Cowichan Watershed Fry Salvage and Coho Colonization Operations (1986): A Review and Preliminary Results

T. Burns, R.A. Bams, T. Morris, T. Fields, and B.D. Tutty

Department of Fisheries and Oceans
Southcoast Division
Habitat Management Operations
3225 Stephenson Point Road
Nanaimo, British Columbia V9T 1K3

May 1987

Canadian Manuscript Report of Fisheries and Aquatic Sciences No. 1949

Fisheries and Oceans Pêches et Océans

Canada

Canadian Manuscript Report of Fisheries and Aquatic Sciences

Manuscript reports contain scientific and technical information that contributes to existing knowledge but which deals with national or regional problems. Distribution is restricted to institutions or individuals located in particular regions of Canada. However, no restriction is placed on subject matter, and the series reflects the broad interests and policies of the Department of Fisheries and Oceans, namely, fisheries and aquatic sciences.

Manuscript reports may be cited as full publications. The correct citation appears above the abstract of each report. Each report is abstracted in *Aquatic Sciences and Fisheries Abstracts* and indexed in the Department's annual index to scientific and technical publications.

Numbers 1–900 in this series were issued as Manuscript Reports (Biological Series) of the Biological Board of Canada, and subsequent to 1937 when the name of the Board was changed by Act of Parliament, as Manuscript Reports (Biological Series) of the Fisheries Research Board of Canada. Numbers 901–1425 were issued as Manuscript Reports of the Fisheries Research Board of Canada. Numbers 1426–1550 were issued as Department of Fisheries and the Environment, Fisheries and Marine Service Manuscript Reports. The current series name was changed with report number 1551.

Manuscript reports are produced regionally but are numbered nationally. Requests for individual reports will be filled by the issuing establishment listed on the front cover and title page. Out-of-stock reports will be supplied for a fee by commercial agents.

Rapport manuscrit canadien des sciences halieutiques et aquatiques

Les rapports manuscrits contiennent des renseignements scientifiques et techniques qui constituent une contribution aux connaissances actuelles, mais qui traitent de problèmes nationaux ou régionaux. La distribution en est limitée aux organismes et aux personnes de régions particulières du Canada. Il n'y a aucune restriction quant au sujet; de fait, la série reflète la vaste gamme des intérêts et des politiques du ministère des Pêches et des Océans, c'est-à-dire les sciences halieutiques et aquatiques.

Les rapports manuscrits peuvent être cités comme des publications complètes. Le titre exact paraît au-dessus du résumé de chaque rapport. Les rapports manuscrits sont résumés dans la revue *Résumés des sciences aquatiques et halieutiques*, et ils sont classés dans l'index annuel des publications scientifiques et techniques du Ministère.

Les numéros 1 à 900 de cette série ont été publiés à titre de manuscrits (série biologique) de l'Office de biologie du Canada, et après le changement de la désignation de cet organisme par décret du Parlement, en 1937, ont été classés comme manuscrits (série biologique) de l'Office des recherches sur les pêcheries du Canada. Les numéros 901 à 1425 ont été publiés à titre de rapports manuscrits de l'Office des recherches sur les pêcheries du Canada. Les numéros 1426 à 1550 sont parus à titre de rapports manuscrits du Service des pêches et de la mer, ministère des Pêches et de l'Environnement. Le nom actuel de la série a été établi lors de la parution du numéro 1551.

Les rapports manuscrits sont produits à l'échelon régional, mais numérotés à l'échelon national. Les demandes de rapports seront satisfaites par l'établissement auteur dont le nom figure sur la couverture et la page du titre. Les rapports épuisés seront fournis contre rétribution par des agents commerciaux.

Canadian Manuscript Report of
Fisheries and Aquatic Sciences No. 1949

May, 1987

COWICHAN WATERSHED FRY SALVAGE AND COHO COLONIZATION OPERATIONS (1986): A REVIEW AND PRELIMINARY RESULTS

by

T. Burns, R.A. Bams, T. Morris, T. Fields, and B.D. Tutty

Department of Fisheries and Oceans
Southcoast Division
Habitat Management Operations
3225 Stephenson Point Road
Nanaimo, British Columbia
V9T 1K3

Cat. No. Fs 97-4/1949E ISSN 0706-6473

Correct citation for this publication:

Burns, T., R.A. Bams, T. Morris, T. Field, and B.D. Tutty. Cowichan watershed fry salvage and coho colonization operations (1986): A review and preliminary results. Can. MS Rep. Aquat. Sci. No. 1949: v + 68 p.

Table of Contents

List of Figures

List of Tables

Abstract

Burns, T., R.A. Bams, T. Morris, T. Field, and B. D. Tutty. Cowichan watershed fry salvage and coho colonization operations (1986): A review and preliminary results. Can. MS Rep. Aquat. Sci. No. 1949: v + 68 p.

Extensive fish habitats frequently dewater during the dry summer months in the Cowichan watershed, Vancouver Island, British Columbia. During the past half century salmonid fry have been salvaged from these habitats and redistributed into anadromous zones of the watershed by Department of Fisheries and Oceans personnel, contractors, and volunteers without the benefit of an evaluation of this fish management strategy. In 1984, a strategic habitat inventory system identified extensive fish habitats above barriers, which were subsequently verified as potentially viable, low gradient coho habitat in the dry summer of 1985. Based on this knowledge, a management team was assembled to plan, conduct, and evaluate the performance and benefits of fry salvage operations in 1986. A total of 174,291 salmonid fry were salvaged (162,219 coho) and 121,306 of these coho were subsequently colonized at specified densities into designated above barrier habitats of which three were selected and trapped the following spring to determine overwintering and eventually ocean survival. Preliminary estimated fry to smolt survival at these three study sites was 6.5% at Bings Creek, 16.4% at Kelvin Creek, and 18.9% at Grant Lake. An economic evaluation of the 1986 fry salvage program indicates that, to break even, at least 100,000 coho must be salvaged and colonized, at the specified densities, into designated habitats, assuming a minimum 1.7% fry to adult survival rate and at 1986 program costs ($22,034 with volunteers). If the highest estimate of 350,000 salvaged coho were obtained at 1986 costs, then a benefit of $50,000 to $115,000 would result with the assumptions of 1.7% and 3.3% fry to adult survival rate, respectively, and a harvest rate of 75%. All economic benefits were derived from the Salmonid Enhancement Program Evaluation model. Economic and operational recommendations to streamline Cowichan fry salvage and transport activities are identified to increase economic benefits and reduce costs in future programs.

Résumé

Burns, T., R.A. Bams, T. Morris, T. Field, and B. D. Tutty. Cowichan watershed fry salvage and coho colonization operations (1986): A review and preliminary results. Can. MS Rep. Aquat. Sci. No. 1949: v + 68 p.

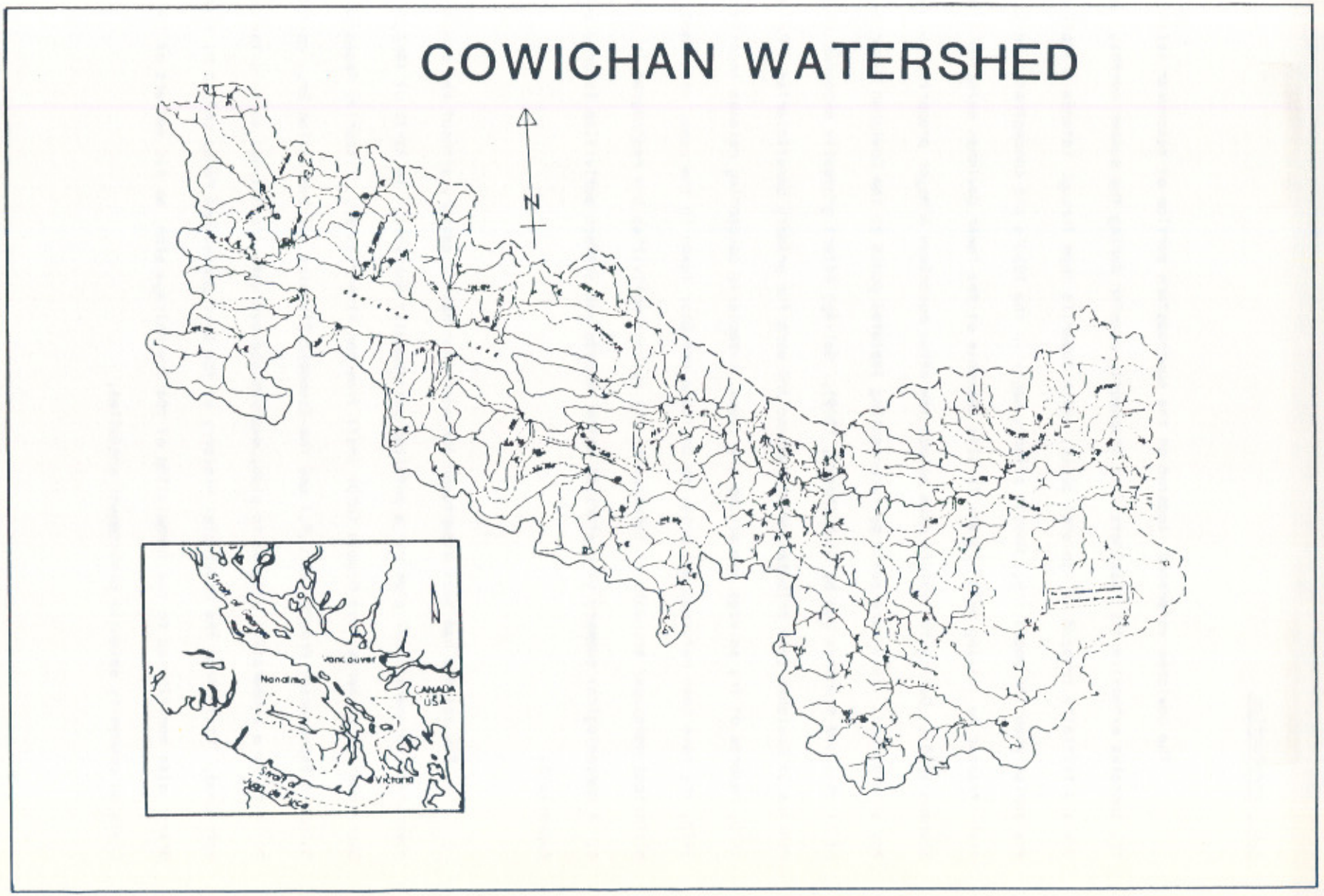
Pendant la sécheresse estivale, on observe fréquemment l'assèchement d'un grand nombre des habitats fréquentés par le poisson dans le bassin versant de la rivière Cowichan, en Colombie-Britannique. Au cours du dernier demi-siécle, le personnel du ministère des Pêches et des Océans, des entrepreneurs et des volontaires ont capturé des alevins de salmonidés peuplant ces habitats et les ont relâchés ailleurs; toutefois, cette stratégie de gestion du poisson n'a jamais été évaluée. En 1984, un système d'inventaire d'habitats stratégiques a permis d'en identifier un grand nombre situés en amont d'obstacles; ces habitats se sont révélés potentiellement viables pour le coho pendant la sécheresse de l'été 1985. Armé de ces données, on a créé une équipe de gestion pour planifier, mener et évaluer le rendement et les avantages des opérations de récupération des alevins en 1986. Au total, 174 291 alevins de salmonidés ont été capturés; des 162 219 saumons cohos, 121 306 ont été relâchés selon des densités précises dans des habitats désignés situés en amont d'obstacles. Le printemps suivant, on a effectué un échantillonnage dans trois de ces habitats afin de déterminer le niveau de survie aprés l'hiver et, en fin de compte, la survie en milieu océanique. Le niveau estimatif préliminaire de survie des alevins jusqu'au stade saumoneau à ces trois endroits se situe à 6,5 % dans le ruisseau Bings, 16,4 % dans le ruisseau Kelvin et 18,9 % dans le lac Grant. Une évaluation économique du programme de récupération d'alevins mené en 1986 révèle que pour atteindre le point mort, on doit récupérer au moins 100 000 cohos et les relâcher aux densités précisées dans les habitats désignés. Ceci suppose un taux de survie minimum de 1,7 % des alevins jusqu'au stade adulte et des coûts de programme égaux à ceux de 1986 ($ 22 034 en plus du travail des volontaires). Si l'on récupérait 350 000 cohos, soit l'estimation la plus élevée, au coût du programme de 1986, on verrait un bénéfice de $ 50 000 et de $ 115 000 si l'on suppose des taux respectifs de survie de 1,7 % et 3,3 % jusqu'au stade adulte et un taux d'exploitation de 75 %. Tous les avantages économiques ont été tirés du modèle d'évaluation du Programme de mise en valeur des salmonidés. Les auteurs formulent des recommandations sur les aspects économiques et oérationnels afin de rationaliser les activités de récupération et de transport des cohos dans le système de la Cowichan, d'accroître les avantages économiques et de réduire les coûts des activités futures.

1.0 Introduction

The Cowichan watershed, located on the southeastern portion of Vancouver Island (Figure 1), contains extensive fish habitats that frequently dewater during the summer months. Salmonid fry are initially trapped in isolated pools, which imperils them through intense predation; the fry perish when the pools dry. Rescue efforts began in the 1930's and concentrated on saving fish stranded by falling water levels in side channels of the lower Cowichan mainstem (Carl 1937; Sherman 1938). During the 1940's chum salmon fry often comprised a major proportion of rescued fry populations. They were saved by reconnecting isolated pools to the Cowichan River by means of ditches and trenches dug by hand (Neave, 1949). Salvage effort gradually expanded to include reaches of Cowichan Lake tributaries where coho fry were the primary beneficiaries. Prior to 1973, reports of fry salvage operations are vague, especially concerning release locations. Since 1973, fry have been returned primarily to Cowichan and Bear lakes in the upper watershed. Some historical newspaper accounts of interesting fry salvage activities are reproduced in Appendix 4. A chronological summary of historical catch records and salvage activities is provided in Appendix 5.

Fry salvage had been undertaken for more than half a century without the benefit of a comprehensive operational plan nor a detailed cost/benefit analysis. In April of 1986, Department of Fisheries and Oceans (DFO) staff from the Fisheries Br., Fisheries Research Br., Salmonid Enhancement Program (S.E.P.) and the Economic Planning and Evaluation Br., collaborated to initiate a cooperative program to plan, execute and evaluate fry salvage work in the Cowichan watershed. Staff from the Provincial Ministry of the Environment and Parks (MOE & P) Fisheries Branch also contributed to the formulation of the fry salvage plan, as did members of the two Cowichan community salmonid enhancement societies.

Figure 1: Cowichan Watershed



The 1986 Cowichan watershed fry salvage implementation and evaluation plan was formulated by an ad hoc working group that:

1. Integrated information from the following sources:

   a) Cowichan Watershed Water Management Plan. Min. of Envir. and Parks (1986); also Tutty (1984).

   b) Investigations of problem areas and the potential of alternative habitat suitable for rearing salvaged fry which included:

      i) surveying and mapping stream reaches which chronically dry and require fry salvage (Burns, 1984).

      ii) estimating and mapping inaccessible (above barrier) habitat less than 5% gradient (Chamberlin et al, 1984), Figure 2 and 3.

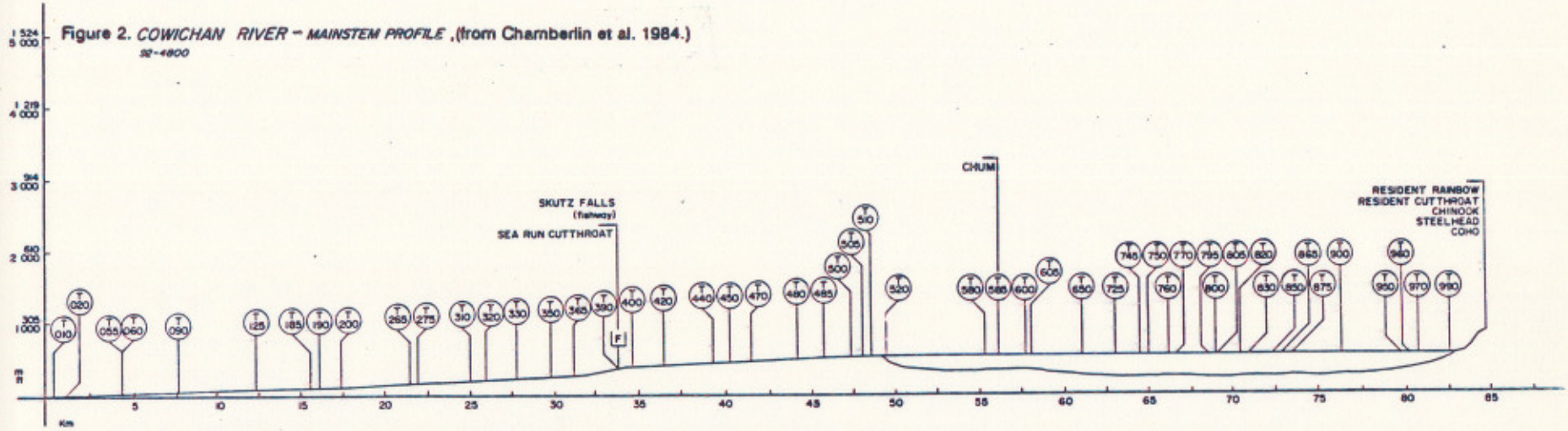
      iii) evaluation of the habitat identified in (ii) suitable for coho colonization (Burns & Tutty, 1986).

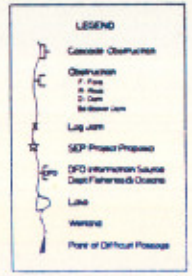
2. Coordinated SEP, operational, economic, and biological evaluation components necessary to undertake the work.

The Fisheries Branch hired a patrolman (T. Burns) as coordinator for the 1986 program to work with local enhancement societies (Cowichan Indian Band and the Lake Cowichan (Salmonid) Enhancement Society).

Preliminary information had identified approximately 567,000 m^2 of accessible stream habitat subject to summer dewatering (Fig. 4). Similarly, lake and stream habitats above barriers to anadromous salmonids were estimated to comprise 6,383,900 m^2 (Burns and Tutty, 1986) potentially suitable for colonization by coho.

Figure 2. *COWICHAN RIVER – MAINSTEM PROFILE* ,(from Chamberlin et al. 1984.)





COHO SALMON

Figure 3. Cowichan watershed planimetric gradient map (from Chamberlin et al.1984.)

