Northwest Atlantic Fisheries Organization

Serial No. N5538 **NAFO SCR Doc. 08/37**

SCIENTIFIC COUNCIL MEETING – JUNE 2008

Assessment of Demersal Redfish in NAFO Subarea 1

by

Rasmus Nygaard
Greenland Institute of Natural Resources
rany@natur.gl

and

Heino Fock and Christoph Stransky

Federal Research Centre for Fisheries, Institute for Sea Fisheries
Palmaille 9, D-22767 Hamburg, Germany
heino.fock@vti.bund.de cristoph.stransky@vti.bund.de

Abstract

At the NAFO 2008 June meeting Scientific Council is requested to provide advice for 2009 and 2010 on management for redfish in Subarea 1. 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). A pelagic fishery for pelagic redfish (*Sebastes mentella*) occurred for the first time off West Greenland in 1999. The pelagic redfish in West Greenland is part of the Irminger stock complex and is assessed by ICES.

The golden redfish SSB and recruitment indices decreased drastically from 1982. Since 2002 minor improvements in SSB and recruitment in the EU German groundfish survey have been observed. However, taking account of the historically low estimates of Redfish found in the Greenland surveys, the stocks must be considered to be depleated with minor signs of recovery.

The deep-sea redfish SSB has been low since 1989. Recruitment variation is high, and the 1997, 2000 and 2001 estimates were above average, but since 2002 recruitment indices have remained at a low level.

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). 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. To reduce the amount of juvenile redfish taken as by-catch in the shrimp fisheries, sorting grids have been mandatory since October 2000.

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 2008), 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.

Substantial numbers of redfish are discarded in the shrimp fishery. From Oct. 1 2000, sorting grids have been mandatory in the shrimp fishery in order to reduce the amount of juvenile redfish taken as by-catch significantly (completely implemented in 2002). Results of experimental fishing with 22mm sorting grids show a nearly complete protection of finfish larger than about 20 cm, but poor protection of the smallest fish (Engelstoft *et al.*, 2001). Studies conducted in 2006 to 2007 have confirmed this, as the level of discard of fish in the shrimp fishery was only 2.2% of the shrimp catch (Sünksen 2007). However, in areas 1B to 1E, the larger fraction of this by-catch was composed of small redfish between 6 and 13 cm (~0.6 % of the shrimp catch). Recent and historical catch figures do not include the weight of the substantial numbers of small redfish discarded by the trawl fisheries directed to shrimp.

3.1. Input Data

3.1.1. 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 70s. There are no data available to estimate the size composition of historical catches of deep-sea redfish.

In 2007 (and 2006) no data was reported from Greenland for Redfish (unspecified) taken as by-catch (SCR 08/11). In 2005 redfish (unspecified) taken as by-catches were reported at 400 tons which must be considered an underestimate. Catches of Golden redfish in 2007 was estimated at 114 tons (SCR 08/11) mainly caught from small-boats by longline, gillnet or jigging.

3.1.2. Survey data

EU-German groundfish survey. Annual abundance and biomass indices were derived from stratified-random bottom trawl surveys commencing in 1982 (SCR 08/16). 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. However, since 2002 a limited but steady increase in both survey and GLM index has been observed, although substantial recovery back to historical levels do not appear (Fig. 3). In 2007 the stock was mainly composed of three length groups 17-20, 25-35 and 25-40 cm in body length. The size group 17-20 cm was particularly strong and indicating potential for recovery.

Biomass estimates for deep-sea redfish (≥17 cm) varied without a clear trend (Fig. 4). Since 1996, the survey abundance has increased, but the stock consists mainly of juvenile fish between 17 and 20 cm in length. It must be noted, that the survey design hardly covers the distribution area of deep sea redfish, and the survey results should be carefully interpreted.

The abundance of juvenile redfish <17 cm *Sebastes spp.* has varied over a wide range since 1982 (Fig. 5). More recent indices since 2001 are among the lowest. The length composition of the stock revealed peaks at 6-7, 10-12 and 14-16 cm, an indication of sizes at ages 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 deep-sea surveys. During 1987-95, cooperative trawl surveys directed towards Greenland halibut and roundnose grenadier were 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 (SCR 08/17).

