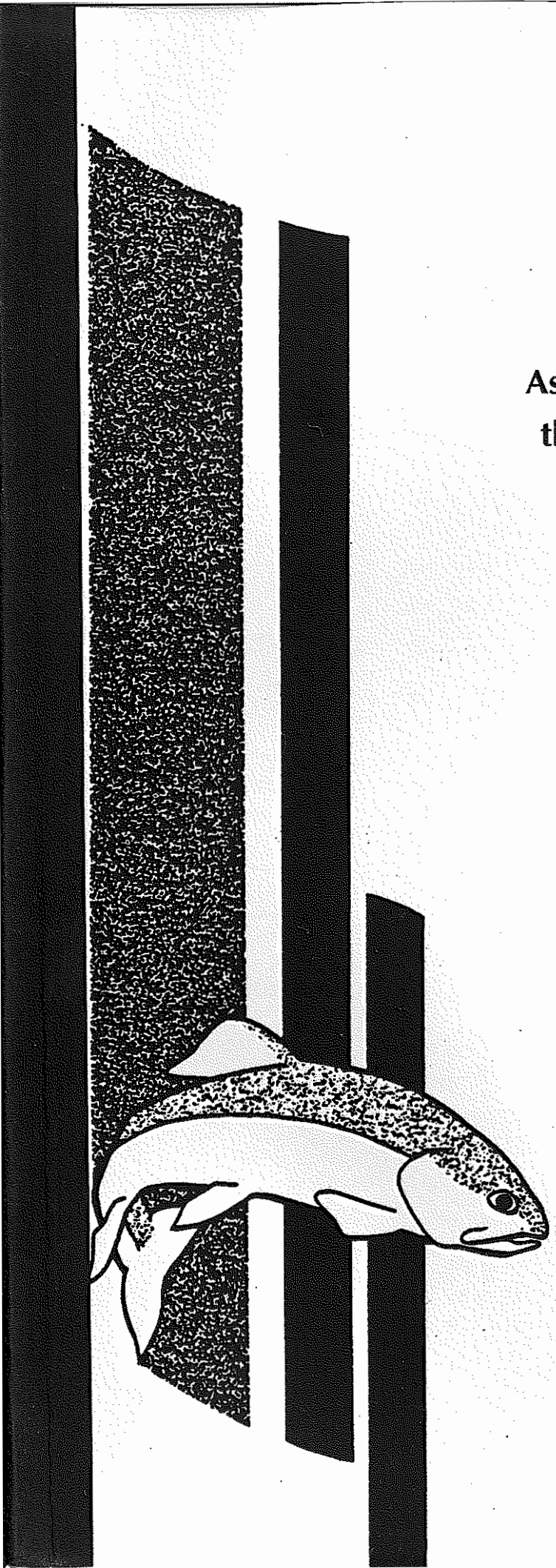

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by

M. Labelle

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Marc Labelle[1]

Stock Management Unit
Conservation Section, Fisheries Branch
Ministry of Environment, Lands and Parks
780 Blanshard Street, Victoria, BC. V8V 1X4

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ABSTRACT

The 1994 steelhead catches in the commercial fishery of Area 4 were estimated by reference to the steelhead:sockeye ratio from observer records, and adjusted hail reports. The estimates obtained indicated that approximately 8494 steelhead were caught in Area 4 seine and gill-net fisheries. A comparison of point estimates suggests that fishermen reported, on average, about 1/3 of the steelhead captured. Observer records indicated that steelhead were slightly less susceptible to capture by modified gill-nets as opposed to standard gill-nets.

INTRODUCTION

In 1994, the Ministry of Environment, Lands and Parks (MELP) in collaboration with the Dept. of Fisheries & Oceans (DFO) implemented a catch-and-escapement monitoring program to provide information on the status of coho and steelhead stocks from the Skeena River. One of the objectives of this program was to obtain reliable estimates of steelhead catches for commercial fisheries operating in the DFO statistical Area 4. About 30 fishery observers were interspersed throughout the gill-net and seine fleets during 1994 to monitor fishing effort, determine catch composition, and conduct bio-sampling. Labelle et al. (1995) provided the rationale for the approach used, and the scientific basis for the design of the catch monitoring program. The main purpose of the present report is to describe the methods used to compile the observer records, and provide preliminary estimates of steelhead catches.

DATA COMPILATION

The 1994 observer program was conducted by J.O. Thomas & Associates Ltd.[2] (JOT), with funds provided by the BC21 Program of the Ministry of Employment and Investment (MEI). Thomas (1994) summarized the results obtained and provided details on the methods used to conduct the catch monitoring, reporting and verification. The data sets provided by JOT were further verified by Fisheries Branch, with mutual agreement on corrections. Observer records for July 17 were assigned to statistical week 73 because the opening was an extension of the Saturday fishery (S. Cox-Rogers, pers. comm.). A new label (C) was added to existing observer codes to indicate that the records were adjusted by JOT staff to account for observations made when catches were unloaded. A field was added for fishing times (in h). A field was added for fishing zones within Statistical Area 4 (Fig. 1-2): Outside + N. Boundary (1), Sound (2), Smith (3), and the River (4). Observations for the Gap, and Slough regions were assigned to sub-area 4-12, and are included in Zone 3 (Smith). Zone 0 was used for all sub-areas in Areas 3 and 5. Finally, all fishing records associated with seine-based radio-tagging operations were included in this data set since these records were considered comparable to those of observers (variables in the data set are listed in Table 1, the large database is on file, MELP Fisheries Research Section, U.B.C.).

