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STATE/FEDERAL NATURAL RESOURCE DAMAGE ASSESSMENT
DRAFT PRELIMINARY STATUS REPORT

Project Title: INJURY TO PINK SALMON SPAWNING AREAS WITHIN THE
KODIAK AND CHIGNIK MANAGEMENT UNITS

Study ID Number: Fish/Shellfish Study Number 7b

Lead Agency: State of Alaska, ADF&G
OSIAR Division

Cooperating Agency(ies): Federal: USFWS
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TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES	ii
LIST OF FIGURES.....	iii
EXECUTIVE SUMMARY.....	1
OBJECTIVES.....	1
INTRODUCTION.....	2
METHODS.....	4
Aerial Surveys.....	4
Weir Stations.....	4
Spawning Habitat Surveys.....	4
RESULTS.....	5
STATUS OF INJURY ASSESSMENT.....	9
LITERATURE CITED.....	13

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LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. Estimated average pink salmon stream life by method for selected Kodiak Management Area streams, 1990.....	6
2. Estimated pink salmon average stream life based on tagged fish carcass recoveries for four color coded tag groups, consisting of about 150 fish per code per week, for selected Kodiak Management Area streams, 1990.....	7
3. Estimated pink salmon average stream life based on live fish foot surveys of four color coded tag groups, consisting of about 150 fish per code per week, for selected Kodiak Management Area streams, 1990.....	8
4. Kodiak Management Area pink salmon preemergent fry index stream estimated escapements, total available spawning habitat, desired escapement goals and theoretical optimum and observed spawner densities, 1989.....	10
5. Chignik Management Area total pink salmon spawning, habitat estimated 1989 total escapements, and observed spawner density by preemergent fry index stream.....	12

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LIST OF FIGURES

<u>Figures</u>	<u>Page</u>
1. Map showing the locations of the Kodiak and Chignik Management Areas.....	3

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EXECUTIVE SUMMARY

Because normal commercial salmon fisheries were not prosecuted in 1989, due to the Exxon Valdez oil spill, target escapement goals were exceeded by a factor of 4.3 within the Kodiak Management Area (KMA), and by a factor of 2.1 for the Chignik Management Area (CMA). The estimated 1989 total pink salmon escapement for the KMA was 20,280,991 (Barrett et. al. 1990), while the CMA estimated total was 1,434,798 (Barrett 1990). Total escapement estimation using area under a spawner abundance curve provided by the Johnson and Barrett (1988) model relies upon a valid stream life parameter. In 1989 total pink salmon escapement for the Afognak District of the KMA utilized an average stream life value of 8.44 days derived from studies conducted at Afognak River and East Paramanof Creek.

Escapements for the remainder of the KMA and CMA were calculated using a 15 day stream life (grounded upon professional judgement of regional ADF&G staff). During the 1990 field season stream life values were obtained from six pink salmon spawning streams within the Kodiak Archipelago. Several approaches were used (pink salmon live and carcasses foot survey escapement counts of both tagged and untagged adults) in conjunction with the Johnson and Barrett (1988) model. Average stream life values derived in 1990 (grand mean 11.0 days; Range 7.4-14.6 days) conformed well with values reported within the literature (Perrin and Irvine 1990) as well as the 8.44d and 15d stream life values relied upon in 1989.

Estimates of total available pink salmon spawning habitat were derived for 43 Kodiak and 14 Chignik Preemergent fry index streams, and when incorporated with stream specific total escapement estimates, provide observed spawner densities ranging from .01 to 163 fish /M² (mean=11.8 fish/M²) for KMA streams, and 0.1 to 4 fish /M² (mean=0.8 fish/M²) for CMA streams. Spawning habitat estimates for selected sites within preemergent fry index streams were sampled but estimates of spawning area have not been calculated.

