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The First Report of the 4Vn Sentinel Survey

Autumn 1994
A Government/Industry Cooperative Venture

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ABSTRACT

After an intensive organisational period the first 4Vn sentinel survey has been successfully completed. Prior to the survey 28 fishermen underwent instruction in collecting and recording scientific data at sea, and upon completion of the survey they received further training in elements of fisheries biology and oceanography. Five of the six longline boats participating in the survey completed their allocation of five trips, while one was able to complete only two of its full complement due to major engine breakdown. Thus 27 trips were made for a total of 54 sets. The set locations were predetermined, being randomly allocated according to a stratified design. Data has been collected, keypunched and preliminary analysis completed.

Over the 19 day survey period (September 20 to October 8), 13,634 kg of cod were taken in 4Vn. The next three most common species taken were dogfish, plaice and skate at 3300, 1932 and 998 kg respectively. The average catch rate of cod over this period was 110.5 kg/1000 hooks. Although it is difficult to compare catch rates from the 1993 test fishery, which had no rigid survey design and also probably exploited Gulf of St. Lawrence (4T) cod over much of its duration, it appears catch rates in the autumn of 1994 had not improved, and if anything, were lower than during the same time in 1993.

The potential of the sentinel survey for providing an index of abundance is good. There was excellent coverage of the survey area and it was possible to construct distributional maps of a number of groundfish species. However, only if maintained on an annual basis can this survey become a valuable tool in evaluating the status of this stock.

Résumé

Après une intense période d'organisation, le premier relevé des pêches sentinelles dans 4Vn a été effectué avec succès. Avant ce relevé, 28 pêcheurs avaient reçu des instructions sur la manière de recueillir et de consigner des données scientifiques en mer. Après le relevé, ils ont reçu une formation plus approfondie sur divers éléments de la biologie des poissons et de l'océanographie. Cinq des six palangriers qui participaient au relevé ont effectué les cinq sorties prévues, tandis que le sixième n'a pu effectuer que deux sorties en raison d'avaries majeures de son moteur. Par conséquent, 27 sorties ont été réalisées, qui ont produit un total de 54 traits. L'emplacement des traits avait été déterminé à l'avance et avait été attribué au hasard selon une formule d'échantillonnage stratifié. Les données ont été recueillies, transcrites sur des cartes perforées, puis analysées de façon préliminaire.

Au cours des 19 jours qu'a duré le relevé (du 20 septembre au 8 octobre) 13 634 kg de morue ont été pêchés dans 4Vn. Les trois principales autres espèces capturées étaient l'aiguillat, la plie et la raie, dans des quantités respectives de 3 300, 1 932 et 998 kg. Le taux moyen de prises de morue durant cette période se situait à 110,5 kg/1 000 hameçons. Quoiqu'il soit difficile de comparer les taux de prises à ceux de la pêche expérimentale de 1993, dans laquelle il n'y avait pas eu de relevé rigoureux et qui exploitait aussi sans doute de la morue du golfe du Saint-Laurent (4T) pendant une bonne partie de sa durée, il semble que les taux de prises de l'automne 1994 ne se soient pas améliorés et qu'ils sont peut-être même inférieurs à ceux de la même période en 1993.

Le relevé des pêches sentinelles semble s'avérer un bon moyen d'obtenir un indice d'abondance. La zone de relevé a été très bien couverte et il a été possible d'établir des cartes de distribution d'un certain nombre d'espèces de poisson de fond. Toutefois, ce relevé ne peut devenir un bon outil d'évaluation su stock que s'il est répété chaque année.

INTRODUCTION

The major goal of the sentinel survey is to provide an index of abundance of the 4Vn cod stock. It also fulfills the desire of the inshore fishing to take an active role in the determination of the status of the 4Vn cod stock while providing information to the DFO that it would be unable to obtain with its own resources. This survey forms an adjunct to DFO groundfish surveys that have been carried out in this area during the past two decades. Having to monitor the entire Scotian Shelf, the DFO groundfish survey cannot afford to expend much effort in 4Vn which is the smallest of the NAFO statistical subdivisions. In recent years 15 of about 100 sets are made in 4Vn. As a result the survey index for 4Vn has a notoriously high variability. The high resolution afforded by the sentinel survey (up to 60 sets) should alleviate this problem and provide a more stable and reliable index.

ORGANISATION

Preliminary

Since late 1993, after the closure of the 4Vn cod fishery, the fishing industry in Cape Breton had been lobbying the government for the opportunity to conduct some type of fishing activity to aid in the assessment of the status of the 4Vn stock. During the summer of 1994 a team made up of personnel from the Department of Fisheries and Oceans (DFO) Operations and Science Branches and Human Resources and Development (HRD) worked out the details of a sentinel fishing program for the 4Vn area off Cape Breton. There was a wide disparity in the amount of fishing wanted by the industry and the amount required by Science to do an adequate assessment of the abundance of the fish stock. By August a compromise plan had been formulated which would have good scientific value and adhere to conservation principals while allowing sufficient fishing to qualify for assistance under the Atlantic Groundfish Strategy (TAGS) program of the Human Resources Department. This program consisted of two three-week periods (during June and September) for a survey of the abundance of resident 4Vn cod and two six-week periods (October/November & April/May) for monitoring the migration of Gulf of St. Lawrence cod to and from Sydney Bight. The surveys would be carried out by six longliners (five trips each) and the migration monitoring by one longliner (six trips). The project would be funded by DFO and HRD and monies gained from sale of catch could be used to subsidise the operation of the project.

A number of fishermen's organisations were interested in participating in the sentinel survey; therefore, to facilitate the operation of the venture, an umbrella organisation, the 4Vn Sentinel Fishery Association was formed. This association comprised representation from five industry groups; the North of Smokey Fishermen's Association, the Glace Bay Fishermen's Association, Maritime Fishermen's Union - Local #6, the Port Morien Fishermen's Association, and the 4Vn Hook and Line Association. Also, three persons not associated with the fishery but residents of the three geographical areas represented by these five associations were named to the Board of Directors. Timothy Lambert and Fred Allen (DFO) were named as ex-officio members. Two officers were elected; they were by acclamation, Greg Organ (North of Smokey F.A.), Chairman, and Kevin Nash (Glace Bay F.A.), Manager. The 4Vn Sentinel Fishery Association was duly incorporated and registered with the N.S. Registrar of Joint Stock Companies.

Selection of Participants

Applicants for participation in the survey had to meet the following criteria:

- be a single groundfish only licence holder
- be eligible for HRD Income Assistance through TAGS
- be the head of an active fishing enterprise
- have fished full-time for seven years
- have earned 75% of income or annual revenues of $20,000 from fishing.

In addition, the applicants had to be prepared to make a multi-year (3-5) commitment to the project. Also the Board decided to make it mandatory that boats must be decked over, have good navigational equipment and carry lifeboats.

After some minor modifications of the eligibility rules the tenders of seven boats were selected by the Association's Board. The vessels and their captains and/or owners were:

ABUNDANCE SURVEY

Heidi M	Robert Courtney
Sonya & Brothers	Nor'East Fish Company
No Sweat	Bruce Strong
Edward & Jason	Larry Parsons
Anita & Sharon	Silby Barrett
Rosa Carlos	John Matias

4T COD MIGRATION MONITORING

Try Me	Herb Nash

Funding

Funding for the project was secured from four sources. HRD provided wages and monies toward overhead under the TAGS program; DFO paid for boat charters, fuel and bait from the Atlantic Fisheries Adjustment Program (AFAP); DFO Science funded training, equipment and operating expenses, and Enterprise Cape Breton Corporation (ECBC) also provided funding on a cost shared basis.

Training

Instruction was provided in two sessions; one prior to the survey, consisting of practical training, and the other a more theoretical course of instruction after the survey.

Pre survey (Practical)

The participants of the Sentinel Survey were divided into two groups for this first session. Each of the groups received one and a half days instruction on the correct procedures for weighing and measuring fish, removing otoliths, and recording these data. Each session was introduced with an overview of the intended project, which included an explanation of the function and design of a scientific survey.

Post survey (Theoretical)

After the survey, the fishermen were given a two-week course on the basic elements of oceanography, marine ecology and fish biology. The topics were selected to be of particular interest and usefulness to the fishing industry. Videos, slides, overheads and other illustrative material were liberally used to make the course as interesting as possible. Each section of the course was followed by a short quiz. These were purely for self-testing and no marks were recorded. Specific topics covered were:

The scientific method.	Body Form and Swimming.
Presentation of data.	Feeding Behaviour and Adaptations
Physical Oceanography.	Growth
Migration and Movement of fishes.	Reproduction and Maturation
Marine Ecology	Stock Assessment
Spawning and Early Life History	Elements of Marine Weather

SAMPLING PROTOCOL

Survey Design

A stratified random sampling scheme was used, similar to that used by the DFO groundfish survey. The sampling area was approximately 4000 sq nautical miles (13,750 km^2), comprising all of 4Vn within the 100 fathom contour and with the omission of about 650 sq miles in the south-east corner of the subdivision. This last area ranged from about 50 miles from shore at its nearest point to about 80 miles at its furthest which was considered an impractical distance to travel. The sampling area was divided into three strata on the basis of depth. Sixty set locations were selected randomly and assigned proportionally among the three strata (Table 1).

Table 1. Three depth strata for the 4Vn Sentinel Survey.

