FISH/SHELLFISH STUDY NUMBER 8

FS008

CONFIDENTIAL

STATE/FEDERAL NATURAL RESOURCE DAMAGE ASSESSMENT
DETAILED STUDY PLAN

Project Title:	INJURY TO PINK AND CHUM SALMON EGG AND PRE-EMERGENT FRY OUTSIDE PRINCE WILLIAM SOUND
Study ID Number:	Fish/Shellfish Study Number 8
Lead Agency:	State of Alaska, ADF&G; Commercial Fisheries Division
Cooperating Agency(ies):	Federal: USFWS State : None
Principal Investigator:	Charles Swanton, Fishery Biologist Henry Yuen, Fishery Biologist
Assisting Personnel:	Kevin Brennan, Fishery Biologist Jeff Fox, Fishery Biologist
Date Submitted:	October 9, 1989

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	Signature	Date
Principal Investigator:	_____	_____
	_____	_____
Supervisor:	_____	_____
OSIAR Senior Biometrician:	_____	_____
OSIAR Program Manager:	_____	_____
OSIAR Director:	_____	_____

ACE 9419392 + 15

I. OVERVIEW

This study is a continuation of the damage assessment process described in F/S 7. As with study 7, the areas under consideration were divided into Lower Cook Inlet and Kodiak Island. Because of different stream morphology and spawner distribution, in addition to variability in oiling and harvests of surplus salmon, the study areas are addressed in separate sections. This study is essential to determine the impacts associated with oil related effects on spawning activity addressed in study 7. The emergent fry program defined for these two areas, coupled with the quanitfication of sampling, should provide the information needed to determine fully the effects of the oil and management activities related to the presence of oil, on subsequent years production of pink and chum salmon.

II. LOWER COOK INLET AND KENAI FIORDS AREA STUDIES

INTRODUCTION

This project was designed to evaluate pink and chum salmon egg to fry survival in the intertidal spawning areas affected by the Exxon Valdez oil spill. Intertidal spawning areas are important to pink and chum salmon and these areas are vulnerable to oil spills.

Pre-emergent fry digs were conducted annually on 24 streams in the Lower Cook Inlet/Kenai Fiords area by the Alaska Department of Fish & Game from 1964 through 1984. Although fry density data were essential for forecasting future pink salmon adult returns, this study was cut from Fish and Game's general fund projects in 1985. This project reinstates the pre-emergent fry study, collects additional information on egg density, and expands upon the methodology for eight of the 24 streams to determine egg to fry survival

OBJECTIVES

1. Assess overwinter survival (eggs to pre-emergent fry) for pink and chum salmon eggs in oiled and non-oiled areas.

2. Assess loss in production, if any, from changes in overwinter survival.

3. Identify potential alternative methods and strategies for restoration of lost use, populations, or habitat where injury is identified.

METHODS/DATA ANALYSIS

Study Design

Sampling will be conducted in two phases: egg-digs which are performed in late October-early November, and preemergent fry digs conducted in mid-March to mid-April.

Streams were selected using the following criteria:

1. Sufficiently large adult salmon returns to indicate a high probability of success in egg/fry digging.
2. Past history of egg/fry digging.
3. Streams covered by spawning ground survey (OSIAR study F/S 7) and aerial escapement survey project.
4. Streams can be safely studied during the winter and early spring months.

Study Sites

The eight streams selected for this project are Windy Creek Left, Port Dick Creek, Windy Creek Right, and Island Creek in the Kenai Fiords area and Humpy Creek, China Poot Creek, Seldovia River, and Port Graham Creek in the Cook Inlet area. The first two creeks have had oil deposited near the stream mouths, the next two have had oil floating offshore, and the remainder may have had no impact.

Sample Design

Sampling methods are identical for the pre-emergent fry and egg digs. On each sample stream, four zones, 3 intertidal and one above tidal inundation, will be identified and marked by crews conducting stream surveys during the Injury to Pink/Chum Salmon Spawning Areas project (OSIAR study F/S 7). The zones are 0.0-0.6 m, 0.6-1.2 m, and 1.2-1.8 m below mean high water, and upstream of tidal inundation.

Separate linear transects 30.5 m in length will be established in each zone (one transect for each type dig). The transects will run diagonally across the river with the downstream end located against one bank and the upstream end against the opposite bank. Overlapping of transects will be kept to a minimum to control the influence of fall egg digs on abundance of fry during spring sampling. Fourteen circular digs (56 per stream), each 0.3 m^2 in size, will be systematically dug along each transect using a high pressure hose to flush eggs and fry from the gravel. Eggs and fry will be caught in a specially designed net. Areas where salmon were not observed spawning during the spawning ground surveys (OSIAR study F/S 7) will be avoided. Numbers of live and dead fry by species as well as numbers of live and dead eggs by species will be collected from each 0.3 m^2 dig. Additional information such as date, time, and zone will also be collected.

Two samples of eggs and alevin will be collected from each of the 0.6-1.2 m below mean high water stream zones for hydrocarbon analysis. A field blank (sample container opened at the collection site, closed and stored as if it contained a sample) will also be collected. Results of the analysis will be used to document the level of oil impact sustained by the stream, eggs, and alevins. Each sample will consist of enough eggs or fry to provide 10 grams of tissue for analysis. Collectors will avoid putting the samples into contact with any plastics, latex, etc when gathering the samples. The sample containers will be pre-rinsed (with dicloromethane) glass jars with teflon lined lids as supplied by I-Chem. The samples will be stored in padlocked containers and kept in a freezer in the Homer ADF&G office. Appropriate chain of custody forms will accompany each sample.

