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The assessment of the silver hake stocks at Nova Scotia in Div. 4VWX

by

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In the present paper the results of silver hake stock size assessment by VPA are given basing on the catches for 1964-1976 from Div. 4VWX, and on the age composition of the USSR catches for the same period from Div. 4W where over 90% of this species is taken. For 1976 the preliminary USSR catch data are reported. A total catch for the period from January to August made up 61215 tons, that is 49035 tons lower than that in 1975 (Table 1).

A total mortality in 1976 was estimated from catches per hauling hour by BMRT (Table 2), the silver hake catch per hauling hour being estimated by catches per hauling hour of all the fish species considering the silver hake share in a total catch. A total mortality of four year old fish and older ones averaged to 1.56 . The value of M for 1976 was taken as 0.5 according to A.S. Noskov and E.D. Anderson. Hence, the original value of F = 1.0 was adopted for the virtual population analysis at age 4 or older, and F = 0.5 at age 3 or younger.

The recruitment estimates for abundance assessment of both one-year-olds and two-year-olds were adopted from E.D. Anderson, (Anderson, 1976). These are 5% and 18% for one-year-olds and two-year-olds, accordingly, which corresponds to the values of F = 0.05 and 0.18. Mean weights by age groups are given according to R.G. Halliday (Halliday, 1973).

The results of VPA of fishing mortality are given in Table 3. As shown by calculations the stock is estimated as $22\ 930 \cdot 10^5$ sp. by 1976 and $16\ 822 \cdot 10^5$ sp. for 1977 (Table 5). The conversion of the stock size in numbers to the stock size in tons, and the correction according to correlation of the calculated and observ-

ed weights (Table 4) indicated that the stock size was 274 096 tons in 1976 and would be 259 314 in 1977. From the stock size estimate and the optimum value of $F = 0.7$ the possible catch for 1977 was calculated as 101 688 tons, 64 034 tons falling on the strong 1974 year-class. Hence, the silver hake catch of 100 thous. tons can be recommended for Div. 4VWX for 1977.

REFERENCES

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3. Noskov, A.S. 1976. Estimation of stock size and allowable catch of silver hake on the Nova Scotia Shelf in ICNAF Division 4W. Int. Comm. Northw. Atlant. Fish., Ann. Mtg., Res. Doc. 76/VI/57, Ser. No. 3843(mimeo).

Table 1. Silver hake catches from Div. 4VWX (10^5 sp. and MT)

| Years | A G E | | | | | | | | | | | Total | Catches in MT |
|-------|-------|------|------|------|------|-----|-----|----|----|----|----|-------|---------------|
| | I | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | II | | |
| 1963 | 12 | 689 | 2778 | 2045 | 442 | 21 | 6 | 6 | 3 | I | - | 6003 | 123028 |
| 1964 | 10 | 86 | 1188 | 1702 | 342 | 83 | 6 | - | - | - | - | 3417 | 81147 |
| 1965 | 1 | 5 | 452 | 1050 | 301 | 44 | 4 | - | - | - | - | 1857 | 50022 |
| 1966 | 1 | 102 | 123 | 182 | 107 | 16 | 1 | - | - | - | - | 532 | 10323 |
| 1967 | 1 | 2 | 20 | 69 | 22 | 3 | 1 | - | - | - | - | 118 | 2483 |
| 1968 | 8 | 77 | 107 | 20 | 9 | 6 | 4 | 1 | - | - | - | 232 | 3523 |
| 1969 | 440 | 261 | 837 | 786 | 300 | 103 | 20 | 12 | - | - | - | 2759 | 46564 |
| 1970 | 921 | 1400 | 3648 | 1952 | 626 | 45 | 29 | 13 | 1 | - | - | 8635 | 169045 |
| 1971 | 201 | 1603 | 2769 | 2758 | 777 | 93 | 28 | 41 | 19 | - | - | 8289 | 128653 |
| 1972 | 430 | 1374 | 2617 | 1531 | 1015 | 146 | 27 | 8 | 5 | 12 | - | 7165 | 144048 |
| 1973 | 591 | 981 | 7612 | 6765 | 2297 | 528 | 146 | 35 | 10 | 5 | 1 | 18971 | 298621 |
| 1974 | 332 | 1081 | 2716 | 1645 | 362 | 82 | 35 | 21 | 7 | 2 | - | 6283 | 95601 |
| 1975 | 349 | 1039 | 2155 | 1491 | 427 | 109 | 50 | 14 | 2 | - | - | 5636 | 110250 |
| 1976 | 287 | 1874 | 1211 | 399 | 147 | 24 | 9 | 2 | 1 | - | - | 3954 | 61215 |

Table 2. Total mortality rates of silver hake from Div. 4VWX by age composition of BMRT catches per trawling hour

| Years | A G E | | | | | | | | | Mean for 3+ |
|---------|-------|-------|-------|-------|-------|-------|-------|-------|--------|-------------|
| | 1 - 2 | 2 - 3 | 3 - 4 | 4 - 5 | 5 - 6 | 6 - 7 | 7 - 8 | 8 - 9 | 9 - 10 | |
| 1970-71 | -0,30 | -0,44 | 0,53 | 1,16 | 2,18 | 0,81 | 0,23 | 0,47 | - | 0,66 |
| 1971-72 | -2,37 | -0,92 | 0,16 | 0,57 | 1,27 | 0,72 | 0,83 | 1,36 | 0,27 | 0,66 |
| 1972-73 | -0,28 | -1,16 | 0,40 | 0,15 | 1,20 | 0,50 | 0,27 | - | - | 0,35 |
| 1973-74 | -0,91 | -1,32 | 1,24 | 2,64 | 2,56 | 2,41 | 2,27 | 1,51 | - | 1,58 |
| 1974-75 | -1,23 | -0,75 | 0,52 | 1,28 | 1,21 | 0,44 | 1,12 | 0,98 | - | 1,46 |
| 1975-76 | -2,66 | -1,13 | 0,71 | 1,34 | 1,90 | 1,52 | 2,24 | 1,67 | - | 1,56 |