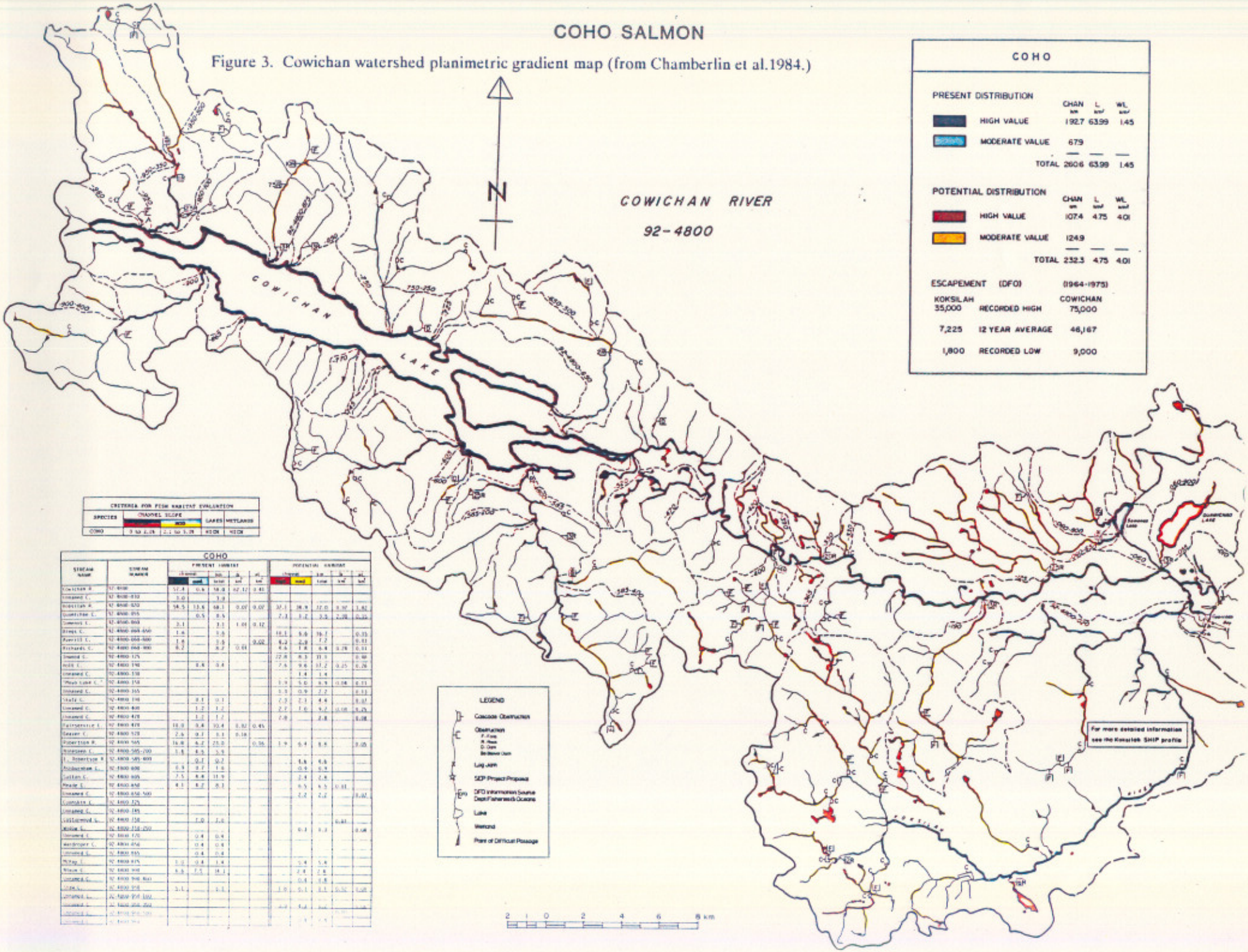
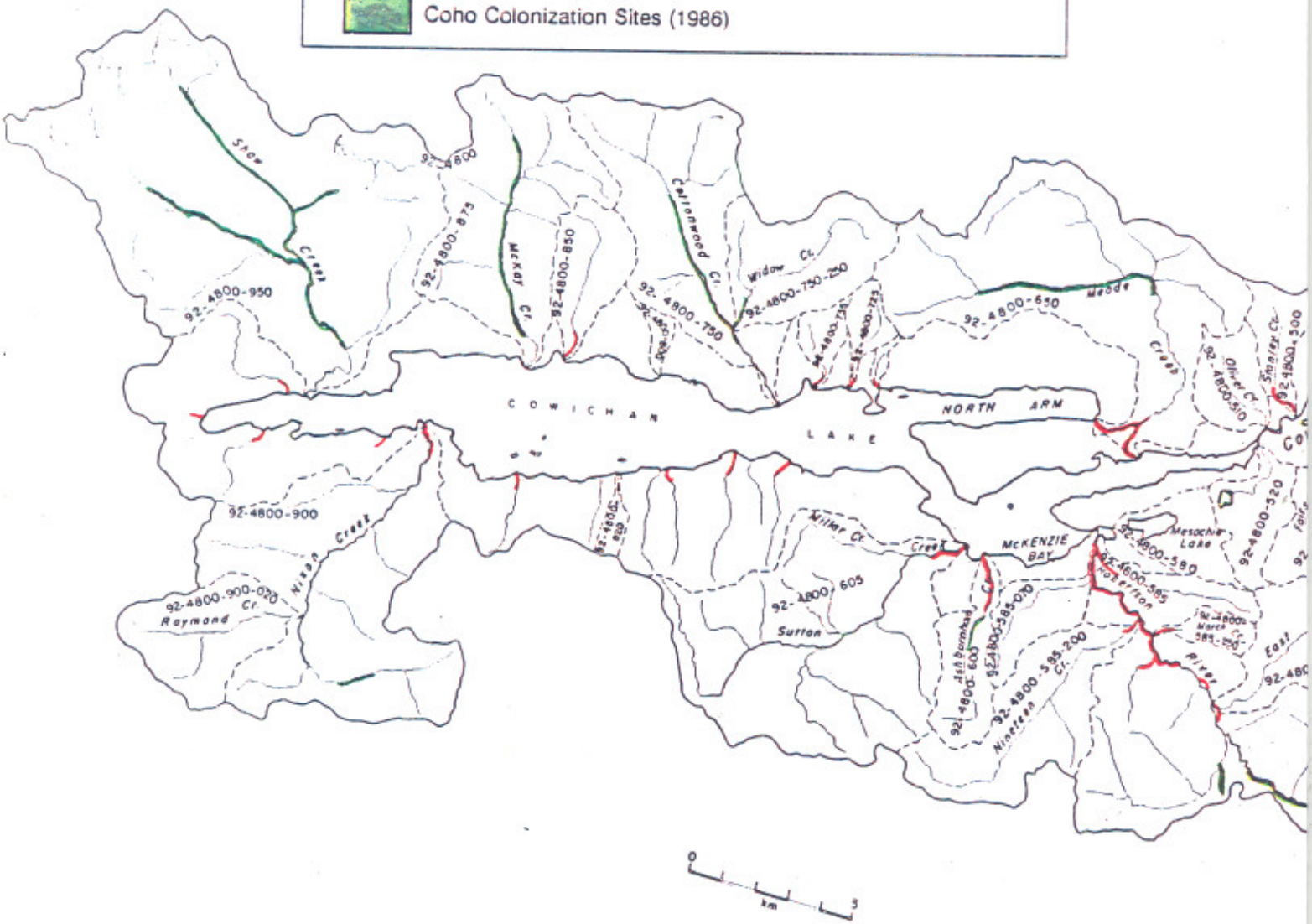
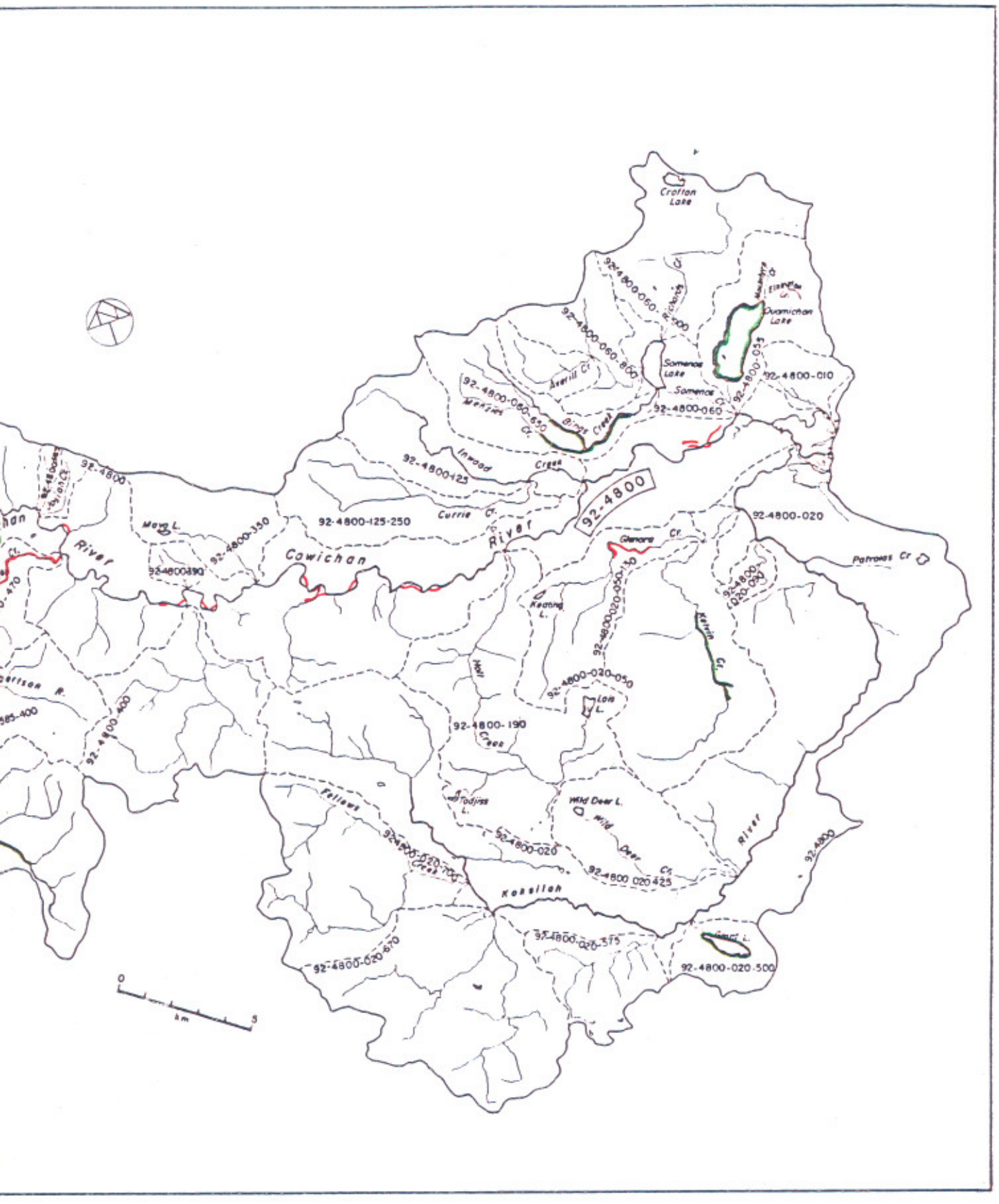


Figure 4. Cowichan Fry Salvage & Coho Colonization Sites (1986)

Fry Salvage Sites

Coho Colonization Sites (1986)




Crofton Lake
92-4800-050-
Richards Cr
Quamichan Lake
Somenos Lake
Somenos
92-4800-060
92-4800-010
Averill Cr
Bings Creek
Inwood Creek
92-4800-125
92-4800
92-4800-020
Currie Cr.
92-4800-125-250
Glenora Cr
Patrons Cr
Cowichan River
Mays L.
92-4800-350
92-4800-020-050
Keating L.
Kelvin Cr
Holt Creek
92-4800-190
Lois L.
Fellows Creek
Todjiss L.
Wild Deer L.
Wild Deer Cr
92-4800-020-425
Koksilah River
92-4800-020-575
92-4800-020-500
92-4800-020-670
92-4800-400
0
5
km

Based on this information, a plan to salvage and colonize as many as 258,000 coho fry was established. The colonization of Quamichan Lake was deferred until further reconnaissance work could be conducted.

The basic rules of the Cowichan fry salvage/coho colonization plan were:

1. Salvaged coho would be colonized only into designated areas in stream and lake habitats above barriers.

2. Stocking densities for coho were to be:

   - 1.0 fry/m^2 for stream habitats with slope $\leq$ 2%;
   - 0.5 fry/m^2 for slope $\geq$ 2% and less than 5%.
   - 0.25 fry/m^2 for lake habitats.

3. All salvaged trout would be released into Cowichan Lake (or River).

These densities were considered to be conservatively low and acceptable for planned evaluation studies on carrying capacity and smolt yield.

The 1986 Cowichan fry salvage/coho colonization work plan is summarized in Table 1. It identifies the donor habitats for fry salvage activities and those target habitats where coho were to be colonized in 1986. Appendix 1 contains the record of management strategy from the meeting minutes summarized by Bonnell (1986).

Geographic zones of fry salvage responsibility were identified. The Cowichan Indian Band was given primary responsibility to salvage fry below Skutz Falls in the Cowichan and the Koksilah watersheds, while the Lake Cowichan (Salmonid) Enhancement Society volunteers and the coordinator and helper would concentrate their activities above Skutz Falls. If one or the other group required additional support, it was the responsibility of the coordinator and Fishery Officer T. Fields to make the appropriate request.

The purpose of this report is to summarize 1986 fry salvage activities, provide a preliminary economic evaluation and a brief historical review of fry salvage in the Cowichan watershed.

Table 1: 1986 Plan of Fry Salvage Locations, Coho Colonization Sites and Maximum Coho Stocking Densities (from Bonnell, 1986)

Fry Salvage (Donor) Locations	System/ Area	Proposed Coho Colonization Site	Coho Colonization Densities	Wetted Area Available per Colonization Site	Maximum No. of Coho Fry per Colonization Site	Gradient
Nixon Cr.	Upper Cowichan	Shaw Cr. - west	1.0 fry/m^2	40,000 m^2	40,000	_2%
Robertson Cr.	"	- mainstem	1.0 fry/m^2	22,500 m^2	22,500	_2%
Robertson Cr.	"	- middle	0.5 fry/m^2	35,000 m^2	17,500	2-5%
Robertson Cr.	"	- lower east	0.5 fry/m^2	10,000 m^2	5,000	2-5%
Lower Nixon Cr.	"	Upper Nixon Cr.	0.5 fry/m^2	4,000 m^2	2,000	2-5%
Meade Cr.	"	McKay Cr.	0.5 fry/m^2	35,000 m^2	17,500	2-5%
Meade Cr.	"	Cottonwood Cr.	0.5 fry/m^2	34,000 m^2	17,000	2-5%
Meade Cr.	"	Widow Cr.	0.5 fry/m^2	6,000 m^2	3,000	2-5%
Meade Cr.	"	Meade Cr.	0.5 fry/m^2	37,500 m^2	18,800	2-5%
Ashburnham Cr.	"	Ashburnham Cr.	0.5 fry/m^2	5,600 m^2	2,800	2-5%
Robertson Cr.	"	Upper Robertson Cr.	0.5 fry/m^2	30,000 m^2	15,000	2-5%
Robertson Cr.	"	Swampwater Cr. Kwassin Lk.	1.0 fry/m^2	4,500 m^2	4,500	_2%
Fairservice Cr.	"	Grant Lk.	1500 fry/ha	3.5 ha.	5,250	-
Rotary Park	Lower	Menzies Cr.*	1.0 fry/m^2	5,000 m^2	5,000	_2%
Rotary Park	Cowichan	Bings Cr.*	1.0 fry/m^2	7,500 m^2	7,500	_2%
		(Quamichan Lk.)+	1500 fry/ha	(310 ha)	(465,000)	
Glenora Cr. or Kelvin Cr.	Koksilah	Kelvin Cr.*	1 fry/m^2	15,000 m^2	15,000	_2%
	"	Grant Lk.*	approx. 925 fry/ha	54 ha	50,000	-

+ Subject to review after reconnaissance and evaluation assessment.

* Biological evaluation sites of the Fisheries Research Branch.

2.0 Methods

Fry were salvaged from pools using a beach seine, pole seine or dip nets. They were placed in 20 litre buckets, and transferred to a 740 litre transportation tank on a rented 3/4 ton 4X4 pickup truck. The tank was aerated by a submersible pump energized by the vehicle's 12 volt battery. For the purpose of tagging, salvaged fry were transferred daily to a small hatchery operated by the Lake Cowichan (Salmonid) Enhancement Society (LCES), held in a "Capilano" rearing trough and fed Oregon moist pellets for approximately one week. When several thousand fry accumulated, they were transferred to the larger Cowichan Indian Band Hatchery where they were held and a portion tagged prior to redistribution.

Estimates of the proportion of trout and salmon species in the salvaged population was determined by subsampling the catch from each stream. No attempt was made to separately identify rainbow/steelhead from cutthroat where they occurred together. Dolly Varden and brown trout were rare and identified separately. Numbers of salvaged coho and trout were estimated volumetrically at the Cowichan Band Hatchery. The total number of hours and expenses associated with the various field activities were recorded daily and summarized monthly. A chronological summary of 1986 fry salvage operations is provided in Appendix 2.

The transfer of fry from the LCES hatchery to the Cowichan Indian Band Hatchery for marking and later redistribution required multiple handling that would not normally occur. These coho fry were fin clipped to assess overwintering survivals at the three evaluation sites (*), (see Table 1).

The rearing areas located above barriers in Kelvin and Bings Creeks and Grant Lake, were selected by the Coho Salmon Program of the Fisheries Research Branch for assessment of coho carrying capacity and coho colonization survival. The results of this work will be reported separately by that Unit (see R. Bams). Some preliminary results are reported in section 3.2.

3.0 Results

3.1 Fry Salvage Catch Results

A total of 174,291 juvenile salmonids was salvaged from 23 locations between June 2 and September 16, 1986. A catch summary by species is contained in Table 2.

Locations of 1986 fry salvage operations and the time and costs of activities in each stream are listed chronologically in Appendix 2. Table 3 summarizes the sources and numbers of fry and the relocation/colonization sites in the Cowichan watershed.

Three size groups noted in the salvaged coho populations were thought to represent:

1. Early Emerged Coho - (presumably from early run spawners, November - December). They accounted for approximately 10 percent of the catch and ranged in size from 55-60 mm in June to 70-85 mm in late summer.

2. Late emerged Coho - (presumably from late run spawners, January - February). They comprised approximately 89 percent of the catch and ranged from 35-40 mm in late June and July to about 45-60 mm in late summer. It is suspected that many proportion of late emerging alevins were trapped in subsurface gravels in cold groundwater fed streams that suffer early surface flow cessation.

3. Overwintering Coho (1+) Juveniles - they ranged in size from 100 to 220 mm and comprised approximately one percent of the salvage catch.

An alternative explanation for early and late coho emergence may be inter-related to different temperature regimes affecting rate of incubation of eggs in redds.

TABLE 2: Summary of Catches from Fry Salvage Operations: Cowichan-Koksilah Watershed - 1986

	Stream Name	Coho	Chinook	Steelhead/Rainbow/Cutthroat	Dolly Varden	Brown Trout
1.	Upper Cowichan River sidechannels	18,000	9	500	--	--
2.	Robertson River sidechannel	13,900	--	--	--	--
3.	Meade Creek sidechannel	22,040	--	1,185	--	--
4.	Meade Creek	12,730	--	2,130	11	--
5.	Robertson River	26,777	--	2,641	1	--
6.	Nixon Creek	9,209	--	1,030	4	--
7.	Sutton Creek	13,248	--	1,470	10	--
8.	Glenora Creek	11,525	--	1,280	--	--
9.	Stoltz sidechannel	11,200	--	--	--	--
10.	Ashburnham Creek	7,163	--	780	3	--
11.	Bible Camp sidechannel	1,500	--	--	--	--
12.	Horsehoe Bend sidechannel	6,750	--	--	--	--
13.	Rotary Park sidechannel	4,390	--	--	--	--
14.	Art Watsons sidechannel	2,000	--	--	--	--
15.	Joginders sidechannel	700	--	--	--	--
16.	Coonskin Creek	200	--	--	--	--
17.	Stanley Creek	180	--	20	--	2
18.	Beadnell Creek	--	--	820	--	--
19.	Mayo Pond	--	--	165	--	--
20.	Helpful Creek	300	--	--	--	--
21.	Dusty Creek	200	--	--	--	--
22.	Utility Creek	60	--	--	--	--
23.	Misery Creek	30	--	--	--	--
24.	Fairservice Creek	8	--	20	--	--
25.	Kalkatza	100	--	--	--	--
	Total By Species	162,210	9	12,041	29	2
	GRAND TOTAL	174,291				

TABLE 3: Summary of Fry Salvage Locations; Relocation and Colonization Sites - 1986

	FRY SALVAGE SOURCES				RELOCATION SITES*				COLONIZATION SITES**				
	Stream Name	Coho	Trout	Total	Relocation Site	Coho	Trout	Total	Colonization Site	Coho	Trout	Total	Period
1.	Upper Cowichan Sidechannel	18,000	500	18,500	Cowichan Lake	*9 chin	500	509	Art Watson's Pond	18,000	—	18,000	(June 10 to
2.	Meade Creek Sidechannel	7,600	380	7,980	Cowichan Lake	—	380	380	UpperMeade Creek	950	—	950	July 2, 1980)
									Beaver Lake	6,650	—	6,650	
3.	Meade Creek	4,475	671	5,146	Cowichan Lake	1,400	671	2,071	Beaver Lake	3,075	—	3,075	
4.	Robertson Sidechannel	13,900	93	13,993	Cowichan Lake	—	93	93	Beaver Lake	13,900	—	13,900	
5.	Nixon Creek	1,980	198	2,178	Cowichan Lake	1,980	198	2,178	—	—	—	—	
6.	Fairservice Creek	8	20	28		—	20	20	Beaver Lake	8	—	8	
	Total	45,972	1,862	47,834	Total	3,389	1,862	5,251	Total	42,583	0	42,583	
7.	Robertson River	15,947	1,772	17,719	Transferred	15,947	1,772	17,719					(July 3 to
8.	Meade Sidechannel	14,250	750	15,000	To Cowichan Hatchery	14,250	750	15,000					Aug. 19, 1980)
9.	Glenora Creek	11,525	1,280	12,805	"	11,525	1,280	12,805					
10.	Stoltz Sidechannel	11,200	—	11,200	"	11,200	—	11,200					
11.	Nixon Creek	7,229	811	8,040	"	7,229	811	8,040					
12.	Horseshoe Bend	6,750	—	6,750	"	6,750	—	6,750					
13.	Meade Creek	5,195	916	6,111	"	5,195	916	6,111					
14.	Ashburnham Creek	5,093	565	5,658	"	5,093	565	5,658					
15.	Rotary Park Sidechannel	4,390	—	4,390	"	4,390	—	4,390					
16.	Art Watson's Sidechannel	2,000	—	2,000	"	2,000	—	2,000					
17.	Bible Camp Sidechannel	1,500	—	1,500	"	1,500	—	1,500					
18.	Joginder's Sidechannel	700	—	700	"	700	—	700					
19.	Sutton Creek	450	50	500	"	450	50	500					
20.	Helpful Creek	300	—	300	"	300	-	300					
21.	Goonskin Creek	200	—	200	"	200	—	200					
22.	Dusty Creek	200	—	200	"	200	—	200					
23.	Stanley Creek	180	20	200	"	180	20	200					
24.	Kalkatza	100	—	100	"	100	—	100					
25.	Utility Creek	60	—	60	"	60	—	60					
26.	Misery Creek	30	—	30	"	30	—	30					
	TOTAL	87,299	6,164	93,463	Total Relocated to Hatch.	87,299	6,164	93,463					

Table 3 (cont'd)

					Emergency release due to pump failure at CEIP Hatchery.	(Cowichan River) 33,709	6,154	39,863	Grant Lake	25,000	—	25,000	
									Upper Kelvin Creek	14,600	—	14,600	
									Upper Bings Creek	13,000	—	13,000	
					Mortality	1,000	—	1,000					
					Total	34,709	6,154	40,863	Total	52,600	0	52,600	
27.	Ashburnham Creek	2,070	—						Upper Robertson	2,070	—	2,070	(August 19 to
28.	Meade Creek	3,060			Cowichan Lake	2,825	—		Upper Meade	425	—	425	Sept. 15, 1986
29.	Robertson River	10,830			—				Swampwater Creek	2,700	—	2,700	
			4,046		—				Upper Robertson Creek	5,130	—	5,130	
					—		4,046	6,832	Grant/Kwassin Lake	3,000	—	3,000	
30.	Sutton Creek	12,798			—				Upper Cotton Wood	6,750	—	6,750	
31.	Beadnell Creek	0	—		—				Upper Meade	6,048	—	6,048	
32.	Meade Creek Sidechannel	190		—	Cowichan Lake	190	—		—				
	Total	28,948	4,007	32,955	Total	2,825	4,007	6,832	Total	26,123	0	26,123	
	GRAND TOTAL	162,219	12,062	174,291		40,923	12,062	52,985		121,306	0	121,306	

3.2 Coho Colonization Smolt Production in Spring 1987

Preliminary coho survival rates to the spring of 1987 from colonization fry plants in 1986 are contained in Table 4.

