# Stock Assessment for British Columbia Herring Management Units in 1978 and Forecasts of the Available Roe Catch in 1979



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# STOCK ASSESSMENTS FOR BRITISH COLUMBIA HERRING MANAGEMENT UNITS in 1979 AND FORECASTS OF THE AVAILABLE ROE CATCH IN 1979

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## ABSTRACT

Hourston, A. S. 1979. Stock assessments for British Columbia herring management units in 1979 and forecasts of the available roe catch in 1979. Fish. Mar. Serv. MS Rep. 1493: 19 p.

The abundance of the 1978 herring run to British Columbian waters was assessed at 311,000 tons. This was down 50,000 tons from 1977 but within 6% of the forecast. A further decline to 238,000 tons is forecast for 1979 as the strong 1971 and 1972 year-classes approach the end of their life span, leaving 1975 as the only strong year-class in most stocks. Abundance should remain high on the West Coast of Vancouver Island, where the 1975 year-class appears very strong, and in the Gulf of Georgia, where the 1974 year-class is also strong. The lack of strong year-classes is expected to reduce the available catch from runs to the Queen Charlotte Islands, North Coast, and Central Divisions considerably below their 1978 levels and to preclude a roe fishery in Johnstone Strait. A good recruitment in 1979 could, however, result in the 1979 abundance being comparable to that in 1978.

Key words: Pacific herring, abundance, forecasts.

## INTRODUCTION

Each year since 1974, forecasts have been made of the available catch for individual British Columbia herring roe fisheries. Initially, while procedures for these analyses were being developed and tested, this information was provided to fisheries managers on an "in-house" basis. With the development of confidence in the system and of basic strategies for management of the resource, the forecasts "went public" in 1978 (Hourston and Humphreys, 1978). Programming of the analysis for computer processing was completed in 1978 and the 1979 forecasts are the first to be undertaken on the basis of a complete analysis of the available monitoring data.

Re-analysis of a 5-year data base has revealed the need for some adjustments in stock groupings and in procedures for gathering and processing the monitoring data. Such adjustments may be expected on an ongoing but diminishing basis as the data base is extended. The development of a longer and broader data base will also provide the basis for analysis of major long-term trends in abundance such as the decline and recovery of the stocks during the 1960's (Hourston 1978).

## METHODS

### DEFINITION OF STOCKS

Herring spawnings are clustered in sections on the British Columbia coast (Fig. 1, 2). These sections have been identified by three-digit numbers, the first two digits of which represent the statistical area in which they are found. Sections whose numbers end in 0 represent an entire statistical area, and sections whose numbers end in 1 represent that part of the statistical area in which no known spawning occurs.

Stock assessments are conducted separately for each section. Spawning grounds and roe fisheries may, however, extend across the boundaries of one or more sections (and statistical areas). As spawnings and/or fisheries develop, shift in their location and/or increase or decrease in their extent, the boundaries of the region occupied by the same stock may shift and stocks may be divided or amalgamated. To accommodate this variability, a flexible concept of "Management Units" (made up of one or more sections) has been developed representing stocks at the current stage of development of the roe fishery (Table 1). Assessments and forecasts of the abundance of stocks presented herein are for management units capable of supporting appreciable roe fisheries. Management units containing minor stocks are combined by division under "other".

### ANALYTICAL PROCEDURES

The abundance of a population of herring (P) supporting a roe fishery may be estimated after the fishery and spawning have been completed by summing the amount caught (C) and the amount that escaped to spawn (S). Thus, in year n

$$P_n = C_n + S_n \qquad (1)$$

Abundance may also be expressed as the amount of adult fish (A) which spawned in the previous year and are returning to spawn again plus the amount of new recruits (R) which are spawning for the first time. Thus a forecast of abundance in the following year is given by

$$P_{n+1} = A_{n+1} + R_{n+1} \tag{2}$$

The amount of adults may be estimated by multiplying the abundance of spawners in the previous season by a predetermined survival rate "s" for the intervening period.

$$A_{n+1} = \sum_{j=k}^{j=\ell} S_{n,j} \cdot s_j \tag{3}$$

S is now the estimated number of spawners in year n of age j, s is the applicable survival rate from age j to j + 1, k is the age of major recruitment and $\ell$ is the oldest age occurring in year n. Values for s were determined by Tester (1955).

The amount of recruits (R) may be estimated as the average for an appropriate series of years preceding year n, i.e.

$$R_{n+1} = \frac{\sum_{a=i}^{a=n} R_a}{n - i + 1} \tag{4}$$

The surplus available for harvesting (H) is the population (P) less the spawning escapement (E) required to maintain and optimize the production of adult fish (year-class strength) from that year's spawning. Thus

$$H = P - E \tag{5}$$

The available roe catch (R) is given by subtracting the catch by other fisheries from this stock (CO) from the surplus (H), i.e.

$$CR = H - CO \tag{6}$$

The nature of most of these calculations requires that amounts be expressed in terms of numbers of fish. However, because industry and fisheries managers deal in tons, the results of the analysis are given in tons.

## DATA BASE

The annual monitoring program provides the following information on which stock assessments and forecasts are based:

1. Catch data in the form of landings in tons (or lbs) by date and locality of capture compiled from sales slips by Economics and Statistical Services;
2. Data on the age, length, weight, sex and maturity for individual fish taken by Field Services technicians from representative samples of about 100 fish collected from seine and gillnet catches.

