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SUMMARY OF 1989 HERRING STOCK ASSESSMENT

by

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ABSTRACT

Canadian scientists conduct herring stock assessments using both an escapement model and an age-structured model. Both models use a 39-year time series of catch, spawn deposition, and age composition data. There has been a slight increase in the abundance of herring in the Charlotte-Vancouver Region in 1989. In the Charlotte Area, the Prince Rupert stock appears to be declining from the high levels maintained through the 1980's. The Central Coast stock remains at high levels due to the strong 1985 year class. Queen Charlotte Islands stocks increased substantially in 1989. In the Vancouver Area, herring stocks in the Strait of Georgia increased in 1989 while stocks on the west coast of Vancouver Island remained stable.

The weighted run forecast for 1990 is 205,600 tonnes for the Charlotte-Vancouver Region. For the Charlotte Area, the forecast is 104,900 tonnes and for the Vancouver Area is 100,700 tonnes. Canadian scientists recommend the annual harvest rate to remain at 20% of the stock forecast estimates.

INTRODUCTION

The herring stock assessment group has standardized its methods by using two stock assessment models to reconstruct historic stock levels and forecast run sizes for B.C. herring stocks during the last several years (eg. Haist et al. 1987). These methods, the age-structured model (Fournier and Archibald 1982), and the escapement model (Schweigert and Stocker 1987), have again been used for the 1989 assessment and 1990 forecasts. Both models utilize the 39 year time series of catch, spawn deposition, and sampling information available from the commercial fishery and pre-fishery and research samples.

The escapement model is based on estimates of egg deposition obtained from annual surveys of all major herring spawns. Historically spawn surveys have been conducted from the surface, using grappling hooks and underwater viewers, to obtain estimates of spawn width and intensity of egg deposition. Surface survey methods underestimate spawn width and do not provide consistent estimates of intensity. Since 1985 dive methods have replaced the traditional surface methods for surveying many spawns. In 1989, most major spawns were surveyed using diver methods; these surveys should provide consistent estimates of spawn width and intensity. Egg deposition estimates are converted to estimates of spawners-at-age using age composition and fecundity data from the bio-sampling data base.

The age-structured model, a modified version of the model described in Fournier and Archibald (1982), has been used to assess B.C. herring stocks since 1982. The model incorporates auxiliary information in the form of spawn index data, separates catch-at-age data by gear type, and includes an availability term to model partial recruitment to the spawning stock. The model includes realistic assumptions about the form of both measurement and process error. A maximum likelihood method is used to simultaneously estimate all model parameters.

Stock assessments and forecasts for 1990 have been conducted for seven major migratory stocks using both assessment methods. For the Queen Charlotte Islands, the areas included in the stock assessment region are the inlets and bays from Selwyn Inlet in the north to Skincuttle Inlet in the south. The Prince Rupert stock assessment region includes all of B.C. Statistical Areas 3 to 5. In the central coast, we attempt to separate the major migratory stock from the non-migratory inlet stocks. For this area, the stock assessment region includes Statistical Area 7 plus Kitasu Bay and Kwakshua Channel. In the south coast, both the Strait of Georgia and west coast of Vancouver Island are separated into two stock assessment regions. The northern Strait of Georgia stock encompasses Statistical Areas 14 to 16 plus Area 17N and parts of Area 13, while the southern stock includes Area 17S and Areas 18 and 19. On the west coast of Vancouver Island, the southern stock comprises Areas 23 and 24, while the northern stock includes Areas 25 to 27.

CATCH TRENDS

Herring in British Columbia waters have supported commercial fisheries since 1877, although reliable records of place, date, and quantity caught are available only since 1950. There was a fishery for a dry salted market from 1904-1934, with catches up to 85,000 tonnes in a year. A reduction fishery, mainly by purse seining followed (1935-1967). Fish were taken during their inshore spawning migrations from October to February. Very large catches, of 200,000 tonnes annually, in the early 1960s followed by a series of poor recruitments led to the collapse of the reduction fishery, with a closure in 1968. Cessation of the intensive reduction fishery resulted in a gradual recovery of stocks. The roe herring fishery began in 1971. Herring are now caught on or near the spawning grounds by both gillnets and purse seines. Roe herring landings have averaged 29,040 tonnes for the last five years.

