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**A biological update of witch flounder, Glyptocephalus
cynoglossus, in NAFO Divisions 4R and 4S**

by

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ABSTRACT

The provisional landings of witch flounder in NAFO Divisions 4R and 4S during 1990 were 590 t. Of this, 508 t were taken in Division 4R during the summer fishery. There were also some catches near the 4T boundary. The mean number per tow from the RV surveys suggested that numbers have declined since the late 1970s and that declines have continued in Division 4R, however, numbers may be recovering in 4S. The estimate of fishable biomass suggests that the current TAC of 3500 t, if caught, would represent substantial overfishing. Fifteen percent of the fishable biomass estimated from the summer surveys (1987-1990) would yield 373 t. Assuming the catchability is 1, fifteen percent of the fishable biomass from the winter survey would yield 1032 t. Due to catches near the boundary with 4T, the discreteness of the 4RS witch flounder stock is questionable. The stock definition for witch flounder should be re-examined.

RÉSUMÉ

Les débarquements provisoires de plie grise dans les divisions 4R et 4S se chiffraient à 590 t en 1990. Là-dessus, 508 t ont été capturées durant la pêche d'été dans la division 4R. Il y eu aussi quelques prises à la frontière près de la zone 4T. D'après la quantité moyenne de prises par trait de chalut effectué au cours des relevés du navire de recherche, les quantités semblent avoir diminué depuis la fin des années 1970. Ces baisses semblent se poursuivre dans la division 4R mais les prises pourraient être en voie de recouvrement dans la division 4S. L'évaluation de la biomasse disponible exploitable laisse supposer que le TPA actuel de 3500 t, s'il est atteint, représenterait une surpêche importante. Quinze pour cent de la biomasse exploitable évaluée lors du relevé d'été (1987-1990) donneraient 373 t. En supposant que la capturabilité est de 1, i.e le filet attrape tous les poissons sur son chemin, quinze pour cent de la biomasse exploitable évaluée lors du relevé d'hiver donneraient 1032 t. Les captures de plies grises près de la frontière de la zone 4T remettent en question et devrait être ré-évaluées.

INTRODUCTION

Landings of 4RS witch flounder have been generally less than 2,000 t, except during the period of 1974-1980 when they rose to as high as 5,341 t (1976) (Tables 1,2,3). A TAC was first established for 1977 at 3,500 t, based on average recent landings. However, due to the presence of large old fish in the population, which were being landed in "jellied" condition, the TAC was increased to 5,000 t in 1979. The objective was to exploit the stock heavily in order to reduce the proportion of old fish in the population. Although the abundance of older fish was reduced, catches did not reach the new TAC and, in fact, declined (Table 1,2,3). The TAC was reduced to 3,500 in 1982. Average landings since 1982 were 788 t.

Historically, over 80 % of the catch has been taken in NAFO Division 4R (Tables 1 and 2). Since 1960, nominal landings of witch flounder taken from 4R have ranged from 3,623 t in 1976 to 79 t in 1984 (Table 1). During the same period, nominal landings taken from NAFO Division 4S have ranged from 1,718 t in 1976 to 38 t in 1985 (Table 2).

Historically, the witch flounder fishery was primarily a by-catch of the northern Gulf of St. Lawrence cod and redfish fisheries, with a small directed component in St. Georges Bay (Nfld). A fishery, involving large vessels using otter trawls, occurred during the winter months in Esquiman Channel and in the Laurentain Channel in Division 4S. A summer fishery, composed mostly of smaller vessels using Danish seines and small trawls, has taken place in St. Georges Bay, Newfoundland (Unit Area 4Rd). The winter fishery has declined to almost nothing (Tables 4, 5 and 6). The summer fishery has also declined in the last 10 years. The stock is exploited both by mobile gears, (such as otter trawler, Danish seines), and fixed gears (e.g. gillnets and longlines).

A) Nominal Landings and Description of the Fishery in 1990

Nominal landings for 1990 were tabulated from provisional data supplied by the Statistics Branches of the four Atlantic regions of the Department of Fisheries and Oceans. The provisional landings for 1990 were 590 t, which represents the second lowest catch in the last 30 years. Of this, 508 t come from Division 4R. Nominal landings by gear and month are presented in Tables 4, 5, and 6. Danish seines were the dominant gear type, accounting for 67.5 % of the landings.

There were no closures in the witch flounder fishery during 1990. The M.G. > 100' exceeded their allocation by 19 t. M.G., 65'-100' caught their quota of 90 t (Table 7). The greatest shortfalls were in the M.G. 65'-100' developmental, which had no reported landings (allocation 2140 t), and the M.G. < 65', which caught only 35% of their 1200 t allocation. The F.G. < 65' caught 8 t over their allocation.

B) DATA

Commercial Fishery Data

1) Commercial Catch Rates

Catch rate analyses for the directed and non-directed fisheries were attempted using a multiplicative model (Gavaris 1981). Neither model produced usable results. In the case of the directed model, there were very few records because the principle gear type that directs for witch flounder is Danish seines under the minimum size of vessels required to fill out a log book. The by-catch fishery had very large effort (i.e. 1000 h) but very little catch. These vessels follow cod or redfish movements, thus the witch catch rates are biased.

2) Research Survey Data

Research surveys have been conducted in Divisions 4R and 4S since 1978. A winter (January) survey has been carried out using the RV Gadus Atlantica in most years since 1978. Bowering (1978, 1979, and 1981) and Bowering and Brodie (1980) summarize the results from the surveys carried out from 1978 to 1981. A summer (August) survey, using the RV Lady Hammond (1983 to 1989) and the RV Alfred Needler (1990), has been carried out since 1983. Surveys were conducted with a random stratified sampling design. Figures 1 and 2 show the stratification scheme used in these surveys. The winter survey takes place during a period of heavy ice cover, therefore, some areas were not surveyed in all years. Thus, the coverage from one year may be somewhat different than the next. The mean number per tow from STRAP runs is shown in Figure 3 for the summer (1984 to 1990) and winter surveys (1983 to 1990) for each Division. The mean number per tow from the winter survey (4R and 4S combined) from 1978-80 (from Bowering and Brodie 1980) and 1983-90 is shown in Figure 4. The mean number per tow was generally lower in the summer survey, perhaps because the flounder were more widely distributed (Tables 8,9 and Fig. 3). As well, the mean number per tow in Division 4S was slightly higher than in 4R in both surveys. The summer survey suggests relative stability in the mean number per tow (except during 1986 in 4S). The winter survey suggests that mean number per tow was highest during 1985 and 1986. The number per tow subsequently declined to 1988, after which the number per tow

increased in Division 4S and decreased in Division 4R. This could be related to the concentration of witch found near the 4T boundary. The mean number per tow in the entire Division 4R and Division 4S area was much higher than present levels during 1978 and 1979 (Figure 4). There was a drop in the mean number per tow in 1980 to a low level.