3. Data on the length, width and intensity of individual spawn depositions surveyed by Fisheries Officers and/or their supporting staff.

All of these data are compiled by Support Services onto computer tapes for analysis by research personnel.

Age composition and the average weight and sex ratio may vary between stocks in any given year and from year to year (and even within a season) for individual stocks. Consequently, the procedures for analysing and forecasting abundance require that the data be expressed in terms of the numbers of fish in each age (year-class) represented. The results of these analyses may then be converted into tons using data on the average weight at age provided by the sampling program.

## ESTIMATION OF VARIABLES

### Catch

Landings (in tons) for each week in each section are converted into numbers of fish at age on the basis of the age composition and average weight at age for that week and section, as determined from sampling data. Because gillnets may be selective for both age and sex, the catches for the two types of gear are estimated separately. The catches (in fish at age and in tons at age) are summed over the season for each of the two gear types in each section.

### Spawners

The number of eggs deposited on each spawning ground may be estimated from the area spawned and the eggs per unit area. Spawn surveys by Fishery Officers provide estimates of the length and width of spawnings and of the density (layers) of eggs on the various substrates involved. Estimates of the eggs per unit area of spawning ground for different spawning intensities on different substrates (research data) are used to convert the monitoring data into numbers of eggs. Information on fecundity (eggs per female) at age (research data) is used, along with sampling data on age composition and the sex ratios at different ages, to convert the numbers of eggs into numbers of spawners at age.

### Adults

The number of adults of each age returning to spawn in the coming year is forecast by applying the appropriate survival rate (Tester 1955) to the numbers of fish one year younger which spawned in the previous season.

### Recruits

The number of recruits in the coming year is forecast to be the average number of fish age III and younger in the spawning runs to that section for the period of years for which suitable data are available. This procedure assumes that the number of late recruits (age IV and older) is either small

or is approximately balanced by the early recruits from the previous year which will spawn for the second time at Age III. The validity of estimates of the numbers of recruits can be checked immediately prior to the fishing season using age compositions from samples of test sets.

Desired spawners

The amount of spawning desired is assessed from historic levels which have produced good recruitment, the spawning area available and the levels of abundance in recent years. Because egg deposition is more closely related to the tonnage than to the numbers of fish which spawn (small fish weigh less and produce fewer eggs), the desired escapements are calculated in tons and subsequently converted to fish on the basis of the age composition forecast for the coming year. Also, because major spawning concentrations can shift across section boundaries from one year to another, desired spawners are estimated by management unit rather than by section.

Surplus and available roe catch

The surplus of fish represents the excess of the predicted run over the desired spawners. Catches by other fisheries from the fish spawning in that management unit are deducted from the surplus to give the available roe catch. These catches may be taken elsewhere on the coast during feeding or spawning migrations at other times of the year. Under these circumstances, their allocation to management units is done at a very general level based on what is known of the migratory movements of the stocks involved.

## RESULTS AND DISCUSSION

### STOCK ASSESSMENTS FOR 1978

Abundance

The total run to the B.C. coast in 1978 was estimated at 311,000 tons (Table 2, Column 3). This is about 50,000 tons less than the 1977 run but average for the last 5 years. Runs to the Gulf of Georgia (127,000 tons) and the Queen Charlotte Islands (41,000 tons) Divisions continued to establish record levels for recent years. Runs to the Central Coast (33,000 tons) and the West Coast of Vancouver Island (90,000 tons) were about average for recent years. A large body of fish was located by echo sounder in Barkley Sound prior to the fishery but disappeared from the normal fishery and spawning grounds. If these were indeed Barkley Sound herring, the 1978 run to the West Coast was also above average. The runs to the North Coast (17,000 tons) and to Johnstone Strait (3,000 tons) apparently suffered major declines to less than half their 1977 levels. This abrupt decline would not appear to result from overfishing since the fishery only took an average of 13 and 9 percent respectively of the runs to these divisions over the previous 5 years and the rate of removal in any one year never exceeded 22 and 11 percent respectively.

The decline in abundance in both the North Coast and Johnstone Strait Divisions was shared proportionately between both management units within these divisions. The only other management unit to show an appreciable decline in abundance was West Barkley on the West Coast of Vancouver Island (16,000 tons) and there is a good possibility that an appreciable portion of this run spawned in relatively deep water and thus escaped detection by the monitoring program. On the other hand, abundance in the Skincuttle Inlet Management Unit in the Queen Charlotte Islands (22,000 tons), the Baynes Sound Management Unit in the Gulf of Georgia (42,000 tons), and the Quatsino Sound Management Unit on the West Coast of Vancouver Island (11,000 tons) was at record levels for the 1970's.