Deep-sea redfish were mainly caught in Div. 1C at depths less than 800 m. In 2000 and 2002, the survey did not cover the shallow areas (<800 m) sufficiently. Therefore, no abundance and biomass indices were calculated. From 1997 and until 2006 the biomass has been stable at about 2 000-2 500 tons (Fig. 4). The 2007 estimate of only 574 tons is however based on only 7 hauls above 800 m of depth where the majority of the fish normally is found. Length measurements revealed that immature individuals <30 cm presently dominate the size composition of the stock. None of the redfish in surveys since 2002 have shown 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 (SCR 08/28). 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 in the period 1992-1996 have fluctuated without a clear trend between 0.9-2.4 billion individuals and 14 000-38 000 tons. From 1997–2004 biomass and abundance have decreased to between 165-719 millions individuals and 11-23000 tons. In 2007 both biomass and abundance reached a historic low level (Fig. 5).

During the years, catches have comprised almost exclusively 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 recent five survey estimates revealed only small peaks at 7-8 cm and 10-14 cm, leaving no sign of prominent future recruitment. In 2007 only one weak mode at 13-14 cm was seen, indicating poor recruitment in 2006.

3.2. **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. In 2007 both SSB and recruitment have increased (Fig. 6). 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. In 2007 an increase in recruits at age five which corresponds to the first yearclass (2002) protected by the sorting grids in the shrimp trawls is seen (Fig 7). (Sorting grids were not fully implemented until 2002)

The German survey biomass of deep-sea redfish >=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. The SSB has been extremely low since 1989, although slowly increasing since 2001 (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 1997, 2000 and 2001 estimates were above average, but since 2002 recruitment indices have remain low. SSB and recruitment indices have decreased drastically from 1982 (fig 9).

4. **Assessment**

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

4.1. **Assessment results**

Although some signs of recovery are seen in the golden redfish SSB and recruits at age 5, substantial recovery back to historical levels do not appear. The Greenlandic groundfish/shrimp survey reveals the lowest abundance and biomass estimates seen since the beginning of the survey in 1992 and the EU-German groundfish survey reveals only minor improvements in the abundance and biomass of redfish below 17 cm. It seems likely that this is related to the substantial numbers of redfish that 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. Although the by-catch of juvenile redfish, since the implementation of sorting grids, is only ~0.6% of the shrimp catch, this can still add up to a significant reduction of several hundred tonnes of redfish below 13 cm, due to the high catches of shrimp (above 100.000 tonnes per year).

Therefore concern must be expressed about the continuing ability of the juveniles to rebuild the pre-mature and mature stock components.

4.2. **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.

References

Engelstoft, J. J, Isaksen, B., Larsen, R. B., Rosing, M. and K. Zachariassen, 2001. Studies of technical methods for secure shrimp fishery in the Redfish Box, East Greenland. Project Report for the Nordic Strategy for the Environment and Fisheries. *Tema Nord* (technical report at Greenland Institute of Natural Resources).

Fock , H. and C. Stransky. 2008. Stock abundance Indices and Length Compositions of Demersal redfish and other finfish in NAFO Subarea 1 and near bottom water temperature derived from the German bottom trawl survey 1982-2007. NAFO SCS Doc. 08/16, Ser. No. N5509:1-28.

Jørgensen, O. A. 2008. Survey for Greenland Halibut in NAFO Divisions 1C-1D, 2007. NAFO SCR Doc. 08/17, Ser. No. N5510:1-31.

Nedreaas, K. 1990: Age determination of Northeast Atlantic Sebastes species. J. Cons. int.Mer. 47: 47: 208-230.

Nygaard, R., Sünksen, K. and Jørgensen O. A., 2008. Biomass and abundance of demersal fish stocks off West Greenland estimated from the Greenland Shrimp Survey, 1988-2007. NAFO SCR Doc. 08/28, Ser. No. N5528:1-28.

Siegstad, H.. 2008. Denmark/Greenland Research Report for 2007. NAFO SCS Doc. 08/11, Ser. No. N5516:1-8.

