

## 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.

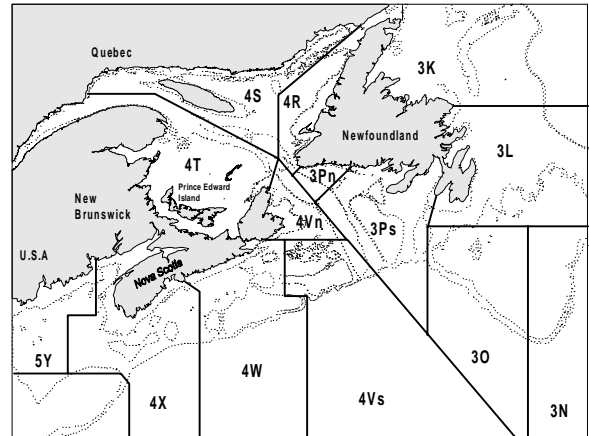


Figure 1. Map of the Northwest Atlantic.

### 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, and there is a geographic cline for *S. mentella* and *S. fasciatus*. *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 distributed deeper than *S. fasciatus*. The

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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. *S. fasciatus* is a smaller size at a specific 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).

Based on previously published information (Ni and Sandeman 1984), the average length at which 50 % of female redfish on the continental slopes in divisions 3O, 3P, 4R, 4S, 4T, 4V, 4W and 4X are mature is about 27 cm (10.5 inches), 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.

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.

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). Except for the Flemish Cap and the Gulf of Maine, Canada has prosecuted redfish fisheries in

these different management areas to varying degrees 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 were based on  $F_{0.1}$  (12% exploitation rate) and  $F_{MAX}$  (24%) or MSY (maximum sustainable yield) and 2/3 the effort at MSY.

A minimum legal fish size of 22 cm was introduced in redfish fisheries, first in 1995 in Division 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 October 14-16 1997. Redfish assessments were updated following the completion of the 1997 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. However, they expressed concerns about the fact that all redfish assessments were heavily dependant on abundance estimates from a single research survey time series.

***For more information***

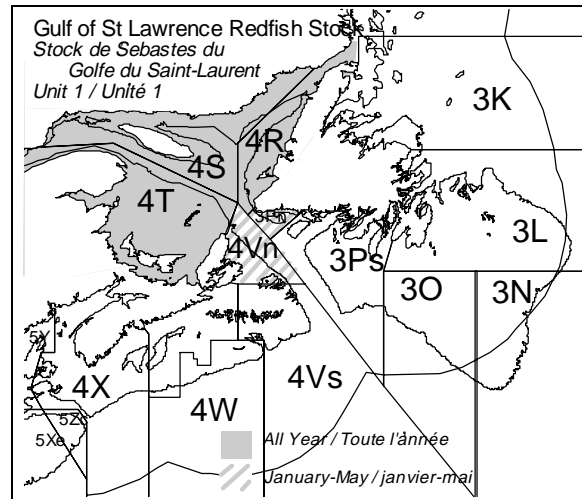
Ni, I-H., and E.J. Sandeman. 1984, Size at maturity of Northwest Atlantic redfishes (*Sebastes*). Can. J. Fish. Aquat. Sci 41:1753-1762.

## 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 1980.



### 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 2). 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 was closed in 1995 due to low stock abundance.

### Landings (thousand tonnes)

| Year   | 70-76<br>Avg. | 77-92<br>Avg. | 1993 | 1994 <sup>1</sup> | 1995 <sup>1</sup> | 1996 <sup>1</sup> | 1997 |
|--------|---------------|---------------|------|-------------------|-------------------|-------------------|------|
| TAC    | -             | -             | 60   | 30                | 0                 | 0                 | 0    |
| Can.   | 79            | 37            | 51   | 19                | 0                 | 0                 |      |
| Others | 3             | 0             | 0    | 0                 | 0                 | 0                 |      |
| Totals | 82            | 37            | 51   | 19                | 0                 | 0                 |      |

<sup>1</sup> Provisional

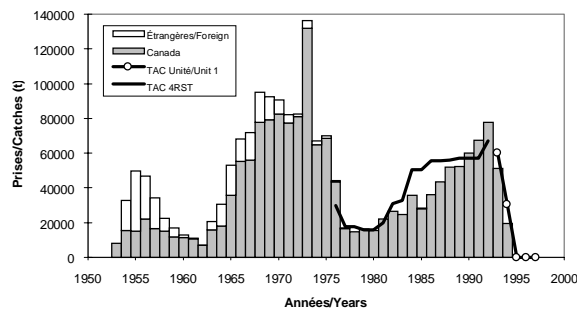


Figure 2. Landings and TACs in tons.

**Resource Status**

Since 1990, **stratified-random groundfish surveys** have been conducted in 4RST in August-September on the Alfred Needler. The biomass index from these surveys has been declining from 1990 to 1996 (Figure 3). In 1997, the index increased slightly but remained at a low level.

