The revised catch history after 1987 is presented, total SA 2+3 roughhead grenadier catch in 2002 was 3 657 tons. The trends in biomass estimates from four survey series are examined: Canadian fall, Canadian spring, Canadian Deepwater and EU summer div. 3M. Only the Canadian fall surveys are considered to cover adequately the species distribution range. The biomass index from this survey in 2002 was 35 282 tons, 43 % of it in Div. 3L.

Commercial catch include mainly ages between 5 and 12, with a peak at age 8, in Spanish and Russian catches; and ages between 3 to 9, with a peak in 5-6, in the Portuguese catches. The C/B index using data from the 2002 Canadian fall survey is 0.1 (C/B2001= 0.07).

RESEARCH SURVEY DATA

- **Canadian fall survey**

Stratified random bottom trawl surveys have been conducted in Div. 2GHJ and 3KL in fall since 1978, usually in October-November. Since 1990 the survey also covered Div. 3NO. Until 1995 an Engel trawl was used, changed since then to a Campelen 1800. Surveys depth is up to 1500m in Div. 2GHJ and 3K and to 730 m in Div. 3LNO, extended to 1 463 m after 1995. A description of those surveys is in McCallum and Walsh (1996) and Power and Parsons (1998). In 2002 Div. 2G and H were not covered by the survey and in Div. 3M a total of 26 hauls were made at depths between 732-1 463 m.

The roughhead biomass indexes from this series of surveys are presented in Table 3 and Fig. 2. The aggregated biomass estimates in 1978 was 24 048 tons, increased to a level about 30 000 tons in 1996 and it has been around...
30,000 and 40,000 tones from that year onward. In 2002 the biomass index was 35,282 tons. However, the estimates from 1995 onwards are not directly comparable with the previous time series because of the change in the survey gear. In addition, in the last three years of the survey Div 2G and H were not covered. According to the biomass estimates from this series of surveys (Table 3), the main part of the stock used to be distributed mainly in Div. 3K, followed by Div. 2J and 3L. Since 1984 the proportion of the biomass in 3L is increasing, as it does also in Div. 3N since 1993. In 2002, 43% of the total roughhead biomass surveyed was found in Div. 3L. Divs. 3K and 3L combined account for 62% of the total. As has been observed in recent years (Junquera et al., 1999), the largest biomass indexes were obtained at depths between 1,000-1,200 m. in all areas.

• **Canadian spring survey**

Stratified random bottom trawl surveys have been conducted in Div. 3L, 3N and 3O in spring since 1978. A description of those surveys is found in McCallum and Walsh (1996). Until 1996 an Engel trawl was used, changed to a Campelen 1800 since then. The depth range of the surveys is up to 731 m.

Roughhead biomass obtained in this series of surveys, are presented in Table 4 and Fig. 2. The biomass estimate slightly decreased to 3,116 tons comparing with the highest level of 5,070 tons in 1998. However, a general increasing trend in biomass is observed from 1995 onwards. But again in this case a direct comparison of the biomass levels through the whole time series is not possible due to the change in the survey gear in 1995. Biomass is largely concentrated in Div. 3L. Biomass estimates from the spring survey series are considerably lower than the ones obtained in the fall series, as the first surveys cover only the southern divisions and the shallower depths, where according to the other results this species is less abundant.

• **Canadian deepwater survey**

Canada conducted deepwater bottom trawl surveys (750-1,500 m.) in 1991, 1994 and in 1995 in Div. 3KLMN. The 1991 survey was carried out in August, the 1994 in February and the 1995 in spring. The results of those surveys were reported by Atkinson et al. (1994) and Bowering et al. (1995), and are presented in Table 5 and Fig. 2. It is observed an increasing trend from 16,215 tons in 1991 to 46,668 tons in 1995. Most part of the biomass was taken in Div. 3L and 3M, which confirms that the stock in those Divisions are distributed beyond the depths covered by the spring surveys in those Divisions. The increased estimates for Div. 3L and 3M in 1994 were probably due, at least in part, to the increased survey area (Atkinson et al., 1994). The results suggest somewhat higher biomass in southern Div. 3L and 3N.