ESTIMATION OF STOCK PARAMETERS

1) Fishable Biomass

Total numbers at length were estimated from the summer (1987 to 1990) and winter (1983 to 1991) RV surveys for males, females, and juvenile flounder using the computer analysis program STRAP. To obtain estimates of the numbers at length retained by the 130 mm mesh gear, we applied a selectivity ogive to the numbers at length. We applied a length-weight relationship for witch flounder for each sex to convert lengths to weights. The parameters of the power curve were $a = 0.0001117$, 0.00000106 , 0.00000106 , and $b = 1.717$, 3.448 , and 3.508 for juveniles, males and females, respectively. Fishable biomass for each sex was estimated by multiplying the average weight at length by the numbers at length. Fishable biomass from the summer and winter surveys is shown in Table 10. Table 11 shows the total biomass calculated by Bowering (1981) for the years 1978 to 1981.

2) Estimation of Total Allowable Catch

To estimate the total allowable catch we multiplied the fishable biomass times 15 % (Tallman and Forest-Gallant, 1990). This approximates an $F_{0.1}$ level of exploitation (D. Rivard, DFO, Ottawa, Pers. comm.).

Area 4Rd

Because this area is supporting a summer directed fisheries, we calculated the fishable biomass of NAFO Division 4R, subarea d, for the summer and winter surveys. The average fishable biomass for 1987-90 from the summer surveys is 755 t. Fifteen percent of this is 113 t. The average fishable biomass for 1987-90 from the winter survey is 2173 t. Fifteen percent of this gives a yield of 326 t. Figure 5 also shows that the fishable biomass has declined since 1987 to its lowest level.

PROGNOSIS

Trends in the mean number per tow from the survey are difficult to interpret but it appears that numbers were higher in the late 1970s than at present. The winter survey suggests that numbers have declined greatly in Division 4R in recent years. Fifteen percent of the mean fishable biomass (1987-1990) from the summer survey yield 90 t in Division 4R and 283 t in Division 4S. Using the winter survey estimates the values would be 378 t in Division 4R and 654 t in Division 4S. Because of some catches near the 4T boundary, the present stock unit definition may not be appropriate, and should be examined again.

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Table 1. Nominal landings (t) of NAFO Division 4R Witch flounder from 1960-1990 by major gear type.

YEAR	OTB	OTB1	OTB2	SNU	GN	LL	LHP	OTHERS	TOTAL
1960	250	-	-	764	-	-	-	26	1040
1961	129	-	-	1409	-	-	-	14	1552
1962	114	-	-	1433	-	-	-	5	1552
1963	49	-	-	2047	-	-	-	-	2166
1964	304	-	-	1413	-	-	-	-	1717
1965	156	-	-	1464	-	-	-	-	1620
1966	-	184	4	1083	-	-	-	-	1153
1967	1	240	19	786	-	-	-	-	1046
1968	-	286	84	861	-	-	-	-	1231
1969	-	639	175	2427	-	1	-	-	3242
1970	-	576	341	2298	-	-	-	-	3215
1971	17	251	139	1604	2	-	-	-	2013
1972	23	243	207	68	2	-	-	7	550
1973	47	86	35	559	7	9	-	8	751
1974	-	218	720	1259	3	-	-	8	2208
1975	-	288	227	1134	6	4	-	5	1664
1976	-	839	2583	101	9	-	-	91	3623
1977	-	496	858	605	4	-	-	5	1968
1978	-	346	2247	787	2	3	-	44	3429
1979	-	485	1564	1007	20	4	-	7	3087
1980	1	208	1149	797	31	-	-	-	2186
1981	15	44	74	729	15	-	-	-	887
1982	22	52	101	733	17	-	-	-	925
1983	40	6	48	577	10	9	-	-	690
1984	20	8	36	-	15	-	-	-	79
1985	21	6	87	539	-	6	-	-	659
1986	30	4	36	480	3	1	-	-	554
1987	46	-	45	757	-	-	-	-	848
1988	43	2	36	946	31	1	-	2	1061
1989*	-	-	67	771	92	-	-	32	962
1990*	-	8	65	697	20	14	-	4	508
AVERAGE	43	17	349	939	9	2	-	8	1554

*(PROVISONAL DATA)

(GEAT TYPE:OTB=otter trawl (unspecified), OTB1=otter trawl-side, OTB2=otter trawl-stern, SNU=seines, GN=gillnets, LL=longlines, LHP=handlines).

Others includes OTM (midwater trawl,unspecied) OTM1 (midwater trawl-side), OTM2 (midwater trawl-stern), PMT (midwater pair trawl), mis (miscellenous gears, not specified in the purchase slips for the landings), and nk (not known, not filled out on the purchase slips).

Table 2. Nominal landings (t) of NAFO Division 4S Witch flounder from 1960-1990 by major gear type.

YEAR	OTB	OTB1	OTB2	SNU	GN	LL	LHP	OTHERS	TOTAL
1960	44	-	-	-	-	3	-	-	47
1961	58	-	-	-	-	16	1	-	75
1962	37	-	-	1	-	22	-	-	60
1963	236	-	-	5	-	21	4	-	266
1964	182	-	-	-	-	86	-	195	463
1965	333	-	-	-	-	36	-	-	369
1966	-	242	5	-	-	3	-	3	253
1967	-	179	1	-	3	4	1	-	188
1968	-	301	3	-	10	13	-	-	327
1969	3	219	96	-	-	-	-	-	318
1970	11	274	102	-	-	-	-	-	387
1971	-	381	7	-	9	40	-	-	437
1972	7	378	10	-	-	7	-	-	402
1973	19	116	1	-	-	-	-	-	136
1974	-	148	154	-	10	-	-	-	312
1975	61	116	90	-	-	-	-	14	281
1976	98	334	1262	-	-	-	-	24	1718
1977	96	171	359	1	-	-	-	1	628
1978	3	238	510	-	45	-	-	70	866
1979	61	340	219	-	74	7	-	-	701
1980	41	235	465	-	19	27	-	-	787
1981	72	92	158	2	-	18	-	-	342
1982	50	32	19	-	-	2	-	-	103
1983	30	39	4	-	-	1	-	-	74
1984	19	68	8	-	3	11	-	-	109
1985	5	5	6	-	1	-	-	21	38
1986	7	3	2	152	-	-	-	9	173
1987	12	6	31	-	-	2	-	5	56
1988	9	37	13	-	-	-	-	13	72
1989*	-	31	62	-	-	-	-	9	103
1990*	-	14	49	1	1	-	-	17	82
AVERAGE	48	116	117	5	6	10	0.2	12	328

*(PROVISONAL DATA)

(GEAT TYPE:OTB=otter trawl (unspecfied), OTB1=otter trawl-side, OTB2=otter trawl-stern, SNU=seines, GN=gillnets, LL=longlines, LHP=handlines).

