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Redfish Catch Results from Summer 2003 Survey in Unit 2

Résultats du relevé du sébaste effectué à l'été 2003 dans l'unité de gestion 2

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FOREWORD

This document was not peer reviewed under the DFO Science Advisory Process coordinated by the Canadian Science Advisory Secretariat. However, it is being documented in the CSAS Research Document series as it presents some key scientific information related to the advisory process.

AVANT-PROPOS

Le présent document n'a pas été revu selon le processus consultatif scientifique du MPO, coordonné par le Secrétariat canadien de consultation scientifique (SCCS). Cependant, il est intégré à la collection de documents de recherche du SCCS car il présente certains renseignements scientifiques clés, liés au processus consultatif.

ABSTRACT

To enhance the fisheries research database in Unit 2, NAFO Subdivisions 3Pn, 3Ps, 4Vn, and 4Vs, the Groundfish Enterprise Allocation Council (GEAC) has funded redfish surveys during winter 1997, and summer 1998, 1999, 2000, 2001, and 2003. The continuing intent is to maintain a series of annual summer surveys to complement current resource assessment activities carried out by the Department of Fisheries and Oceans (DFO). GEAC funded and performed the surveys with scientific guidance from DFO in the design and execution of a stratified random survey and the associated sampling. The data collected during these surveys have been subsequently analysed on behalf of GEAC and for the additional intent of providing this information to DFO, for their databases and their assessment work. This is the sixth such GEAC redfish survey in Unit 2 following on the previous 1997 to 2001 surveys. Catch statistics, length distribution, and stratified analysis estimates of redfish abundance and biomass, and interpretation of results are presented.

The 2003 Unit 2 biomass estimate of 82 ktonnes is down 57 and 45% from the 2001 and 2000 estimates of 141 ktonnes and 169 ktonnes, respectively. The estimate is the lowest in survey history, down 4% from the 1999 estimate of 94 ktonnes. The total abundance in 2003 is 175 million, less than half the 2002 estimate of 404 million and just below the pervious lowest estimate of 182 million in 1999. The greatest decrease is in 4Vs where the biomass estimate is down 60% from the 2001 survey: there appears to be a significant reduction in the numbers of the 1988 year class seen there compared with 2001. The 1988 year-class, remains absent from 3Pn and 4Vn and is at comparable (low) levels in 3Ps. The 1980 yearclass is still present in all subdivisions at magnitudes that are slightly reduced but comparable to the 2001 survey. The greatest concentrations of redfish continue to be along the southeastern slopes of the continental shelf. The numbers of fish within the Laurentian Channel and slopes and on both sides of the Channel appear to be less in 2003. Distributions northwest of St. Pierre Bank in 3Ps which had been somewhat consistent in previous years are smaller in 2003. Depth and oceanographic conditions may be factors associated with these aggregations.

RÉSUMÉ

Pour améliorer la base de données de recherche sur les pêches pour l'unité de gestion 2 (sous-divisions 3Pn, 3Ps, 4Vn et 4Vs de l'OPANO), le Conseil des allocations aux entreprises d'exploitation du poisson de fond (GEAC) a financé des relevés du sébaste effectués à l'hiver 1997 et aux étés 1998, 1999, 2000, 2001 et 2003. Ces travaux ont pour but d'obtenir une série de relevés annuels d'été afin de compléter les activités d'évaluation des ressources que mène actuellement le ministère des Pêches et Océans (MPO). Le GEAC a financé et réalisé les relevés avec l'aide du MPO, qui a fourni des conseils scientifiques pour la conception et la réalisation d'un relevé aléatoire stratifié et des échantillonnages connexes. Les données ainsi recueillies ont été analysées pour le compte du GEAC et en vue de les transmettre au MPO afin qu'il puisse les utiliser dans ses bases de données et ses travaux d'évaluation. Ce document porte sur le sixième relevé annuel du sébaste dans l'unité de gestion 2, lequel donne suite aux relevés effectués de 1997 à 2001. On y présente des statistiques de capture, des données sur la répartition des longueurs, des estimations par analyse stratifiée de l'abondance et de la biomasse du sébaste ainsi qu'une interprétation des résultats.

La biomasse estimée pour l'unité de gestion 2 en 2003, qui se chiffre à 82 kilotonnes, a diminué de 57 % et de 45 % par rapport aux estimations de 2001 et de 2000 qui sont de 141 et de 169 kilotonnes respectivement. L'estimation est la plus basse de l'histoire des relevés, une baisse de 4 % par rapport à celle de 1999 (estimation de 94 kilotonnes). L'abondance totale en 2003, qui se chiffre à 175 millions, correspond à moins de la moitié de l'estimation de 2002 (404 millions) et est légèrement inférieure à l'estimation de 182 millions de 1999, soit l'estimation la plus faible enregistrée lors des relevés précédents. La baisse la plus importante a lieu dans 4Vs où la biomasse estimée a diminué de 60 % par rapport au relevé de 2001; il semble y avoir une réduction importante de l'effectif de la classe d'âge de 1988 dans 4Vs comparativement à 2001. La classe d'âge de 1988 est toujours absente de 3Pn et de 4Vn et atteint des niveaux comparables (faibles) dans 3Ps. La classe d'âge de 1980 est toujours présente dans toutes les sous-divisions, bien que son effectif soit légèrement inférieur, quoique comparable, à celui enregistré lors du relevé de 2001. Les plus grandes concentrations de sébastes se trouvent toujours le long des pentes sud-est de la plate-forme continentale. Leur abondance dans le chenal Laurentien, le long de ses pentes et de ses deux côtés semble moins élevée en 2003. Dans 3Ps, les répartitions au nord-ouest du banc de Saint-Pierre qui avaient été relativement constantes au cours des années précédentes sont inférieures en 2003. La profondeur et les conditions océaniques pourraient être des facteurs liés à ces concentrations.

INTRODUCTION

To enhance the fisheries research database in Unit 2, NAFO Subdivisions 3Pn, 3Ps, 4Vn, and 4Vs, the Groundfish Enterprise Allocation Council (GEAC) has funded redfish surveys during winter 1997, and summers 1998 to 2001, and 2003. These surveys are the only available index of stock condition given the Department of Fisheries and Oceans (DFO) last conducted a Unit 2 redfish survey in 2002 and there are no plans to continue with the DFO surveys. GEAC funded and performed the surveys with scientific guidance from DFO in the design and execution of a stratified random survey and the associated sampling. The data collected during these surveys have been subsequently analyzed on behalf of GEAC and for the additional intent of providing this information to DFO, for their databases and their assessment work. This is the sixth such redfish survey in Unit 2 following on the previous 1997-99 (Power 1999), 2000 (McClintock 2000) 2001 (McClintock 2001), and 2003 (McClintock 2003) surveys. Under contract to GEAC, AMEC has taken the set catch and length frequencies data logged using the DFO FFS system, and performed a first analysis of the survey results. This document presents these results.

METHODS AND MATERIALS

A Stratified Random survey was carried out in Unit 2 by the *M.V. Cape Beaver.* A summary of the trip is presented below.

TRIP 5: STRATIFIED RANDOM SURVEY

Trip 5 was carried out from 17 to 26 August 2005. These dates generally match earlier dates of 26 August to 5 September 2003, 31 August to 9 September in 1999, 16-23 August in 1998, 15-23 August in the 2000, and 10-18 September 2001. The 1997 survey was carried out from 1 to 12 December. The *Cape Beaver,* also performed the 1997, 1999, 2000, and 2003 surveys. The *Cape Ballard*, a ship of comparable size and design, performed the 1998 and 2001 surveys. During the trip, length sampling was carried out on board, and the set details and length frequencies data were logged onboard in the DFO FFS system.

Tows of duration 30 min were conducted at a speed of 3.5 knots using a commercial Engel 170’ bottom trawl with a 105-110 mm lined cod end. Performance of the trawl was checked onboard using the NETMIND system. The trawl gear and configuration were identical to those used in the earlier years with the exception that the 1997-99 surveys did not use a liner.

