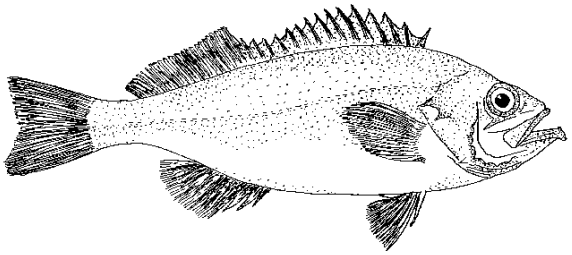

Status Of Redfish Stocks in the Northwest Atlantic: Redfish in Units 1, 2, and 3, and in Division 3O

Background

Redfish assessments have been reviewed at zonal meeting since 1995. Following the redefinition of redfish management units in 1993, it became evident that these various management units were closely linked, and that there was a need to co-ordinate the research and the assessment of these resources.

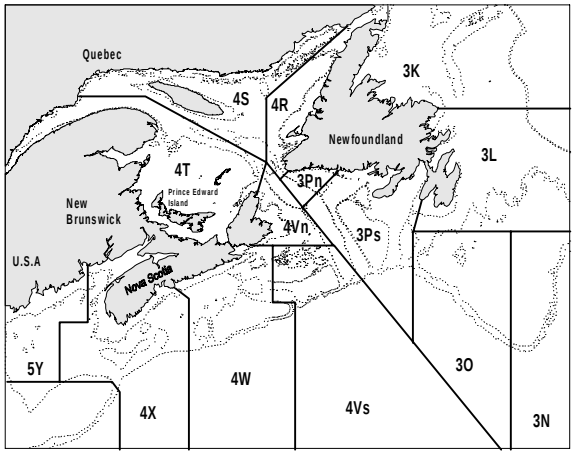

Figure 1. Map of the Northwest Atlantic.

Redfish Overview

Redfish, also known as ocean perch or rosefish, belongs to a group of fish that are commercially exploited in both the Atlantic and Pacific Oceans. They occur on both sides of the Atlantic Ocean in cool waters (3° to 8° C) along the slopes of fishing banks and deep channels in depths of 100-700 m. In the west Atlantic, redfish range from Baffin Island in the north to waters off New Jersey in the south.

Three species of redfish are present in the Northwest Atlantic (*Sebastes mentella*, *S. fasciatus* and *S. marinus* (=*S. norvegicus*)). These three species are similar and are nearly impossible to distinguish by their appearance. They are not separated in the fishery, and they are managed together.

Except for the area of the Flemish Cap, *S. marinus* is relatively uncommon. Along the continental shelf and slope, *S. mentella* is the only species in the far north (Davis Strait) and *S. fasciatus* is the only species in the south (Gulf of Maine). In the intermediate areas, a mixture of the two is found, with *S.* mentella generally a higher percentage in

more northerly samples, and *S. fasciatus* generally a higher percentage inmore southerly samples. Also *S. mentella* is generally distributed deeper than *S. fasciatus*. The exception to this general trend is the Gulf of St. Lawrence where *S. mentella* dominates.

Redfish are slow growing and long lived. Specimens have been aged to at least 80 years. Growth rates differ among the species of redfish, wirh *S. fasciatus* smaller at each age than *S. mentella*. Growth is usually faster in southern areas than in northern areas, and females grow faster than males.

On average, redfish take approximately 8 to 10 years to reach commercial size (25 cm or 10 inches). The length at which females mature is also a few cm longer than in males, although the length at which half the females are mature varies throughout their range; for example ranging from 24.4 cm (9.6 inches) in 4W to 29.6 cm (11.7 inches) in 3P.

Unlike many other fish species, fertilisation in redfish is internal and females bear live young. Mating occurs in the fall and females carry the developing young until the spring when they are released from April to July. In all areas examined, *Sebastes mentella* release their young a month earlier than *S. fasciatus*.

Recruitment success in redfish is extremely variable, and significant year-classes have been observed at intervals from 5 to 12 years apart. Again, the difference between strong and weak year-classes appear to be somewhat less in the southern part of the range of redfish. Moreover, some year-classes which appeared strong at young ages in research surveys have subsequently failed to contribute significantly to fisheries or surveys.

In addition to being found near the bottom, redfish are often distributed well up in the water column. Fisheries take place using both bottom and mid-water trawls. The vertical distribution of redfish in the water column varies both diurnally and seasonally, which affects catches in both commercial fisheries and research surveys.

At present, there are eight (8) redfish management areas in the Northwest Atlantic: Subarea 2 + Division 3K, Divisions 3LN, Division 3O, Division 3M (Flemish Cap), Unit 1 (Gulf of St. Lawrence), Unit 2 (Laurentian Channel), Unit 3 (Scotian Shelf) and Gulf of Maine (Subarea 5). The current management units are thought to be more biologically appropriate than stock boundaries used in the 1980s. Nonetheless, uncertainty remains about the amount of exchange among units.

Canada has prosecuted redfish fisheries since the late 1940s. The most commonly fished areas have been Subarea 2 + Division 3K, as well as Units 1, 2 and 3.

Assessment and management strategies employed for redfish stocks have been the same as those applied to other groundfish. Reference levels for sustainable exploitation of Canadian Atlantic redfish stocks are based on $F_{0.1}$ (12% exploitation rate) and F_{MAX} (24%) or MSY (maximum sustainable yield) and 2/3 the effort at MSY. These estimates of sustainable exploitation rates assume that natural mortality is 0.1 (about 8% of commercial size redfish will die each year from causes other than fishing).

Some other jurisdictions which manage species of *Sebastes* assume lower natural mortality rates (0.05 or even lower), on the basis of directed research and the presence of old *Sebastes* in research and commercial samples. Comparable studies have not been completed for *Sebastes* in the Canadian Atlantic, and the assumption that m=0.1 has been used for these stocks for over 30 years. As a result, the reference exploitation levels for Canadian Atlantic *Sebastes* stocks are

high, compared to some other parts of the world, and the reference exploitation rate of 12% of total exploitable biomass should be considered an upper limit for conservation.

A minimum legal fish size of 22 cm was introduced in redfish fisheries, first in 1995 in Divsion 3O, and in 1996 to the other management areas.

Because of their biology, the pattern of recruitment, and the presence of two or three species currently indistinguishable on a routine basis, management strategies and tools developed for other groundfish are not easy to apply and may not be appropriate for redfish. There is a need to develop new approaches, specific to redfish, to better understand and manage these stocks.

In recent years, with the decline of other groundfish, many sectors of industry have shown a renewed interest in redfish. This was particularly true in the Gulf of St. Lawrence (Unit 1), off Newfoundland's south coast (Unit 2) and in the Scotian Shelf area (Unit 3). Although Division 3O has been traditionally avoided because of small fish, interest in fishing this area increased as well.