During the period of decline, the distribution of redfish became more restricted and concentrations are mainly found now in the Cabot Strait area (Figure 4). Also, in 1997, the highest catch of the survey was observed north of Anticosti Island.

Numbers at length from the summer surveys (Figure 5) for the period 1990 to 1997 indicate the presence of only two important modes, corresponding to the 1980 and 1988 year-classes. The 1980 year-class dominated

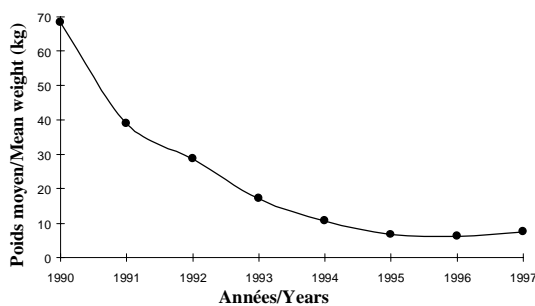


Figure 3. Research vessel survey biomass index.

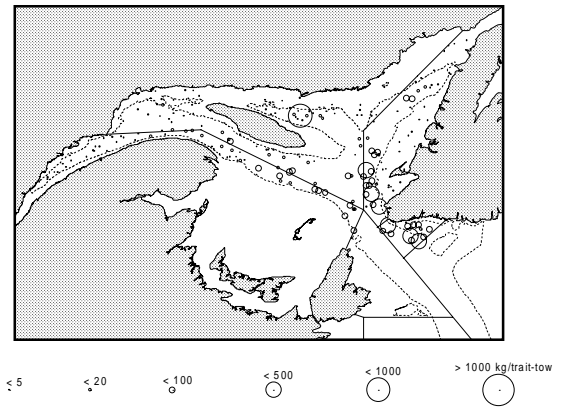


Figure 4. Redfish catch distribution on research vessel survey in August 1997.

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 and from 1994, it has almost disappeared from survey catches, for reasons that remain unclear, prior to contributing to the commercial catches.

**Five sentinel surveys** targeting 4RS3Pn cod have been conducted by small otter trawlers since August 1995. Three of these surveys were conducted in the summer (July and August) when Unit 1 redfish are within Divisions 4RST. These surveys could provide information on Unit 1 redfish. The other two surveys were conducted in the fall (November 1995 and October 1996), when the migration of Unit 1 redfish at the entrance of the Gulf might has started.

In order to standardize the various vessels participating in the surveys, several modifications have been made to the gears used in the sentinel surveys. These early adjustments to the design of these surveys make the inter-year comparisons difficult.

Catch rate from the fall sentinel surveys were much lower than in the summer sentinel surveys. This difference could be accounted for by a combined effect of movement of

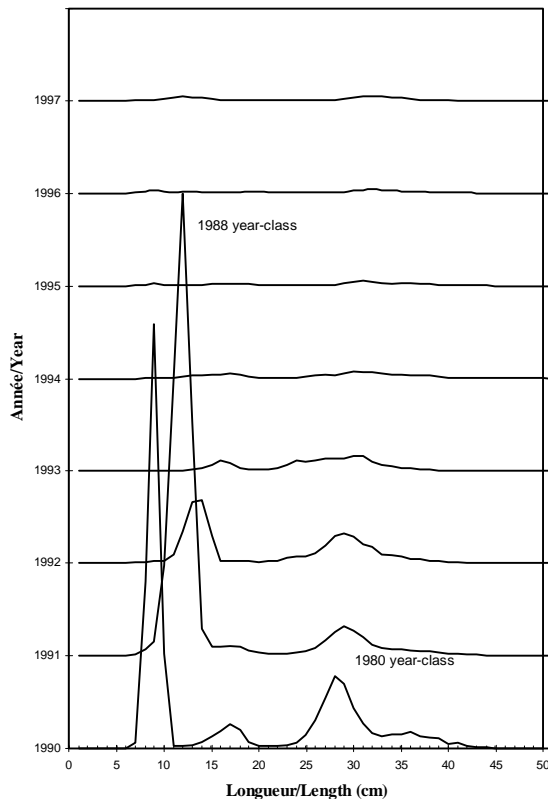


Figure 5. Size compositions from the summer research survey (1990-1997).

redfish in the Cabot Strait area and changes in the seasonal availability of redfish to bottom trawl. Length frequencies from all the sentinel surveys showed that larger fish were caught in the fall surveys.

**A comparison of the sentinel surveys and research surveys** shows that the distribution of catches in early years of the research surveys were similar to those seen in July-August sentinel surveys, but, from 1993, distributions were more similar to October-November sentinel surveys. Size compositions in recent research surveys were also more similar to those in the October-November sentinel surveys than those conducted in July-August. Industry participants indicated that, in their view, seasonal migration out of the Gulf occurred progressively earlier in the years immediately prior to fishery closure. 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*

Given that the Unit 1 fishery has been closed since 1995, industry representatives had no direct information regarding the state of the stock. However, those involved in the cod sentinel surveys indicated that redfish were more wide spread in the Gulf in the summer of 1997 than in 1996. Also, some participants indicated that larger fish were caught in 1997 surveys than in 1996.