Table 4. Preliminary coho smolt production in spring 1987 from coho colonization fry plants.

Location	Plant Date	Fry Planted (1,000)	Smolts Out	Survival (% fry to smolt)
Grant Lake	31/7/86	76.1	14,400	18.9
Bings Cr.	14/8/86	13.0	850	6.5
Kelvin Cr.	15/8/86	14.6	2,400	16.4

Available evidence indicates negligible residualism at all locations. Grant Lake smolts were largest and Bings Creek smallest which, indicates a difference in opportunity for growth over the 9 month rearing period.

4.0 Discussion

4.1 Fry Salvage: 1986 Operations

Despite apparently normal coho escapement to the Cowichan system in 1985, fry numbers were low the following spring compared to those observed in previous years. This was particularly evident in the Robertson River which is usually the highest producer of salvaged fish. A possible explanation for the apparently low egg-fry survival in 1985-86 is thought to be unusual winter weather conditions. Arctic air spilled out over the south coast on November 8, 1985. Air temperature was exceptionally cold until December 3, 1985; a hard freeze occurred with significant snowfall to sea level (60 cm). Low elevation snow slowly melted between December 3 and mid-January but the ground remained frozen in most areas until January 19, 1986 when a warm

storm from the southwest quickly melted remaining snow and thawed the soil. Local flooding occurred, particularly in Robertson River with unusually high levels of sedimentation. Thawing soils compounded by rain and melt water caused numerous mud flows which increased sediment concentrations in the floodwaters in many streams.

The early coho run spawned during the cold spell and a large proportion of the late run was spawning just before the flood event in January. It is possible that coho spawner distribution and egg development might have been inhibited by frozen streams and cold water temperatures during the early run. Survival of both early and late run eggs was believed to be affected by sedimentation, particularly in Robertson River, Meade and Sutton creeks. Survival of eggs and alevins might have been further reduced by cold, dry weather in February 1986 when redds became dewatered by low flows, which persisted throughout the exceptionally cool and dry spring period. In Cottonwood Creek, a cold tributary of Cowichan Lake where most coho spawned from mid to late January, fry with externally visible yolk sacs did not emerge until August 2, 1986. Similarly, fry were salvaged from isolated pools in the Lower Robertson River on July 15, 1986, in the same condition, suggesting large numbers of alevins were trapped in their redds as the streams dried.

Trout, particularly early spawning steelhead and cutthroat, were similarly effected but probably not to the same degree.

In conclusion, adverse weather conditions are believed to have caused lower than normal egg to fry survival which translated to smaller populations available to be captured in the 1986 fry salvage operations. It is believed higher catch per unit effort could be expected in average years.

The 1986 total of all fry species salvaged (174,291) probably represents the low end of catch per unit effort and thus provides a baseline comparison for future salvage operations. Although the 1986 coho colonization plan could accommodate the capture of 258,000 coho, it may not be possible to salvage this number even in a year with very high fry abundance. If colonization of coho proves to be a viable and acceptable management strategy, then alternative ways to provide sufficient coho fry to serve a Cowichan watershed salmonid production plan may be required. The existing hatcheries could aid this strategy if a comprehensive plan were developed and approved by the Fisheries Branch.

4.2 Economic Evaluation.

From Hobbs (1987).

4.2.1 Economic Assumptions and Technical Details

The purpose of this section is to document the assumptions made and the biostandards used in evaluating the 1986 Cowichan coho fry salvage program.

The major assumption in this analysis is that all coho fry not salvaged would die, but that once these fry were relocated, the fry-to-adult survival rate would range from 1.7% to 3.3%. Bams (1986) considers these rates realistic and conservative; survival could well be higher from good coho habitats with adequate winter refuges. These rates are based on tagging results from colonization activities in the Upper Quinsam River from 1978 - 1983. These data and others were outlined in a memo from Tutty (November 3, 1986) to participants in the Cowichan Fry Salvage/Coho Colonization Program, Appendix 3. The exploitation rate used in this analysis was 75%. This was based on discussions with Cross (1986). An exploitation rate of 70% for Cowichan coho is used in the EPIC Data Base while T. Shardlow suggested that 80% is more representative of Cowichan coho stock (Tutty 1986).

With a 75% exploitation rate it is assumed that there is a 25% escapement rate. Since this rate is independent of population size, two assumptions can be made concerning current coho escapement in the system that affect how the spawners are dealt with in the analysis. If it is assumed that current escapement to the Cowichan is inadequate, then these additional spawners would augment existing populations. In this case there would be additional benefits as a result of the colonization techniques. Alternatively, if it is assumed that current escapement to the Cowichan is adequate, then the escapement as a result of the colonization would be surplus and no additional benefit ensues. This analysis assumes that current escapement to the Cowichan is adequate and consequently no additional benefits will result from escapement of the colonized coho fry. Surplus escapement could, however, be taken for eggs and used for additional colonization activities.

Benefits of the 1986 program will accrue as these fish are harvested in the commercial, sport, and native fisheries. It is assumed that 7% will be taken in 1987 and 93% in 1988. It is further assumed that each sport-caught coho will generate 1.3 angler days and, based on willingness-to-pay, it can be said that each coho will generate $32.00 worth of benefits (Mylchreest, 1986).

Total fry salvaged in 1986 was 174,291. Of these, 162,219 were coho and the remainder were trout. Because of a pump failure at the Cowichan hatchery, 34,709 fry were released to a tributary of the south Fork of the mainstem. Therefore, since their subsequent fate is unknown it was assumed, that 127,510 coho fry were successfully salvaged (Table 5). The analysis was conducted using four levels for salvaged fish: 127,510 (with pump failure), 162,219 (without pump failure), 100,000 (low estimate), 350,000 (high estimate). Two fry-to-adult survival rates were employed (1.7% and 3.3%). It was also assumed, first, that volunteers and donations were part of the program and second, that they were not so that DFO had to absorb the full program costs.

Detailed project costs are presented in Table 6. All costs associated with the evaluation component of the program have been subtracted. In the analysis with volunteers and donations, the actual costs were used, that is, the co-ordinator's costs of $7,485 and the band's costs of $11,976. No costs were included for volunteer labour or donations. Volunteer labour was not priced because it is assumed that the benefits volunteers earn working for the Public Involvement Program (PIP) at least equals the opportunity cost of their time. Although the size of either value is unknown, for a volunteer to work for PIP, they should perceive their recreational benefits of involvement to exceed their leisure costs.

However, for the analysis without volunteers and donations estimates had to be made of the incremental cost to DFO if it had to absorb full program costs. These costs are estimated to total $2,573 and details of how they were calculated are provided in the footnote #3 of Table 5.

Table 5: Distribution of Number of Fry Salvaged and Costs Incurred by Groups Involved

Group	Total Fry Salvaged[1]		Total Cost Incurred[2]	
	Number	Percent	$[1986]	Percent
Co-ordinator	116,824	67%	$ 7,485.07	34%
Volunteers	30,124	17%	2,573.00	12%
Cowichan Indian Band Hatchery	27,343	16%	11,976.51	54%
	174,291	100%	$22,034.58	100%

[1]These figures include trout fry. The total coho fry salvaged is 162,219. A breakdown of the number of coho fry salvaged by each group was not available. An accidental pump failure led to the early release of 34,709 coho fry thus leaving 127,510 as the actual number of coho fry successfully salvaged and released in the summer of 1986.

[2]For a detailed breakdown of costs see Table 6. The costs associated with volunteer labour and donations were estimated in order to complete a portion of the analysis.

Table 6: 1986 Coho Fry Salvage Program Expenditures
With and Without Volunteers and Donated Materials

			1986,$
Co-ordinator[1]			
	Labour		$ 2,253.15
	Reconnaisance, net repairs, notes		2,717.00
	O & M: Truck rental		1,608.25
	Gas		541.95
	Supplies		51.22
	Meals		313.50
		Subtotal	$ 7,485.07
Cowichan Indian Band CEDP Hatchery[2]	Labour: Salvage		$ 1,971.10
	Sorting		2,674.40
	Feeding		3,740.00
	O & M: Overhead		1,022.01
	Truck		800.00
	Fish food		165.00
	Hydro costs		1,604.00
		Subtotal	$11,976.51
Volunteers and Donations[3]			
Estimated Costs Assuming DFO had to absorb full program costs.			
	Labour		$ 740.00
	Donations (Cash Vancouver Sun Newspaper)		1,000.00
	O & M: Material for beach seine		200.00
	Material for small nets		300.00
	Equipment for truck)		123.00
	Aerator		
	Buckets		50.00
	Increment gas, supplies & meal costs		160.00
			$ 2,573.00

Total DFO Costs With Volunteers and Donations	$19,461.58
Total DFO Costs Without Volunteers and Donations	$22,034.58

(Footnotes over page)

TABLE 6 FOOTNOTES

1. Source: Burns, Ted. 1986, Co-ordinator of the Cowichan Fry Salvage Program. These expenses represent actual costs incurred in salvaging fry. All costs related to evaluation, eg. tagging component of the program have been taken out. Burns documented total salvage labour costs at $4,224.25 including the band contribution. The Band estimated their labour costs at $1,971.10 which leaves $2,253.15 as labour costs for the co-ordinator.

2. Source: Charlie, John. 1986, in a memo from C. Masson to D. Deans. Two adjustments were made to the information provided. The first concerns the labour costs of feeding the fry while they are held. It was estimated that in a normal fry salvage year one trough would be used. It would take one person four hours a day, seven days a week for about three months at $10.00 per hour to care for the fry in this trough. This amounts to approximately $3,740.00 allowing for overtime on weekends (Charlie, 1986). The second adjustment concerns fish food. Fish food expenses in 1986 were $500.00. It was assumed that 2/3 of this cost could be attributed to the evaluation component of this program. That is, fry had to be held longer than would normally be required in order to be tagged. Therefore, food costs in a normal salvage year would be $165.00. The hydro cost represents 13% of the annual hydro costs for the hatchery. This seems reasonable considering only a portion of the hatchery is used over a 3 - 4 month period.

3. Source: The costs of the labour and materials were estimated assuming that DFO would have to absorb the full costs of the program.

   Labour: 74 hours of volunteer labour were used. It was assumed that given no volunteers DFO could hire additional help when required at $10.00 per hour. ($10 x 74 = $740)

   Donation: A donation of $1,000.00 was made by the Vancouver Sun to provide salary for the co-ordinator's aide.

   O & M: Material for beach seine and small nets was estimated by Burns (1986) to cost $500.00 and would be an annual expense. Buckets were estimated to cost $50.00. Equipment required in the truck to transport the fish would cost $615.00 ($550.00 for trough and $65.00 for the aerator). Nelson (1986) suggested their life span was 10 years. Therefore an annual cost for these capital expenditures is estimated at 20% of $615.00 = $123.00. This assumes an annual depreciation rate of 10% and an interest charge of 10%. The incremental cost of gas, supplies, and meals was estimated by taking the average cost for these items per hour of labour from co-ordinator's information.

4.2.2 Evaluation Methodology

Net economic returns resulting from the 1986 fry salvage program were calculated by taking the gross benefits of the fish taken in the commercial, native, and sport fisheries and subtracting from them the related harvesting and processing costs, and the costs of the fry salvage program. The costs were incurred in 1986, and the benefits are assumed to accrue mainly in 1988. Program costs are actual costs in 1986 dollars. Because of the methods used to salvage fry (beach seine, pole seine, and dip nets) a wide range of numbers of fry can be salvaged with the same level of expenditure. For example, in beach seining one haul could result in the capture of none or as many as 2,000 fry. The determining factor appears to be fry availability, not effort, up to a point. Therefore, for the purposes of this analysis, program costs were assumed to remain constant for a range of fry salvage levels. The total number of coho fry salvaged in 1986 was 162,219. It was assumed that this number of coho would be salvaged in an average year. Coho fry salvage levels for low and high years were estimated* at 100,000 and 350,000 respectively

A pump failure in the Cowichan Indian Band Hatchery forced emergency release of an estimated 34,709 salvaged coho fry into the Cowichan River mainstem. This represented approximately 21% of the salvaged coho fry and reduced the colonization level from 162,219 to 127,510. Since these fry were not released in their intended location, their survival may have been different from normally colonized fish. Assuming either no or comparable survival levels for these fish, the evaluation is conducted using four different fry salvage levels 100,000 (low catch estimate), 127,510 (actual with pump failure), 162,219 (medium catch estimate without pump failure), and 350,000 (high catch estimate).

* T. Fields, T. Burns, B.D. Tutty

The fry salvage program has traditionally relied on the use of volunteers and donated materials. It was decided to evaluate the merits of the program both with and without the volunteers and donations. The "without volunteers and donation" assessment will provide DFO with results that can be used when considering implementation of fry salvage where there are no volunteers or donations. To complete the "without volunteers and donations" component, it was necessary to estimate the additional costs of labour and materials that DFO would incur if these were not available free.

Two fry-to-adult survival rates (1.7% and 3.3%) were used to provide a realistic range of likely values to model various habitat yields from coho colonization. These rates are taken from the results of tagging studies done on colonized coho fry in the upper Quinsam watershed and on Vancouver Island and other unpublished data, Appendix 3, and are considered conservative (Bams, 1986). The coho exploitation rate was assumed to be 75% (Cross, 1986).

Costs and benefits were analyzed using the National Income Account of the SEP Evaluation Model. This account is based on the principles of benefit-cost analysis. Costs are disaggregated into capital, operations and maintenance, and associated fish harvesting and processing costs. Benefits are disaggregated into commercial, native, and sport values. Commercial and native values are based on wholesale prices but harvesting and processing costs are netted out for commercial value only. Sport values are calculated on the basis of consumer surplus as determined by willingness-to-pay. All figures are in 1986 dollars and the analysis is conducted for a one year program with costs incurred in 1986 and benefits accruing primarily in 1988. Discount rates of 5%, 10% and 15% are used in compliance with the Treasury Board Guidelines. It is also assumed that capital investment in the fleet will continue. The analysis is done at four fry levels, and two fry-to-adult survival rates, both with and without volunteers and donations.

4.2.3 Results

4.2.3.1 Assuming Volunteer Labour and Donations

This section assumes that both volunteers and donations form part of the program. Program expenditures remain constant at $19,500 throughout this analysis. (See Section 4.3.1, Table 6 for a breakdown of these costs). The results of this analysis are presented in Table 7 and Figure 3. The results indicate that net returns are positive in all cases, although zero $ returns are generated at fry salvage levels of 100,000 and discount rates of 10% and 15%. Unlike most economic analysis, the discount rates are not important in this study because the analysis is conducted over such a short time (costs occur in year one and benefits accrue in years two and three) that the effect of different discount rates is negligible.

The fry-to-adult survival rate is, however, very important in this analysis. For example, at a 10% discount rate, net returns of $19,000 associated with a salvage level of 100,000 and a survival rate of 3.3% are greater than the net returns of $13,000 associated with a salvage level of 162,219 and a survival rate of 1.7%. This indicates how sensitive the overall results are to the selection of a specific fry-to-adult survival rate.

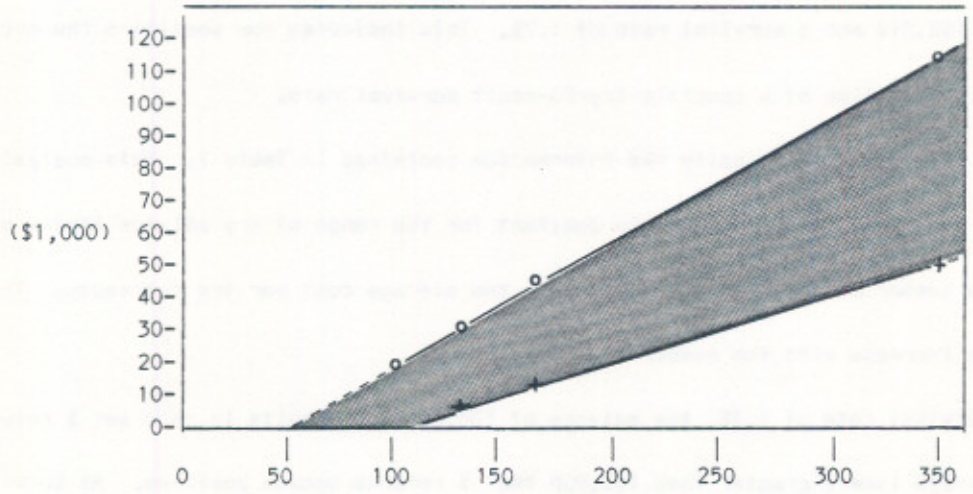
Figure 5 presents graphically the information contained in Table 7. This analysis assumes that the program expenditures remain constant for the range of fry salvage levels used. Therefore, as the number of fry salvaged increases, the average cost per fry decreases. The net returns therefore increase with the number of fry salvaged.

At a survival rate of 1.7%, the salvage of 100,000 fry results in zero net $ returns. It is only at salvage levels greater than 100,000 that $ returns become positive. At survival rates of 3.3% the salvage of 50,000 or more fry will generate positive net $ returns.

TABLE 7: Net Present Value of 1986 Coho Fry Salvage Program, (With Volunteers and Donations).

No. of Coho Fry Salvaged	Fry/Adult Survival Rate %	(1986 $,000) Discount Rates 5%	10%*	15%
Low estimate:	1.7	$ 2	$ 0	$ 0
100,000	3.3	22	19	16
Medium estimate (with pump failure):	1.7	8	6	4
127,510	3.3	34	29	25
Medium estimate (without pump failure):	1.7	16	13	10
162,219	3.3	48	43	38
High estimate:	1.7	56	50	44
350,000	3.3	127	115	104

FIGURE 5: Net Present Value of 1986 Coho Fry Salvage Program, (With Volunteers, 10% Discount Rate)*.



* + 1.7% Survival o 3.3% Survival

4.2.3.2 Assuming No Volunteer Labour and Donations

The results of the analysis assuming that DFO had to absorb the full program costs (i.e., no volunteers and no donations of either materials, goods, or cash) are presented in this section. The program expenditures in this section remain constant at $21,900 O & M and $100 capital, throughout the analysis (see Section 4.3.1, Table 5 for a breakdown of costs). The results are presented in Table 8 and are positive with one exception. Salvaging 100,000 fry and assuming a 1.7% fry-to-adult survival rate generates zero $ returns at 5% discount rate and net losses of $1000 and $3000 at 10% and 15% respectively; obviously worst case scenarios.