Age composition

The age composition of the runs to the major management units (Table 3) indicate that the 1971, 1972, and 1975 year-classes (ages VII, VI, and III, respectively) were generally strong everywhere on the coast while the 1973 year-class (Age V) was weak. The 1974 year-class (Age IV) was strong in the Gulf of Georgia and the North Coast, but weak elsewhere. The 1971 and 1972 year-classes accounted for approximately half of the run in most management units north of Vancouver Island. The strong 1975 year-class also made a major contribution to the management units on the Queen Charlotte Islands and the 1974 year-class was also strong in two of the four management units. This would account for the high abundance of the runs in this district. The 1975 year-class was also strong in the two largest management units in the Central District (Milbanke Sound and Queens Sound). This, along with the strong 1971 and 1972 year-classes, would account for the average level of abundance in the runs to this district. The 1975 year-class did not make a strong showing in either of the North Coast management units but late recruitment (at ages IV and V) is not uncommon in this district. This could account for the low levels of abundance observed in the Chatham Sound and Porcher Island Management Units in 1978 (although the 1974 year-class was relatively strong here).

In Johnstone Strait, the 1975 year-classes did not show up in strength and the two preceding year-classes appear to have been of average abundance at best. This would account for the poor showing in this district in 1978.

In the Gulf of Georgia, where III and IV year fish usually account for the bulk of the run, the 1975 and 1974 year-classes both appear to have been strong in most management units. Only one (1973) of the six year-classes represented was weak. This would account for the record run to the three largest management units (Baynes Sound, Nanaimo-Qualicum and Yellow Point). Most of the other runs to this district maintained average abundance.

On the West Coast of Vancouver Island, the 1975 year-class was exceptionally strong in the five more northerly management units and strong in South Clayquot. However, both the 1974 and 1973 year-classes were weak in all management units so that abundance was about average. Only in the West Barkley Management Unit was the 1975 year-class weak where it was the third weak year-class to be recruited in a row. This would account for the poor level of abundance in West Barkley in 1978.

ACCURACY OF FORECASTS FOR 1978

The major declines recorded in the 1978 runs to both the North Coast District, the Johnstone Strait District, and the West Barkley Management Unit, resulted from local failures in recruitment and thus would not have been anticipated by this analysis. As a result, the forecasts for these management units (Table 2, Column 2) were at least twice as high as the actual runs (Column 3). The forecast for the small runs grouped under "Other" considerably exceeded the observed runs in all districts. These latter discrepancies probably result mainly from weakness of the data base for both the stock assessments and the forecasts for these groups of miscellaneous small stocks.

The run to the Louscoone Inlet Management Unit was only half as large as the forecast level although recruitment was good. The low level of spawn deposition recorded in 1977 and 1978 (about 1/8 of that in previous years) would not support the catches taken from this management unit while sustaining the observed age composition. This suggests that a large proportion of the spawning escapement from the 1977 and 1978 fisheries in this management unit either escaped detection or spawned in an adjacent section.

The runs to the Baynes Sound and Yellow Point Management Units in the Gulf of Georgia were much larger than forecast. This may be attributed to the stronger than average recruitment and to spillover of fish from the strong Nanaimo-Qualicum run.

FORECASTS FOR 1979

Predicted run

The forecast for the total run in 1979 is 238,000 tons (Table 2, Column 7), about 30% less than in 1978. Smaller runs are forecast for almost all management units as the strong 1971 and 1972 year-classes approach the end of their lifespan and are replaced by the weak 1973 and (in most stocks) 1974 year-classes. Stocks in which the 1974 year-class is strong (Naden Harbour and the Gulf of Georgia), and those in which the 1975 year-class is dominant (all management units on the West Coast of Vancouver Island with the exception of West Barkley) are expected to maintain their abundance close to 1978 levels. If, as suggested above, appreciable portions of the 1978 spawning escapement to West Barkley and Louscoone Inlet were not detected in 1978, the 1979 runs for these management units would be of average abundance (24,000 and 6,000 tons respectively). However, the runs to the Skincuttle Inlet Management Unit in the Queen Charlotte Islands, the Chatham Sound and Porcher Island Management Units on the North Coast, and the Kitasu Bay, Milbanke Sound and Queens Sound Management Units in the Central District are expected to be only about half as large as those in 1978. These runs provided 76%, 100%, and 99% respectively, of the 1978 roe catch from these three districts.

Available roe catch

The surplus available for harvesting (Table 2, Column 9) is estimated by subtracting the desired spawners (Column 8) from the predicted run (Column 7).

Catches by other fisheries (Column 10) are subtracted from this surplus to give the available roe catch (Column 11). The autumn food fishery in the lower Gulf was assumed to have operated mainly on the major stocks migrating northward to the Yellow Point, Nanaimo-Qualicum and Baynes Sound Management Units. The food fishery in Johnstone Strait was assumed to have been catching mainly fish migrating southward to the Powell River and Baynes Sound Management Units. Catches by other food fisheries were assumed to have been taken from the runs to the nearest management unit.

On this basis, there will be no surplus available for a roe fishery in 1979 in the Northern and Johnstone Strait Districts. However, the run to the Porcher Island Management Unit on the North Coast consistently exceeded spawning requirements for the previous six years. Since the 1978 spawning escapement may well have been underestimated, a small roe fishery would appear to be warranted there in 1979. Small surpluses will be available in the Queen Charlotte Islands (6,000 tons) and Central (1,500 tons) Districts. However, the nature of the current data base for these two divisions and its effect on the analytical procedures involved suggest that these estimates are minimal, and that the actual surplus available for harvesting in these two divisions could be considerably larger. The available roe catch predicted for the Gulf of Georgia and on the West Coast of Vancouver Island exceeds the 1978 catch but practical considerations in the management of these fisheries will probably preclude the 1979 catches from appreciably exceeding those in 1978.