The roe fishery first came under quota regulations in 1983. Prior to this, guidelines of anticipated roe catches were given. Roe catches (since 1980; for 1989 data are hailed catches) and quotas (since 1983) in thousands of tonnes are shown below:

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Queen Charlotte Islands										
Roe Catch	3.4	6.4	5.3	8.1	5.0	6.3	3.6	2.0	0.3	1.4
Roe Quota					4.6	5.0	3.8	1.4	0.0	0.9
Prince Rupert District										
Roe Catch	2.7	1.4	0.1	0.0	3.5	6.5	8.3	6.1	7.9	8.0
Roe Quota					4.0	5.0	6.4	5.4	7.5	7.3
Central Coast										
Roe Catch	0.5	2.6	6.3	5.6	7.2	5.2	3.3	3.6	4.5	8.5
Roe Quota					6.6	4.1	2.3	3.4	3.7	7.8
Strait of Georgia										
Roe Catch	3.3	7.1	8.9	16.4	10.2	6.2	0.2	9.1	7.5	7.3
Roe Quota				11.7	11.6	4.7	0.0	8.1	6.4	7.4
W. Coast Vancouver Is.										
Roe Catch	4.5	8.8	6.1	8.7	6.7	0.2	0.2	15.9	9.7	13.4
Roe Quota				4.5	4.5	0.0	0.0	9.4	8.1	10.3
Total Coast										
Roe Catch	14.4	26.3	26.5	38.8	32.6	24.4	15.6	36.7	29.9	38.6
Roe Quota				28.0	31.3	18.8	12.5	27.7	25.8	33.7

STOCK TRENDS

Herring abundance along the B.C. coast increased slightly in 1989. The estimated spawning biomass for the seven assessment regions is 190,300 tonnes, a 4% increase over 1988 spawn levels. The 1985 year class was dominant in all assessment regions. This year class is well above average in size throughout the coast. The following discussion of stock trends and 1989 spawning biomass are based on the weighted escapement estimates of both assessment methods.

NORTH COAST STOCKS

Spawning stocks in the Queen Charlotte Islands increased substantially in 1989; the estimated biomass of 25,500 tonnes represents a 55% increase over 1988 spawn levels. Four year olds (1985 year class) comprised 50% of the stock and 3 year olds (1986 year class) 28% of the stock. The 1985 year class is estimated to be double the 1951-1989 average and the 1986 year class is estimated as average.

The two assessment models produce significantly different estimates of stock size for the Prince Rupert District. The escapement model estimate of 12,900 tonnes of spawners is down substantially from 1988, whereas age-structured model analysis suggests an increase in spawners to 47,800 tonnes. The reason for such major differences in stock estimates is not apparent. The majority of spawns in this region were surveyed by SCUBA divers in 1989 so estimates from the escapement model should be reasonably accurate. Inconsistencies could result if stocks holding in this region prior to spawning moved elsewhere to spawn.

The 1989 weighted spawning biomass estimate for the central coast stock is 40,800 tonnes, a 9% decrease from 1988. The 1985 year-class was particularly dominant in this region; 4 year olds comprised 76% of the stock. This cohort is one of the largest over the 1951-1989 time period.

SOUTH COAST STOCKS

Spawning biomass in the Strait of Georgia increased in 1989. The weighted biomass estimate was 52,500 tonnes, with 45,160 tonnes spawning in the northern area and 7,360 tonnes spawning in the southern area.

On the west coast of Vancouver Island the 1985 year class comprised 63% of the southern stock and 51% of the northern stock. In both assessment regions this year class is estimated to be double the long term average year class size. Spawning stocks in the southern

area remained stable at 27,500 tonnes while stocks in the northern area decreased slightly to 13,600 tonnes. Stock estimates from the age-structured model continue to be unrealistically high for the northern assessment region so estimates from this model are weighted less than those from the escapement model.