Data Analysis

This study will be used to test for differences in egg to fry survival between streams which were oiled and those that were not. The power of the test is unknown; consequently, the number of streams sampled is based on what can be surveyed in a reasonable manner given the window of time sampling must take place.

A mixed effects analysis of covariance will be used to test for differences in egg to fry survival due to oiling. Level of hydrocarbon impact and height in the tidal zone will be treated as fixed effects. Height in the tidal zone is nested within stream, a random effect. The level of hydrocarbon impact will be determined from hydrocarbon analysis of mussels collected by the Injury to Pink/Chum Salmon Spawning Areas project (OSIAR study F/S 7).

Analysis of variance will be used if no suitable hydrocarbon data are available. Degree of oiling as visually assessed by the Injury to Pink/Chum Salmon Spawning Areas (OSIAR study F/S 7) will be used to post-stratify streams. Degree of oiling will be treated as a fixed effect and height in the tide zone will also be a fixed effect nested in stream, a random effect.

An assessment of lost fry production will be made if differences in egg to fry survival due to oiling are detected. Average survival from unoiled areas will be used to estimate potential fry density in oiled areas. Observed and potential fry densities will then be expanded to estimate total observed and potential fry. The difference between the two estimates will be considered lost fry production.

Specific statistics to be estimated are:

1. Number of dead and viable eggs per square meter by salmon species, stream, and stream zone.
2. Number of dead and live fry per square meter by salmon species, stream, and stream zone.
3. Egg to fry survival by salmon species, stream, and stream zone.
4. Lost production by salmon species, stream, and stream zone.

SCHEDULES AND REPORTS

Date(s)	Activity
Oct 23 - Nov 3 1989	Egg digs in 8 study streams.
Nov 6 - Dec 17 1989	Data entry and preliminary analysis
Mar 12 - Mar 23 1990	Fry digs in same 8 study streams.
Mar 26 - May 3 1990	Data entry, final analysis, and report.

PROJECT BUDGET[1]

Line Item	Category	Budget	
100	Personnel Services	$ 5,200	
200	Travel	$ 600	
300	Contractual	$ 5,000	
400	Commodities	$ 800	
500	Equipment	$ 4,100	
700	Grants		$ 0
Total		$ 15,700	

[1] Budget is for all activities performed from March 27, 1989 to February 28, 1990.

FUNDED PERSONNEL

Class	PCN	Name	PFT_mm	SFT_mm
FB II	11-1258		2.5 (funded under CF-381)	
FB I	new		1.5	
FT III	11-1590		0.7	
FT II	11-1369		0.7	

II. KODIAK AND CHIGNIK MANAGEMEMENT AREA STUDIES

INTRODUCTION

During 1989, circumstances surrounding the EXXON VALDEZ oil spill caused curtailment of commercial salmon fisheries in the Kodiak and Chignik Management Areas. A potential outfall of these events could be overescapement into pink and chum salmon streams. Intent of this investigation is to quantify effects of the 1989 escapements upon future brood year production. Pink and chum salmon constitute 87% (6,517,000 pinks, 745,000 chums) and 35% (705,097 pinks, 165,725 chums) of the Kodiak and Chignik salmon harvests respectively. Average value of pink and chum salmon harvested in Kodiak and Chignik has been 14.8 and 3.7 million dollars during the last 9 odd years (Malloy 1989; Thompson and Fox 1989).

Within the Kodiak and Chignik Management Areas there are 346 and 90 streams which support populations of pink and or chum salmon. Pink salmon pre-emergent sac fry sampling has been conducted in 43 Kodiak and 8 Chignik streams periodically over the last 20 years. Indices of pre-emergent sac fry coupled with aerial survey escapement counts, provide the foundation for forecasting returns and projecting harvest potential of these species.

To elucidate potential damage to future brood year pink and chum salmon production, total escapements, pre-emergent sac fry, available spawning habitat, fecundity and egg retention variables can be used to evaluate trends in over wintering survival of egg to pre-emergent sac fry. A relationship using these objective measures for quantifying potential damage to future brood year production will be developed and assessed.

OBJECTIVES

A. Determine abundance of pink and chum salmon eggs and pre-emergent fry. Objective includes:

   1. Derive a length-fecundity relationship for odd year Kodiak and Chignik pink salmon.

   2. Determine egg retention and fork length for female pink salmon in selected pre-emergent streams.

   3. Ascertain total available spawning habitat for selected pre-emergent index streams.

   4. Estimate potential egg deposition for pink and chum salmon in selected streams.

   5. Estimate number of pre-emergent sac fry.

B. Determine over winter mortality (egg to pre-emergent fry) of pink and chum salmon eggs.

C. Determine reductions, if any, in pink and chum salmon pre-emergent fry abundance due to oiling.

D. Identify potential alternative methods and strategies for restoration of lost use, populations, or habitat where injury is identified.