Set 40 reported zero catch numbers but non-zero catch weight (set sheet noted “"All Marinus measured, Mentella were not measured" with no further

explanation) and was excluded from the analysis. A total of 92 successful stratified random tow sets were completed.

RESULTS AND DISCUSSION

The set details and redfish length frequencies were exported from FFS to create ASCII digital data files.

ACON plots of the 2005 spatial distribution of catch weights are presented in Fig. 1 together with results from the other surveys. Figure 1a shows a map illustrating the location of the strata surveyed. Table 1 presents a summary of the redfish set details and catch numbers and weights. All but one set (number 83) were 30 min duration. All set catches were adjusted to a standard 30 min tow in the presentation of Table 1 and Fig. 1 results and also in the stratified analysis (see below). The redfish were sampled in 1 cm length groupings and all ratio/percentages of catch measured were applied.

The redfish catch number and weight statistics in 2005 were up by about a factor of two compared with 2003. The mean redfish catch for the 92 successful stratified random sets was 607 fish and the mean catch weight was 366 kg. The corresponding values in 2003 were 306 redfish and 131 kg, in 2001, 650 redfish and 207 kg, and in 2000, 553 redfish and 256 kg. The median catch for all sets in 2005 was 171 fish compared with 89 in 2003, 176 in 2001 and 182 in 2000. The median catch weight was 172 kg compared with 49 kg in 2003, 70 kg in 2001 and 96 kg in 2000. The total number of redfish caught in 2005 was just less than 56,000 compared with 29,000 in 2003. The total redfish catch weight in 2005 was just less than 34,000 kg compared with 12,400 kg in 2003. The largest set 91 located in 4Vs along the southeastern slopes in a water depth of 356 m yielded a catch of 7883 redfish weighing 5206 kg. Five additional sets with weights greater than 1000 kg (two sets greater than 2000 kg) were also caught.

As shown in Fig. 1, the 2005 catch weights appear consistently larger than those from 2003 and 2001. While set magnitudes are comparable with 2003 and 2001along the southeastern shelf slopes, in virtually every other subdivision location, the weights appear to be noticeably increased. This is particularly evident in the northern portions of 4Vn and 3Pn near Cabot Strait, and along both sides of the Laurentian Channel, both in 4Vs and on the western slopes of the St. Pierre Bank all the way from St. Pierre to the southern tip of the Bank. Indeed, for the given expanding symbol weight class scale, the 2005 survey catch distribution appears to be as uniformly large as any of the survey years.

Stratified Random surveys analysis was carried out using the DFO stratified analysis STRAP software and applying the French Exclusion Zone around St. Pierre et Miquelon for area calculations. A wingspread of 69 ft was used, consistent with the 1997-2003 analyses.

Table 2 presents mean weight per set and biomass estimates. Observations to make include:

- Overall, in Unit 2, the total biomass estimate for 2005 is 183 ktonnes, more than double the 2003 estimate of 82 ktonnes, up slightly from the 2001 value of 141 ktonnes, comparable to the 2000 estimate of 169 ktonnes and slightly less than the early survey years 1997 and 1998 estimates of 140 and 111 ktonnes. The 2005 estimate is the largest in the past five survey years back to 1999.

- The total abundance estimate of 298 million for 2005 in Unit 2 is increased 70% from the 2003 survey estimate of 175 million, and is itself at least 60-70% of the largest estimates on record: 486 and 497 million in 1997 and 1998, and 404 in 2001.

- In 3Pn, the biomass estimate of 28.2 ktonnes is the largest of any survey year: the next largest being 11.1 ktonnes in 1999.

- In 3Ps, the biomass estimate is 60 ktonnes which is the largest since 1997.

- In 4Vn, the 2005 biomass estimate of 36.7 ktonnes, is increased by more than 100% from that in 2003, and is the largest since 1998.

- In 4Vs, the biomass estimate is 58.6 ktonnes, almost identical to the 2005 estimate in 3Ps. While this estimate is increased almost 70% from the 2003 estimate it is generally on a par or less than the large biomass estimates for 4Vs for the other years.

Figures 6a-c present 3D charts of the Table 2 abundance estimates. Figure 6a shows mean weight per tow by subdivision and by year. Figure 6b shows the total biomass estimate by subdivision and by year. The 2005 estimate appears to be certainly on a par with the largest estimates from 1997 and 1998. The large estimate for 3Pn in 2005 is evident. In 4Vs the 2005 estimate is comparable to that from 1997 while not quite matching the large contributions 4Vs provided in the survey years 1998-2001. The 2005 estimates are similar with those from 1997 and to a degree 1998 in that the abundance estimates are more apportioned amongst the four subdivisions compared with the other years where clearly 4Vs dominates. Indeed, in 2005, the abundance appears to be the most evenly distributed amongst the four subdivisions, noticeably again with much larger estimates for 3Pn.

Figure 6c shows mean weight per tow by stratum for each year. On the x-axis the subdivision, stratum number, and stratum depth range are noted. The stratum are shown left to right for the four subdivisions, and within each subdivision the stratum are listed from shallowest to deepest (as in Table 2). Depth ranges of stratum that are the same as their neighbor listed on their left are left blank. As

noted with Fig. 1, the 2005 survey appears to show uniform contributions from many strata and there does not readily appear to be one or two strata or a depth regime that are exclusively dominant.

There were five strata in 2005 which did not factor into the STRAP estimates since only one set was sampled: strata 309, 310, 313 in 3Ps, 417 in 4Vn, and 468 in 4Vs (the largest set). These sets account for about 20% of the total set catch numbers and weights. Set 66 (one of three sets in stratum 416) appears to actually have been in stratum 417 based on a set depth of 247m, so conceivably it could get rebinned into the shallower stratum 417. A review of these other solitary sets/strata did not suggest any other obvious neighbouring sets that could get "re-assigned" to yield more strata for the STRAP run.

Figure 2 presents the redfish survey abundance index at length values, by sex, for the 1997-2005 Unit 2 surveys. In 2005 there appears to be indication of four population groups. The 1980 year class is present at length about 35 cm and the 1998 year class peaks at about 20 cm. A third peak around 25 cm for males and 26 cm for females corresponds to growth for the 1994 year class which was at a peak of 22 cm for males and 24 cm for females in the 2003 survey [4]. Lastly, there are a largish number of unsexed redfish in the 8 to 10 cm range, which are mostly from 3Pn and also 3Ps. These year classes correspond well to the generalized mean length at age tables for commercial and research survey data (Don Power, pers. comm. March 2006).

Figure 4 presents the male and female abundance distributions for all seven years together. Compared to 2001 and 2003, in 2005 there are generally similar abundance numbers for the 1980 year class centered around 36 cm for females and 34 cm for males. For females in 2005 there are slightly less numbers in the 26-33 cm range compared with 2001 and 2003 but greater numbers for lengths less than about 23 cm. This population at the smaller lengths of about 16-21 cm was initially seen in 2000, also present in 2001, not too visible in 2003, and in 2005 is distinctive and the largest seen to date. A similar pattern is seen for the males, with a slight increase in abundance at lengths less than about 28 cm and a large peak at about 19 cm.

Figure 3 presents the length distributions for each subdivision. The mean number per standard tow is presented. Figure 5 presents the same information, arranged with all years together in a graph for each subdivision. In 3Pn and 3Ps in 2005 there is a noticeable presence of fish at lengths 8-10 cm, something not seen in 2003 although in 3Pn in 2001 there was a similar, though smaller, peak at these small lengths. These 2005 results equate to about the 2003 year class. The 1980 year class at lengths 31-36 cm is present in all subdivisions with the greatest magnitudes in 4Vs and 3Pn. The 1994 year class at lengths 25-26 cm is evident in 4Vs and to a lesser degree in 3Ps but is virtually non-existent to the north in 4Vn and 3Pn. The 1998 year class at lengths 16-22 cm is distinctly present in all subdivisions and of greatest magnitude in 4Vn and 4Vs.

