THE PACIFIC SALMON COMMISSION

JOINT CHUM SALMON TECHNICAL COMMITTEE REPORT

REPORT TCCHUM (87) 3

RESEARCH NEEDS ON SOUTHERN BRITISH COLUMBIA

AND WASHINGTON STATE CHUM

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I. INTRODUCTION

This report identifies research needs for chum salmon management required for the implementation of the chum salmon annex of the Pacific Salmon Treaty (PST). The chum technical committee has been charged by the PST (annex IV, chapter 6) with identifying information and research needs with particular emphasis in the areas of stock composition, stock assessment and evaluation of alternative regulatory and production strategies. The implementation of the PST requires an assessment of the research conducted by the two countries, and it is the assignment of the joint technical committees to identify appropriate research topics. These PST related topics can then be considered within the research prioritization and budgeting processes of each country.

Special emphasis is placed on stock composition research as this has been identified as a high priority by the Pacific Salmon Commission (PSC), through a specific assignment to the chum technical committee in November, 1986. The areas of research covered in this report are those deemed most important to the satisfactory quantification of stock composition in each country's fisheries and for assessment of the levels of interception as required by the treaty. There are other research needs for chum salmon that are important for domestic management obligations within each country. These are not addressed in this report.

II. BACKGROUND

The following is a brief review of the history and current status of research activities relating to chum salmon in each country. This review is general in nature, and again, is limited to those research areas of importance to the PST.

United States

The original estimates of stock composition in northern Puget Sound and the Strait of Juan de Fuca were revised in 1979, and form the basis for current management strategies. A genetic stock identification (GSI) research program was initiated in 1976, with collection of baseline samples from Puget Sound chum. Since 1983, further baseline sampling has occurred and some mixed stock fishing areas were also sampled. The latter GSI sampling occurred at west Lummi Island and on the Salmon Banks, both in

the San Juan Islands (Area 7). In 1985, mixed stock fishery sampling was expanded to include the western portion of the Strait of Juan de Fuca (Area 5) and Point Roberts (Area 7A).

Major adult tagging and recapture studies for stock identification, stock abundance estimation and migration timing have been conducted by the Washington Department of Fisheries, the U.S. Fish and Wildlife Service, and the Treaty Tribes in many areas of Puget Sound. Barker (1979) summarizes travel time information from 14 WDF tagging studies conducted between 1950 and 1974. Fiscus et al (1975) and Fiscus (1968) reported on stock composition tagging studies in the eastern portion of the Strait of Juan de Fuca (areas 6A and 7) and Admiralty Inlet (areas 6B and 9), respectively. Cole et al (1986), Hiss et al (1982) and Hiss, Martin et al (1982) reported on adult mark and recapture population estimation studies on the Nisqually, Nooksack and Stillaguamish rivers, conducted during the 1974-80 period. These studies have yielded information on patterns of entry into these rivers, spawning ground residency timing and escapement estimation methodologies.

Canada

Research during the 1960's and 1970's focused on providing: (a) stock identification and migrational data in major fishing areas; (b) spawning grounds timing and escapement estimates; (c) spawning ground capacities; and (d) age analysis of catch and escapements for determination of brood year productivities. The majority of the research was conducted on the inside stocks.

Major tag and recapture studies for stock identification and migrational data were conducted on the Johnstone Strait-Fraser River area in years 1962 and 1965 to 1970 (Lister 1963, and Anderson and Beacham 1983). Palmer (1972) conducted spawning ground timing and escapement estimate studies for the Fraser River during years 1960 to 1970. Spawning ground capacity studies were conducted for the east coast of Vancouver Island stocks during 1969 and 1970 (Bailey 1976) and for the Fraser River during the 1960's (Palmer 1972).

For the major inside stocks, age at return studies were conducted annually since 1960. This and other information formed the basis of stock status determination reported annually since 1960.

For the west coast stocks, Robertson (1970) consolidated and reported stock status information for years 1951 to 1970. Since the mid 1970's, age at return studies for west coast stocks have been conducted annually. This and other information formed

the basis for stock determinations to 1982 as reported by Lightley et. al. (1983).