CATCH ESTIMATION

The corrected observer record data set was read into a relational database (MS FOXPRO) for data compilation. Only records with available catch records (codes A, C, P) were used for the initial analysis. Fishing periods also had to be available to ensure that the records could eventually be linked to fishing effort. Records that met these criteria were compiled by gear, time, zone, and species, along with the corresponding DFO hail and effort statistics (Tables 2a,b). Steelhead catch by gear, time, and area strata was estimated using the standard ratio estimator described by Cochran (1977, p. 151):

(1) $$\hat{Y}_r = \frac{y}{x} X$$

2. 1370 Kootenay Street, Vancouver, B.C. V5K 4R1

where:

$\hat{Y}_r$ = ratio estimate of steelhead catch in a given stratum
y = observed steelhead catch in a given stratum
x = observed sockeye catch in a given stratum
X = total number of sockeye caught in a given stratum

After adding subscripts and making a few substitutions, Eq. 1 is transformed into an estimator of total steelhead catch in commercial net fisheries for a given statistical Area:

(2) $$\hat{C}_{st} = \sum_{G}\sum_{W}\sum_{Z} \frac{c_{st,g,w,z}}{c_{sk,g,w,z}} H_{sk,g,w,z}$$

where:

$\hat{C}_{st,...}$ = Estimate of total steelhead catch
$c_{sk,....}$ = Observed sockeye catch by gear (g), week (w), zone (z)
$H_{sk,..}$ = Reported hail catch of sockeye in the corresponding stratum

Eq. 2 can be used to estimate catches based on catch-per-effort (CPUE) statistics by substituting the observed and hail catch with the corresponding fishing effort in a given stratum. However, in the present analysis, catches were estimated from the ratio of steelhead to sockeye. This approach eliminated the need to account for CPUE problems such as non-representative efforts (gill-nets tied to trees at night), and possible non-linear relations between catch and effort.

Catches can be estimated with Eq. 2 if observer and hail (or sales slip) records are available for every stratum. A cursory examination of the Table 2 contents shows no observer records for some strata, which precludes the expansion of the survey statistics. There are also several strata with no observed steelhead catches, yet some were reported during hails. In such cases, an expansion of observer records would obviously underestimate the steelhead catch. The later points suggests that sampling effort was not sufficient to provide steelhead catch estimates for all strata. Problems due to sampling deficiencies can be partly compensated for by pooling observer and hail statistics across strata. Pooling also serves to increase the sample sizes, which can improve the accuracy of the catch estimates. However, pooling can only be conducted across strata with comparable steelhead:sockeye ratios. To determine where pooling was justified, catch statistics were compared across strata from adjacent weeks, zones or gear types.

Statistical comparisons were first made of the steelhead:sockeye ratios in observed catches of regular and modified gill-nets during July in Statistical Area 4. Steelhead always accounted for 3% of the combined steelhead-sockeye catches in gill-nets (Table 3). The relative abundance of steelhead tended to be slightly lower in modified gill-nets, which supports the notion that weed-lines allow more steelhead to escape. However, log-likelihood ratio tests of the steelhead:sockeye ratios in catches revealed no significant differences between net types in all possible comparisons. This indicates that there are only small differences the selectivity of both gear types for steelhead. This difference will be quantified by reference to the relative selectivity index of gear 1 over gear 2:

$$\hat{S}_{1,2} = \frac{\sum_{w=1}^{W}\sum_{z=1}^{Z} \frac{p_{g1,w,z}}{p_{g2,w,z}}}{W+Z} \quad (3)$$

where:

$\hat{S}_{1,2}$ = Relative selectivity index of modified gill-nets (1) against regular nets (2)
$p_{g2...}$ = Contribution of steelhead in catches for a given stratum (St/[St+Sk])
$W+Z$ = Total number of week/zone strata over which comparisons are made.

The above index is simply the mean ratio of steelhead contributions in both gear types across strata. As such, it is not influenced by differences in sample sizes across strata, or by changes in the relative abundance of steelhead or sockeye during the season. The relative selectivity index of modified gill-nets was estimated to be 0.906. This indicates that steelhead are less susceptible to capture by modified gill-nets under actual fishing conditions, and that modified gill-nets caught about 10% fewer steelhead than regular gill-nets during July in Area 4.

A greater number of observer records were available for regular gill nets, which allowed for more detailed comparisons of trends in steelhead:sockeye ratios. The relative selectively of regular gill-nets against seine nets was determined based on catch statistics associated with seining activities conducted for tagging purposes during July-August in sub-areas 4-9 and 4-12. For this purpose, it was necessary to pool gill-net observer records from Zones 2 and 3 (Table 4). The relative selectively of gill-nets against seine nets was estimated to be 1.37. This indicates that gill-nets intercept about 37% more steelhead that seine nets for comparable catches of sockeye. Log-likelihood ratio tests of the steelhead:sockeye ratios in catches of both vessel types revealed significant differences in two of five possible comparisons. Such results warn against the pooling of observer records across gear types.