At the same salvage level and a survival rate of 3.3%, positive returns are generated that are greater than returns generated for salvage levels of 162,219 and survival rates of 1.7%. This indicates once again the overall sensitivity of the results to selection of a fry-to-adult survival level. The discount rates are not important in this analysis either, for the same reason discussed in the previous section.

Figure 6 presents graphically, the information presented in Table 8. At a survival rate of 1.7% the salvage of 100,000 fry results in a net loss of $1,000 net returns. It is only at salvage levels greater than 117,000 that net $ returns become positive. However, at survival rates of 3.3% salvage levels must only be greater than 67,000 to generate positive net returns.

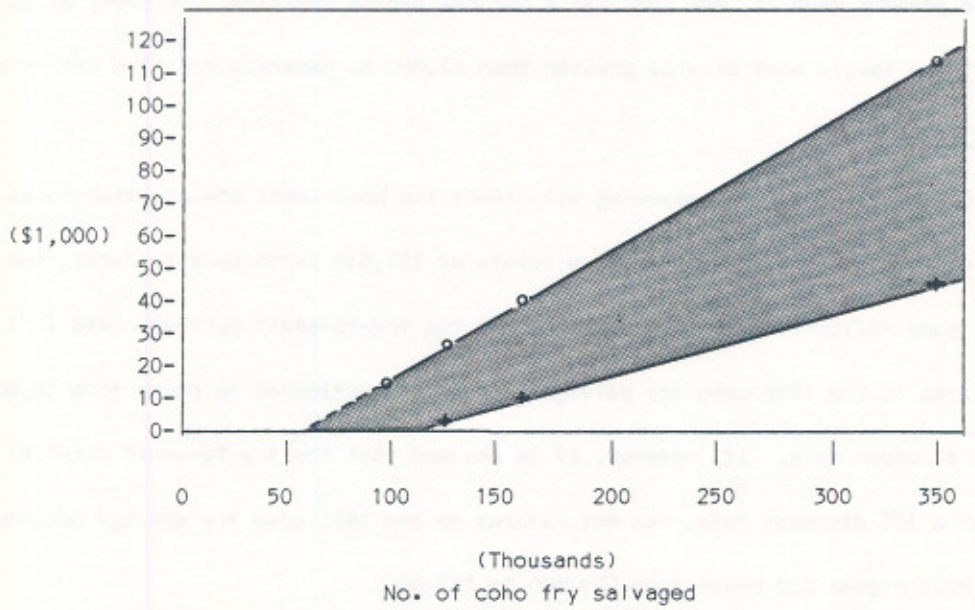
4.3.3 Economic Returns

The 1986 program benefits (assuming volunteers and donations) are expected to be between the net returns associated with salvage levels of 127,510 (with pump failure), and 162,219 (without pump failure). If it is assumed that the fry-to-adult survival rate is 1.7%, then the net returns to the 1986 coho fry salvage program are estimated to range from $6,000 to $13,000 at a 10% discount rate. If, however, it is assumed that the fry-to-adult survival rate is 3.3%, then, at a 10% discount rate, the net returns to the 1986 coho fry salvage program are estimated to be much higher and range from $29,000 to $43,000.

TABLE 8: Net Present Value of 1986 Coho Fry Salvage Program, (Without Volunteers and Donations).

No. of Coho Fry Salvaged	Fry/Adult Survival Rate %	(1986 $,000) Discount Rates 5%	10%*	15%
Low estimate:	1.7	$ 0	$ -1	$ -3
100,000	3.3	20	16	13
Medium estimate (with pump failure):	1.7	6	3	1
127,510	3.3	31	27	23
Medium estimate (without pump failure):	1.7	13	10	7
162,219	3.3	46	40	35
High estimate:	1.7	54	47	41
350,000	3.3	125	112	101

FIGURE 6: Net Present Value of 1986 Coho Fry Salvage Program, (Without Volunteers; 10% Discount Rate)*.



* + 1.7% survival o + 3.3% survival

As part of the 1986 Cowichan coho fry salvage plan, the Cowichan Indian Band was given primary responsibility for salvaging fry in the lower portion of the Cowichan watershed (below Skutz Falls and the Koksilah basin), while the coordinator, his helper, and the volunteers were principally responsible for salvaging in the upper watershed. In hindsight, this may not have been a good decision because the band was only able to salvage 27,343 fry from that lower portion. It might be useful to assess giving the band a larger role to play in future salvage activities. It is also questionable whether this program should continue to require involvement by all three groups (co-ordinator and paid helper, volunteers, and band) to the same extent. It may be possible to streamline the organization, thus further reducing costs and increasing net returns. There is no doubt however, that without the plan and a co-ordinator in 1986, the program would not have been as successful.

The final point to be made concerns the projected economic returns. Although, at a 10% discount rate, the results show positive returns for all scenarios except two, it should be noted that these results are dependent on the assumptions made, particularly the fry-to-adult survival rates. Ongoing evaluation of this program and its verification several years from now will provide a valuable piece of information to fishery managers. The results will provide an assessment of the net $ returns that can be expected from this colonization technique. Information concerning how fry salvage survival compares with returns of other colonization techniques is also required. In addition, information is needed on interactions of planted fish with resident species, which may have serious impacts on resident species especially at high stocking densities. It is only with these kinds of information that balanced decisions concerning implementation of various colonization strategies can be made.

4.4 Economic Recommendations

Four recommendations are made as a result of the economic analysis. It is recommended that:

1. The assumptions and biostandards used in this analysis be verified when the results of the coho colonization studies being conducted by the Fisheries Research Branch are available.

2. The salvage program attempt to increase participation by volunteers.

3. The way in which the program is organized be reviewed with a view to increasing efficiency and reducing costs, (see Section 4.5).

4. DFO continue in its efforts to evaluate semi-natural salmon production programs and techniques to provide fishery managers with the information they need to make fisheries management decisions to optimize watershed production.

4.5 Fry Salvage Operations Recommendations

1. It is necessary to salvage and colonize at least 100,000 coho fry to break even each year in the Cowichan watershed , assuming a 1.7% fry to adult minimum survival rate and a similar cost salvage program ($22,034- $[1986]).

2. A fry salvage coordinator for the Cowichan watershed familiar with an established operations plan is essential. The coordinator (T. Burns) should be re-employed for 1987 and be required to provide a comprehensive operational fry salvage report that delineates detailed areas, methods, access, timing and volunteer contacts.

3. Fry salvage should begin in April or early May each year with rescue of stranded fry along the Cowichan mainstem to occur immediately when the weir is closed and/or if a sudden drop in the Cowichan River occurs. Chum salmon may make up a large proportion of the early season catch, with the remainder being chinook, coho fry and presmolts.

4. The ideal fry salvage crew unit is three. The third member scouts ahead, transports buckets of salvaged fry back to the tank truck, monitors fry survival in the holding tanks and makes repairs. When large numbers of fry and long carrying distances are involved, three people are essential. The few situations that require more than three people, volunteers should be requested to provide help. A minimum crew size is two for reasons of safety.

5. As a result of the high hatchery operations costs, salvaged fry should be colonized into the targetted sites as soon as possible. This should also reduce handling stress and mortality of both trout and salmon.

6. Due to the small proportion of trout species in the salvaged populations of fry and the high cost of sorting them, trout should not be separated from coho prior to colonization unless deemed absolutely necessary by management (DFO & MOE&P) and authorized by the local fishery officer.

7. Salvage crews should employ the fry salvage field report (Appendix 6) to record and report fry salvage activities. These reports should be annually summarized and become part of the Record of Management Strategies for the Duncan subdistrict.

8. Information on coho fry survival rates and interactions with resident species is required.

Bibliography

Bonnell, R.G. MS 1986. Cowichan fry salvage working meeting of April 21, 1986. Unpubl. Internal Rep., Dept. of Fisheries and Oceans, Vancouver, 16 p.

Burns, T. 1984. Fish habitat inventory of Map 92C/16: Cowichan Lake. B.C. Forest Products Resource Planning Group. 57 p.

Burns, T. and B. D. Tutty. 1986. Coho colonization potential of the Cowichan-Koksilah watershed: a habitat evaluation. Can MS Rep. Fish. Aquat. Sci. No. 1865: iv + 64 p.

Carl, G. C. 1937. Identification of fry salvaged from Cowichan River pools. Can. Dept. Fish. Internal Report (Duncan subdistrict file).

Chamberlin T.W., E.A. Harding, and B.D. Tutty. 1984. Salmonid habitat information project (SHIP): a strategic level inventory approach. Can. MS Rep. Fish. Aquat. Sci. No. 1821: vii + 25 p.

Hobbs, M. 1987. Economic evaluation of the 1986 Cowichan coho fry salvage program. Internal report of Program Planning and Economics Branch, Dept. of Fish. and Oceans.

Ministry of Environment and Parks. Cowichan watershed water management plan. Vancouver Island Region, Water Management Branch. 2569 Kenworth Road, Nanaimo, B.C.

Neave, F. 1949. Game fish populations of the Cowichan River. Bulletin LXXXIV. Fish. Res. Board Can. 32 p.

Sherman, A. A. 1939. Report of fry salvaging operations of salmon and trout fry in the Cowichan River. Dept. Fish Internal Report (Duncan subdistrict file).

Tutty, B. D. 1984. The Koksilah River: streamflows and salmon production. Can. MS Rep. Fish. Aquat. Sci. No. 1822: 35 p.

References for Economic Evaluation (from Hobbs, 1987)

Bams, R. 1986, Personal Communications - Research Scientist, Coho Salmon Program, Fisheries Research Branch, Nanaimo, B.C.

Burns, T. 1986, Telephone Conversation - Consulting Biologist Lake Cowichan.

Burns, T. and Tutty, B.D. 1986. Coho colonization potential of the Cowichan-Koksilah watershed: a habitat evaluation. Can. Ms. Rep. Fish. Aquat. Sci. No: 1865. IV + 65.

Charlie, J. 1986, Telephone Conversation - Manager of the Cowichan (CEDP) Indian Band Hatchery.

Cordocedo, B. 1986, Telephone Conversation - Project Co-ordinator, Community Economic Development Program-SEP, Dept. of Fisheries and Oceans.

Cross, C. 1986, Telephone Conversation - Assessment Biologist, SEP.

Fields, T. 1986, Telephone Conversation - Fishery Officer, Duncan Sub-District.

Kadowaki, R. Minutes of the Cowichan River Co-ordination Meeting April 10 and November 4, 1986.

References for Economic Evaluation (continued)

Masson, C. 1986, Memo to D. Deans outlining 1986 Cowichan Indian Band fry salvage costs. DFO. Pacific Region.

Mylchreest, R. 1986, Personal Communications. SEP Analyst Economics and Commercial Analysis Branch, DFO. Pacific Region.

Nelson, L. 1986, Telephone Conversation. Member of CLES Public Involvement Group.

Shardlow, T. 1986. In conversation with B.D. Tutty.

Tutty, B.D. 1986, Telephone Conversation. Habitat Biologist. Dept. of Fisheries and Oceans, Fisheries Branch, South Coast Division, 3225 Stephenson Pt. Road, Nanaimo, B.C.

Acknowledgments

The authors express appreciation to all those individuals who have helped save the fish over the last half century, many of whom cannot be cited here. With regard to the work related to the 1986 operation and evaluation, we specifically thank the following individuals for their efforts and hard work:

Lake Cowichan (Salmonid) Enhancement Society (LCSES):

Leo, Richard and Leonard Nelson, Art and Blake Watson, Earle Darling, Dave Carr, Steven Hill, Howard and Paul Smith, Robert Bell, John Tuck, Bill Leitch, Stew Geoghegan, Darcy Lubin, Paul and John Switzer, Ahmed Khan, Yvette Erskine, Rene Bateman, Alice Pedersen, Rosemary Sharp, and Asha Durrance.

Cowichan River (Salmonid) Enhancement Society (CRES):

John Charlie, Lambert Goldsmith, J.R. Elliot, Gary Roland, Alec Johnny, Wayne Page, Frank Wilson.

A special thanks to Philip Lorenson, Jim Tansky and Bruce Watt.

The Vancouver sun Newspaper contributed $1,000 to the 1986 operations fund.

The authors wish to thank M. Hobbs for undertaking the economic assessment work described in this report.

Appendix 1: Development of a Preliminary Fry Salvage/Coho Colonization Plan for the Cowichan Watershed.

PART I: OUTLINE OF THE AD HOC WORKING GROUP MEETING -(APRIL 21, 1986).
PART II: COWICHAN RIVER FRY SALVAGE MEETING - DISCUSSION AND MINUTES OF MEETING.
PART III: PROPOSED PLAN FOR 1986 FRY SALVAGE OPERATIONS ON THE COWICHAN AND KOKSILAH RIVER SYSTEMS.

Part I: Ad Hoc Working Group:

Rob Bams - Fisheries Research Branch, PBS, Coho Group

Greg Bonnell (Chair)- SEP, Special Projects Division, Small Projects Unit

Ted Burns - Private Consulting Biologist, under (1985) contract to Habitat Management Unit, South Coast Division, Fisheries Branch.

Barry Cordocedo - SEP, Special Projects Division, Community Economic Development Program

Trevor Fields - Field Services Branch, Duncan sub-district office

Blair Holtby - Fisheries Research Branch, PBS, Coho Group

Trevor Morris - SEP, Special Projects Division, Public Involvement Program

Brian D. Tutty - Field Services Branch, South Coast Division, Habitat Management

Purpose of April 21, 1986 Meeting (from previous Cowichan Coordination meeting of April 9, 1986)

- to design a program for the coming fry salvage season (May - Aug. 1986)
- this plan will be submitted to the South Coast Division Area Planning Committee as an interim working document until direction from that group is obtained
- important to produce some plan because fry salvage work will be carried out in any case and would far prefer it to be productive
- options involving stocking of salvaged fry into areas already utilized by coho ("augmentation"), not a good idea - especially for streams. Concerns over negative impacts on existing fry and the possibility that accessible stream areas may already be seeded to capacity. Options for stocking of areas not utilized by coho preferred.
- stocking numbers/criteria for inaccessible streams reaches debated due to lack of overwintering habitat and low gradients in upper Cowichan streams and disagreement over the capacity of

Appendix 1 (continued)

Cowichan Lake as an overwintering "sink". Nevertheless, agreed upon suggestions of 1.0 fry/m for gradients less than 2% and 0.5 fry/m for gradients between 2% and 5% as these are conservative in relation to other estimates of carrying capacity. Systems stocked should be trapped in the fall and preferably in the spring also using a fence type total downstream.

- stocking numbers/criteria for inaccessible lakes should not exceed 1500 fry per hectare (in accordance with most of the current literature). Smolt and adult production are unpredictable since most of the work to date has involved lakes which are either barren, or have been previously treated with a piscicide. Lakes of the Cowichan system all appear to support populations of other salmonids and other species with potential for negative interaction with introduced coho. Assessment of the technique in lake plants will be important.

- proposed donor and stocking sites were culled from a large list of candidates presented by Burns based on his observations and measurements throughout the watersheds during extreme low flows in summer of 1985. The sites chosen are presented in table form as the proposed plan (attached). Selection criteria are included there. The discussion mainly involved those of the group with good local knowledge of systems and access routes (Burns, Fields, Morris) with input from others.

- no conclusion regarding a specific coordinator was reached. Some further investigation of funding and personnel will be done. Good possibility of obtaining funding and perhaps a portion of a person year for this position through Regional Planning or through Habitat Management, South Coast (Tuttyto follow up). General agreement that ideally the coordinator would be based out of Duncan sub-district office (preferably as a guardian). Any coordinator should:
    - be centrally located
    - be easily reached (by telephone and/or radio)
    - be mobile - preferably with any necessary salvage and transport equipment
    - have a good knowledge of the Cowichan and Kokisilah watersheds
    - be able to work full time on fry salvage concerns for the period May to September inclusive
    - be a DFO employee, or funded through DFO and thus responsible to the department rather than any particular interest group

- John Charlie (manager of the CEDP hatchery) has volunteered his services as coordinator. Although he would meet most of the above criteria, felt that other avenues should be pursued first. If ad hoc funding or PY cannot be obtained, then this and other options should be considered.

- It was agreed that having drafted an interim plan, the group need not schedule another meeting. The next steps will be;

    - Bonnell to write up and distribute minutes and plan, then present to Area Planning Committee for approvals process
    - Tutty to investigate funding and person year for coordination position
    - Morris to canvas volunteers for work on salvage and assessment (trapping) work
    - Holtby and Bams to obtain further information when available on funding for and scope of research involvement, then to integrate assessment requirements with confirmed operations on Mesachie Lake and Grant Lake where possible.

Appendix 1 (continued)

Part II: Cowichan River Fry Salvage Meeting - Discussion and Minutes of Meeting.

The following will approximate minutes of the meeting in the order of agenda given earlier.

Holtby: presentation of possible options and designs

- notes presented in handout (attached), "Fry salvage in the Cowichan area: suggested battle plan."
- seven options for fry salvage work expanded upon with descriptions of assessment required and constraints involved
- discussion points given for each option

- preamble

- most work assumed to be done by volunteers
- important objective to evaluate cost effectiveness
- CWT necessary for "hard" data, but may still be able to benefit from "soft" data from trap counts and fry marking, etc.
- options 1 & 2 have genetic implications requiring investigation
- full spawning ground recoveries will be done as part of research

- option 1: Rearing at hatchery to full smolt

- thought not to be cost effective since collection of broodstock and eggs would likely be easier and less expensive
- some question of straying of returning adults to the hatchery rather than distributing throughout the system.

- option 2: Rearing in lake pens to smolt

- technical and logistical concerns raised about this option; primarily funding, security, location
- also concerns generally with lake pens as a rearing technique (Bonnell)
  - temperatures, growth rates, loading densities, paracitism and general operation can present problems
- nevertheless, this option may have merit if, instead of pens, other possibilities for rearing are considered (e.g. groundwater-fed rearing channel proposed by Small Projects Unit, SEP - Bonnell)

- option 3: Release into lakes already utilized by coho

- requires a fairly high degree of assessment (fry marking, subsequent population sampling for mark recapture information, growth, migration, etc.) in order to gauge effects on extant population of coho
- also requires control lake already utilized by coho (volitional recruitment) nearby and small enough in size to be easily sampled.
- from discussion - there are few if any areas which would meet the necessary requirements (Burns)

Appendix 1 (continued)

- some discussion of the feasibility of trapping Cowichn Lake itself since in the past, many salvaged fry have simply been put there - thought generally to be difficult if not impossible due to large size

- option 4: Release into an inaccessible lake

- should employ the same strategy for assessment as option 3, except without the control lake (viz pre-stocking fry trapping, marking of stocked fry, post stocking sampling at least twice and spring downstream trapping for full smolt enumeration)
- lake would need to be small enough to trap easily
- again, very few candidates meeting all these requirements (Burns)
- Quamichan Lake suggested as a possibility (Tutty)
  - appears to offer potential because of large surface area, above barriers to coho, and outlet small enough to be easily trapped
  - concerns (Bonnell) - potential for negative interaction effects is very high, especially from stocked trout; lake morphology (very shallow, marshy) results in extensive drying and likely high summer temperatures and high biochemical oxygen demand. These two features would be expected to strongly limit the growth and survival of stocked fry. Also, the large area would make effective sampling difficult
  - general discussion about whether returning adults from a plant in Quamichan could be fished and if so, how.

- option 5: Release into stream reaches already occupied by coho

- generally not felt to be a good idea
- expected to depress growth rates and survivals, and cause displacement
- information from Argue et al (1979) using historical escapement and smolt production data, suggests that smolt production from the Cowichan system does not increase once escapements reach about 50,000 (although "excess" escapements can provide an important "buffering" effect in the face of environmental variability). (Bonnell)
- escapement currently is a very approximate estimation of 50,000 to 60,000 for Cowichan and Kokisilah together (Fields)
- assessment of this option would have to be fairly rigorous - similar to option 3 (Holtby)
- agreement that we do not recommend planting below barriers into areas already utilized by coho.