Industry has expressed a great deal of concern about the status of these redfish resources. Questions of stock structure, recruitment, assessment, and management approaches have been identified by stakeholders as the major issues, This has led to the establishment of a joint DFO/Industry Multidisciplinary Research Programme on redfishes in these areas.

What follows includes information specific to four redfish stocks (Units 1, 2, 3, and Division 3O). It was prepared at a meeting of a zonal working group of redfish scientists held in Moncton during November 4-6 1998. Redfish assessments were updated following the completion of the 1998 summer groundfish surveys on the Scotian Shelf (conducted by the Maritimes Region), in the Laurentian Channel (Newfoundland Region) and the Gulf of Saint Lawrence (Laurentian Region).

Members of industry participated in the reviews of the redfish stocks, and contributed significantly to the interpretation of data that were presented during the meeting. Past industry concerns that all redfish assessments were heavily dependant on abundance estimates from a single research survey time series remained, but surveys sponsored jointly or totally by industry contributed significantly to these assessments. In Unit 1 joint surveys included two sentinel survey series with cod as the primary target, in cooperation with the Fisheries, Food and Allied Workers Union, Association des Capitaines Propriétaires de la Gaspésie (ACPG) and a grid-based survey by the Groundfish Enterprise Allocation Council (GEAC). In addition there was a survey by GEAC in Unit 2, and in Unit 3 a survey by the 4X mobile gear ITQ fleet. These surveys add substantially to the information available for evaluation of stock status.

For more information

See following evaluations of individual Units.

Unit 1 Redfish

Background

Redfish in the Gulf of St. Lawrence was previously managed as Divisions 4RST. In 1993, Divisions 3Pn and 4Vn , from January to May, were included in the management unit to take into account the winter migration of redfish in these areas.

The directed redfish fishery in Unit 1 was closed in 1995 due to low stock abundance and the absence of significant recruitment since the early 1980s.

In response of the FRCC recommendations for 1998 to gather more information on Unit 1 redfish, Redfish Industry Surveys (RIS) were established with two components : two scientific surveys and indexed fishing trips. A maximum catch of 1,000 t was allowed in 1998 for the RIS.

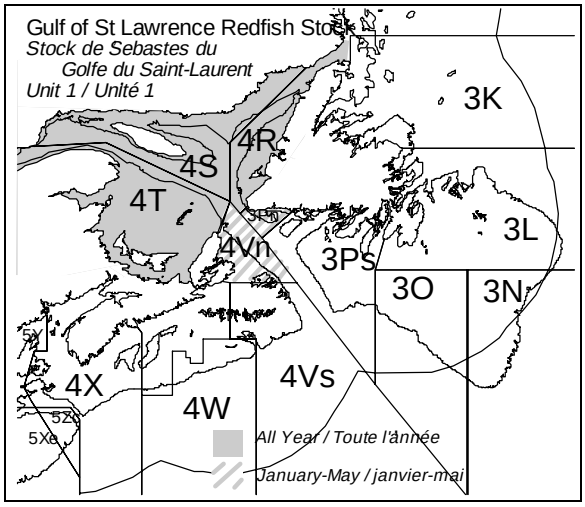

Figure 2. Map of the Gulf of St. Lawrence and nearby regions showing Unit 1 redfish stock.

The Fishery

The redfish fishery in the Gulf of St. Lawrence has been characterized by two periods of high exploitation; the first one at the beginning of the 1970s and the second in the 1990s (Figure 3). These two periods are closely linked to the recruitment of strong year-classes. Following these peaks, landings dropped rapidly. For the most recent years, landings have decreased from 77,000 t in 1992 (old management units) to about 19,500 t in 1994. The TAC for Unit 1 redfish was set at 60,000 t in 1993 and reduced to 30,000 t in 1994. The directed redfish fishery in Unit 1 has been closed since 1995 due to low stock abundance and the absence of strong recruitment since the early 1980s.

Landings (thousand tonnes)

Year	70-76 Avg.	77-93 Avg.	1994	1995[1]	1996[1]	1997[1]	1998
TAC	-	-	30	0	0	0	1[2]
Can.	79	38	19	0	0	0	
Others	3	0	0	0	0	0	
Totals	82	38	19	0	0	0	

[1] Provisional

[2] Redfish Industry Surveys

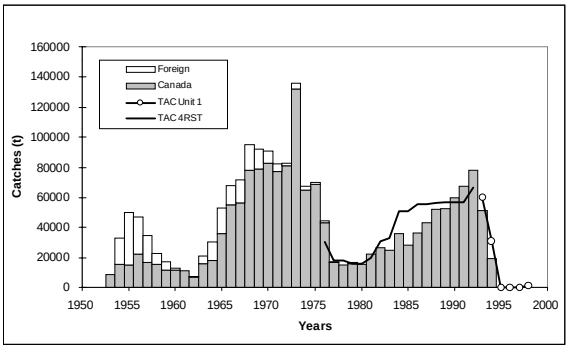

Figure 3. Landings and TACs in tons.

Resource Status

Since 1990, stratified-random groundfish surveys have been conducted in 4RST in August-September on the Alfred Needler (Figure 4). The biomass index from these surveys declined consistently from 1990 to 1995. From 1996 to 1998, the Index remained low. A comparison to the 1984-1989 Lady Hammond Index series showed that the peak of abundance was in 1988 and the biomass index has been declining since then.

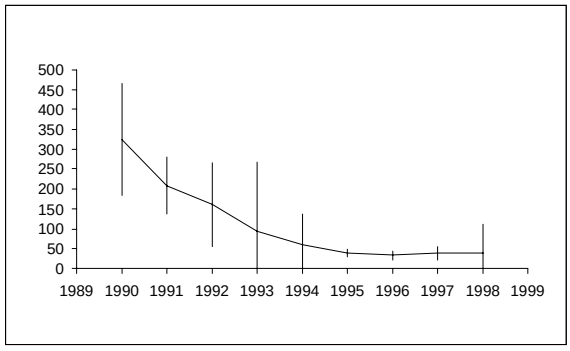

Figure 4. Research vessel survey biomass index (in thousands of tons).

During the period of decline, the distribution of redfish became more restricted and concentrations are mainly found now in the Cabot Strait area (Figure 5) in divisions 4R and 3Pn (considered as part of Unit 2 the period of decline). The highest survey catch in 1998 inside the Gulf was observed close to the Gaspe Peninsula in division 4T. This tow accounted for a large part of the biomass index variance.