STOCK FORECASTS FOR 1990

The two stock assessment models used for the herring assessment rely on different sources of information to derive their stock estimates. The escapement model relies most strongly on the estimates of spawn deposition while the age-structured model relies primarily on estimates of catch-at-age data for each population. As such they provide two, essentially independent, estimates of population abundance. Beginning with the 1986 assessment, the two models were assigned an equal weighting or given an equal probability of providing the best or most accurate forecast for stock biomass in any particular area unless we felt one of the models provided more reliable current stock estimates. For the current analysis, the only suspect stock assessment is the age-structured model analysis for the northern west coast of Vancouver Island, so we have given the escapement model estimates a higher weighting in this area (Table 1). Recruitment forecasts are based on the historic estimates of age 3 biomass. Poor, average, and good recruitment are the mean of the lowest third, the mid third, and the highest third of the historic estimates.

We continue to recommend a 20% annual harvest rate for Pacific herring. In addition, we recommend that areas be closed to commercial fishing when stock forecasts are below CUTOFF levels. CUTOFF levels are established at one-fourth of the unfished average biomass, as estimated from simulation analyses. The CUTOFF levels for the seven assessment regions are:

Queen Charlotte Islands	10,600 tonnes
Prince Rupert District	12,100 tonnes
Central Coast	10,600 tonnes
Strait of Georgia	22,100 tonnes
W.C. Vancouver Island - South	15,100 tonnes
W.C. Vancouver Island - North	8,700 tonnes

The weighted run forecast for the Queen Charlotte Islands for 1990, assuming average recruitment, is 25,600 tonnes (Table 1), a substantial increase over the 1989 forecast. The strong 1985 year class has substantially improved the fishery prospects for this area.

The Prince Rupert District forecast run of 36,100 tonnes with average recruitment is down slightly from the 1989 forecast. Recruitment of 3 year olds in 1989 was less than the previous two years and this stock may be declining from the high levels maintained through the 1980's.

The central coast stock is forecast at 43,200 tonnes with average recruitment. The strong 1985 year-class should sustain this stock for a few more years.

The weighted run for the northern Strait of Georgia is 47,800 tonnes and for the southern Strait of Georgia 9,100 tonnes assuming average recruitment. Good recruitments would see 58,000 and 11,500 tonnes in the northern and southern areas, respectively.

The weighted average runs to the west coast of Vancouver Island stocks are 28,800 and 15,000 tonnes for the southern and northern areas, respectively. Another good recruitment in both areas could see stock levels of 38,200 and 22,200 tonnes in the south and north.

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Table 5.1. Summary of 1990 forecast stock biomass (thousands of tonnes) from (age-structured and escapement models and weighted runs for poor, average, and good recruitment levels.

| | AGE-STRUCTURED MODEL | | | | ESCAPEMENT MODEL | | | | WEIGHTED RESULTS | | | |
| | | Recruitment level | | | | Recruitment level | | | | Recruitment level | | |
	AGE 4+	Poor	Avg.	Good	AGE 4+	Poor	Avg.	Good	Rel. Weight	Poor	Avg.	Good
Queen Charlotte Islands	31.4	32.3	34.5	41.8	14.3	14.9	16.6	22.4	50:50	23.6	25.6	32.1
Prince Rupert District	50.9	53.2	57.4	70.9	10.0	11.6	14.8	23.8	50:50	32.4	36.1	47.4
Central Coast	40.6	43.7	47.6	57.7	32.0	34.8	38.8	49.9	50:50	39.3	43.2	53.8
Strait of Georgia northern stock	31.1	35.7	41.0	51.0	40.8	48.6	54.5	64.9	50:50	42.2	47.8	58.0
southern stock[a]	8.2	9.3	11.2	14.4	2.4	5.4	7.7	8.5	50:50	7.4	9.1	11.5
West Coast Vancouver Is. southern stock	17.6	21.4	25.6	37.0	24.8	28.4	32.0	39.4	50:50	24.9	28.8	38.2
northern stock	22.3	24.3	28.3	34.5	7.0	8.8	11.6	19.1	20:80	11.9	15.0	22.2

[a] Recruitment estimates based on data from roe fishery only.