METHODS

Length-Fecundity Sampling

Kodiak weir station personnel responsible for foot surveys and escapement counts (OSIA Study No. 7) will also be required to collect pink salmon fecundity data. Length (mid-eye to fork-of-tail) and fecundity from pink salmon will be obtained from each weired system and an additional sample taken from the Chignik Area. A sample of 100 females per weir system is considered adequate. The sample size is a compromise between effort associated with sampling and number of samples necessary to determine a relationship. Sampling will consist of randomly selecting (prior to upstream migration) and killing a fish, measuring length and counting eggs. Length will be measured to the nearest millimeter and counting of eggs will be direct, no volumetric or indexing procedures will be permitted.

Sampling will be spaced over a two week period in an attempt to represent a wide spectrum of the particular run. All data will be recorded on form AKA89-2 (Appendix A.1).

Index Stream Survey and Spawner Distribution Mapping

Using enlargements (27% greater than 1:1) of 1:250,000 United States Geological Survey (U.S.G.S.) topographical maps encompassing index streams, experienced management personnel will demarcate upper and lower limits of pink salmon spawning distribution based upon past years aerial surveys. Information from 1989 aerial escapement surveys (OSIAR Study No. 7) and spawner distribution derived from helicopter helicopter over flight from this study (forthcoming methods section) will be integrated into maps providing detailed spawner distribution information for all index streams where information has been collected. Spawner distribution for this study will be marked on maps during peak spawning activity (or noted otherwise) and aerial estimates of pink salmon numbers recorded by stream reach.

Egg Retention Sampling

For each index stream selected for surveying, a 150 fish egg retention sample will be obtained (B. Alan Johnson, ADF&G, Kodiak, personal communication). Sampling intensity will be proportional (weighted) to where major spawning densities have been marked by the aerial escapement survey observers (OSIAR Study No. 7), to a mile down stream from this area. A systematic stratified sampling program will be utilized. Streams where major concentrations in specified areas are low (< 1,000 carcasses) every other female will be sampled, where densities are high (> 5,000) every fifth female will be sampled until the complete sample of 150 is obtained. Actual sampling will consist of making an incision in the fish and either extracting the eggs into a ziplock bag (if number of eggs is greater than 200) or actually counting the eggs if the number is less than 200. Length (mid-eye to fork-of-tail) to the nearest millimeter will also be measured. Eggs extracted into ziplock bags will be labeled with the stream name, number and length of the fish sampled. Data will be recorded on form AKA89-4 (Appendix A.2).

Spawning Habitat Survey Design

Using maps which delineate the upper and lower limits of spawner distribution for a given index stream, total stream length will be estimated in meters using a calibrated map wheel. Overall stream length (length of stream available to spawning fish) will be measured with no attempt made to stratify tributaries or braided channels, which will be included in total length measures. Upon deriving total stream length, it will be broken down into 300 meter sections beginning at the lower, and extending to the upper limits of historical spawner distribution. Each section will be assigned a random number beginning at 01, distinguished on the sectioned map, and sections for habitat surveys selected using a random number generator.

Numerous aquatic habitat inventory survey designs exist (Platts et. al. 1983; Frissell 1986; Murphy et. al. 1987; Hankin and Reeves 1988), however for purposes of this study a systematic cluster transect sampling design was deemed most appropriate based upon temporal constraints and unique requirements of the objectives. Five 300 meter sections were randomly selected, within each section

beginning at the down stream end cluster transects were run perpendicular to the stream bank at 25 meter intervals. Twelve transects per section and a maximum of 60 per stream were measured.

According to the literature and also habitat suitability index models from Raleigh and Nelson (1985) velocity and substrate size appear to be the most critical variables with regard to spawning success of pink salmon. They state that substrate particle size has a prominent role in survival of eggs to advanced life history stages and that velocity and depth are directly related. Substrate embeddedness was considered due to information contained in Platts et. al. 1983, however its importance as a quantitative variable related to initial pink salmon life history stage survival is unknown. Measurements and assessments were recorded on the variables stream width, spawning habitat, water velocity and depth as well as substrate embeddedness. Ranges for substrate sizes, water velocity and depth were derived from the literature (Divinin 1952; Chambers 1956; Andrew and Geen 1960; Krueger 1981; Neave 1966; Wilson et. al. 1981). I choose to take averages of literature based estimates for use in habitat surveys, as specific values for Kodiak Archipelago and Chignik pink salmon are unknown. Stream width according to Platts et.al. (1983) is the horizontal distance along a transect line from stream bank to stream bank over the water surface. Measured width for this study will be from a minimum depth of six inches of water to either the opposite stream bank or up to the point where water is less than 6 inches in depth. In maintaining consistency of measures both within and between streams, protruding logs, rock outcroppings, etc.. surrounded by water are included in measurements of width. Islands are not included; an island is any object protruding above the water surface greater than .3 m in width. Spawning habitat will be determined based upon the previously mentioned variables and recorded as a percent. Substrate sizes were .58 to 13.75 cm (.24 to 5.4 inches), stream depth of .15 m (6 inches) and up, with water velocities ranging from .28 to 0.9 m/second (.9 to 2.7 ft/sec). For this study, spawning habitat will be deemed unsuitable if substrate sizes are less than .58 cm or greater than 13.75 cm, substrate embeddedness is such that excessive foot pressure must be exerted before gravel is displaced, water depth is less than .15 m or water velocity is stagnant or greater than .9 m/sec. Data from habitat surveys will be recorded on form AKA89-3 (Appendix A.3). Initially, a 12 hour training session with experienced field personnel will be conducted. In which substrate size, water velocity, depth and embeddedness will be measured and assessed. This exercise will allow field personnel to visualize substrate size, etc. and therefore promote confidence as well as standardization of procedures.