Sünksen, K. 2007: Discarded by-catch in shrimp fisheries in Greenlandic offshore waters 2006-2007. NAFO SCR Doc. 07/88, Ser. No. N5474:1-12.

Table 1. TAC and annual catches of redfish in NAFO Subarea 1 (exclusive catches reported as pelagic redfish): golden and deep-sea redfish combined (SCS Doc. 08/11).

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	8	0.5
2003	1	0.5
2004[1]	1	0.5
2005	1	0.2
2006	1	0.3
2007	1	0.1
2008	1	

1) Provisional catches

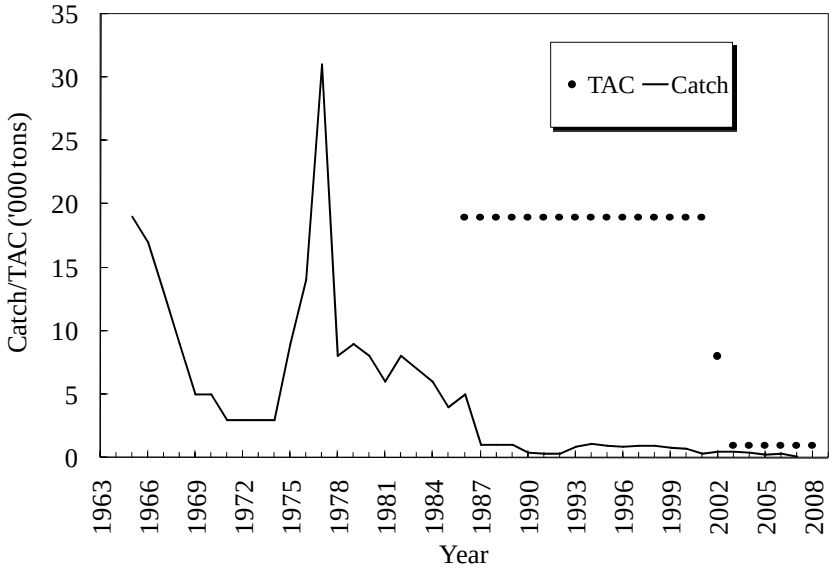

Fig. 1. TAC and catches of redfish in NAFO Subarea 1, both golden and deep-sea redfish combined.

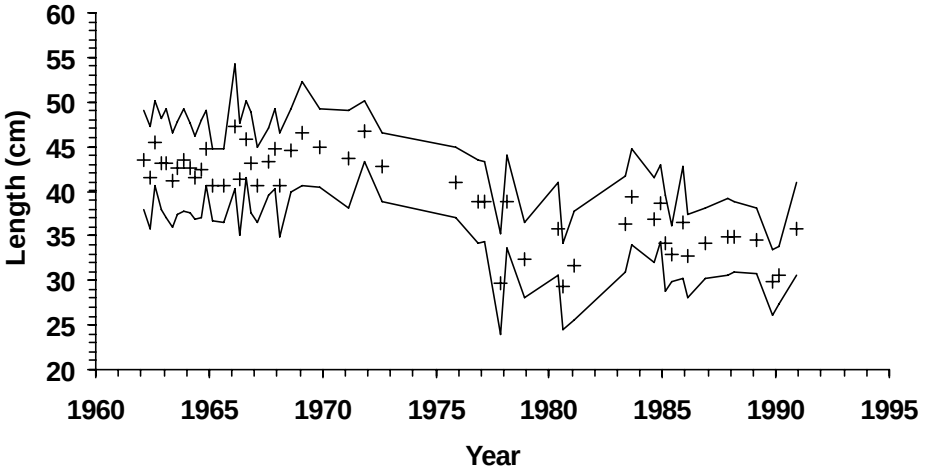

Fig. 2. Mean length ± standard deviation derived from German catches of golden redfish in NAFO Subarea 1, 1962-90.