Since pooling across gear/zones/time strata was not found to be justified, efforts were made to determine if hail records could be used to estimate steelhead catches in a given strata where observer records were lacking. Statistical comparisons of the steelhead:sockeye ratios from both surveys was not conducted in view of the hypothesized under-reporting. Instead, comparisons were conducted primarily to determine the level of similarity between the two sets of data. Steelhead:sockeye ratios in observer samples and hail surveys from Area 4 tended to increase from Zone 1 to 4 (Fig. 3). This increase was most obvious during July, but was not clearly apparent or consistent during August. The lack of close similarity in trends precludes the simple substitution of observer samples by hail survey statistics in cases where the former are not available. However, it was reasoned that adjusted hail survey statistics could still be used for catch estimation purposes if evidence was found of some underlying relation between indices derived from both surveys.

Steelhead catches were estimated with Eq. 2 for all strata with complete observer and hail survey records. Observer-based catch estimates were regressed against the corresponding hail survey records. The two variables are not entirely independent, so any apparent relation is less strong that the regression would suggest. The best fitting linear relation was:

(4) $$\hat{C}_{st,w,z} = 153.1 + 1.085\, H_{st,w,z}$$ (n = 25, r^2 = 0.30)

where:

$\hat{C}_{st,w,z}$ = Estimate of total steelhead catch for a week/zone stratum
$H_{st,w,z}$ = Reported hail catch of sockeye in the corresponding stratum

An examination of the fit associated with the linear model (Fig. 4, line A) shows that the predicted catches tended to exceed the lower observer-based catch estimates, and to be lower than the higher observer-based estimates. Nevertheless, the distribution patterns of the residuals did not indicate serious anomalies, and the probability levels associated with the intercept and the slope coefficients were highly significant (P = 0.007 and 0.005 respectively). This relation would suggest that on average, fishermen report about 60% of steelhead caught, which supports the hypothesis that fishermen under-report steelhead catches in this fishery.

A cursory examination of the fit suggests that one point seems to have a relatively large influence on our perception of the shape of the relation. This point is the one on the lower right hand side of the Fig. 4 (in the box). This point is based on a relatively small sample (8 sets of short duration), so the possibility exist that this 'outlier' was the result of too few observations within the stratum. If one omits this point, the scatter would be better described by a steeper linear relation, or an non-linear asymptotic one. At this stage, there is no reason to believe that the true relation between these variables (if any) is linear. Several non-linear models could be used to describe the apparent relation between the two variables. The model selected here was assumed to have the same structure as the von Bertalanffy model used to describe growth in some fish species (see Ricker 1975, P. 221). In the present context, this model could be written as:

(5) $$C_{st,w,z} = L_{max}\{1 - e^{-K(H_{st,w,z} - H_o)}\}$$

where:

L_{max} = Parameter representing the asymptote
K = Parameter affecting the initial slope steepness
H_o = Parameter affecting influence of hail catch reports

Least-squares estimates of the Eq. 5 parameters were generated using the Quasi-Newton algorithm in the NONLIN statistical module of the SYSTAT microcomputer program (Wilkinson 1989). Estimates were generated using the data set without the apparent outlier. The values for L_{max}, K and H_O were estimated to be 629.49, 0.007 and -18.51 respectively. Least-squares estimates for the linear model were also generated from the same data set. The intercept and regression coefficients were estimated to be 144.1 and 1.389 respectively.

The non-linear model fit was superior to that of the linear model (Fig. 4, lines C and B). Predicted catches showed a strong non-linear dependency on hail catch reports (Fig. 4). The shape of the relation indicates that fishermen under-report proportionally fewer steelhead at higher catch levels. One plausible explanation is that fishermen fail to identify steelhead in their catches when they are not very abundant. However, no significant

correlation was detected between the contribution of steelhead in gill-net catches and the estimated fraction of steelhead catches reported.

Knowledge of the relation between hail reports and observer-based estimates of steelhead catches can be used to predict steelhead catches directly from hail survey data when observer records are available for a given stratum. To assess the suitability of this approach, predicted and estimated catches were generated for each regular gill-net fishery stratum in Area 4 with complete observer and hail records. Total predicted and estimated catches were 6,237 and 6,429 steelhead respectively. Predicted catches are lower that observer-based estimates for some stratum, and higher for others, but these tend to cancel out each other such that total catch figures are similar. The closeness of both figures supports the use of the non-linear model as an alternative to Eq. 2 when no observer records are available.

