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Assessment of Demersal Redfish in NAFO Subarea 1

by

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Abstract

Two species of redfish of commercial interest occur off West Greenland inshore and offshore, golden redfish (*Sebastes marinus* L.) and deep-sea redfish (*Sebastes mentella* Travin). SSB and recruitment indices for golden redfish decreased drastically from 1982 and have remained significantly below the average level since 1989. Taking into account the recent very low SSB and the recruitment failure together with the absence of golden redfish in the Greenland surveys, the stock of golden redfish in Subarea 1 is considered to be severely depleted with no signs of recovery. The deep-sea redfish SSB has been extremely low since 1989. The deep-sea redfish show high variation in recruitment. Good recruitment has been seen in 1997, 2000 and 2001, while the recruitment in 2002 again was very poor. Substantial numbers of redfish are discarded in the shrimp fishery, and concern must be expressed about the continuing failure of the juveniles to rebuild the pre-mature and mature stock components. From Oct. 1 2000, sorting grids have been mandatory in the shrimp fishery and this will hopefully reduce the amount of juvenile redfish in the by-catch significantly. Considering the depleted SSBs, the recruitment potential of the very abundant early life stages at an age of 0-2 years to the Subarea 1 stocks remains unclear.

1. Introduction

Two species of redfish of commercial interest occur inshore and offshore at West Greenland, golden redfish (*Sebastes marinus* L.) and deep-sea redfish (*Sebastes mentella* Travin). Stock identities in terms of reproduction were investigated by a joint ICES/ICNAF Study Group (Anon., 1983). The concept of self-sustaining units or stocks in NAFO Subarea 1 remains unproved for both species due to a general lack of records of maturing or spawning (bearing) specimens. Therefore, the working group suggested strong relations to the two golden and deep-sea redfish stock complexes off East Greenland, Iceland and Faroes (ICES Subareas V and XIV) as well as the management unit of oceanic redfish (*Sebastes mentella* Travin) in the central Irminger Sea (ICES Subareas XII

and XIV). However, the common occurrence of golden redfish at length groups being mature in other areas were proved from historical length measurements before the 1970s.

2. Description of the Fisheries

Historically, redfish were taken mainly as by-catch in the trawl fisheries for cod and shrimp. However, occasionally during 1984-86, German and Japanese trawlers prosecuted a directed fishery on redfish. With the collapse of the Greenland cod stock during the early-1990s, resulting in a termination of that fishery, commercial sized redfish were only taken inshore by long-lining or jigging and offshore as by catch in the shrimp fisheries. There are also substantial numbers of juveniles discarded in the shrimp fishery. Since Oct. 1.t 2000, sorting grids have been mandatory in the shrimp fishery and this will hopefully reduce the amount of juvenile redfish taken as by-catch significantly.

3. Catches

The two redfish species, golden redfish (*Sebastes marinus* L.) and deep-sea redfish (*Sebastes mentella* Travin) are combined in the catch statistics. Other data suggest that until 1986, landings were almost exclusively composed of golden redfish. Subsequently, the proportion of deep-sea redfish represented in the catches increased, and since 1991, the majority of catches are believed to be deep-sea redfish. Recently, redfish catches has been reported as "Redfish" (unspecified - mainly taken as by-catch by the offshore shrimp trawlers), "Golden redfish" and "Beaked redfish" (pelagic redfish fishery). Since pelagic redfish is assessed by ICES (NWWG report 2003), the catch statistic reported as "Beaked redfish" is not included here.

In 1977, total reported catches peaked at 31 000 tons (Table 1, Fig. 1). During the period 1978-83, reported catches of redfish varied between 6 000 and 9 000 tons. From 1984 to 1986, catches declined to an average level of 5 000 tons due to a reduction of effort directed to cod by trawlers of the EU-Germany fleet. With the termination of the offshore cod fishery in 1990, catches decreased further to 1 200 tons, and remained at that low level. The Greenland nominal catch of redfish in Subarea 1 in 2000, 2001 and 2002 is 735 tons, 332 tons and 487 tons, respectively (Siegstad and Frandsen, 2003). Norway reported 5 tons from NAFO 1C in 2002 (Gundersen and Høines, 2003).