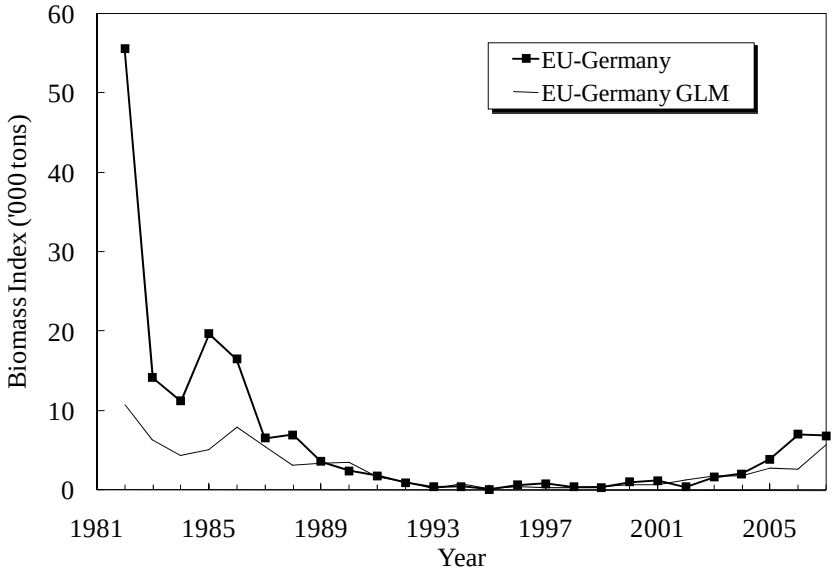

Fig. 3. Survey biomass indices for golden redfish (≥17 cm) in NAFO Subarea 1 derived from the EU-German groundfish survey.

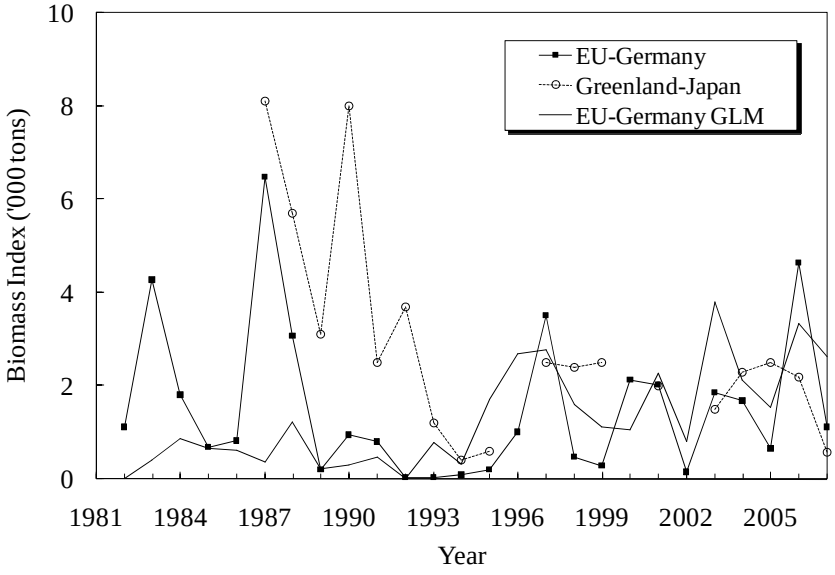

Fig. 4. Survey biomass indices for deep-sea redfish (≥17 cm) in NAFO Subarea 1 derived from the EU-German groundfish survey and from the Greenland-Japan survey including the entire length range (since 1997 Greenland only).