They were also concerned that the abundance and distribution information is mainly coming from one survey. This could limit the possibility to describe changes in movements and distribution that may have occurred in recent years.

### *Outlook*

The abundance index from the summer research survey is still at a low level. At this time there is no sign of any significant incoming recruitment and the stock will remain at a low level.

### *For further information*

Morin, B. and B. Bernier 1997. The status of redfish in Unit 1 (Gulf of St. Lawrence). DFO Atl. Fish. Res. Doc. 97/112.

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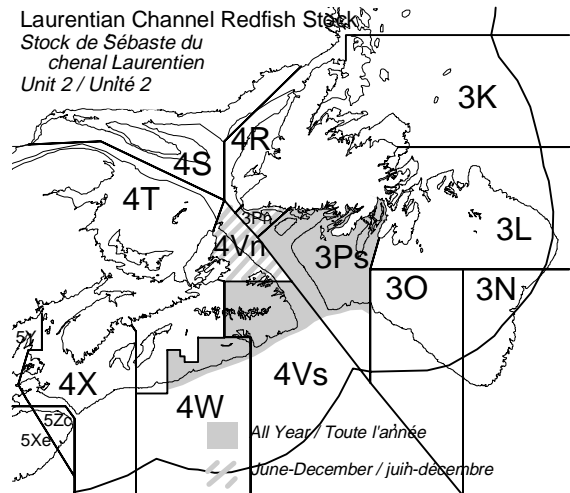
## Unit 2 Redfish

### Background

The Unit 2 management unit for redfish was implemented in 1993. The resource in this area (NAFO 3Ps4Vs, 3Pn4Vn-June to Dec., 4W<sub>fgi</sub>) 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 which 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 has remained closed in November and December since 1994.



### The Fishery

From 1960 to 1968, landings were about 20,000 t. Landings increased to an average of 43,000 t up to 1975 mainly due to increases by foreign fleets, then subsequently declined to the lowest on record in 1984 at 8,100 t. Catches then steadily increased to 27,000 t in 1993 and have declined subsequently to 9,000 t in 1996; matching reductions in TACs (Figure 6). Up to the beginning of October 1997, about 9,000 t of a 10,000 t TAC had been taken.

#### Landings (thousand tonnes)

| Year   | 70-76<br>Avg. | 77-92<br>Avg. | 1993 | 1994 <sup>1</sup> | 1995 <sup>1</sup> | 1996 <sup>1</sup> | 1997 |
|--------|---------------|---------------|------|-------------------|-------------------|-------------------|------|
| TAC    | -             | -             | 28   | 25                | 14                | 10                | 10   |
| Can.   | 17            | 16            | 27   | 24                | 12                | 9                 |      |
| Others | 15            | 1             | 0    | 0                 | 0                 | 0                 |      |
| Totals | 32            | 17            | 27   | 24                | 12                | 9                 |      |

<sup>1</sup> Provisional

Since declaration of the 200 mile limit in 1977, catches have been primarily by Canadian fleets. Maritimes vessels have generally accounted for the majority of landings from subdivisions 4Vs and 4Vn

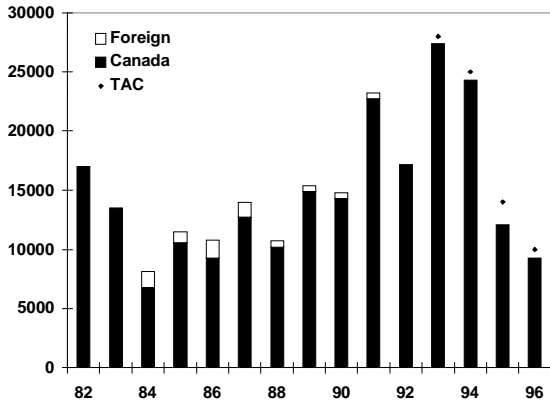


Figure 6. Reported catches and TACs (in tons).

whereas Newfoundland vessels concentrated in subdivisions 3Ps and 3Pn.

In 1996, over half of the 9,000 t catch had been taken in the first quarter and primarily from 3Ps. About 2,500 t of this had been taken in statistical area 3Psd, adjacent to 3Pn. In 1997, over 90% of the TAC has been taken up to Oct. 1 primarily in the first quarter and the majority of which was again taken in 3Ps.

Sampling of the fishery in recent years suggests the majority of the catch was comprised of fish between 28 cm (11 inches) to 33 cm (13 inches), the bulk of which is likely the early 1980s year-class. The 1988 year-class was present in the catches in 1994, 1995 and 1997 but to a lesser extent in 1996. This was likely because of the effect of the higher small fish protocol at 25 cm in 1996 compared to 22 cm in 1997.