Recent and historical catch figures do not include the weight of substantial numbers of small redfish discarded by the trawl fisheries directed to shrimp.

4. Assessment

Due to a lack of adequate commercial data no analytical assessment could be formulated. Therefore, the assessment was based on survey indices.

4.1. Input Data

4.1.1. Commercial fishery data

Information on historical length composition was derived from sampling of EU- German commercial catches of golden redfish during 1962-90 covering fresh fish landings as well as catches taken by freezer trawlers. Samples were quarterly aggregated and mean length was calculated. These data revealed significant size reductions from 45 to 35 cm, with the most significant reductions occurring during the 1970s. There are no data available to estimate the size composition of historical catches of deep-sea redfish.

No quantitative information on the amount of juvenile redfish in the by-catches of the shrimp fishery was available from 2000 to 2002.

4.1.2. **Survey data**

EU-German groundfish survey. Annual abundance and biomass indices were derived from stratified-random bottom trawl surveys commencing in 1982 (Rätz *et al.*, 2003). These surveys covered the areas from the 3-mile limit to the 400 m isobath of Div. 1B to 1F and were primarily designed for cod as target species. Therefore, the high variation of the estimates for redfish could be caused as a result of the incomplete survey coverage in terms of depth range and pelagic occurrence of redfish. The survey results indicated that both abundance and biomass estimates of golden redfish (≥17 cm) decreased by more than 90% until 1990 and remained at that low level since then (Fig. 3). Biomass estimates for deep-sea redfish (≥17 cm) varied without a clear trend but have frequently been extremely low since 1989 (Fig. 4). However, the 1997, 2000 and 2001 estimate indicated a significant biomass increase due to good recruitment (Fig. 8). The good recruitment could however not be traced in 2002, where biomass index was back at a very low level. Unspecified redfish <17 cm were found to be very abundant, especially in 1986, 1991, and 1996-98 (Fig. 5). The abundance index of these small redfish has since 2000 decreased to a very low level. Reappearing peaks at 6, 9-11 and 13-15 cm might indicate annual growth increments and represent the age groups 0, 1 and 2 years. Comparisons between the survey results off West and East Greenland revealed that all three redfish components were almost exclusively distributed off East Greenland.

Greenland-Japan and Greenland groundfish surveys. During 1987-95, cooperative trawl surveys directed towards Greenland halibut and roundnose grenadier have been conducted on the continental slope in Div. 1A-1D at depths between 400 and 1 500 m. This deep-water survey was discontinued in 1996 but conducted again since 1997 by Greenland with another vessel and changed gear (Jørgensen, 2003). Deep-sea redfish were mainly caught in Div. 1C and at depths less than 800 m. From 1997 to 1999 and in 2001, the biomass has been stable at about 2 000-2 500 tons (Fig. 4). In 2000 and 2002, the survey did not cover the shallow areas (<800 m) sufficiently. Therefore, no abundance and biomass indices were calculated. Length measurements revealed that immature individuals <30 cm presently dominate the size composition of the stock. From the 2002 survey 30 redfish (between 18-39 cm) were examine for maturity. None of the fish showed any sign on maturity.

Greenland groundfish/shrimp survey. Since 1988, a shrimp survey was conducted by Greenland covering the Div. 1A to 1F down to 600 m depth (Storr-Poulsen and Jørgensen, 2003). Due to changes in survey strategy and sampling of fish, determinations of abundance and biomass indices and length composition were considered comparable since 1992. Redfish was found in all the survey areas, but was most common in Div. 1B and 1C.

The abundance and biomass estimated of redfish *(Sebastes sp.)* in the period 1992-1996 have fluctuated without a clear trend between 1.1-2.8 billion individuals and 12 000-31 000 tons. In 1999 the biomass decreased to 13 000 tons from the 1998 level at 21 000 tons and has stayed at that level since. The biomass in 2002 was estimated to 12 400 tons. The abundance has shown a gradual decrease from 2.4 billion individuals in 1996 to 122 mill. in 2001 (Fig. 5). The abundance increased however slightly to 277 millions individuals in 2002.