- option 6: Release into inaccessible headwater streams

- recommended assessment would be to: mark all stocked fry; follow up spring trapping with several interim population estimates throughout the year; choose area with a nearby control stream of similar morphology (not stocked; and require study and control streams, enough length to have five distinct reaches of 100 m. each
- discussion of overwintering potential - little or none available in Cowichan headwaters but good in the Kokisilah (Burns)
- fry apparently move out (or are forced out) of Cowichan headwater tributaries during the first fall freshet (Fields, Morris, Burns)
- the wisdom of stocking these tributaries is questionable if there is no overwintering habitat and gradients exceed 2% (Bonnell)

Appendix 1 (continued)

- option 6 (continued)

- suggestion that overwintering capacity is not important here so fry will find other areas in Cowichan Lake or downstream (Tutty)
- no information available on the rearing potential of the lake for coho and considered too large to effectively investigate.
- discussion of tagging fry in the fall as they move out of lake tributaries to provide survival, contribution info
- logistically would be difficult (flows, trapping technique) and based on current statistical marking acquirements, estimate 60,000 tags would have to be placed (Bonnell)
- general agreement that the option perhaps is worth pursuing with low stocking numbers if the systems can be trapped at least in the fall, and preferably in the spring also using a fence type total downstream. Assessment as described above may be approached later.

- option 7: Leaving fish in high risk areas

- unfortunately, this option was given little discussion
- this option would attempt to determine the extent of the problem (drying of streams in late spring and summer) and quantify it.
- some feeling that while a good thing to do, it may not be easily accepted (or understood) by volunteers or the general public (who do much of the fry salvage work)

Bonnell - Suggested initial criteria for fry salvage work on Cowichan system

- based on experience of Small Projects Unit with fry planting and on literature.

- planting streams with coho fry:

1. Stock above barriers only.

2. Use stream reaches of less than 2%
   - general agreement with B. C. Fisheries Branch from past operations
   - suggested by Slaney et al, 1985 (manuscript report on interactions among salmonids)

3. Use only streams with good overwintering potential.

4. To determine planting level use:
   a) maximum of 40 smolts/100 m (determined to be maximum smolt yield for accessible areas of the Cowichan by Argue et al (1979), and work back to 1 g fry based on constant biomass and mean smolt weight of 8.1 g; or
   b) calculate potential smolt carrying capacity using the biomass vs area option from Marshall and Britton (1980 draft MS) and work back to 1 g fry as above; or
   c) using either (a) or (b) work back to fry assuming 10% fry to smolt survival for 1 g fry or 8% for emergent fry (SEP biostandards)

5. Priority for stocking:
   a) exclude areas involved in experiments (PBS)

Appendix 1 (continued)

b) go first to streams in the same sub-watershed
c) go to streams identified which are the shortest distance away (transport time not to exceed one hour)

6. Distribute fry evenly throughout the section to be stocked. If access is a problem, plant toward the upstream end of the section.

7. Technique:
   a) minimize handling at all times. During capture, suggest use of in-stream net pens
   b) use fresh water for each trip
   c) use aeration (oxygen, air, or combination) but ensure not too much (bubbles should be very small and barely discernible)
   d) do not exceed recommended loadings for transport:
      - 10 fry/L. (0.01 kg/L) without aeration
      - 100 fry/L (0.10 kg/L) with aeration
   e) ensure that temperature difference between donor streams, transport truck, and stocking site is not more than 2 C (preferably less than 1 C). Avoid using ice.

- planting lakes with coho fry:

1. Select barren lakes if at all possible

2. Use low stocking densities to ensure optimum growth and attainment of threshold size for smolting in spring (1.0 age smolts) by the maximum percentage of fish.

3. May wish to stock only every two to three years to allow macrozooplankton populations a chance to recover and to reduce the rate of exploitation of benthic invertebrates (main diet in summer observed on some studies).

4. Interaction with other species:
   - resident populations will likely have a negative effect on introduced coho fry growth and survival (and possibly vice versa)
   - Crone (PhD thesis, 1981) suggested that, in Alaska, resident species having such a negative impact (in order of least to greatest) would be the coast range sculpin, Dolly Varden char, rainbow trout and cutthroat trout. He also suggested that competition would be great from traditional planktivores such as sockeye (and presumably kokanee) and sticklebacks.
   - Small Projects Unit coho lake plants have been carried out for two to three years in systems where species interaction is likely to be high (sculpin, stickleback, rainbow, cutthroat, kokanee, and naturally lake rearing coho populations). Planting densities were initially low (less than 100 fry/ha. and were increased to a maximum level of 1000 fry/ha. Survivals have been in the neighborhood of 15% fry to smolt.

5. Suggest planting densities less than 1000 fry/ha and initial expected survival of 15%.

Cordocedo: Possibility of CEDP manager to act as Coordinator (and general discusssion of Coordinator)
- John Charlie (manager of Cowichan CEDP Hatchery) has volunteered his services as Coordinator
- advantages would include:
  - DFO funded personnel
  - Central location (Duncan area)

Appendix 1 (continued)

- office/telephone contact
- vehicle with transport tank equppped with aeration
- knowledge of watersheds, tributaries and access
- some portion contract time for Cowichan CEDP already allocated for salvage operations

- concerns:
  - John may not have enough time to give to the coordination in addition to his other duties
  - potential for friction between interest groups (Cowichan Band, volunteers)

- wide discussion ensued over the role of a coordinator. In the past, this responsibility given to a guardian working out of the Duncan sub-district office who did nothing but fry salvage for the months in question (about May to September). This still generally felt to be the best situation, but funding and person-year constraints will likely not allow it.

- Tutty suggested there is a very good possibility of obtaining funding and perhaps a portion of a person year from Regional Planning through the South Coast Division.

- general agreement that in whatever form, the coordinator should:
  - be centrally located
  - be easily contacted (by telephone and/or radio)
  - be mobile - preferably with the necessary salvage and transport equipment
  - have a good knowledge of the Cowichan and Kokisilah watersheds
  - be able to work full time or fry salvage concerns as needed from about May
    - September
  - be a DFO employee or funded through DFO and thus responsible to the department rather than a particular interest group

- it was decided that further steps to be taken as regards coordination will be:
  - Tutty to pursue funding and PY option he suggested
  - others to investigate possibilities for funding/involvement when more details are known
  - if ad hoc funding or PY cannot be obtained, other options should be considered (such as use of CEDP manager).

Burns: Suggested stocking (and donor) sites with discussion and selection of proposed candidates.

- the discussion of stocking sites dealt only with those candidates applicable to Holtby's options 4 and 6 (inaccessible areas to coho)
- Burns presented a review of candidates for both donor and stocking sites. These were broken down into the areas above and below Skutz falls.
- stocking densities discussed:
  - lake planting -
    - suggestion of 1 fry/m^2 from Burns and Tutty (draft MS) considered very high (equals 10,000 fry/ha)
    - more realistic number from literature and experience would be 1500 fry/ha.(Bams, Holtby, Bonnell)
    - important to assess any lake plant well
  - stream planting
    - discussion about coho planting above 5% gradient or in areas lacking overwintering habitat (upper Cowichan) (see previous discussion)

Appendix 1 (continued)

  - general agreement for the sake of having some target, suggest 1.0 fry/m in areas below 2% gradient and 0.5 fry/m in areas from 2-5% gradient. (as per Burns and Tutty draft MS.)

- stocking site selections were made from Burns' list with some discussion of local considerations (Fields, Morris) together with suggested donor sites for each. Selection criteria included proximity to lake Cowichan or Duncan, accessibility, potential for trapping, and exclusion of current study areas.

- the proposed plan agreed to with stocking sites, donor sites, numbers of fry to be planted, and other information appear in the following section.

Implementation:

- the group felt that with the proposed plan completed that no further meetings would be necessary

- the method for coordination of fry salvage work was left unresolved until more information is obtained

- the allocation of work (who should salvage and plant where) was also left undecided, although the Cowichan CEDP will continue to salvage the fry necessary for the PBS Grant Lake study at least.

- budget and person allocations for the PBS studies were not finalized, but ideally, that group would coordinate assessment in order to tie in with ongoing work. Preferred sites for trapping are given in the plan following. Tentatively, trap construction and operation could be done using volunteer labour with direction and collation of data coming from the research group.

- copies of these minutes and the proposed plan will be circulated among those attending the meeting. They will then be taken to the Area Planning Committee and presumably go to an approvals process (A copy will also be given to the transplant committee).

Appendix 1 (continued)

Part III: PROPOSED PLAN FOR 1986, FRY SALVAGE OPERATIONS ON THE COWICHAN AND KOKISILAH RIVER SYSTEMS

On April 21, 1986 a meeting was held with representatives from Research Branch, Habitat Management (South Coast Division), Field Services (Duncan sub-district) and SEP (Special Projects Division) involved in the Cowichan River watershed. The purpose of the meeting was to work out a tentative plan for the 1986 coho fry salvage operations, and to coordinate the efforts of the various groups involved. Fry salvage work has gone on in the watershed for many years - carried out by government agencies and/or members of the public and will continue. This plan is an attempt to apply biological criteria and to establish guidelines and priorities for stocking and assessment.

REFER TO TABLE 1, Page 8 of this Report for Summary of Cowichan Fry Salvage and Coho Colonization Plan

Notes:

1 This plan is to be considered a proposal and an interim working plan. Where applicable, approvals for work must be obtained and agreements made - notably with B.C. Fisheries Branch as regards potential interactions with trout.

2. The number of fry to be stocked totals 196,600 excluding lake plants. If lakes (except Quamichan) are included, the total becomes 258,000. Fry salvage efforts in recent years have been less than 200,000. Thus, the proposed plan should account for all fry salvaged in 1986.

3. Stocking sites chosen from list supplied by Burns and Tutty (draft MS) on the basis of: proximity either to Lake Cowichan village, or Duncan for personnel; accessibility by road; feasibility of trap operation; and absence of other stocking programs.

4. Donor Sites selected as being close to stocking sites and having high likelihood of stranded fry. Estimated abundance of donor fry calculated by Burns based on observed amount of habitat (m) lost due to drying and an initial density of 4 fry/m.

5. Stream stocking densities (1 fry/m for gradients less than 2% and 0.5 fry/m for gradients between 2 and 5%) suggested by Burns and Tutty (draft MS). Considered conservative (cf. 3.2 fry/m estimated from production from lower Cowichan of 40 smolts/100 m and mean smolt weight of 8.1g (Argue et al 1979) assuming a constant biomass). Lake stocking criteria suggested by Holtby and Bams (1500 fry/ha) as a starting point (based on results by various authors in the literature). Smolt production will be determined by a variety of factors to be part of research work.

6. Cowichan system broken down for convenience into "upper" above Skutz Falls and "lower" below Skutz Falls.

1. Quamichan Lake is considered to have some potential for coho stocking, but due to its size, morphology and concerns over interaction with stocked trout, it should be addressed more closely before proceeding.

2. These sites (in addition to Mesachie and Grant Lakes) are considered by the PBS research group to be the best candidates for trapping and further work.

Appendix 2. Chronological summary of fry salvage operations, expenses and fry distribution in 1986 program.

Date (1986)	Fry salvage No.	Salvage site	Relocation site		Time (hours)	Wages ($)
Late May-		Upper Cowichan S.C.s				
mid-June	18,509	and flood pools	Art Watson's Ponds	18,509	8	0
6/2	5,000	Meade SC	Upper Meade	1,000	2	
			Beaver L.	4,000	30	0
6/9	1,200	Nixon	Cowichan L.	1,200	4	0
6/9	600	Rotary Park S.C.	CEDP	600	6	64.50
6/10	400	Robertson S.C.	Beaver L.	400	6	0
6/11	5,000	Robertson S.C.	Beaver L.	5,000	6	39.00
6/12	1,000	Nixon	Cowichan L.	1,000	12	129.00
6/12	1,500	Bible Camp S.C.	CEDP	1,500	2	21.50
6/13	1,000	Horseshoe Bend S.C.	CEDP	1,000	4	43.00
6/17	28	Fairservice Cr.	Beaver L.	28	2	0
6/18	8,500	Robertson S.C.	Beaver L.	8,500	24	39.00
6/19	800	Rotary Park S.C.	CEDP	200	6	64.50
6/21	960	Robertson R.	CEDP	960	9	96.50
6/25	1,500	Glenora Cr.	CEDP	1,500	6	64.50
6/26	400	Horseshoe Bend S.C.	CEDP	400	2	21.50
6/26	100	Stanley Cr.	Beaver L.	100	4	0
6/26	100	Meade Cr.	Beaver L.	100	1	0
6/26	500	Meade S.C.	Beaver L.	500	1	0
6/27	3,000	Meade S.C.	Beaver L.	3,000	10	85.00
6/30	6,000	Meade S.C.	CEDP	6,000	8	98.00
7/2	500	Meade Cr.	Beaver L.	500	2	17.00
7/2	2,300	Meade Cr.	Beaver L.	2,500	3	25.00
7/2	1,400	Meade Cr.	Cowichan L.	1,400	2	17.00
7/2	500	Robertson S.C.	CEDP	500	3	56.00
	2,000	Meade S.C.	CEDP	2,000	3	56.00
7/3	1,500	Meade S.C.	CEDP	1,500	2	19.00
7/5	30	Misery Cr.	CEDP	30	1	9.50
	200	Dusty Cr.	CEDP	200	1	9.50
	300	Helpful Cr.	CEDP	300	2	17.00
	404	Nixon Cr.	CEDP	404	2	17.00
	155	Ashburnham Cr.	CEDP	155	2	17.00
	100	Coonskin Cr.	CEDP	100	1	8.50
7/6	1,600	Rotary Park S.C.	CEDP	1,600	3	31.50
7/7	3,002	Nixon Cr.	CEDP	3,002	18	84.00
7/7	790	Rotary Park S.C.	CEDP	790	2	21.00
7/7	800	Glenora	CEDP	800	6	63.00
7/8	2,405	Glenora	CEDP	2,405	15	157.50
7/9	600	Rotary Park S.C.	CEDP	600	2	21.00
7/9	1,300	Robertson R.	CEDP	1,300	21	80.00
7/11	2,003	Ashburnham Cr.	CEDP	2,003	15	70.00
7/14	2,000	Ashburnham Cr.	CEDP	2,000	12	56.00
7/15	200	Meade Cr.	CEDP	200	3	14.00
7/16	600	Robertson R.	CEDP	600	5	42.50
7/16	4,000	Meade S.C.	CEDP	4,000	3	25.50
7/16	2,500	Robertson S.C.	CEDP	2,500	3	25.50

Appendix 2 cont'd.

Date (1986)	Fry salvage No.	Salvage site	Relocation site		Time (hours)	Wages ($)
7/16	500	Meade Cr.	CEDP	500	2	17.00
7/17	500	Horseshoe Bend S.C.	CEDP	500	4	42.00
7/17	1,000	Glenora Cr.	CEDP	1,000	9	94.50
7/17	1,000	Robertson R.	CEDP	1,000	4	32.00
7/18	1,000	Horseshoe Bend	CEDP	1,000	12	126.00
7/18	100	Coonskin Cr.	CEDP	100	2	17.00
7/18	60	Utility Cr.	CEDP	60	2	17.00
7/18	400	Meade Cr.	CEDP	400	2	17.00
7/20	1,200	Horseshoe Bend S.C.	CEDP	1,200	15	157.75
7/21	3,000	Robertson R.	CEDP	3,000	12	102.00
7/21	959	Robertson R.	CEDP	959	9	94.50
7/22	5,900	Robertson R.	CEDP	3,900	6	51.00
7/22	100	Ashburnham Cr.	CEDP	100	3	0
7/23	2,250	Meade Cr.	CEDP	2,250	5	38.25
7/23	704	Nixon Cr.	CEDP	704	7	59.50
7/24	900	Ashburnham Cr.	CEDP	900	3	0.00
7/29	1,500	Meade S.C.	CEDP	1,500	3	0.00
7/29	1,511	Meade Cr.	CEDP	1,511	3	39.00
7/30	4,000	Nixon Cr.	CEDP	4,000	18	153.00
7/31	500	Sutton Cr.	CEDP	500	2	17.00
7/31	500	Ashburnham Cr.	CEDP	500	2	17.00
7/31	1,500	Stoltz S.C.	CEDP	1,500	4	34.00
8/4	102	Stanley Cr.	CEDP	102	1	0.00
8/5	1,700	Glenora Cr.	CEDP	1,700	9	96.75
8/6	2,500	Stoltz S.C.	CEDP	2,500	8	68.00
8/6	1,600	Glenora Cr.	CEDP	1,600	6	64.50
8/7	800	Glenora Cr.	CEDP	800	4	43.00
8/7	3,600	Stoltz S.C.	CEDP	3,600	8	68.00
	100	Kalkatza S.C.	CEDP	100	1	8.00
8/8	700	Joginders S.C.	CEDP	700	3	25.50
8/8	3,400	Stoltz S.C.	CEDP	3,400	6	51.00
8/8	800	Beadnell Cr.	CLSES	800	2	0
8/9	20	Beadnell Cr.	CLSES	20	1	0
8/10	800	Meade Cr.	CEDP	800	2	17.00
8/10	3,000	Glenora Cr.	CEDP	3,000	6	64.50
8/11	1,500	Robertson R.	CEDP	1,500	5	42.50
8/12	2,000	Art Watson's S.C.	CEDP	2,000	3	25.50
8/13	450	Meade Cr.	CEDP	450	2	17.00
8/19	500	Meade Cr.	CLSES	500	1	9.00
8/19	1,500	Robertson R.	CLSES	1,500	3	25.50
8/19	3,000	Sutton Cr.	CLSES	3,000	3	25.50
8/20	5,700	Sutton Cr.	CLSES	5,700	8	68.00
8/28	2,500	Robertson Cr.	Upper Robertson	2,500	6	51.00
8/29	5,519	Sutton Cr.	CLSES	5,519	14	119.00
8/30	3,100	Meade Cr.	Cowichan L.	3,100	5	0
8/20	1,250	Horseshoe Bend S.C.	CEDP	1,250	6	64.50

Appendix 2 cont'd.

Date (1986)	Fry salvage No.	Salvage site	Relocation site		Time (hours)	Wages ($)
9/7	2,300	Ashburnham Cr.	Upper Robertson	2,300	2	17.00
9/7	1,600	Robertson	CLSES	1,600	2	17.00
9/10	155 ct					
	10 rb	Mayo Pond	Cowichan L.	85		
			CLSES	80	4	0
9/11	2,500	Robertson R.	Upper Robertson	2,500	4	32.0
9/12	3,000	Robertson R.	Grant Lake	3,000	4	32.0
9/16	600	Robertson R.	Upper Robertson	600	3	39.00
9/16	200	Meade S.C.	Cowichan L.	200	2	17.00
Totals	174,291			174,291	567	4,224.25

Appendix 3: Preliminary Coho Colonization Biostandards

Government of Canada / Gouvernement du Canada

MEMORANDUM **NOTE DE SERVICE**

TO / À
R. Kadowaki
Head, Coho Salmon Program
Fisheries Research Branch

FROM / DE
B. D. Tutty
Biologist, Habitat Management
South Coast Division
Fisheries Branch

SECURITY - CLASSIFICATION - DE SÉCURITÉ
OUR FILE/NOTRE RÉFÉRENCE
YOUR FILE/VOTRE RÉFÉRENCE
DATE: January 29, 1987

SUBJECT / OBJET: Regional Coho Colonization Biostandards

The request for coho colonization data summaries (November 18, 1986) have been received and collated on the attached draft table. A total of 17.5 million coho fry have been colonized into above barrier habitats to 1986, excluding many CEDP and other enhancement projects not included in this overview. This is rather a fantastic investment and undertaking considering what is known! I encourage further investigation of this data base so that high and low survivals from the various target habitats can be determined with a view that improved management strategies should follow.

We plan to use the survival range as part of the 1986 Cowichan Fry Salvage/Colonization Assessment.

B. D. Tutty

BDT/dl

cc: R. Higgins

Government of Canada / Gouvernement du Canada

MEMORANDUM NOTE DE SERVICE

TO / À: DISTRIBUTION

FROM / DE: B. Tutty
Habitat Biologist
South Coast Division

SECURITY - CLASSIFICATION - DE SÉCURITÉ:

OUR FILE/NOTRE REFERENCE: 5300-4-2

YOUR FILE/VOTRE REFERENCE:

DATE: November 13, 1986

SUBJECT / OBJET

Coho Colonization Biostandards
Cowichan River Coho Colonization Program

The Habitat Section of the South Coast Division has been asked by R. Kadowaki, Head, Coho Salmon Program, to coordinate a preliminary review of the biological expectations which we could expect from colonization of inaccessible rearing habitats. The information gained from the review will be used specifically to evaluate the economics of the 1986 Cowichan Fry Salvage Program. However, these planning standards also provide an operational foundation in this Division for the Area Manager and A.P.C. to review and plan where and how this type of production could best be utilized. (It may be prudent to quickly expand this initial review to incorporate a Regional overview of coho colonization.)

Should the investigative work currently underway produce further positive results, a significant coho production strategy would be apparent based on the preliminary historical findings attached. By way of this memorandum, if there are any other results of historical or ongoing coho colonization/ augmentation activities, would you please add the information to the list and return a copy to me by December 1, 1986.