The relation between reported hail catches and the observer-based estimates of steelhead catches for modified gill-nets could not be established for lack of sufficient information. However, no evidence was obtained to indicate that such a relation (if any) would differ from the one described above. Therefore, the same relation was used to estimate steelhead catches for modified gill-nets for strata without observer records. The total steelhead catch in the gill-net fishery of Area 4 was thus determined from a combination of estimated and predicted catches (Table 5). This approach would indicate that approximately 8,494 steelhead were caught in the Area 4 gill-net fishery during the June-September period. Of these, only 2,584 were reported, which amounts to an overall reporting rate of about 30%. Any estimate of Skeena River steelhead catch in would also have to account for steelhead caught in the Area 3 gill-net and seine fisheries. Preliminary observer-based catch estimates indicate that at least 1,800 steelhead were caught in the Area 3 seine fishery during July-August 1994. If one assumes that most of the steelhead released from commercial vessels eventually die, and that most of the steelhead caught in these fisheries are of Skeena River origin, then the total commercial harvest of Skeena River steelhead in Area 3-4 during 1994 exceeded 10,000 fish. It should be stressed that this catch estimate does not account for contribution of non-Skeena steelhead, the survival rate of steelhead released from commercial vessels after capture, and the catch of Skeena River steelhead in native and US fisheries.

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Table 1. Description of fields and variables used in the database of commercial catch of the Area 4 fishery near the mouth of the Skeena River.

Field label	Field description
Date	Fishing date (mm/dd/yy)
Stat wk	DFO stat wk (mmww) starting sunday, ending saturday, as in JOT manual
ID	Sampler identification.
Vessel name	Vessel name (deleted for purposes of confidentiality)
CFV	Registration number for the vessel (deleted for purposes of confidentiality)
Gear type	10 Vessels with regular 60 mesh gill-net 11 Vessels with modified 90 mesh gill-net and weed-line. 20 Vessel with seine net.
Mesh size	In inches when stretched.
Net length	In fathoms (x 2 m). Actual size of net, and not length deployed.
Net depth	Net depth in number of meshes.
Stat Area	DFO Statistical area.
Sub Area	DFO statistical sub-area.
Zone	0 for all subs in DFO areas 5 and 3. 1 for outside + N. Boundry (Areas 4-1 to 4-8, 4-13, 4-14). 2 is used for the Sound or N. Porcher (Area 4-9). 3 is used for Smith (Area 4-12 including 'Slough' and 'Gap' regions). 4 is used for the 'River' region (Area 4-15).
Set #	Order of the set as observed.
Time in	Time (hhmm) when net is starting to be deployed.
Time out	Time (hhmm) when fishermen start drumming up the net.
Time	Duration of fishing period for a given set, in hours.
% Fished	Fraction of net used during fishing. Could be <100 for gill-nets.
Tide	E Ebb, F Flood, H Low water slack, L High water slack.
Caught	Numbers caught, include lost while hauling, and jacks.
Code	Observed (A), Estimated (E), No count (N), Partial count (P), Corrected (C)
Ads	Number of fish that lacked an adipose.
Rel	Numbers of fish released.
Notes	Miscell noted about the operation.

Table 2a. Summary of observer records. Statistical weeks with no fishery openings were omitted. The species labels correspond to sockeye (Sk), coho (Co), chinook (Ck), steelhead (St). Hail records for Zones 1-3 of Statistical Area 4 in July were adjusted to account for gear contributions of 97% for regular gill-nets, and 3% for modified gill-nets. The label n/a indicates that data are still forthcoming.

Gear code	Stat. area	Stat. week	Zone	Obs. sets	Obs. time (h)	Obs. Sk	Obs. Co	Obs. Ck	Obs. St	Boats days	Hail Sk	Hail Co	Hail Ck	Hail St
10	3	73	0	164	267.9	1681	214	1099	15	n/a	7328	1617	187	17
10	3	74	0							n/a	4558	1670	66	8
10	3	75	0							n/a	4830	997	3	0
10	3	81	0	22	52.9	146	25	91	3	n/a	8186	3432	2	0
10	3	82	0							n/a	3406	802	0	0
10	3	83	0	2	7.0	26	0	9	0	n/a	2052	768	5	0
10	3	84	0							n/a	1327	1635	8	0
10	3	91	0							n/a	226	401	3	3
10	4	63	4							52	20	0	520	0
10	4	64	4							56	280	0	756	0
10	4	71	1							215	4831	606	27	0
10	4	71	2							63	1827	89	32	0
10	4	71	3							63	2268	0	44	0
10	4	71	4							52	1560	0	416	9
10	4	72	1							460	22206	3141	176	8
10	4	72	2							180	10692	887	117	0
10	4	72	3							187	6980	483	146	14
10	4	72	4							123	8304	3	907	62
10	4	73	1	161	251.8	1345	190	920	13	943	65314	7882	332	141
10	4	73	2	192	383.4	1501	134	279	10	469	31706	4297	302	47
10	4	73	3	95	157.4	1133	5	28	18	535	31561	503	478	287
10	4	73	4	69	63.4	486	0	6	9	404	20486	168	1813	298
10	4	74	1	83	146.4	664	157	383	5	637	35487	8064	174	50
10	4	74	2	15	32.4	86	20	10	0	233	8905	2997	111	17
10	4	74	3	27	40.8	156	4	1	5	220	6968	661	135	38
10	4	74	4	27	35.3	274	4	7	5	209	14000	161	1015	143
10	4	75	1	56	109.4	895	74	276	13	624	50158	5648	47	108
10	4	75	2	93	204.2	1285	45	196	26	324	25779	5715	323	89
10	4	75	3	85	129.2	1128	9	20	13	383	29784	890	733	39
10	4	75	4	31	37.0	721	11	5	10	353	47772	636	714	442
10	4	81	1	50	100.1	507	33	124	4	126	11508	836	8	12
10	4	81	2	12	22.4	139	8	1	2	84	5418	1211	60	24
10	4	81	3	3	3.6	9	8	1	0	123	11878	808	41	82
10	4	81	4	8	6.4	166	0	2	1	310	24180	1163	156	327
10	4	82	1	30	62.8	430	48	133	4	43	5289	172	4	30
10	4	82	2							31	5394	217	93	40
10	4	82	3							48	6528	720	19	10
10	4	82	4	5	5.1	102	1	1	2	120	30720	1200	120	0
10	4	83	1							27	2337	357	14	2
10	4	83	2	10	8.0	102	5	7	1	18	1980	864	36	0
10	4	83	3	6	8.1	63	4	4	5	30	2310	150	9	30
10	4	83	4							80	5760	640	320	144
10	4	93	1	1	1.1	0	0	4	0	5	0	90	0	0
10	4	93	2	6	10.5	5	32	31	0	19	56	642	5	0
10	4	93	3							40	48	120	0	0
10	4	94	1							20	30	780	0	0
10	4	94	2							35	42	1085	0	0
10	4	94	3							21	21	357	0	4