During the years catches has comprised almost exclusively of specimens less than 20 cm. Annual growth increments of 4 cm were indicated by repeatedly pronounced peaks in length compositions at 7-8 cm and 12 cm probably corresponding to age 1 and 2 (Nederaas, 1990). The resent four survey estimates revealed only small peaks at 7-8 cm and 12 cm, leaving no sign of prominent future recruitment.

4.2. **Estimation of parameters**

The golden redfish spawning stock biomass was assessed assuming knife edge maturity at 35 cm as observed in East Greenland applied to the length disaggregated abundance indices derived from the EU-German groundfish survey. The length groups 17-20 cm was chosen as recruitment indices at age 5. SSB and recruitment indices decreased drastically from 1982 and have remained significantly below the average level since 1989 (Fig. 6). Taking into account the recent very low SSB and the recruitment failure together with the absence of golden redfish in the Greenland surveys, the stock of golden redfish in Subarea 1 is considered to be severely depleted with no signs of recovery. There are indications that the probability of future recruitment is reduced at the current low SSB (Fig. 7).

The German survey biomass of fish >=35 cm and the abundance of length groups 17-20 cm were taken as proxies for deep-sea redfish SSB and recruitment at age 5, respectively. No clear trend can de derived from these estimates but SSB has been extremely low since 1989 (Fig. 8). The recently depleted status of the SSB is confirmed by the lack of adult fish in the Greenland deep-water survey. Recruitment variation is high, and the 1996, 2000 and 2001 estimates were above average, but the 2002 value decrease again to a very low value.

4.3. **Assessment results**

Substantial numbers of redfish are caught and discarded by the shrimp fishery, and concern must be expressed about the continuing failure of the juveniles to rebuild the pre-mature and mature stock components. Considering the depleted SSBs, the recruitment potential of the very abundant early life stages at an age of 0-2 years to the Subarea 1 stocks remains unclear. Recruitment indices for golden redfish have been extremely poor while those for deep-sea redfish indicate god recruitment in some years.

The probability of recovery of the redfish stocks in Subarea 1 should increase if the by-catches taken by the shrimp fishery are reduced to the lowest level possible. The application of mandatory sorting grids since 1 Oct 2000 will hopefully help to reduce by-catches of young redfish. Results of experimental fishing with 22mm sorting grids show a nearly complete protection to finfish larger than about 20 cm, but poor protection of the smallest fish (Engelstoft *et al.*, 2001).

4.4. **Reference points**

Given the lack of long-term data on SSB and recruitment and the uncertainties regarding reproduction and maturation of redfish in this area, proposals for any limit of buffer reference points for fishing mortality or spawning stock biomass for the stocks of golden and deep-sea redfish stocks in Sub-area 1 could not be given. However, given the relationship observed for golden redfish between adult biomass and recruitment, there appears to be a very high probability of decreased recruitment below biomass index levels of 5 000 tons. Recent survey results indicate that biomass of golden redfish remains below this level.

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Table 1. TAC and annual catches of redfish in NAFO Subarea 1 (exclusive catches reported as pelagic redfish): golden and deep-sea redfish combined (Siegstad and Frandsen, 2003, Gundersen and Høines, 2003).

Year	TAC (1 000 t)	Catch (1 000 t)
1965		19
1966		17
1967		13
1968		9
1969		5
1970		5
1971		3
1972		3
1973		3
1974		3
1975		9
1976		14
1977		31
1978		8
1979		9
1980		8
1981		6
1982		8
1983		7
1984		6
1985		4
1986	19	5
1987	19	1
1988	19	1
1989	19	1
1990	19	0.4
1991	19	0.3
1992	19	0.3
1993	19	0.8
1994	19	1.0
1995	19	0.9
1996	19	0.9
1997	19	1.0
1998	19	0.9
1999	19	0.8
2000	19	0.7
2001	19	0.3
2002[1]	8	0.5[2]

1) Estimated catches (no official data available).
2) Incl. Norway reports on 5 tons of redfish from a trawl fishery targeting Greenland halibut in 1C.

