were too restrictive. E.G. 3-5 July 1994 fixed gear fishery off east PEI landed 40,000 lbs of cod vs 4,800 lbs of hake
- Some stated decline in abundance in West Gulf was real but the overall consensus was that East P.E.I. hake is in good shape
- Some noted hake were no longer in areas where cod were found in 1994
- Some felt it was difficult to comment on abundance due to large numbers of closures.
- Big reduction in mobile gear catch off East PEI (Souris) but the hake were plentiful in the shallow warm water near end of Strait.
- Dogfish were driving fishers off of hake grounds
- Many small hake in silverside (October onwards) and eel fishery (September onwards) Island wide in estuaries

- Want abundance expressed in terms of stock units not whole Gulf, what is DFO doing to resolve stock identity problem?
- One commented that mesh changes mean trawl fisheries are now cleaner than longline fishery for hake and longline use of #9 & 10 hook meant many small fish were caught.

Science Workshop
Chéticamp Fire Hall, Chéticamp, N.S.
 November 24, 1994

White Hake

- There was an abundance of small hake in St. Georges Bay in 92 and 93
- The hake fishery was very good off St. George's Bay in 1994, have not seen a decline in abundance.
- Very little hake directed fishing east of Sight Point this year because of closures (cod)
- Hake fishing should be controlled in 4Vn during winter
- Mobile vessels are targeting hake in 4Vn now (winter and early spring) - It was a fixed gear (longline) fishery in the past
- There was more hake in 3Pn in 94 during Sept. and Oct. (coincides with time that hake start migration out of Gulf)
- Scallop draggers from Pictou area reported catching juvenile hake in their drags in the fall of 94
- Lobster fishers reported catching more hake in their traps this year (as high as 200-300/day)
- Disagree with results of Groundfish Index Fisher Program (Not true that hake were smaller and scarcer)
- Recommend an inquiry into disagreements re. status of cod and hake
- Landing statistics need to be improved
- Hake caught in eastern end of N. Strait were in better condition (fatter) this fall (feeding on herring)
- Catch rate of hake in commercial gears was higher in 1994 (eastern 4T)
- Opinions of fishers expressed in 1994 Stock Status Report (re. hake) are not scientific - Recommend a survey of opinions from active fishers
- C & P officers are not informed about regulations

Science Workshop
Château Madelinot, Cap-aux-Meules, Magdalen Islands
 November 28, 1994

White Hake

- There was general agreement that the abundance of hake has declined.
- There is a lot less large hake and more small ones.
- Hake are taken as by-catch in the redfish fishery in June-August along the Channel edge north of the Magdalens

Appendix 2: Results of the 1994 Groundfish Index Fisher Program 'Year End Questionnaire'

In 1994, 36 of the 53 (68%) fishers who volunteered to participate in the Gulf Region's Groundfish Index Fisher Program actually fished and submitted log records.

At the end of the fishing season (Nov. 1994) all of the volunteers were contacted by phone and asked for their responses to a questionnaire concerning the 1994 groundfish fishery. Some of the questions and the responses from respondents that fished in 1994 and directed for white hake (12) follow:

"Did closures of the fishery or lack of quota reduce the time that you spent fishing for groundfish this year?"

Responses: Yes - 25%(3) No - 75%(9)

"Ignoring the number of days that you actually fished this year, would you say that you fished **LESS, MORE**, or the **SAME** amount of gear (ie. # of hooks, nets, or tows per day) than you did in the past (i.e. 1984-1993)?"

Responses: Less - 33%(4) Same Amount - 50%(6) More - 17%(2)

"On a scale from 1 to 5, how would you describe the abundance of white hake this year, where 1 represents the lowest (or minimum), 3 represents the average and 5 represents the highest (or maximum)?"

Responses: 1 - 17%(2) 2 - 25%(3) 3 - 33%(4) 4 - 25%(3) 5 - 0%(0)

"How would you describe the size of white hake this year? Small(er), Average, or Large(r)?"

Responses: Small(er) - 42%(5) Average - 42%(5) Large(r) - 16%(2)

"On a scale from 1 to 5, how would you compare the 1994 groundfish fishery to the 1993 fishery, where 1 represents lower (or worse), 3 represents the same and 5 represents higher (or better)?"

Responses: 1 - 17%(2) 2 - 25%(3) 3 - 33%(4) 4 - 17%(2) 5 - 0% N/A* - 8%(1)

"On a scale from 1 to 5, how would you compare the 1994 groundfish fishery to the last five years (i.e. 1989 - 1993), where 1 represents the lowest (or worst), 3 represents the average and 5 represents the highest (or best)?"

Responses: 1 - 25%(3) 2 - 34%(4) 3 - 25%(3) 4 - 8%(1) 5 - 8%(1) N/A* - 0%(0)

"On the same scale from 1 to 5, how would you compare the 1994 fishing season to all of the years that you have fished for groundfish?"

Responses: 1 - 25%(3) 2 - 25%(3) 3 - 33%(4) 4 - 17%(2) 5 - 0%(0) N/A* - 0%(0)

(N/A* - Response Not Applicable)