SUMMARY

The following summary observations can be made:

- The 2005 Unit 2 total biomass estimate is 183 ktonnes which is more than double the 2003 estimate of 82 ktonnes and greater than or at least in keeping with the estimates back to 1999 which ranged from 94 to 169 ktonnes.

- The total abundance estimate for Unit 2 in 2005 is 298 million, an increase of 70% from the 2003 survey estimate of 175 million and is itself at least 60-70% of the largest estimates on record: 486 and 497 million in 1997 and 1998, and 404 in 2001.

- In 2005 redfish catches were present in virtually all of the survey set locations indicating a distinctly uniform coverage over Unit 2, perhaps as pronounced as any in the survey history. Of particular note is the greater presence of catches in the northern part of the Unit (in 3Pn, the biomass estimate of 28.2 ktonnes is the largest of any survey year: the next largest being 11.1 ktonnes in 1999) and along the Laurentian Channel.

- In 3Ps, the biomass estimate is 60 ktonnes which is the largest since 1997.

- In 3Pn and 3Ps a distinct population of smaller redfish in the 8-10 cm range is seen in 2005. A smaller representation of these fish was seen in 2001 in 3Pn.

- In 4Vn, the 2005 biomass estimate of 36.7 ktonnes, is increased by more than 100% from that in 2003, and is the largest since 1998.

- In 4Vs, the biomass estimate is 58.6 ktonnes, almost identical to the 2005 estimate in 3Ps. While this estimate is increased almost 70% from the 2003 estimate it is generally on a par with or less than the large biomass estimates for 4Vs for the previous years.

- In each of the four subdivisions there continues to be a presence of fish in virtually all the 1988, 1994, and 1998 year class groupings. An exception is the absence of the 1994 year class in 4Vn and 3Pn to the north.

REFERENCES

Power, D. 1999. The status of redfish in Unit 2. DFO Can. Sci Advis. Sec. Res. Doc. 99/155.

McClintock, J., 2000. Redfish catch results from summer 2000 survey in Unit 2. DFO Can. Sci. Advis. Sec. Res. Doc. 2000/133.

2001. Redfish catch results from summer 2001 survey in Unit 2. DFO Can. Sci. Advis. Sec. Res. Doc. 2001/145.

2003. Redfish catch results from summer 2003 survey in Unit 2. DFO Can. Sci. Advis. Sec. Res. Doc. 2005/061.

Table 1 Summary of Redfish Catches for Stratified Random Survey Sets, Unit 2, 17-26 August 2005.

Cape Beaver (vessel code 47) Trip 5, August 2005						Set Location		Redfish		Set	Tow	Redfish
Set	Day	StrLin	Division	Unit Area	Depth (m)	Latitude (deg N)	Longitude (deg W)	Catch ** # of Fish	Catch ** Weight (kg)	Duration (min)	Distance (n.mi.)	Mean Weight (kg)
1	17	707	3Ps	N32	221	45.05	54.90	1097	738	30	1.9	0.67
2	17	318	3Ps	M32	267	45.13	55.17	2575	1496	30	1.8	0.58
3	17	707	3Ps	M33	595	45.00	55.46	632	582	30	1.7	0.92
4	17	708	3Ps	M33	313	44.98	55.51	764	712	30	2.0	0.93
5	17	318	3Ps	M33	240	44.99	55.58	578	170	30	1.8	0.29
6	17	708	3Ps	M33	476	44.85	55.68	3389	2362	30	1.9	0.70
7	17	398	4Vs	L33	406	44.83	56.62	260	278	30	1.6	1.07
8	17	398	4Vs	L33	406	44.90	56.61	428	446	30	1.7	1.04
9	17	711	3Ps	L33	404	44.97	56.57	231	236	30	1.7	1.02
10	18	711	3Ps	L32	403	45.07	56.56	94	90	30	1.8	0.96
11	18	711	3Ps	L32	409	45.20	56.77	528	560	30	1.7	1.06
12	18	706	3Ps	L32	342	45.35	56.53	199	192	30	1.7	0.96
13	18	316	3Ps	L32	269	45.38	56.44	900	344	30	1.9	0.38
14	18	712	3Ps	L31	398	45.50	56.83	160	176	30	1.7	1.10
15	18	706	3Ps	L31	371	45.61	56.76	61	58	30	1.7	0.95
16	18	712	3Ps	L31	380	45.70	56.91	243	264	30	1.7	1.09
17	18	316	3Ps	L31	271	45.76	56.76	2575	798	30	1.7	0.31
18	18	712	3Ps	K31	436	45.74	57.19	202	218	30	1.7	1.08
19	18	712	3Ps	K31	421	45.76	57.10	86	92	30	1.9	1.07
20	18	706	3Ps	L31	318	45.82	56.89	140	114	30	1.6	0.81
21	19	713	3Ps	K30	446	46.06	57.40	180	210	30	1.7	1.17
22	19	713	3Ps	K30	500	46.08	57.81	55	70	30	1.6	1.27
23	19	705	3Ps	K30	343	46.18	57.37	79	74	30	1.8	0.94
24	19	313	3Ps	K30	250	46.35	57.35	385	146	30	1.7	0.38
25	19	705	3Ps	K30	309	46.47	57.47	123	82	30	1.7	0.67
26	19	713	3Ps	K30	463	46.26	57.89	176	210	30	1.7	1.19
27	19	713	3Ps	K30	462	46.32	57.99	100	118	30	1.7	1.18
28	19	713	3Ps	J30	455	46.35	58.15	181	214	30	1.8	1.18
29	19	714	3Ps	J30	459	46.45	58.12	136	160	30	1.8	1.18
30	19	415	4Vn	J30	448	46.42	58.34	147	174	30	1.8	1.18
31	19	415	4Vn	J29	441	46.52	58.43	156	192	30	2.0	1.23
32	19	714	3Ps	J29	457	46.54	58.30	95	114	30	1.8	1.20
33	20	714	3Ps	J29	459	46.62	58.20	47	56	30	1.7	1.19
34	20	714	3Ps	J29	457	46.61	58.36	84	104	30	1.7	1.24
35	20	415	4Vn	J29	428	46.64	58.45	387	490	30	1.8	1.27
36	20	415	4Vn	J29	440	46.90	58.94	76	104	30	1.8	1.37
37	20	305	3Pn	J28	393	47.19	58.60	107	136	30	1.8	1.27
38	21	716	3Ps	L28	335	47.22	56.90	73	98	30	1.8	1.34
39	21	716	3Ps	K28	324	47.13	57.15	100	132	30	1.8	1.32
41	21	309	3Ps	K28	187	47.36	57.31	285	40	30	1.8	0.14
42	21	306	3Ps	K28	208	47.39	57.49	774	38	30	1.9	0.05
43	21	310	3Ps	K29	208	46.85	57.22	2344	250	30	1.7	0.11
44	21	716	3Ps	K29	318	46.77	57.53	439	278	30	1.8	0.63
45	21	714	3Ps	K29	417	46.71	57.82	127	142	30	1.7	1.12
46	21	714	3Ps	K29	439	46.77	57.96	47	51	30	1.8	1.09
47	21	715	3Ps	K29	359	46.85	57.92	110	128	30	1.9	1.16
48	21	715	3Ps	J28	342	47.05	58.18	155	78	30	1.7	0.50
49	22	306	3Ps	K28	208	47.35	57.96	1020	66	30	1.8	0.06
50	22	303	3Pn	K28	231	47.49	57.98	1453	140	30	1.7	0.10
51	22	303	3Pn	J28	223	47.43	58.09	1510	80	30	1.7	0.05
52	22	303	3Pn	J28	265	47.21	58.33	1653	1166	30	1.7	0.71
53	22	304	3Pn	J28	357	47.19	58.47	113	134	30	2.0	1.19
54	22	304	3Pn	J28	317	47.35	58.80	109	124	30	1.7	1.14
55	22	305	3Pn	H28	396	47.37	59.00	50	64	30	1.7	1.28
56	22	305	3Pn	H28	443	47.26	59.12	144	190	30	1.7	1.32
57	22	305	3Pn	H28	443	47.28	59.22	241	336	30	1.7	1.39
58	22	305	3Pn	H28	445	47.39	59.28	719	1122	30	1.7	1.56
59	22	415	4Vn	H27	533	47.60	59.84	132	194	30	1.8	1.47
60	22	415	4Vn	G27	524	47.70	60.03	34	50	30	1.8	1.47
61	22	415	4Vn	G27	511	47.61	60.08	37	56	30	1.8	1.51
62	22	415	4Vn	H28	509	47.47	59.93	24	36	30	1.7	1.50
63	23	415	4Vn	H28	499	47.44	59.88	8	10	30	1.8	1.25
64	23	415	4Vn	H28	480	47.38	59.75	30	42	30	1.7	1.40
65	23	417	4Vn	G28	275	47.28	60.18	1088	740	30	1.7	0.68
66	23	416	4Vn	G28	247	47.25	60.06	3177	948	30	1.8	0.30
67	23	415	4Vn	G28	229	47.11	60.13	1066	606	30	1.8	0.57
68	23	415	4Vn	H28	436	47.08	59.73	105	130	30	1.8	1.24
69	23	415	4Vn	H29	406	47.00	59.74	90	124	30	1.8	1.38
70	23	416	4Vn	H29	328	46.87	59.76	83	108	30	1.7	1.30
71	23	415	4Vn	H28	445	47.00	59.42	75	98	30	1.7	1.31
72	23	415	4Vn	H28	448	47.03	59.29	102	140	30	1.7	1.37
73	23	415	4Vn	H29	435	46.81	59.35	98	136	30	2.0	1.39
74	23	415	4Vn	H29	433	46.76	59.20	64	88	30	1.9	1.38
75	23	415	4Vn	H29	380	46.66	59.32	225	280	30	1.7	1.24
76	24	416	4Vn	K31	320	45.69	58.00	119	148	30	1.7	1.24
77	24	397	4Vs	K31	461	45.63	57.65	122	166	30	1.7	1.36
78	24	397	4Vs	K31	451	45.57	57.34	230	274	30	1.7	1.19
79	24	400	4Vs	K31	455	45.53	57.65	70	82	30	1.8	1.17
80	24	397	4Vs	K32	459	45.44	57.49	159	198	30	1.8	1.25
81	24	400	4Vs	K32	456	45.31	57.48	139	166	30	1.8	1.19
82	24	398	4Vs	K32	438	45.15	57.02	319	362	30	1.9	1.13
83	24	399	4Vs	K33	441	44.94	57.15	165	198	40	1.7	1.20
84	25	398	4Vs	L33	423	44.89	56.86	317	424	30	1.7	1.34
85	25	398	4Vs	L33	425	44.85	56.91	327	394	30	1.8	1.20
86	25	446	4Vs	K33	329	44.72	57.26	1103	418	30	1.9	0.38
87	25	399	4Vs	L33	420	44.64	56.96	370	462	30	1.9	1.25
88	25	399	4Vs	K33	364	44.52	57.09	4312	2286	30	1.8	0.53
89	25	446	4Vs	K33	302	44.52	57.17	2095	764	30	1.8	0.36
90	25	451	4Vs	K34	350	44.39	57.41	1378	566	30	1.7	0.41
91	25	468	4Vs	K34	356	44.29	57.77	7883	5206	30	1.7	0.66
92	25	451	4Vs	J34	218	44.20	58.21	717	324	30	1.7	0.45
93	26	711	3Ps	L33	390	44.77	56.35	409	226	30	1.8	0.55
						Minimum		8.0	10.0	30.0	1.6	0.0
						Maximum		7883.0	5206.1	40.0	2.0	1.6
						Mean		606.5	366.2	30.1	1.8	1.0
						Median		170.5	172.0	30.0	1.8	1.2
						Standard Error		12.1	7.1	0.0	0.0	0.0
						Total		55794.0	33687.1	2770.0	162.5	
						Count		92	92	92	92	