In earlier years, fluctuations in the **standardized commercial catch rate series** (Figure 7) agree with recruitment of major year classes in the fishery. However, there was a brief but major increase in CPUE centered around 1990 that cannot be explained by the biology of redfish alone. This peak is associated with the recruitment of the 1980s year class(es) to the fishery but

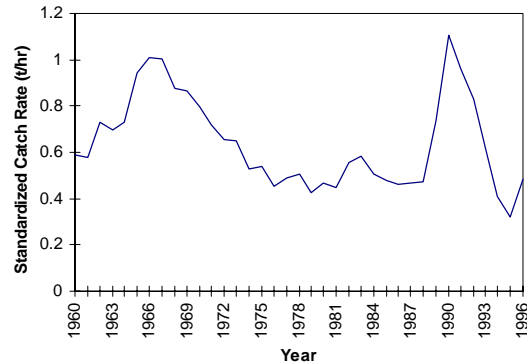


Figure 7. Standardized commercial catch rate of vessels directing towards redfish in Unit 2 (in tons per hour).

coincided also with the introduction of major changes in fishing technology. The suddenness of this event is not understood, and the changes in catch rates from 1988 cannot be interpreted in relation to abundance of the stock.

### Resource Status

#### Indices of Stock Size

The most valuable information used to assess this stock comes from research surveys conducted in subdivisions 3Ps, 3Pn, 4Vs and 4Vn during the summer from 1994-1997. The summer is when redfish in this area are considered to be most separated from Unit 1 fish. The **biomass index** (thousands of metric tons) from these surveys is :

|       | 1994 | 1995 | 1996 | 1997 |
|-------|------|------|------|------|
| Index | 239  | 209  | 196  | 214  |

The summer survey results suggest that stock size remained stable at about 200,000 t between 1994 and 1997, slightly below the 1994 level. As the survey was conducted by a shrimp trawl, which samples pre-recruits, an exploitable biomass index was calculated by applying selectivity curves corresponding



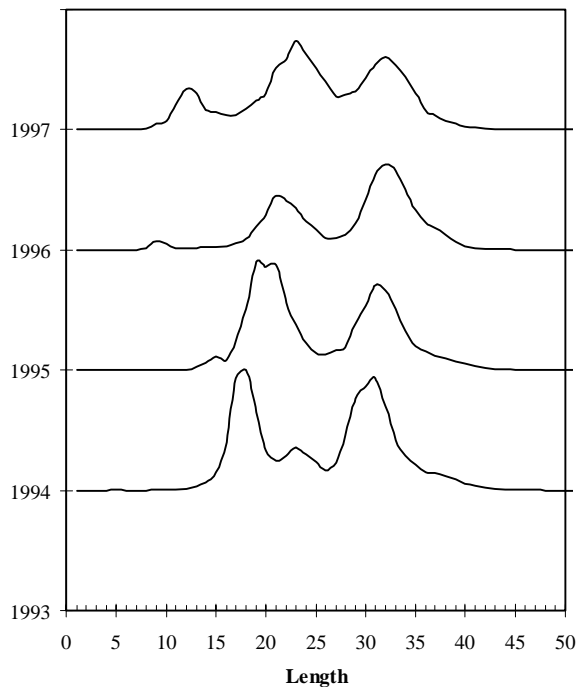


Figure 8. Number at length of redfish from the research survey in Unit 2.

to the commercial fishery. This results in an exploitable biomass index of about 100,000 t.

The length compositions from these surveys (Figure 8) 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 early 1980s year class(es) in 1997. The 1997 survey also indicates a relatively strong abundance of fish at 12 cm (about 5 inches), corresponding to the 1994 year class, that was primarily caught in 3Pn. Although the estimated abundance index of the 1988 year-class in the 1997 survey was higher than in the 1996 survey, it does not appear to be as abundant as it was in the 1994 and 1995 surveys.

Three other stratified-random groundfish surveys are available up to 1997 but 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 trend.

### *Industry Perspectives*

Because of the change in fishing pattern that resulted from the implementation of this management Unit in 1993, as well as the regulation in 1995 of seasonal closures (in May-June for all of Unit 2 and November-December for 3Pn and 4Vn) and the small fish protocol, the major stakeholders in the fishery cannot relate their past experiences to the current situation.

The 1996 fishery had been conducted primarily in areas 3Psd and 4Vsc with one stakeholder experiencing a substantial increase in catch rate compared to 1995. This increase was the result of the detection of a relatively large body of fish in 3Psd during the first quarter of the year. Fish were large in this area and the small fish protocol was not restrictive. One other stakeholder also experienced similar catch rates and fish sizes but was concerned about the recent recurrence of the parasite problem.

The 1997 fishery to date was generally conducted in a similar pattern as the 1996 fishery and was considered by some to be as good or better than 1996. It was noted that most of the difficulties were related to bad weather rather than the fishery. One stakeholder related that fish sizes were generally larger in 3Psd than 4Vsc and had more parasites.