Pre-emergent Fry Sampling

Pre-emergent sac fry sampling will be conducted on index streams and stream reaches in the Kodiak and Chignik Management Areas based upon results from OSIAR Study 7 and finalized spawner distribution maps, escapement magnitudes, spawner densities and other information as it becomes available. Selection of index streams and stream reaches to be sampled will be the responsibility of the Regional Biometrician. All streams and reaches in the Kodiak Area which are annually sampled for pre-emergent fry will be treated separately from the present investigation. Circular digs 0.3 m^2 in size will be conducted along a transect line run perpendicular to the stream bank in selected areas. Digs will be conducted using a high pressure hose to extract eggs and fry from the substrate and a specially designed net will be used to catch eggs and fry as they are displaced. Numbers of live and dead fry and eggs by species will be collected

and enumerated from each 0.3 m^2 dig. Data will be recorded on water resistant forms in the field and transferred to the regional data base upon completion of a specific stream.

DATA ANALYSIS

The analytical component of this investigation will integrate data and results from OSIA Study No. 7 as well as historical escapement and pre-emergent sac fry indices, length-fecundity data, potential egg deposition and spawning habitat estimates. A cohesive series of analyses will address the following estimates:

1. Total available spawning habitat in index streams for Kodiak and Chignik.
2. Spawner density in No./m^2 for a spectrum of escapement magnitudes.
3. Potential egg deposition for pink and chum salmon for the index streams addressed.
4. Number of pre-emergent sac fry in index streams.
5. Overwinter mortality (egg to pre-emergent fry) in index streams.

SCHEDULES AND REPORTS

Dates	Function
June - September	Field surveys, data collection
October - November	Historical data collection, editing, preliminary analysis and map preparation
December 1 - December 21	Data analysis, interim report submitted
December - February 1	Report Finalization
February 10	Pre-emergent fry sampling

PROJECT BUDGET

Line Item	Category	Budget[1]
100	Personnel	39,200
200	Travel	800
300	Contractual	44,100
400	Supplies	6,900
500	Equipment	6,900
700	Grants	-0-
Total		$95,700

[1]Budget includes activities performed from 15 July 1989 to February 1990.

FUNDED PERSONNEL

Class	PCN	Name	MM	OT	SEA	HAZ	COST
FB IV	1202	D. Schmidt	0.0	0	0	0	-0-
FB III	7016	B. Barrett	0.0	0	0	0	-0-
FB II	7017	C. Swanton	7.5	350	0	0	30,054.72

LITERATURE CITED

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Appendix A.1.

Form for Recording Egg Retension and Fecundity Data

AKA

Stream Name	Date	Length (mm)	Retained Eggs	Fecundity[1]	Remarks/Comments

[1] Fecundity data should be recorded on forms separate from those used for egg retension data.

Appendix A.2. PINK SALMON EGG RETENSION AND LENGTH RECORDING FORM AKA89-4

Stream Name _____ Date: _____

No. _____

Observer(s) _____

Specimen #	Retained	Length	Specimen #	Retained	Length
1			26		
2			27		
3			28		
4			29		
5			30		
6			31		
7			32		
8			33		
9			34		
10			35		
11			36		
12			37		
13			38		
14			39		
15			40		
16			41		
17			42		
18			43		
19			44		
20			45		
21			46		
22			47		
23			48		
24			49		
25			50		

COMMENTS:

Appendix A.3.

AKA89-3

Stream Name: _____ Date: _____

Stream No.: _____ Survey Crew: _____

Section: _____

Transect[a] #	Width (m)	Habitat[b&c] Spawning	Habitat[b&c] Non-Spawning	COMMENTS[d]
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

[a]Standard distance between transects is 25m.

[b]Record % spawning habitat to nearest 10%.

[c]Spawning habitat: Substrate = 0.60cm - 13.75cm (0.25 - 5.40 inches), Velocity = 0.3 - 0.9 m/sec, Depth = ≥ 0.15m (≥ 6 inches), and non-embedded substrate.

[d]Comments should include stage of pink spawning activity, sampling problems, and stream temperature where applicable.

STATE/FEDERAL NATURAL RESOURCE DAMAGE ASSESSMENT
DETAILED STUDY PLAN

Project Title:	INJURY TO PINK AND CHUM SALMON EGGS AND PRE-EMERGENT FRY OUTSIDE PRINCE WILLIAM SOUND (Lower Cook Inlet/Kenai Fiords)
Study ID Number:	Fish/Shellfish Study Number 8a
Lead Agency:	State of Alaska, ADF&G; Commercial Fish Division
Cooperating Agency(ies):	Federal: NPS, USFS, USFWS State: DNR
Principal Investigator:	Henry Yuen, Fishery Biologist II
Assisting Personnel:	Brian Bue, Biometrician II Rancy Morrison, Fishery Biologist II
Date Submitted:	February 23, 1990

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Titles	Signature	Date
Principal Investigator:	Henry Yuen	2/23/90
Consulting Biometrician:		3/5/90
Regional Research Supervisor:	Stephen M Fried	3/5/90
Regional Supervisor:		3/5/90
OSIAR Program Manager:		
OSIAR Director:		

ACE 644207

INTRODUCTION

Wild stocks of pink and chum salmon provide major fisheries in areas outside Prince William Sound where extensive oiling has occurred. In 1988, the year before the oil spill, the ex-vessel value of the commercial catch of wild and hatchery stocks of salmon from the lower Cook Inlet/Kenai Fiords area was more than $8.2 million. Salmon are also very important to the sport, subsistence, and personal use fisheries. The future abundance of wild stocks of pink and chum salmon in the lower Cook Inlet/Kenai Fiords areas may be adversely impacted as their intertidal spawning areas were affected by the oil spill. This project continues the evaluation of pink and chum salmon egg to fry survival in the intertidal spawning areas affected by the Exxon Valdez oil spill.