• **EU (Spain and Portugal) summer survey**

EU- Spain and Portugal conduct a stratified bottom trawl survey in Div. 3M since 1988, up to depths of 730. The survey procedure is described in Saborido-Rey and Vázquez (2003). The roughhead grenadier biomass indexes and mean catch per standardised tow from this survey series, updated from Murua (2003), are presented in Table 6 and Fig. 2. A peak biomass of 3,595 tons was observed in 1993, but since then has been somewhat stable, at between 1,500 and 2,000 tons. In 2002 the total biomass index was 1,440 tons. Roughhead significant biomass only is found at depths beyond 500 m every year. The mean catch per tow in the survey shows the same trend, with a peak in 1993 of 7.88 (s.d ± 0.69) and a decreasing trend to stabilize around 1.8 to 3. In 2002 the mean catch per standardized tow was 1.79 (s.d ± 0.26).

**BIOLOGICAL DATA**

Roughhead length frequencies from the Spanish, Portuguese and Russian trawl catches in Div. 3LMNO are available from Gonzalez et al. (2003), Vargas et al. (2003) and Rikhter and Sigaev (2003), respectively. The Spanish and Portuguese lengths frequencies are presented as pre-anal fin length, while the Russian ones as total lengths. The roughhead length composition from the Russian catches have been converted to AFL using the total length / AFL relationship presented by Murua and Motos (1997). The mean pre-anal fin lengths from the Spanish, Portuguese and Russian commercial catches are presented since 1995 in Fig. 3. Mean pre-anal fin lengths are higher every year in the Spanish and Russian catches, and they maintain rather stables since 1995. In 2002 the proportion of both sexes in the Spanish commercial fishery was similar, females made up to 52% of the catches. Females attain larger sizes than do males, and from 24 cm (AFL) all the individuals are females (Fig. 4).
Catch at age data of the Spanish, Portuguese and Russian commercial catches are presented in Table 7, based in the Spanish age-length key used in Gonzales et al. (2003), and in data from Vargas et al. (2003) and Rikhter and Sigaev (2003). Most of the Spanish and Russian catches are from ages between 5 and 12, with a mode at age 8, while the modal age in the Portuguese ones are age 5.

The total catch at age in 2002 (Table 7) has been used to obtain a synthetic catch curve (Fig 5) and according to it, a total mortality of 0.39 was estimated. In previous studies Murua (2002 and 2003) suggested a difference in M between sexes. The proportion of sexes at length shown in Fig. 4 could also support this view, as males disapper from 24 pre-anal fin length onwards in the Spanish catches, and there is no indication of an increase in fishing mortality on males at previous lengths. In order to analyse this, an estimate of Z by sexes have been performed using the catch at age by sexes of Spanish catch (Fig. 6). The results indicate a total mortality values of 0.3 and 0.9 for females and males respectively, both values higher than the ones obtained by Murua (2003) based upon data collected on the Flemish Cap survey, which covers the shallowest distribution of roughhead grenadier.

ASSESSMENT

The Canadian fall survey series is the best input for the assessment of this stock, because it provides a synoptic view of the species distribution over a wide geographic and depth range, in spite the objections that has been pointed to this series, regarding the changing depth coverage and the change of the survey gear (Anon., 1998). In 2002 most of the biomass concentrated in Div. 3L, 3K and 3N, at depths between 1 000-1 200 m.

According the fall Canadian survey the roughhead grenadier total biomass indices would indicate a general increasing trend. The rest of the survey series analysed, the total biomass indexes were stable in the last year, although in the EU Flemish Cap survey the index slightly decreases. The catch / biomass (C/B) index obtained using the Canadian fall survey biomass index (Fig. 7) is 0.1 which is at the same level as in 2001 (C/B2001 = 0.07). The trend in this index shows a great increase in 1992-1994 period, then decrease to an average value of 0.2 between 1996-2000 and in the last two years decrease again to a level of 0.1, due to an increasing trend in the survey biomass and a decreas of catches.

The Z estimate from the 2002 Spanish catches is 0.3 for females and 0.9 for males. A yield per recruit has been performed using the input data presented in Table 8. The partial recruitment vector comes from Cárdenas et al. (1995), the maturity curve at age from Murua and Motos (1997) and the mean weight at age from the 2002 age-length key. The input value of M has been set for males and females separately, and it has been estimated as the difference between Z by sex and the C/B index. The results of the yield-per-recruit appears in Fig. 8. The estimated F0.1 is 0.12 and Fmax is 0.22. The F0.1 and Fmax value are in the same level than previous years (F0.1 = 0.13 and Fmax = 0.24). In this regard, considering the reference F obtained from the C / B index, the stock would exploited at level around F0.1.

No changes in the mean length (Fig. 3), that could suggest an excessive fishing pressure, are observed on the catch since 1995. The available time series of catches at age is too short to analyse trends in the SSB, however it can be noted that in 2002 only about 4% of the catch in abundance and 20% in weight was above the female age at maturity (15 years). We have scarce information at the moment to assess an appropriate exploitation level.

REFERENCES


Table 1. Revised grenadier catches, updated from Power and Parsons (1998), Gonzalez et al. (2003), Vargas et al. (2003) and Rikhter and Sigaev (2003).

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*a Catch could not be well estimated; based on revised data is estimated to be 8000 to 14000 t mixed roundnose and roughhead grenadiers. (Power and Parsons 1988).

b Provisional.

Table 2. Roughhead grenadier nominal catches (t) in Subarea 2+3, updated from Power and Parsons (1998), Gonzalez et al. (2003), Vargas et al. (2003) and Rikhter and Sigaev (2003).

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a Provisional.
b First reported as roundnose grenadier.
c Reported as roundnose grenadier in STATLANT 21A.
Table 3. Roughhead biomass indexes from the fall survey series and percentages of the biomass by Division. ns = not surveyed.

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Table 4. Roughhead biomass indexes (tons) from the Canadian spring survey series and percentages of biomass in the Divisions surveyed. ns = not surveyed.

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Table 5. Roughhead grenadier biomass index (tons) from the deepwater Canadian surveys and percentages of biomass by Divisions (from Bowering et al., 1995)

<table>
<thead>
<tr>
<th>Year</th>
<th>Biomass (t.)</th>
<th>3K</th>
<th>3L</th>
<th>3M</th>
<th>3N</th>
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<td>25</td>
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Table 6. Rouhhead grenadier mean catch per tow (Kg.) per depth intervals, in parenthesis the corresponding total biomass indexes (t.), from the EU summer survey in Div. 3M.

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<th>Depth</th>
<th>Bimass indexes (t.)</th>
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Table 7. Spain, Portugal and Russia roughhead grenadier catch at age in Div. 3LMN in 2002.

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<th>RUSSIA</th>
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Table 8. Input parameters of the roughhead grenadier yield per recruit analysis.

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<th>Partial R.</th>
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<th>M males</th>
<th>Mat. Og.</th>
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Fig. 1. Roughhead grenadier nominal catches by Division and the total for Subareas 2+3.
Fig. 2. Roughhead grenadier survey biomass indexes from Canadian fall survey, Canadian spring survey and deepwater survey in Subareas 2 + 3 and mean catch per tow from the EU bottom summer survey.

Fig. 3. Roughhead grenadier mean pre-anal fin lengths in the Spanish (SP), Portuguese (PT), and Russian (RUS) catches.
Fig. 4. Percentages of females at pre-anal fin length in the Spanish roughhead grenadier commercial catches in 2002.

Fig. 5. Roughhead grenadier synthetic catch curve estimated based upon data of international total catches of 2002. Z is estimated as the slope of the regression line for the fully recruited ages (ages 8 and older).

Fig. 6. Roughhead grenadier synthetic catch curve by sex from the total Spanish catch of 2002. Z is estimated as the slope of the regression line for the fully recruited ages (ages 8 and older).
Fig. 7. Roughhead grenadier C/B Index based upon Canadian Fall survey.

Fig. 8. Roughhead grenadier yield per recruit analysis for roughhead grenadier in 2002.