Table 2b. Summary of observer records. Statistical weeks with no fishery openings were omitted. The species labels correspond to sockeye (Sk), coho (Co), chinook (Ck), steelhead (St). Hail records for Zones 1-3 of Statistical Area 4 in July were adjusted to account for gear contributions of 97% for regular gill-nets, and 3% for modified gill-nets. Labels n/a indicate no data received from DFO.

Gear code	Stat. area	Stat. week	Zone	Rec. count	Obs. time (h)	Obs. Sk	Obs. Co	Obs. Ck	Obs. St	Boats days	Hail Sk	Hail Co	Hail Ck	Hail St
11	4	73	1	242	385.7	2239	373	1308	19	29	2020	244	10	4
11	4	73	2	54	80.2	465	62	52	0	14	981	133	9	1
11	4	73	3							17	976	16	15	9
11	4	74	1	84	147.7	1177	79	447	21	20	1098	249	5	2
11	4	74	2	4	11.9	17	10	12	0	7	275	93	3	1
11	4	74	3							7	215	20	4	1
11	4	75	1	74	125.2	1026	67	168	12	19	1551	175	1	3
11	4	75	2	28	64.1.0	326	47	56	5	10	797	177	10	3
11	4	75	3	25	34.3.0	284	9	24	1	12	921	28	23	1
20	3	73	0	50	23.8	100	76	243	0	n/a	11885	2340	197	0
20	3	74	0	83	33.6	4017	399	898	17	n/a	11699	5566	484	11
20	3	75	0	54	24.3	698	48	264	14	n/a	64105	10609	513	46
20	3	81	0	21	11.2	258	28	109	2	n/a	27398	5039	203	0
20	3	82	0	83	43.0	3531	307	2079	13	n/a	58647	4982	188	0
20	3	83	0							n/a	7701	1690	26	0
20	4	73	0	30	11.0	220	41	42	3	0				
20	4	74	0	25	7.8	949	104	27	4	0				
20	4	75	0	61	20.3	660	247	104	25	0				
20	4	81	0	65	21.6	1259	250	43	44	0				
20	4	82	0	24	8.7	163	108	52	32	0				
20	4	83	0	41	15.5	578	259	61	12	0				
20	4	84	0	32	11.6	122	220	28	19	0				
20	4	91	0	42	13.8	51	211	50	3	0				
20	4	92	0	16	5.0	15	141	21	0	0				
20	5	73	0							n/a	320	131	2	0
20	5	74	0							n/a	0	0	0	0
20	5	75	0							n/a	150	0	0	0
20	5	81	0	14	5.4	23	49	39	0	n/a	8616	523	42	0

Table 3. Steelhead:sockeye ratios regular and modified gill-net catches during July 1995 in Area 4. The term St/(St + Sk) is the contribution of steelhead to the combined catch of steelhead and sockeye. Bold figures next to label *P* are probabilities associated with log-likelihood ratio tests of steelhead:sockeye ratios of the two gill-net types in the same week/zone stratum.

