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The Roundnose Grenadier of Subareas 0+1 and 2+3

by

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Introduction

Catches of roundnose grenadier have been very low in Subareas 0+1 in recent years and have been consistently below 1000 t since 1980. Almost no data are available for this stock and the assessment process has been one of monitoring only.

In Subareas 2+3, catch rates for grenadier have shown a steady decline since the early 1970's. This decline prompted NAFO, in 1982, to impose a precautionary TAC of 11,000 t although it was recognized that the problem of a 'restrictive' 10% by-catch of Greenland halibut imposed on the Soviet fleet tended to complicate the situation. Insufficient data are available to carry out any analytical assessment of this stock.

Methods and Results

The USSR took the majority of the total landings from Subareas 0+1 up until 1978. Since that time, FRG has taken the majority. In recent years (since about 1980) the fishery has been by-catch only. There was a shift in the seasonality of the fishery with the change in fleets. The USSR, fishing more predominantly in SA 0, fished during the second half of the year because of ice. The GDR fishes, more commonly, in SA 1 where ice is not a problem and their landings are spread more evenly throughout the year. Recent catches by country, month and Subarea are summarized in Tables 1, 2 and 3, and the catches are illustrated in Fig. 1.

The USSR has predominated in the fishery in Subareas 2+3 except for the most recent years. In 1983 and 1984, catches by GDR were greater than those of the Soviets (Table 4). Fishing is carried out during the second half of the year when the area is ice free (Table 5). Except for 1971, landings have been greatest from Div. 3K (Table 3). It can be seen from this table and Fig. 3 that there was a drop in the catches between 1978 and 1979 and that catches have remained low since then (below 10,000 t).

Although there has been no directed fishery for grenadier in SA 0+1 since 1978, the available catch and effort data were analysed using a multiplicative model (Gavaris 1980). The analysis indicated that there were no seasonal differences so the months were combined. In addition, no significant differences in catch rates existed between SA 0 and SA 1 so these were combined as well. Only catches where grenadier was >50% of the total were used in the analysis. All catches and effort of <10 units were discarded as it was felt that rounding of these small values may introduce considerable bias. The data were weighted step-wise by $\log_{10}(\text{catch} \times \text{effort})$ since this improved the regression without altering the year to year trends. The parameters used in the model are summarized in Table 6.

The regression results (Table 7) indicate significance. The resultant effort and catch rate series are shown in Table 8 and Fig. 2 and 5. The catch rates declined in the early 1970's but remained fairly steady after this.

An equilibrium surplus production model was carried out with these limited data (unlagged only because of the few data points). The resultant of the least squares regression of CPUE on effort was significant (95%) (Fig. 6). The surplus production curve (Fig. 7) suggests an effort at $\frac{2}{3}$ effort_{msy} of 6305 hr and a corresponding yield of 8390 t. This yield is close to the present TAC of 8000 t.

The multiplicative model (Gavaris 1980) has been used in the past to examine the catch and effort data from the grenadier fishery in SA 2+3. It was again used this year with two separate data bases. The first was obtained from NAFO statistics where grenadier accounted for >50% of the landings. The second was obtained from the Canadian observer data from 1978-1984. Again, only catches with >50% grenadier were used. All catches and effort of <10 units were deleted from the analysis and weighting for both series was step-wise using $\log_{10}(\text{catch} \times \text{effort})$. The parameters used are illustrated in Table 9.

The regression results (Table 10) indicate significance for both sets of data. The NAFO data (Table 11a, Fig. 8) indicate a decline in catch rates since 1973. Both series show fairly steady rates from 1978 on (Table 11b and Fig. 9). A comparison of the two series (standardized to the mean of 1978-1983) is shown in Fig. 10. The trends are the same but differences exist, probably due to the very few data points in the observer data. Effort has been low in recent years (Fig. 4).

The regression of CPUE on effort using unlagged data was not significant (Fig. 11) and those with data lagged (Gulland 1961) data (6, 8 and 10 years) all had positive slopes so this was not carried further and an equilibrium general production model was not run.

No Canadian research data are available for either of these two stocks.

Discussion

In recent years the catch of grenadier from SA 0+1 has been as a by-catch only. There are no catch and effort data since 1978 but the earlier data indicate a yield at $2/3$ effort_{msy} of 8390 t, a level close to the present TAC of 8000 t. The data do not suggest a change in this for 1986.

Catch rates for grenadier in SA2+3 have leveled off in recent years but remain at a low level. The limited data do not allow for any in depth assessment of the stock. The information presented above are insufficient to suggest any change in the advice for 1986.

References

- Gavaris, S. 1980. Use of a multiplicative model to estimate catch rate and effort from commercial data. Can. J. Fish. Aquat. Sci. 37: 2272-2275.
- Gulland, J.A. 1961. Fishing and stocks of fish at Iceland. U.K. Min. Agric. Fish. Food, Fish. Invest. (Ser. 2) 23(4): 52 p.