The use of genetic markers as a means of identifying stocks was initiated on some southern British Columbia chum stocks in 1981. This work included an assessment of the variable markers that might be usable for chum salmon. During the period from 1981 to 1984, research was directed towards the collection of samples to complete a catalog of genetic baseline profiles. The composition of the major stocks in most southern British Columbia chum fisheries has been estimated since 1982 through the use of GSI.

III. IMMEDIATE RESEARCH NEEDS

The most immediate need for additional research is in the area of resolution of stock composition in commercial fishery areas and its application to catch data. This priority was established by the PSC in its assignment to the chum technical committee of November 1986. The most recent technique for identifying stock composition is based on protein electrophoresis and is referred to as genetic stock identification (GSI). Appropriate GSI research can provide estimates of stock composition in mixed stock fishing areas, as well as information on stock timing and migrational patterns.

Sampling of mixed stock chum fisheries for GSI began in southern British Columbia in 1982. Each successive year, the sampling has been expanded in duration and area and in 1986 sampling was conducted in Johnstone Strait (areas 12 and 13), the Juan de Fuca Strait (Area 20), Mid Vancouver Island (Area 14), Nitinat (Area 21), and the west coast Vancouver Island troll fishery (areas 126, 127, and 111). Sampling of mixed stock chum fisheries for GSI began in Puget Sound in 1983. Sampling has now expanded to include commercial and test fisheries in the western portion of the Strait of Juan de Fuca (Area 5), and the San Juan Islands (Area 7), and Point Roberts (Area 7A) areas.

It is the recommendation of the committee that sampling of all of these areas should be a continuing priority. It is further recommended that sampling of commercial chum fisheries in the eastern portion of the Strait of Juan de Fuca (US), off the mouth of the Fraser River (Canada), and in any other commercial fisheries which may intercept chum salmon originating from the other country, be undertaken. Without this continuing mixed stock data collection program, the committee's assignment to identify stock composition can not be met.

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Current estimates of stock composition from GSI work regularly have large variances. The committee recommends that any significant sources of bias and variance in stock composition estimates from GSI studies should be investigated in order to obtain more accurate and precise estimates. The chum committee recommends research in the area of standardization of analytical methods, in order to further improve accuracy, precision, and consistancy in statistical methods, including variance estimation.

Accuracy and precision of estimated stock contributions in mixed stock fisheries is dependent upon sample size and the number and quality of markers used to discriminate chum salmon of different origins. Research may identify additional useful markers and these could be added to the ones presently used to increase accuracy and precision of the estimates.

The design of sampling programs to ensure adequate sample sizes for each time and area strata should be the subject of investigation. The committee recommends that mutually acceptable guidelines for sampling programs should be developed and adopted.

Laboratory procedures for analysis of samples should be standardized, especially if different laboratories are using different genetic markers. The effect of subjectivity in the reading of gel patterns should be quantified. Additionally, standardized baseline profiles should be identified and used by both countries.

Currently, there are no agreed upon guidelines for the apportionment of catches to country and region of origin using GSI. Investigation of methods to ensure consistent and sound applications of GSI to catch, as required by the PST, is recommended.

Although GSI analysis is promising and the only empirical stock identification technique currently being used for chum salmon, the variances associated with some of these estimates are still quite high and the committee recommends that alternative stock identification techniques be investigated. Estimates of stock composition from GSI studies could be verified using independent estimates such as: adult tagging programs conducted concurrently with GSI sampling, morphometric analysis, and scale analysis. However, research in Canada into morphometric characters has shown little promise for chum stock identification. The potential of using direct DNA analysis, rather than indirect analysis from electrophoresis, also bears investigation. Analysis of variation in DNA has been successfully used for identification in other species, and may hold promise for salmonids. The use of other stock identification tools such as coded wire tagging and induced biological markers should be further investigated, particularly to assess production from enhancement programs. These alternate methods may prove

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useful for comparative purposes or in combination with GSI.

The following is a summary of the immediate research needs related to stock identification. It should be remembered that the continuation of GSI sampling from the mixed stock areas is vital to long term research needs.