***Outlook***

An estimate of exploitable biomass from the summer survey of about 100,000 t indicates that a catch of 10,000 t in 1998 would generate an exploitation rate of about 10%. The survey results provide minimum estimates of exploitable biomass so the actual exploitation rate is likely to be lower than 10%. Therefore, a catch in 1998 of 10,000 t is not likely to be higher than the catch associated with fishing at  $F_{0.1}$ .

Current commercial catches are composed primarily of the early 1980s year-class(es) which have been fished for about eight years. The next anticipated pulse of recruitment (the 1988 year-class) is now becoming more fully recruited to the fishery. However, its contribution to the fishable stock will not be as great as that of the early 1980s year class(es).

A pulse of pre-recruits was observed in the 1997 survey at 12 cm (about 5 inches), corresponding to the 1994 year class. This pulse is much larger than any other observed after the 1988 year class. Its potential will require a few years of monitoring before its relative strength can be related to other year classes comprising the commercial fishery. In any case, its contribution will not be fully realized in the fishery for at least another 7-10 years.

***For Further Information***

Power, D., and D. Orr. 1996. The status of Redfish in Unit 2 (Laurentian Channel Management Unit). DFO Atl. Fish. Res. Doc. 97/113.

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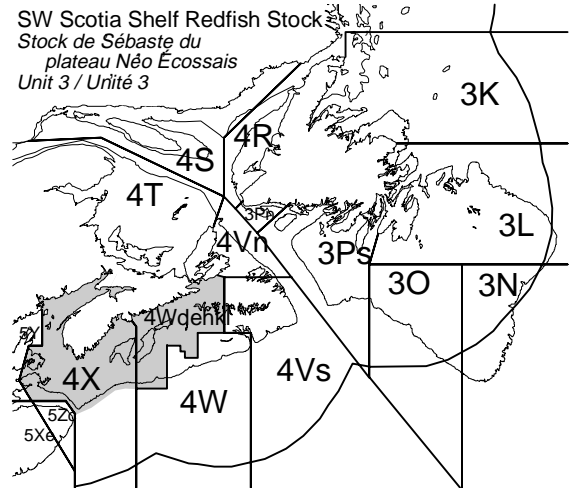
## Unit 3 Redfish

### 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.

Starting in 1995, the Scotia-Fundy summer groundfish survey, which is the primary source of population and size composition data for this stock was enhanced to include redfish species identification techniques and extended to 400 fathom in order to cover redfish habitat at the shelf edge previously not covered by the survey. Size composition of fish taken there are now beginning to explain differences between the survey and the commercial fishing results in the area.



### The Fishery

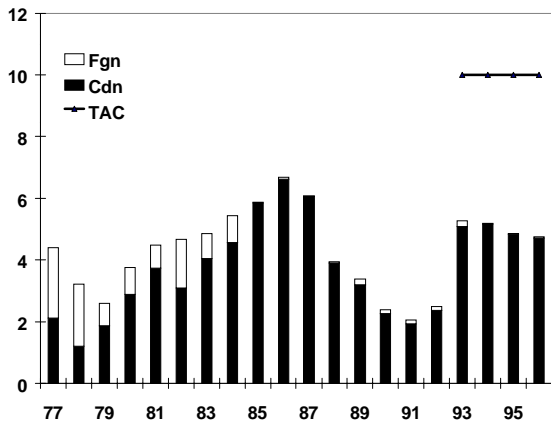
#### Landings (thousands of tonnes)

| Year    | 70-79            | 80-89 | 90-92 | 93 <sup>2</sup> | 94 <sup>2</sup> | 95 <sup>2</sup> | 96 <sup>2</sup> | 97   |
|---------|------------------|-------|-------|-----------------|-----------------|-----------------|-----------------|------|
|         | avg              | avg   | avg   |                 |                 |                 |                 |      |
| TAC     |                  |       |       | 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             |      |
| Foreign | 5.7 <sup>1</sup> | 0.5   | 0.1   | 0.2             | +               | +               | +               |      |
| Total   | 9.7              | 4.9   | 2.3   | 5.3             | 5.2             | 4.9             | 4.8             |      |

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

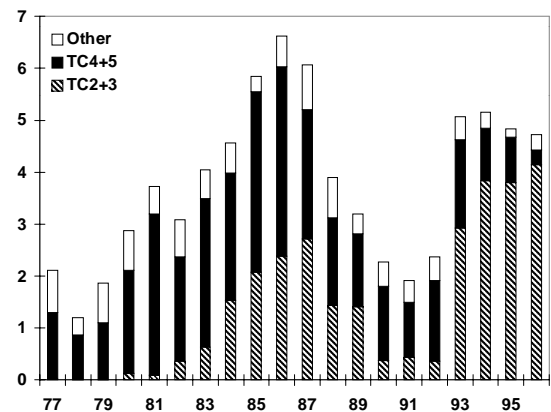
<sup>2</sup> Provisional

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. Provisional catches for 1996 were about 4,800 t, slightly less than in 1993-95 and well below the 10,000 t TAC. The provisional Canadian catch for January through July 1997 was about 3,200 t, somewhat more than for the same time period in 1996 (2,700 t).