*** set catch numbers and weights adjusted to a standard 30 minute tow at 3.5 knots*

Table 2 Mean weight (kg) of redfish caught per standard 30 minute tow and survey biomass in UNIT2 during GEAC surveys from 1997-2005. (Numbers in brackets are successful sets, "-" indicates strata not sampled, "x" indicates strata with less than 2 sets). Total abundance estimates are noted at the bottom of the table.

STRATUM	Depth Range (m)	Area sq. n. mi.	1997 Dec 1-12	1998 Aug16-23	1999 Aug31-Sep9	2000 Aug15-23	2001 Sep10-18	2003 Aug26-Sep5	2005 Aug17-26
3Pn									
303	185-274	554	187.8 (2)	651.2 (2)	271.4 (3)	50.9 (3)	89.7 (3)	195.7 (4)	489.18 (3)
304	275-366	151	194.2 (2)	49.8 (2)	36.3 (2)	388.5 (2)	27.5 (2)	79.7 (2)	125.95 (2)
305	367+	733	27.2 (2)	76.8 (2)	96.7 (4)	58.8 (4)	61.9 (4)	146.4 (3)	389.74 (5)
Upper			828.3	982.8	443.2	175.8	147.5	250.2	893.9
Mean			108.4	126.7	157.7	90.4	69.0	108.6	400.35
Lower			-611.6	-729.4	-127.8	5.0	-9.5	-33.0	-93.2
Biomass (metric tons)			**7630**	**8918**	**11100**	**6362**	**4858**	**7646**	**28183**
3Ps									
306	185-274	363	0.1 (2)	11.7 (2)	9.2 (2)	54.5 (2)	100.6 (2)	81.0 (2)	51.0 (2)
309	185-274	296	10.7 (2)	106.4 (2)	411.0 (2)	149.0 (2)	249.9 (2)	98.5 (2)	x (1)
310	185-274	170	-	20.7 (2)	8.4 (2)	70.5 (2)	42.9 (2)	10.9 (2)	x (1)
313	185-274	165	10.6 (2)	10.6 (2)	5.0 (2)	33.0 (2)	40.8 (2)	21.0 (2)	x (1)
316	185-274	189	40.6 (2)	68.3 (2)	19.1 (2)	104.5 (2)	66.2 (2)	84.8 (2)	585.4 (2)
318	185-274	129	1697.5 (2)	-	173.6 (2)	71.0 (2)	47.1 (2)	344.1 (2)	833.0 (2)
705	275-366	195	105.8 (2)	29.1 (2)	32.5 (2)	56.6 (2)	18.5 (2)	38.6 (2)	80.4 (2)
706	275-366	476	-	97.4 (2)	58.3 (3)	49.3 (3)	120.4 (3)	84.1 (2)	131.0 (3)
707	275-366	74	707.3 (2)	931.2 (2)	202.0 (2)	373.5 (2)	169.4 (2)	721.1 (2)	657.7 (2)
715	275-366	128	204.3 (2)	397.1 (2)	249.5 (2)	108.0 (2)	446.1 (2)	45.0 (2)	101.9 (2)
716	275-366	539	-	195.4 (2)	88.1 (3)	80.0 (3)	163.4 (3)	28.2 (3)	169.3 (3)
708	367-549	126	1267.8 (2)	995.3 (2)	1906.5 (2)	1104.5 (2)	382.2 (2)	238.5 (2)	1439.2 (2)
711	367-549	593	482.1 (2)	173.1 (2)	75.0 (3)	172.3 (3)	191.3 (3)	96.7 (3)	289.7 (4)
712	367-549	731	74.5 (3)	160.4 (2)	64.9 (4)	190.8 (4)	119.4 (4)	91.4 (4)	196.0 (4)
713	367-549	851	1285.5 (4)	31.1 (3)	123.1 (5)	113.6 (5)	43.2 (5)	67.1 (5)	172.5 (5)
714	367-549	1047	236.2 (3)	312.4 (3)	99.3 (6)	64.7 (6)	63.0 (6)	28.5 (6)	107.5 (6)
709	550-731	147	-	-	-	-	-	-	-
Upper			903.1	267.4	552.2	184.2	162.6	108.2	308.8
Mean			444.4	173.3	135.5	127.6	117.5	80.3	224.8
Lower			-14.2	79.2	-281.2	71.0	72.3	52.3	140.9
Biomass (metric tons)			**106329**	**50412**	**40273**	**37916**	**34919**	**23853**	**59887**
4Vn									
417	185-274	387	17.9 (2)	347.6 (2)	332.1 (2)	108.5 (2)	85.8 (2)	81.6 (16)	x (1)
416	275-366	671	73.7 (2)	242.5 (2)	118.6 (4)	83.8 (4)	134.7 (4)	83.3 (4)	406.4 (3)
415	367-532	2915	416.7 (7)	347.6 (8)	92.5 (16)	195.5 (16)	68.9 (15)	76.9 (2)	163.8 (18)
Upper			1010.0	648.2	145.1	287.5	122.1	107.9	396.7
Mean			319.9	382.9	120.3	168.2	81.7	55.0	209.2
Lower			-370.2	117.6	95.4	48.9	41.2	81.5	21.6
Biomass (metric tons)			**62219**	**74474**	**23391**	**32714**	**15881**	**15841**	**36717**
4Vs									
446	185-366	313	32.4 (2)	3550.8 (2)	-	542.5 (2)	176.8 (2)	19.1 (2)	580.0 (2)
451	185-366	147	1995.7 (3)	-	-	56.0 (2)	1012.2 (2)	1358.5 (2)	471.2 (2)
452	185-366	345	-	-	-	-	-	-	-
397	367-549	540	1403.5 (3)	279.0 (2)	106.2 (2)	1003.7 (3)	76.9 (3)	220.6 (3)	221.3 (3)
398	367-549	833	51.1 (4)	558.4 (3)	320.6 (3)	258.7 (6)	240.4 (6)	154.0 (5)	394.2 (5)
399	367-549	465	56.3 (3)	132.4 (2)	97.3 (2)	1378.5 (2)	2443.4 (2)	443.6 (3)	1001.1 (3)
400	367-549	270	36.6 (2)	78.4 (2)	93.4 (2)	138.5 (2)	61.4 (2)	60.8 (2)	124.0 (2)
468	367-549	148	1077.6 (2)	-	-	1796.0 (2)	1011.2 (2)	235.1 (2)	x (1)
Upper			828.8	6604.9	357.5	1924.1	2055.4	514.7	981.4
Mean			478.5	747.6	187.3	692.1	643.7	261.6	466.4
Lower			128.1	-5109.7	17.1	-540.0	-767.9	8.5	-48.6
Biomass (metric tons)			**63619**	**88601**	**19329**	**92020**	**85593**	**34782**	**58630**
TOTAL GEAC SURVEY BIOMASS			**239797**	**222405**	**94093**	**169012**	**141251**	**82122**	**183417**
TOTAL ABUNDANCE (millions)			***486***	***497***	***182***	***318***	***404***	***175***	***298***