OBJECTIVES

1. Determine abundance of pink and chum salmon eggs and pre-emergent fry by intertidal and upstream areas for 12 streams in the Lower Cook Inlet/Kenai Fiords area. This is an expansion of the number of streams studied in 1989. The additional steams will be non-oiled in the Kenai Fiords to provide comparisons with oiled streams in the same geographical area.

2. Determine overwinter mortality (egg to pre-emergent fry) of pink and chum salmon eggs.

3. Determine reductions, if any, in pink and chum salmon pre-emergent fry abundance due to oiling.

4. Identify potential alternative methods and strategies for restoration of lost use, populations, or habitat where injury was identified.

METHODS/DATA ANALYSIS

Study Design

Sampling will be conducted in two phases: egg-digs performed in October and pre-emergent fry digs conducted in March. The number of streams to be studied is limited by the number of days in October and November with low tides (maximum of +4.0 feet) during daylight hours.

Streams were selected using the following criteria:

1. Sufficiently large adult salmon returns to indicate a high probability of success in egg/fry digging.
2. Past history of egg/fry digging.
3. Streams covered by Natural Resource Damage Assessment Fish/Shellfish Study No. 7 (NRDA F/S Study NO. 7) and aerial escapement survey project.
4. Streams can be safely studied during the winter and early spring months.

Study Sites

The nine streams studied during 1989 were Windy Creek Left, Port Dick Creek, Windy Creek Right, and Island Creek in the Kenai Fiords area and Humpy Creek, China Poot Creek, Seldovia River, Tutka Lagoon Creek, and Port Graham Creek in

the Cook Inlet area (Figure 1). The first two creeks have had oil deposited near the stream mouths, the next two have had oil floating offshore, and the remainder had no visible impact. One of the non-oiled streams, China Poot, will not be studied during 1990 due to its small size. Four new non-oiled streams in the Kenai Fiords area will be added to facilitate comparisons with oiled streams in this area.

Sample Design

Sampling methods are identical for the pre-emergent fry and egg digs. On each sample stream, four zones, 3 intertidal and one above tidal inundation, will be identified and marked by crews conducting stream surveys during the Injury to Pink/Chum Salmon Spawning Areas project (NRDA F/S study 7). The zones are 0.0-0.6 m, 0.6-1.2 m, and 1.2-1.8 m below mean high water, and upstream of tidal inundation (Figure 2).

Separate linear transects will be established in each zone (one transect for each type dig). The transects will run the entire length of the zone (Figure 3). Overlapping of transects will be kept to a minimum to control the influence of fall egg digs on abundance of fry during spring sampling. Fourteen circular digs (56 per stream), each 0.3 m^2 in size, will be systematically dug along each transect using a high pressure hose (Figure 4) to flush eggs and fry from the gravel. Eggs and fry will be caught in a specially designed net (Figure 5). Areas where salmon were not observed spawning during the spawning ground surveys (NRDA F/S study 7) will be avoided. Numbers of live and dead fry by species as well as numbers of live and dead eggs by species will be collected from each 0.3 m^2 dig. Additional information such as date, time, and zone will also be collected (Appendix A).

Eggs and fry will be collected for analysis of mixed-function-oxidase (MFO), an enzyme system which is increased when sub-lethal contaminants such as PCB and PAH are present.

Data Analysis

A mixed effects analysis of covariance will be used to test for differences in egg to fry survival due to oiling. The level of hydrocarbon impact will be determined from hydrocarbon analysis of mussels collected in 1989 and 1990 by NRDA F/S study 7.

Analysis of variance will be used if no suitable hydrocarbon data are available. Degree of oiling as visually assessed by NRDA F/S study 7 will be used to post-stratify streams. Degree of oiling and height in the tidal zone will be treated as fixed effects. Height in the tidal zone is nested within stream, a random effect.

The number of streams sampled is based on what can be surveyed in a reasonable manner given the window of time sampling must take place. Power was estimated for the analysis of variance (ANOVA) using data from the 1975 and 1976 egg and pre-emergent fry digs in Prince William Sound. This analysis indicated the ANOVA could detect an increase of 20% (e.g. 10% mortality to 30% mortality) in egg to fry mortality at $\alpha = 0.05$, 90% of the time.

An assessment of lost fry production will be made if differences in egg to fry survival due to oiling are detected. Average survival from unoiled areas will be used to estimate potential fry density in oiled areas. Observed and

potential fry densities will then be expanded to estimate total observed and potential fry. The difference between the two estimates will be considered lost fry production.

Specific statistics to be estimated are:

1. Number of dead and viable eggs per square meter by salmon species, stream, and stream zone.
2. Number of dead and live fry per square meter by salmon species, stream, and stream zone.
3. Egg to fry survival by salmon species, stream, and stream zone.
4. Lost production by salmon species, stream, and stream zone.