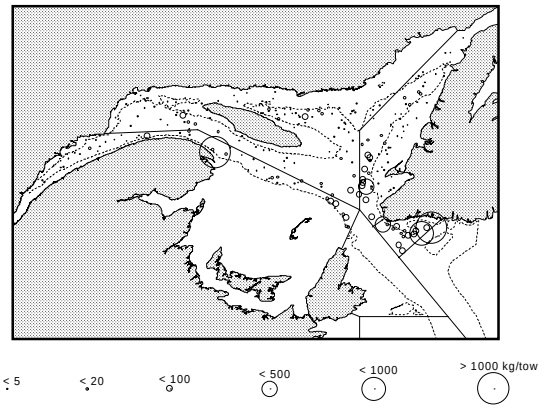

Figure 5. Redfish catch distribution on research vessel survey in August 1998.

Numbers at length from the summer surveys (Figure 6) for the period 1990 to 1998 indicate the presence of only two important modes, corresponding to the 1980 and 1988 year-classes. The 1980 year-class dominated the fishery catches in the late 1980s and at the beginning of the 1990s. Surveys indicate that the 1988 year-class declined rapidly after 1991. Since 1994, it has almost disappeared from survey catches, for reasons that remain unclear, prior to contributing to the commercial catches. A new year-class (1996) appeared in the 1998 size composition. Although this mode is small in comparison to the 1988 year-class, it is the most important observed for the last 6 years.

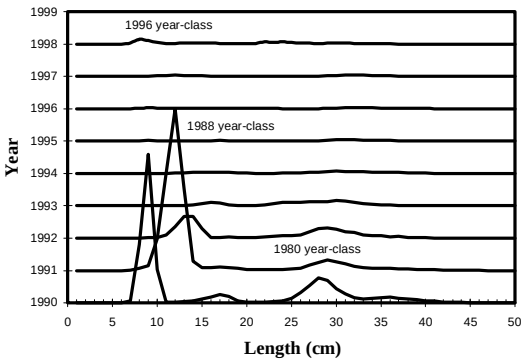

Figure 6. Size compositions from the summer research survey (1990-1998).

Redfish Industry Surveys were established in 1998 to collect additional information on the status of the stock and redfish distribution. A systematic grid survey by GEAC using a bottom trawl was conducted in June-July 1998 in divisions 4RST3Pn4Vn. The positions of the stations were selected by the skipper prior to the beginning of the survey and the tow duration was 30 min. Highest catches were observed in divisions 4T and 4Vn (considered part of Unit 2) and redfish were mainly distributed in the Laurentian Channel south and east of Anticosti Islands (Figure 7). Length frequencies showed the presence of two modes, one at 15-20 cm and one at 25-35 cm. Good catches of small redfish (< 20 cm) were mainly in division 3Pn (considered part of Unit 2). This survey will become usefull as an index of abundance after several years.

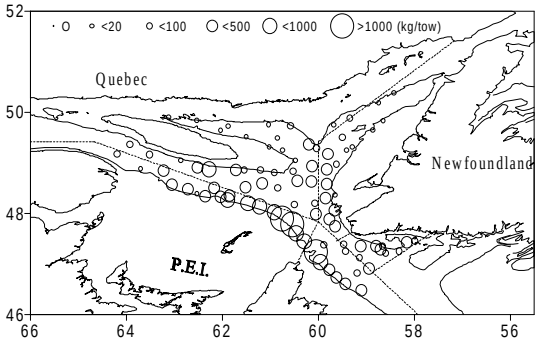

Figure 7. Redfish catch distribution on the grid redfish industry survey in June-July 1998.

Indexed fishing trips were done by two otter trawlers in the summer of 1998 in division 4RST using a bottom trawl similar to gear used in the fishery prior to 1994. Preliminary analyses of the catch rates (CPUE) of the larger vessel (tonnage class 4) showed that during the first trip the average catch rate was around 2 ton / hour which is comparable to standardized catch rates in 1994 (the last year of the fishery). However, in the second trip a decrease (50 %) in the CPUE was observed, mainly in division 4T, which is probably due to rapid changes in distribution of redfish. A third indexed fishing trip by the larger vessel took place in September, but this time with a midwater trawl, in 4RST. The catch rates of this trip were very low and no concentrations of redfish were observed in the area covered by the vessel. The smaller otter trawler (TC 3) conducted 3 fishing trips in July and August and the catch rates were low in comparison to the mean catch rates of this vessel before 1995.

Seven sentinel surveys targeting 4RS3Pn cod have been conducted by small otter trawlers since August 1995 that could provide information on Unit 1 redfish. Four of these surveys were conducted in the summer (July-Aug. 1995 and July in 1996-98) and three in the fall (November 1995 and October 1996, 1997) when the migration of Unit 1 redfish

at the entrance of the Gulf might have started.

These surveys show a more or less stable abundance since 1995. For the summer series, biomass indices from the sentinel surveys are 2 to 3 times higher than the survey on the Alfred Needler, which is conducted about one month later. The difference might be due to gear and survey design differences which may affected redfish catchability. Also, changes in the availability of redfish to the fishing gear between July and August might occur due to movement vertically in the water column, horizontally out of the survey area or both.

Biomass indices from the fall sentinel surveys were much lower than in the summer surveys. This difference could be attributed to a combined effect of movement of redfish in the Cabot Strait area and changes in the seasonal availability of redfish to bottom trawls. Length frequencies from all the sentinel surveys showed that larger fish were caught in the fall surveys.

A comparison of the research, sentinel and industry surveys shows that the distribution of catches in early years of the research surveys were similar to those seen in July-August sentinel and grid industry surveys, but, from 1993, distributions were more similar to October-November sentinel surveys. Thus, the research survey may be measuring both reduced abundance and earlier migration. Nonetheless, the reduction in abundance in the early 1990s was clearly substantial.

Industry perspectives

Most members of Industry agree that the abundance of the stock is much lower than at the beginning of the 1990. However, some are mentioning the presence of good concentrations of large size redfish in the Gulf of St. Lawrence in early summer. The industry is divided in the explanation for the reduced availability of redfish to fishing gear at the end of the summer and in the fall : some are saying that redfish have started to move out of the Gulf but other feel that fish may be dispersed in the water column. Industry participants feel that it is hard to compare the results of the indexed fishing trips with the Unit 1 redfish commercial fishery because in the index survey only one vessel at a time was searching and fishing the redfish concentrations. More effort should be directed to understanding the migration pattern of Unit 1 redfish in relation the environmental conditions.

Sources of uncertainty

Unit 1 redfish show seasonal migrations both vertically in the water column and horizontally in the Gulf and Cabot Strait. Possible changes to the magnitude and timing of these migrations and the impacts of any changes on the survey indices is a major source of uncertainty about this stock. It is also uncertain if the index fishery is able to achieve its primary objectives operating with a single vessel at a time.