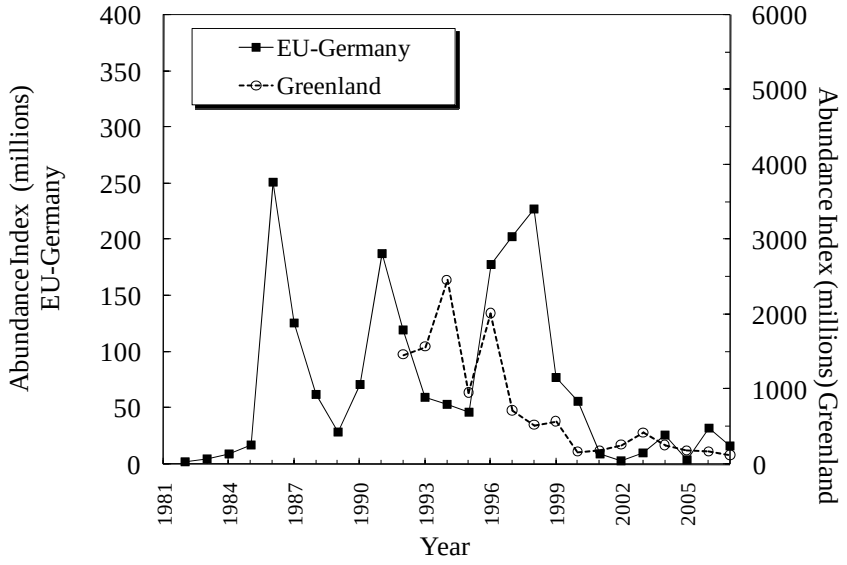

Fig. 5. Abundance indices for unspecified redfish (<17 cm) in Subarea 1: survey abundance indices derived from the EU-German groundfish survey and from the Greenland groundfish/shrimp survey including the entire length range.

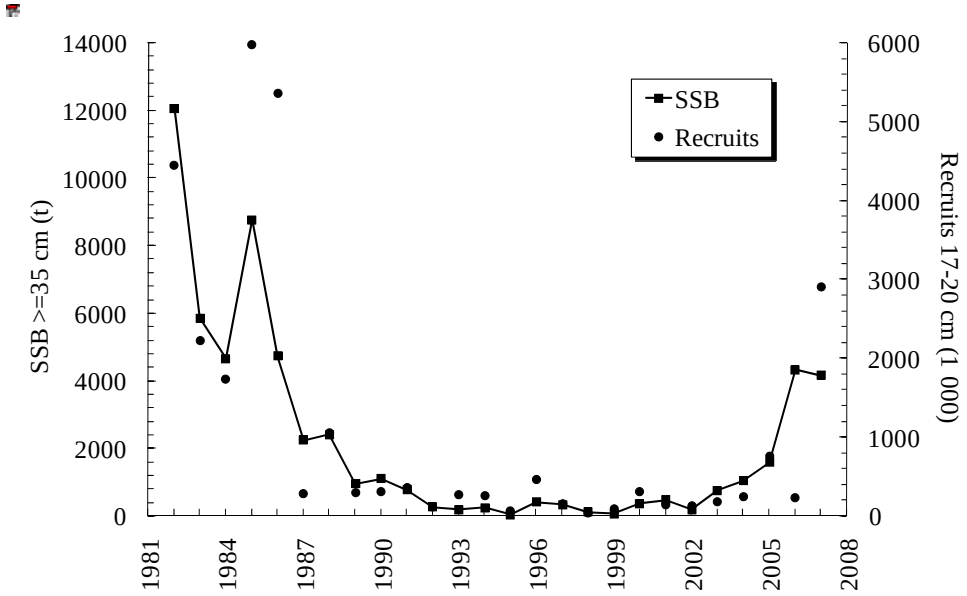

Fig. 6. Golden redfish Subarea 1. SSB and recruitment indices as derived from the German groundfish survey in the given years.