Depth (fath)	Depth (m)	Area (nm^2)	Area (km^2)	% of Total	# of Sets
<30	<55	1,070	3,674	25	15
30 - 49	55 - 91	1,320	4,532	32	19
50 - 100	92 - 183	1,780	6,112	43	26

Fifty-four of the sixty assigned sets were completed. Due to major engine problems one vessel was unable to complete three of its trips. The sets that were done can be located in Fig 1.

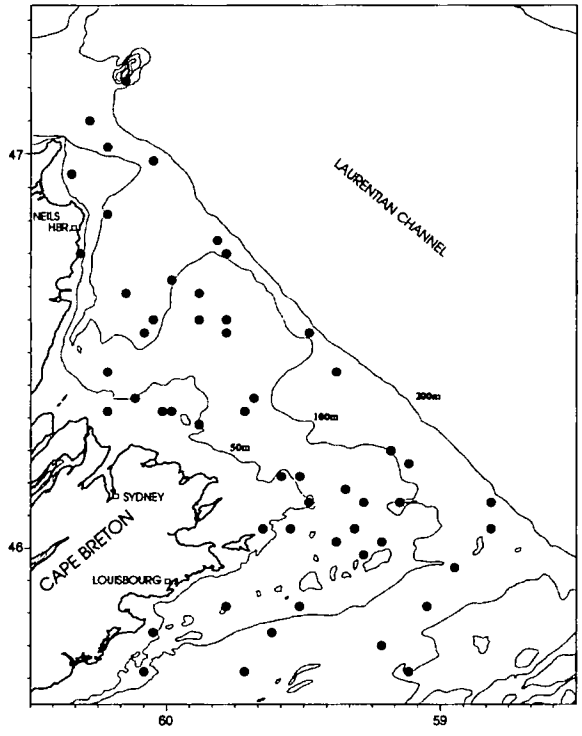

Fig 1. Set locations for the autumn, 1994 Sentinel Survey.

Fishing gear.

Fishing effort in the survey was standardized. Fishing sets, gear specifications and methods of deployment were standardized in consultation with industry. The original proposal of gear specifications was:

- One set consisted of 5 tubs of gear.
- A tub of gear contained 450-500 hooks.
- Hooks - #12 circle.

- Gangions - 18 in. long, made of 150-200 lb. test (3-4 lb. linear weight) braided nylon set 6 ft apart along the groundline.
- Bait - mackerel.
- Soak time will be 3 to 6 hours.

An additional standardisation was added to recognise a tactic common in the Cape Breton area; the groundline had floating line spliced to it at intervals to raise hooks off the bottom. The floating line is added every 60 hooks; thus from the anchor, by groups of hooks: 30-normal back line; 60-floating line spliced in; 60-normal; 60-float; 60-normal; 60-float etc.

Statistics collected after the survey to monitor the degree of conformity to standards showed the following gear values for the six boats :

	Maximum	Minimum	Average	Stan.Dev.
Soak Time (hours)	12.1	2.6	6.2	2.0
Hooks (total)	2,550	2,295	2,295	60
(per tub)	510	445	460	12
Length of set (km)	4.5	3.5	3.9	0.3

In addition, it was found that four boats used short shank hooks, one boat long shank hooks and one boat a mix of each. It is hoped that an experiment can be conducted within the next year to compare the effectiveness of a #12 short shank circle hook to that of a #12 long shank circle hook.

All the gear variables listed above appeared to be well within limits of tolerance with perhaps the exception of soak time. It was found not possible to be more consistent with set duration due to the positioning of set locations. The travel time between the two sets on each trip was quite variable due to the random positioning of the set locations. Because of the constraints of the survey design this is unavoidable. However, the variation in soak time did not appear to affect the catch rate of cod as the points on the graph are well scattered (Fig 2). The duration of most sets was between four and eight hours. If anything this graph tells us that there is little, if any, advantage in leaving the gear in the water longer than four hours. The variation of total catch with soak time also shows the same scatter with no apparent pattern.

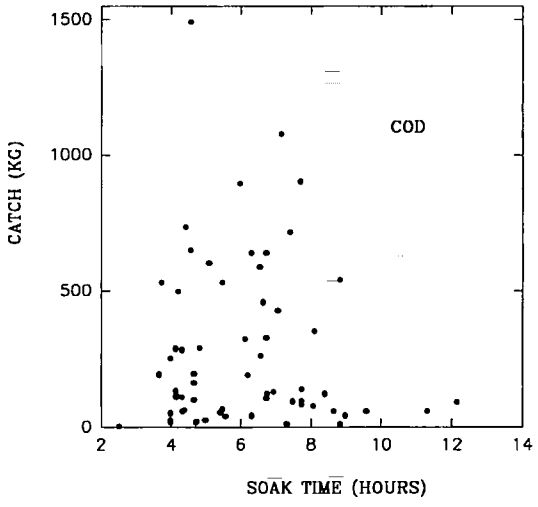

Fig 2. Relation of catch rate to soak time.

Observers

Observers were deployed for the first two trips of each vessel. Their presence was primarily to ensure the integrity of the data collection. In addition, they were to intervene in any way that would aid in the training of fishermen in scientific sampling of fish. Fishermen kept their own data sheets, so there were in essence, "duplicate books" for these trips to allow a comparison between observer and fishermen collected data. Observers kept all otoliths from trips on which they took part.

Instructions for measurements at sea.

- Take surface temperature for each set.
- Secure temperature recorder to one string of gear before setting and remove after gear is retrieved at end of the set. To be delivered to field data coordinator for data recovery.
- Standard set and gear details to be recorded.
- Count and total weight estimate to be recorded for all species, including discards.
- For each set, sample of 200 cod, randomly selected, to be reserved for individual length and weight measurements.
- From each of these random samples of 200 cod, collect otoliths from a random sub-sample of 50 fish.[1]
- Record all measurements on data sheets.

Each boat was provided with a sampling kit which, along with instructions on sampling protocol, included measuring board, scales, clipboard, pencils, data sheets, temperature recording instruments, a wheelhouse logbook for recording of information other than that recorded on data sheets (presence of other sealife such as whales, seals etc.; damage to gear; tide and current conditions, weather; any unusal event), and tables for conversion of measurement units.

RESULTS

Catch

Details of catch taken during the survey can be found in Table 2. Less than fourteen tonnes of cod were caught. The next most common species in the catch was spiny dogfish. Whereas most of the cod were taken in deeper water, the opposite was true of dogfish. Plaice andskate were the next two prevalent species, both preferring deeper water. The bulk of skate taken were thorny skate. Three species of wolffish were reported; striped, spotted and Northern. The striped or Atlantic wolffish was by far the most common. Seven sharks were caught, six of which were blue, the seventh being a mako. Miscellaneous species included 8 kg of haddock, 6 kg of eel and 1 kg of redfish. About 20 kg of assorted crabs and other invertebrates were also

[1] Detailed measurements of cod can be done ashore or at sea, depending on weather.

reported in the catch. Detailed catch records by set for each trip can be found in Appendix A.

Table 2. Total estimated catch (kg) by species and depth in 4Vn Sentinel Survey.

SPECIES	<30 F	30-50 F	>51 F	TOTAL
COD	1,662	5,098	6,874	13,634
DOGFISH	1,935	1,061	304	3,300
PLAICE	36	638	1,258	1,932
SKATE	71	295	632	998
WHITE HAKE	130	15	360	505
WOLFFISH	135	287	78	500
SHARK	-	155	35	190
SCULPIN	34	26	7	67
POLLOCK	-	-	58	58
HAGFISH	-	-	11	11
MISCELLANEOUS	-	6	9	15
TOTAL	4,003	7,581	9,626	21,210

Distribution

The distribution of the six main species caught are illustrated in Figs 3(a) to 3(f). Most of the species appeared to have strong depth preferences. The majority of cod and plaice were found in deep water whereas dogfish and wolffish appeared to prefer shallower water. Skate and white hake showed no clear affiliation with depth; however, whereas skate were most abundant in the south of the survey area, more hake were found to the north.

It should be borne in mind that because of hook size selectivity, these distributions are representative of larger, mature fish. It is known for instance, that substantial numbers of juvenile plaice are located in shallow inshore waters (DFO inshore survey - unpublished information); these would be largely unsampled. Also young cod (1 to 3 yrs old) prefer shallower water and would be undersampled if caught at all.

The distribution of cod as seen by the sentinel survey can be compared to two DFO surveys in 4Vn; one in July run by the Scotia Fundy Region and the other in September run by the Gulf Region as an extension to their annual groundfish survey during that month. For all three surveys the distribution of cod was very similar. The similarities between the sentinel survey, Fig 3(a) and the Gulf region's survey, Fig 4, are striking.