SCHEDULES AND REPORTS

Date(s)	Activity
Oct 5-8, 19-21, Nov 5-6, 11-14 1990	Egg digs in 12 study streams.
Nov 14 - Dec 31 1990	Data entry and preliminary analysis
March 1991	Fry digs in same 12 study streams.
May 1991	Data entry, final analysis, and report.

PROJECT BUDGET[1]

Line Item	Category	Budget
100	Personnel Services	$ 48,200
200	Travel	$ 1,700
300	Contractual	$ 19,700
400	Commodities	$ 1,300
500	Equipment	$ 1,400
Total		$ 71,000

[1] Budget is for all activities performed from March 27, 1989 to February 28, 1990.

FUNDED PERSONNEL

Class	PCN	Name	PFT_mm	SFT_mm
FB II	11-1258		3.0 (funded under CF-381)	
FT II	11-1505			0.7
FT III	11-1590			0.7
FT II	11-1516			3.0

ACE 644210

Figure 1. Study locations in Lower Cook Inlet, 1989.

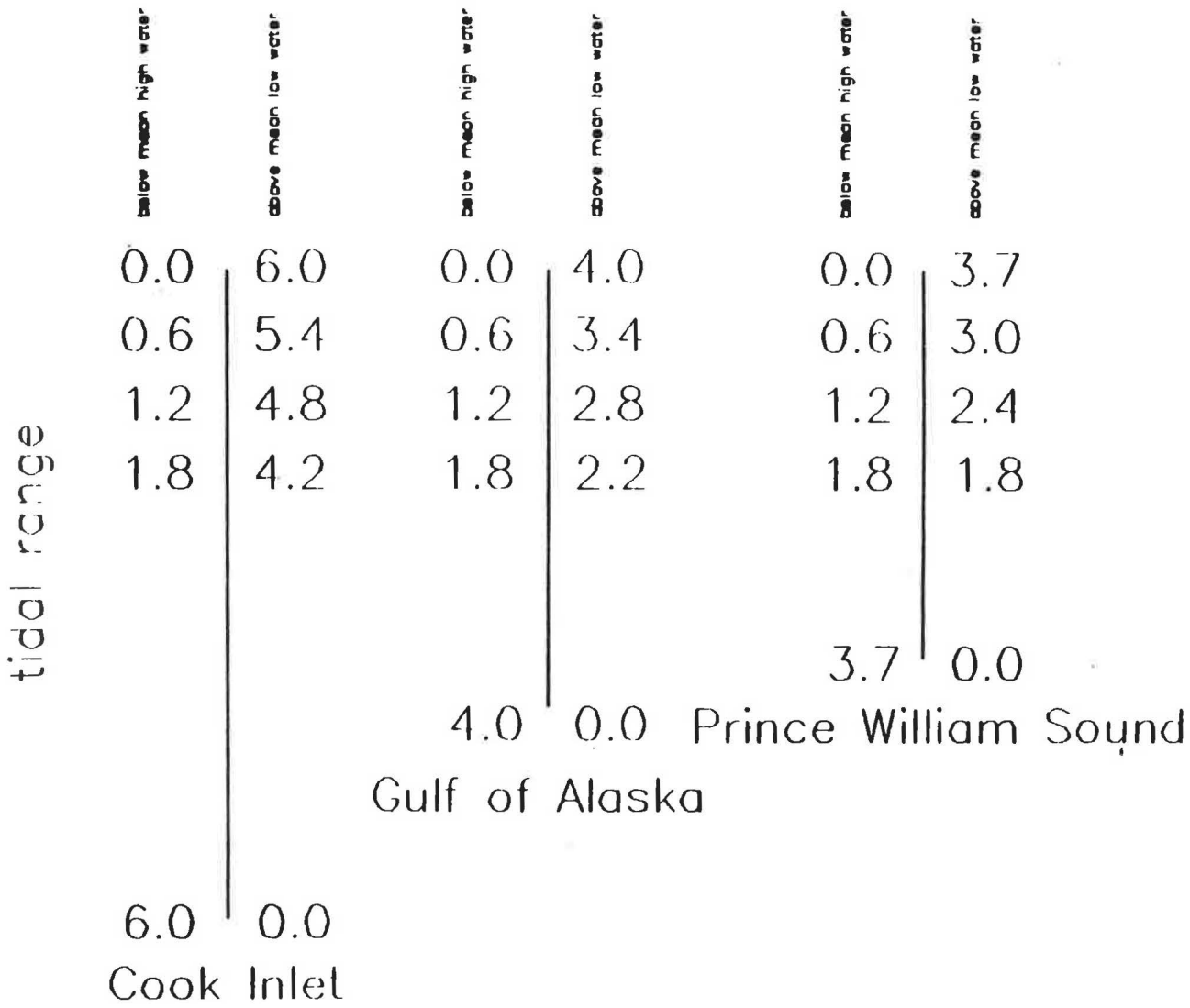

Figure 2. Tidal range and stream zones.