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

In 1996, small otter trawlers (less than 65 ft), fishing in the basins, took most of the reported catch. Large otter trawlers (greater than 65 ft) fishing in the basins and at the edge of the shelf, took only a very small portion of the catch (Figure 10). In early 1997 (to July), small otter trawlers began to catch large redfish on grounds deeper than 200 fathoms at the shelf edge. Landings of smaller redfish from 4Xo and basins to the east were much less than for this period in 1996. Large otter trawlers took almost no redfish in this period.

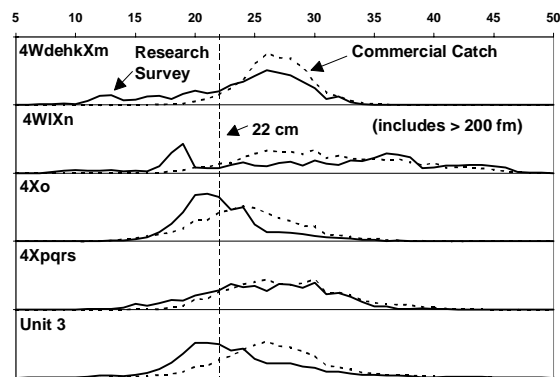


**Figure 10.** Canadian landings by vessel type (in thousands of tons)

Unit 3 redfish landings have traditionally had a high proportion of fish in the 20-25 cm range. However catches of fish less than this size were rare. Increased catches of fish less than 20 cm in 1994-95 resulted in a portion of 4Xo known as the ‘Bowtie’ being closed to fishing from late May of 1995 (at industry’s request) and for a 22 cm minimum fish size to be included in the Conservation Harvesting Plans for 1996. Percentages by number of redfish landings from combined port and observer samples under this size were:

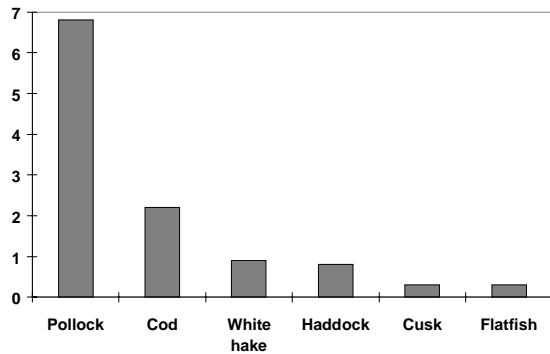
|           | 93  | 94   | 95   | 96   | 97<br>(to July) |
|-----------|-----|------|------|------|-----------------|
| % < 22 cm | 3.5 | 14.8 | 15.1 | 10.3 | 6.9             |

The proportions of small redfish were higher in catches from 4Xo, where most of the small redfish occur as shown from research surveys, than for other areas of Unit 3 (Figure 11).



**Figure 11.** Research (solid) and commercial (dotted) size composition (cm) by area for 1995-97 (%).

In addition to using bycatch trip limits, a number of areas were closed to redfish fishing in 1996 to further limit bycatch. Landings statistics for 1996 indicated that

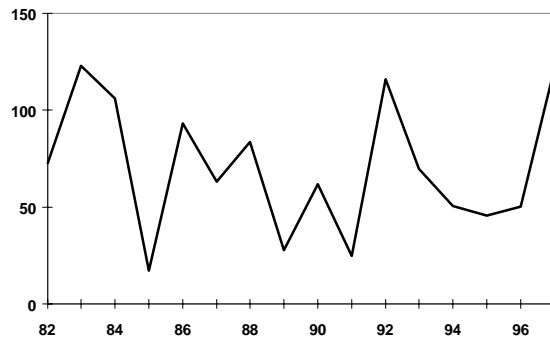


**Figure 12.** Bycatch by species for 1996 (%).

pollock accounted for most of the bycatch in Unit 3 (Figure 12). The highest rates for all species combined were in the west (4Xpq), but neither industry nor management consider the situation there to be a problem because most of the bycatch consisted of legal sized fish and was counted towards the vessels' quota of these species.

**Resource Status**

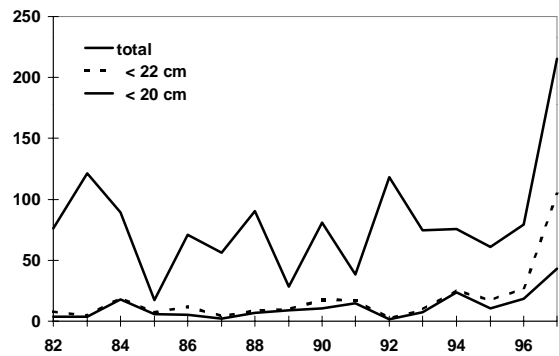
The increase in catches in 1993, compared to 1988-92, resulted from an increase in fishing effort by small otter trawlers, reflecting decreased fishing opportunities for more valuable species, and not an increase in redfish abundance. The many changes in this



**Figure 13.** Biomass index from summer survey (in thousands of tons)

fishery make commercial catch rates impossible to interpret in the context of redfish abundance.