A. GSI sampling programs - Canada

   1. Continue and expand the West coast Vancouver Island troll fishery sampling

   2. Continue the sampling of the Juan de Fuca Strait test fisheries

   3. Continue sampling of the Johnstone Strait test fisheries and initiate sampling of the commercial catch

   4. Continue sampling of Nitinat commercial fisheries

   5. Continue sampling of Qualicum commercial fisheries

   6. Continue and expand sampling of other Strait of Georgia fisheries, including the Fraser River Mouth, that have the potential to intercept Puget Sound chum

   7. Initiate sampling to modify the Canadian baseline catalog, if additional representative stocks are identified.

B. GSI sampling programs - United States

   1. Continue sampling of western Strait of Juan de Fuca commercial fisheries

   2. Continue and expand sampling of the San Juan Islands test and commercial fisheries

   3. Continue and expand sampling of the Point Roberts test and commercial fisheries

   4. Initiate the development of baseline for the Strait of Juan de Fuca, Grays Harbor and Willapa Bay stocks

   5. Continue sampling to complete the baseline catalog for Puget Sound stocks

6. Initiate sampling of commercial fisheries in the eastern Strait of Juan de Fuca and other areas of potential interception of Canadian chum

C. Methods and analysis

1. Standardize sampling procedures.

2. Standardize baseline profiles.

3. Standardize analytical procedures.

4. Blind test laboratories and analytical methods to evaluate accuracy and precision.

D. Develop methods for apportioning catch by GSI

E. Alternative stock identification methods

1. Conduct independent verification of GSI results.

2. Examine alternative methods and their accuracy and precision (e.g. direct DNA analysis, morphometric and scale analysis, adult and/or juvenile tagging).

IV. LONG TERM CHUM SALMON RESEARCH NEEDS

Other chum salmon research topics that relate to the implementation of the PST are in the areas of productivity, stock assessment and management strategies. Currently, little research on the effects of alternative management approaches on each country's stocks has been done. The committee recommends that the current and some alternative management approaches should be quantitatively investigated in order to evaluate their relative effectiveness towards achieving each country's management goals.

Productivity of chum salmon can differ among stocks, as a result of environmental and/or genetic differences among stocks. The abundance of a particular stock is dependent upon many factors, but the level of spawning escapement is a significant determinant of subsequent production. Studies directed towards estimation of spawning levels that will produce maximum sustained harvest (MSH) returns are needed for specific watersheds and stocks of concern. Stock productivity knowledge is dependent on improved stock composition data from terminal fisheries, as well as those fisheries of concern to the PST. Management for stock specific escapement and/or harvest depends on accurate stock

composition as well as production information. Research to improve our methods for estimating spawning escapement and the resulting production is desirable in many areas.

Returning abundance of a salmon species is the first consideration in planning any fishery strategy. Both preseason and inseason forecasting methods for chum salmon exhibit less than desired accuracy and precision. Proper implementation of the fishing regimes developed between the two countries depends on accurate estimates of run strength. This is an area where improvement is desirable from both a domestic and international perspective, and research to develop improved run size forecasting models should be undertaken, where appropriate. An agreed upon run reconstruction method for southern chum salmon should be developed.

In addition to information on stock abundance, it is also necessary to know something about annual deviations in migration patterns. Early GSI results suggest that significant numbers of United States origin chum migrate through Johnstone and Georgia straits, and significant numbers of Canadian origin chum migrate through the Strait of Juan de Fuca. There may also be annual variation in these migration patterns (often referred to as diversion rates). The committee recommends that research into assessing and predicting diversion rates be done.

It is currently assumed that there is little short term change in the genetic patterns exhibited by a stock; however, various factors could contribute to short term changes. These potential changes could affect GSI results. The committee recommends that the stability of genetic patterns in stocks be confirmed.

The following is a summary of the committee's long term research recommendations.

A. Management approaches

    1. Investigate current and other management approaches and evaluate relative effectiveness.

B. Productivity

    1. Continue the development of optimum escapement goals.

    2. Improve methods for estimating spawning escapement.

3. Improve stock specific stock/recruit information including terminal area stock composition estimates.

C. Stock assessment

    1. Improve methods for preseason and inseason estimation of run strength.

    2. Assess migration paths and diversion rates.

    3. Formulate a southern chum salmon run reconstruction method.

D. Assess the temporal consistancy of the GSI Baseline