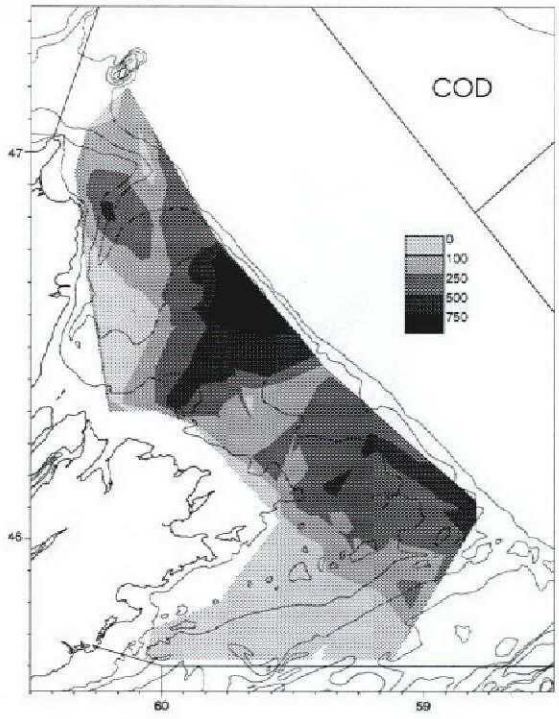

Fig 3(a) Cod abundance (kg per set)

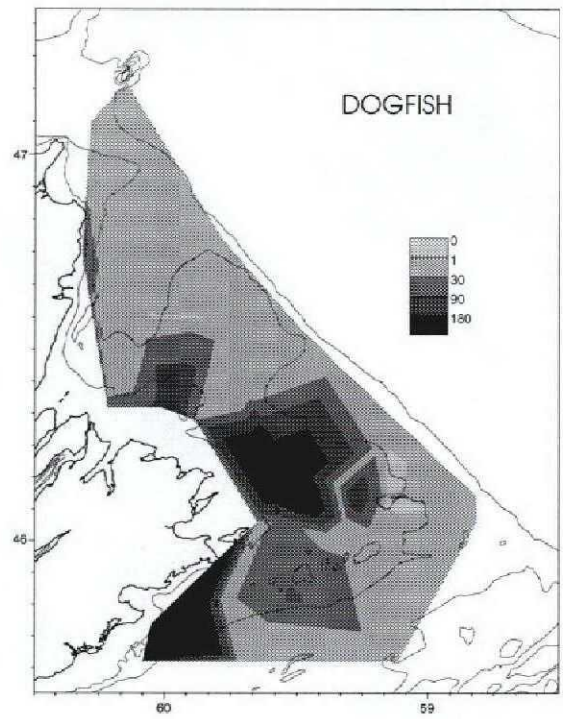

Fig 3(b) Dogfish abundance (kg per set)

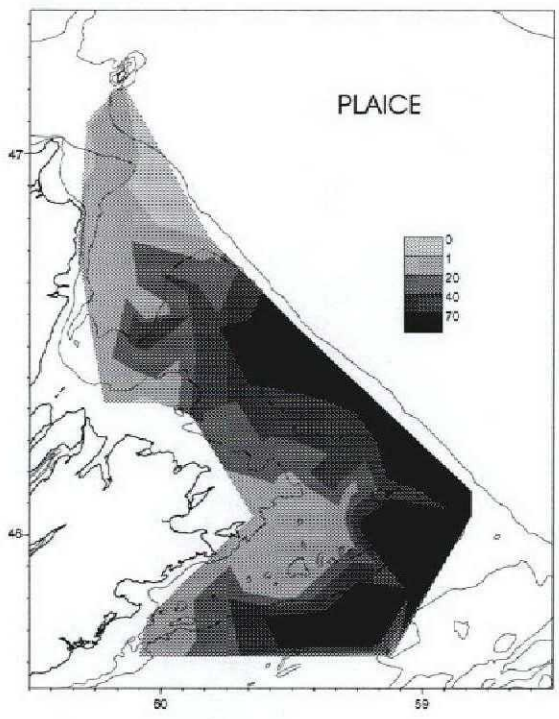

Fig 3(c) Plaice abundance (kg per set)

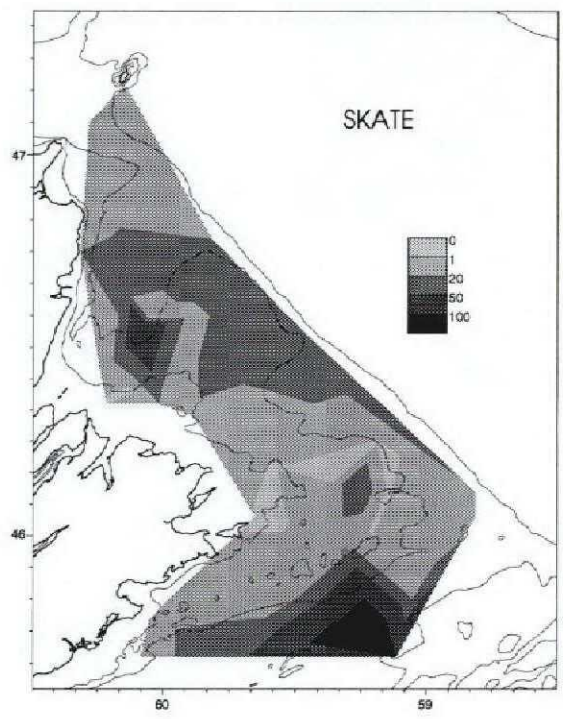

Fig 3(d) Skate abundance (kg per set)

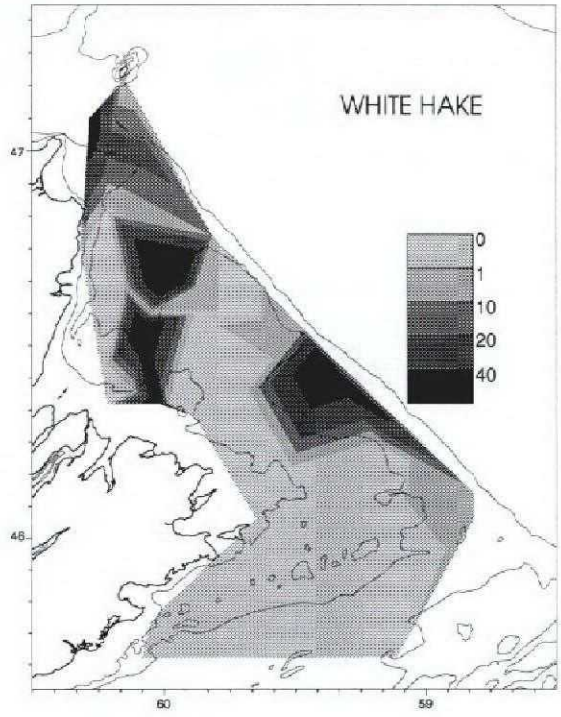

Fig 3(e) White hake abundance (kg per set)

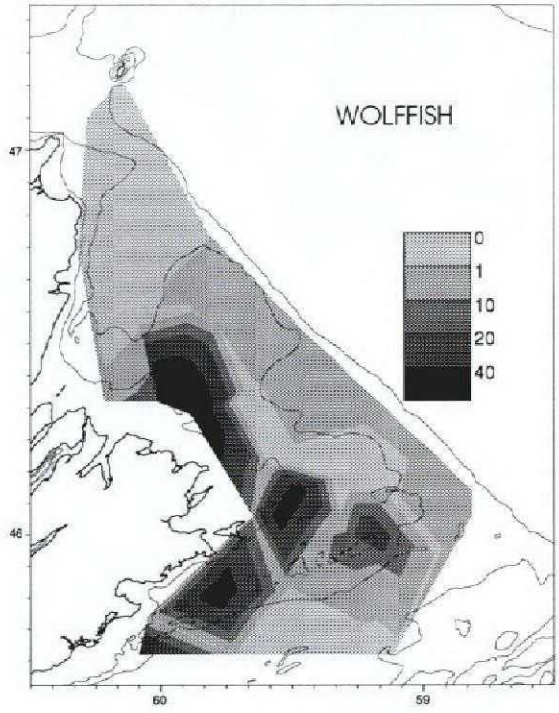

Fig 3(f) Wolffish abundance (kg per set)

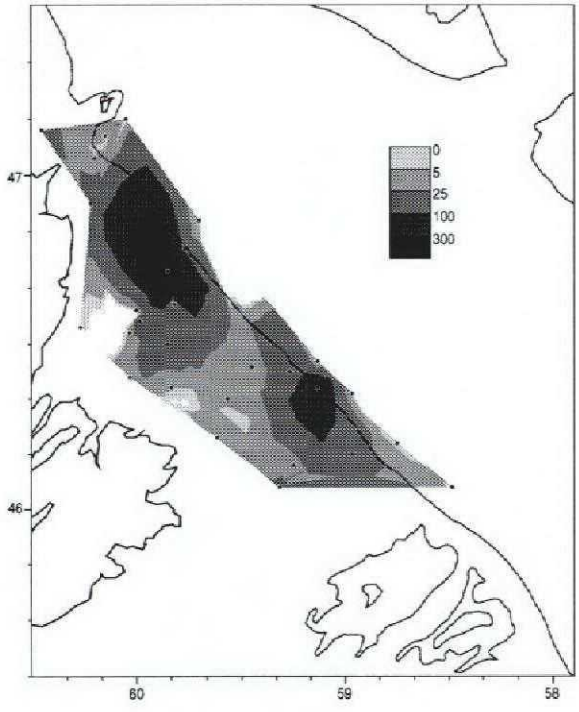

Fig 4. Cod aundance (kg/tow). DFO (Gulf Region) September groundfish survey.

Cod

CATCH RATE

Catch rates ranged from 0 to 467 kg per 1000 hooks (475 lbs per tub), with the average being 110.5 kg per 1000 hooks (112 lbs per tub). Over the duration of the survey, the average catch rate of cod in the deep statum (> 50 fathoms) was about double that of from the shallow statum (<30 fathoms). The medium depth stratum catch rates were intermediate between the other two (Fig 5). Catch rates were higher in the deep stratum at the end of the survey than at the beginning; the opposite was true of the shallow stratum. It is possible this reflects an autumn inshore to offshore. movement of cod. This overwintering behaviour of local inshore stocks was first noted by McKenzie (1934).