Table 3. Fishing mortality rate of silver hake from Div. 4VWX at M = 0.5

| Year | A G E | | | | | | | | | | |
|------|-------|------|------|------|------|------|------|------|------|------|--|
| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | |
| 1964 | 0,03 | 0,45 | 1,43 | 1,74 | 2,38 | 1,00 | - | - | - | - | |
| 1965 | <0,01 | 0,28 | 1,49 | 2,25 | 3,06 | 1,00 | - | - | - | - | |
| 1966 | 0,04 | 0,08 | 0,24 | 0,88 | 1,42 | 1,00 | - | - | - | - | |
| 1967 | <0,01 | 0,02 | 0,08 | 0,06 | 0,07 | 0,41 | - | - | - | - | |
| 1968 | 0,01 | 0,03 | 0,03 | 0,02 | 0,03 | 0,17 | 1,00 | - | - | - | |
| 1969 | 0,02 | 0,12 | 0,38 | 0,72 | 0,39 | 0,15 | 1,91 | - | - | - | |
| 1970 | 0,08 | 0,32 | 0,59 | 0,88 | 0,31 | 0,25 | 0,18 | 1,00 | - | - | |
| 1971 | 0,07 | 0,27 | 0,61 | 0,73 | 0,43 | 0,45 | 0,97 | 0,62 | - | - | |
| 1972 | 0,08 | 0,20 | 0,33 | 0,71 | 0,41 | 0,30 | 0,31 | 0,41 | 1,91 | - | |
| 1973 | 0,11 | 1,07 | 2,07 | 2,20 | 1,82 | 1,52 | 1,24 | 1,24 | 1,00 | 1,00 | |
| 1974 | 0,17 | 0,65 | 1,13 | 1,00 | 0,69 | 0,87 | 1,80 | 1,00 | 1,00 | - | |
| 1975 | 0,19 | 0,83 | 1,58 | 2,03 | 1,71 | 2,35 | 2,04 | 1,00 | - | - | |
| 1976 | 0,50 | 0,50 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | - | - | |

Table 4. Calculated and observed catches of silver hake
from Div. 4VWX in 1964 - 1976 (MT)

| Year | Observed catch | Calculated catch | Calculated Observed |
|------|----------------|------------------|---------------------|
| 1964 | 81,147 | 70,449 | 8682 |
| 1965 | 50,022 | 41,274 | 8251 |
| 1966 | 10,323 | 10,960 | 1,0617 |
| 1967 | 2,483 | 2,704 | 1,0890 |
| 1968 | 3,523 | 3,683 | 1,0454 |
| 1969 | 46,564 | 51,067 | 1,0967 |
| 1970 | 169,045 | 140,587 | 8317 |
| 1971 | 128,653 | 152,313 | 1,1839 |
| 1972 | 114,048 | 130,830 | 1,1471 |
| 1973 | 298,621 | 382,964 | 1,2824 |
| 1974 | 95,601 | 108,064 | 1,1304 |
| 1975 | 110,250 | 99,158 | 8994 |
| 1976 | 61,215 | 58,897 | 9621 |

$\bar{X} = 1,0325$

Table 5. Silver hake stocks in Div. 4VWX in 1964 - 1977 (10^5 sp. and MT)

| Year | A G R | | | | | | | | | | Stock at 2 years of age and older | |
|------|-------|-------|------|------|-----|-----|----|----|----|----|-----------------------------------|--------|
| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 10^5 sp. | MT |
| 1964 | 3693 | 4090 | 2687 | 493 | 106 | 12 | - | - | - | - | 11081 | 202469 |
| 1965 | 3180 | 2325 | 1624 | 393 | 53 | 8 | - | - | - | - | 7583 | 140051 |
| 1966 | 3300 | 2026 | 1073 | 224 | 25 | 2 | - | - | - | - | 6650 | 879580 |
| 1967 | 2543 | 1282 | 1137 | 479 | 56 | 4 | - | - | - | - | 5501 | 789835 |
| 1968 | 16353 | 4595 | 859 | 577 | 258 | 32 | 2 | - | - | - | 22676 | 263764 |
| 1969 | 16736 | 9359 | 3110 | 721 | 399 | 181 | 17 | - | - | - | 30523 | 382949 |
| 1970 | 23063 | 16706 | 5433 | 1312 | 212 | 165 | 99 | 2 | - | - | 46992 | 787718 |
| 1971 | 30043 | 14706 | 7486 | 1850 | 332 | 96 | 81 | 51 | - | - | 54645 | 639655 |
| 1972 | 22634 | 18195 | 6828 | 2465 | 542 | 131 | 38 | 19 | 17 | - | 50869 | 656439 |
| 1973 | 11913 | 14103 | 9095 | 3022 | 746 | 224 | 60 | 17 | 10 | 2 | 39192 | 523518 |
| 1974 | 8725 | 7032 | 2951 | 699 | 203 | 74 | 30 | 13 | 4 | - | 19731 | 258017 |
| 1975 | 7570 | 4695 | 2243 | 578 | 158 | 63 | 19 | 4 | - | - | 15330 | 246611 |
| 1976 | 17480 | 3832 | 1262 | 284 | 49 | 17 | 4 | 2 | - | - | 22930 | 274096 |
| 1977 | 4445 | 10401 | 1410 | 464 | 63 | 33 | 5 | 1 | - | - | 16822 | 259314 |