Others includes OTM (midwater trawl,unspecied) OTM1 (midwater trawl-side), OTM2 (midwater trawl-stern), PMT (midwater pair trawl), PTB bottom pair trawl, mis (miscellenous gears, not specified in the purchase slips for the landings), and nk (not known, not filled out on the purchase slips).

Table 3. Reported landings (t) of 4RS Witch from 1960-1990 by major gear type.

YEAR	OTB	OTB1	OTB2	SNU	GN	LL	LHP	OTHERS	TOTAL
1960	294	-	-	764	-	3	-	26	1087
1961	187	-	-	1409	-	16	1	14	1627
1962	151	-	-	1434	-	22	-	5	1612
1963	355	-	-	2052	-	21	4	-	2432
1964	486	-	-	1413	-	86	-	195	2180
1965	489	-	-	1464	-	36	-	-	1989
1966	-	426	9	1083	-	3	-	3	1524
1967	1	419	20	786	3	4	1	-	1234
1968	-	587	87	861	10	13	-	-	1558
1969	3	858	271	2427	-	1	-	-	3560
1970	11	850	443	2298	-	-	-	-	3602
1971	17	632	146	1604	11	40	-	-	2450
1972	30	621	217	68	8	7	-	-	952
1973	66	202	36	559	7	9	-	-	887
1974	-	366	874	1259	13	-	-	8	2520
1975	61	404	317	1134	6	4	-	19	1945
1976	98	1173	3845	101	9	-	-	115	5341
1977	96	667	1217	606	4	-	-	6	2596
1978	3	584	2757	787	47	3	-	114	4295
1979	61	825	1783	1007	94	11	-	7	3788
1980	42	443	1614	797	50	27	-	-	2973
1981	87	136	232	7	15	18	-	724	1219
1982	72	84	120	-	17	2	-	733	1028
1983	70	45	52	-	10	10	-	577	764
1984	39	76	44	-	18	11	-	-	188
1985	26	11	93	539	1	6	-	21	697
1986	37	7	38	632	3	1	-	9	727
1987	58	6	76	757	2	-	-	5	904
1988	52	39	49	946	31	1	1	15	1133
1989*	-	31	130	771	92	-	-	41	1065
1990*	-	22	114	398	31	14	-	21	590
AVERAGE	93	306	471	90	15	12	0.2	85	1886

*(PROVISIONAL DATA)

(GEAT TYPE:OTB=otter trawl (unspecified), OTB1=otter trawl-side, OTB2=otter trawl-stern, SNU=seines, GN=gillnets, LL=longlines, LHP=handlines).

Others includes OTM (midwater trawl,unspecied) OTM1 (midwater trawl-side), OTM2 (midwater trawl-stern), PMT (midwater pair trawl), PTB bottom pair trawl, mis (miscellenous gears, not specified in the purchase slips for the landings), and nk (not known, not filled out on the purchase slips).

Table 4. Preliminary landings (t) of NAFO Division 4R Witch Flounder for 1990 by gear and month.

GEAR	MONTH												TOTAL
	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	
OTB1	0	0	0	0	6	2	0	0	0	0	0	0	8
OTB2	29	0	0	0	15	12	2	2	0	0	0	5	65
QTM2	-	-	-	-	-	-	-	-	-	-	-	-	-
PTB	-	-	-	-	-	-	-	-	-	-	-	-	-
TXS	-	-	-	-	1	1	1	-	-	-	-	-	3
SDN	-	-	-	-	42	91	69	45	62	56	32	-	397
SSC	-	-	-	-	-	-	-	-	-	-	-	-	-
SPR	-	-	-	-	-	-	-	-	-	-	-	-	-
GNS	-	-	-	-	-	7	8	2	1	2	-	-	20
LLS	-	-	-	-	-	-	8	3	2	0	1	-	14
LHP	-	-	-	-	-	-	-	-	-	-	-	-	-
LLB	-	-	-	-	-	-	-	-	-	-	-	-	-
FPN	-	-	-	-	-	-	-	-	-	-	-	-	-
OTHERS	1	-	-	-	-	-	-	-	-	-	-	-	1
TOTAL	30	0	0	0	64	113	88	52	65	58	33	5	508

* Values of 0 indicate landings of less than 50 Kg.

- Indicate no landings

(Gear types: OTB1= otter trawl-side, OTB2= otter trawl-stern, QTM2= midwater trawl-stern, PTB= bottom pair trawl, TXS= shrimp trawl, SDN= danish seine, SSC= scottish seine, SPR= pair seine(2 boats), GNS= gillnet set, LLS= set lines, LHP= handlines, LHB= handlines with bait, FPN= uncovered pound nets., FWR= weirs, 66= , RT= rakes and tongs.)

Table 5. Preliminary landings (t) of NAFO Division 4S Witch Flounder for 1990 by gear and month.

GEAR	MONTH												TOTAL
	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	
OTB1	-	-	-	-	-	1	-	1	2	9	1	-	14
OTB2	17	-	-	-	1	3	15	4	5	2	0	2	49
OTM2	-	-	-	-	-	-	-	-	-	-	-	-	-
PTB	-	-	-	-	-	-	-	-	-	-	-	-	-
TXS	-	-	-	-	8	1	1	2	3	-	-	-	15
SDN	-	-	-	-	-	-	1	-	-	-	-	-	1
SSC	-	-	-	-	-	-	-	-	-	-	-	-	-
SPR	-	-	-	-	-	-	-	-	-	-	-	-	-
GNS	-	-	-	-	-	1	-	-	-	-	-	-	1
LLS	-	-	-	-	-	-	-	-	-	-	-	-	-
LHP	-	-	-	-	-	-	-	-	-	-	-	-	-
LLB	-	-	-	-	-	-	-	-	-	-	-	-	-
FPN	-	-	-	-	-	-	-	-	-	-	-	-	-
OTHERS	2	-	-	-	-	-	-	-	-	-	-	-	2
TOTAL	19	0	0	0	9	6	17	7	10	11	1	2	82

* Values of 0 indicate landings of less than 50 Kg.