## GENERAL COMMENTS

Stock assessments are based mainly on the results of spawning ground surveys. Current techniques for locating and recording spawn depositions have severe limitations and the resources available for these surveys are limited. Until newly developed techniques can be fully implemented and additional resources can be committed to these surveys, the reliability of the stock assessments on which they are based will be limited correspondingly.

Forecasts assume an average recruitment for each management unit. With the relatively short time series of data now available, one or two unusually large (or small) year-classes can distort this "average" considerably (as may be the case for the 1979 forecasts for Skincuttle Inlet, Kitasu Bay, Milbanke Sound and Queens Sound). The extent and degree of error arising from this source should decrease as the time series of data is extended over the next few years.

Because forecasts assume average recruitment, and recruits frequently make up the majority of the run, there is a need to revise the forecasts prior to the fishery. Information on recruitment may be obtained by sampling the catches by the food fishery and test sets made by research vessels and commercial fishermen.

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TABLES

Table 1. The relationship between herring divisions, management units, and sections.

| Division | | Management Unit | | Sections |
|---|---|---|---|---|
| 1. | Queen Charlotte Islands | 01 | Naden Hb. | 012 |
| | | 02 | Other Area 1* | 011 |
| | | 03 | Rennell Sound* | 003 |
| | | 04 | Englefield Bay* | 005 |
| | | 05 | Louscoone Inlet | 006 |
| | | 06 | Other Area 2W | 001, 002, 004 |
| | | 07 | Skidegate Inlet | 022 |
| | | 08 | Gumshewa Inlet | 023 |
| | | 09 | Skincuttle Inlet | 025 |
| | | 10 | Other Area 2E | 021, 024 |
| 2. | North Coast | 11 | Chatham Sound | 033, 042 |
| | | 12 | Other Area 3* | 031, 032 |
| | | 13 | Other Area 4* | 041 |
| | | 14 | Porcher Island | 043, 044, 045, 052 |
| | | 15 | Other Area 5* | 051, 053, 054 |
| 3. | Central | 16 | Kitasu Bay | 067 |
| | | 17 | Other Area 6* | 061-066 |
| | | 18 | Milbanke Sound | 072, 073, 074 |
| | | 19 | Queens Sound | 075, 076 |
| | | 20 | Other Area 7* | 071 |
| | | 21 | Burke Channel* | 084 |
| | | 22 | Kwakshua Channel | 085 |
| | | 23 | Other Area 8* | 081, 082, 083 |
| | | 24 | Rivers Inlet* | 091, 092, 093 |
| | | 25 | Smith Inlet* | 101, 102, 103 |
| 4. | Johnstone Strait | 26 | Area 11* | 111, 112 |
| | | 27 | Upper Johnstone Str. | 123-126 |
| | | 28 | Knight Inlet | 127 |
| | | 29 | Other Area 12* | 121, 122, 128 |
| | | 30 | Area 13 (non-Gulf)* | 131-134 |
| 5. | Gulf of Georgia | 31 | Other Areas 13, 14, 15* | 136, 137, 138, 141 (Other 13, 14) |
| | | 32 | Baynes Sound | 142 |
| | | 33 | Nanaimo-Qualicum | 143, 144, 172 |
| | | 34 | Yellow Point | 173 |
| | | 35 | Ganges-Plumper | 182, 183 |
| | | 36 | Other Areas 17, 18* | 171, 181, 184, 185 |
| | | 37 | Areas 19, 20* | 191, 192, 193, 201, 202 |
| | | 38 | Powell River | 152, 162 |
| | | 39 | Other Areas 15, 16 | 151, 161, 163, 164, 165 |
| | | 40 | Area 28* | 280 |
| | | 41 | Area 29* | 290 |

Table 1 (cont'd)

| Division | Management Unit | | Sections |
|---|---|---|---|
| 6. West Coast of Vancouver Island | 42 | West Barkley | 232, 233 |
| | 43 | Other Barkley | 210, 218, 220, 231, 234, 235, 238 |
| | 44 | Hesquiat Harb. | 242 |
| | 45 | Sydney Inlet | 243 |
| | 46 | South Clayoquot | 244, 245 |
| | 47 | Other Area 24* | 241, 248 |
| | 48 | Nootka Sound | 252, 254 |
| | 49 | Nuchatlitz Inlet | 253 |
| | 50 | Other Area 25* | 251 |
| | 51 | Area 26* | 261, 262, 263 |
| | 52 | Quatsino Sound | 272, 273 |
| | 53 | Other Area 27* | 271, 274 |

*Included in Other for that division in the current analysis.