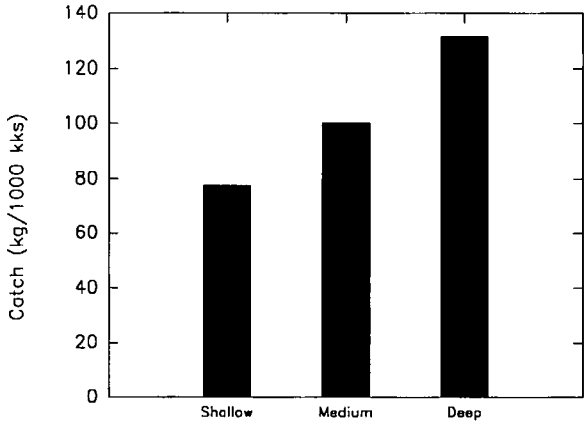

Fig 5. Average catch rate of cod by depth stratum (<30, 30-50 and 51-100 fathoms).

LENGTH FREQUENCY

The overall length frquency of cod was strongly unimodal at 50 cm (Fig 6). At this length a cod in 4Vn would be around five years old. According to the DFO July 1994 groundfish survey the dominant ages at present are 5 and 7 years (1987 & 1989 year-classes). The age structure of the population as determined by the present survey is not yet available. That awaits analysis of the otoliths collected during the survey. An examination of length frequency by stratum (Fig 7) confirms earlier evidence of a relationship of size with depth (Lambert 1992). Younger cod are found at shallower depths than older cod. The length frequency curve of the shallow stratum is quite polymodal in relation to the deeper strata, showing the existence of younger age classes. The average length and weight of cod weighted by catch was computed for each stratum and shows the trend of increasing size of cod with depth Figs 8 & 9.

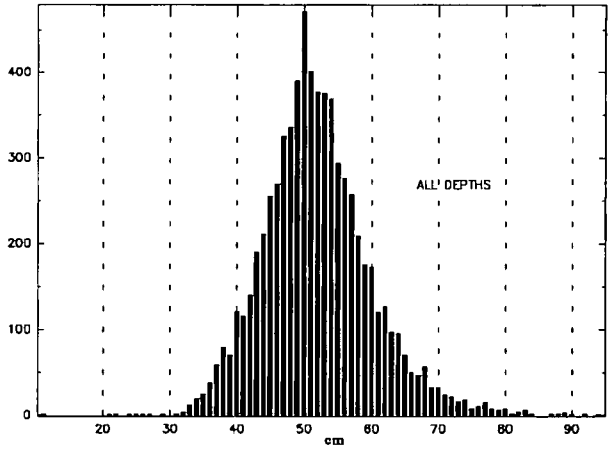

Fig 6. Overall length frequency of cod (all strata).

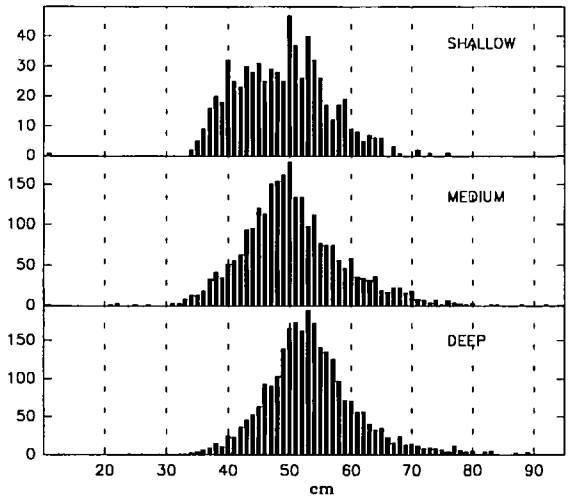

Fig 7. Length frequency of cod by stratum.

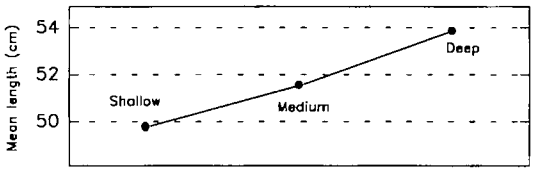

Fig 8. Mean length of cod by depth.

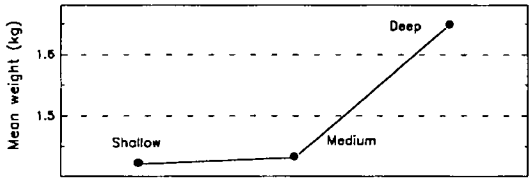

Fig 9. Mean weight of cod by depth.

CONDITION FACTOR

The change of weight of a fish relative to its length, in other words its "fatness", can give valuable insights into the circumstances of its life, such as with regard to feeding conditions and breeding cycle. A convenient and easily measured index to monitor this is the so-called condition factor, K. This is expressed as:

$$W/L^3 \times 100$$

where W = weight and L = length.

K was calculated for cod in the survey and showed interesting differences between strata. The condition factor for the medium and deep strata was close to 1.0; whereas, that for the shallow stratum was about 15% higher (Fig 10)

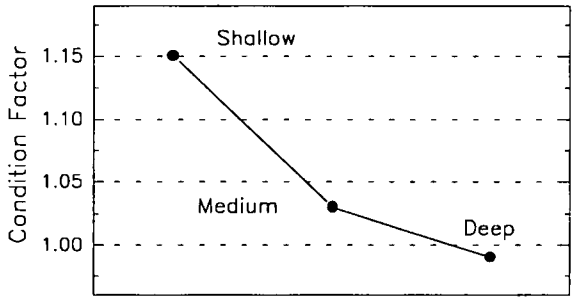

Fig 10. Average condition factor by depth.

Temperature

A total of 195 sea surface temperature (SST) readings were made (two measurements at each end of a string of gear). Therefore for each set there were four readings; start of setting of gear, end of setting of gear, beginning of haulback of gear, and end of haulback of gear (see text

table, page 7, for average distance between readings at ends of string of gear [length of set], and average time between first and last measurements[soak time]). The average SST for about the first two weeks of the survey was 14.7°C (Fig 11); thereafter cooling became quite rapid and the average SST for the last week of the survey fell to 13.1°C (Fig 12). For the construction of these contour maps, all measurements taken within a one square mile area were combined to an

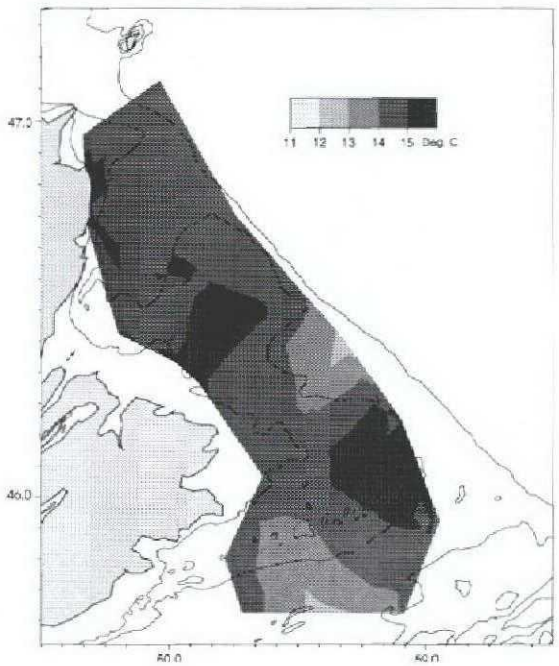

Fig 11. Sea surface temperature °C: Sept 20-28

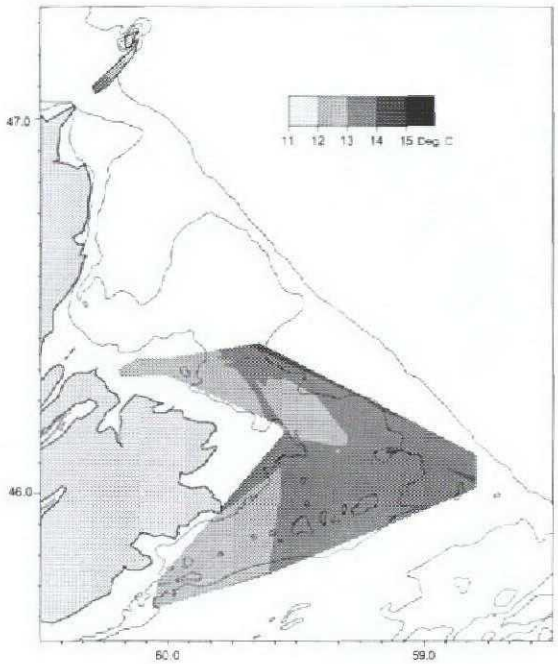

Fig 12. Sea surface temperature°C: Oct 1-8.

average value. Since the SST measurement at the end of a set was on average 6 hours later than the initial reading, the latter reading tended to be higher than the former. Generally gear was set before dawn, but haulback of gear was not completed until well after daybreak. Therefore local diurnal solar heating of the surface layers is probably responsible for the higher temperatures of the later measurements. During the first two weeks of the survey, surface temperature readings at the completion of the set were on average 0.2 °C higher than those at the start. Over the last week of the survey, final readings were on average 0.3 °C higher than initial measurements.