- Indicate no landings

(Gear types: OTB1= otter trawl-side, OTB2= otter trawl-stern, OTM2= midwater trawl-stern, PTB= bottom pair trawl
 TXS= shrimp trawl, SDN= danish seine, SSC= scottish seine, SPR= pair seine(2 boats), GNS= gillnet set
 LLS= set lines, LHP= handlines, LHB= handlines with bait, FPN= uncovered pound nets.
 FWR= weirs, 66= , RT= rakes and tongs.)

Table 6. Preliminary landings (t) of Witch Flounder in NAFO Divisions 4R and 4S for 1990 by gear and month.

GEAR	MONTH												TOTAL
	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	
OTB1	-	-	-	-	6	3	-	1	2	9	1	-	22
OTB2	46	-	-	-	16	15	17	6	5	2	0	7	114
OTM2	-	-	-	-	-	-	-	-	-	-	-	-	-
PTB	-	-	-	-	-	-	-	-	-	-	-	-	-
TXS	-	-	-	-	-	-	-	-	-	-	-	-	-
SDN	-	-	-	-	42	91	70	45	62	56	32	-	398
SSC	-	-	-	-	-	-	-	-	-	-	-	-	-
SPR	-	-	-	-	-	-	-	-	-	-	-	-	-
GNS	-	-	-	-	-	8	8	2	1	2	-	-	21
LLS	-	-	-	-	-	-	8	3	2	-	1	-	14
LHP	-	-	-	-	-	-	-	-	-	-	-	-	-
LLB	-	-	-	-	-	-	-	-	-	-	-	-	-
FPN	-	-	-	-	-	-	-	-	-	-	-	-	-
OTHERS	3	-	-	-	9	2	2	2	3	-	-	-	21
TOTAL	49	0	0	0	73	119	105	59	75	69	34	7	590

* Values of 0 indicate landings of less than 50 Kg.

- Indicate no landings

(Gear types: OTB1= otter trawl-side, OTB2= otter trawl-stern, OTM2= midwater trawl-stern, PTB= bottom pair trawl

TXS= shrimp trawl, SDN= danish seine, SSC= scottish seine, SPR= pair seine(2 boats), GNS= gillnet set

LLS= set lines, LHP= handlines, LHB= handlines with bait, FPN= uncovered pound nets.

FWR= weirs, 66= , RT= rakes and tongs.)

Table 7. Quota allocation of 1990 management plan for Witch
 Flounder in NAFO Divisions 4R and 4S for 1990
 (M.G. =mobile gear, F.G. =fixed gear).

YEAR	GEAR	FINAL ALLOCATION (tonnes)	LANDINGS (tonnes)	CLOSURE
1990	M.G (>100')	50	69	none
	M.G (65'-100')	90	74	none
	M.G (65'-100) developmental	2140	0	none
	M.G (<65')	1200	416	none
	F.G (<65')	20	28	none

Table 8. Mean number per tow by stratum estimated from catches by the RV *Gadus Atlantica*, 1983 to 1990. Strata between 401 and 408 are in NAFO Division 4T. Strata greater than 800 are in Divisions 4R and 4S.

STRAT	YEAR							
	1983	1984	1985	1986	1987	1988	1989	1990
401	4.00	1.67	.	1.00	.	0.00	.	.
402	2.00	0.00	.	.	.	.	.	.
404	2.00	2.33	.	4.33	.	1.75	.	.
405	1.00	0.33	.	.	0.25	1.50	.	.
407	30.50	10.50	.	21.33	.	48.29	.	64.50
408	13.00	14.14	.	.	8.00	33.75	0.67	.
801	13.67	86.50	153.67	40.33	56.50	37.00	.	.
802	34.57	9.40	96.00	53.00	195.33	146.33	136.33	35.50
803	21.45	31.59	113.40	64.26	53.94	49.44	57.50	52.79
804	12.00	19.00	25.00	.	11.60	.	.	.
805	9.33	.	.	.	.	.	.	.
806	0.50	.	.	.	.	.	.	.
807	4.00	1.83	5.17	1.00	5.02	0.67	0.00	1.33
808	30.13	22.00	43.00	91.10	37.63	5.50	10.17	9.75
809	38.00	67.00	34.13	109.57	62.50	14.00	19.56	6.00
810	7.00	47.00	115.00	15.71	10.25	5.00	2.67	1.67
811	2.57	6.43	4.43	7.25	6.50	1.00	2.50	0.43
812	13.50	10.56	4.71	10.40	2.60	3.46	4.65	1.13
813	10.04	18.40	9.30	36.90	1.50	2.88	5.17	1.50
814	1.33	5.33	5.20	0.00	3.00	0.67	.	.
815	4.00	11.13	18.90	3.50	7.56	6.91	3.17	4.83
816	5.10	18.50	11.25	.	.	4.77	6.00	.
817	3.33	.	.	.	.	.	.	.
818	2.67	.	.	.	.	.	.	.
819	0.00	1.75	4.43	4.20	3.00	2.67	0.40	1.00
820	0.86	3.80	1.60	4.13	2.80	0.00	1.33	0.17
821	0.43	0.40	0.60	0.11	0.33	0.00	0.00	0.83
822	1.90	0.38	4.50	2.56	0.88	0.25	0.13	0.00
823	17.00	26.25	20.33	5.67	.	.	0.50	0.33
824	1.00	1.33	0.00	0.50	.	0.00	.	.
825	1.50	.	.	.	.	.	.	.
826	0.00	.	.	.	.	.	.	.
827	0.00	0.40	0.00	0.00	.	0.20	.	.
828	0.00	.	.	.	.	.	.	.
829	0.00	0.50	.	.	0.50	0.14	0.00	.
830	0.00	0.25	0.20	0.00	0.00	0.00	0.00	0.00
832	0.00	.	.	.	.	.	.	.
833	0.00	0.33	0.67	.	.	0.00	.	.
835	0.00	.	.	.	.	0.80	0.00	0.00
836	0.00	.	.	.	.	0.00	.	.

Table 9. Mean number per tow by stratum estimated from catches by the RV Lady Hammond, 1984 to 1989, and RV Alfred Needler, 1990. Strata between 401 and 408 are in NAFO Division 4T. Strata greater than 800 are in Divisions 4R and 4S.