Outlook

After the decline of the biomass index from the summer research survey at the beginning of the 1990s, it has stabilized at a low level since 1995. Although the biomass index estimates from the summer sentinel surveys are higher than research survey estimates for recent years, both show stable abundance during the same period (1995-1998), with the biomass estimated from the sentinel survey less than one third the biomass estimated from the research survey index at the beginning of the 1990's. The new year-class (1996) observed in the research survey may be stronger than previous years.

However, more years of survey information are required before its strength can be evaluated. Moreover this year-class will not recruit to the fishery until approximately 2005. It appears that catches of around 1,000 t, established last year for the industry surveys, would not generate a high exploitation rate if the biomass index stays at the present level. However, due to the poor recruitment observed in the Gulf of St. Lawrence since the beginning of the 1980, the exploitation rate should remain low.

For further information

Morin, B. , B. Bernier and N. St-Hilaire 1998. The status of redfish in Unit 1 (Gulf of St. Lawrence). DFO Atl. Fish. Res. Doc. 98/XX.

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Unit 2 Redfish

Background

The Unit 2 management unit for redfish was implemented in 1993. The resource in this area (NAFO 3Ps4Vs, 3Pn4Vn-June to Dec., $4W_{fgj}$) were previously managed separately as a 3P stock and part of a 4VWX stock, The change was recommended in 1991, based on a detailed examination of available data that suggested that a realignment in the existing management units was warranted to better represent what was known about redfish in these areas.

The first quota for Unit 2 in 1993 was 28,000 t. Since then TACs have been reduced successively to 10,000 t for 1996 as a conservation measure and was maintained at that level for 1997. In 1995 area/season closures were implemented to (i) minimise possible overlaps with Unit 1 redfish given a lack of understanding of redfish migration patterns and (ii) allow for a period when peak spawning of females is likely to occur. A small fish protocol at 25 cm (10 inches) was imposed for 1996 aimed at protecting the 1988 year-class as it appears this may be the major contributor to the fishable population in the near future given the current exploitation pattern in the fishery. In 1997 the small fish protocol was reduced to the standard 22 cm for redfish.

The implementation of this new management unit in 1993 resulted in a change in the fishing pattern from that generally in place under the old 3P, 4RST and 4VWX units, There was a 10,000 t increase from the 1992 catch of about 17,000 t and this was almost totally accounted for by landings from 3Pn during the last quarter of the year. Based on information presented to the Fisheries Oceanography Committee of DFO, Science in March, 1994 these catches were probably of Unit 1 redfish that moved into the area earlier in 1993. Although relatively large catches did not occur in these adjacent subdivisions in 1994, possible overlaps with Unit 1 fish in 3Pn/4Vn during November and December were cause for concern, given that Unit 1 is at a very low level (under moratorium from 1995-1997). Subsequently 3Pn/4Vn have remained closed in November and December since 1994.

The Fishery

From 1960 to 1968, landings averaged about 20,000 t, but then increased to an average of 43,000 t up to 1975 mainly due to increased catches by foreign fleets. Catches then declined to the lowest on record in 1984 at 8,100 t. Since then, catches steadily increased to 27,000 t by 1993 but declined subsequently to about 9,000 t in 1996 and 1997 due to reductions in TACs (Figure 8). Up to the end of October 1998, about 9,800 t of an 11,000 t TAC had been taken.

Landings (thousand tonnes)

Year	70-76 Avg.	77-93 Avg.	1994[1]	1995[1]	1996[1]	1997[1]	1998[1]
TAC	-	-	25	14	10	10	11
Can.	21	17	24	12	9	9	9.3
Others	20	1	0	0	0	0.2	0.3
Totals	40	18	24	12	9	9	10

[1] Provisional, 1998 to Oct. 28.

Since declaration of the 200-mile limit in 1977, catches have been taken mainly by Canadian fleets. Maritimes vessels have generally accounted for the majority of landings from subdivisions 4Vs and 4Vn whereas Newfoundland vessels concentrated in subdivisions 3Ps and 3Pn.

In both 1996 and 1997, a significant portion of the total catch was taken in the first quarter, primarily from 3Ps and 4Vs. **In 1998**, about 90% of the TAC had been taken up to Oct. 28.

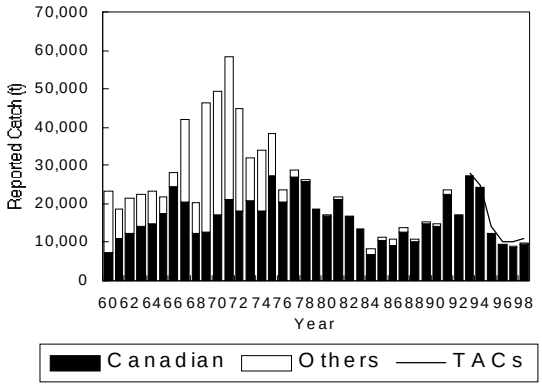

Figure 8. Reported catches and TACs (in tons).

Sampling of the fishery in 1997 indicated that the majority of the catch was comprised of fish between about 28 cm (11 inches) and 35 cm (14 inches), the bulk of which is likely the 1980 year-class. The 1988 year-class was also present in the catches with a peak size of about 24 cm (9 inches). This year-class is now mainly larger than the minimum allowable fish size of 22 cm.

Resource Status

Indices of Stock Size

In earlier years, fluctuations in the **standardized commercial catch rate series** agreed with recruitment of major year classes in the fishery. However, in more recent years, major changes in fleet efficiency, and fishing patterns as a result of changing management regimes and small fish protocols are such that changes in catch rates from 1988 cannot be interpreted in relation to abundance of the stock. Therefore analyses of these data was not conducted.

Summer is when redfish in this area are considered to be most separated from Unit 1 fish. **Departmental research surveys** conducted in subdivisions 3Ps, 3Pn, 4Vs and 4Vn during the summer from 1994-1997 have formed the basis for evaluation of stock status in past years. This survey was not carried out in 1998. The **total biomass index** (all fish sizes) (thousands of metric tons) from these surveys has been :

	1994	1995	1996	1997
Index	239	209	196	214

The summer survey results suggest that **stock size remained stable** between 1994 and 1997.

Length compositions from these surveys were dominated by two modes, the peaks of which were 23-24 cm (about 9 inches), corresponding to the **1988 year class** and 31-33 cm (about 13 inches), corresponding to the **1980 year-class** in 1997. The 1997 survey also indicated a relatively strong abundance of fish at 12 cm (about 5 inches), corresponding to the **1994 year class**. It was primarily caught in 3Pn, whereas the 1988 year-class, when first caught was present over a much wider area. Industry did report that during the 1998 fishery, small redfish (possibly the 1994 year-class) were found in parts of both 3Ps and 4Vs.