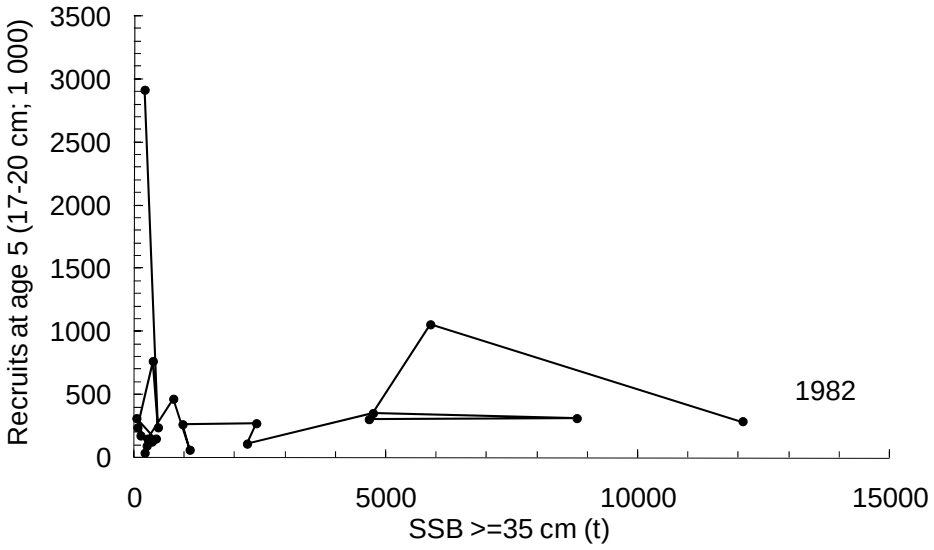

Fig. 7. Golden redfish Subarea 1. Recruitment at age 5 plotted against SSB 5 years before.

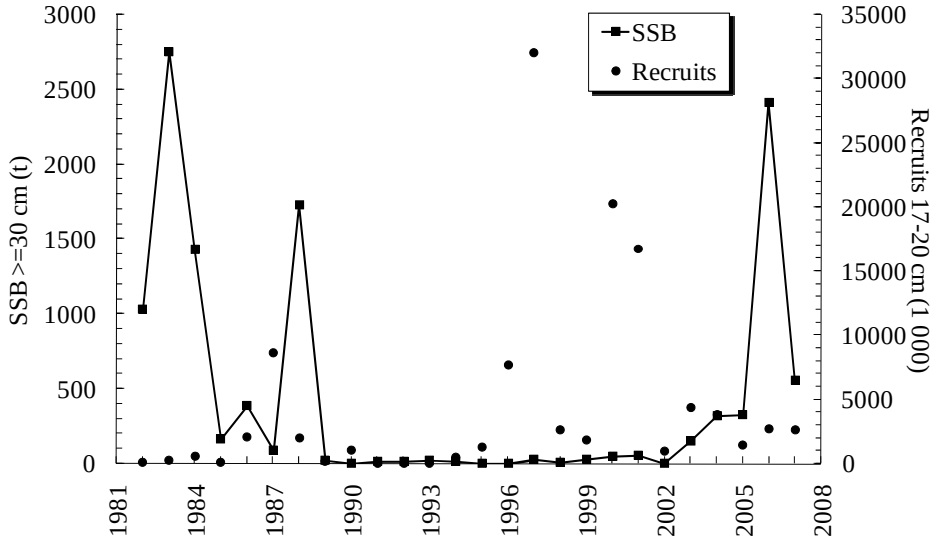

Fig. 8. Deep-sea redfish Sub-area 1. SSB and recruitment indices as derived from the German groundfish survey.

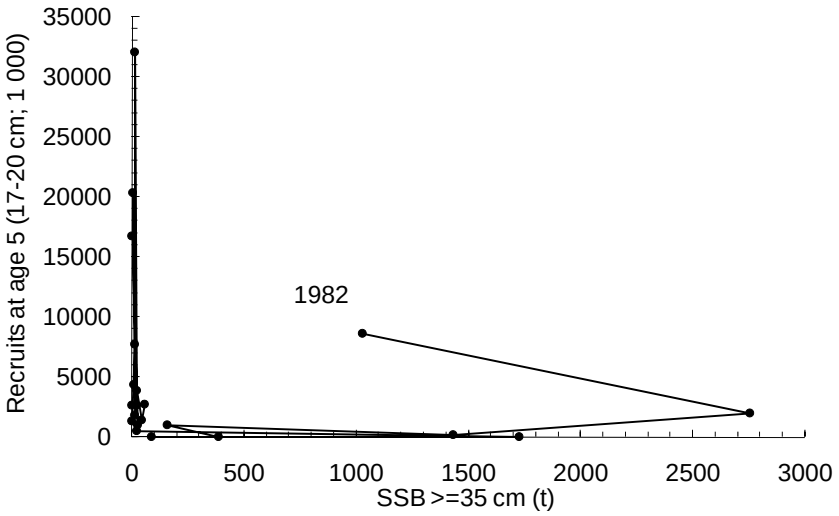

Fig. 9. Deep-sea redfish Sub-area 1. Recruitment at age 5 plotted against SSB 5 years before.