STRAT	YEAR						
	1984	1985	1986	1987	1988	1989	1990
401	0.00	2.20	.	.	5.27	2.38	2.04
402	.	8.70	3.01	7.00	5.44	5.32	59.77
403	.	51.72	56.76	3.71	39.53	6.00	.
404	2.54	3.25	3.85	8.15	2.67	1.71	4.09
405	2.29	2.25	1.71	6.00	3.45	1.04	1.83
406	.	5.00	5.82	2.69	4.06	0.80	.
407	3.15	3.16	4.44	6.05	11.10	7.91	9.30
408	2.22	3.40	11.38	4.80	3.73	1.97	8.16
409	.	.	.	42.65	28.99	13.42	.
410	.	.	19.55	.	9.86	6.33	.
411	.	.	.	41.29	15.78	.	.
412	.	.	.	64.50	18.35	.	.
413	.	.	.	48.20	21.75	.	.
414	.	.	.	4.00	22.22	.	.
801	38.38	7.08	12.00	2.00	5.59	4.54	18.27
802	8.54	6.06	13.33	8.24	14.18	6.65	7.71
803	7.50	5.27	11.41	5.18	7.31	9.19	10.71
804	8.44	3.18	9.57	6.45	6.35	2.68	.
805	9.29	27.31	14.80	8.70	6.97	1.73	.
806	11.25	0.98	9.84	5.62	6.50	0.33	.
807	1.14	3.26	10.09	3.05	4.18	1.24	.
808	3.48	1.56	3.65	4.08	5.87	2.91	1.97
809	2.76	7.27	.	7.00	4.01	2.00	3.52
810	4.31	17.25	5.04	11.11	6.63	3.00	5.00
811	1.50	10.56	8.49	5.15	1.73	1.67	0.75
812	0.45	1.96	4.41	3.94	2.94	1.77	3.65
813	.	6.45	24.66	7.39	3.14	3.16	4.58
814	.	1.02	.	5.21	6.33	2.33	3.56
815	.	4.82	3.82	3.47	2.07	1.59	.
816	15.13	7.82	15.67	5.78	7.45	4.29	.
817	5.84	14.39	17.19	16.84	9.74	6.26	.
818	14.54	2.81	24.96	19.46	5.53	6.42	.
819	.	3.39	6.80	4.66	4.22	0.67	3.07
820	0.00	2.48	4.95	10.06	19.04	0.33	7.51
821	1.00	0.69	7.04	1.00	1.32	4.00	2.04
822	5.70	0.74	3.27	4.83	5.69	3.37	7.39
823	15.69	7.58	9.84	54.00	30.71	26.00	7.37
824	6.86	2.29	4.00	46.11	5.81	2.35	5.73
825	.	50.65	4.68	.	0.00	.	.
827	.	8.55	1.76	3.41	4.51	.	.
828	.	2.00	1.06	0.50	8.32	10.93	.
829	.	2.23	12.00	0.00	6.21	4.23	.
830	1.59	0.67	5.16	0.25	3.50	1.00	.
831	.	1.96	0.45	10.00	14.56	8.11	.
832	.	40.39	506.19	30.40	39.78	45.91	.
833	.	.	.	0.47	1.06	0.32	0.00

Table 10. Fishable biomass estimated from the summer (1987 to 1990) and winter (1983 to 1991) RV surveys.

		Year								
		1983	1984	1985	1986	1987	1988	1989	1990	1991
Survey	Div.									
Summer	4R					1004	789	327	285	
	4S					1570	2821	2452	715	
Winter	4R	1816	2319	4184	3902	4268	3258	1995	562	1236
	4S	2539	3839	11189	6058	5731	4015	4207	3493	1138

Table 11. Total biomass from winter survey, 1978-81 in Divisions 4R and 4S (from Bowering and Brodie 1980)

		Year			
		1978	1979	1980	1981
Division					
4R		5837	6594	2538	5910
4S		6873	343	20013	7890

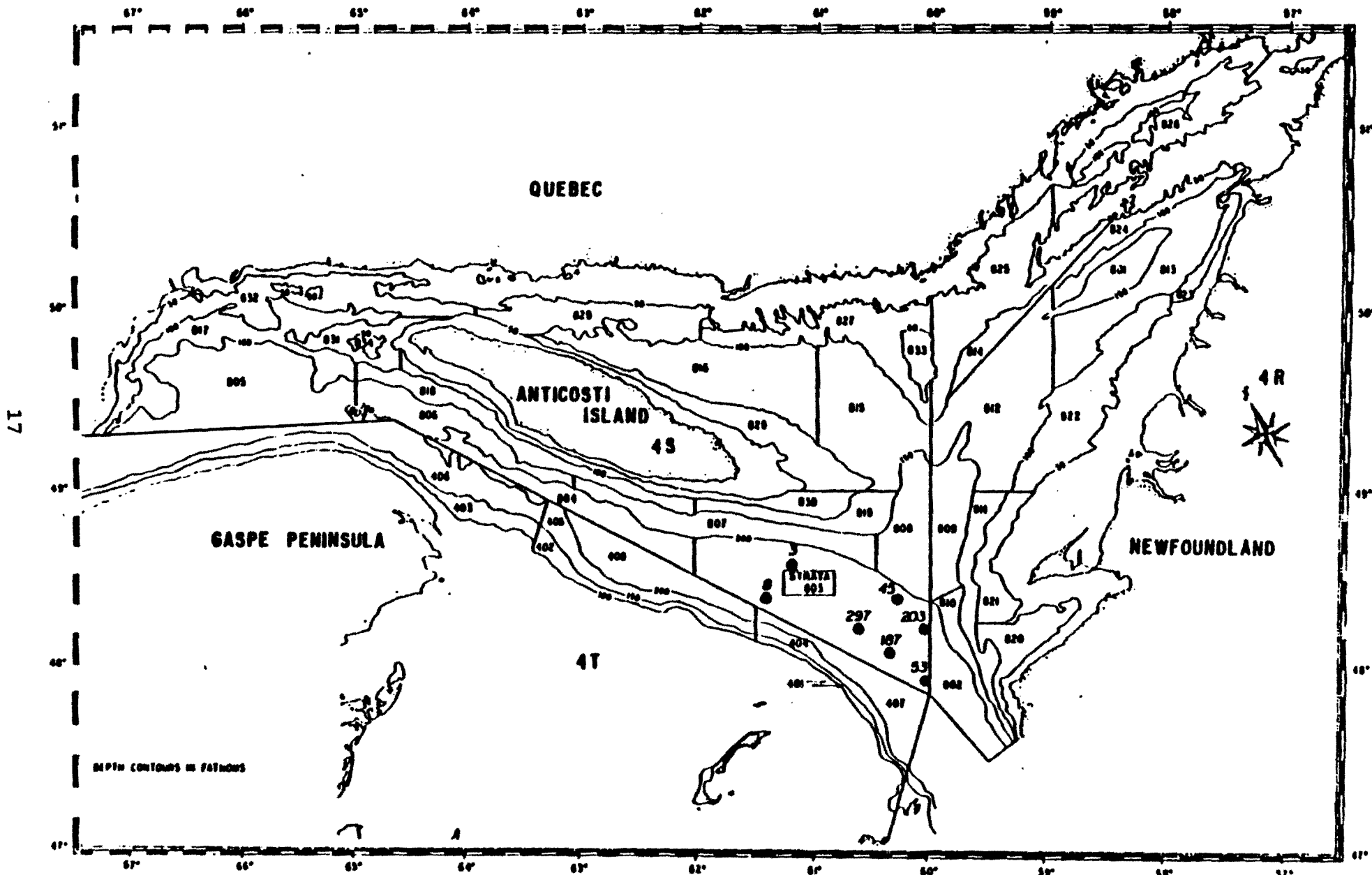


Figure 1. Stratification scheme for the Northern Gulf of St. Lawrence with results of 1980 survey for Stratum 803. Winter survey (after Bowering 1981).