Bottom temperatures were collected by recording instruments mounted on the longline gear. Although 54 sets were made, just 13 were succesfully monitored for water temperature (These data are available in Appendix F). Data could only be collected from one of the two sets made per trip due to a limit on the number of temperature recorders. Also late availability of instruments and other logistical problems resulted in only half of the trips having associated temperatures at gear. The average bottom temperature over all strata was 3.4°C. As might be expected for this time of year, there was a negative relationship between bottom water temperature and depth. The best catch rates of cod were in water less than 2°C. Similar data collected during the test fishery in the autumn of 1993 showed a significant inverse relationship between catch rate and water temperature at-gear. The present (1994) data show the same trend but, with only 13 measurements, the relationship was not statistically significant.

Conclusions

The autumn 1994 inaugural sentinel survey of groundfish in 4Vn was very successful. Areal coverage was extensive and the data allowed the construction of probably the best distributional maps of groundfish species ever produced for 4Vn. In addition the strict sampling design combined with good standardisation of fishing gear provide statistically robust estimates.

Strong similarities in the information collected by the sentinel survey and DFO surveys in July and September indicate that patterns of distribution and areas of aggregation as derived from longline and otter trawl catch can be compared. It also shows that the distribution of cod appears to change little during the summer, or at least between July and October.

Over the 19 day survey period (September 20 to October 8), an estimated 13,634 kg of cod were taken in 4Vn. The average catch rate of cod over this period was 110.5 kg/1000 hooks (SD 111.25). Only ten of the 54 sets made could be considered good; that is, in excess of 500 kg/1000 hooks. A direct comparison between a 1993 test fishery in 4Vn (Lambert 1994) and the sentinel survey cannot be made with any statistical validity since the former had a different survey design. Nevertheless, selected catch rates of cod from the present survey in localities fished during the test fishery at the same time of year, appear to be no better, if not worse, than catch rates experienced during the test fishery.

During the sentinel survey dogfish were the second most common species caught after cod and they were most prevalent in shallow inshore waters. The survey also showed that smaller cod were taken in the shallowest of the three strata. An inshore survey carried out by the DFO in recent years (Lambert 1992) shows this preference of young cod for shallower water very clearly and has identified a nursery area in the south-west of Sydney Bight. This overlap in distribution of dogfish and young cod is perhaps more significant when viewed in light of data collected by the longliner monitoring the migration of 4T cod out of the Gulf of St. Lawrence. This vessel operated in the White Point Bank - St. Pauls Island area between October 30 and December 3. The main species in its catch were dogfish (10,331 kg) and cod (3,856 kg). Most of the dogfish were taken in the latter half of November seemingly toward the end of the 4T migration when cod catch had diminished in the area. These high numbers of dogfish were taken in an area where few had been seen by the sentinel survey a month earlier. Thus it seems clear that the dogfish were also moving out of the Gulf of St. Lawrence somewhat behind the cod. Since dogfish were caught at the same time as the tail end (youngest fish) of the cod migration was apparently moving throught the area, and since dogfish were caught by the sentinel survey in areas favoured by young cod, one cannot help but wonder if this is but a coincidence or if indeed, the dogfish are preying on the smaller cod. The latter suspicion is perhaps more probable since many partly eaten cod were found on hooks in November when dogfish catch was at its height. Indeed Bigelow and Schroeder (1953) state that dogfish are "Voracious almost beyond belief...." and that "....they bite groundfish from the hooks of long lines, or take the baits and make it futile to fish with hook and line where they abound."

Condition factor data indicated that cod in shallow water were "fatter" than their counterparts in deeper water. This is a consistent feature found by the DFO July groundfish survey in 4Vn over the past 25 years. It is difficult to see why cod in the shallower water strata should be consistently in better condition and perhaps indeed this is not the case. An alternative explanation is that the fish in the inshore areas of 4Vn may be a distinct group of cod with

different body proportions from the cod found in deeper waters.

The potential of the sentinel survey for providing an index of abundance is excellent. With the addition over time of more data collected in an equally rigourous manner, an invaluable time series could be developed. However, only if maintained on an annual basis will this survey achieve its potential of becoming a powerful tool in the evaluatation of the status of this stock.

Acknowledgements

The participants of this, the first, sentinel survey are to be commended for agreeing, despite some misgivings, to fish in a manner quite contrary to their normal practice, and for their quickly learned proficiency in the collection of reliable scientific data at sea. I sincerely hope they come to see the fruit of their labours in the not too distant future.

Two individuals deserve particular recognition for giving more than their share to the project, and in particular, for keeping it on the rails during the early stages when things threatened to fall apart: Kevin Nash, Manager and Greg Organ, President 4Vn Sentinel Fishery Association.

Thanks are also due to Gus van Helvoort, DFO (Halifax) for his major contribution in the critical initial stages of the organisation of the project. I would also like to thank colleagues in the Marine Fish Division (MFD), Chris Annand (Reproduction & Maturity), Bob Mohn (Stock Assessment) and in particular, Scott Wilson (practical demonstrations: plankton, otoliths etc.), for their assistance during the course on fish biology. My appreciation also to Cynthia Greencorn and Bob Branton (MFD) for their expertise in the setting up of the mainframe database. Greg Croft (Biorex) ably provided training to the participants in the correct procedures for data entry.

I am grateful to Ghislain Chouinard for providing the illustrative plot of that part of the September, 1994 Gulf groundfish survey which sampled 4Vn (appearing herein as Fig 4).

I am also most appreciative of the generous assistance and hospitality afforded to us by Wayne Ashford and his staff during the training sessions held at the Canadian Coast Guard College in Westmount, Cape Breton.

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APPENDICES

A. LIST OF PARTICIPANTS

B. INDIVIDUAL BOAT CATCH RECORDS BY SET.

C. WATER TEMPERATURE DATA BY SET

D. GRAPHICAL RECORD OF TEMPERATURE-AT-GEAR.

APPENDIX A:

LIST OF PARTICIPANTS

Participants in the 4Vn Sentinel Survey and 4T Migration Monitoring

Barret Jr., Silby
Barrett, Sylby
Campbell, Roy
Courtney, Robert
Dollimount, Gilbert
Eddy, Arnold
Ford, William
Frazer, William
Hearn, Bernard
Hillier, Joseph
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MacGillivary,Daniel
MacKinnon, Dale
MacKinnon, Leo
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Martino, Dennis
Matias, John
Mauger, Dale
Mauger, Russell
Melnyk, John
Morrison, Robert
Nash, Herbert
Parsons, Lawrence
Saccary, John
Snook,Henry
Snook,James
Strong, Bruce

APPENDIX B:

INDIVIDUAL BOAT CATCH RECORDS BY SET.

Latitude and longitude values are degrees and minutes.

Different species within the wolffish, skate and sculpin categories are not identified although these data are available.

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
AS94-SS01	1	23 Sept	4603	5938	48	14.6	0.08

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	23		23
Plaice	1		1
Wolffish	8		8
Dogfish		16	16
Sculpin		30	30
Snow crab		1	1
Starfish		2	2
Cucumber		1	1

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
AS94-SS01	2	23 Sept	4603	5933	56	14.7	0.2

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	52		52
Plaice	6		6
Wolffish	50		50
Dogfish		41	41
Blue shark	40		40
Sculpin		9	9
Snow crab		1	1
Starfish		1	1
Cucumber		1	1

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
AS94-SS02	1	25 Sept	4600	5923	81	14.7	0.16

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	126		126
Plaice	10		10
Wolffish	6		6
Skate		5	5
Dogfish		10	10

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
AS94-SS02	2	25 Sept	4558	5916	68	14.7	0.3

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	251		251
Plaice	10		10
Wolffish	15		15
Skate		10	10
Dogfish		15	15

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
AS94-SS03	1	27 Sept	4603	5918	68	15.5	0.15

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	110		110
White hake		1	1
Plaice	6		6
Skate		20	20
Dogfish		5	5
Eel		3	3
Shrimp		4	4
Cucumber		1	1

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
AS94-SS03	2	27 Sept	4600	5913	59	15.6	0.52

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	320		320
Plaice	90		90
Wolffish		30	30
Dogfish		3	3
Blue shark		70	70
Sculpin		6	6
Shrimp		1	1
Starfish		1	1
Cucumber		1	1

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
AS94-SS04	1	05 Oct	4606	5928	55	13.7	0.78

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	350		350
White hake	1		1
Plaice	5		5
Wolffish	50		50
Skate		5	5
Dogfish		359	359
Sculpin		10	10
Shrimp		1	1

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
AS94-SS04	2	05 Oct	4606	5917	73	13.7	0.51

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	288		288
Plaice	10		10
Skate		47	47
Dogfish		155	155
Eel		3	3
Shrimp		1	1
Starfish		1	1

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
AS94-SS05	1	08 Oct	4606	5848	143	13.8	0.87

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	730		730
White hake	5		5
Plaice	100		100
Wolffish	5		5
Skate		18	18
Dogfish		8	8

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
AS94-SS05	2	08 Oct	4603	5848	150	13.8	0.73

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	636		636
White hake	5		5
Plaice	80		80
Wolffish	6		6
Skate		5	5
Dogfish		2	2

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
EJ94-SS01	1	24 Sept	4618	5953	57	15.1	0.25

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	89		89
Plaice	42		42
Wolffish	70		70
Skate		16	16
Dogfish		30	30

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
EJ94-SS01	2	24 Sept	4621	5958	47	15.1	0.85