Gill-net type	Category	Stat Week	Zone 1	Zone 2	Zone 3	Zone 4
Modified	sockeye	73	2239	465		
Modified	steelhead	73	19	0		
Modified	St/(St+Sk)	73	0.008	0.000		
Regular	sockeye	73	1345	1501	1133	486
Regular	steelhead	73	13	10	18	9
Regular	St/(St+Sk)	73	0.010	0.007	0.016	0.018
		***P* =**	**0.720**	**0.160**[1]	-	-
Modified	sockeye	74	1177	17		
Modified	steelhead	74	21	0		
Modified	St/(St+Sk)	74	0.018	0.000		
Regular	sockeye	74	664	86	156	274
Regular	steelhead	74	5	0	5	5
Regular	St/(St+Sk)	74	0.007	0.000	0.031	0.018
		***P* =**	**0.062**	**0.999**[2]	-	-
Modified	sockeye	75	1026	326	284	
Modified	steelhead	75	12	5	1	
Modified	St/(St+Sk)	75	0.012	0.015	0.004	
Regular	sockeye	75	895	1285	1128	721
Regular	steelhead	75	13	26	13	10
Regular	St/(St+Sk)	75	0.014	0.020	0.011	0.014
		***P* =**	**0.591**	**0.562**	**0.177**	-

1. Probability associated with Chi-Square test corrected for continuity.
2. Probability associated with Fisher's Exact Test.

Table 4. Steelhead:sockeye ratios in regular gill-net and seine catches from Area 4, Zones 2-3 (combined). Other terms are as described in Table 3.

Gear Type	Observation	Statistical Week				
	category	73	74	75	81	83
Regular gill-net	sockeye	2634	242	2413	148	165
Regular gill-net	steelhead	28	5	39	2	6
	St/(St+Sk)	0.011	0.020	0.016	0.013	0.035
Seine	sockeye	220	949	660	1259	578
Seine	steelhead	3	4	25	44	12
	St/(St+Sk)	0.0135	0.004	0.036	0.034	0.02
	***P* =**	**0.693**	**0.021**	**0.002**	**0.131**	**0.286**

Table 5. Reported, estimated and predicted catches of steelhead catch by strata for the Area 4 gill-net fishery. Estimated catches are observer-based estimates of steelhead catches. Predicted catches are those based on the non-linear model using hail survey reports,

Gear code	Stat are	Stat week	Zone	Hail Effort (boat·days)	Reported hail catch	Estimated catch	Predicted catch
10	4	63	4	52	0		76
10	4	64	4	56	0		76
10	4	71	1	215	0		76
10	4	71	2	63	0		76
10	4	71	3	63	0		76
10	4	71	4	52	9		110
10	4	71	1	460	8		107
10	4	72	2	180	0		76
10	4	72	3	187	14		128
10	4	72	4	123	62		271
10	4	73	1	943	141	631	
10	4	73	2	469	47	211	
10	4	73	3	535	287	501	
10	4	73	4	404	298	491	
10	4	74	1	637	50	267	
10	4	74	2	233	17	0	
10	4	74	3	220	38	223	
10	4	74	4	209	143	255	
10	4	75	1	624	108	729	
10	4	75	2	324	89	522	
10	4	75	3	383	39	343	
10	4	75	4	353	442	663	
10	4	81	1	126	12	91	
10	4	81	2	84	24	78	
10	4	81	3	123	82	0	
10	4	81	4	310	327	146	
10	4	82	1	43	30	49	
10	4	82	2	31	93		212
10	4	82	3	48	19		114
10	4	82	4	120	0	602	
10	4	83	1	27	2		84
10	4	83	2	18	0	19	
10	4	83	3	30	30	183	
10	4	83	4	80	144		428
10	4	93	1	5	0	0	
10	4	93	2	19	0	0	
10	4	93	3	40	0		76
10	4	94	1	20	0		76
10	4	94	2	35	0		76
10	4	94	3	21	4		92
11	4	73	1	29	4	17	
11	4	73	2	14	1	0	
11	4	73	3	17	9		110
11	4	74	1	20	2	20	
11	4	74	2	7	1	0	
11	4	74	3	7	1		80
11	4	75	1	19	3	18	
11	4	75	2	10	3	12	
11	4	75	3	12	1	3	
			Totals =		2584	6074	2420