Table 1. Roundnose grenadier catches by country and year in Subarea 0+1.

| Country | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 ^a | 1984 ^a |
|---------|-------|--------|-------|-------|-------|-------|-------|-------|------|------|-------------------|-------------------|
| Den(G) | 11 | 5 | 6 | 1 | 10 | 32 | 21 | - | 39 | 37 | 22 | - |
| GDR | 1,835 | 2,804 | 186 | 181 | 61 | - | - | - | - | - | - | - |
| FRG | - | - | 33 | 147 | 519 | 5,807 | 6,794 | 1,721 | 353 | 11 | - | - |
| Poland | - | - | - | - | - | - | - | - | - | - | - | - |
| USSR | 3,038 | 9,509 | 4,728 | 8,174 | 2,345 | - | 106 | 32 | - | 43 | 46 | 19 |
| Total | 4,884 | 12,318 | 4,953 | 8,503 | 2,935 | 5,839 | 6,921 | 1,753 | 392 | 91 | 68 | 19 |

^a provisional.

Table 2. Roundnose grenadier catches by month and year in Subarea 0+1.

| Year | Jan. | Feb. | Mar. | Apr. | May | June | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | NK | Total |
|-------------------|------|------|------|-------|-------|-------|------|-------|-------|-------|-------|-------|----|--------|
| 1973 | - | - | - | - | 4 | - | 47 | 494 | 528 | 1,098 | 289 | 2,424 | - | 4,884 |
| 1974 | 85 | - | - | 1 | - | 1 | 390 | 1,306 | 182 | 528 | 2,289 | 7,527 | - | 12,318 |
| 1975 | 46 | 158 | 35 | 43 | - | 111 | 307 | 672 | 439 | 109 | 1,171 | 1,862 | - | 4,953 |
| 1976 | 475 | 7 | 1 | 197 | - | - | - | 206 | 631 | 1,793 | 3,276 | 1,917 | - | 8,503 |
| 1977 | 464 | 94 | 20 | 14 | 2 | 5 | 58 | 1,094 | 1,089 | 38 | 18 | 39 | - | 2,935 |
| 1978 | 139 | 130 | 723 | 2,554 | 1,942 | 343 | 4 | 2 | 1 | - | - | - | - | 5,839 |
| 1979 | 605 | 759 | 348 | 626 | 1,658 | 1,122 | 123 | 118 | 1 | 185 | 545 | 831 | - | 6,921 |
| 1980 | 686 | 385 | - | - | - | - | - | 418 | 117 | 118 | 23 | 6 | - | 1,753 |
| 1981 | 1 | 4 | 13 | 12 | 1 | 2 | - | - | 170 | 183 | - | - | - | 392 |
| 1982 | 1 | 3 | 9 | 6 | 4 | 11 | 1 | 3 | - | 14 | 25 | 7 | 7 | 91 |
| 1983 ^a | - | 3 | 6 | 5 | 1 | - | - | - | 7 | 5 | 21 | 14 | 6 | 68 |
| 1984 ^a | - | - | - | - | - | - | - | 15 | 4 | - | - | - | - | 19 |

^a provisional.

Table 3. Roundnose grenadier catches by Subarea and Division, SA 0+1 and SA 2+3.

| Year | 0 | 1 | Total 0+1 | Subarea/Division | | | | | Total 2+3 |
|-------------------|-------|-------|-----------|------------------|-------|-------|--------|-------|-----------|
| | | | | 2G | 2H | 2J | 3K | Other | |
| 1967 | 1,129 | 6 | 1,135 | - | 868 | 217 | 16,009 | 210 | 17,304 |
| 1968 | 5,996 | 284 | 6,280 | 2,536 | 4,089 | 479 | 23,553 | 606 | 31,263 |
| 1969 | 2,642 | 68 | 2,710 | 387 | - | 264 | 11,682 | - | 12,333 |
| 1970 | 545 | 5,980 | 6,525 | - | - | 468 | 22,267 | 129 | 22,864 |
| 1971 | 4,172 | 4,132 | 8,304 | 54,179 | 2,738 | 81 | 18,392 | 55 | 75,445 |
| 1972 | 5,783 | 2,311 | 8,094 | 2,161 | 655 | 293 | 21,122 | 155 | 24,386 |
| 1973 | 1,054 | 3,830 | 4,884 | 5,880 | 232 | 632 | 10,655 | 165 | 17,564 |
| 1974 | 2,661 | 9,657 | 12,318 | 3,220 | 2,007 | 333 | 22,816 | 40 | 28,416 |
| 1975 | 204 | 4,749 | 4,953 | 6,489 | 3,536 | 1,754 | 15,388 | 258 | 27,425 |
| 1976 | 2,610 | 5,893 | 8,503 | 3,841 | 1,460 | 1,381 | 13,636 | 275 | 20,953 |
| 1977 | 721 | 2,214 | 2,935 | 2,597 | 525 | 206 | 11,935 | 123 | 15,387 |
| 1978 | - | 5,839 | 5,839 | 3,112 | 1,412 | 913 | 15,250 | 12 | 20,699 |
| 1979 | 106 | 6,815 | 6,921 | 1,035 | 3,090 | 438 | 3,200 | 19 | 7,782 |
| 1980 | 32 | 1,721 | 1,753 | 279 | 493 | 726 | 451 | 104 | 2,053 |
| 1981 | - | 392 | 392 | 967 | 1,693 | 463 | 3,920 | 42 | 7,085 |
| 1982 | 43 | 48 | 91 | 719 | 734 | 182 | 2,709 | - | 4,344 |
| 1983 ^a | 46 | 22 | 68 | 140 | 1,390 | 36 | 1,916 | 87 | 3,569 |
| 1984 ^a | - | - | 19 | - | - | - | - | - | 3,917 |