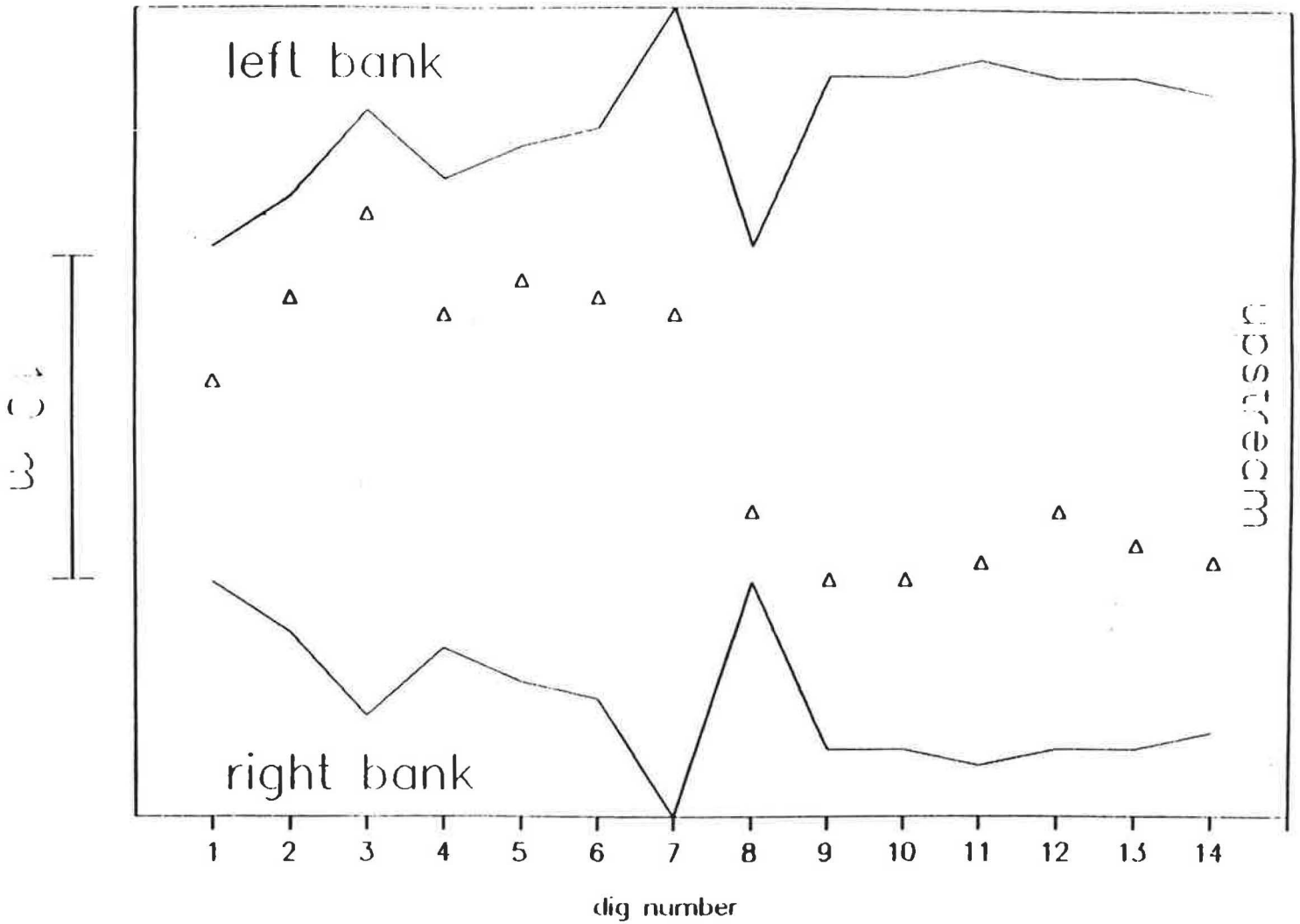

Figure 3. Egg dig transect, Windy Creek Left, 1.2--1.8 m below high tide line.