Survey estimates of population biomass (less than 200 fathoms), are highly variable between years and show no trend since the late 1980s (Figure 13). In recent years, there has been evidence that there are more small fish, particularly in the area north and east of Brown's Bank. A large proportion of these small fish are now between 20 and 22 cm long (Figure 6).



**Figure 14.** Survey numbers per tow by size class.

The 1997 abundance estimate is much higher than earlier values but that this is, at least in part, a reflection of higher catch-ability to the survey in that year.

The ratio of recent catch tonnages to total survey biomass gives an estimate of exploitation rate of less than 10 percent. Total survey biomass was used for this calculation without adjustment as survey and commercial catch size compositions usually do not differ greatly. However, survey biomass is considered a conservative estimate of actual exploitable biomass and thus the calculated exploitation rate is thought to be an upper estimate.

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### ***Industry Perspectives***

Large otter trawler owners claim that they are increasingly unable to operate due to conflicts with fixed gear and to high bycatch levels as well as high proportions of small fish in the catches. Small otter trawler captains and plant operators in Southwest Nova Scotia are pleased with the catches of large redfish at the shelf edge but are concerned about the smaller redfish elsewhere. There were reports of small redfish being landed after the July opening of Brown's Bank to small mesh gear in the area immediately south of the 'Bowtie' in both 1996 and 1997. Industry processing records confirm that biological sampling does not fully reflect the landings of small fish from this area during this period. Industry also note a lack of DFO enforcement of the 22 cm small fish protocol in 4X but claim some self-regulation of the catching of fish less than 20 cm. Most operators advocate that these small fish should be avoided through modification of the closed area boundaries and/or a system of test fishing.

### ***Outlook***

Research vessel surveys indicate stability in the population biomass with improved recruitment particularly in and around 4Xo. However, it is not yet clear to what extent this recruitment will increase exploitable biomass and hence improve fishing success.

TACs for Unit 3 redfish of 10,000 tons, when compared to survey biomass estimates, correspond to an exploitation rate of about 15 percent. As survey biomass estimates are considered underestimates of actual biomass, a catch of 10,000 tons is not likely to exceed that corresponding to  $F_{0.1}$  in 1998.

### ***For Further Information***

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## Division 3O Redfish

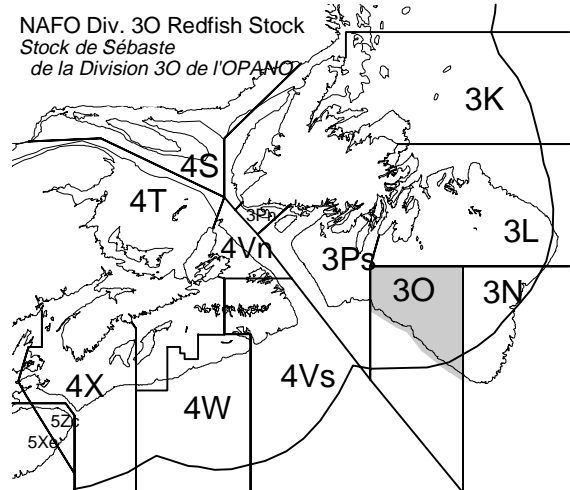
### Background

Traditionally, 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. Recently, because of declines in other resources and developing markets for small redfish for lobster bait, there has been some increased interest in fishing in this area.

A TAC of 16,000 t was first implemented on this stock in 1974. The TAC was increased in 1978 to 20,000 t. The TAC for 1988 was reduced to 14,000 t and remained unchanged until 1994 when it was reduced to 10,000 t as a precautionary measure and maintained at that level to 1997.

In addition to catch regulation, a small fish protocol at 22 cm was implemented inside the 200 mile limit for this stock in 1995. The current TAC (10,000 t) is divided into a Canadian quota (5,590 t), a French (St. Pierre et Miquelon) quota (1,500 t) and a Foreign Quota (2,910 t).

About 10% of the stock area lies outside Canada's 200 mile Exclusive Economic Zone (EEZ).



### The Fishery

Nominal catches have ranged between 3,000 t and 35,000 t since 1959 (Figure 15). 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 1994 catch, at about 5,400 t, represented an 11,000 t reduction from 1993. Catches declined further to about 3,000 t in 1995 but increased to 9,000 t in 1996 due to activity by various Canadian enterprises.