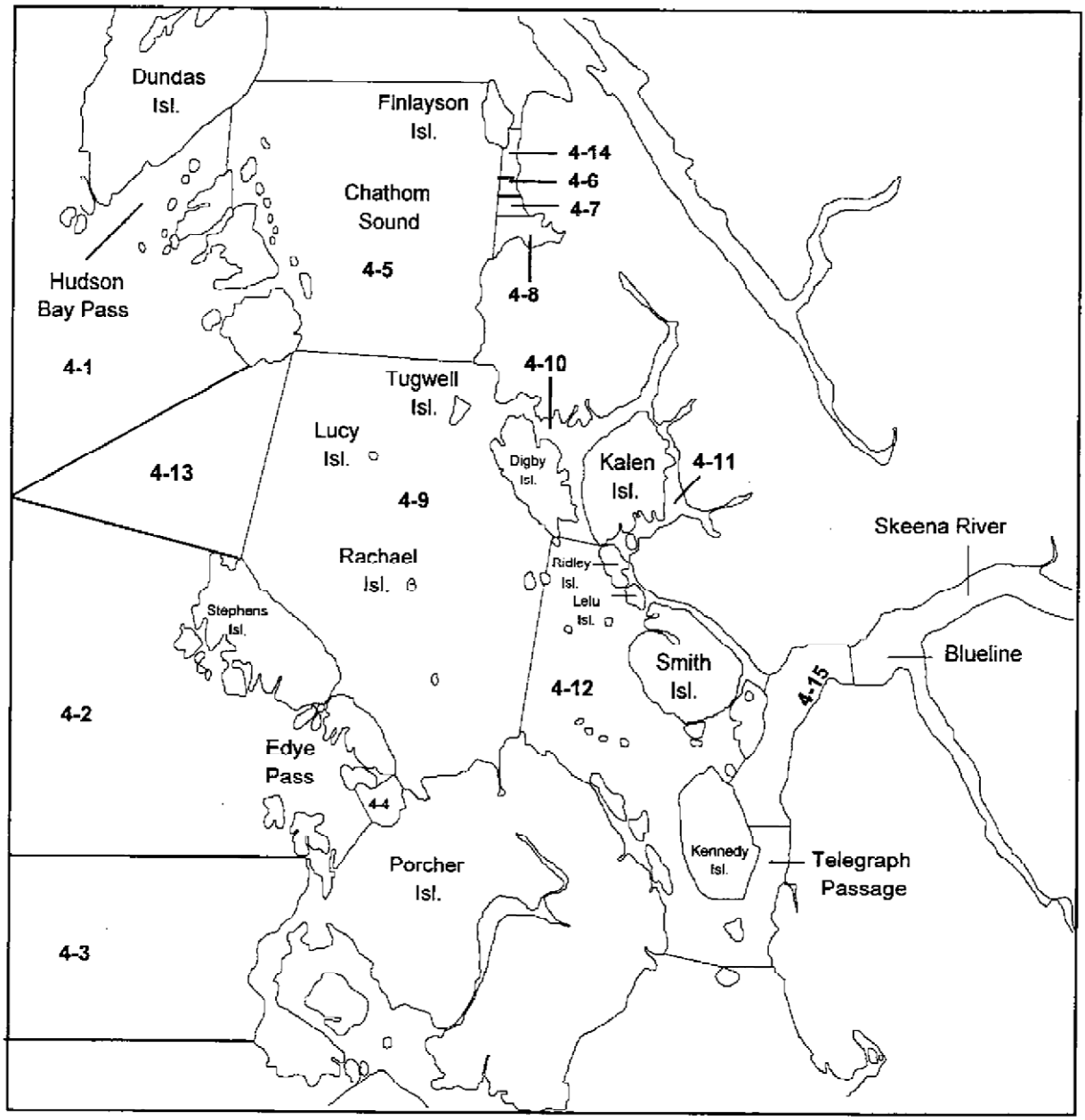

Figure 2.1. Major geographical features and management zones of Statistical Area 4 at the entrance to the Skeena River. Statistical Area 3 lies further to the south.