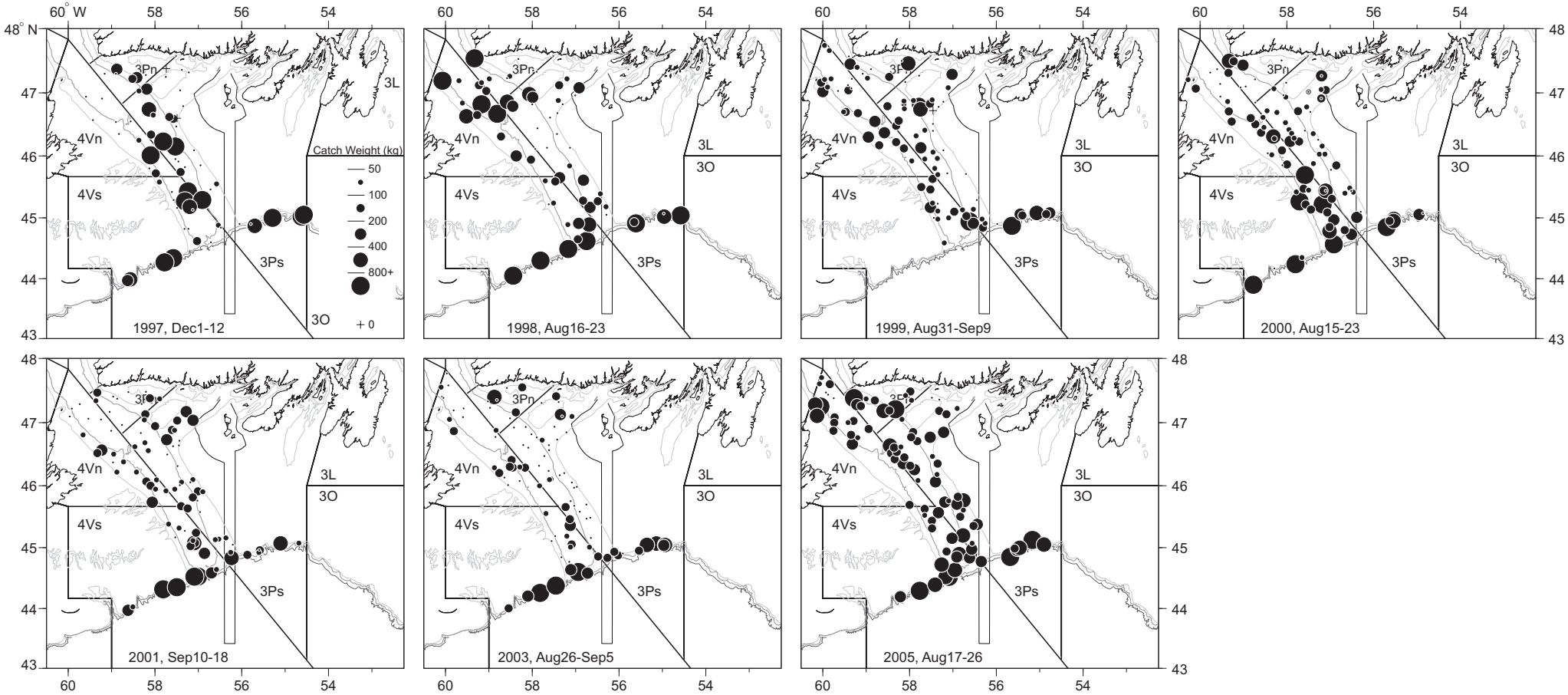

Figure 1 Redfish Catch Weight Distribution from Stratified Random Surveys, Unit 2, 1997-2005. 200, 400, and 800 m depth contours are shown.