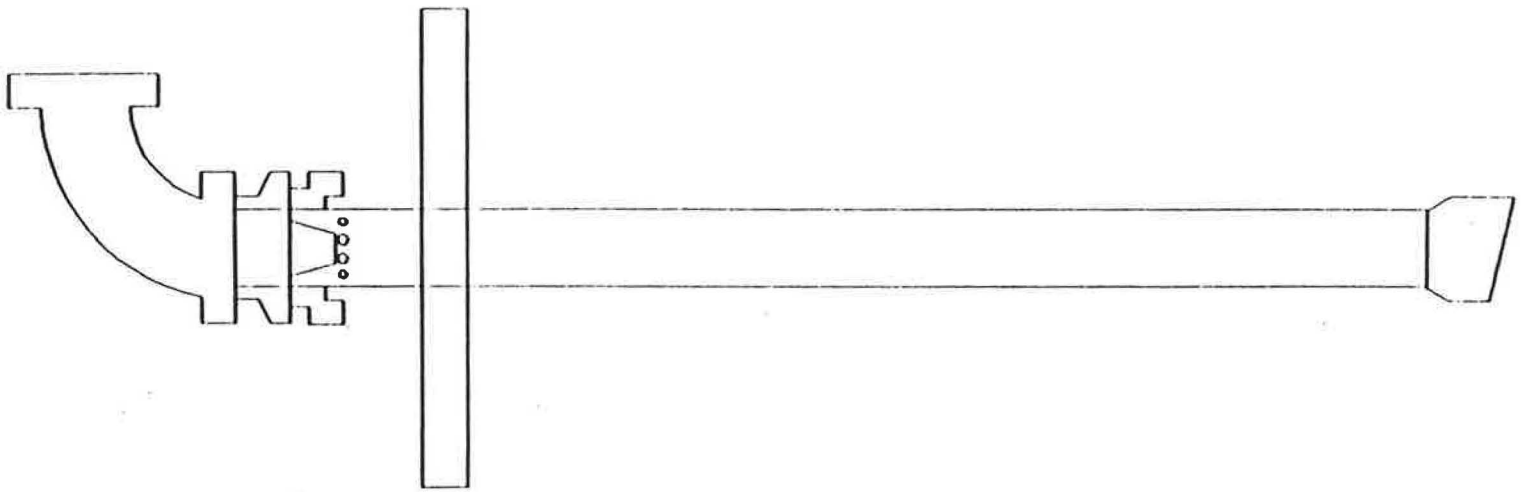

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Figure 4. Nozzle and venturi.

not to scale

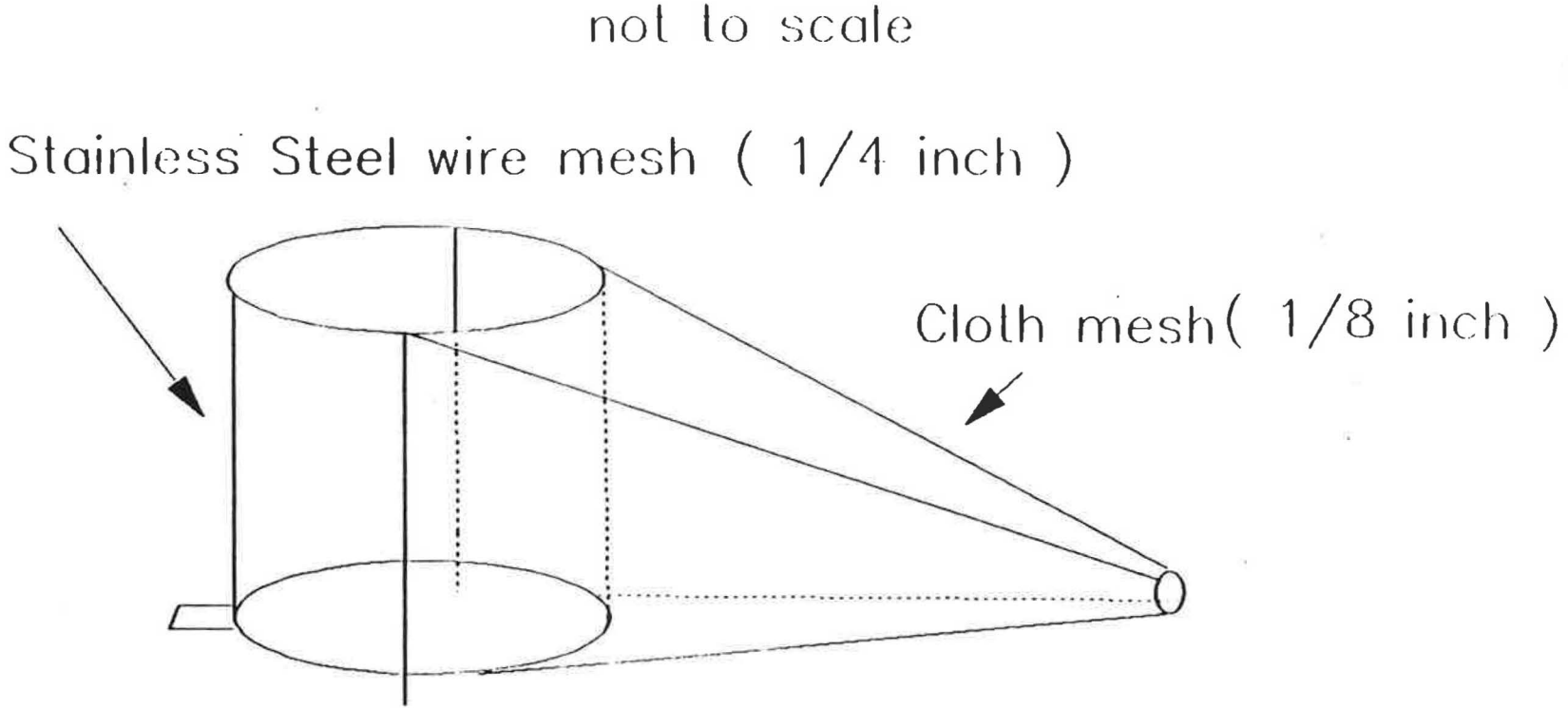

Figure 5. Egg and fry dig net.

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Pre-emergent Pink and Chum Salmon Data Form

PAGE ___ OF ___ FOR STREAM

Field 1	2	3	4	5	6	7	8	9
DATE (MO DAY YR)	DIST NO	SUB DIST	STREAM NO	STUDY AREA	STRM AREA	TEMP	CREW LEADER	DIG TYPE

10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
LOCATION	SAMPLE POINT	LIVE PINK EGGS	LIVE PINK FRY	PERCENT ABSORB	DEAD PINK EGGS	DEAD PINK FRY	LIVE CHUM EGGS	LIVE CHUM FRY	PERCENT ABSORB	DEAD CHUM EGGS	DEAD CHUM FRY	REMARKS	CONDITION	

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