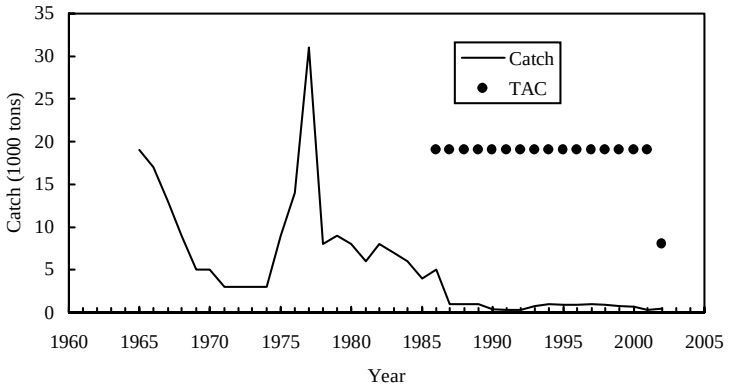

Fig. 1. TAC and catches of redfish in NAFO Subarea 1, both golden and deep-sea redfish combined.

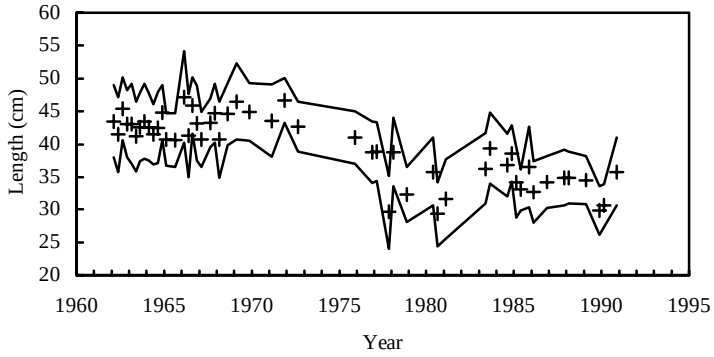

Fig. 2. Mean length ± standard deviation derived from German catches of golden redfish in NAFO Subarea 1, 1962-90.

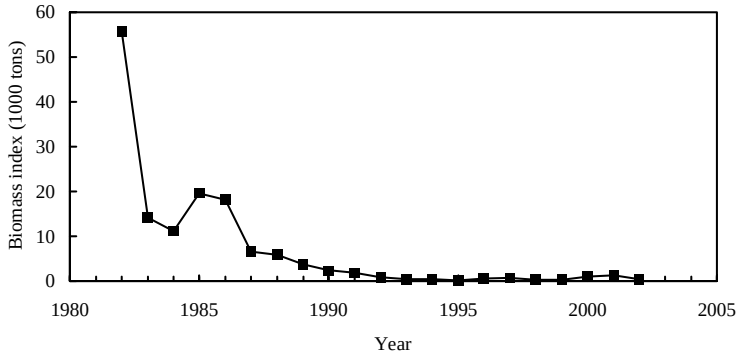

Fig. 3. Survey biomass indices for golden redfish (≥17 cm) in NAFO Subarea 1 derived from the EU-German groundfish survey.

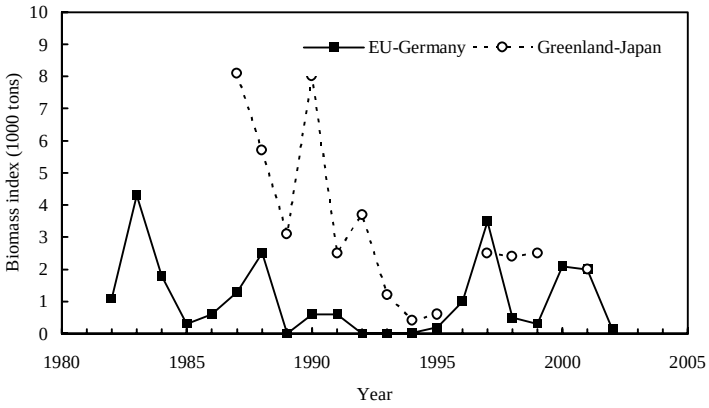

Fig. 4. Survey biomass indices for deep-sea redfish (≥17 cm) in NAFO Subarea 1 derived from the EU-German groundfish survey and from the joint Greenland-Japan survey including the entire length range (since 1997 Greenland only).