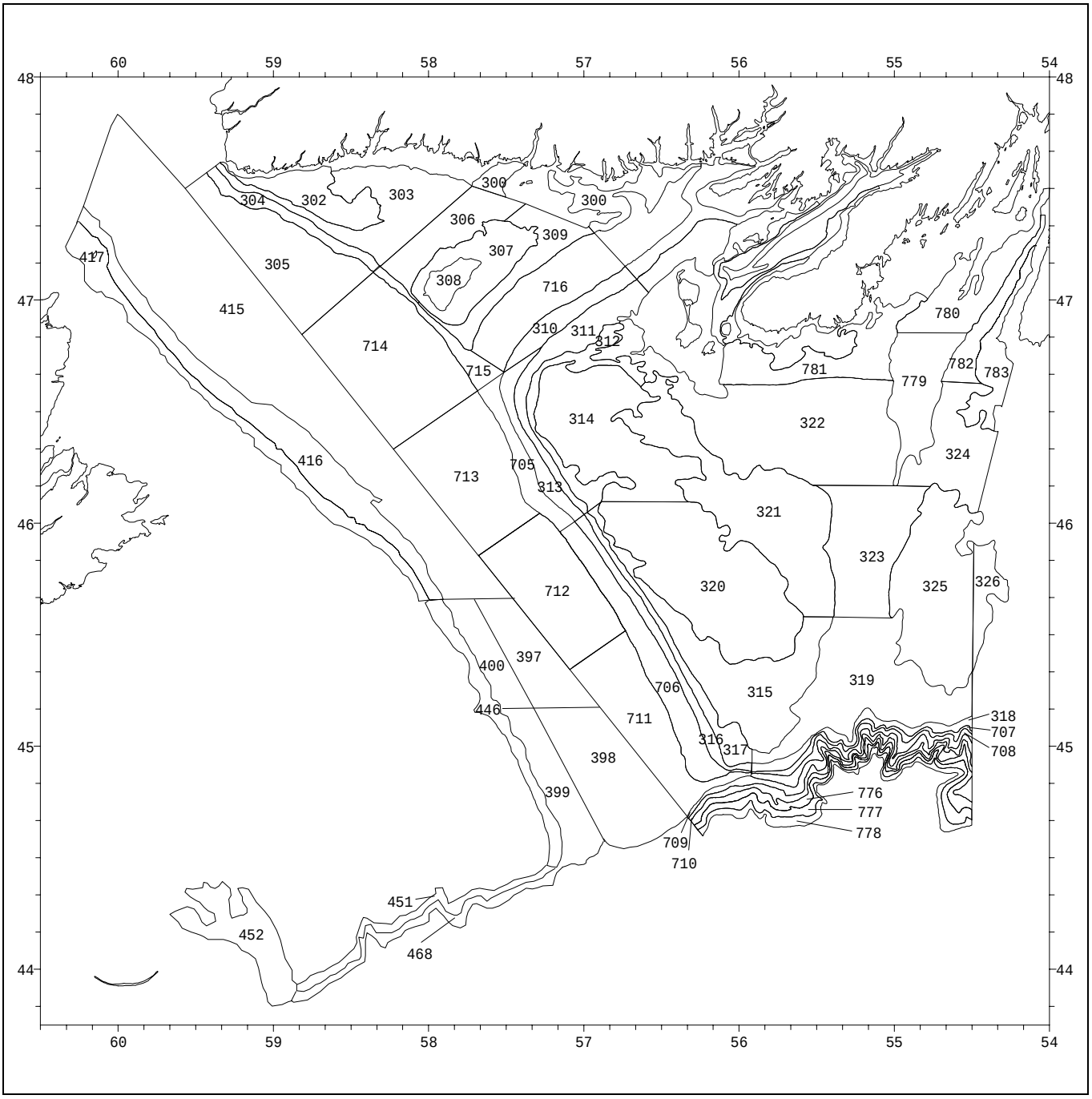

Figure 1a Stratum boundaries within Unit 2.
Numbered strata indicate those surveyed during summer GEAC survey of Unit 2.

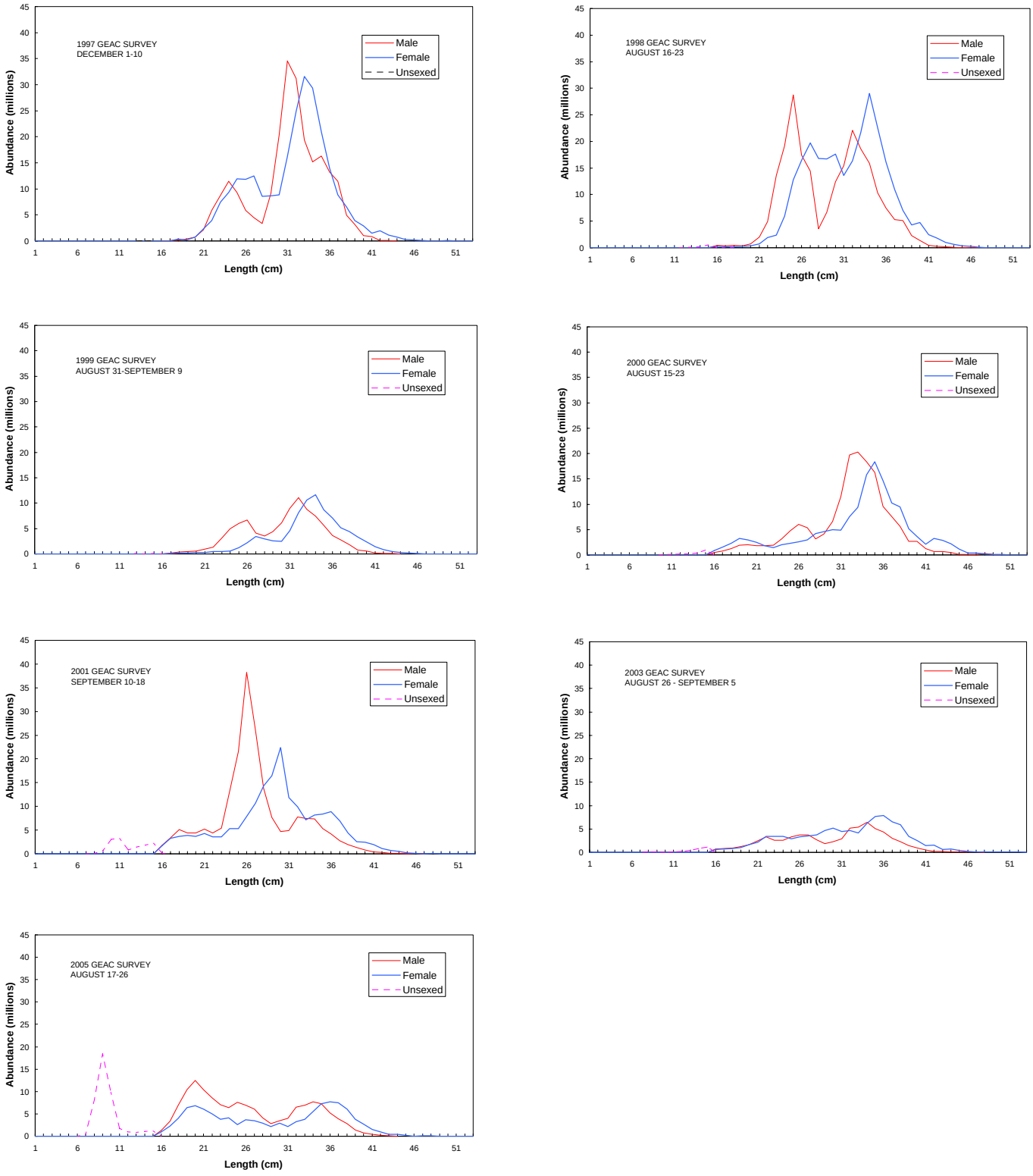

Figure 2 Redfish survey abundance index at length from GEAC Industry surveys of UNIT 2 from 1997-2005.