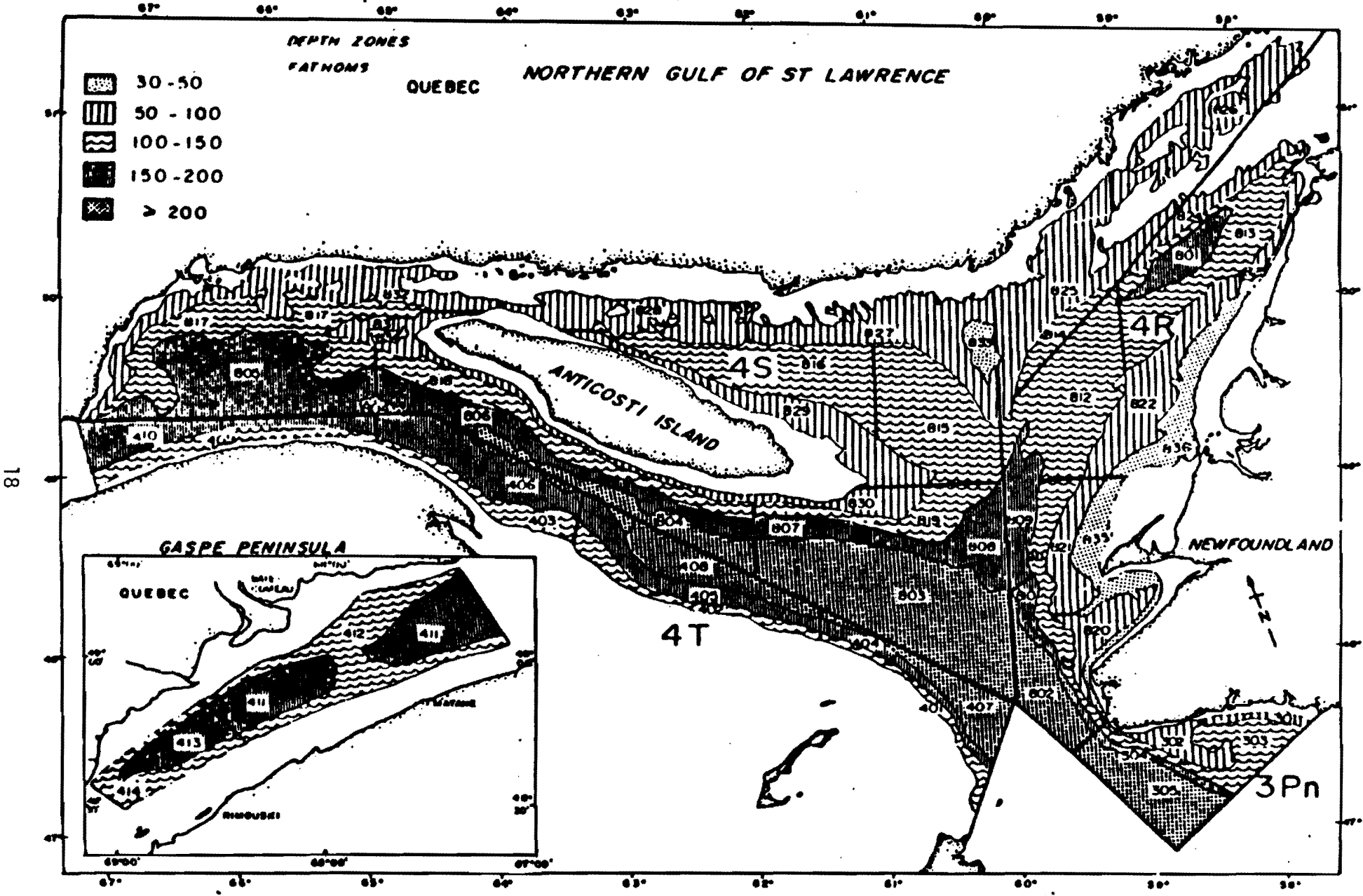
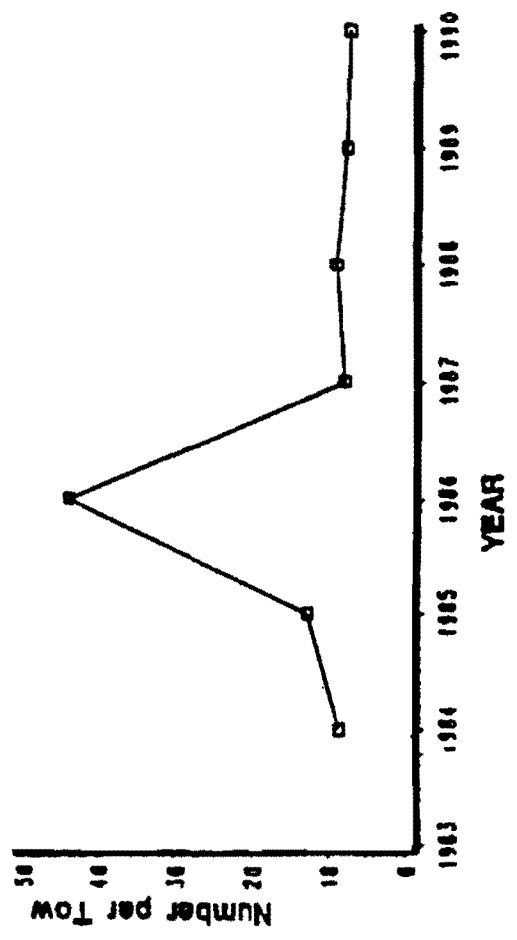