Table 2. Abundance of the 1978 herring runs (in tons) by Division and Management Unit (in tons) and forecasts of the 1979 runs.

| Division and Management Unit | 1979 Pred. run | 1979 Desired spawners | 1979 Surplus | 1979 Other fisheries | 1979 Available roe catch | 1978 Pred. run | 1978 Actual run | 1978 Spawners | 1978 Roe catch | 1978 Other fisheries |
|---|---|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| Q.C.I. | | | | | | | | | | |
| Naden Harb. | 5,545 | 3,000 | 2,545 | 55 | 2,490 | [a] | 6,841 | 6,672 | 169 | - |
| Louscoone In. | 1,191 | 4,000 | - | - | - | 7,000 | 3,169 | 703 | 2,466 | - |
| Cumshewa In. | 3,650 | 4,000 | - | - | - | 4,000 | 4,575 | 4,575 | - | - |
| Skincuttle In. | 9,872 | 7,000 | 2,782 | 90 | 2,692 | 20,000 | 21,727 | 11,267 | 10,459 | - |
| Other | 3,677 | 3,000 | 677 | - | 677 | 14,000 | 4,693 | 4,029 | 663 | - |
| Total | 23,935 | 21,000 | 6,004 | 145 | 5,859 | 45,000 | 41,005 | 27,247 | 13,758 | - |
| North Coast | | | | | | | | | | |
| Chatham Sd. | 2,045 | 10,000 | - | - | - | 18,000 | 4,996 | 1,289 | 3,707 | - |
| Porcher Is. | 5,166 | 10,000 | - | 1,827 | - | 20,000 | 11,539 | 5,787 | 1,873 | 3,879 |
| Other | 68 | 100 | - | - | - | 2,000 | 141 | 133 | 8 | - |
| Total | 7,280 | 20,000 | - | 1,827 | - | 40,000 | 16,676 | 7,210 | 5,587 | 3,879 |
| Central | | | | | | | | | | |
| Kitasu Bay | 2,486 | 3,000 | - | - | - | 5,000 | 5,900 | 3,411 | 2,490 | - |
| Milbanke Sd. | 5,009 | 8,000 | - | - | - | 22,000 | 14,457 | 4,673 | 9,784 | - |
| Queens Sd. | 4,465 | 4,000 | 465 | - | 465 | 6,000 | 7,571 | 4,481 | 3,090 | - |
| Burke Chan. | - | (2,000)[b] | - | - | - | 3,000 | - | - | - | - |
| Kwakshua Chan. | 2,507 | 2,000 | 507 | - | 507 | 2,500 | 2,362 | 2,327 | 36 | - |
| Rivers Inlet | 1,352 | 1,500 | - | - | - | 2,000 | 1,191 | 1,191 | - | - |
| Smith Inlet | 1,013 | 500 | 513 | - | 513 | 200 | 784 | 784 | - | - |
| Other | 407 | 400 | 7 | - | 7 | 2,000 | 311 | 162 | 84 | 63 |
| Total | 17,240 | 19,400 (2,000) | 1,492 | - | 1,492 | 42,700 | 32,576 | 17,030 | 15,483 | 63 |
| Johnstone Str. | | | | | | | | | | |
| Upr. Johnstone | 2,112 | 4,000 | - | - | - | 5,000 | 1,458 | 1,044 | 414 | - |
| Knight Inlet | 1,728 | 5,000 | - | - | - | 5,000 | 1,168 | 931 | 236 | - |
| Other | 1,259 | 1,200 | 59 | - | 59 | 1,600 | 617 | 617 | - | - |
| Total | 5,098 | 10,200 | 59 | - | 59 | 11,600 | 3,242 | 2,592 | 650 | - |

Table 2 (Continued)

| Division and Management Unit | 1979 Pred. run | 1979 Desired spawners | 1979 Surplus | 1979 Other fisheries | 1979 Available roe catch | 1978 Pred. run | 1978 Actual run | 1978 Spawners | 1978 Roe catch | 1978 Other fisheries |
|---|---|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| Gulf of Georgia | | | | | | | | | | |
| Baynes Sound | 31,227 | 5,000 | 26,227 | 4,821[c,d] | 21,406 | 5,000 | 42,235 | 36,585 | 71 | 5,579[c,d] |
| Nanaimo-Qualicum | 34,583 | 25,000 | 9,583 | 3,907[c] | 5,676 | 50,000 | 40,844 | 26,227 | 11,066 | 3,551[c] |
| Yellow Pt. | 21,413 | 10,000 | 11,413 | 3,906[c] | 7,497 | 5,000 | 22,583 | 19,302 | - | 3,551[c] |
| Ganges-Plumper | 4,060 | 3,000 | 1,060 | - | 1,060 | 3,500 | 1,676 | 740 | 936 | - |
| Powell River | 18,191 | 10,000 | 8,191 | 916[d] | 7,275 | 20,000 | 17,375 | 15,347 | - | 2,028[d] |
| Other | 2,404 | 1,100 (1,500)[b] | 1,404 | - | 1,404 | 7,000 | 1,946 | 1,944 | 2 | - |
| Total | 111,879 | 54,100 | 57,868 | 13,550 | 44,318 | 90,000 | 126,929 | 100,145 | 12,075 | 14,709 |
| W. Coast V.I. | | | | | | | | | | |
| West Barkley | 8,192 | 15,000 | - | - | - | 35,000 | 16,310 | 3,666 | 10,410 | 2,234 |
| Hesquiat Hb. | 4,459 | 1,000 | 3,459 | - | 3,459 | 1,000 | 3,930 | - | - | - |
| Sydney Inlet | - | (1,000)[b] | - | - | - | 3,000 | - | - | - | - |
| S. Clayoquot | 28,263 | 20,000 | 8,263 | - | 8,263 | 30,000 | 37,902 | 30,660 | 7,242 | - |
| Nootka Sound | 2,346 | 6,000 | - | - | - | 3,000 | 617 | - | 617 | - |
| Nuchatlitz In. | 17,347 | 10,000 | 7,347 | - | 7,367 | 8,000 | 19,733 | 16,160 | 3,573 | - |
| Quatsino Sd. | 10,367 | 3,000 | 7,367 | - | 7,367 | [a] | 10,874 | 10,791 | 83 | - |
| Other | 1,690 | 1,000 (1,000)[b] | 690 | - | 690 | 19,000 | 1,470 | 1,470 | - | - |
| Total | 72,664 | 56,000 | 27,126 | - | 27,126 | 99,000 | 90,936 | 66,677 | 22,025 | 2,234 |
| North | 48,455 | 60,500 (2,000)[b] | 7,496 | 1,972 | 7,351 | 127,700 | 90,257 | 51,487 | 34,828 | 3,942 |
| South | 189,641 | 120,300 | 85,053 | 13,550 | 71,503 | 201,100 | 221,107 | 169,414 | 34,750 | 16,943 |
| All | 238,096 | 179,800 (5,500)[b] | 92,549 | 15,522 | 78,854 | 328,800 | 311,364 | 220,901 | 69,578 | 20,885 |