Results of three other departmental stratified-random groundfish surveys are available, but these are of limited value in determining the status of the Unit 2 resource. Each survey covers only part of the entire area where the resource occurs. This makes it difficult to interpret apparent trends over time because they may not be reflective of changes occurring throughout the entire management unit but may reflect movement into and out of the surveyed areas. Nonetheless, these series are consistent with the Unit 2 survey in terms of size composition and general trends.

In December 1997, and again in August 1998, **industry stratified-random surveys** were conducted by GEAC in Unit 2. Fishing

was conducted using commercial gear with 90 mm mesh in the codend. Thus, the survey sampled the commercially exploitable portion of the population. Estimates were 240,000 and 222,000 t respectively. The surveys also indicated the presence of both the 1980 and 1988 year-classes. The proportion of the 1988 year-class in the catches increased between 1997 and 1998, indicative of these fish growing to commercial size. Although only 2 years of data are available, like the departmental summer surveys, these **suggest stability** in the resource.

Available data were analysed to examine size at maturity. The information suggests that in Unit 2, 50% of redfish males are mature at about 21.5 cm, whereas 50% of females do not reach maturity until about 27.5 cm.

Industry Perspectives

Because of changes in fishing patterns brought about by redefinition of management units in 1993, seasonal closures introduced in 1995, and small fish protocols (minimum size of 22 cm), industry has difficulty relating current fishing to past experiences.

In 1997 and 1998 fishing took place throughout different areas within the management unit depending on the fleet, and industry considers that the fishery was very successful in both years. There have been little to no difficulties encountered as a result of the small fish protocol. At present, the majority of the fish caught are in the 31-35 cm (13-14 inch) range.

Sources of Uncertainty

Questions remain concerning stock structure and mixing, particularly with redfish in Unit 1. The movements of redfish between the 2 areas, and especially in 3Pn/4Vn require further clarification and understanding.

The strength of the 1988 year-class relative to that of the 1980 year-class is unknown so it is not possible to determine how many years it may be able to support a commercial fishery. Generally however, it is not believed to be as strong as the 1980 year-class that has supported good catches for about 8 years now.

It remains uncertain whether the 1994 year-class, first seen in 3Pn during the 1997 departmental summer survey, and noted by industry in some parts of 3Ps and 4Vs in their 1998 fisheries, is strong. The industry survey is designed to give specific information regarding the commercially exploitable portion of the biomass. It is equally important to be able to monitor and measure the strength of pre-recruit year-classes as has been achieved in the past using departmental surveys in order to better forecast the future for this resource.

Outlook

Current commercial catches are composed primarily of the 1980s year-class which have been fished for about eight years. The 1988 year-class is now becoming more fully recruited to the fishery, and it will probably be fully recruited in 1999. However, as noted above, its contribution to the fishable stock may not be as great as that of the 1980 year class.

Last year's estimate of commercially exploitable biomass from the 1997 summer survey (100,000-120,000 t) was based on application of selectivities for mesh sizes of 90-130 mm to the summer departmental survey results. This suggested that catches of 10,000 t would generate a relative exploitation rate (ratio of TAC to survey biomass) of about 10%. The gear dominating the fishery is 90 mm, the same as was used in the GEAC survey. Recalculation of the commercially exploitable biomass from the

1997 departmental survey using selectivity for 90 mm gear alone results in an estimate of 175,000 t. An 11,000 t catch would represent a relative exploitation rate of about 6%.

Assuming the results from the 1998 industry survey represent the commercially exploitable portion of the stock, the relative exploitation rate is about 5%.

The stock biomass is expected to remain stable over the next few years although there will be a shift from the 1980 year-class to the 1988 year-class dominating. Coincidentally, the 1988 year-class will gradually replace the 1980 year-class as the dominant group in the commercial catches.

There are some indications that the 1994 year-class may be relatively strong, but a number of years of monitoring will be required to clarify this. This year class would not contribute significantly to the commercial fishery until about 2004.

It appears that catches in the range of the current TAC are sustainable over the longer term taking the variable and intermittent good recruitment into consideration.

For Further Information

Power, D.. 1998. The status of Redfish in Unit 2 (Laurentian Channel Management Unit). DFO Atl. Fish. Res. Doc. 98/xxx.

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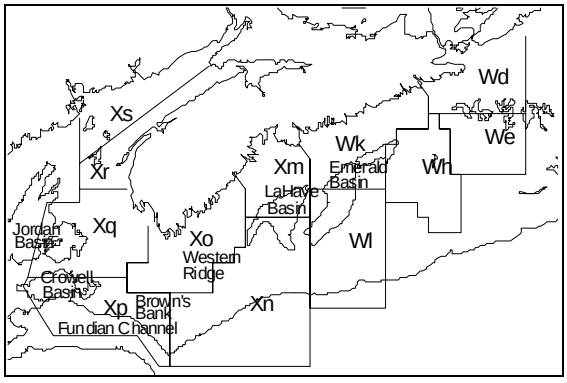
Unit 3 Redfish

Background

The Unit 3 management area for redfish was first implemented in the 1993 Groundfish Management Plan with a quota of 10,000 t. Redfish in this area were previously managed as part of a larger 4VWX management area.

Redfish in Unit 3 are primarily caught in the basins and at the edge of the Scotian Shelf by otter trawlers using 90 mm mesh. Regulations limit the bycatch in NAFO division 4X of other groundfish species to 10 % by weight of redfish caught and the bycatch in NAFO divisions 4VW to 2 % by weight each of cod and haddock



The Fishery

Landings (thousands of tonnes)

Year	70-79 avg	80-89 avg	90-92 avg	93	94[2]	95[2]	96[2]	97[2]	98[3]
TAC				10.0	10.0	10.0	10.0	10.0	10.0
Canada	4.1	4.4	2.2	5.1	5.2	4.9	4.7	6.3	4.2
Foreign	5.7[1]	0.5	0.1	0.1	+	+	+	0.1	+
Total	9.7	4.9	2.3	5.2	5.2	4.9	4.8	6.4	4.3

1 1970-79 foreign landings exclude up to 4,420 t/yr on average not assignable to statistical unit area

2 Provisional

3 Provisional to the end of July 1998.

Redfish landings from Unit 3 (Figure 9) gradually increased from the late 1970s, peaking at almost 7,000 t in 1986, followed by a decline to about 2,000 t in 1991. Landings for 1997 were about 6,350 t, higher than average for the period 1993-96 but well below the 10,000 t TAC. In 1997, the highest landings were in May to July as was the case in 1993-96. The provisional Canadian catch by mobile gear for January through July 1998 was about 4,000 t, similar to the same time period in 1997.