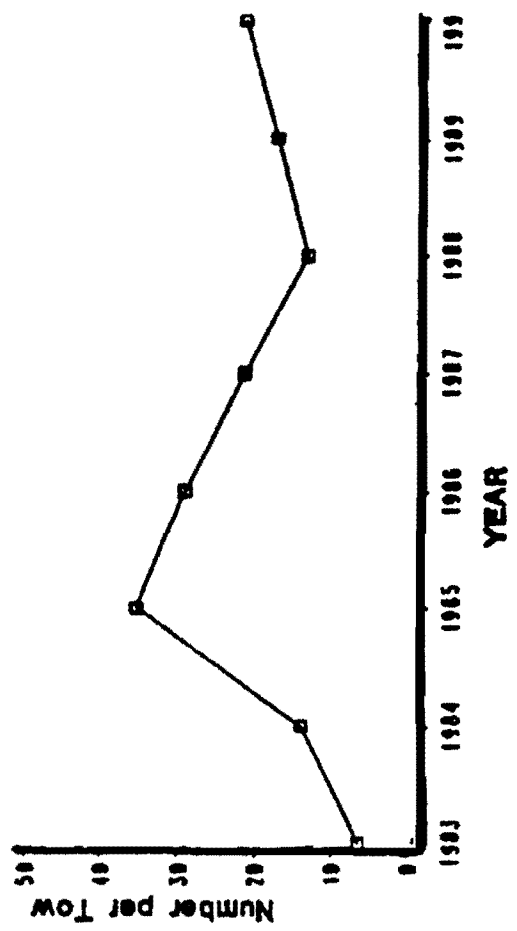
Figure 2: Stratification scheme for the Northern Gulf of St. Lawrence summer survey. (Courtesy of D. Gascon, Can. Dept. Fisheries and Oceans, Quebec Region.)

Figure 3. WITCH FLOUNDER DIVISION-4S SEASON-SUMMER



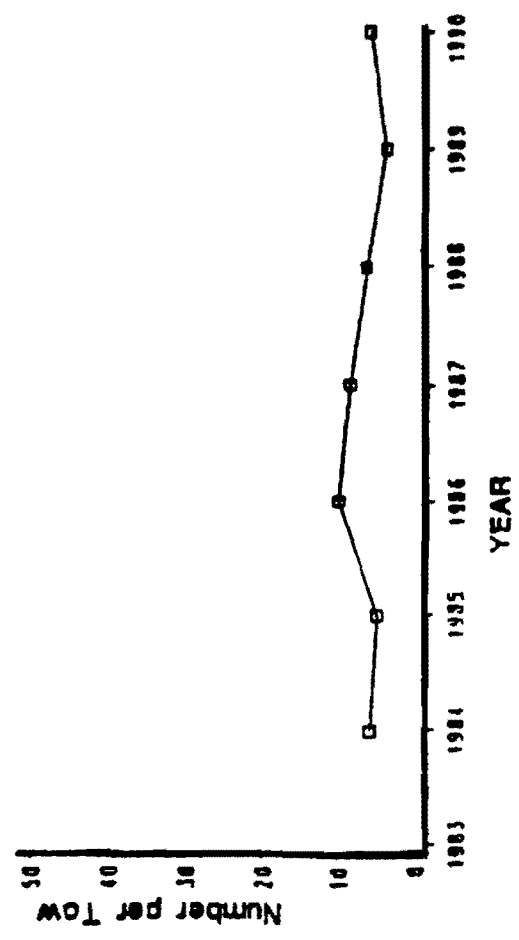
Mean number per tow from research vessel survey

WITCH FLOUNDER DIVISION-4S SEASON-WINTER



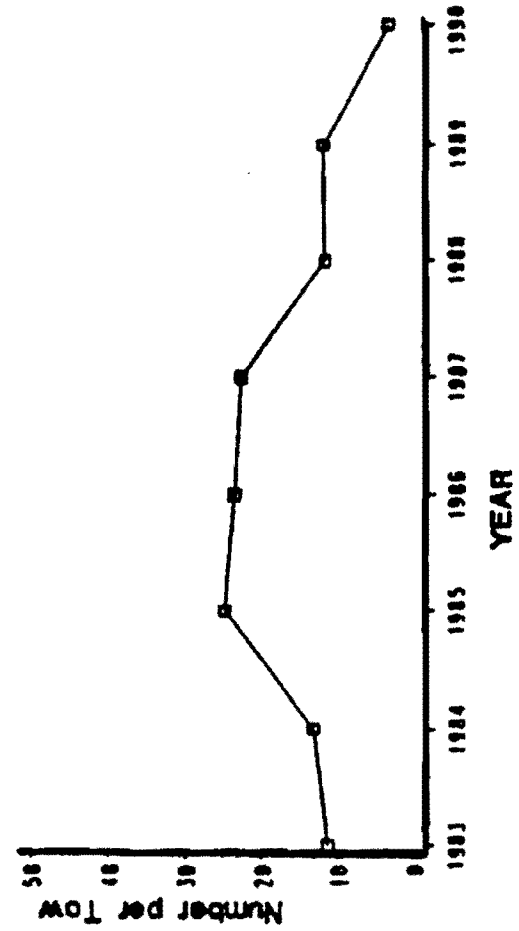
Mean number per tow from research vessel survey