^a provisional.

Table 4. Roundnose grenadier catches by country and year in Subarea 2+3.

| Country | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 ^a | 1984 ^a |
|----------|--------|--------|--------|--------|--------|--------|-------|-------|-------|-------|-------------------|-------------------|
| Can(N) | - | - | - | 16 | 15 | 7 | 4 | - | - | - | - | - |
| Can(MQ) | - | - | - | - | - | 2 | - | - | - | - | - | - |
| FRG | - | 199 | - | 1 | 174 | 973 | - | 32 | - | - | - | - |
| GDR | 684 | 1,766 | 2,705 | 497 | 613 | 1,801 | 480 | 898 | 1,407 | 1,640 | 2,586 | 3,650 |
| Poland | 294 | 181 | 1,499 | 101 | - | 51 | 96 | 36 | 18 | 15 | 50 | 51 |
| Romania | - | - | - | - | 7 | 108 | - | - | - | - | - | - |
| USSR | 16,586 | 26,270 | 23,221 | 19,978 | 14,577 | 17,760 | 7,201 | 1,087 | 5,660 | 2,689 | 933 | 214 |
| Faroës | - | - | - | - | - | - | - | - | - | - | - | - |
| Portugal | - | - | - | - | - | - | - | - | - | - | - | - |
| Japan | - | - | - | - | - | - | - | - | - | - | - | 2 |
| Total | 17,564 | 28,416 | 27,425 | 20,593 | 15,386 | 20,702 | 7,781 | 2,053 | 7,085 | 4,344 | 3,569 | 3,917 |

^a provisional.

Table 5. Subarea 2+3 R.N. Grenadier catches by month and year.

| Year | Jan. | Feb. | Mar. | Apr. | May | June | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | NK | Total |
|-------------------|------|-------|------|------|-----|-------|-------|-------|-------|-------|-------|-------|----|--------|
| 1973 | 466 | 60 | 37 | 123 | 51 | 277 | 5,202 | 3,663 | 3,514 | 1,785 | 1,453 | 933 | - | 17,564 |
| 1974 | 205 | 22 | 187 | 5 | 2 | 520 | 2,479 | 1,459 | 2,214 | 4,976 | 9,050 | 7,297 | - | 28,416 |
| 1975 | 784 | 1,388 | 400 | 807 | 47 | 1,596 | 812 | 6,516 | 7,498 | 3,301 | 2,332 | 1,944 | - | 27,425 |
| 1976 | 843 | 1,225 | 1 | 605 | 290 | 106 | 257 | 1,856 | 1,170 | 3,961 | 4,530 | 5,749 | - | 20,593 |
| 1977 | 44 | 8 | 12 | 45 | 13 | 6 | 1,776 | 5,698 | 3,411 | 1,973 | 1,681 | 719 | - | 15,387 |
| 1978 | 264 | 467 | 13 | 45 | 7 | 405 | 6,416 | 3,963 | 1,814 | 3,964 | 1,487 | 1,866 | - | 20,699 |
| 1979 | 103 | 32 | 44 | 6 | 136 | 683 | 1,169 | 1,612 | 1,691 | 611 | 745 | 949 | - | 7,782 |
| 1980 | 3 | 4 | 48 | 13 | 2 | - | - | 130 | 376 | 794 | 577 | 106 | - | 2,053 |
| 1981 | 40 | 14 | 1 | 2 | 4 | 1 | 168 | 1,636 | 1,391 | 759 | 1,751 | 1,318 | - | 7,085 |
| 1982 | 4 | - | 3 | 5 | 3 | 4 | 559 | 563 | 410 | 698 | 1,465 | 630 | - | 4,344 |
| 1983 ^a | 3 | 18 | 4 | - | 3 | 1 | 1 | 74 | 1,292 | 861 | 866 | 446 | - | 3,569 |
| 1984 ^a | 31 | - | 6 | 9 | - | 5 | - | 108 | 463 | 3,019 | 117 | 159 | - | 3,917 |

^a provisional.