OBJECTIVES

- A. Determine total pink salmon escapements for streams where historic preemergent sac fry density data exist for 1989. This includes 44 Kodiak and 18 Chignik Management Area streams.
 1. Periodically count the number of live pink salmon by aerial and foot survey methods, 1990.
 2. Determine average pink salmon stream life using weir and foot survey counts of live fish for selected streams, 1990.

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- B. Define the distribution of spawning pink salmon for index streams within the Kodiak and Chignik Management Areas. This entails mapping and photographing of spawner distribution, 1989.
- C. Estimate total available spawning habitat for preemergent fry index streams within the Kodiak and Chignik Management Areas.
 - 1. Measure the amount of spawning habitat using habitat suitability indices and historic spawner distribution information.
 - 2. Measure the amount of spawning habitat within areas sampled by the preemergent fry program (Fish/Shellfish Study 8b).

INTRODUCTION

In 1989, oil emanating from the Exxon Valdez spill caused contamination of marine waters and tidally influenced nearshore environments within the Kodiak and Chignik Management Areas. Documented presence of petroleum based products in these areas was cause for the Alaska Department of Fish and Game (Commercial Fisheries Division) to severely limit commercial salmon fishing opportunities due to the threat of contaminated fishing gear and fish product. The Kodiak Management Area encompasses 451 anadromous salmonid streams within the Kodiak Archipelago and Alaska Peninsula area from Kilokak Rocks at the southern boundary, to Cape Douglas (Figure 1). In 1989, at least one aerial and or foot survey was completed on 334 of the 451 anadromous streams (Barrett et. al. 1990). The Chignik Management Area (CMA) has 107 recognized anadromous salmon streams and is delineated by Kilokak Rocks to the north with the southern boundary being Kupreanof Point (Figure 1). All 107 CMA salmon streams were surveyed in 1989.

In 1989 the estimated total pink salmon escapement for the KMA was 20,280,991 fish which exceeded the odd year target escapement goal of 4.7 million fish by a factor of 4.3, while the CMA escapement of 1,434,798 fish exceeded the escapement goal of 0.7 million fish by a factor of 2.1.

Contemporary commercial salmon management is grounded upon the convention that if escapement goals are met, subsequent production will provide for a maximum sustained yield. To determine if the total estimated escapements observed in 1989 will result in lower production, had there not been an oil spill, a life history analysis is being conducted. This approach is superior to evaluation of production trends or spawner-recruit analyses due to

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Figure 1. Map showing the location of the Kodiak and Chignik Management Areas.

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the ability to evaluate events occurring at each successive stage and not requiring returns from the 1989 brood year being present. Within this study, escapement and spawner density parameters surrounding the first life history stage are estimated. Successive life history stage analyses will rely upon these parameters for impact assessment (Fish/Shellfish Study 8b).

METHODS

Aerial Surveys

Aerial surveys were conducted using fixed wing aircraft and trained fisheries biologists on all Kodiak and Chignik escapement index streams in 1989 and 1990. Surveys were conducted weekly (weather permitting) and observers recorded: 1) Stream name and statistical number; 2) Date, weather conditions, survey visibility and time; 3) Numbers of live and dead fish by species; 4) Observer, pilot, aircraft type and general comments. Data were recorded on standard forms and entered into the regional stream survey database.

Weir Stations

In 1990 weirs were located on five systems within the Kodiak Archipelago (East Paramanof Ck., Afognak R., Saltery Ck., Barling Ck. and Akalura Ck.) to count daily pink salmon escapements. In addition, 150 pink salmon were tagged with color coded 30cm floy tags on a weekly basis (over a 4 week period with each tag color representing a specific week). As part of the program every three days foot surveys were conducted upstream of the weir to enumerate tagged and untagged live and dead fish. During each survey dead pink salmon were removed from the effective counting area to prevent recounting on subsequent foot surveys. Aerial surveys were made on the weired systems on a time available basis in an attempt to calibrate aerial counts with total escapement.

Pink salmon stream life was estimated using weir and foot survey counts of escapement in 1990, in conjunction with the Johnson and Barrett (1988) model. Four distinct methods were used in calculating stream life: 1) total live fish days (derived using live fish foot survey counts and the JB model, divided by the known cumulative pink salmon weir count; 2) Total live fish days (determined using live fish foot survey counts and the JB model, divided by the cumulative dead fish count; 3) Total number of live fish days per color code derived from foot survey counts divided by total number of fish tagged of that color code with and without adjustment for fish observability; 4) Total number of fish days from time of tagging until recovery of tagged carcasses based upon foot surveys and weir tag recoveries, divided by total number of tagged carcasses. Aerial survey calibration was investigated using a portion of the above data and instantaneous live fish population estimates. Instantaneous live fish population estimates were

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derived using cumulative live pink salmon counts through the weir, less cumulative carcasses counted by date.

Spawning Habitat Surveys

Total available spawning habitat estimates were derived using a two stage sampling design (5-300m primary units and 60 secondary units per stream) with variance estimates derived using equation 11.24 of Cochran(1977) with modification by Wolter (1984) for linear trends. Necessary metrics were obtained from United States Geological Survey 1:250,000 maps for both Kodiak and Chignik index streams and ranges of habitat suitability indices extracted from available scientific literature (Andrew and Geen 1960; Chambers 1956; Divinin 1952; Krueger 1981; Neave 1966; Raleigh and Nelson 1985; Wilson et.al. 1981.). Indices used for habitat designation were substrate size and embeddedness, water velocity and depth. All habitat data were recorded on standardized forms and entered into the regional database.

In addition, spawning habitat was estimated for preemergent fry sampling sites for all 44 Kodiak and 18 Chignik index streams using the same criteria as above.

RESULTS

To calculate total escapement estimates using a spawner abundance curve a reliable stream life estimate is required. In 1989, the average pink salmon stream life for East Paramanof creek and Afognak River was an estimated 8.7 days and 8.19 days respectively (average 8.44 days). The 1989 pink salmon total escapements for the Afognak District were calculated based upon this value. However, for the remainder of the Kodiak and Chignik management districts a stream life value of 15 days was employed (grounded upon the professional judgement of regional ADF&G staff). In 1990, six stream systems provided pink salmon stream life estimates. The average for each of the four methods used are: 8.6 days, 12.4 days, 7.4/12.2 days, and 14.6 days (Table 1). According to Perrin and Irvine (1990) the true or theoretical stream life is one which is neither positively or negatively biased, which relates to whether the method over or under represents the actual population present. This value is felt to be approximated by the weighted average of 15.7 days (Table 1). In evaluating the various methods both methods 1 and 2 previously mentioned have a negative bias due to fish visibility by observers (Table 3). This problem influences the estimates derived by the first two methods but has no influence on the latter two methods due to the use of tagging data. Stream life estimates derived using tagged fish data are depicted in Tables 2 and 3. The overall or theoretical stream life value calculated in 1990 (14.6 days), is not appreciably different than the 15 day value used for estimating total escapements in 1989. It should be noted that the stream life values observed for 1990 were under distinctly different escapement magnitudes and spawner

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Table 1. Estimated average pink salmon stream life by method for selected Kodiak Management Area streams, 1990.

System	Stream Life Method				
	Cum. Fish Days From Foot Survey Counts/Total Escap. Through Weir	Cum. Fish Days From Foot Survey Counts/Cum. Carcass Count	Weighted Avg. for Surveyed Counted Live Tagged Fish (Not Adj. for Visibility)	Weighted Avg. for Surveyed Counted Live Tagged Fish (Adj. for Visibility)	Weighted Avg. for Tagged Fish Using Carcass Recoveries
Barling	7.9	15.4	7.8	14.9	17.5
Afognak	6.7		3.8	7.8	9.9
Pink	6.5	6.8			
Akatara	3.5	5.9	6.0	9.9	10.8
Pillar		16.4			
Saltery	13.7	15.8	14.2	18.8	18.6
Paramanof	13.2	14.2	5.1	9.6	15.9
Average	8.6	12.4	7.4	12.2	14.6

6

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Table 2. Estimated pink salmon average stream life based on tagged fish carcass recoveries for four color coded tag groups, consisting of about 150 fish per code per week, for selected Kodiak Management Area streams, 1990.

System	Stream Life in Number of Days				Weighted Average
	Tag Group 1	Tag Group 2	Tag Group 3	Tag Group 4	
Barling	19.89	17.61	17.26		17.5
Afognak	10.14	8.43			9.9
Akalura	13.42	8.05			10.8
Saltery	25.08	18.90	14.77	13.44	18.6
Paramanof	21.43	20.19	14.77	9.50	15.9
Average	17.99	14.64	15.60	11.47	14.6

7

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Table 3. Estimated pink salmon average stream life based on live fish foot surveys of four color coded tag groups, consisting of about 150 fish per code per week, for selected Kodiak Management Area streams, 1990.

System	Stream Life in Number of Days										
	Tag Group 1		Tag Group 2		Tag Group 3		Tag Group 4		Weighted Average ^a		
	Not Adj.	Adj. ^b	Not Adj.	Adj. ^b	Not Adj.	Adj. ^b	Not Adj.	Adj. ^b	Not Adj.	Adj. ^b NA/A	
Barling	10.4	15.4	7.3	15.1	7.7	14.8			7.8	14.9	0.53
Afognak	4.0	8.1	2.6	6.3					3.8	7.8	0.48
Akalura	7.5	9.7	4.3	10.0					6.0	9.9	0.61
Saltery	19.1	26.1	13.8	18.7	10.5	14.6	11.2	13.2	14.2	18.8	0.76
Paramanof	7.9	11.8	4.0		4.2	11.5	3.8	6.4	5.1	9.6	0.53
Average	9.8	14.2	6.4	12.5	7.5	13.6	7.5	9.8	7.4	12.2	0.58

^a Weighted average stream life derived by a weighting factor representing the escapement counted during the respective tagging periods.

^b The adjustment is based on the visibility of tagged fish by tag color group and stream. For example if only 75 of 150 tagged fish of a specific color code were observed on the first survey following tagging, the number of tagged fish observed beginning with the first survey following release of the 150 color coded tagged fish was increased by a factor of 2.0.

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densities than those which were experienced during the 1989 spawning event.

Aerial survey calibration as defined (Fish/Shellfish Detailed Study Plan 7b) could not be adequately evaluated due to prolonged inclement weather which limited the number of surveys available for the stream systems designated. It is doubtful whether the calibration information, if obtained, would have been useful in evaluating 1989 escapements in light of the rather minimal escapements observed in 1990, Paramanof Ck.(24,446), Saltery Ck.(5,121), Akalura Ck.(2,604), Barling Ck.(18,953), Afognak R.(27,808), Pillar Ck.(13,348).

Total available pink salmon spawning habitat estimates and variances were estimated for 43 Kodiak and 18 Chignik index streams (Tables 4 and 5). Spawner densities were calculated using finalized escapement data from 1989, and total available spawning habitat estimates. In addition, 95% confidence intervals were calculated based upon the assumption that the habitat data is approximated by a symmetrical distribution. Stream specific spawner densities and 1989 total estimated escapements are used as a preliminary step in evaluation of preemergent fry data collected as part of Fish/Shellfish Study 8b, and associated impact assessment modeling forthcoming.

At this time, spawning habitat estimates for the preemergent fry sampling sites have not been calculated.

STATUS OF INJURY ASSESSMENT

All of the stated objectives within this project have been met, except for calculation of the spawning area estimates for the preemergent fry sampling sites and the detailed spawner distribution maps. The 1989 spawner distribution maps for each of the index streams within the Kodiak and Chignik Management Areas will be completed by 15 January, while estimates for the preemergent fry sampling site spawning habitat should be completed by February 1991.

Within this study and its associated objectives impact is not directly addressed; results from this investigation will be integrated into an impact assessment conducted within Fish/Shellfish Study 8b.

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Table 4. Kodiak Management Area pink salmon preemergent fry index stream estimated escapements, total available spawning habitat, desired escapement goals and theoretical optimum and observed spawner densities, 1989.

Stream Name	Stream Number	Habitat Est.	Std. Dev.	Escapement (# of Fish)		Spawner Density (Inds./M ²)			
				1989	Desired	Opti.	Point Est.	95% C.I. Low High	
Afognak District									
Malina	251-105	5,524.4	42.81	4,022	18,418	3.333	0.728	0.721	0.735
Paramanof	251-404	41,345.9	128.32	20,056	18,418	0.445	0.485	0.483	0.486
Waterfl.	251-822	10,414.6	380.701	106,347	30,000	2.880	10.21	9.768	10.69
Peranosa	251-830	29,223.2	145.21	95,700	73,671	2.520	3.274	3.254	3.295
Seal	251-901	619.7	24.33	6,000	6,000	9.682	9.682	9.233	10.17
Danger	252-332	839.7	17.92	39,207	-----	-----	46.69	45.48	47.95
Afognak	252-342	27,864.6	62.66	41,611	20,000	0.717	1.493	1.489	1.497
Marka	252-343	58,724.6	196.51	20,794	36,835	0.627	0.354	0.352	0.355
Subtotals		174,557		333,737	203,342	1.164	1.911		
Northwest District									
Sheratin	259-371	67,847.2	170.78	119,943	36,835	0.542	1.767	1.762	1.773
Little R.	253-115	62,370.7	159.92	193,167	55,253	0.885	3.097	3.087	3.106
Uganik	253-122	46,903.4	352.74	795,899	257,847	5.497	16.96	16.81	17.12
Terror	253-331	68,798.2	275.38	410,913	110,506	1.606	5.972	5.943	6.002
Baumans	253-332	44,646.3	253.7	353,333	18,418	0.412	7.914	7.858	7.970
Browns	254-204	40,176.9	213.82	63,820	18,418	0.458	1.588	1.578	1.599
Uyak	254-202	97,817.9	145.08	645,157	184,176	1.882	6.595	6.583	6.607
Zachar	254-301	116,852.0	314.32	103,983	73,671	0.630	0.889	0.887	0.893
Subtotals		428,561		2,686,215	755,124	1.762	6.268		
Southwest District									
Karluk	255-101	829,515	820.2	109,880	40,000	0.048	0.132	0.132	0.132
Ayakulik	256-201	364,644	511.36	45,655	10,000	0.027	0.125	0.124	0.125
Sturgeon	256-401	176,630	244.43	1,692	18,418	0.104	0.009	0.009	0.009
Subtotals		1,370,789		157,227	68,418	0.049	0.114		
Alitak District									
Narrows	257-401	21,532	104.98	2,097	7,367	0.342	0.097	0.096	0.097
Dog Sal.	257-403	137,755	354.84	315,559	120,000	0.871	2.290	2.283	2.298
Deadman	257-502	111,431	279.8	1,093,543	221,012	1.983	9.813	9.783	9.844
Humpy	257-701	171,739	272.08	1,783,196	331,517	1.930	10.38	10.36	10.40
Subtotals		442,457		3,194,395	679,896	1.536	7.219		
Eastside District									
Killuda	258-207	22,738	181.74	69,762	36,835	1.619	3.068	3.038	3.098
Barling	258-522	75,210	197.93	147,423	110,506	1.469	1.960	1.953	1.966
Kaiugnak	258-542	7,824	57.95	118,323	36,835	4.707	15.12	14.98	15.26
Seven R.	258-701	19,588	97.2	1,192,683	147,341	7.521	60.88	60.51	61.26
Miam	259-412	53,637	156.5	196,087	36,835	0.686	3.655	3.642	3.669
Hurst	259-414	32,472	118.87	142,535	36,835	1.134	4.389	4.369	4.409
Saltery	259-415	53,695	121.32	214,541	60,000	1.117	3.995	3.984	4.006
Subtotals		265,164		2,081,354	465,187	1.754	7.849		

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Table 4. (page 2 of 2)

Stream		Habitat Est.	Std. Dev.	Escapement (# of Fish)		Spawner Density (Inds./M ²)			
Name	Number			1989	Desired	Opti.	Point Est.	95% C.I. Low	95% C.I. High
Northeast District									
Pillar	259-102	2,541	23.12	42,950	-----	-----	16.90	16.71	17.09
Buskin R.	259-211	47,945	222.86	272,785	100,000	2.085	5.689	5.656	5.722
Subtotals		50,486		315,735	100,000	1.980	6.253		
Mainland District									
Kukak	262271	21,257	82.24	3,802	7,367	0.346	0.178	0.178	0.179
Missack	262-402	5,345	121.06	36,120	11,051	2.067	6.757	6.572	6.952
Kinak	262-451	21,738	126.93	54,327	73,671	3.389	2.499	2.481	2.517
Dakavak	262-551	34,635	365.18	65,910	73,671	2.127	1.902	1.878	1.928
Kashvik	262-604	117,682	219.38	282,600	92,088	0.782	2.401	2.395	2.406
Alinchak	262-651	3,317	42.98	541,827	73,671	22.20	163.3	160.7	166.0
Portage	262-702	4,543	79.98	138,880	36,835	8.107	30.56	29.91	31.25
Oil	262-751	10,966	87.96	115,612	36,835	3.358	10.54	10.43	10.64
Jute	262-801	5,473	60.62	23,303	3,684	0.673	4.257	4.200	4.316
Kanatak	262-802	23,005	140.18	158,350	36,835	1.601	6.883	6.831	6.935
Big Ck.	262-851	77,704	184.84	2,078,433	221,012	2.844	26.74	26.66	26.82
Subtotals		325,667		3,499,164	666,720	2.047	10.74		

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Table 5. Chignik Management Area total pink salmon spawning habitat estimated 1989 total escapements and observed spawner density by preemergent fry index stream.

Stream		Habitat Est (M ²)	Std. Dev.	1989 Escapement (# of Fish)	Spawner Density (Inds./M ²)		
Name	Number				Point Est.	95% Low	C.I. High
Hook	272-302	153,244	390.46	45,000	0.293	0.292	0.294
Kumliun	272-501	24,234	74.05	89,499	3.693	3.679	3.707
North Fk.	272-702	128,837	280.06	25,497	0.197	0.197	0.198
Amber	272-703	200,041	632.83	53,000	0.264	0.263	0.265
Ocean Bh.	272-801	80,014	279.47	14,080	0.175	0.175	0.176
Chg. (904)	272-904	19,245	188.23	32,000	1.662	1.642	1.683
Chg. (905)	272-905	54,284	132.53	89,000	1.639	1.634	1.644
Agripina	272-961	115,699	251.61	82,592	0.713	0.711	0.715
Ivan R.	273-722	189,000	416.27	32,000	0.169	0.168	0.169
Foot Bay	273-802	18,063	120.45	10,800	0.597	0.593	0.602
Spoon	273-823	23,652	60.79	1,700	0.071	0.071	0.072
Portage	272-842	19,107	76.62	1,200	0.062	0.062	0.063
Ivanof	275-406	256,723	302.304	168,403	0.655	0.655	0.656
Humpback	275-502	110,294	208.29	51,000	0.462	0.461	0.463

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