[a] Included in "Other."
[b] Stocks not included in forecast.
[c] Gulf of Georgia food catch split 3 ways.
[d] Johnstone Strait food catch split 2 ways.

Table 3. Age composition by management unit in 1977-78. Data for strong year classes are underlined with solid lines (same samples) or dotted lines (gillnet samples).

| Year class: / Age in 1977-78: | 76 II | 75 III | 74 IV | 73 V | 72 VI | 71 VII+ |
|---|---|---|---|---|---|---|
| Division and Management Unit | | | | | | |
| Queen Charlotte Island | | | | | | |
| Naden Harbour[a] | - | 3 | 47 | 15 | 14 | 21 |
| Louscoone Inlet | - | 24 | 24 | 3 | 9 | 40 |
| Gumshewa Inlet | - | 23 | 19 | 19 | 20 | 19 |
| Skincuttle Inlet | - | 28 | 17 | 10 | 31 | 14 |
| North Coast | | | | | | |
| Chatham Sound | 1 | 12 | 22 | 12 | 23 | 29 |
| Porcher Island | - | 11 | 38 | 5 | 23 | 23 |
| Central | | | | | | |
| Kitasu Bay | - | 10 | 13 | 11 | 34 | 32 |
| Milbanke Sound | 1 | 36 | 15 | 18 | 16 | 14 |
| Queens Sound | - | 35 | 16 | 25 | 16 | 8 |
| Kwakshua Channel[a] | - | 1 | 10 | 18 | 37 | 34 |
| Johnstone Strait | | | | | | |
| Upper Johnstone | 2 | 23 | 35 | 23 | 10 | 7 |
| Knight Inlet | - | - | - | - | - | 7 |
| Gulf of Georgia | | | | | | |
| Baynes Sound | 1 | 27 | 48 | 12 | 10 | 2 |
| Nanaimo-Qualicum | 1 | 35 | 42 | 14 | 7 | 2 |
| Yellow Point | - | - | - | - | - | - |
| Ganges-Plumper | 10 | 73 | 12 | 5 | - | - |
| Powell River | 5 | 31 | 32 | 13 | 13 | 6 |
| West Coast of Vancouver Island | | | | | | |
| West Barkley | 1 | 29 | 17 | 21 | 25 | 7 |
| Hesquiat Harbour | - | - | - | - | - | - |
| Sydney Inlet | 1 | 71 | 13 | 7 | 6 | 2 |
| South Clayoquot | 1 | 23 | 19 | 25 | 24 | 8 |
| Nootka Sound | - | 68 | 9 | 15 | 4 | 4 |
| Nuchatlitz Inlet | 16 | 52 | 10 | 14 | 4 | 4 |
| Quatsino Sound | 2 | 60 | 5 | 17 | 14 | 2 |

[a]Gillnet samples.