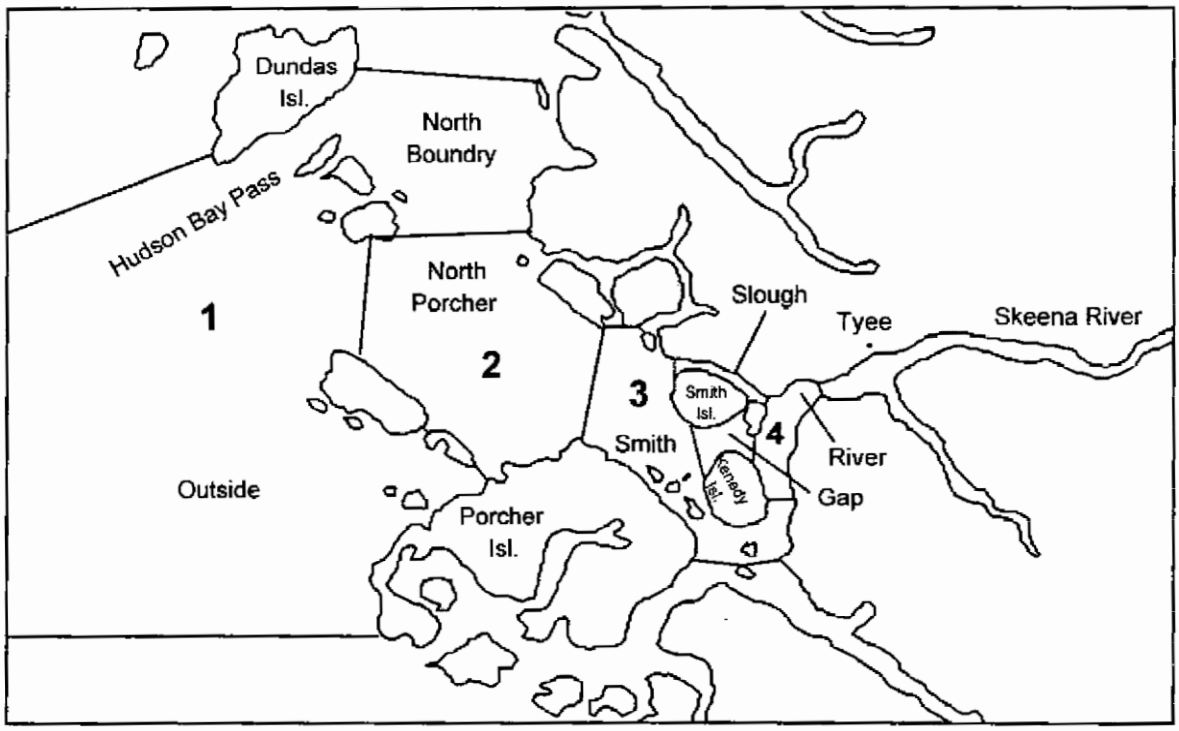

Figure 2. Fishing zone boundaries within DFO statistical Area 4. Labels 1-4 used to represent combinations of sub-areas; Zone 1 is Outside + N.Boundry (4-1 to 4-8, 4-13, 4-14), Zone 2 is Sound or North Porcher (4-9), Zone 3 is Smith (4-12, including Slough and Gap regions), and Zone 4 is River (4-15).

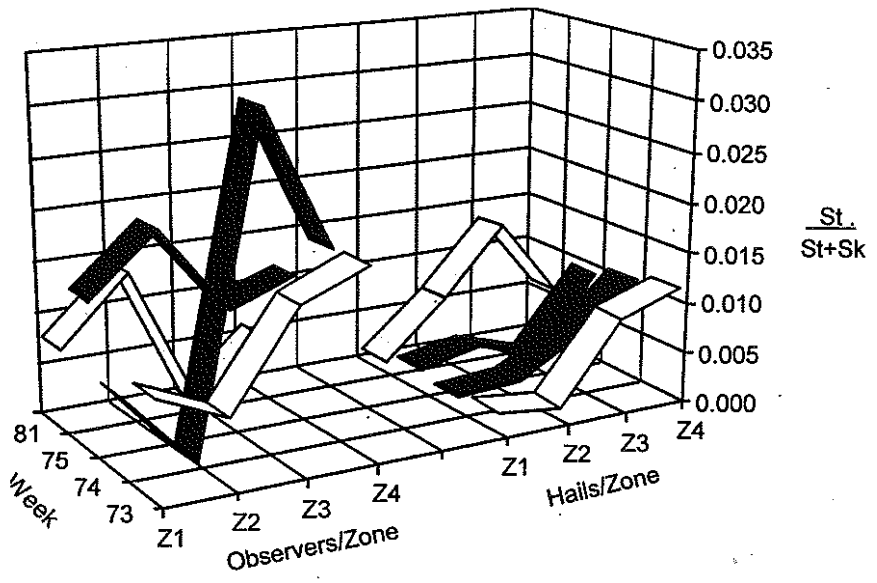

Figure 3. Comparison of steelhead:sockeye ratio based on observer and hail records from regular gill-net vessels in Area 4 in July and August, 1994. Weeks correspond to the DFO statistical weeks.

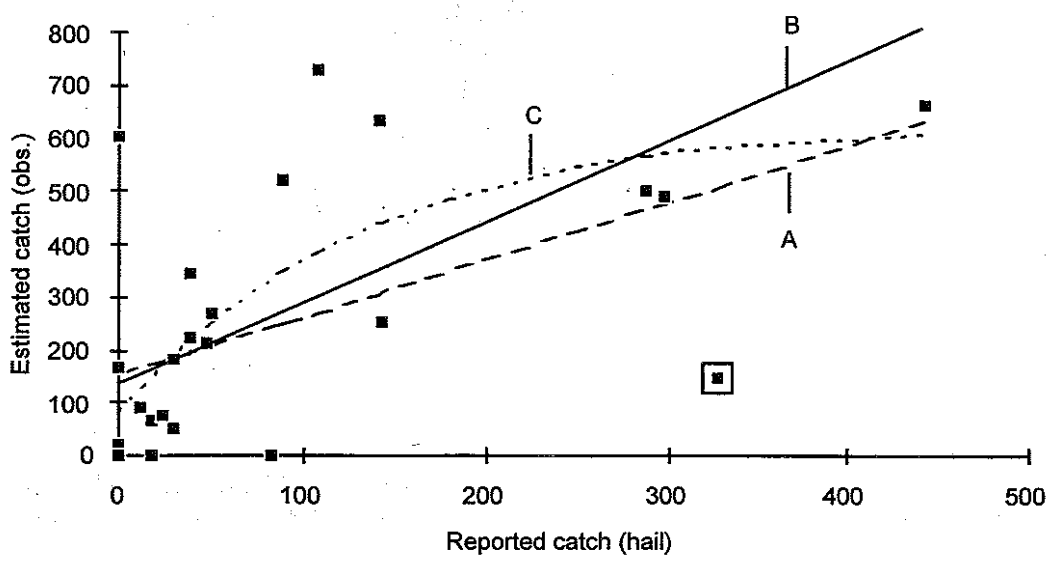

Figure 4. Observer-based estimate of steelhead catch against the reported catch from hail surveys for the Area 4 gill-net fishery. The records correspond to each week/zone stratum during weeks 73-81, 1995. The observation having a large influence on the hypothesized relation (linear vs. non-linear) is in the lower box. That observation was omitted to fit the linear and non-linear models (predicted values represented by lines B and C, respectively).