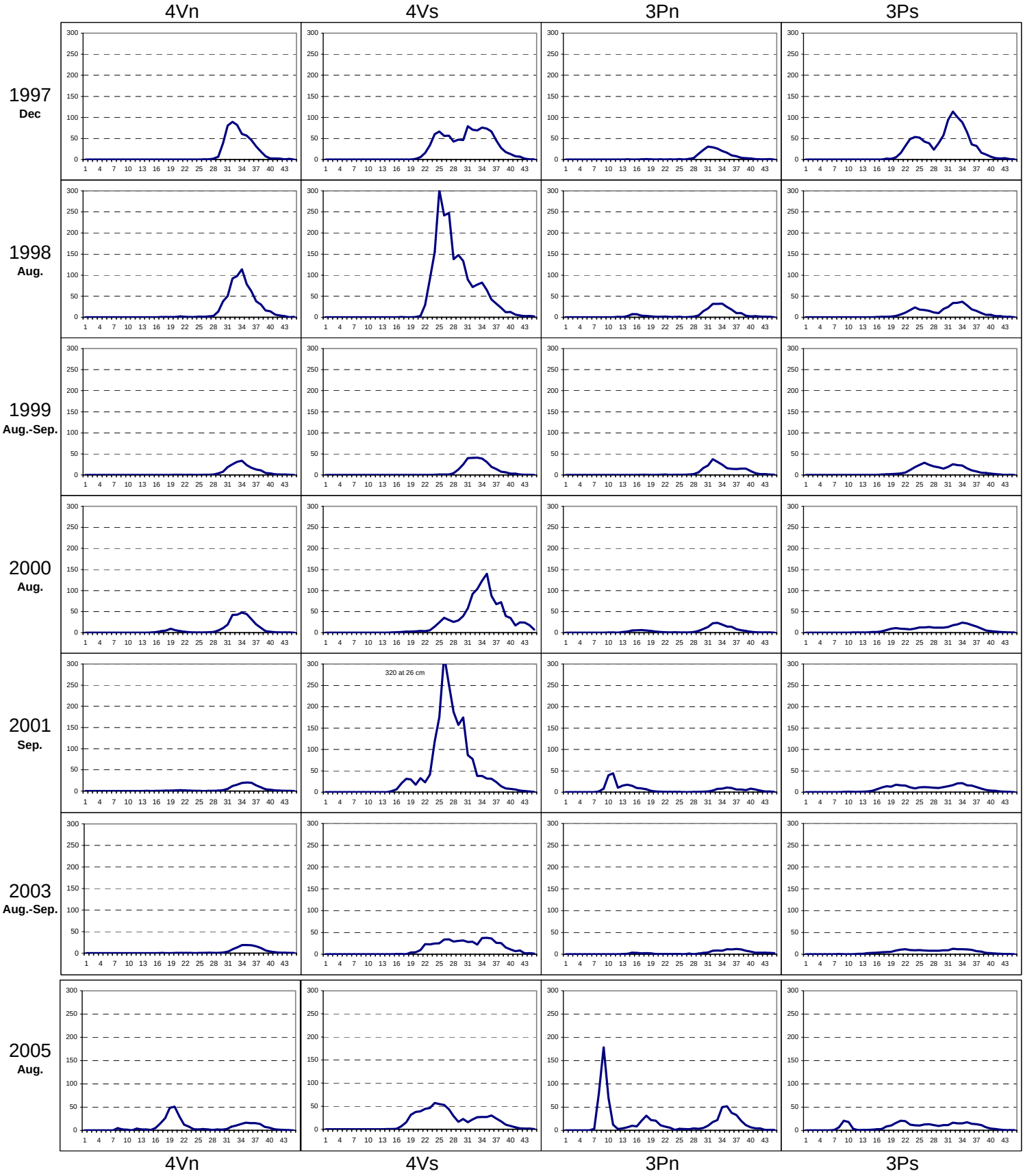

Figure 3 Length distributions from stratified-random GEAC industry surveys to UNIT2 for 1997-2005. Plotted are mean number per standard (1.75 n. mi.) tow. X-axis is forklength in centimetres. The 1997, 1999-2000, 2003 and 2005 surveys were conducted by the MV Cape Beaver and the 1998 and 2001 surveys by the MV Cape Ballard. All surveys utilized an Engel 170 trawl. The 1997-1999 surveys did not utilize a liner.

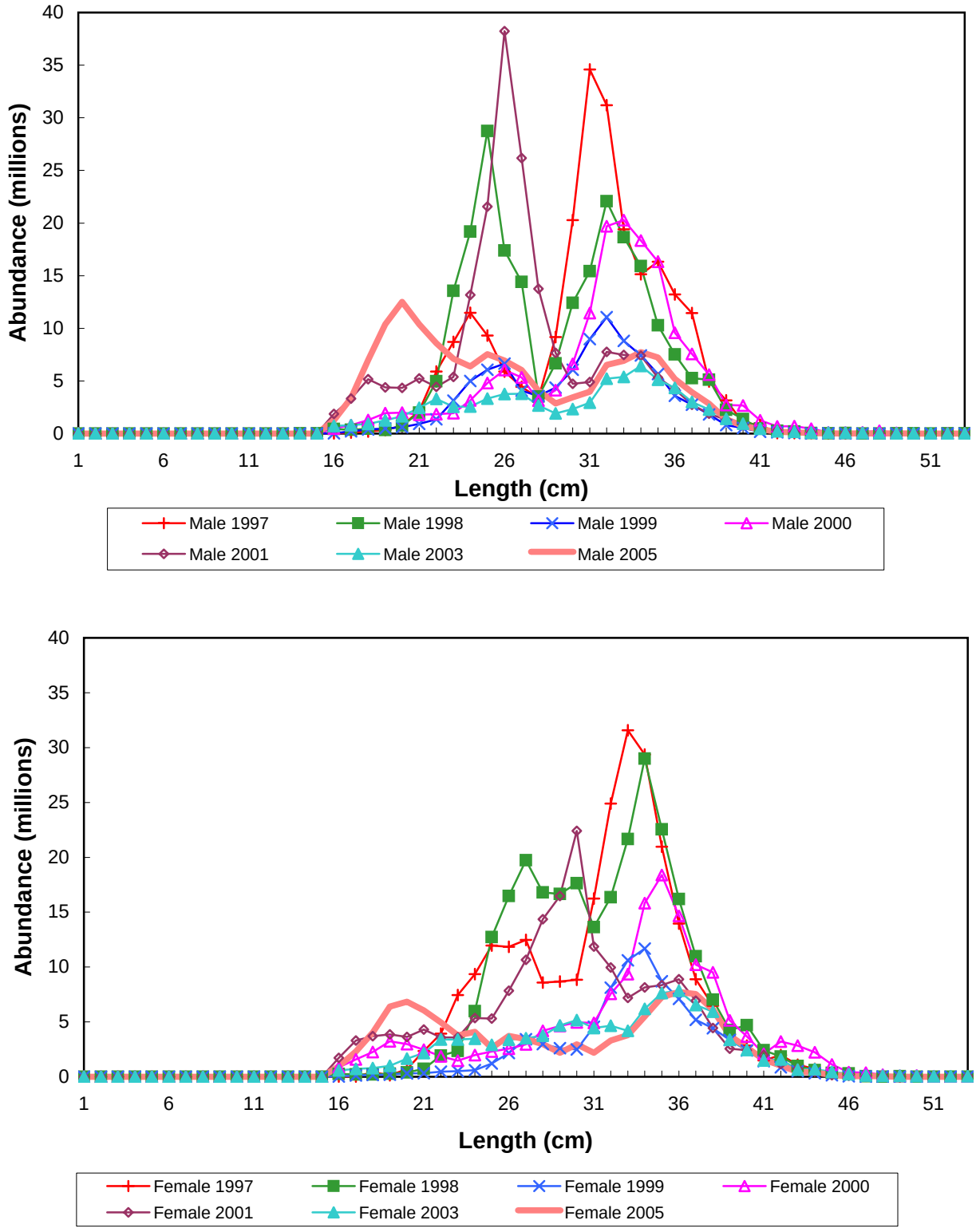

Figure 4 Redfish survey abundance index at length from GEAC Industry surveys of Unit2, 1997-2005. Distributions are shown for male and female populations.