Thanks for your help in this cooperative investigative phase.

B. Tutty

BT/lr

Attach.

Distribution:

R. Kadowaki
T. Fields
T. Morris
T. Burns
R. Slater
R. Bams
G. Bonnell
K. Pitre
A.D. Anderson
T. Shardlow
R. Higgins
T. Perry

cc: A. Wood
G. Jones

TABLE 1 COHO COLONIZATION/AUGMENTATION SURVIVAL DATA (FROM HEAD RECOVERY DATA BASE)

				COHO RELEASED TO DONOR HABITATS								HARVEST											ESCAPEMENT					
							RELEASE					CATCH OF MARKED FISH					ESTIMATED TOTAL CATCH											
SPECIES	INCUBATION FACILITY	BROOD YEAR	BROOD SOURCE	RELEASE SITE	RELEASE CODE	RELEASE DATE	SIZE (gm)	C,W,T,	NUMBER TAGGED	NUMBER RELEASE	$ FRY/ SMOLT SURVIVAL	CANADA NET	CANADA TROLL	CANADA SPORT	USA	TOTAL CAUGHT	CANADA NET	CANADA TROLL	CANADA SPORT	USA	TOTAL CAUGHT	PERCENT CAUGHT	TAGGED ESCAP. TO RIV.	TOTAL ESCAP. TO RIV.	TOTAL ADULT C&E RTN.	TOTAL RECOVERY (TAGGED)	PERCENT EXPLOIT. RATE	TOTA $ SURV
Coho	Nanaimo	1980	Nanaimo	N.Nan.Trib.	Aug.	07-81	3.6	02-19-35	15249	15881		29	97	27	0	153	30	101	28	0	159	1.0						
Coho	Nanaimo	1980	Nanaimo	N. Nanaimo	Aug.	07-81	4.5	02-21-04	15779	15779		81	265	140	2	488	81	265	140	2	488	3.1						
Coho	Nanaimo	1980	Nanaimo	Millstone R	Colon.	08-81	4.2	02-21-05	15554	15554		96	147	30	6	279	96	147	30	6	279	1.8						
Coho	Nanaimo	1980	Nanaimo	Haslam Ck.	Aug.	08-81	3.6	02-21-06	15275	15275		29	93	58	19	199	29	93	58	19	199	1.3						
Coho	Nanaimo	1981	Nanaimo	Upper Nan.R.	Aug.	08-82	3.8	02-23-44	14780	14780		32	196	25	0	253	32	196	25	0	253	1.7						
Coho	Nanaimo	1981	Nanaimo	North Nan. R.	Aug.	07-82	2.5	02-23-45	15026	15026		36	427	140	0	603	36	427	140	0	603	4.0						
Coho	Nanaimo	1981	Nanaimo	Lower Nan. R.	Aug.	08-82	3.0	02-23-46	14870	14870		45	304	80	0	429	45	304	80	0	429	2.9						
Coho	Nanaimo	1981	Nanaimo	Lower Nan. R.	Aug.	08-82	3.1	02-23-47	13590	13590		44	254	47	0	345	44	254	47	0	345	2.5						
Coho	Nanaimo	1981	Nanaimo	Napoleon Ck.	Colon.	08-82		02-20-30	3958	3958		43	66	36	0	145	43	66	36	0	145	3.8						
Coho	Nanaimo	1982	Nanaimo	Napoleon Ck.	Colon.	08-83	6.8	02-24-55	9852	9852		102	175	85	0	362	102	175	85	0	362	3.7						
Coho	Nanaimo	1982	Nanaimo	North Nan. R.	Aug.	08-83	4.5	02-24-56	8200	8200		35	229	76	0	340	35	229	76	0	340	4.1						
Coho	Nanaimo	1982	Nanaimo	Lower Nan. R.	Aug.	08-83	6.0	02-24-57	10097	10097		42	111	41	0	194	42	111	41	0	194	1.92						
Coho	Nanaimo	1982	Nanaimo	Millstone R.	Colon.	08-83	6.0	02-25-07	14775	34000		94	237	95	0	426	218	551	221	0	990	2.9						
Coho	Sooke PIP	1981		Sooke R.		06-82	2.0	02-24-20	59876	59876		4	228	12	0	244						0.4						
Coho	Sooke PIP	1981		Sooke R.		06-82	2.0	02-24-21	10210	10210		4	43	8	0	55						0.5						
Coho	Quinsam	1977	Quin. R.	Upper Quinsam	Colon.	10-78	7.9	02-17-25	100753	199751		813	1086	1236	137	3272	1610	2150	2447	271	6478	3.2	415	822	3687	7300	88.7	3.6
Coho	Quinsam	1978	Quin. R.	Upper Quinsam	Colon.	09-79	4.9	02-17-43	48235	121697		454	440	236	14	1144	1144	1109	595	35	2883	2.4	240	605	1749	4407	81.8	3.6
Coho	Quinsam	1978	Quin. R.	Upper Quinsam	Colon.	09-79	4.9	02-17-43	47528	120968		394	355	156	17	922	1001	902	396	43	2342	1.9	168	427	1090	2769	84.6	2.3
Coho	Quinsam	1979	Quin. R.	Upper Quinsam	Colon.	09-80	8.2	02-18-36	103592	199999		862	830	676	67	2435	1664	1602	1305	129	4700	2.4	736	1420	3171	6120	76.8	3.1
Coho	Quinsam	1980	Quin. R.	Upper Quinsam	Colon.	08-81	10.3	02-22-43	109428	296063		646	680	348	16	1690	1744	1836	940	43	4563	1.5	246	664	1936	5225	87.3	1.8
Coho	Quinsam	1982	Quin. R.	Upper Quinsam	Colon.	09-83	10.5	02-24-13	100425	243192		559	462	744	8	1773	1353	1118	1800	19	4291	1.8	763	1846	2536	6137	69.9	2.5
Coho	Quinsam	1983	Quin. R.	Upper Quinsam	Colon.	09-84	8.0	02-29-63	25191	25293		02	62	212	0	276												
Coho	Quinsam	1983	Quin. R.	Upper Quinsam	Colon.	09-84	8.0	02-29-62	25155	25358		02	66	136	0	204												
Coho	Quinsam	1983	Quin. R.	Lower Quinsam	Colon.	09-84	8.0	02-30-01	25362	25464		02	42	80	0	124												1
Coho	Quinsam	1983	Quin. R.	Lower Quinsam	Colon.	09-84	8.0	02-30-02	25086	25187		0	45	96	0	141												45
Coho	Quinsam	1984	Quin. R.	Lower Quinsam	Colon.	09-85	6.8	02-32-01	24857	24852																		
Coho	Quinsam	1984	Quin. R.	Lower Quinsam	Colon.	09-85	6.8	02-32-02	25653	25653																		
Coho	Quinsam	1984	Quin. R.	Upper Quinsam	Colon.	09-85	6.8	02-32-05	24712	24911																		1
Coho	Quinsam	1984	Quin. R.	Upper Quinsam	Colon.	09-85	6.8	02-32-07	24650	24849																		
Coho	Quinsam	1985	Quinsam		Colon.			R.V.	100076	100076																		
Coho	Puntledge	1980	Puntledge	Cr+ up. Punt.	Colon.	11-81	14.3	02-19-54	99783	203154						339					2733	1.4	355	725	1694	3458	79.0	1.7
Coho	Puntledge	1981	Puntledge	Up.Punt+Willm	Colon.	06-82	2.4	02-24-01	34759	458877																		
Coho	Puntledge	1981	Puntledge	Crunk+Comox L	Colon.	06-82	2.5	02-23-62	38034	497408																		
Coho	Puntledge	1981	Puntledge	Comox+Toma.	Colon.	08-82	2.5	02-23-63	33514	1661748																		
Coho	Puntledge	1982	Puntledge	Upper Punt.	Colon.	07-83	3.1	02-26-04	32732	467378		29	29	34	0	92	414	414	485	0	1313	0.3						
Coho	Puntledge	1982	Puntledge	Crunk L.	Colon.	07-83	3.5	02-26-03	36878	301638		78	32	49	0	159	650	267	408	0	1325	0.4						
Coho	Puntledge	1982	Puntledge	Comox	Colon.	07-83	3.1	02-24-07	36978	1925465		21	38	29	0	88	1105	2000	1526	0	4631	0.24						
Coho	Puntledge	1983	Puntledge	Comox L.	Colon.	06-84	3.9	02-27-62	36769	2086582																		
Coho	Puntledge	1983	Puntledge	Upper Punt.	Colon.	06-84	3.9	02-27-63	35439	426068																		
Coho	Puntledge	1983	Puntledge	Cruickshank R.	Colon.	06-84	3.9	02-28-01	36728	422063																		
Coho	Puntledge	1983	Puntledge	Halldimmer L.	Colon.	08-84	7.4	02-29-03	10417	148500																		
Coho	Puntledge	1983	Puntledge	Blue Grouse	Colon.	08-84	7.4	02-29-06	10728	35784																		
Coho	Puntledge	1983	Puntledge	Little Lost L.	Colon.	08-84	7.4	02-29-04	10394	35450																		
Coho	Puntledge	1983	Puntledge	Lower Lost L.	Colon.	08-84	7.4	02-29-05	9524	70854																		
Coho	Puntledge	1983	Puntledge	Constitution	Colon.	08-84	7.4	02-29-02	7727	54601																		
Coho	Puntledge	1984	Puntledge	Blue Grouse L.	Colon.	08-85	2.8	02-31-52	18585	32985																		
Coho	Puntledge	1984	Puntledge	Lost Lake	Colon.	08-85	2.8	02-31-54	19999	71114																		
Coho	Puntledge	1984	Puntledge	Constitution	Colon.	09-85	4.2	02-31-56	19949	31997																		
Coho	Puntledge	1984	Puntledge	Comox L.	Colon.	06-85	3.5	02-32-31	32069	2733945																		
Coho	Puntledge	1984	Puntledge	Little Lost L.	Colon.	08-85	2.8	02-31-53	19979	34196																		
Coho	Puntledge	1984	Puntledge	Hall Diver L.	Colon.	08-85	2.8	02-31-55	20358	126482																		
Coho	Puntledge	1984	Puntledge	Wilm P. Lk.	Colon.	07-85	3.5	02-32-32	36672	255553																		
Coho	Puntledge	1984	Puntledge	Cruickshank	Colon.	07-85	3.5	02-32-33	36131	236916																		
Coho	Puntledge	1985	Puntledge	Comox Lk.	Colon.	07-86	3.7	02-40-60	33321	914145																		
Coho	Puntledge	1985	Puntledge	Will. + For L	Colon.	07-86	4.0	02-36-55	29205	252131																		
Coho	Puntledge	1985	Puntledge	Cruickshank	Colon.	07-86	3.7	02-40-58	29687	329937																		
Coho	Puntledge	1985	Puntledge	Constitution	Colon.	07-86	3.7	02-35-30	17978	19756																		
Coho	Puntledge	1985	Puntledge	Blue Grouse	Colon.	07-86	3.8	02-35-32	17774	40056																		
Coho	Puntledge	1985	Puntledge	Litt. & Low.L.	Colon	07-86	3.7	02-25-33	18438	89212																		
Coho	Puntledge	1985	Puntledge	Halldiver	Colon.	07-86	3.9	02-25-34	19613	97001																		

COHO COLONIZATION/AUGMENTATION SURVIVAL DATA (FROM HEAD RECOVERY DATA BASE)

				COHO RELEASED TO DONOR HABITATS								HARVEST										ESCAPEMENT					
				RELEASE							$ FRY/	CATCH OF MARKED FISH					ESTIMATED TOTAL CATCH						TAGGED	TOTAL	TOTAL	TOTAL	PERCENT	TOTAL
SPECIES	INCUBATION FACILITY	BROOD YEAR	BROOD SOURCE	RELEASE SITE	RELEASE CODE	RELEASE DATE	SIZE (gm)	C,W,T,	NUMBER TAGGED	NUMBER RELEASE	SMOLT SURVIVAL	CANADA NET	CANADA TROLL	CANADA SPORT	USA	TOTAL CAUGHT	CANADA NET	CANADA TROLL	CANADA SPORT	USA	TOTAL CAUGHT	PERCENT CAUGHT	ESCAP. TO RIV.	ESCAP. TO RIV.	ADULT C&E RTN.	RECOVERY (TAGGED)	EXPLOIT. RATE	$ SURV.
Coho	Nitinat	1982	Nitinat	Litt. Nitinat	Colon.	06-83	4.1	02-25-47	51167	51167		469	1026	5	0	1500	469	1026	5	0	1500	2.9						
Coho	Conuma	1982	Conuma	Upper Conuma	Colon.	05-83	2.5	02-22-61	69695	79920		113	221	0	0	334	50	254	0	0	384	0.5						
Coho	Conuma	1982	Conuma	Conuma	Colon.	09-83	4.0	02-26-01	38204	a1090		4	0	0	0	4	6	0	0	0	6	0.0						
Coho	Nanaimo	1984	Millstone	Brannen L.	Colon.	16-07-85	3.6	None	-	26221	6.76%																	
Coho	Nanaimo	1984	Millstone	Brannen L.	Colon.	15-09-85	5.8	None	-	11300	18.7 %																	
Coho	Nanaimo	1984	Millstone	Millstone R.	Colon.	17-07-85	3.6	None	-	29447	17.7 %																	
Coho	Courtney	1984	Trent	Bradley L.	Colon.	30-06-85	2.4	None	-	18185	19.6 %																	
Coho	Courtney	1984	Trent	Up. Trent R.	Colon.	03-07-85	2.4	None	-	7500	5.3 %																	
Coho	Cowichan	1984	Cowichan	Grant L.	Colon.	09-08-85	5.0	None	-	53103	18.8 %																	
Coho	Cowichan	1985	Cowichan	Grant L.	Colon.	01-08-86	3.8	None	-	76157	-																	
Coho	Cowichan	1985	Cowichan	Kelvin Cr.	Colon.	15-08-86	1.9	None	-	14600	-																	
Coho	Cowichan	1985	Cowichan	Kings Cr.	Colon.	14-08-86	1.6	None	-	13000	-																	
Coho	Pallant	1980	Pallant	Pallant Cr.	Colon.	06-81	5.2	02-22-20	39643	40843																		
Coho	Pallant	1980	Pallant	Up. Pallant	Colon.	06-81	4.6	02-22-21	31587	32387																		
Coho	Pallant	1981	Pallant	Mosquito L.	Colon.	02-82	4.9	01-24-02	31282	68023																		
Coho	Pallant	1982	Pallant	Up. Pallant	Colon.	06-83	4.5	02-25-35	47951	59727																		
Coho	Pallant	1982	Pallant	Pallant	Colon.	06-83	4.0	02-24-49	48143	98751																		
Coho	Pallant	1982	Pallant	Mosquito L.	Colon.	06-83	5.2	02-24-03	15475	26968																		
Coho	Pallant	1983	Pallant	Pallant	Colon.	06-84	2.4	02-27-46	49542	99186																		
Coho	Pallant	1984	Pallant	Braverman	Colon.	06-85	1.6	02-32-50	49561	103653																		
Coho	Pallant	1984	Pallant	Pallant	Colon.	06-85	1.6	02-32-49	47576	102822																		
Coho	Pallant	1985	Pallant	Braverman	Colon.	06-85	1.8	02-35-26	21375	54565																		
Coho	Pallant	1985	Pallant	Braverman	Colon.	06-85	1.8	02-35-27	21351	54236																		
Coho	Pallant	1985	Pallant	Braverman	Colon.	06-85	1.8	02-35-28	21384	54044																		
Coho	Pallant	1985	Pallant	Braverman	Colon.	06-85	1.8	02-35-29	21113	53619																		
Coho	Pallant	1985	Pallant	Mosq. Lk.	Colon.	06-85	1.9	02-39-30	9992	17203																		
Coho	Pallant	1985	Pallant	Mosq. Lk	Colon.	06-85	1.9	02-39-31	10006	17238																		
Coho	Pallant	1985	Pallant	U. Pallant	Colon.	06-85	1.9	02-39-32	10596	10703																		
Coho	Pallant	1985	Pallant	U. Pallant	Colon.	06-85	2.0	02-39-33	9942	10063																		
Coho	Pallant	1985	Pallant	Mosq. Cr.	Colon.	06-85	1.9	02-39-34	10646	30808																		
Coho	Pallant	1985	Pallant	Pallant	Colon.	06-85	1.6	02-39-26	10584	25843																		
Coho	Pallant	1985	Pallant	Pallant	Colon.	06-85	1.6	02-39-27	9629	23750																		
Coho	Pallant	1985	Pallant	AB Falls	Colon.	06-85	2.0	02-39-28	10639	10896																		
Coho	Pallant	1985	Pallant	Mosq. Lk.	Colon.	06-85	1.9	02-39-29	9872	17200																		
Coho	Pallant	1985	Pallant	Pallant	Colon.	06-85	1.6	20-39-25	10713	25824																		

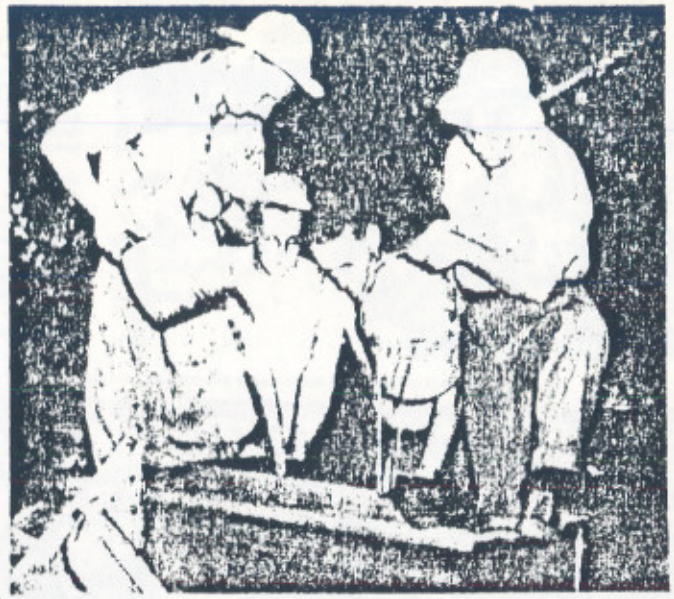
GRAND TOTAL 17,424,101

Victoria Daily Times

VICTORIA, B.C., THURSDAY, AUGUST 21, 1952 13

Thousands of inch-long young salmon are "rescued" daily by federal fisheries department workers from streams which are drying up. Above, Inspector Archie Sherman, Duncan, and Guardian George Lovitt, Victoria, drag net through channel of Cowichan River.

These shining fry (young chum, coho, sockeye, spring or humpback) have been rescued from certain death in a fast-disappearing pool. They will live to swell commercial fishermen's catch in two, three or four years. Working in annual "salmon fry salvage" are Inspector Sherman, sportsman Albert Atkinson, Guardian Lovitt and Gordon Evans, secreary of Cowichan Fish and Game Association.



When salmon fry must be transported long distances to running streams, they are poured into trailer-mounted water tank containing block of ice. Ice keeps water temperature down and at same time aerates water, keeping young fish alive. Trailer in many cases is backed into running stream and young fish "flushed" out. Work is carried on from April to August. (Times Photos.)

If the distance to a running stream is short, the rescued young salmon are carried in buckets and poured into their fresh new environment. Sometimes a ditch is dug from drying up river channels to running streams so the salmon can escape.

If the moving waterway is fairly distant, they are placed in the trailer-mounted water tank with a bobbling block of ice. The ice performs the necessary life and death job of keeping the water cool, at the same time aerating it. If ice isn't used, air must be pumped into the tank to keep the "young'uns" alive.

The young chum salmon migrate to the sea immediately after they mature to the point where they have shaken free from the egg which is attached to the underside of their bodies. They have already had a struggle fighting their way up through a foot of gravel where their life started in egg form. They are in the "alevin" stage when the egg, from which they are feeding, is still attached to them.

The coho and spring salmon, however, wait until they are one year old before taking off to the ocean.

ENJOY LABORS

A cheery lot, the fisheries workers enjoy their salvage work and only regret that more commercial fishermen don't appreciate the value of the salmon fry salvage.

"Our work means dollars in the pockets of commercial fishermen," said one worker.

Of course, it also puts more salmon in the ocean for the sport fishermen. Realizing this, members of the Cowichan Fish and Game Association, headed by Albert Atkinson of Duncan, have volunteered to aid in the work.

The work of the fisheries department has increased because of the heavy industrialization of rivers and the logging off of watershed areas.

Less foliage on the mountains means the water run-off is sudden instead of gradual. This causes dried up streams in summer, and thousands of "landlocked" fry must be rescued.