Table 6: Parameter estimates from the analysis of catch rates for grenadier in SA 0+1 using a multiplicative model.

| country-gear-TC | estimate | month | estimate |
|-----------------|----------|---------|-------------|
| GDR-OTB5 | -0.672 | JAN | |
| | | FEB | |
| USSR-OTB7 | 0.000 | MAR | |
| | | APR | combined |
| GDR-OTB7 | 1.611 | MAY | since |
| | | JUN | differences |
| | | JUL | were |
| | | AUG | not |
| | | SEP | significant |
| | | OCT | |
| | | NOV | |
| | | DEC | |
| | | Subarea | |
| | | 0 | differences |
| | | 1 | not |
| | | | significant |

Table 7: Regression of multiplicative model for grenadier in SA 0+1.

multiple r0.713
 multiple r squared.....0.508

analysis of variance

| source of variation | df | sums of squares | mean squares | f_value |
|---------------------|----|-----------------|--------------|---------|
| intercept | 1 | 9.608e0 | 9.608e0 | |
| regression | 12 | 1.688e1 | 1.407e0 | 5.359 |
| type 1 | 2 | 1.412e1 | 7.058e0 | 31.900 |
| type 2 | 10 | 4.794e0 | 4.794e-1 | 2.157 |
| residuals | 74 | 1.637e1 | 2.212e-1 | |
| total | 87 | 4.286e1 | | |

Table 8: Predicted catch rate for grenadier in SA 0+1.

| year | total catch | catch rate | | effort |
|------|-------------|------------|-------|--------|
| | | mean | s.e. | |
| 1968 | 6280 | 1.036 | 0.528 | 6059 |
| 1969 | 2710 | 2.136 | 0.444 | 1269 |
| 1970 | 6525 | 1.506 | 0.371 | 4332 |
| 1971 | 8304 | 2.199 | 0.384 | 3777 |
| 1972 | 8094 | 1.381 | 0.198 | 5862 |
| 1973 | 4884 | 1.174 | 0.181 | 4160 |
| 1974 | 12318 | 1.138 | 0.165 | 10823 |
| 1975 | 4953 | 1.335 | 0.169 | 3710 |
| 1976 | 8503 | 0.984 | 0.157 | 8645 |
| 1977 | 2935 | 1.806 | 0.267 | 1625 |
| 1978 | 5839 | 1.564 | 0.431 | 3734 |

average c.v. for the mean:0.208

Table 9: Parameter estimates from the analysis of catch rates for grenadier in SA 2+3 using a multiplicative model with data from NAFO and the observer program.

| country-gear-TC | estimate | month | estimate |
|------------------------|----------|-----------------|-------------|
| <u>NAFO statistics</u> | | | |
| GDR-OTB5 | | JAN | |
| GDR-OTB6 | -0.282 | FEB | |
| | | MAR | |
| USSR-OTB7 | 0.000 | APR | combined |
| | | MAY | since |
| GDR-OTB7 | | JUN | differences |
| USSR-OTB6 | 0.245 | JUL | were |
| USSR-OTM7 | | AUG | not |
| | | SEP | significant |
| <u>Observer data</u> | | | |
| | | OCT | |
| GDR-OTB5 | 0.175 | NOV | |
| GDR-OTB7 | | DEC | |
| | | <u>Division</u> | |
| USSR-OTB7 | 0.000 | 2B | differences |
| | | 2H | not |
| | | 2J | significant |
| | | 3K | |

Table 10a: Regression of multiplicative model for grenadier in SA 2+3 using NAFO Statistics.

multiple r.....0.634
multiple r squared.....0.402

analysis of variance

| source of variation | df | sums of squares | mean squares | f_value |
|---------------------|-----|-----------------|--------------|---------|
| intercept | 1 | 1.743e1 | 1.743e1 | |
| regression | 18 | 2.403e1 | 1.335e0 | 7.547 |
| type 1 | 2 | 3.526e0 | 1.763e0 | 9.964 |
| type 2 | 16 | 1.781e1 | 1.113e0 | 6.291 |
| residuals | 202 | 3.574e1 | 1.769e-1 | |
| total | 221 | 7.720e1 | | |

Table 10b: Regression of multiplicative model for grenadier in SA 2+3 using observer data.

multiple r.....0.477
multiple r squared.....0.228

analysis of variance

| source of variation | df | sums of squares | mean squares | f_value |
|---------------------|----|-----------------|--------------|---------|
| intercept | 1 | 7.706e-2 | 7.706e-2 | |
| regression | 7 | 2.838e0 | 4.054e-1 | 2.193 |
| type 1 | 1 | 3.598e-1 | 3.598e-1 | 1.946 |
| type 2 | 6 | 2.612e0 | 4.354e-1 | 2.355 |
| residuals | 52 | 9.613e0 | 1.849e-1 | |
| total | 60 | 1.253e1 | | |

Table 11a: Predicted catch rate of grenadier in SA 2+3 from NAFO Statistics.

| year | total catch | catch rate | | effort |
|------|-------------|------------|-------|--------|
| | | mean | s.e. | |
| 1967 | 17304 | 1.569 | 0.354 | 11029 |
| 1968 | 31263 | 1.190 | 0.148 | 26270 |
| 1969 | 12333 | 1.351 | 0.266 | 9131 |
| 1970 | 22864 | 2.267 | 0.237 | 10086 |
| 1971 | 75445 | 1.817 | 0.136 | 41520 |
| 1972 | 24386 | 1.650 | 0.202 | 14782 |
| 1973 | 17564 | 2.191 | 0.335 | 8016 |
| 1974 | 28416 | 1.536 | 0.221 | 17912 |
| 1975 | 27425 | 1.772 | 0.221 | 15473 |
| 1976 | 20953 | 1.487 | 0.191 | 14091 |
| 1977 | 15387 | 1.245 | 0.133 | 12358 |
| 1978 | 20699 | 1.342 | 0.121 | 15420 |
| 1979 | 7782 | 0.922 | 0.091 | 8440 |
| 1980 | 2053 | 1.101 | 0.165 | 1864 |
| 1981 | 7085 | 0.832 | 0.106 | 8511 |
| 1982 | 4344 | 0.805 | 0.120 | 5397 |
| 1983 | 3569 | 0.800 | 0.181 | 4460 |

average c.v. for the mean:0.138

Table 11b: Predicted catch rate of grenadier in SA 2+3 using observer data.

| year | total catch | catch rate | | effort |
|------|-------------|------------|-------|--------|
| | | mean | s.e. | |
| 1978 | 20699 | 0.891 | 0.218 | 23237 |
| 1979 | 7732 | 1.556 | 0.443 | 5002 |
| 1980 | 2053 | 0.959 | 0.180 | 2140 |
| 1981 | 7085 | 0.884 | 0.124 | 8011 |
| 1982 | 4344 | 1.030 | 0.129 | 4216 |
| 1983 | 3569 | 0.597 | 0.108 | 5982 |
| 1984 | 3917 | 1.234 | 0.202 | 3174 |

average c.v. for the mean: 0.190

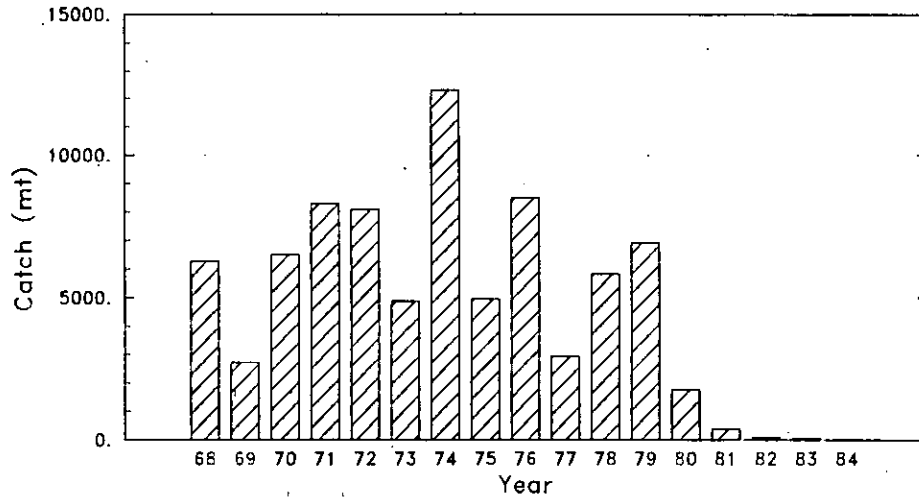


Fig.1: Nominal catches of grenadier in Subareas 0+1, 1968-1984. (1983 and 1984 Provisional)

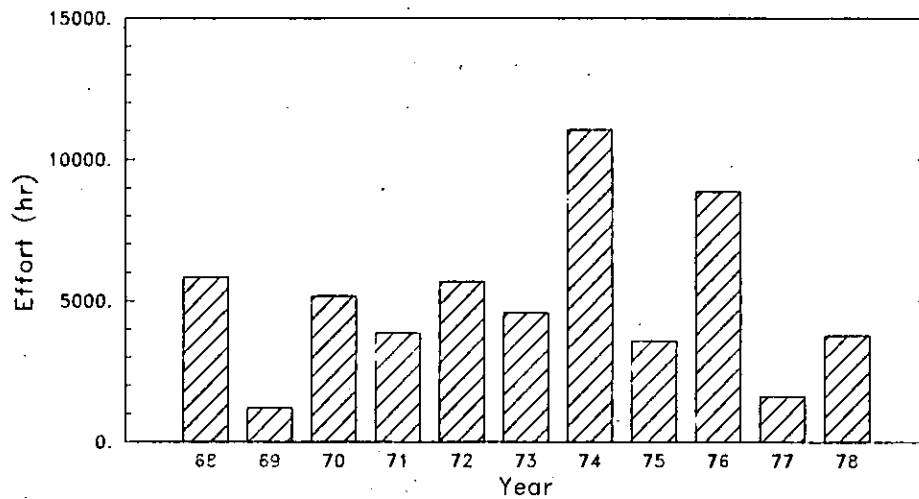


Fig.2: Standardized directed effort for grenadier, 0+1, 1968-1978.

Table 10. Predicted

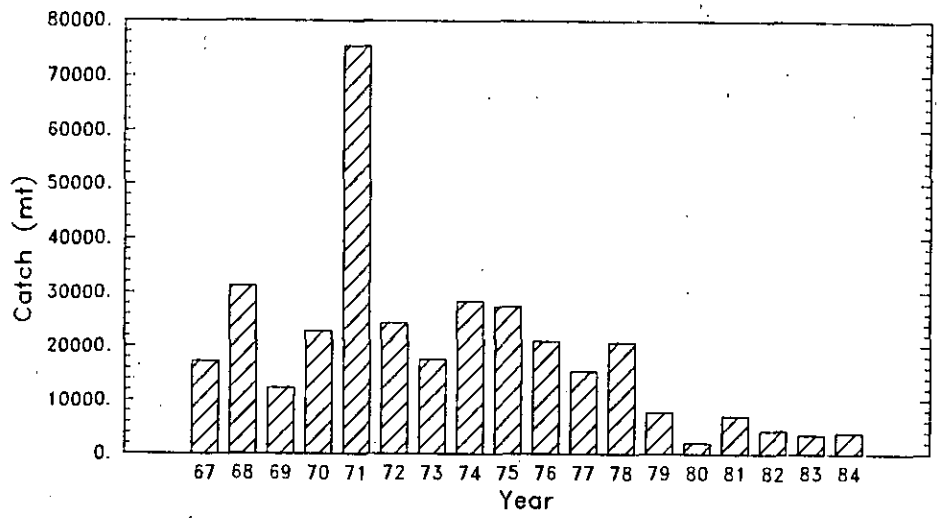


Fig.3: Nominal catches of grenadier in Subareas 2+3, 1967-1984. (1983 and 1984 Provisional)

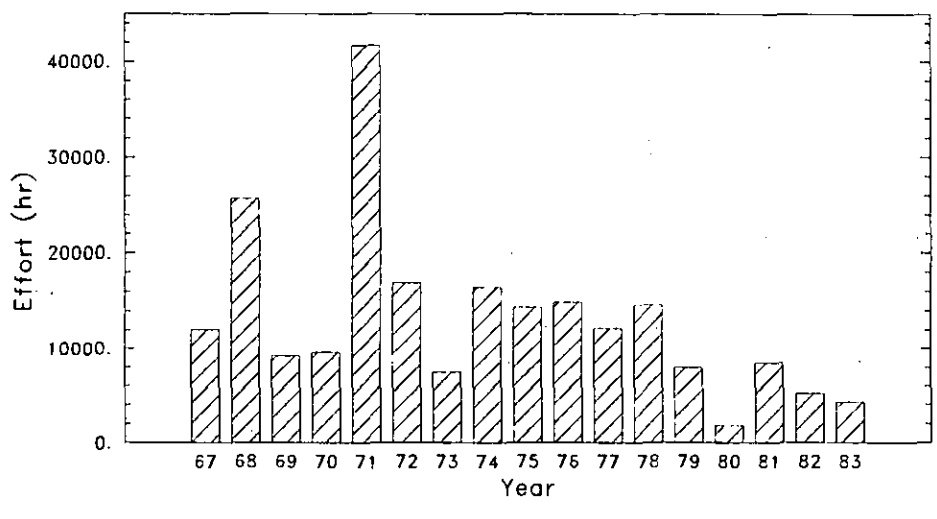


Fig.4: Standardized directed effort for grenadier, 2+3, 1967-1983. (1983 Provisional)

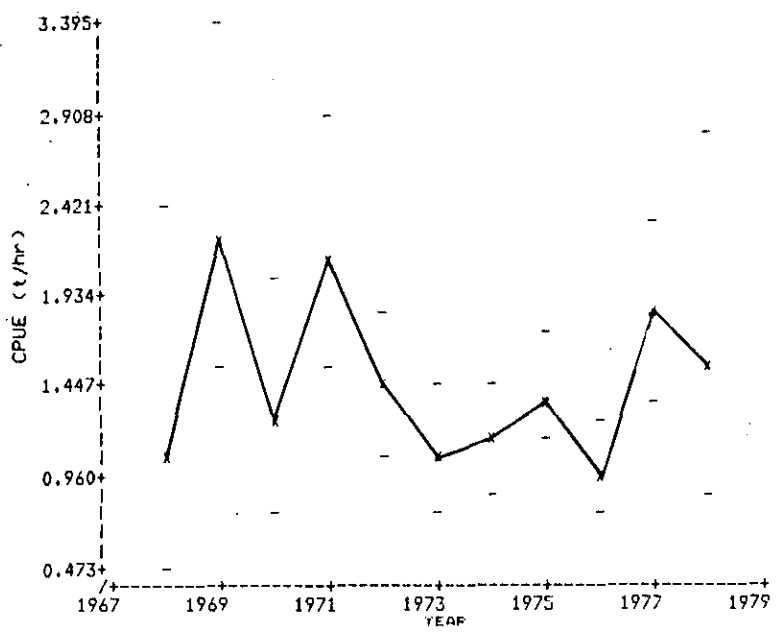


Fig 5. Standardized catch rates for grenadier in SA 0+1.

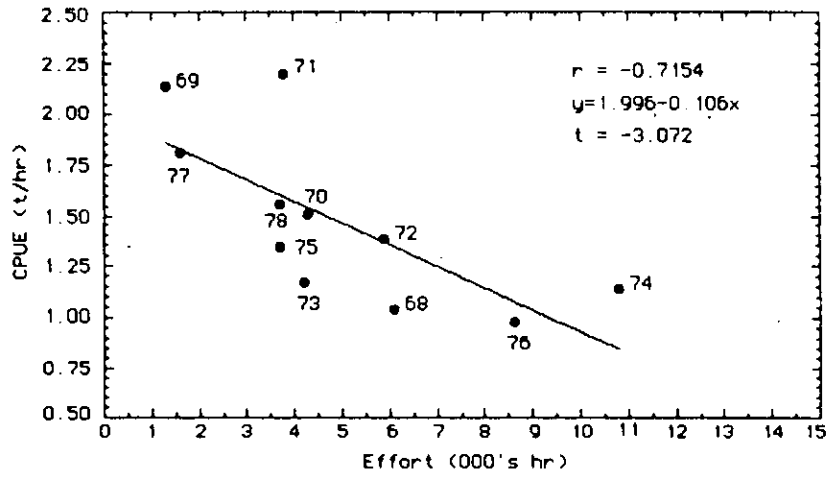


Fig. 6: Regression of CPUE on effort for grenadier in SR 0+1.

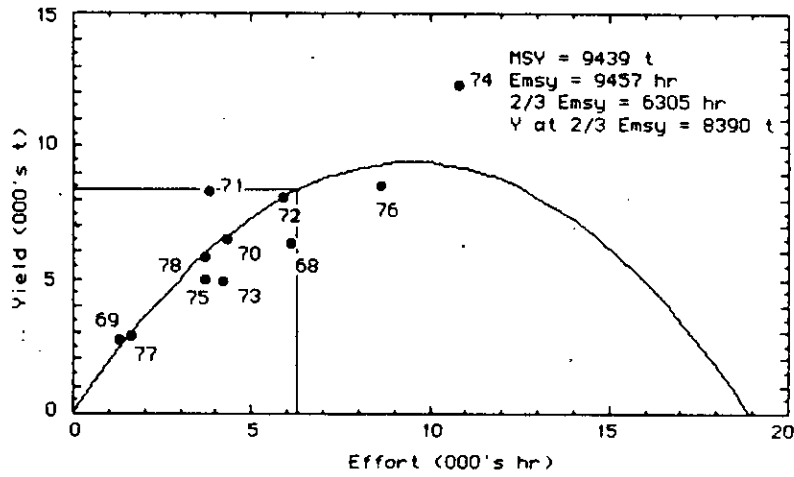


Fig. 7: Surplus production curve for grenadier in SR 0+1 derived from regression of Fig. 6.

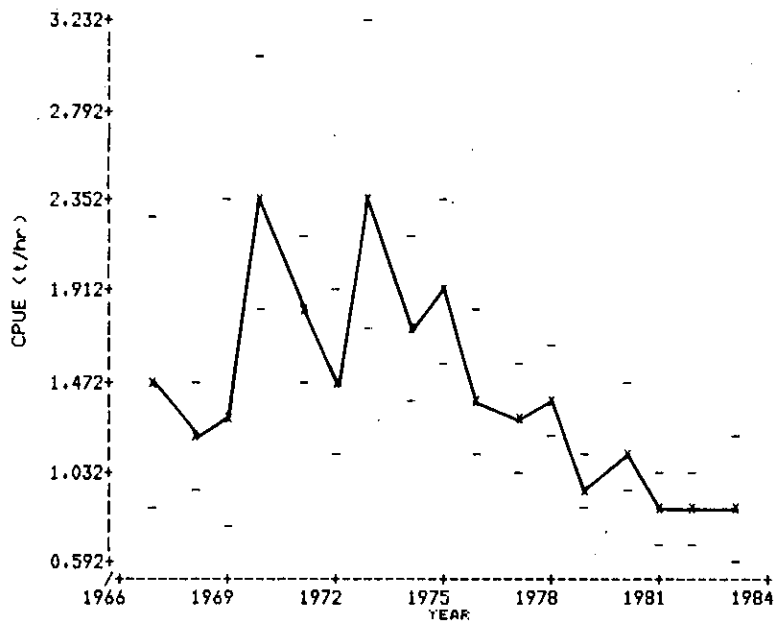


Fig. 8: Standardized CPUE for grenadier in SR 2+3 using NAFO statistics.