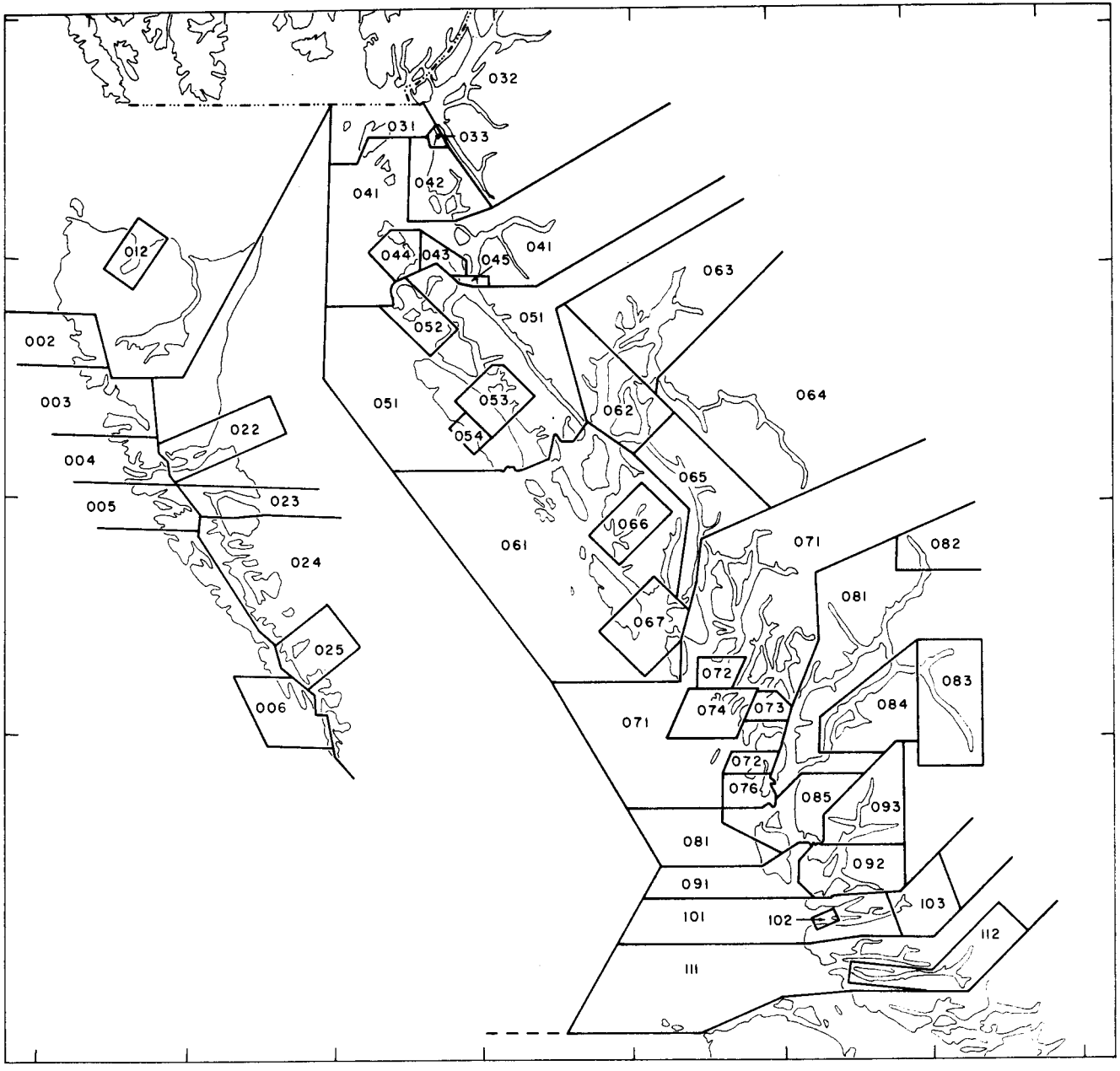


Fig. 1. Herring sections in northern British Columbia.