THEY FISH FOR LITTLE FELLOWS

Fingerlings Rescued From Nature's Traps

By GORDON FORBES

Vancouver Island rivers and streams are being prowled day and night by 17 men whose main purpose in life is to make money for other men and their families.

They are the enthusiastic, hard-working fisheries inspectors and guardians of the federal government's fisheries department.

They are engaged in the important "salmon fry salvage," an annual task starting about April and lasting until August.

Briefly, the work entails the transfer to running streams of thousands of wiggling, darting, inch-long (fry), and their one-year-old counterparts (fingerlings or yearlings) from waterways which are drying up.

This saves the lives of the young ones, and in a few years' time provides a larger harvest for commercial fishermen who reap the benefits of the fisheries department's workers' back-breaking effort in latter payrolls.

THOUSANDS SAVED

To date this season, 316,050 "fry" have been salvaged from drying rivers and streams on the island, dumped into moving water and allowed to continue their life span—to the monetary benefit of the commercial fisherman. The same work is being done all over B.C.

These "released" young salmon have a potential value at maturity of $252,840 to British Columbia's $90,000,000 fishing industry—no small accomplishment for a small group of "fish-saving" civil servants. The value is based on calculations after an estimated 20 per cent loss to ocean prey.

In other words, the work of the federal fisheries department on the island alone has made another $252,840 worth of salmon available to the fishermen. These young salmon otherwise would have died, and been lost to the industry in dried-up waterways far from the money-making commercial fishing areas.

Thus, the fisheries inspectors and guardians and their helpers are dedicated to the preservation of the young wish so they can grow large enough to be of commercial value and give additional raw material to the fishing industry.

The work of salvaging the young salmon, which may be coho, chum, sockeye, spring or humpback, is done by manual labor, often between 6 a.m. and 10 a.m. The man on the job don't get paid overtime, either.

The fisheries' men wade into dwindling streams, or pools left when the river levels fall, and pull hand dragnets through the water, catching thousands of the struggling young salmon.

They are dumped into containers and transported to running streams, sometimes in small car-drawn trailers with mounted water tanks.

Sept. 1952

Features Books Records

MAGAZINE

Music and Drama Humor

VANCOUVER, BRITISH COLUMBIA, SATURDAY, SEPT. 13, 1952

These Fishermen Are After the Little Ones

Salmon fry salvage in B.C. is big job

By L. G. SWANN

A "FISH fry" normally calls to mind a deep pan on a hot stove, where, in sizzling fat, floured and bread-crumbled fillets are turning to a delicious light brown. But to Canadian fishery officers in B.C., fish fry means something quite different.

It means heavy responsibility; frequently a lot of little lives to save at the most inconvenient places.

That's when "fry" refers to young salmon which have emerged from gravel beds of our inland streams, after spending a winter as eggs and emerging in the spring as tiny, free swimming fishes. From the time they are deposited in the gravel as eggs by the parent fish, until they finally reach salt water, Pacific coast salmon are subject to heavy mortality from various natural causes, such as predator birds, animals and fresh water fishes. About most of these things little can be done, but about losses from unfavorable stream conditions, something has been done right along—with gratifying results.

Fry salvage, it's called, and it is a major item on the itinerary of quite a few officers of the Federal Department of Fisheries.

An estimated one million salmon, mostly Cohoe and Spring, and some Chum, are saved annually in this province.

Recently I followed Fisheries Inspector Archie Sherman along a bank of the Cowichan River after we had driven some few miles west of Duncan on Vancouver Island. At this point the stream snaked through second growth of alder, spruce and cedar.

It was pretty. The sun was shining and the main stream was sparkling and lively as it bustled towards the salt water of Cowichan Bay. But close to the bank was something else again.

A stretch of water about a quarter of a mile long and a few yards in width was separated from the river by a wide bar of gravel. Here the water was still and warm; it looked peaceful and kindly, but actually there was tragedy under the calm. Little fish were dying.

We were joined by volunteer helpers: Albert Atkinson, president, and Gordon Evans, secretary, of the Cowichan Fish and Game Club who, with Fisheries Guardian G. L. Lovitt and the inspector, made up the fry salvage crew.

The idea was to get the young salmon out of these killing stagnant pools and put them into the cool and aerated waters of the main Cowichan River. That's just what they did—and that's what Federal fisheries officers are doing right along in various parts of the province.

Two kinds of nets are used. One is a hand dip net, fastened to two sticks, which a man pushes along in front of him as he wades through the pool. The other is a small beach-seine type of net, with a line of corks to float the top and a leadline to keep it stretched vertically. Two men operate this, traversing the pool abreast with the net stretched to its full length.

At the end of the first sweep hundreds of wriggling little critters were brought to the edge of the pool in both types of net. Without delay these were carefully shaken into pails of water. Some were in poor shape, listless and hardly moving, but two or three pourings back and forth from one pail to another, bromo seltzer style, seemed to give them new life.

One man apiece took a pail and made fast time over fifty yards of gravel to the river. There the fry were poured into water which would give them safe passage to the sea. You could see them plainly. They schooled up among the smooth rocks, stayed around for a few minutes—getting their bearings and probably savoring the feel of cold water. Then, by twos and threes, they started out to see what was cooking in those deeper reaches.

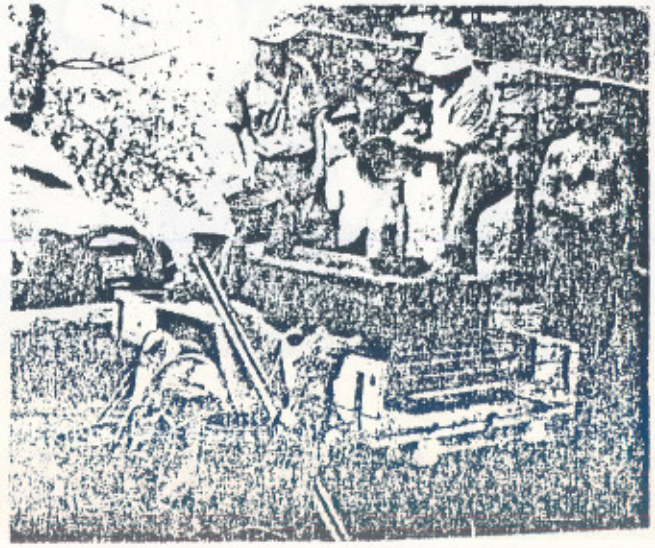
Occasionally the pools are so far cut off from the main stream that hand-carrying in pails is not practicable. So what? So then the little fishes get a road trip. The youngsters after netting are poured from pails into tin cans or a specially constructed tank, carried on an automobile trailer. Then the car is driven to a part of the river where the fish can be rehabilitated without undue loss. Salmon fry have been carried in this manner for distances up to forty miles, but as a rule fisheries men try to make the trips as short as possible.

Actually the campaign starts in the preceding fall, when fisheries men tour the rivers to observe spawning conditions. They note where heavy spawning has taken place; make sketches of certain areas which look as if they may dry out in the spring.

In late spring and early summer, when river levels start dropping, they are out there fighting to keep water over gravel which, they know, contains embryo salmon. With shovels they ditch and dam, to divert water from one place to another, where it will do the most good.

Later comes the inevitable stage when some of the little ones are cut off. That's when they pick 'em up and put 'em back where they belong ●

The wee salmon are taken from the streams that are drying up.



SALVAGING SALMON

Project aids survival of fish

By KEITH NORBURY

The chances of a salmon fry surviving to adulthood are slim at best. When streams in which they spend their first year of life dry up, as often occurs in the Cowichan River system, the fry have no chance at all.

Enter Ted Burns, freelance biologist, with a federal department of fisheries and oceans' project to save those fry from an untimely demise. Burns is the coordinator of a fry salvage project which expects to relocate Coho fry from diminishing stream beds to higher, safer, reaches of the watersheds of local rivers.

Two local groups are involved in the project. The Community Economic Development Hatchery, operated by the Cowichan Indian Band, and the Cowichan Lake Salmonid Enhancement Society, a volunteer group. The hatchery takes care of the area down river of Skutz Falls. The society looks after streams in the upper watershed.

The society is hoping to secure grants, either from government or service clubs, to hire high school students to assist Burns, [illegible] the project's only paid [illegible].

The fry salvage is just part of the local salmonid enhancement picture, but it has become the significant part, says Leo Nelson, society president.

"It started this time last year, when Ted advised us of the fry salvage program," Nelson said. Since then the society has helped prolong the lives of thousands of salmon.

Nelson, who operates a plumbing and heating business, will spend much of the summer wading in receding streams with a fine meshed seine net.

"Summers are slow, so I have to do something."

Society president for the past three years, Nelson has concentrated on other enhancement projects in the past. His home overlooks Beaver Creek, which the society had earlier dredged for more than a mile to create a proper spawning bed. Last year the society introduced 130,000 additional fry to the stream, which had been home to 100 spawners in 1982.

The society now concentrates on fry relocation.

Burns expects to relocate 633,600 fry this summer. Of those, 233,600 will go to headwater streams, the other 400,000 to lakes, primarily Quamichan and Grant.

Of the headwater fry, Burns expects 18,000 to become smolts, and 2,800 to mature to adults, with 560 returning to spawn. Fry relocated in lakes will fare better because of more favorable wintering conditions. Roughly half will become smolts, with 30,000 reaching adulthood. Burns anticipates 6,000 returning to the Koksilah and Cowichan River systems.

The remaining 26,240 Coho will end up on barbecues, in cans, or on the table, enriching the sport, commercial, and Indian food fisheries. At a conservatively priced $3 a pound, the value of the salmon saved is more than $75,000. And these were fish that would have died.

The vast numbers of spawners may create a traffic jam on such streams as Quamichan Creek because falls on the creek will prevent fish from returning to the lake. Burns said the problem can be solved by taking the eggs from the excess salmon to the hatchery and releasing the subsequent fry to the lake.

While Burns has been dabbling with fry salvage since 1982, this is the first year he has worked with a plan. The plan is a direct result of severe drought last summer. The dry weather created a worse-case scenario usually seen once every 40 years.

"That was a help," Burns said. "The drought last year gave us the bottom line of the worst possible habitant conditions."

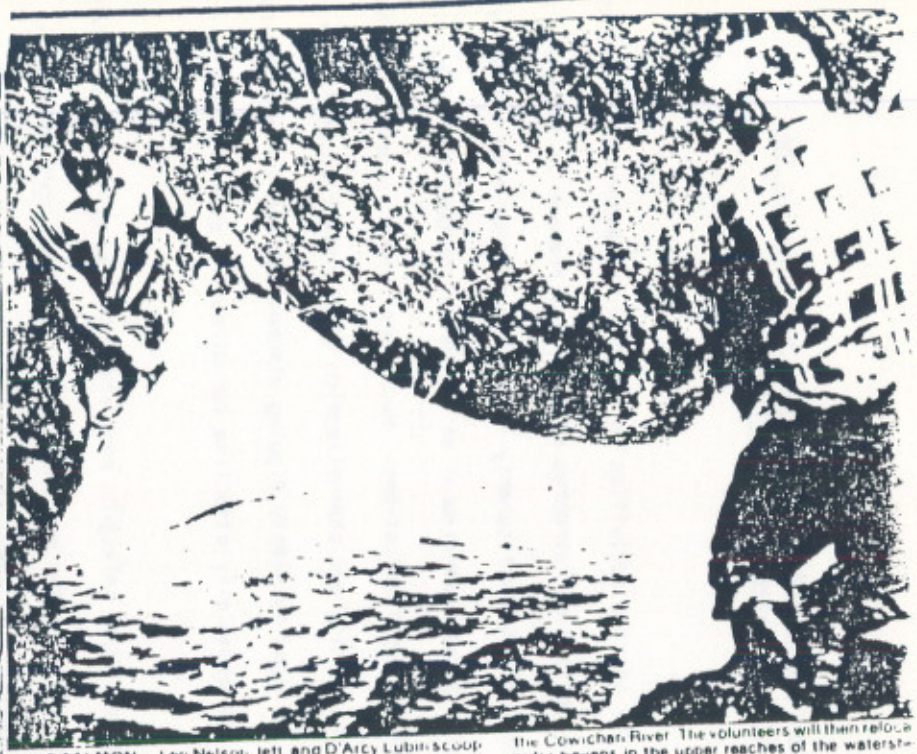
Burns now knows which streams will dry up and can act accordingly. In a typical year, the streams will dry up but only for a week or so. In a bad year, they remain dry from July to September. One year in five, they won't dry at all, such as the summers of '76 and '83.

"Eighty-six started out to look like that kind of year," Burns said. Indeed, recent rains are all that have maintained a flow in certain creeks.

Burns will also track the progress of the fry. Where confusion might arise between stocks from different groups, he will clip fins or nick tails. It increases the risk of individual fry mortality, as does the relocation itself, but says Burns, "It's a small price to pay if you get good information."

Keith Norbury photos

HANDLING WITH CARE ... It's not the recommended method of extracting fry from the river, but an algae-clogged net left Leo Nelson no choice but to gingerly pick Coho fry by hand.



[illegible]VING SALMON ... Leo Nelson, left, and D'Arcy Lubin scoop [illegible]ho fry from certain death in soon-to-diminish tributary of the Cowichan River. The volunteers will then relocate safer havens in the upper reaches of the watersh[illegible]

Keith N[illegible]

APPENDIX 5. Historical Review of Fry Salvage Activities in the Cowichan Watershed (1937-1986).

Historical Synopsis

The earliest record of fry salvage activities in the Cowichan Watershed is by Carl (1937) and Sherman (1938). Initial effort was directed at early fry trapped in temporary pools and side channels along the Cowichan River, particularly in the RiverBottom area and below White Bridge. Prior to 1956 when the weir became operational at the outlet of Cowichan lake, river levels were subject to considerable spring fluctuations. Much more lateral side channel habitat existed below the White Bridge before dyking and channelization of the river began in the 1950s. During this period, many fry were salvaged by simply digging ditches between isolated pools and the main channel. This technique was especially effective for directing chum fry back to the main river.

By 1946, Fisheries personnel began salvaging coho fry from drying reaches of Cowichan Lake tributaries. Rescue effort on the mainstem continued until 1973 when work shifted to concentrate on Cowichan Lake tributaries. An noteworthy exception to this pattern occurred in 1983 when fry salvage activity was entirely from the Cowichan mainstem.

With occasional exceptions, fry release sites were not recorded until 1975. A review of fry salvage reports of Lake Cowichan tributaries indicate many fish were moved progressively upstream to avoid dewatering. This necessitated repeated handling of the fish.

Salvage crews employed a truck-mounted tank to transfer fry as early as 1952.

Budget reports for fry salvage work have not been recorded to our knowledge. Newspaper accounts in 1952 indicate that four people worked that year; two fisheries employees and two volunteers from the Cowichan Fish and Game Club. Annual reports from other years indicate that two or three Fisheries personnel did the work with occasional assistance from volunteers.

The 1983 fry salvage work was undertaken through a Fisheries Employment Bridging Assistance Program (FEBAP). Wages of $300.00 per week were paid to the employees. Eight people spent eight weeks on fry salvage for a salary cost of $19,200.00 with unknown, but significant, operations expenses. A total of 497,336 salmonid fry were salvaged that year.

(Appendix 5: continued)

CHRONOLOGICAL SUMMARY OF FRY SALVAGE RECORDS (1937 - 1985).

Year

1937 Fry salvage activities occurred on the Lower Cowichan.

1938 836,500 fry were salvaged from Cowichan River side pools by ditching and hand netting.

1939

Capture sites	Fry Caught	Release sites
Cowichan R.	136,200	Cowichan R.
Kelvin Cr.	800	Unknown
Meade Cr.	8,000	"
Holmes (Bing's) Cr.	5,000	"
Unknown	18,500	"
Total	168,500	

84,800 coho
65,000 chum
16,900 chinook
1,800 steelhead

Duration : April 15 - September 15, 1939.

1940 No report.

1941 55,200 fry salvaged from the Cowichan River; 5,200 by netting, 50,000 by ditching. Duration: March 21 - July 3, 1941.

1942 During the 1941-42 spawning season, high water permitted spawning high on gravel bars. At fry emergence time, the river had dropped a foot below normal spring levels causing a very serious dewatering condition. Some small impoundments were constructed to flood these areas so emergent fry could escape from the perched gravels. Ditches were dug to provide escape routes for fry. Fry were also dip-netted from pools where conditions were favourable. A total of 974,650 fry was released to the Cowichan River between April 16 and July 16, 1942.

Appendix 5 (continued)

1943 The river maintained a favourable level throughout the spawning and incubation period, eliminating the need for the previous year's extraordinary efforts. Streams maintained very favourable levels well after fry emergence. A total of 131,000 fry (2,000 chinook, 78,000 coho, and 51,000 chum) were netted and released in the Cowichan River.

1944 Salmonids that spawned in the main river experienced favourable water levels during the incubation and fry emergence period. A total of 400 coho fry were salvaged from Robertson River by net.

1945 No data, however salvage need was slight and numbers were "very low compared to some former years".

1946 An unusual spring freshet kept the water level of the Cowichan River high for an extended period that spring, resulting in a very satisfactory escapement of fry to the river. Summer drying in Robertson River and Meade Creeks necessitated considerable work.

Capture sites	Fry Caught	Release sites
Robertson R.	68,000	Robertson R.
Meade Cr. (N.Fk.)	62,500	Cowichan R.
Meade Cr. (S.Fk.)	54,000	Cowichan R.
Kelvin Cr.	2,000	Kelvin Cr.
Total	186,500	

Exact catch composition unknown but "practically all coho."

Duration: April 14 to August 17, 1946

1947

Capture Sites	Fry Caught	Release sites
Cowichan R.	126,000 chum	Cowichan R.
	30,500 coho	"
Glenora Cr.	9,025 coho	"
	275 steelhead and cutthroat trout	"

Appendix 5 (continued)

Meade Cr. (N and S Forks), Robertson River, Cottonwood Cr., Beadnell Cr., Green's Cr., and Bear (Mesachie) Cr. are grouped	48,475	coho	Unknown "
	15	chinook	"
	1,055	trout	"
Total	215,345		

126,000 chum
88,000 coho
1,330 trout
15 chinook

Catch composition:

Duration: April 22 to July 19, 1947.

1948

Capture Sites	Fry Caught		Release sites
Koksilah R.	3,950	coho	N.S.
	4,000	chum	Koksilah R.
Kelvin Cr.	2,850	coho	N.S.
Glenora Cr.	4,870	coho	N.S.
Cowichan R.	4,000	chinook	Cowichan R.
	120,060	chum	Cowichan R.
	4,850	steelhead	Cowichan R.
Neilson Cr.	5,000	coho	N.S.
Meade Cr.	68,570	coho	N.S.
Robertson R.	14,655	coho	N.S.
Total	232,805		

124,060 chum
99,895 coho
4,000 chinook
4,580 steelhead

Catch composition:
Duration: unknown.

1949 375,850 fry salvaged (700 chinook, 205,450 coho, 163,500 chum, 6,300 steelhead).

1950 206,500 fry salvaged (1,400 chinook, 101,700 coho, 98,800 chum, 4.100 steelhead, 500 trout).

1951 High spring water levels provided favourable conditions for fry emergence in Cowichan Lake tributaries, particularly Robertson River and Nixon Creek, until early July. When fry salvaging activities became necessary, a forest closure was imposed to protect against fire which prevented salvage operations. Thousands of fry were lost. In one small reach of Nixon Creek, it was estimated that no less than 100,000 coho fry perished.

Appendix 5 (continued)

Capture Sites	Fry Caught	Release Sites
Cowichan River	1,225 chinook	Unknown
	37,000 coho	"
	68,000 chum	"
	1,100 steelhead	"
Stoltz (Dale's) Cr.	6,000 coho	"
Koksilah R.	3,900 coho	"
	300 steelhead	"
Kelvin Cr.	2,500 coho	"
Glenora Cr.	28,500 coho	"
Meade Cr.	15,500 coho	"
Robertson R.	5,000 coho	"
Nixon Cr.	9 coho	"
Total	179,034	

1,225	chinook
98,409	coho
68,000	chum
1,400	steelhead

Catch composition:
Duration: unknown.

1952 125,450 fry salvaged (2,000 chinook, 88,000 coho, 292,150 chum, 5,400 steelhead, 900 trout).