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	584		584
Wolffish	81		81
Dogfish		181	181

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
EJ94-SS02	1	08 Oct	4620	6001	40	12.1	0.25

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	58		58
White hake	59		59
Wolffish	12		12
Skate		18	18
Dogfish		102	102

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
EJ94-SS02	2	08 Oct	4620	6001	40	12.1	0.35

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	121		121
White hake	70		70
Wolffish	19		19
Skate		21	21
Dogfish		118	118

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
HM94-SS01	1	21 Sept	4700	6112	131	14.7	0.24

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	189		189
White hake	25		25
Plaice	5		5
Wolffish	1		1
Skate		15	15
Dogfish		5	5

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
HM94-SS01	2	21 Sept	4658	6003	155	14.4	0.05

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	11		11
White hake	25		25
Skate		5	5
Dogfish		5	5

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
HM94-SS02	1	23 Sept	4644	5946	112	14.2	0.94

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	281		281
Haddock	8		8
White hake	10		10
Skate		20	20
Dogfish		3	3
Hagfish		10	10

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
HM94-SS02	2	23 Sept	4644	5946	112	14.2	0.94

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	890		890
Plaice	15		15
Wolffish	5		5
Skate		25	25
Dogfish		3	3

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
HM94-SS03	1	26 Sept	4645	6018	54	14.7	0.08

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	10		10
Plaice	2		2
Skate		20	20
Dogfish		45	45

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
HM94-SS03	2	26 Sept	4639	6009	131	14.6	0.1

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	62		62
Plaice	8		8
Skate		27	27
Dogfish		5	5

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
HM94-SS04	1	28 Sept	4657	6020	60	14.9	0.13

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	120		120
White hake	1		1
Plaice	6		6
Skate		3	3
Dogfish		2	2

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
HM94-SS04	2	28 Sept	4651	6013	106	14.9	0.63

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	600		600
Plaice	2		2
Wolffish	1		1
Skate		17	17
Dogfish		8	8

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
HM94-SS05	1	05 Oct	4704	6017	171	13.4	0.21

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	76		76
White hake	60		60
Pollock	58		58
Skate		1	1
Dogfish		10	10
Hagfish		1	1

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
HM94-SS05	2	05 Oct	4710	6008	90	11.1	0.13

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	132		132
Plaice	1		1
Wolffish	1		1
Dogfish	2		2

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
NS94-SS01	1	20 Sept	4635	5947	62	14.6	1.15

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	1,074		1,074
Plaice	40		40
Wolffish	5		5
Skate		32	32
Dogfish		3	3

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
NS94-SS01	2	20 Sept	4632	5946	64	15.5	0.65

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	536		536
White hake	1		1
Plaice	69		69
Wolffish	1		1
Skate		35	35
Dogfish		5	5

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
NS94-SS02	1	23 Sept	4632	5929	113	14.1	0.88

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	712		712
White hake	2		2
Plaice	114		114
Wolffish	6		6
Skate		45	45
Dogfish		5	5

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
NS94-SS02	2	23 Sept	4627	5923	146	13.2	0.41

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	191		191
White hake	69		69
Plaice	90		90
Wolffish	5		5
Skate		32	32
Dogfish		8	8
Blue shark		10	10

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
NS94-SS03	1	27 Sept	4641	5959	119	14.5	0.36

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	193		193
White hake	91		91
Plaice	42		42
Skate		30	30
Dogfish		8	8

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
NS94-SS03	2	27 Sept	4638	5952	65	14.5	0.43

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	326		326
White hake	10		10
Plaice	45		45
Wolffish	4		4
Skate		35	35
Dogfish		12	12

NO SWEAT continued

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
NS94-SS04	1	01 Oct	4621	5942	77	13.1	0.14

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	95		95
White hake	1		1
Plaice	35		35
Skate		11	11
Dogfish		1	1

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
NS94-SS04	2	01 Oct	4622	5941	82	14	0.15

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	64		64
Plaice	65		65
Skate		18	18
Dogfish		2	2

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
NS94-SS05	1	05 Oct	4611	5934	52	13.1	0.92

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	425		425
Plaice	28		28
Dogfish		462	462

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
NS94-SS05	2	05 Oct	4610	5931	55	12.9	0.42

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	98		98
Plaice	24		24
Dogfish	300		300

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
RC94-SS01	1	23 Sept	4550	5947	70	14.4	0.16

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	58		58
Plaice	30		30
Wolffish	55		55
Skate		5	5
Dogfish		10	10

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
RC94-SS01	2	23 Sept	4541	5942	70	14.4	0.11

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	37		37
Plaice	35		35
Dogfish		40	40

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
RC94-SS02	1	25 Sept	4544	5912	165	13.6	0.4

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	92		92
Redfish	1		1
Plaice	140		140
Skate		150	150
Dogfish		20	20

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
RC94-SS02	2	25 Sept	4541	5907	185	13.6	0.17

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	56		56
Plaice	4		4
Skate		100	100
Dogfish		15	15

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
RC94-SS03	1	27 Sept	4551	5902	145	14.5	0.49

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	374		374
Plaice	75		75
Wolffish	4		4
Skate		8	8
Dogfish		3	3
Mako shark		25	25

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
RC94-SS03	2	27 Sept	4556	5857	133	14.1	0.39

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	136		136
Plaice	235		235
Skate		14	14
Dogfish		4	4

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
RC94-SS04	1	05 Oct	4547	5937	110	12.9	0.11

Species	Kept (kg)	Disc. (kg)	Total (kg)
Plaice	68		68
Skate		20	20
Dogfish		25	25

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
RC94-SS04	2	05 Oct	4551	5930	74	12.9	0.13

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	23		23
Plaice		3	3
Skate		5	5
Dogfish		100	100
Sculpin		1	1

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
RC94-SS05	1	08 Oct	4541	6004	92	12.5	0.3

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	82		82
Plaice	6		6
Wolffish	45		45
Skate		9	9
Dogfish		154	154
Sculpin		7	7

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
RC94-SS05	2	08 Oct	4546	6002	48	12.5	0.98

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	20		20
White hake	1		1
Plaice	1		1
Skate		12	12
Dogfish		940	940
Sculpin		4	4

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
SB94-SS01	1	20 Sept	4635	6002	118	15.3	0

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	2		2

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
SB94-SS01	2	20 Sept	4634	5952	61	15.1	0.38

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	285		285
Plaice	40		40
Skate		3	3
Blue shark	45		45

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
SB94-SS02	1	23 Sept	4632	6004	111	13.9	0.28

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	50		50
White hake	68		68
Plaice	57		57
Skate		91	91
Dogfish		11	11

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
SB94-SS02	2	23 Sept	4626	6012	68	14.3	0.04

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	17		17
Plaice	9		9
Skate		5	5
Dogfish		6	6

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
SB94-SS03	1	27 Sept	4615	5911	103	15.3	0.6

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	528		528
Plaice	58		58
Skate	2		2

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
SB94-SS03	2	27 Sept	4612	5907	128	14.4	0.64

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	528		528
Plaice	114		114

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
SB94-SS04	1	05 Oct	4608	5921	55	12.9	0.7

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	647		647
Plaice	57		57

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
SB94-SS04	2	05 Oct	4607	5909	117	13	0.5

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	455		455
Plaice	45		45

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
SB94-SS05	1	08 Oct	4622	6007	21	12.5	0.20

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	160		160
Plaice	2		2
Wolffish	8		8
Dogfish		33	33

Trip	Set #	Date	Latitude	Longitude	Depth (m)	S Temp (°C)	Catch (t)
SB94-SS05	2	08 Oct	4620	6012	28	12.6	0.31

Species	Kept (kg)	Disc. (kg)	Total (kg)
Cod	261		261
Plaice	2		2
Wolffish	7		7
Dogfish		38	38

APPENDIX C:

WATER TEMPERATURE DATA BY SET

Surface water temperatures recorded at the start of setting and end of haul back of each longline set. Bottom water temperatures recorded by instruments attached to one end of longline gear. Readings taken from records (see Appendix D) for beginning of bottom time and end of bottom time.

For names of boats and positions of sets see Appendix B using Trip Number and Set Number as a cross reference.

APPENDIX C

Trip	Set #	Date	Depth (m)	Start (°C)		Finish (°C)	
				Surface	At Gear	Surface	At Gear
AS94-SS01	1	23 Sept	48	14.6		14.6	
AS94-SS01	2	23 Sept	56	14.7		14.7	
AS94-SS02	1	25 Sept	81	14.7		14.7	
AS94-SS02	2	25 Sept	68	14.7		14.7	
AS94-SS03	1	27 Sept	68	15.5	0.8	15.5	0.8
AS94-SS03	2	27 Sept	59	15.6		15.6	
AS94-SS04	1	05 Oct	55	13.7	5.5	14.2	6.5
AS94-SS04	2	05 Oct	73	13.7		14	
AS94-SS05	1	08 Oct	143	13.8	1.5	14.1	1.3
AS94-SS05	2	08 Oct	150	13.8		14.1	
EJ94-SS01	1	24 Sept	57	15.1		15.1	
EJ94-SS01	2	24 Sept	47	15.1	3.2	15.1	3.5
EJ94-SS02	1	08 Oct	40	12.1	9.2	12.4	
EJ94-SS02	2	08 Oct	40	12.1		12.6	
HM94-SS01	1	21 Sept	131	14.7		14.8	
HM94-SS01	2	21 Sept	155	14.4		14.6	
HM94-SS02	1	23 Sept	140	14.4		14.1	
HM94-SS02	2	23 Sept	112	14.2		14.2	
HM94-SS03	1	26 Sept	54	14.7		15	
HM94-SS03	2	26 Sept	131	14.6		14.5	
HM94-SS04	1	28 Sept	60	14.9		14.9	
HM94-SS04	2	28 Sept	106	14.9		14.9	
HM94-SS05	1	05 Oct	171	13.4		13.2	
HM94-SS05	2	05 Oct	90	11.1		11.2	
NS94-SS01	1	20 Sept	62	14.6	1.7	14.8	1.4
NS94-SS01	2	20 Sept	64	15.5		15.5	
NS94-SS02	1	23 Sept	113	14.1	1.1	14.6	1.3
NS94-SS02	2	23 Sept	146	13.2		13.3	
NS94-SS03	1	27 Sept	119	14.5		14.7	

APPENDIX C

				Start (°C)		Finish (°C)	
Trip	Set #	Date	Depth (m)	Surface	At Gear	Surface	At Gear
NS94-SS03	2	27 Sept	65	14.5	1.4	14.8	1.4
NS94-SS04	1	01 Oct	77	13.1	1.5	13.1	1.5
NS94-SS04	2	01 Oct	82	14		14.2	
NS94-SS05	1	05 Oct	52	13.1	11.7	13.1	10
NS94-SS05	2	05 Oct	55	12.9		12.8	
RC94-SS01	1	23 Sept	70	14.4		15.1	
RC94-SS01	2	23 Sept	70	14.4		15.1	
RC94-SS02	1	25 Sept	165	13.6		14.2	
RC94-SS02	2	25 Sept	185	13.6		14.1	
RC94-SS03	1	27 Sept	145	14.5	1.4	15.1	1.3
RC94-SS03	2	27 Sept	133	14.1		15.1	
RC94-SS04	1	05 Oct	110	12.9	0.8	13.5	0.8
RC94-SS04	2	05 Oct	74	12.9		13.5	
RC94-SS05	1	08 Oct	92	12.5	4.6	13.1	2.7
RC94-SS05	2	08 Oct	48	12.5		13.1	
SB94-SS01	1	20 Sept	118	15.3		15.1	
SB94-SS01	2	20 Sept	61	15.1		14.8	
SB94-SS02	1	23 Sept	111	13.9		14.3	
SB94-SS02	2	23 Sept	68	14.3		15.3	
SB94-SS03	1	27 Sept	103	15.3		15.7	
SB94-SS03	2	27 Sept	128	14.4		15.9	
SB94-SS04	1	05 Oct	55	12.9		12.7	
SB94-SS04	2	05 Oct	117	13		13.9	
SB94-SS05	1	08 Oct	21	12.5		12.7	
SB94-SS05	2	08 Oct	28	12.6		13.1	

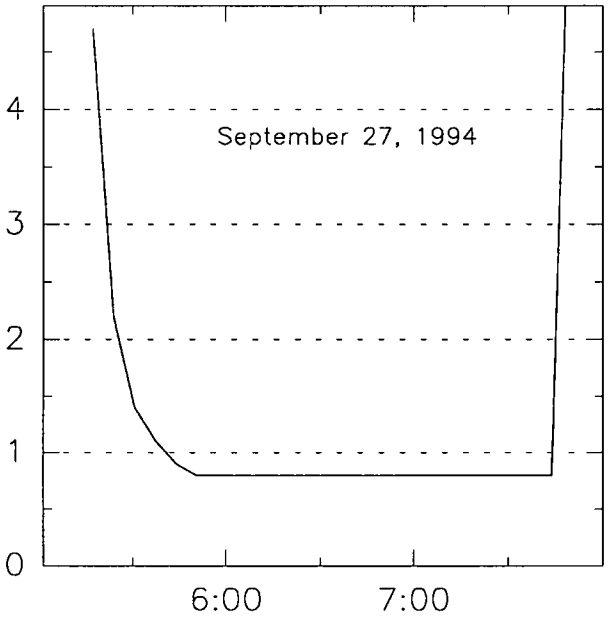
APPENDIX D

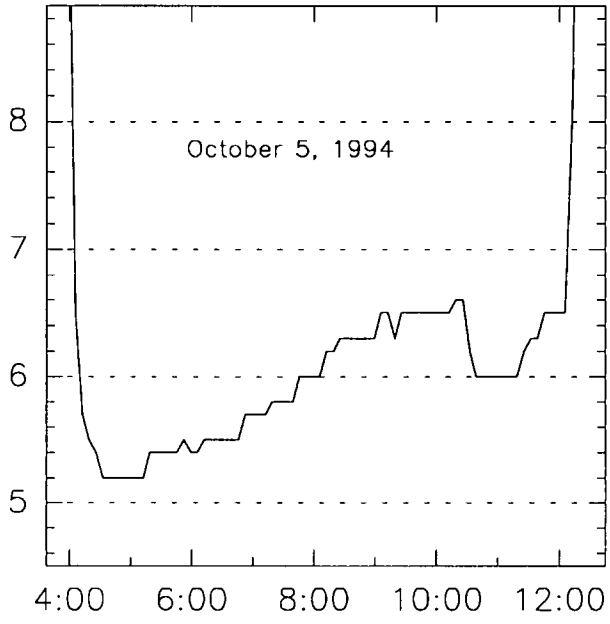
GRAPHICAL RECORD OF TEMPERATURE-AT-GEAR

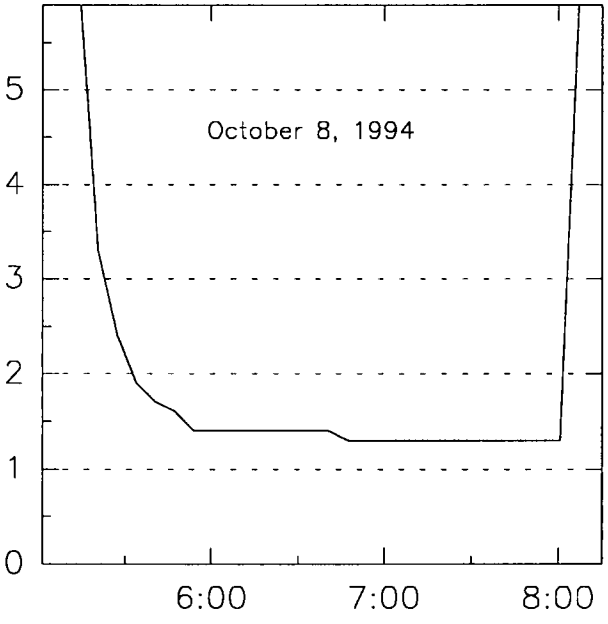
On a typical temperature trace, the downleg at the left of the plot marks the entry of the temperature recorder into the water; the flat portion represents time on the bottom and the upleg to the right of the plot marks the recovery of the instrument.

Sometimes when air temperature is lower than water temperature the plot is more difficult to interpret. In these cases arrows superimposed on the plots indicate the beginning and end of the set.

Locations of the following bottom temperature records can be derived from Appendix C.







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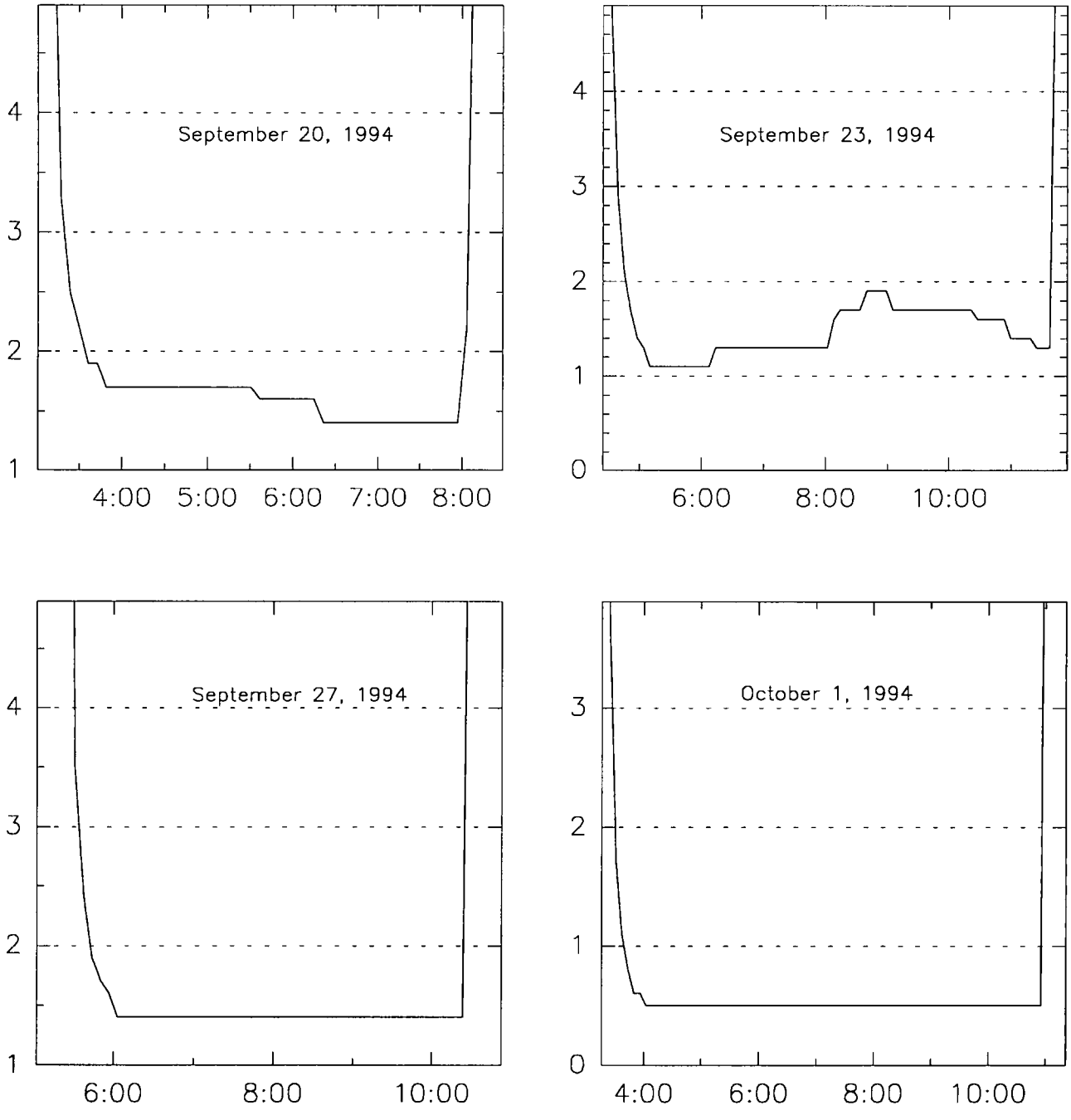
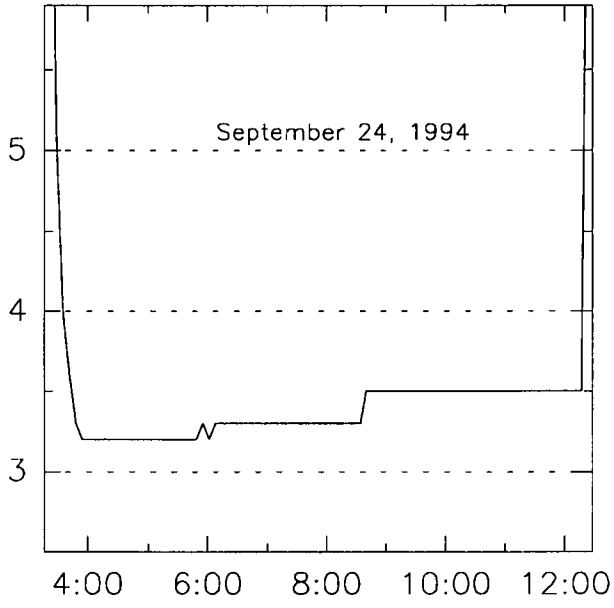
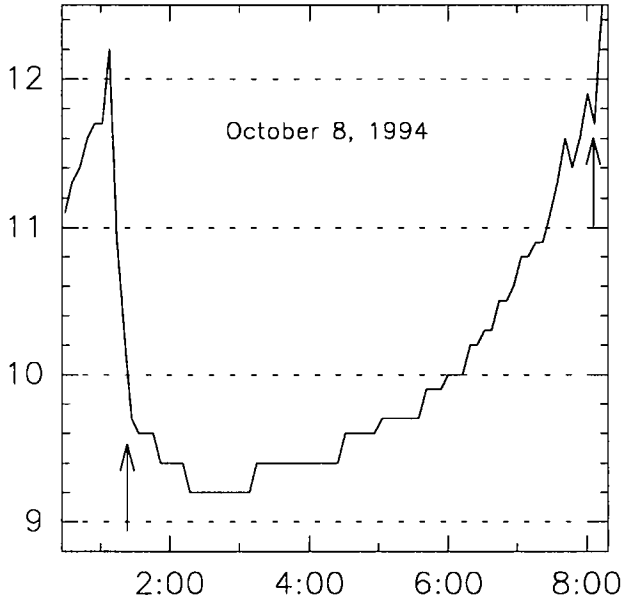
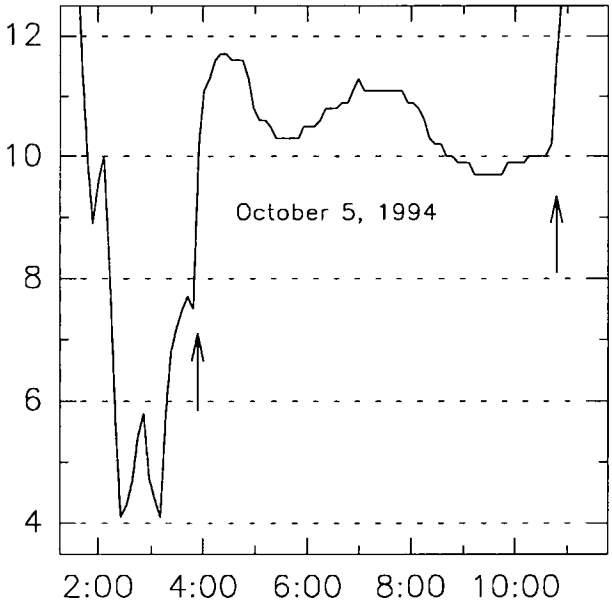


NO SWEAT

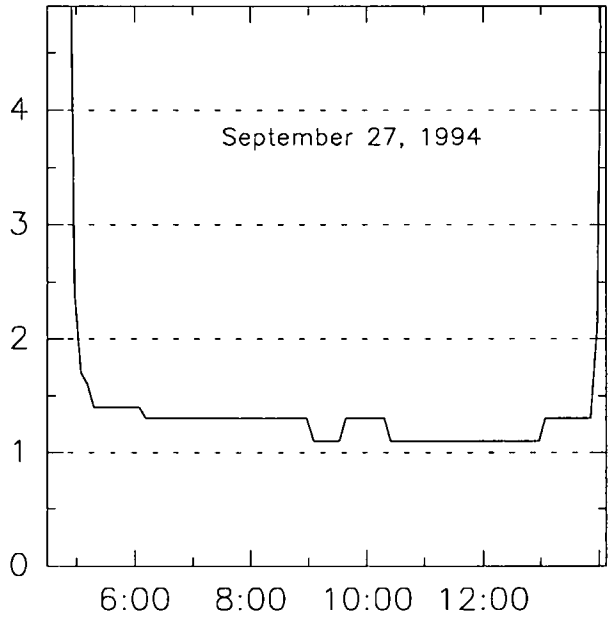
EDWARD JASON

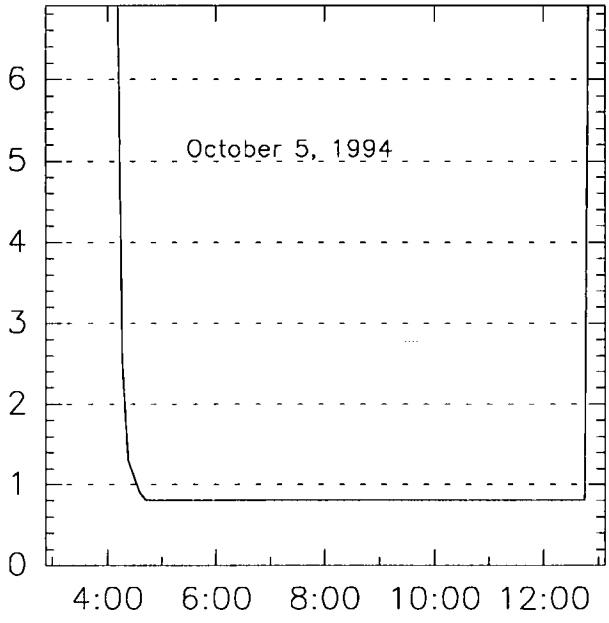


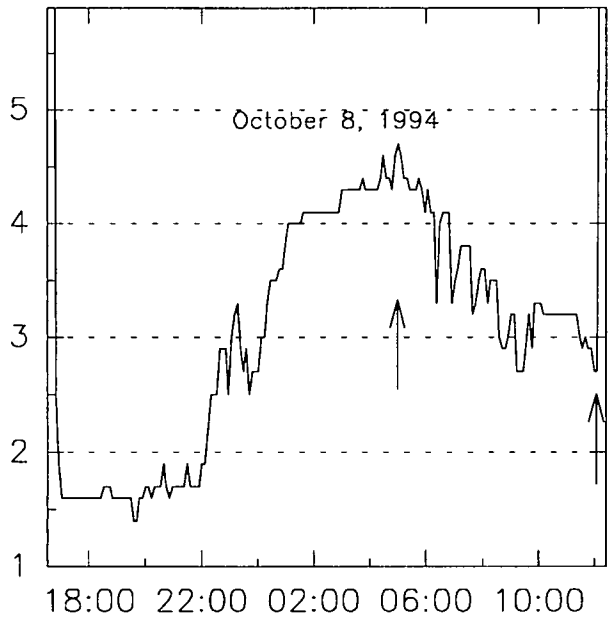




NO SWEAT


September 27, 1994
0
1
2
3
4
6:00
8:00
10:00
12:00


October 5, 1994
0
1
2
3
4
5
6
4:00
6:00
8:00
10:00
12:00


October 8, 1994
1
2
3
4
5
18:00
22:00
02:00
06:00
10:00

ROSA CARLOS