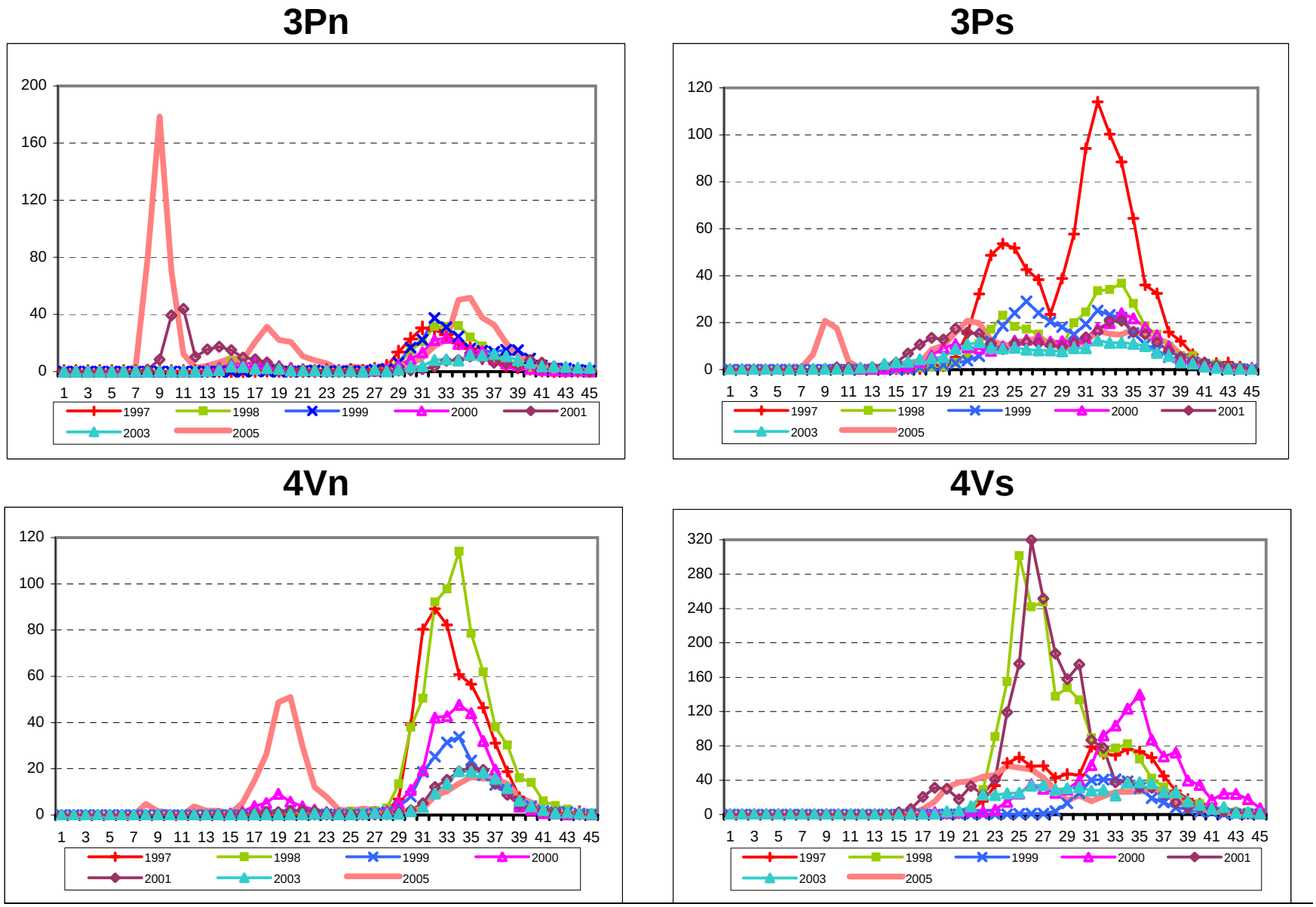

Figure 5 Length distributions as per Figure 3, showing 1997-2005, one panel for each division. Plotted are mean number per standard (1.75 n. mi.) tow. X-axis is forklength in centimetres. Note different y-axis scales.

Figure 6a Redfish, Unit 2, 1997-2005, Mean Weight Per Tow

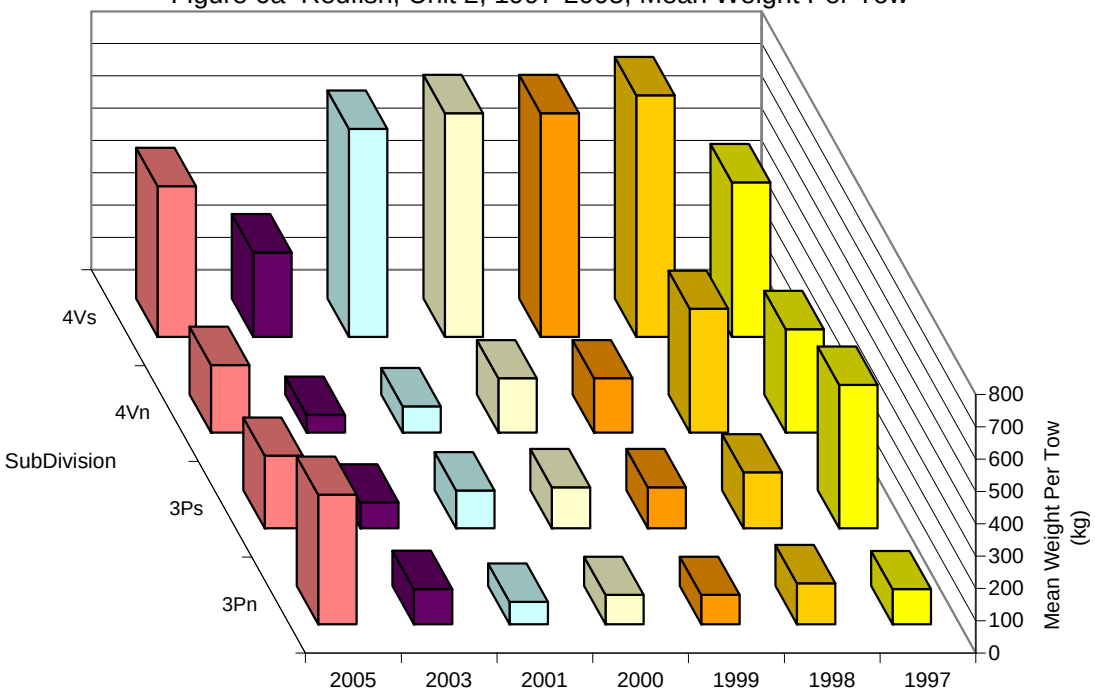

Figure 6b Redfish, Unit 2, 1997-2005, Total Biomass Estimate

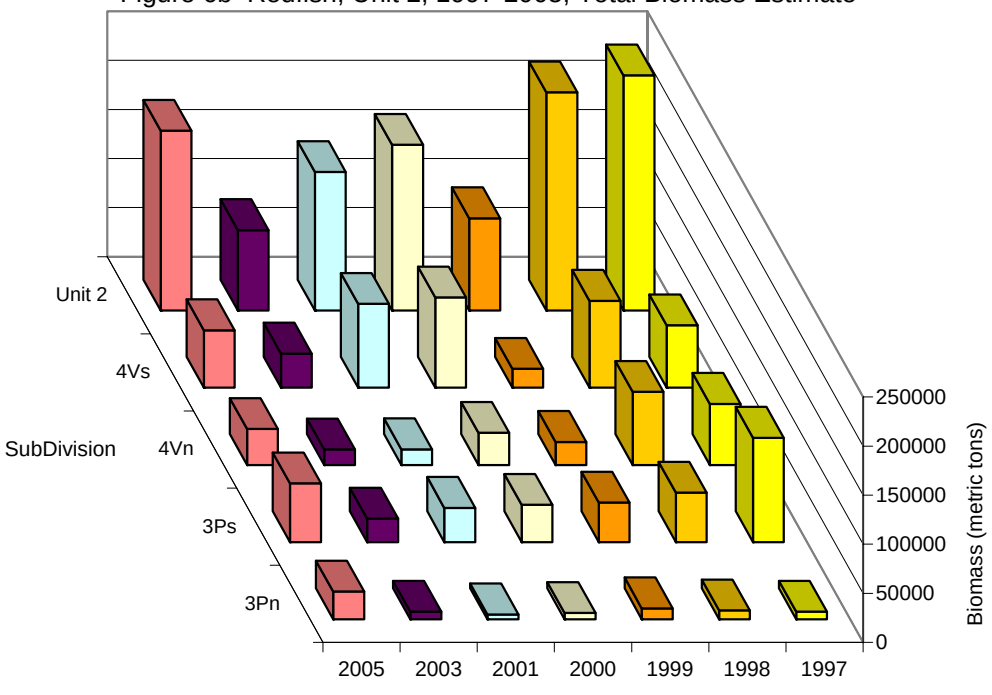

Figure 6c Redfish, Unit 2, 1997-2005, Mean Weight Per Tow