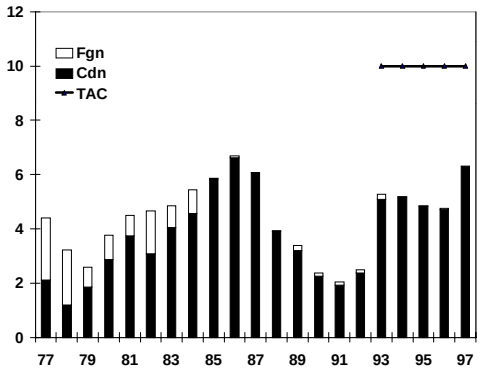


Figure 9. Canadian, foreign landings and TACs (in thousands of tons)

In 1997, small otter trawlers (<65'), fishing in the basins and at the edge of the Scotian Shelf, took most of the reported catch. In 1998 (to July), small otter trawlers again took most of the catch fishing almost entirely in the Crowell and Jordan basin portions of the Gulf of Maine *(Figure 10)*.

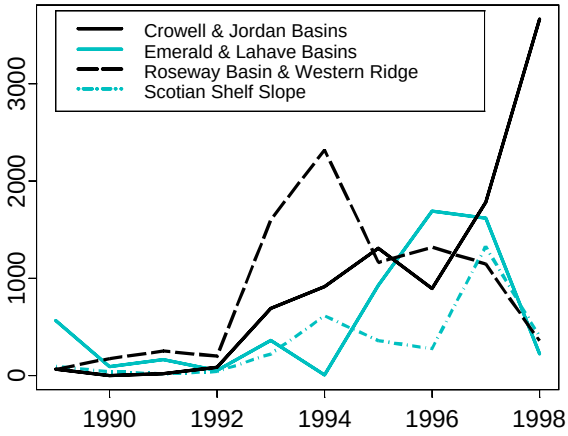


Figure 10. Small otter trawler catch by fishing area and year (tonnes).

In 1996, DFO Operations began to use 22 cm as the minimum size for its Conservation Harvesting Plans (CHP). Percentages by number of redfish landings under this size were:

	93	94	95	96	97	98 (to July)
% < 22 cm	4	15	15	10	6	7

Following an FRCC recommendation the small redfish protection area located north of Brown's bank (known as the 'Bowtie') was redefined in early 1998 (Figure 11).

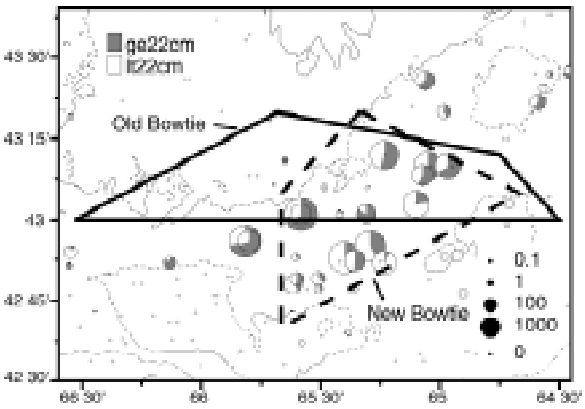


Figure 11. Old and new definitions for 'Bowtie' area with DFO and Industry survey size composition data for 1996-97.

A number of areas were closed to redfish fishing to avoid bycatches of other species, in addition to limits on percentage bycatch. Pollock accounted for most of the reported bycatch in Unit 3 *(Figure 12)*. The highest bycatch rates (all species combined) were in Crowell and Jordan basins, but neither industry nor management consider the situation there to be a problem because most of this bycatch consisted of legal sized fish and was counted towards the vessels' quota of these species.

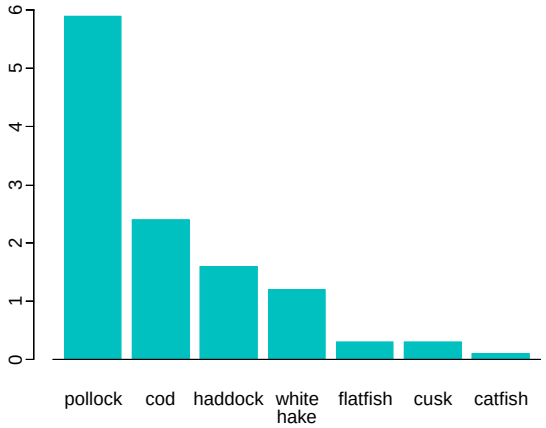


Figure 12. Bycatch by species for 1997 (%).

Observer data for 1998, although very limited, show much higher bycatch rate for pollock in Crowell and Jordan basins than do commercial statistics. There were no observer data from Crowell and Jordan basins for 1997.

Industry Perspective

Captains of small otter trawler are concerned over the concentration of fishing ef-fort in Crowell and Jordan basins in 1998, but indicated that catch rates of market sized redfish were good and that the bycatch rates of spiny dogfish were much lower than in previous years. They are particularly con-cerned over the lower catch rates encoun-tered in the eastern part of the management unit (Emerald and LaHave basins) and on the shelf slope, in 1998. The greatest con-cern was expressed for the eastern area. Areas which produced good catch rates in 1995-97 could not be fished economically in 1998. This when combined with the cost of a mandatory observer when fishing in 4W resulted in little or no fishing in those areas. One hundred percent observer coverage is not a requirement in 4X.

Some captains claim that the total bycatch limit for 4X should be 20%, as most of the fish caught as bycatch are of market size. They claim also that small mesh fishing could be safely extended northward from 43° 30' to 43° 40'. Most captains and plant operators have responded favourably to the 'Bowtie' closed area revisions.

Resource Status

The increase in catches after 1992, resulted from an increase in fishing effort by small otter trawlers <65', reflecting decreased fishing opportunities for more valuable species, and not an increase in redfish abun-dance.

Fishing success of small otter trawlers did decline in 1998 to the eastward (Lahave and Emerald basins) and along the shelf edge and did increase slightly to the westward in Crowell and Jordan basins (Figure 13). The substantial increase in the proportion of catch to the westward resulted mainly from the concentration of fishing effort there, en-couraged by the relatively greater fishing success compared to the more eastern areas.

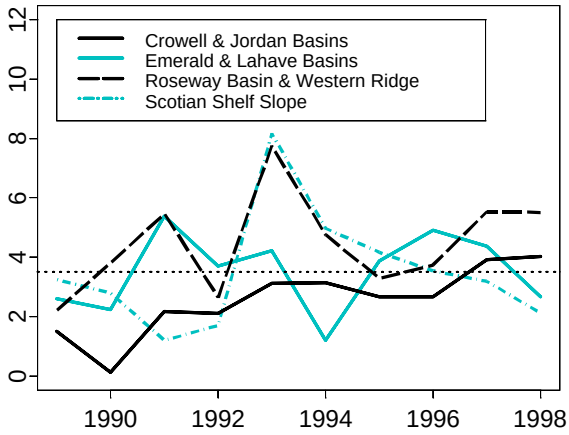


Figure 13. Small otter trawler catch rates by fishing area (tonnes per days fished)

Changes in the RV survey biomass by area in recent years do not correspond with changes in the fishing success experienced by the commercial fishery. Survey estimates of biomass in the most eastern areas has been fairly stable in the last five years. The most significant change shown by surveys is an increase in biomass in and around the 'Bowtie' which is partially protected from fishing with small mesh gear. The 4X industry groundfish survey biomass distribution is in general agreement with that of the DFO survey (but does not include 4W).