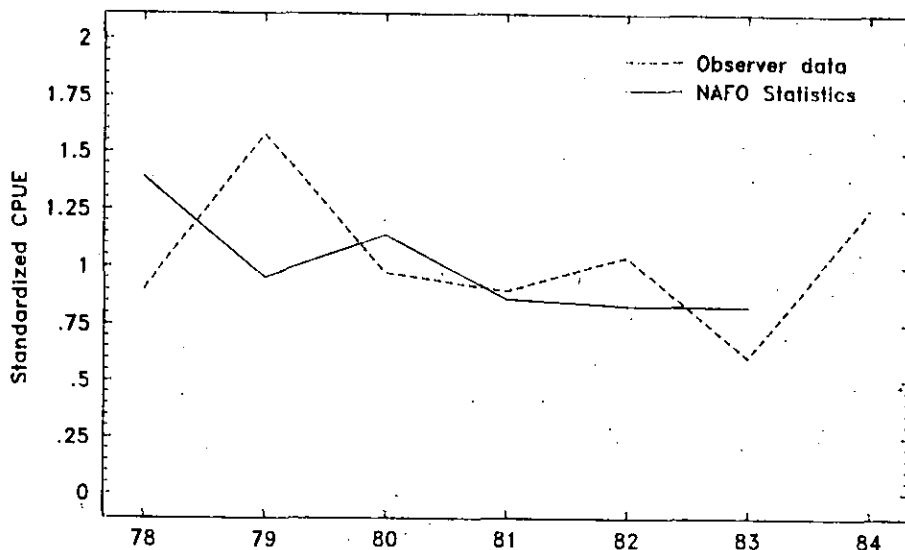


Fig. 10: Comparison of standardized CPUE for SA 2+3 grenadier using NAFO and observer data, 1978-1984.

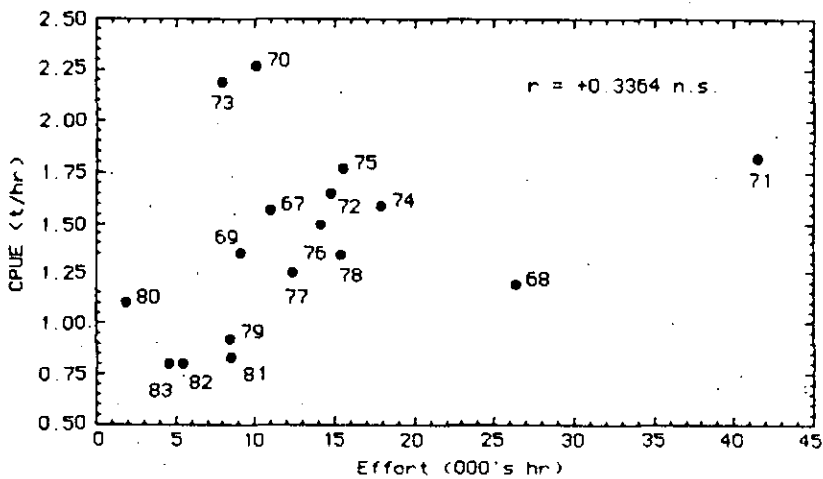


Fig. 11: Regression of CPUE on effort for SA 2+3 grenadier (1967-1983).

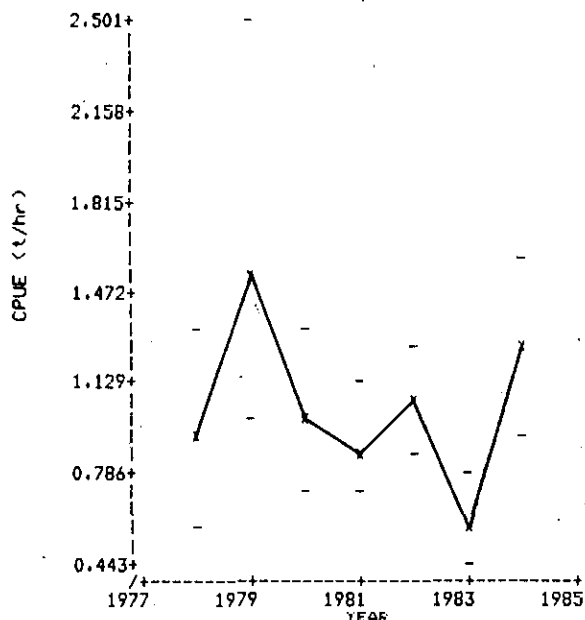


Fig. 9 Standardized CPUE for grenadier in SA 2+3 using observer data.