WITCH FLOUNDER / PLIE GRISE DIVISION-4S SEASON-SUMMER



Mean number per tow from research vessel survey

WITCH FLOUNDER DIVISION-4S SEASON-WINTER



Mean number per tow from research vessel survey

WITCH FLOUNDER

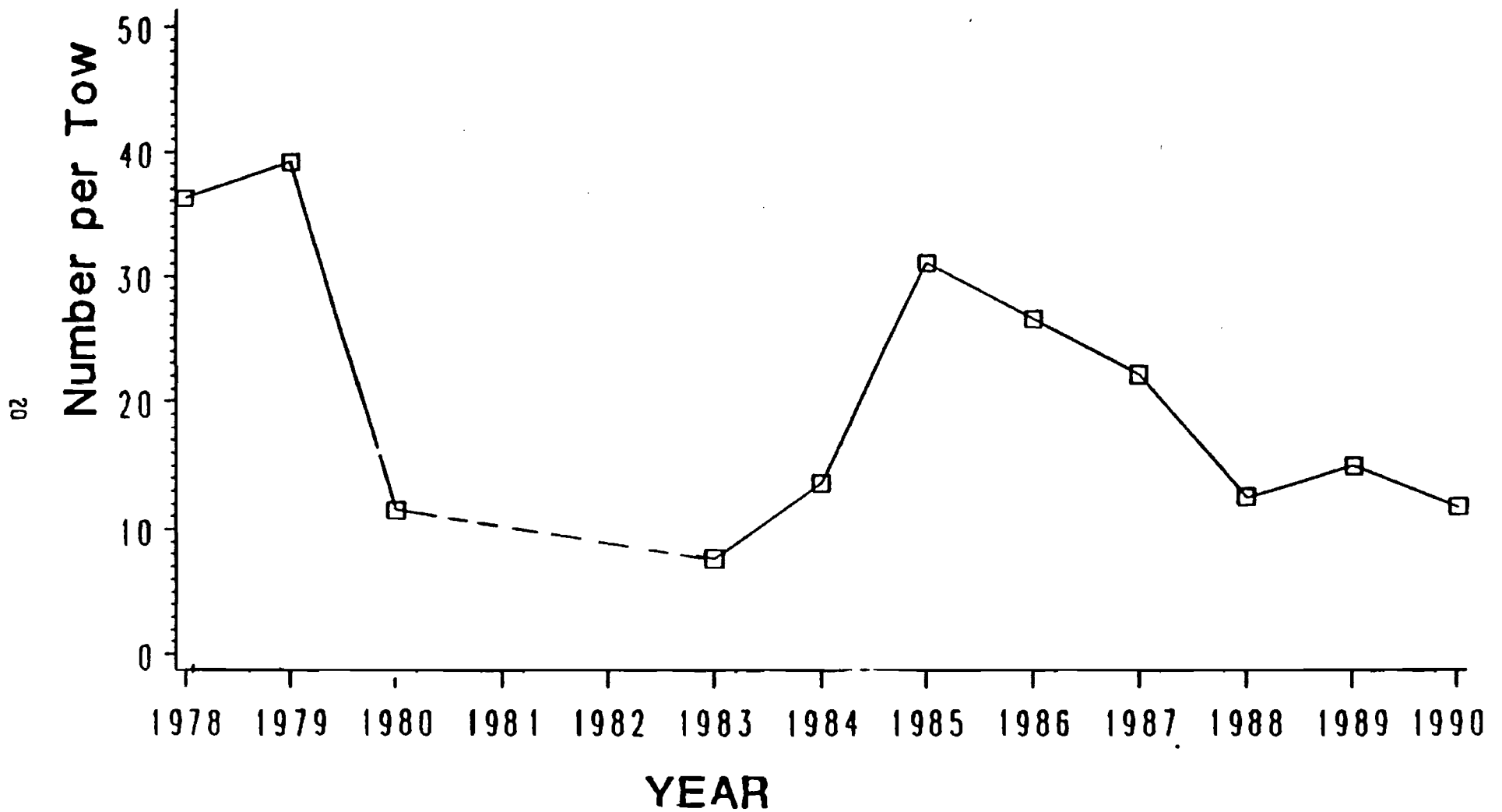


Figure 4. Mean number per tow from winter research vessel surveys in NAFO areas 4R and 4S.

WITCH FLOUNDER

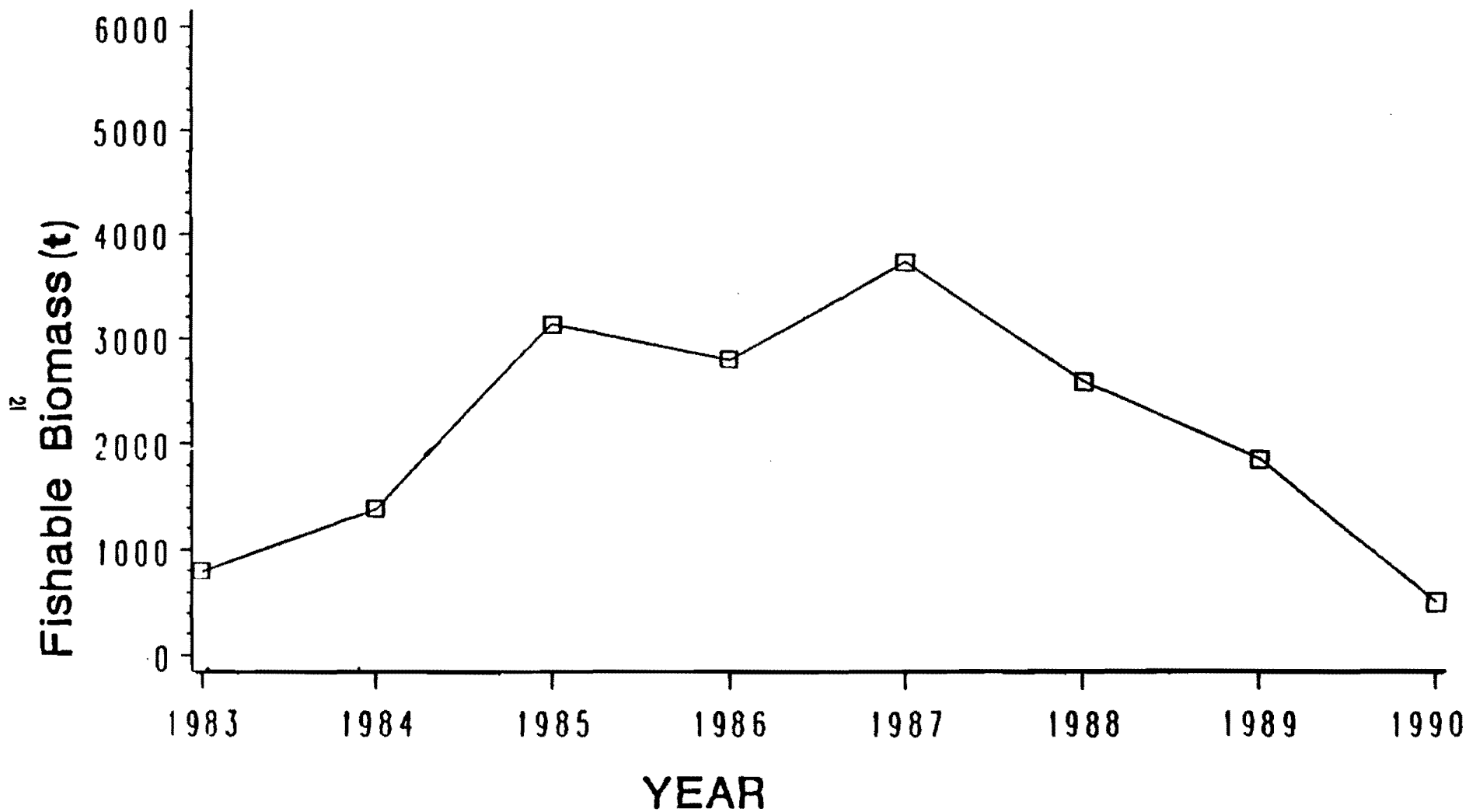


Figure 5. Fishable biomass from summer and winter surveys in NAFO area 4Rd.