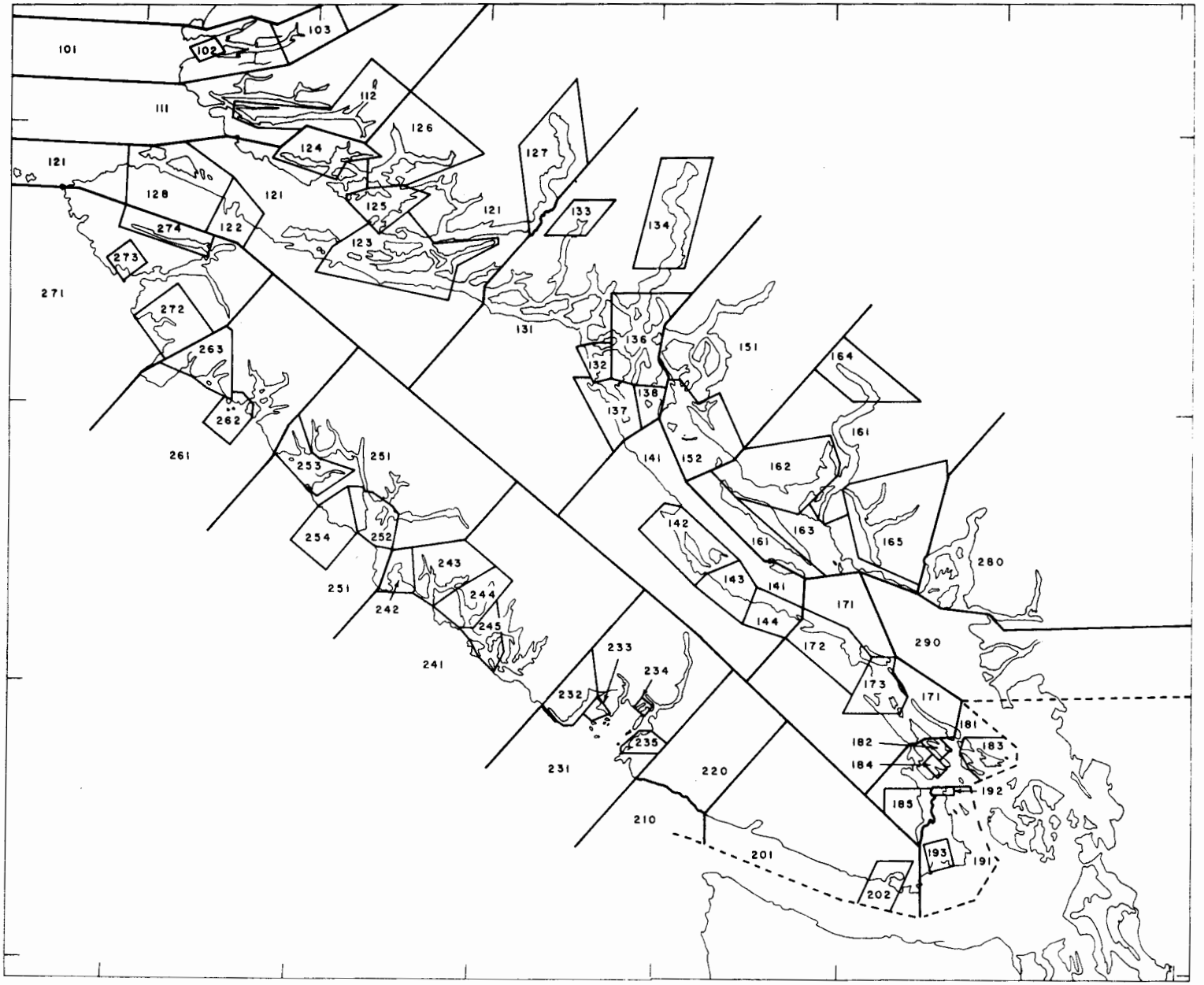


Fig. 2. Herring sections in southern British Columbia.

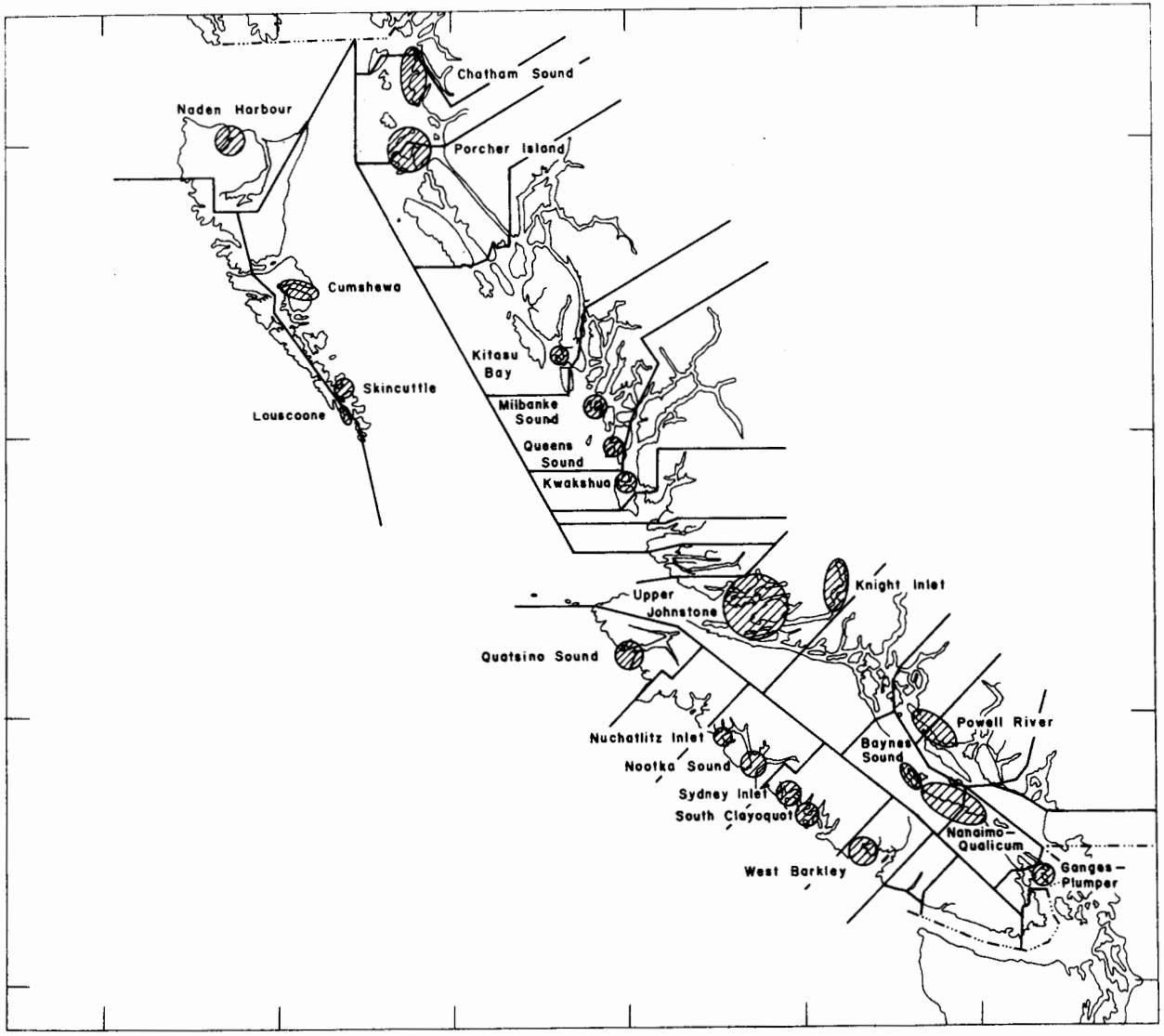


Fig. 3. Major management units employed in stock assessments in 1979.