Survey estimates of population (< 200 fm), are highly variable between years but show no trend over time (Figure 14). Redfish smaller than commercial size do not contribute greatly to this biomass estimate, so survey biomass can be taken as an indicator for the size classes fished commercially. However, survey biomass underestimates the actual biomass on which the commercial fishery is based, as not all of the commercial sized fish are available to the survey gear, and some are outside the survey area (deeper than 200 fm).

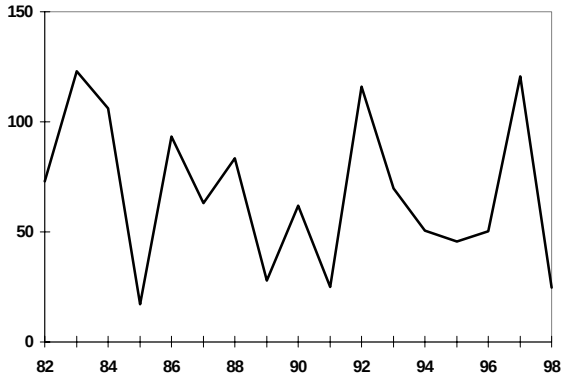


Figure 14. Biomass index from summer survey (in thousands of tonnes).

The industry survey in 4X provides biomass estimates similar to the RV survey for that area, but the estimates are less variable. The industry survey indicates abundance in 1998 was similar to the previous three years. USA surveys of the Gulf of Maine and Georges Bank, which include Crowell and Jordan basins, have shown an increase in resource abundance in 1996-97.

In recent years, there has been evidence that there are more small fish, particularly in the area north and east of Brown's bank (Figure 15).

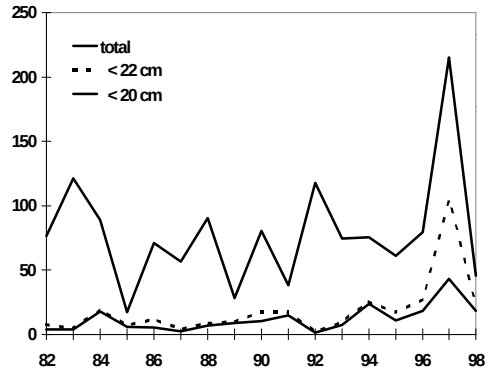


Figure 15, Survey numbers per tow by size class.

Recent catches compared to survey biomass estimates indicate an exploitation rate of 7 to 9 percent, but this is an over estimate of the actual exploitation rate in the fishery because survey biomass is an underestimate of the actual biomass.

Outlook

The reduced commercial fishing success in eastern areas during 1998 is inconsistant with the results of research vessel surveys. The factors underlying this inconsistancy are presently not understood and this requires further study in cooperation with industry.

Research vessel surveys indicate stability in the population biomass with improved recruitment particularly in and around Roseway Basin and Western Ridge. This recruitment, although promising, has not yet resulted in a detectable increase to the population biomass, but combined with the low exploitation rates which currently prevail, should result in fishing and stock conditions in 1999 being very much the same as in recent years. However the reduced commercial success in the east and the concentration of effort in the west justify extra caution in the management of this resource. Catches of 10,000 t in 1999 would be consistent with an exploitation of 15% of

survey biomass. Since survey biomass in this area is an underestimate of actual biomass the harvest rate is less than 15% and probably does not exceed $F_{0.1}$.

For Further Information

Branton, R. 1998 Update on the Status of Unit 3 redfish: 1998. DFO Atl. Fish. Res. Doc. 98/139.

Branton, R. and J. Black 1998. 1998 Summer Groundfish Survey Update for Selected Scotia-Fundy Groundfish Stocks: 1998. Res. Doc. 98/133.

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Division 3O Redfish

Background

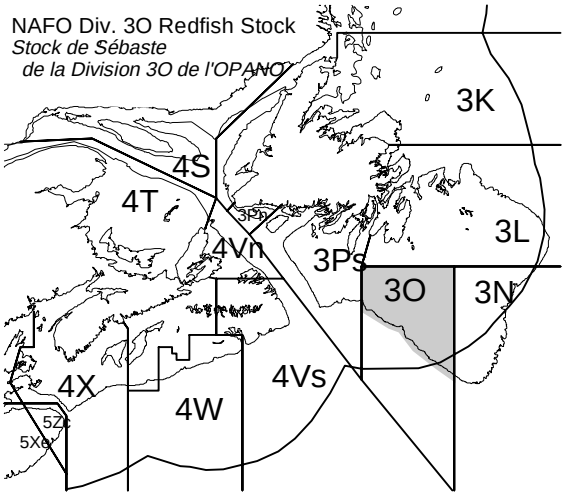
Historically, Canadian industry has not had a great deal of interest in redfish in this area because of the relatively small sizes of fish found in the areas with trawlable bottom. Recent declines in other groundfish resources and the marketability for small redfish have resulted in increased interest in fishing in this area.

The TAC is set by Canada and imposed on domestic fleets and countries which have had bi-lateral trade agreements.

A TAC of 16,000 t was first implemented on this stock in 1974. The TAC was increased in 1978 to 20,000 t and generally remained at that level through to 1987. The TAC was reduced in 1988 to 14,000 t and maintained until 1994 when it was lowered to 10,000 t as a precautionary measure. This TAC has remained in effect to 1998.

A small fish protocol at 22 cm was implemented inside the 200 mile limit in 1995. The current TAC is divided into a Canadian quota (8,500 t), a French (St. Pierre et Miquelon) quota (1,500 t).

About 10% of the stock area lies outside Canada's 200 mile Exclusive Economic Zone (EEZ) and subject to unregulated fisheries. Between 1985 and 1995, estimates of unreported foreign catches have ranged between 400 tons (1995) and 24,000 tons (1988) From 1991 to 1996 the average has been 1100 tons. For 1997 the estimate was close to zero.



The Fishery

Nominal catches have ranged between 3,000 t and 35,000 t since 1960. Up to 1986 catches averaged 13,000 t, increased to 27,000 t in 1987 with a further increase to 35,000 t in 1988, exceeding TACs by 7,000 t and 21,000 respectively. Catches declined to 13,000 t in 1989, and were about this amount annually through to 1993. The decrease of the catch in 1994, at about 5,400, t was related to a reduction in foreign allocations. Since 1995 catches have primarily been accounted for by the increased activity of Canadian enterprises. Total Canadian and foreign catches approached 10,000 t in 1996 and 1998.