### Landings (thousand metric tons)

| Year   | 70-76<br>Avg. | 77-92<br>Avg. | 1993 | 1994 <sup>1</sup> | 1995 <sup>1</sup> | 1996 <sup>1</sup> | 1997 |
|--------|---------------|---------------|------|-------------------|-------------------|-------------------|------|
| TAC    | -             | -             | 14   | 10                | 10                | 10                | 10   |
| Can.   |               | 1             | 1    | 2                 | .1                | 7                 | 2    |
| Others | 13            | 14            | 15   | 4                 | 3                 | 2                 |      |
| Totals | 14            | 15            | 16   | 6                 | 3                 | 9                 |      |

<sup>1</sup> Provisional

Russia predominated in this fishery until 1993, but had much lower catches in 1994 and 1995 and no effort in 1996. Cuba has not participated in the fishery in this area since 1993. Portugal, which began fishing in

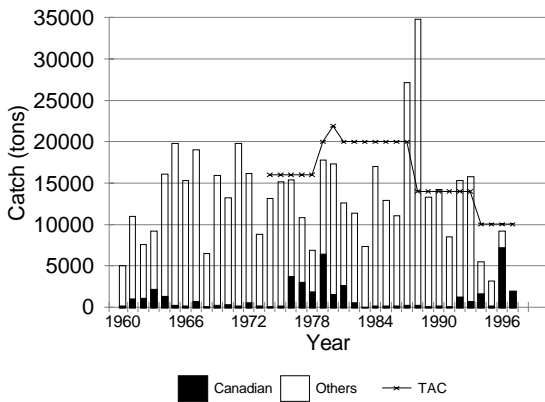


Figure 15. Reported catches and TACs of redfish from Division 30 (in tons),

the area in 1992, took 2,900 t in 1994 and about 1,800 t in each of 1995 and 1996. 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 in 1996 to about 7,000 t. About 2,000 have been taken by Canada to Oct. 1 in 1997. The fishery has occurred primarily in the second and third quarters of the year since 1983. The 1996 Canadian catch was taken from September to December. 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.

Length frequency information from the 1996 fishery indicated a preponderance of fish

greater than 25 cm with modes at around 30 cm. The 1996 Portuguese catches showed a much broader range of lengths from about 25 cm to 42 cm with modes at 30 cm and 38 cm.

A **standardised catch rate index** using Canadian data only, and based on effort in hours fished, shows much inter-annual variability over the 1959-1996 period but without any discernible trend with time. Previous analyses of catch rate data from foreign fleets fishing the area outside 200 miles have indicated declines in recent years.

### Resource Status

**Stratified random groundfish surveys** have been conducted in the spring and fall in Division 30 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.

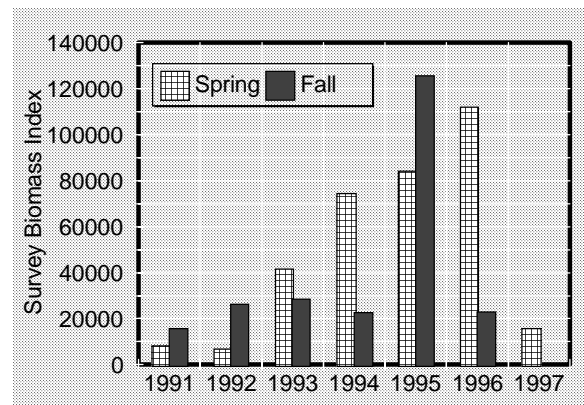


Figure 16. Research survey index for Division 30 redfish.

The spring **survey index** (Figure 16) increased steadily from 1992 through 1996 but declined sharply in 1997. Stratum by stratum estimates indicate that the increases



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during the spring surveys occurred over a great deal of the area, although in the spring of 1996 only a few large sets were responsible for the observed increase.

The fall survey index increased gradually from 1991 through 1993 but declined slightly in 1994 before increasing significantly in 1995. The index declined sharply in 1996 but the extent of the decline is unknown because four important strata were not sampled.

The surveys catch fish in the 10 cm to 25 cm range whereas the commercial catch is mostly comprised of fish greater than 25 cm. Given that the surveys are not measuring the main portion of the stock exploited by the fishery, recent declines in the survey estimates therefore, do not appear to be related to fishing. The surveys only monitor pre-recruit size groups and while the recent declines should be viewed with concern, it is difficult to interpret these events in relation to what is happening to the stock as a whole. There is also some 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.

### ***Industry Perspectives***

The increased activity in 1996 for some Canadian enterprises was motivated by a need to find fish of marketable size in light of the moratorium in Unit 1 and was based on the premise that there were larger fish in deeper water in Div. 3O. The experience of this fishery was different from other Canadian fisheries but 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. So far in 1997, there were reports of much greater mixtures of small fish with the large fish in the area and there are indications that catch rates are lower than 1996. This fishery is still considered to be in the learning stage.

### ***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. On the assumption that the pre-recruits measured by the survey in recent years have now largely passed through the size ranged measured by these surveys but remained in Div. 3O, they represent an addition to the exploitable stock of about 100,000 t. Thus, catches of about 10,000 t are not likely to generate fishing mortality above  $F_{0.1}$ .

### ***For Further Information***

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