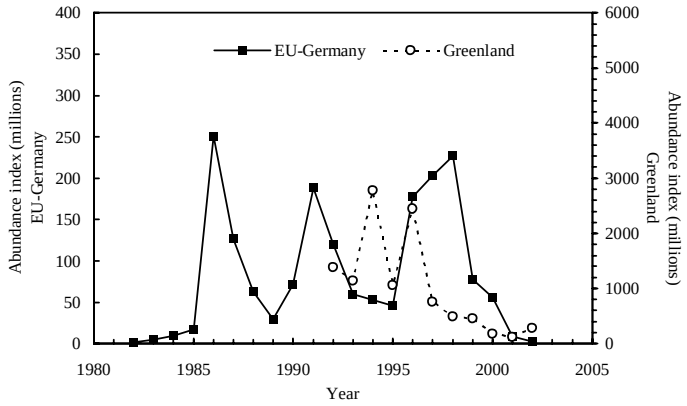

Fig. 5. Abundance indices for unspecified redfish (<17 cm) in Subarea 1: survey abundance indices derived from the EU-German groundfish survey and from the Greenland groundfish/shrimp survey including the entire length range.

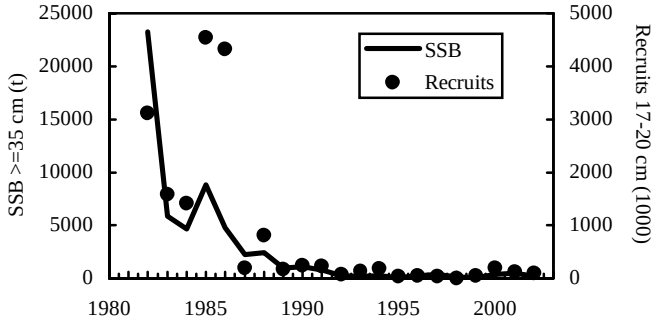

Fig. 6. Golden redfish Subarea 1. SSB and recruitment indices as derived from the German groundfish survey in the given years.

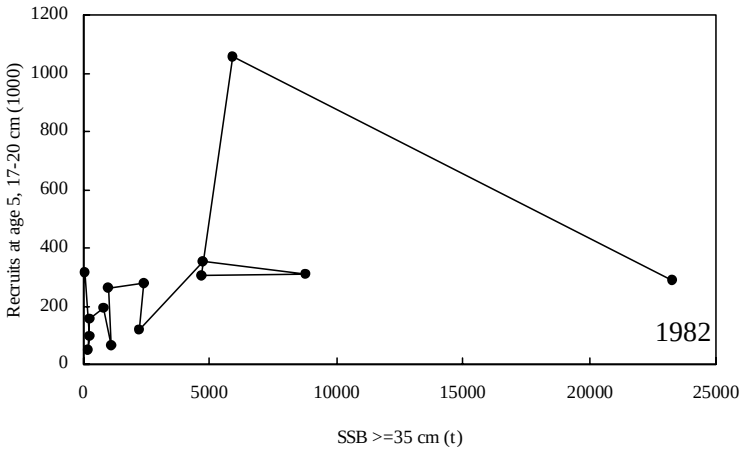

Fig. 7. Golden redfish Subarea 1. SSB-recruitment plot.

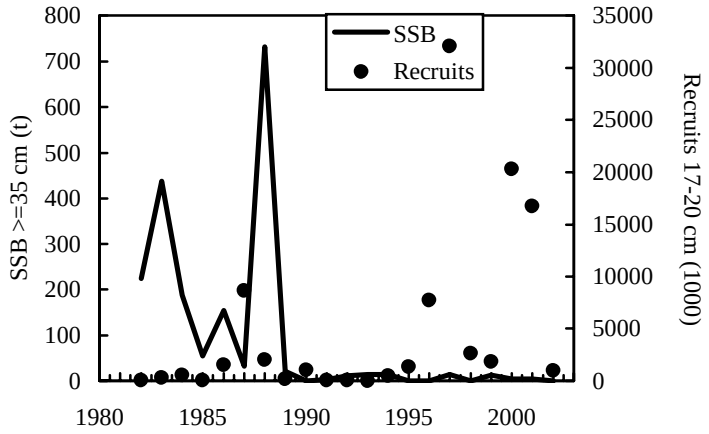

Fig. 8. Deep-sea redfish Sub-area 1. SSB and recruitment indices as derived from the German groundfish survey.