Catches (thousand metric tons)

Year	70-76 Avg.	77-93 Avg.	1994[1]	1995[1]	1996[1]	1997[1]	1998[1]
TAC[2]	-	18	10	10	10	10	10
Can.	1	1	2	0.2	7	2	7
Others[3]	14	14	4	3	3	3	2
Totals	15	15	6	3	10	5	9

1 Provisional
2 Canadian domestic TAC
3 Includes estimates of unreported catch

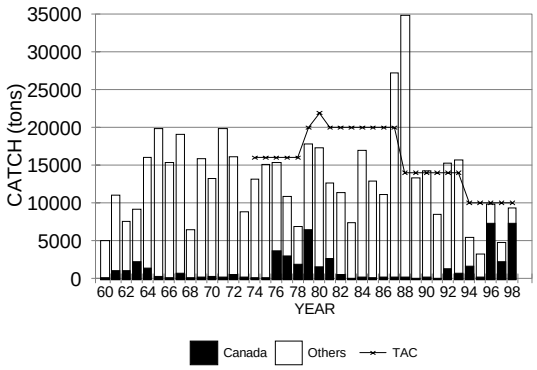


Figure 16. Catches and TACs of redfish from Division 3O (in tons),

Russia predominated in this fishery until 1993, but had much lower catches in 1994 and 1995 and no effort since 1996. Cuba has not participated in the fishery in this area since 1993. Portugal, which began fishing in the area in 1992, have reduced it catches from about 2,900 t in 1994 to about 900 t in 1997. Russia, Cuba and Japan fished throughout the stock area after extension of jurisdiction through agreements with Canada. Other non-Canadian catches including those of Portugal were taken in the limited stock area outside 200 miles.

Canada, which has had limited interest in a fishery in this area because of the small sizes of redfish encountered, landed less than 200 t annually from 1983-1991, took 1,600 t in 1994, but their catches declined to only about 100 t in 1995. Canadian catches have increased dramatically to about 7, 000 t in 1996, declined to 2,100 t in 1997 and have accounted for at least 7,000 t to Oct. 28 in 1998. The renewed interest and fluctuations in the Canadian catches are related to available markets and the acceptability of fish sizes near the 22cm small fish protocol. The fishery has occurred primarily in the second and third quarters of the year since 1983. Recent Canadian catches have been taken during the second half of the year. The predominant means of capture from the mid-1970s to the early 1980s was the bottom otter trawl. Since 1984, there has been an increase in the use of midwater trawls although bottom trawl catches still dominate.

Information on size distribution from one Canadian fleet in the 1998 fishery indicated its catch ranged from 22cm to 30cm range with over half occurring between 22-25 cm. The most recent length distribution information available from Portuguese catches in 1996 showed a much broader range of lengths from about 25 cm to 42 cm with modes at 30 cm. and 38 cm.

Resource Status

Because of the large interannual variability in commercial catch rates and recent changes in the composition of the Canadian fleet participating in this fishery, the catch rate series cannot be used to draw inferences about stock status.

Stratified random groundfish surveys have been conducted in the spring and fall in Division 3O since 1991, with coverage to depths down to 730 m. Beginning in the fall of 1995, the survey gear was changed from the Engel trawl to a Campelen shrimp trawl, This new gear has a similar catchability for large redfish, but a much greater catchability for very small redfish. For this year's assessment of the resource, conversion factors were applied to the Engel trawl for a more appropriate comparison to the Campelen results. The result was a upward revision of the biomass index in years where the Engel was used.

The revised spring index (Figure.17) suggests that the stock may have increased since the early 1990s, but has stabilized at around 100,000 t since 1994. The low 1997 value is considered a sampling anomaly. The fall survey generally supports this pattern. The surveys catch fish in the 10 cm to 25 cm range whereas the commercial catch was generally comprised of fish greater than 25 cm prior to 1998. Indications from the 1998 Canadian fishery suggest that fleets now are targeting the size groups sampled by the surveys.

There is concern that there has been little sign in the recent surveys of size groups smaller than 17 cm. despite using a shrimp trawl which is very effective at catching small fish.

In all surveys, the biomass indices in strata outside 200 miles were low compared to those inside.

Recent data were analysed to examine size at maturity. The information suggests that in Div. 3O, 50% of the males are mature at about 21 cm, whereas 50% of females do not reach maturity until about 28 cm.

Industry Perspectives

The increased activity in 1996 for some Canadian enterprises was motivated by a need for an alternate supply of redfish, in light of the moratorium for redfish in Unit 1 and reduction of TAC in Unit 2. There was reasonable success in finding good concentrations of acceptable size fish, primarily from October to December.

The knowledge from the Russian fishing experience in the area available to some Canadian enterprises suggests that water temperature influences fishing success.

In the 1998 fishery there were reports of much fish in the landings close to the 22 cm

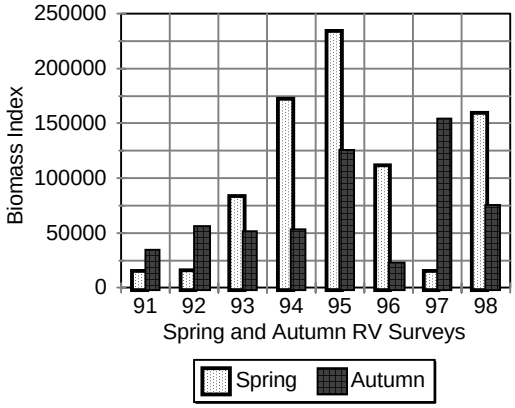


Figure17. Research survey index for Division 3O redfish.

small fish protocol. The targeting for fish sizes greater than 30cm results in substantial reduction of catch rates. This fishery is still considered to be in the learning stage and the acceptability of fish near the small fish protocol will likely result in a targeting of effort for these sizes as catch rates are more cost effective.

Outlook

It is still not possible to describe overall trends in total stock size, or estimate the current size of the fishable portion of the population, nor is possible to determine current fishing mortality rate. Although variable, recent surveys indicate the current exploitable stock to be about 100,000 t. Thus, catches of about 10,000 t are not likely to generate fishing mortality in excess of $F_{0.1}$. Before 1998, the surveys were considered to have been monitoring pre-recruits to the fishery and tracked a relatively strong yearclass which in recent years has caused problems for industry in complying with the small fish protocol. This year-class has now reached a size where it contributed to the 1998 commercial catches. The Canadian

fishery will target this year-class in the future. There is concern, however, about the poor sign of subsequent recruitment (less than 17 cm).

For Further Information

Power, D., and D. B. Atkinson. (1998). Update on the status of redfish in Division 3O . DFO Atl. Fish. Res. Doc. 98/xx.

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