1953 No report.

1954

Capture Sites	Fry Caught	Release Sites
Cowichan R.	250 chinook	Unknown
	19,450 coho	"
	29,500 chum	"
	300 steelhead	"
	50 trout	"
Koksilah R.	6,000 coho	"
	4,900 chum	"
Meade Cr.	4,000 coho	"
	100 steelhead	"
Glenora Cr.	21,900 coho	"
	200 steelhead	"
	300 trout	"
Holmes (Bing's) Cr.	300 coho	"
	25 trout	"
Kelvin Cr.	2,800 coho	"
	50 trout	"
Total	87,125	

Appendix 5 (continued)

Catch composition:

250	chinook
44,250	coho
34,400	chum
600	steelhead
425	trout

Duration: April 29 to August 13, 1954

1955	Capture Sites	Fry Caught	Release Sites
	Sutton	109,000 coho	Unknown
	Robertson	21,000 chum	"
	Glenora		"
	Somenos Trib.		"
	Lower Cowichan		"
	Total	130,000	

109,000	coho
21,000	chum

Catch composition:
Duration: unknown.

1956	Capture Sites	Fry Caught	Release Site
	Cowichan R.	24,500 coho	Unknown
		400 chum	"
		500 trout	"
	Koksilah R.	18,400 coho	"
		150 trout	"
	Kelvin Cr.	22,800 coho	"
		500 trout	"
	Glenora Cr.	5,200 coho	"
		15 trout	"
	Robertson R.	71,800 coho	"
		1,300 trout	"
	Ashburnham Cr.	8,100 coho	"
	Sutton Cr.	8,000 coho	"
	Meade Cr.	15,300 coho	"
		500 trout	"
	Cottonwood Cr.	1,200 coho	"
		35 trout	"
	Somenos Cr.	350 coho	"
		35 trout	"
	Nixon Cr.	14,300 coho	"
		300 trout	"
	Total	193,410	

189,650	coho
400	chum
3,360	trout

Catch composition:
Duration: unknown

Appendix 5 (continued)

1957	Capture Sites	Fry Caught	Release Sites
	Cowichan R.	51,400 chum	Unknown
		8,775 coho	"
		500 trout	"
	Koksilah R.	1,300 coho	"
		4,950 chum	"
		250 trout	"
	Kelvin Cr.	4,750 coho	"
		150 trout	"
	Glenora Cr.	850 coho	"
		50 trout	"
	Somenos Cr.	150 chum	"
		45 trout	"
		100 coho	"
	Robertson R.	17,600 coho	"
		100 trout	"
	Ashburnham Cr.	2,100 coho	"
	Sutton Cr.	1,500 coho	"
		130 trout	"
	Meade Cr.	6,400 coho	"
		500 trout	"
	Nixon Cr.	2,000 co	"
		100 trout	"
	Total	110,300	

52,850 chum
55,025 coho
2,425 trout

Catch composition:
Duration: unknown.

1958	Capture Sites	Fry Caught	Release sites
	Cowichan R.	51,200 chum	Unknown
		24,500 coho	"
		1,500 trout	"
	Koksilah R.	500 chum	"
		6,200 coho	"
		150 trout	"
	Kelvin Cr.	12,000 coho	"
		25 trout	"
	Glenora Cr.	5,000 coho	"
		35 trout	"
	Robertson R.	61,800 coho	"
		2,000 trout	"
	Ashburnham Cr.	2,100 coho	"
		50 trout	"
	Sutton Cr.	6,600 coho	"
	Nixon Cr.	400 coho	"
		50 trout	"

Appendix 5 (continued)

	Meade Cr.	10,500 coho	Unknown
		125 trout	"
	Cottonwood Cr.	450 coho	"
	Total	185,165	
	Catch composition:	128,550 coho 51,700 chum 3,935 trout	
	Duration: May 14 to August 26, 1958		

	Capture Sites	Fry Caught	Release Sites
1959	Cowichan R.	23,900 chum	Unknown
		45,450 coho	"
		445 trout	"
	Koksilah R.	6,900 coho	"
		100 trout	"
	Kelvin Creek	5,700 coho	"
		50 trout	"
	Glenora Creek	2,080 coho	"
	Robertson R.	50,500 coho	"
		1,100 trout	"
	Ashburnham Cr.	2,000 coho	"
	Sutton Cr.	500 coho	"
	Meade Cr.	8,000 coho	"
		175 trout	"
	Cottonwood Cr.	400 coho	"
	Nixon Cr.	4,000 coho	"
	Total	151,280	
	Catch composition:	126,230 coho 23,900 chum 1,150 trout	
	Duration: unknown.		

1960 No report.

1961 No report.

	Capture Sites	Fry Caught	Release Sites
1962	Cowichan R.	5,000 chum	Unknown
		19,000 coho	"
		75 trout	"
	Koksilah R.	5,000 coho	"
		30 trout	"
	Kelvin Cr.	5,000 coho	"
		10 trout	"
	Glenora Creek	31,000 coho	"
	Robertson R.	57,000 coho	"
		550 trout	"
	Ashburnham Cr.	1,000 coho	"

Appendix 5 (continued)

Sutton Cr.	7,000 coho	Unknown
Meade Cr.	2,400 coho	"
	50 trout	"
Shaw Cr.	2,000 coho	"
Nixon Cr.	9,000 coho	"
	20 trout	"
Total	144,135	

138,400 coho
5,000 chum
135 trout

Catch composition:
Duration: unknown.

1963

Capture Sites	Fry Caught	Release Sites
Cowichan R.	3,500 chum	Unknown
	1,500 coho	"
	10 trout	"
Koksilah R.	2,000 coho	"
Kelvin Cr.	1,000 coho	"
Glenora Cr.	5,000 coho	"
Robertson R.	45,000 coho	"
	250 trout	"
Ashburnham Cr.	3,100 coho	"
Sutton Cr.	3,500 coho	"
	20 trout	"
	10 trout	"
Total	75,940	

69,100 coho
3,500 chum
340 trout

Catch composition:
Duration: unknown.

1964

Capture Sites	Fry Caught	Release Sites
Cowichan R.	84,000 chum	Unknown
	7,600 coho	"
	150 trout	"
Koksilah R.	5,000 chum	"
	3,000 coho	"
	10 trout	"
Glenora Cr.	4,200 coho	"
Robertson R.	11,000 coho	"
	12 trout	"
Total	116,972	

89,000 chum
27,800 coho
172 trout

Catch composition:
Duration: unknown.

Appendix 5 (continued)

1965	Capture Sites	Fry Caught	Release Sites
	Cowichan R.	51,000 coho	Unknown
		2,050 chum	"
		60 trout	"
	Glenora Cr.	25,000 coho	"
		70 trout	"
	Robertson R.	54,550 coho	"
		205 trout	"
	Robertson S.C.	54,500 coho	"
	Sutton Cr.	10,200 coho	"
		50 trout	"
	Meade Cr.	27,000 coho	"
	Nixon Cr.	100 coho	"
	Ashburnham Cr.	2,000 coho	"
	Cottonwood Cr.	500 coho	"
	Total	227,350	
	Catch composition:	224,950 coho 2,050 chum 350 trout	

Duration: June 2 to August 10, 1965.

1966	Capture Sites	Fry Caught	Release Sites
	Cowichan R.	65,200 coho	Unknown
		50,423 chum	"
		95 trout	"
		200 co smolts	"
	Glenora Cr.	13,500 coho	"
		25 co smolts	"
		10 trout	"
	Holmes (Bing's)Cr.	250 coho	"
	Meade Cr.	20,700 coho	"
		10 trout	"
		75 co smolts	"
	Robertson R.	5,700 coho	"
	Robertson S.C.	4,500 coho	"
	Total	160,688	
	Catch composition:	109,850 coho 50,425 chum 300 co smolts 105 trout	

Duration: May 5 to August 4, 1966.

1967	Capture Sites	Fry Caught	Release Sites
	Cowichan R.	15,250 coho	Unknown
		40,700 chum	"

Appendix 5 (continued)

	185	co smolts	Unknown
	10	trout	"
Glenora Cr.	4,200	coho	"
	15	co smolts	"
Robertson R.	85,000	coho	"
	35	chum	"
	30	co smolts	"
	60	trout	"
Robertson S.C.	30,000	coho	"
	15	co smolts	"
Meade Cr.	29,000	coho	"
	10	co smolts	"
	190	trout	"
Sutton Cr.	19,500	coho	"
	10	co smolts	"
	35	trout	"
	2,000	coho	"
Total	230,690		

Catch composition:

189,400	coho
40,735	chum
295	trout
250	co smolts

Duration: May 3 to September 17, 1967.

1968

Capture Sites	Fry Caught		Release Sites
Cowichan R.	20,880	coho	Unknown
	5	co smolts	"
	11	trout	"
	75	chinook	"
	21,500	chum	"
Glenora Cr.	5,000	coho	"
	10	trout	"
Robertson S.C.	9,000	coho	"
	6	trout	"
Meade Cr.	4,150	coho	"
	10	trout	"
Total	51,167		

Catch composition:

29,550	coho
21,500	chum
5	co smolts
75	chinook
37	trout

Duration: May 6 to July 29, 1968.

Appendix 5 (continued)

1969	Capture Sites	Fry Caught	Release Sites
	Cowichan R.	24,400 coho	Unknown
		15 co smolts	"
		235 trout	"
		1,600 chum	"
	Glenora Cr.	2,200 coho	"
	Nixon Cr.	9,000 coho	"
		5 co smolts	"
	Meade Cr.	23,400 coho	"
		436 co smolts	"
		605 trout	"
	Robertson S.C.	13,200 coho	"
		9,500 coho	"
		15 co smolts	"
		75 trout	"
	Total	86,186	
	Catch composition:	83,200 coho 1,600 chum 855 trout 531 co smolts	

Duration: June 12 to July 22, 1969.

1970	Capture Sites	Fry Caught	Release Sites
	Cowichan R.	17,000 coho	Unknown
		35,000 chum	"
		155 chinook	"
		125 co smolts	"
	Glenora Cr.	1,000 coho	"
		25 co smolts	"
	Meade Cr.	14,000 coho	"
	Robertson R.	15,000 coho	"
		160 co smolts	"
		20 trout	"
	Nixon Cr.	6,500 coho	"
		150 co smolts	"
		25 trout	"
	Sutton Cr.	3,000 coho	"
		20 co smolts	"
		5 trout	"
	Total	66,995	
	Catch composition:	62,000 coho 3,500 chum 155 chinook 1,255 co smolts 85 trout	

Duration: April 29 - July 24, 1970.

Appendix 5 (continued)

1971	Capture Sites	Fry Caught	Release Sites
	Cowichan R.	30,625 coho	Unknown
		500 co smolts	"
		765 chum	"
		100 chinook	"
		10 trout	"
	Glenora Cr.	15,700 coho	"
		5 co smolts	"
	Robertson R.	25,740 coho	"
		50 co smolts	"
	Sutton Cr.	5,900 coho	"
		5 co smolts	"
	Meade Cr.	350 coho	"
		10 co smolts	"
	Total	79,770	
	Catch composition:	78,325 coho 570 co smolts 765 chum 10 chinook 10 trout	

Duration: May 17 - July 13, 1971.

1972	Capture Sites	Fry Caught	Release Sites
	Robertson R.	42,625 coho	Unknown
		424 co smolts	"
		114 trout	"
	Robertson S.C.	3,800 coho	"
		18 co smolts	"
		8 trout	"
	Meade Cr.	9,575 coho	"
		171 co smolts	"
		107 trout	"
	Glenora Cr.	4,100 coho	"
	Nixon Cr.	1,800 coho	"
		9 co smolts	"
		5 trout	"
	Total	62,756	
	Catch composition:	61,900 coho 622 co smolts 234 trout	

Duration: June 27 - July 31, 1971.

1973	Capture Sites	Fry Caught	Release Sites
	Cowichan R.	14,200 coho	Unknown
		511,800 chum	"

Appendix 5 (continued)

	425	co smolts	Unknown
	15	trout	"
Koksilah R.	175	co smolts	"
Robertson R.	202,800	coho	"
	7,680	co smolts	"
	2,190	trout	"
Glenora Cr.	35,120	coho	"
	3,080	co smolts	"
	540	trout	"
Meade Cr.	19,325	coho	"
	325	co smolts	"
	105	trout	"
Nixon Cr.	18,450	coho	"
	2,675	co smolts	"
	395	trout	"
Sutton Cr.	15,300	coho	"
	11,645	co smolts	"
	1,002	trout	"
Robertson S.C.	24,600	coho	"
	975	co smolts	"
	202	trout	"
Nineteen Cr.	1,200	coho	"
	25	co smolts	"
	3	trout	"
Shaw Cr.	7,000	coho	"
	225	co smolts	"
	110	trout	"

Total	881,587	
Catch composition:		337,995 coho 511,800 chum 27,230 co smolts 4,562 trout

Duration: May 15 - September 18, 1973.

1974	Capture Sites	Fry Caught		Release Sites
	Robertson R.	39,300	coho	Unknown
		3,075	co smolts	"
		855	trout	"
	Robertson S.C.	11,200	coho	"
		4335	co smolts	"
		245	trout	"
	Glenora Cr.	29,000	coho	"
		830	co smolts	"
		445	trout	"
	Sutton Cr.	3,800	coho	"
		50	co smolts	"
		10	trout	"
	Meade Cr.	8,800	coho	"
		155	co smolts	"

Appendix 5 (continued)

Nixon Cr.	1,200 coho	Unknown
	10 co smolts	"
Bonsall Slough	1,500 chum	"
Total	101,010	

Catch composition:

93,300 coho
4,555 co smolts
1,655 trout
1,500 chum

Duration: June 24 - September 1, 1974.

NOTE: Salvage of chum fry at Bonsall Slough occurred June 24, 1974.
The main salvage effort began on August 7, 1974.

1975	Capture sites	Fry Caught	Release sites
	Glenora Cr.	6850 coho	Holt Cr.
		420 co smolts	
		140 trout	
	Glenora Cr.	25,800 coho	Koksilah R.
		1,090 so smolts	
		365 trout	
	Glenora Cr.	3,600 coho	Cowichan R.
		175 co smolts	
		40 trout	
	Meade Cr.	15,000 coho	Cowichan L.
		555 co smolts	
		260 trout	
	Ashburnham Cr.	8,600 coho	Cowichan L.
		500 co smolts	
		75 trout	
	Robertson R.	10,800 coho	Cowichan L.
		735 co smolts	
		15 trout	
	Robertson R.	300 coho	Bear L.
		10 co smolts	
	Robertson S.C.	6,550 coho	Bear L.
		125 co smolts	
		75 trout	
	Robertson S.C.	1,500 coho	Cowichan L.
		25 co smolts	
		5 trout	
	Mesachie Cr.	600 coho	Cowichan L.
		250 co smolts	
		35 trout	
	Nixon Cr.	23,150 coho	Cowichan L.
		1,550 co smolts	
		710 trout	
	Sutton Cr.	16,675 coho	Cowichan L.
		2,215 co smolts	
		650 trout	

Appendix 5 (continued)

	Unnamed Cr.	300 coho	Cowichan L.
		10 trout	
	Stoltz (Dale's) Cr.	3,500 coho	Cowichan L.
		180 co smolts	
		135 trout	
	Total	141,318	
	Catch composition:	130,625 coho 8,240 co smolts 2,453 trout	
	Duration: unknown.		
1976	No report.		
1977	Capture sites	Fry Caught	Release sites
	Robertson S.C.	1,700 coho	Cowichan L.
		35 co smolts	
		10 trout	
	Robertson S.C.	15,500 coho	Bear L.
		335 co smolts	
		354 trout	
	Glenora Cr.	10,400 coho	Koksilah R.
		435 co smolts	
		183 trout	
	Meade Cr.	25,800 coho	Cowichan L.
		1,031 co smolts	
		1,224 trout	
	Riverbottom S.C.	3,475 coho	Cowichan R.
		37 co smolts	
		18 trout	
	Meade Cr.	350 coho	Bear L.
		4 co smolts	
		7 trout	
	Nineteen Cr.	2,800 coho	Bear L.
		35 co smolts	
	Sutton Cr.	21,263 coho	Cowichan L.
		1,264 co smolts	
		653 trout	
	Sutton Cr.	1,200	Bear L.
		135 co smolts	
		12 trout	
	Robertson R.	21,440 coho	Bear L.
		868 co smolts	
		512 trout	
	Nixon Cr.	3,175 coho	
		205 co smolts	
		39 trout	
	Unnamed Cr. in the Riverbottom	450 coho	Cowichan R.
		15 co smolts	

Appendix 5 (continued)

Ashburnham Cr. in Bk 51 (Watercress Cr?)	235 coho		Cowichan R.
	18 co smolts		
	20 trout		
Total	116,476		
Catch composition:	108,208 coho 4,428 co smolts 3,840 trout		

Duration: June 6 - August 10, 1977.

(1977 was a very dry summer that followed a winter of exceptionally light precipitation.)

1978	Capture sites	Fry Caught	Release site
	Rotary Park S.C.	4,110 coho	Cowichan R.
		85 steelhead	
		46 co smolts	
	Major Jimmy's Slough	500 coho	Cowichan R.
	Meade Cr.	5,990 coho	Cowichan L.
		99 co smolts	
		3 trout	
	Nixon Cr.	10,180 coho	Cowichan L.
		72 co smolts	
		3 trout	
	Glenora Cr.	8,000 coho	Koksilah R.
		88 co smolts	
	Robertson S.C.	3,650 coho	Bear L.
		3 co smolts	
		1 trout	
	Ashburnham Cr.	1,700 coho	Cowichan L.
		13 co smolts	
	Robertson R.	6,376 coho	Bear L.
		11 co smolts	
	Sutton Cr.	5,100 coho	Bear L.
		80 co smolts	
		7,446 unknown	
	Total (Cowichan Band CEDP)	53,555	
	Catch composition:	45,606 coho 415 co smolts 85 steelhead 4 trout 7,446 unknown	

Duration: June 20 - August 31, 1978.

1979	Capture sites	Fry Caught	Release sites
	Nixon Cr.	17,140 coho	Cowichan L.
		78 co smolts	

Appendix 5 (continued)

	3 trout	
Sutton Cr.	2,800 coho	Cowichan L.
Meade Cr.	12,233 coho	Cowichan L.
	69 co smolts	
Wardroper Cr.	530 coho	Cowichan L.
Norrie (Mtn. Rd.) Cr.	450 coho	Koksilah R.
Glenora Cr.	300 coho	Koksilah R.
Bible Camp S.C.	4,169 coho	Cowichan R.
	1,900 chum	
	110 chinook	

Total (Cowichan Band CEDP) 61,719

57,393 coho
1,900 chum
223 co smolts
2200 chinook
3 trout

Catch composition:

Duration: June 25 - July 3, 1979.

1980 Total (Cowichan Band CEDP) 35,000 fry

1981 Total (Cowichan Band CEDP) 10,434 fry (6,000 lost due to power failure).

1982 2,000 fry salvaged from Cowichan side channels and released to the river. Cowichan Band CEDP captured 34,022 fry.

1983 497,336 fry were salvaged from mainstem side channels of the Cowichan mainstem and flood pools along the Lower Cowichan and released to the main river by 8 employees hired under an (FEBAP) employment program. The summer of 1983 was relatively wet. Fry salvage was not required in Cowichan Lake tributaries such as Meade, Sutton and Robertson.

Total 497,336

160,979 coho
333,308 chum
3,049 co smolts

Duration: May 2 - June 17, 1983.

Cowichan Band CEDP captured 26,280 fry

17,973 coho
8,157 smolts
148 co smolts
2 trout

1984 Cowichan Band CEDP captured 111,931 coho fry (86% from Cowichan, 14% from Koksilah).

1985 150,000 fry salvaged by volunteers from Meade, Sutton, and Fairservice creeks and Robertson River and Sidechannel. Release sites: 10,000 to Beaver Creek; 10,000 to Cowichan Lake; 40,000 to Mesachie Lake; and 90,000 to Beaver Lake. Although 1985 was an extremely dry summer, salvage activities were terminated early due to unresolved internal DFO and provincial Fisheries concerns about fry transfer above barriers within the basin.

Cowichan Band CEDP captured 78,763 fry

76,149 coho
2,588 chum
26 trout

Appendix 6: Fry Salvage Field Report

FRY SALVAGE FIELD REPORT

FORM NO.

Date: Year | Month | Day | Time :

Capture Site:		Species	Code	Number Caught
	Stream Name:	Coho	CO	
	Temperature:	Chinook	CH	
	Location Comments:	Chum	CM	
		Rainbow	RB	
		Cutthroat	CT	
		Other		

Release Site:		Species	Code	Number Released
	Stream Name:	Coho	CO	
	Temperature:	Chinook	CH	
	Location Comments:	Chum	CM	
		Rainbow	RB	
		Cutthroat	CT	
		Other		

Labour Costs:

	#		hours		TOTAL (HRS)
Number of People		x	Number of Hours	=	

Name:

Expenses:

mileage:	km	
equipment:		
other:		

General Comments: