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Marine Roadside Creel Survey, Ketchikan, Alaska, July 1990 - September 1990

by

Dennis Hubartt

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Alaska Department of Fish and Game

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ABSTRACT

Based on a stratified multi-stage random sample creel survey conducted from 2 July through 9 Sept 1990, anglers expended an estimated 10,958 angler-hours (standard error = 1,345) fishing at three sites on the southern Ketchikan road system. Biweekly estimates of effort ranged from 746 to 2,924 angler-hours. Pink salmon *Oncorhynchus gorbuscha* was the most frequently captured species. The estimate for the total catch of pink salmon was 6,284 (standard error = 1,248), while the estimated harvest was 3,073 (standard error = 552). Biweekly estimates of catch ranged from 70 to 2,072 pink salmon. An estimated 350 (standard error = 85) chinook salmon *Oncorhynchus tshawytscha* were caught in the fishery, of which 139 (standard error = 44) were harvested. An estimated 119 (standard error = 84) coho salmon *Oncorhynchus kisutch* were caught and 17 (standard error = 17) were harvested. Too few tagged chinook and coho salmon were encountered to enable an estimate of hatchery contribution.

KEY WORDS: Southeast Alaska, Ketchikan, pink salmon, *Oncorhynchus gorbuscha*, chinook salmon, *Oncorhynchus tshawytscha*, coho salmon, *Oncorhynchus kisutch*, creel survey, angler interviews, estimated effort, estimated harvest, hatchery contributions.

INTRODUCTION

The roadside marine waters in Ketchikan, Alaska support a popular sport fishery. This fishery is expected to expand with time as the influence of increased hatchery production of coho salmon *Oncorhynchus kisutch* and chinook salmon *O. tshawytscha*, and improvements in wild stocks provide increased opportunity for resident and nonresident anglers. The increasing effort along the numerous Ketchikan roadside fishery access points, coupled with ongoing user group conflicts over these resources, necessitates a more precise definition of sport angling effort, catch, and hatchery contributions at these locations. In response to this need, the current project was designed to examine angler effort, catch, and harvest along the southern portion of the Ketchikan road system by interviewing and counting shoreline anglers. Prior to this study, the only site-specific information regarding shoreline effort, catch, and harvest was from general observation and from voluntary angler reports.

This survey focused on the south-end road system fisheries (Figure 1). Three site-specific creel surveys and one overall angler effort survey were conducted in this area.

The objectives of the 1990 Ketchikan roadside creel surveys were to estimate:

1. angler effort in the saltwater shoreline fishery from the Mountain Point area north to Herring Cove during the 2 July through 9 September period;

2. angler effort, catch, and harvest of chinook, coho, and pink salmon *O. gorbuscha* harvested in the saltwater shoreline fisheries in the Thomas Basin (TB), Mountain Point (MP), and Herring Cove (HC) areas during the 2 July through 9 September period; and

3. the contribution of hatchery stocks to the TB, MP, and HC saltwater shoreline chinook and coho salmon fisheries during the 2 July through 9 September period.

METHODS

Angler Effort Survey

The 1990 angler effort survey covered the entire shoreline from mile 4 on the south Tongass Highway to Herring Cove and involved counting shoreline anglers by roving the fishery from a boat or a vehicle along the shoreline. The strata for this survey were defined as follows:

1. 2 July - 29 July-weekdays (i.e., Mondays-Fridays, excluding the 4 July holiday);

2. 2 July - 29 July-weekend/holidays (i.e., Saturdays and Sundays, and 4 July);

3. 30 July - 26 August-weekdays;

4. 30 July - 26 August-weekends;

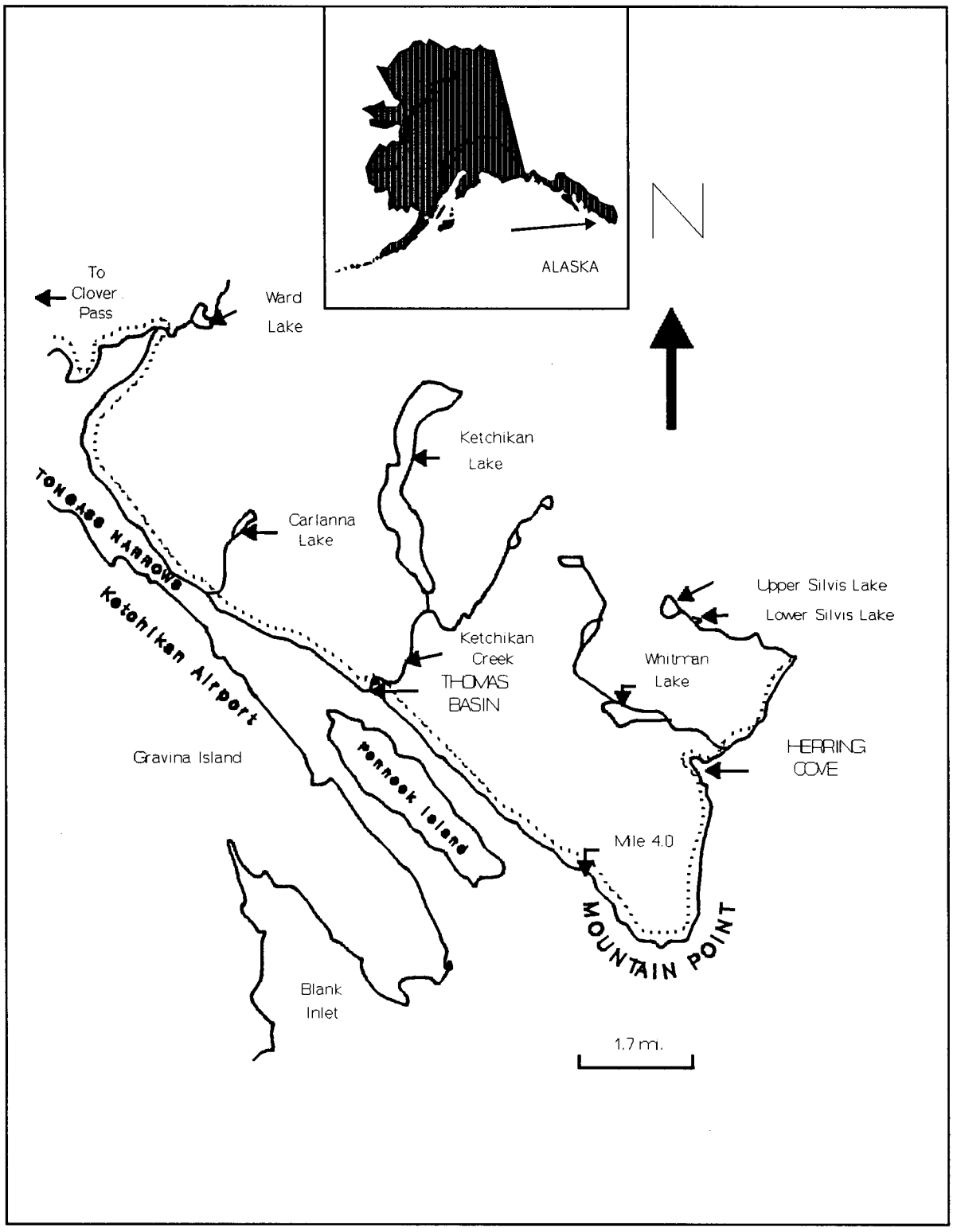

Figure 1. Location of sample sites for the Ketchikan south-end roadside survey, 1990.

5. 27 August - 9 September-weekdays (excluding the 3 September holiday); and

6. 27 August - 9 September-weekend/holidays (including 3 September).

Within each stratum days were selected at random for sampling, and represent the first stage sample units. Within each selected day two systematically chosen count times were selected, and represent the second stage sample units. The angler day was defined to be 16 hours long during strata 1-4 (0600-2200 in strata 1 and 2; 0530-2130 in strata 3 and 4), and 14 hours long during strata 5-6 (0700-2100). Since angler counts were estimated to take approximately one hour to complete, during strata 1-4 there were 8 possible combinations of systematic-randomly chosen start times (e.g., 0600, 0700, 0800, 0900, 1000, 1100, 1200, and 1300). After selecting the first count-time at random from the possible combinations, the second count-time was set at eight hours later for strata 1-4 and seven hours later for strata 5-6 (note that only seven possible count-times existed for strata 5-6).

The estimate of angler effort on a daily basis was obtained by averaging the two counts conducted each day and then expanding by the number of hours in the angling day. Next I obtained a mean angler effort estimate for all days sampled within each stratum, and then expanded by the number of days in each stratum to obtain the angler effort estimates for each stratum. Stratum estimates were summed to provide the seasonal angler effort estimate.

The following equations outline the procedures in detail. The first step involved obtaining the daily mean count:

$$\overline{x}_{hi} = \frac{\sum_{j=1}^{r_{hi}} x_{hij}}{r_{hi}} \qquad (1)$$

where r_{hi} equals the number of angler count samples conducted on day i within stratum h (set to be 2 according to the schedule) and x_{hij} is the number of anglers counted fishing during count sample j on day i within stratum h.

Next, I obtained the estimated daily angler effort:

$$\hat{E}_{hi} = H_h \overline{x}_{hi} \qquad (2)$$

where H_h equals the number of hours within each angling day for stratum h.

Then I estimated the mean angler effort over the days sampled in each stratum:

$$\overline{\hat{E}}_h = \frac{\sum_{i=1}^{d_h} \hat{E}_{hi}}{d_h} \qquad (3)$$

where d_h equals the number of days sampled in each stratum.

Finally, I expanded for the total number of possible primary sampling units (i.e., number of days in each stratum):

$$\hat{E}_h = D_h \overline{\hat{E}}_h \qquad (4)$$

where D_h is the number of possible days to sample in stratum *h*.

The variance of the estimated angler effort for each stratum was then obtained by the two-stage variance equation (following the approach outlined in Cochran 1977, equation 11.24, page 303), omitting the finite population correction (fpc) factor for the second stage units:

$$\hat{V}[\hat{E}_h] = \left\{(1 - f_{1h})D_h^2 \frac{S_{1h}^2}{d_h}\right\} + \left\{f_{1h} \frac{D_h^2}{d_h^2} \sum_{i=1}^{d_h} \hat{V}[\hat{E}_{hi}]\right\} \quad (5)$$

where f_{1h} equals the first stage sampling fraction (= d_h / D_h).

S_{1h}^2 equals the among day variance for the total effort estimate observed over all days sampled, and was obtained as follows:

$$S_{1h}^2 = \frac{\sum_{i=1}^{d_h} (\hat{E}_{hi} - \bar{\hat{E}}_h)^2}{d_h - 1} \quad (6)$$

where $\hat{V}[\hat{E}_{hi}]$ is the variance for the effort estimate for each sampled day and was obtained by using the successive differences formula appropriate for systematic samples (adapted from Wolter 1985, equation 7.2.4, page 251):

$$\hat{V}[\hat{E}_{hi}] = \left\{\frac{H_h^2}{r_{hi}}\right\}\left\{\frac{\sum_{j=2}^{r_{hi}} [x_{hij} - x_{hi(j-1)}]^2}{2(r_{hi} - 1)}\right\} \quad (7)$$

Total angler effort across all strata (or select combinations of strata) and the associated variances were obtained by adding the corresponding estimates (i.e., assuming independence). Since our estimates of angler effort are estimates of totals, standard error (SE) was obtained by taking the square root of the corresponding variance estimate.

Assumptions necessary for unbiased estimates of angler effort and its variance as obtained by the above procedures include the following:

1. No significant fishing effort occurs outside of the hours defined as the sampling day.

2. Duration of each angler count was essentially instantaneous (that is, no appreciable change in angler effort occurred during each count).

3. Counts of "anglers" accurately reflect the number of anglers actually fishing at the time of the count (i.e., no misidentification of anglers occurred).

All of these assumptions were felt to be valid for the following reasons:

1. The angler day was defined to include all available daylight hours, and ranged from 14 to 16 hours in length. I feel that no significant effort occurred after dark.

2. The time required to count all the active anglers along the shoreline was less than an hour, and because the counter moved continually, the count was essentially instantaneous.

3. Only actively fishing anglers were counted.

Site-specific Effort, Catch, and Harvest Surveys

Stratified multi-stage random sample surveys were used to obtain estimates of angler effort, catch, and harvest for the sport fisheries associated with the south-end saltwater shoreline in the Ketchikan area. Individual site-specific surveys in the Thomas Basin area (TB), the Mountain Point area (MP), and the Herring Cove area (HC) involved surveying completed-trip anglers as they exited each fishery (i.e., direct expansion surveys). The strata for these surveys were defined as the following biweekly periods:

1. 2 July - 15 July (biweek 14);
2. 16 July - 29 July (biweek 15);
3. 30 July - 12 August (biweek 16);
4. 13 August - 26 August (biweek 17); and
5. 27 August - 9 September (biweek 18).

For each individual site survey (e.g., MP survey), within each stratum, days were selected at random, and represented the first stage sample units. However, the random selection process was constrained in that only one technician was available for sampling; as such, only one site survey could be sampled each day. Additionally, during each week two contiguous days off for the technician were required. Note, that a total of six sample-days for the shoreline angler effort survey, described above, were sampled by permanent staff, and were available for allocation in the site-specific surveys.

Since I expected that the MP fishery was approximately twice as large (in terms of angler effort) as the TB fishery, and that the TB fishery was larger than the HC fishery, I first selected days at random, without replacement, for sampling the MP fishery within each stratum. Then days were selected, at random without replacement, from the remaining available days for the TB fishery in each stratum. Finally, days were selected from the remaining days for the HC survey. This procedure ensured that the random selection process was least constrained for the more important fisheries. The MP fishery was sampled on 3 of the 14 possible sampling days in biweeks 14 and 16, and on 2 of the possible 14 sampling days in all other periods. The TB and HC fisheries were each sampled on 2 of the 14 possible sampling days in each period.

Within each selected day two randomly chosen periods were selected for sampling. The sampling day was defined as 0600-2200 during biweeks 14 and 15, 0530-2130 during biweeks 16 and 17, and 0700-2100 during biweek 18. During biweekly periods 14-17 the angling day was split into five possible sampling periods (each 3.2 hours long). During biweekly period 18 the angling day was split into four 3.5 hour long periods. Sample periods within each day represented the second stage sampling units. All anglers exiting the fishery during the sample period were interviewed or counted. Exiting anglers represented third stage sample units. Each sport angler interviewed was asked the number of hours fished, and the number of fish kept and/or released by species.

In order to estimate angler effort within this framework I first obtained the

mean effort over all anglers exiting the fishery at each site separately and interviewed within each sampling period in each sampled day:

$$\bar{e}_{ghij} = \frac{\sum_{k=1}^{m_{ghij}} e_{ghijk}}{m_{ghij}} \tag{8}$$

where m_{ghij} is the number of interviewed anglers exiting the fishery during sample j on day i within stratum h for fishery g, and e_{ghijk} is the effort in angler-hours expended by angler k interviewed during sample j within day i and stratum h for fishery g.

Then I expanded for "missed" anglers in each period sampled to obtain the estimated total angler effort for each sample (in angler-hours):

$$\hat{E}_{ghij} = M_{ghij}\bar{e}_{ghij} \tag{9}$$

where M_{ghij} equals the number of anglers exiting fishery g during each sample (including both interviewed and "missed" anglers).

Next, I estimated the mean angler effort exiting each fishery over all periods sampled within each day:

$$\bar{\hat{E}}_{ghi} = \frac{\sum_{j=1}^{p_{ghi}} \hat{E}_{ghij}}{p_{ghi}} \tag{10}$$

where p_{ghi} equals the number of periods sampled in fishery g in stratum h on day i (set to 2 as per schedule).

I then expanded for the total number of possible secondary sampling units (i.e., number of periods within each day in each stratum):

$$\hat{\hat{E}}_{ghi} = P_{gh}\bar{\hat{E}}_{ghi} \tag{11}$$

where P_{gh} is the number of possible sampling periods within each day for fishery g in stratum h.

Next, I estimated the mean angler effort exiting fishery g over all days sampled within each stratum:

$$\bar{\hat{E}}_{gh} = \frac{\sum_{i=1}^{d_{gh}} \hat{E}_{ghi}}{d_{gh}} \tag{12}$$

where d_{gh} is the number of days sampled in fishery g in stratum h.

Finally, I expanded for the total number of possible primary stage sampling units (i.e., number of days in each stratum):

$$\hat{\hat{E}}_{gh} = D_{gh}\bar{\hat{E}}_{gh} \tag{13}$$

where D_{gh} is the number of possible days for fishery g in stratum h.

The variance of the estimated angler effort for each stratum in each fishery was

obtained by the three-stage variance equation (following the approach outlined in Cochran 1977):

$$\hat{V}_h[\hat{E}_{gh}] = (1 - f_{1gh})D_{gh}^2\frac{S_{1gh}^2}{d_{gh}} + f_{1gh}\frac{D_{gh}^2}{d_{gh}^2}\sum_{i=1}^{d_{gh}}\left\{(1 - f_{2ghi})P_{gh}^2\frac{S_{2ghi}^2}{p_{hi}}\right\} \tag{14}$$

$$+ f_{1gh}\frac{D_{gh}^2}{d_{gh}^2}\sum_{i=1}^{d_{gh}}\left\{f_{2ghi}\frac{P_{gh}^2}{p_{ghi}^2}\sum_{j=1}^{p_{ghi}}(1 - f_{3ghij})M_{ghij}^2\frac{s_{3ghij}^2}{m_{ghij}}\right\}$$

where

f_{1gh} equals the sampling fraction for days (= d_{gh} / D_{gh});
f_{2ghi} is the sampling fraction for periods within each day (= p_{ghi} / P_{gh});
f_{3ghij} is the sampling fraction for anglers interviewed within each period (= m_{ghij} / M_{ghij}); and
S_{1gh}^2 is the among day variance for the total effort estimate observed over all days sampled for fishery g within stratum h, obtained as follows:

$$S_{1gh}^2 = \frac{\sum_{i=1}^{d_{gh}}\left(\hat{E}_{ghi} - \bar{\hat{E}}_{gh}\right)^2}{d_{gh} - 1} \tag{15}$$

S_{2ghi}^2 equals the within day variance for the total effort estimate, obtained as follows:

$$S_{2ghi}^2 = \frac{\sum_{j=1}^{p_{ghi}}\left(\hat{E}_{ghij} - \bar{\hat{E}}_{ghi}\right)^2}{p_{ghi} - 1} \tag{16}$$

s_{3ghij}^2 is the sample variance for the effort estimate observed over all anglers interviewed during each sampled, obtained as follows:

$$s_{3ghij}^2 = \frac{\sum_{k=1}^{m_{ghij}}\left(e_{ghijk} - \bar{e}_{ghij}\right)^2}{m_{ghij} - 1} \tag{17}$$

Estimates of catch and harvest of chinook, coho, and pink salmon, and the variances for each estimate, were obtained by substituting the appropriate catch (c and C) or harvest (h and H) statistics into equations (8) through (17) above.

Total angler effort, catch, or harvest across all strata (or select combinations of strata) and the associated variances were obtained by adding the corresponding estimates (i.e., assuming independence). Since our estimates of angler effort were estimates of totals, standard error (SE) was obtained by taking the square root of the corresponding variance estimate.

Assumptions necessary for unbiased point and variance estimates of angler effort, catch, and harvest by species obtained by the procedures outlined above included:

1. Interviewed anglers accurately reported their hours of fishing effort and the number of fish released by species.

2. No significant fishing effort occurred during the hours not included in the fishing day.

3. All anglers participating in the fishery exited the fishery through a surveyed access site.

4. Total angler effort, catch, and harvest does not vary within a weekly period.

The first assumption is the most troublesome of the four assumptions, because there is no way to guarantee that every angler will accurately report their effort and harvest. In many cases the creel technicians may actually observe how many hours the angler fished, and how many fish were kept, but rarely do they observe anglers releasing fish. So, although observation supports the first assumption regarding effort and the number of fish caught and kept, I cannot be confident that the reports of the number of fish caught and released are as accurate. Even if all anglers accurately reported the number of released fish, I have no way of knowing how many of these fish had been caught repeatedly. To the best of our knowledge, assumptions (2) and (3) were true. The fourth assumption is undoubtedly invalid, in that comparatively more anglers participate in each fishery on certain days of each week. This assumption was necessitated by the non-random sampling procedure for the selection of days within each week. Since I constrained our sampling to guarantee two contiguous days off each week, then each day within the week did not have an equal probability of selection. Accordingly, our estimates of effort, catch, and harvest are assumed to be biased to an unknown degree.

Additionally, I assume that our estimates of variance are biased due to the constraint that sampling in each fishery-stratum was not conducted independently. As such, I expect some covariance among our fishery estimates. The degree of this bias is unknown.

Hatchery Contributions

As many as possible of the chinook and coho salmon observed in the angler's creel during the site-specific creel surveys were inspected for adipose fin clips (indicating the presence of a coded-wire tag). Heads from adipose fin clipped salmon were then obtained (with angler's permission) and cinched-strapped (with unique numbered cinch straps) and forwarded to the Fisheries Rehabilitation Enhancement and Development (FRED) Division tag lab in Juneau for tag dissection and decoding. Accurate records of the number of salmon inspected for adipose fin-clips, and the number of heads obtained and forwarded to the tag lab were maintained. These statistics, along with those provided by the tag lab and from the creel surveys (described above), were used to estimate the harvest of chinook and coho salmon by tag lot from a variety of tagged releases. The estimates were obtained following the approach outlined in Clark and Bernard (1987).

RESULTS

Angler Effort Survey

Angler counts were made on 13 of 70 possible sampling days, and 331 anglers were counted (Table 1; Appendix A1). Estimated total angler-effort from July 2 through September 9 along the Ketchikan roadside was 13,630 angler-hours (SE = 8,767).

Table 1. Angler effort survey statistics, Ketchikan roadside, 1990.

Time period	Day type	Days per stratum	Days sampled	Anglers observed	Mean stratum angler-effort	Estimated total angler-effort	SE
7/02 - 7/29	weekday	19	3	57	152.00	2,888	3,884
7/02 - 7/29	weekend	9	2	88	352.00	3,168	3,224
7/30 - 8/26	weekday	20	3	88	234.67	4,693	6,608
7/30 - 8/26	weekend	8	2	71	284.00	2,272	2,742
8/27 - 9/09	weekday	9	1	3	21.00	189	63
8/27 - 9/09	weekend	5	2	24	84.00	420	440
All strata		70	13	331		13,630	8,767

Site-specific Effort, Catch, and Harvest Surveys

Tables 2, 3, and 4 present the biweekly and total estimates and standard errors for effort, catch, and harvest for Mountain Point, Thomas Basin, and Herring Cove, respectively. Observed and average effort, catch, and harvest for these sites are listed in Appendices A2-A4. Most of the effort (6,349 angler-hours or 58% of the total) was expended at Mountain Point, while 27% of the effort (3,002 angler-hours) was expended at Thomas Basin, and 15% of the effort (1,607 angler-hours) was expended at Herring Cove. The most frequently captured species was pink salmon. The patterns of catch and harvest of pink salmon were somewhat different at the three harvest areas. Catches of pink salmon at Mountain Point and Herring Cove were nearly equal (2,233, SE = 590, at Mountain Point; Herring Cove 2,229, SE = 941), while catches at Thomas Basin were slightly lower (1,821, SE = 570). Most of the pink salmon harvest, on the other hand, occurred at Mountain Point (1,997, SE = 512), with Herring Cove second (840, SE = 199) and Thomas Basin third (236, SE = 48). The biweekly patterns of angler effort and pink salmon catch showed similar trends at Mountain Point (Figure 2). Effort and catch were fairly low during biweek 14 (2 July - 15 July) and then increased dramatically in biweek 15 (16 July - 29 July). The increased effort continued through biweek 16 and then steadily declined during biweeks 17 and 18. The pink salmon catch steadily declined through all three late periods with biweek 18 (27 August - 9 September) having the lowest effort and catch. The pattern of pink salmon harvest at Mountain Point (Figure 3) was very similar to the catch; most of the pink salmon caught were kept.

At Thomas Basin, angler effort was the highest during biweek 14. Effort steadily declined through biweek 17, and then increased slightly during biweek 18. Pink salmon catch was quite different; little or no catch was observed during biweeks 14 and 15, low catches (less than 400 pink salmon) were observed during biweeks 16 and 17, and the highest catch (more than a thousand pink salmon) occurred during biweek 18 (Figure 2). There was no harvest of pink salmon during biweeks 14 and 15 (i.e., none of the pink salmon caught were kept), and the harvest during biweeks 16 through 18 was fairly constant at just under a hundred pinks per period in spite of changing effort and catch (Figure 3). Thus, the relative rate of harvest decreased as the season progressed.

At Herring Cove, the highest effort occurred during biweek 14, and the lowest occurred during biweek 15. There was no catch of pink salmon during either of these biweekly periods. Effort then increased during biweeks 16 and 17, and then dropped during biweek 18. Pink salmon catch rose to around 200 fish during biweek 16, increased to over a thousand fish during biweek 17, and then fell slightly during biweek 18 (Figure 2). The ratio of catch to harvest increased from biweek 16 through 18; none of the pink salmon caught during biweek 18 were kept (Figure 3).

Overall, the estimated total angler-effort was 10,958 angler-hours (SE = 1,345) (Table 5). The estimated total catch of pink salmon was 6,284 (SE = 1,248), and the estimated total harvest of pink salmon was 3,073 (SE = 552). An estimated 350 (SE = 85) chinook salmon were caught in the fishery, of which 139 (SE = 44) were harvested. An estimated 119 (SE = 84) coho salmon were caught and 17 (SE = 17) were harvested.

Hatchery Contributions

A total of three chinook salmon and one coho salmon were inspected for adipose

Table 2. Estimates and standard errors of effort, catch, and harvest at Mountain Point by biweekly period during the Ketchikan roadside creel survey (5 July - 9 September 1990).

	Biweekly period[a]					
	14	15	16	17	18	Total
EFFORT (angler hours)						
Estimate	766	2,087	2,100	1,312	84	6,349
SE[b]	96	550	794	630	30	1,157
KS CATCH[c]						
Estimate	0	70	0	122	0	192
SE	0	68	0	20	0	71
KS HARVEST						
Estimate	0	0	0	0	0	0
SE	0	0	0	0	0	0
SS CATCH[d]						
Estimate	17	0	0	88	0	105
SE	17	0	0	81	0	83
SS HARVEST						
Estimate	17	0	0	0	0	17
SE	17	0	0	0	0	17
PS CATCH[e]						
Estimate	70	1,137	700	298	28	2,233
SE	33	480	291	180	5	590
PS HARVEST						
Estimate	70	1,050	583	280	14	1,997
SE	33	433	215	165	13	512
CS CATCH[f]						
Estimate	0	0	0	0	0	0
SE	0	0	0	0	0	0
CS HARVEST						
Estimate	0	0	0	0	0	0
SE	0	0	0	0	0	0
RF CATCH[g]						
Estimate	35	0	12	35	0	82
SE	32	0	11	34	0	48
RF HARVEST						
Estimate	17	0	0	0	0	17
SE	17	0	0	0	0	17

[a] 14 = 2 July - 15 July;
15 = 16 July - 29 July;
16 = 30 July - 12 August;
17 = 13 August - 26 August;
18 = 27 August - 9 September.

[b] SE = standard error.
[c] KS = chinook salmon.
[d] SS = coho salmon.
[e] PS = pink salmon.
[f] CS = chum salmon.
[g] RF = rockfish.

Table 3. Estimates and standard errors of effort, catch, and harvest at Thomas Basin by biweekly period during the Ketchikan roadside creel survey (5 July - 9 September 1990).

	Biweekly period[a]					
	14	15	16	17	18	Total
EFFORT (angler hours)						
Estimate	1,028	726	505	306	438	3,003
SE[b]	378	105	235	183	161	518
KS CATCH[c]						
Estimate	0	35	0	0	0	35
SE	0	34	0	0	0	34
KS HARVEST						
Estimate	0	35	0	0	0	35
SE	0	34	0	0	0	34
SS CATCH[d]						
Estimate	0	0	0	0	0	0
SE	0	0	0	0	0	0
SS HARVEST						
Estimate	0	0	0	0	0	0
SE	0	0	0	0	0	0
PS CATCH[e]						
Estimate	0	17	362	350	1,092	1,821
SE	0	17	254	243	448	570
PS HARVEST						
Estimate	0	0	82	70	84	236
SE	0	0	33	14	31	48
CS CATCH[f]						
Estimate	0	0	0	0	0	0
SE	0	0	0	0	0	0
CS HARVEST						
Estimate	0	0	0	0	0	0
SE	0	0	0	0	0	0
RF CATCH[g]						
Estimate	0	17	0	0	0	17
SE	0	17	0	0	0	17
RF HARVEST						
Estimate	0	0	0	0	0	0
SE	0	0	0	0	0	0

[a] 14 = 2 July - 15 July;
15 = 16 July - 29 July;
16 = 30 July - 12 August;
17 = 13 August - 26 August;
18 = 27 August - 9 September.

[b] SE = standard error.
[c] KS = chinook salmon.
[d] SS = coho salmon.
[e] PS = pink salmon.
[f] CS = chum salmon.
[g] RF = rockfish.

Table 4. Estimates and standard errors of effort, catch, and harvest at Herring Cove by biweekly period during the Ketchikan roadside creel survey (5 July - 9 September 1990).

	Biweekly period[a]					
	14	15	16	17	18	Total
EFFORT (angler hours)						
Estimate	543	96	319	424	225	1,607
SE[b]	166	46	296	197	209	447
KS CATCH[c]						
Estimate	88	17	0	17	0	122
SE	22	17	0	17	0	33
KS HARVEST						
Estimate	70	17	0	17	0	104
SE	14	17	0	17	0	28
SS CATCH[d]						
Estimate	0	0	0	0	14	14
SE	0	0	0	0	13	13
SS HARVEST						
Estimate	0	0	0	0	0	0
SE	0	0	0	0	0	0
PS CATCH[e]						
Estimate	0	0	210	1,067	952	2,229
SE	0	0	201	277	876	941
PS HARVEST						
Estimate	0	0	175	665	0	840
SE	0	0	167	109	0	199
CS CATCH[f]						
Estimate	0	0	17	0	0	17
SE	0	0	17	0	0	17
CS HARVEST						
Estimate	0	0	17	0	0	17
SE	0	0	17	0	0	17
RF CATCH[g]						
Estimate	0	0	35	0	0	35
SE	0	0	34	0	0	34
RF HARVEST						
Estimate	0	0	0	0	0	0
SE	0	0	0	0	0	0

[a] 14 = 2 July - 15 July;
15 = 16 July - 29 July;
16 = 30 July - 12 August;
17 = 13 August - 26 August;
18 = 27 August - 9 September.

[b] SE = standard error.
[c] KS = chinook salmon.
[d] SS = coho salmon.
[e] PS = pink salmon.
[f] CS = chum salmon.
[g] RF = rockfish.

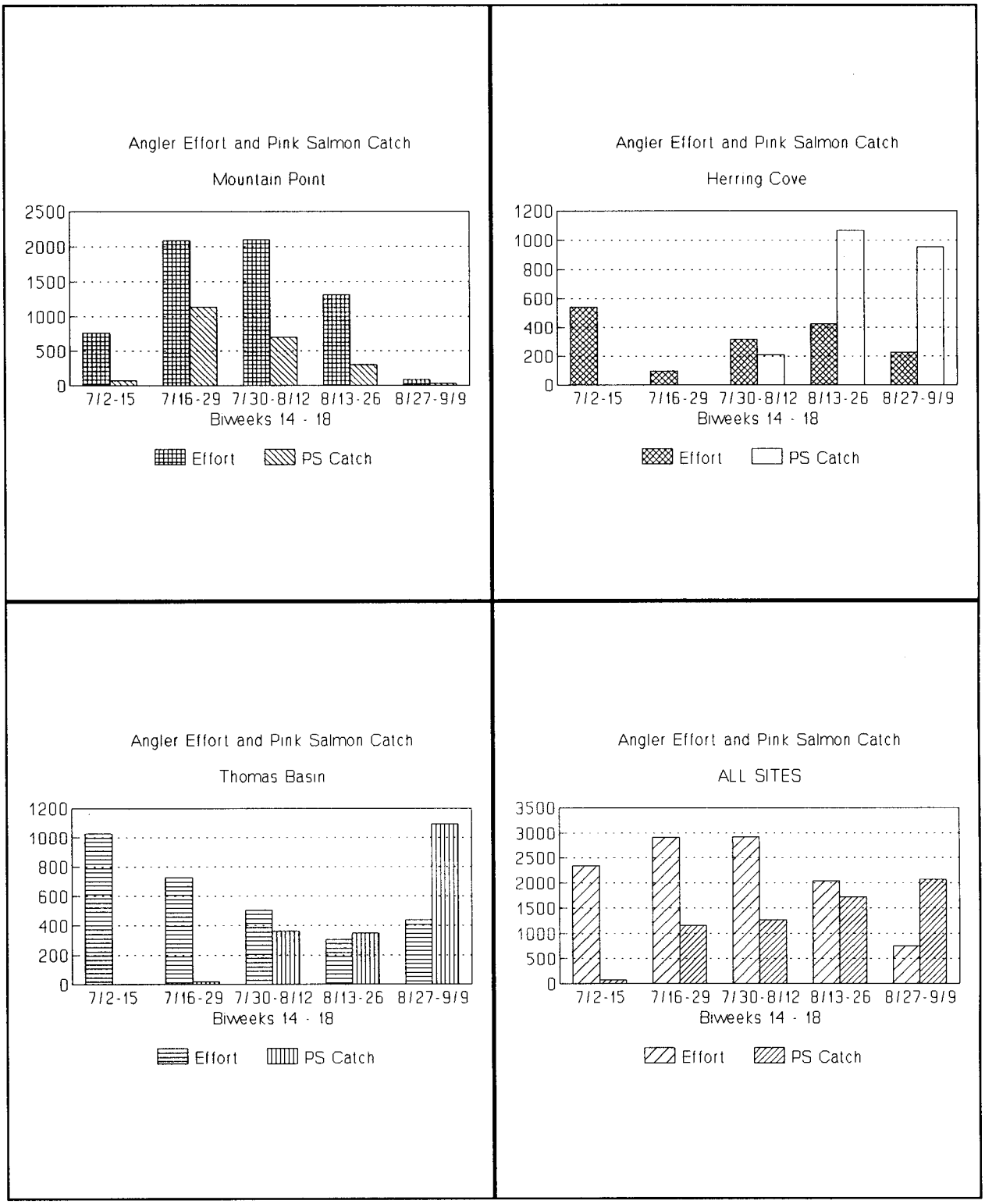

Figure 2. Estimated angler effort (angler-hours) and pink salmon (PS) catch at Mountain Point, Herring Cove, Thomas Basin, and at all sites combined, by biweekly period.

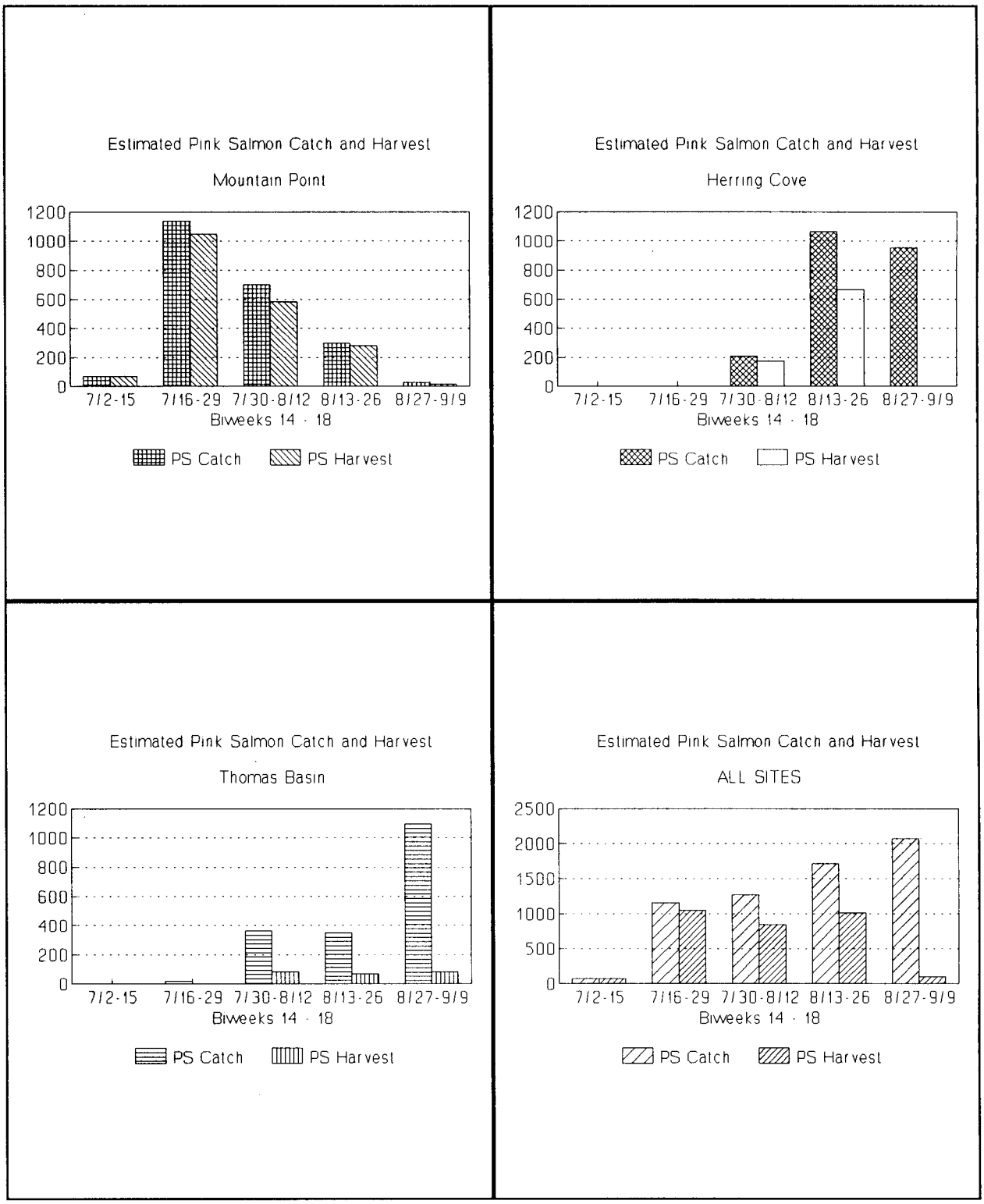

Figure 3. Estimated pink salmon (PS) catch and harvest at Mountain Point, Herring Cove, Thomas Basin, and at all sites combined, by biweekly period.

Table 5. Estimates and standard errors of effort, catch, and harvest at all three sites by biweekly period during the Ketchikan roadside creel survey (5 July - 9 September 1990).

	Biweekly period[a]					
	14	15	16	17	18	Total
EFFORT (angler hours)						
Estimate	2,336	2,909	2,924	2,043	746	10,958
SE[b]	424	562	879	685	266	1,345
KS CATCH[c]						
Estimate	88	122	0	140	0	350
SE	22	78	0	26	0	85
KS HARVEST						
Estimate	70	52	0	17	0	139
SE	14	38	0	17	0	44
SS CATCH[d]						
Estimate	17	0	0	88	14	119
SE	17	0	0	81	13	84
SS HARVEST						
Estimate	17	0	0	0	0	17
SE	17	0	0	0	0	17
PS CATCH[e]						
Estimate	70	1,155	1,272	1,715	2,072	6,284
SE	33	480	435	410	985	1,248
PS HARVEST						
Estimate	70	1,050	840	1,015	98	3,073
SE	33	433	274	198	34	552
CS CATCH[f]						
Estimate	0	0	17	0	0	17
SE	0	0	17	0	0	17
CS HARVEST						
Estimate	0	0	17	0	0	17
SE	0	0	17	0	0	17
RF CATCH[g]						
Estimate	35	17	47	35	0	134
SE	32	17	36	34	0	61
RF HARVEST						
Estimate	17	0	0	0	0	17
SE	17	0	0	0	0	17

[a] 14 = 2 July - 15 July;
15 = 16 July - 29 July;
16 = 30 July - 12 August;
17 = 13 August - 26 August;
18 = 27 August - 9 September.

[b] SE = standard error.
[c] KS = chinook salmon.
[d] SS = coho salmon.
[e] PS = pink salmon.
[f] CS = chum salmon.
[g] RF = rockfish.

fin clips during the site-specific creel survey. All three chinook salmon were adipose fin clipped fish and had tag codes from the Whitman Lake hatchery. The coho salmon was not fin clipped. Because of the low estimated catches of chinook and coho salmon, and because of the small number of fish that were examined for marks, hatchery contributions to the fishery were not estimated.

DISCUSSION

Two estimates of angler effort were generated during this project. The estimated total angler effort produced from the angler count survey is different from the total estimated angler effort produced from the three site-specific surveys for the following reasons:

1. The angler count survey included all anglers fishing along the shoreline from mile 4.5 on the South Tongass Highway to Herring cove. This area includes the Mountain Point and Herring Cove sites, but does not include Thomas Basin, which is located near downtown Ketchikan at the mouth of Ketchikan Creek (see Figure 1)

2. The site-specific surveys only included anglers fishing at the Mountain Point, Herring Cove, and Thomas Basin sites and did not include anglers fishing the shoreline between the sites.

Thus, the estimate of 13,630 angler-hours from the angler count survey could be compared to the sum of angler effort estimates from Mountain Point and Herring Cove (6,349 + 1,607 = 8,056 angler-hours), and the difference (13,630 - 8,056 = 5,574 angler-hours or 41% of the total) could represent the angler effort along the shoreline between Mountain Point and Herring Cove. While the statistical power of this estimate is low because of the large variance associated with the total angler effort estimate (SE = 8,767), it does suggest that a substantial amount of the angler effort may be distributed along the shoreline between the Mountain Point and Herring Cove sites.

The high ratio of catch to harvest that occurred during biweek 18 at both Herring Cove and at Thomas Basin is probably related to the fact that this was late in the season and both of these sites are situated near streams. Most of the pink salmon caught were probably in spawning condition and not very desirable as food.

One of the surprising results of this project was the low estimated harvests of chinook and coho salmon (Tables 2 - 5). Prior to the study, I had anticipated higher catches and harvests of chinook and coho salmon because of expected returns of these species from hatchery releases in the vicinity. Estimated hatchery contributions of chinook and coho salmon to the Ketchikan marine boat sport fishery in 1989 were 52% of the total chinook harvest and 11% of the total coho harvest (Suchanek and Bingham 1990), and these estimates contributed to that expectation. The reasons for these low catches and harvests are unknown, but I expect that they are related both to the timing of the creel survey and to the availability of these species to the shoreline angler. Although I drove the southern road system on several occasions after the study was terminated and observed almost no angler effort, the possibility remains that shoreline angling directed towards coho salmon could have been more productive later in September or even into October. Also, since this is a relatively new fishery and is apparently targeting on pink salmon, it is possible that the anglers have not yet developed the techniques to efficiently catch coho salmon from the shoreline.

ACKNOWLEDGMENTS

I thank Wendy Ness for conducting the angler counts and interviews. Scott Walker, Joseph Bond, Kathleen Wendt, and Steve Hoffman also helped with counts and interviews. I also thank Allen Bingham who provided biometric support in the form of methods, equations, and computer programs for estimating catch, harvest, and effort.

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APPENDIX A

Appendix A1. Summary of sample data for the angler effort survey for the Ketchikan roadside fishery, 3 July - 8 September 1990.

Date	Time of count	Number of anglers counted
900703	0800 - 0830	0
900703	1600 - 1630	10
900717	1100 - 1145	7
900717	1900 - 1935	11
900721	1000 - 1035	23
900721	1800 - 1830	24
900723	0900 - 0920	11
900723	1700 - 1730	18
900729	1300 - 1330	36
900729	2100 - 2130	5
900813	1130 - 1200	16
900813	1930 - 1955	20
900814	0930 - 1000	17
900814	1730 - 1800	18
900817	0930 - 1000	5
900817	1730 - 1800	12
900818	0930 - 1000	17
900818	1730 - 1800	34
900826	1130 - 1155	14
900826	1930 - 1950	6
900827	0700 - 0720	1
900827	1400 - 1420	2
900901	0900 - 1000	0
900901	1600 - 1700	6
900908	1000 - 1100	8
900908	1700 - 1800	10
Total anglers		331

Appendix A2. Summary of sample statistics for angler effort, catch, and harvest for pink salmon at Mountain Point, 1990.

Date	Time of sample	No. of anglers counted	No. of anglers interviewed	Mean effort (angler-hours)	Variance of mean effort	Mean catch of pink salmon	Variance of pink salmon catch	Mean harvest of pink salmon	Variance of mean harvest
900711	0912	7	7	1.11	0.21	0.14	0.14	0.14	0.14
900711	1224	9	9	1.25	0.78	0.00	0.00	0.00	0.00
900713	1224	9	9	1.19	0.61	0.11	0.11	0.11	0.11
900713	1848	11	11	1.27	0.24	0.18	0.16	0.18	0.16
900723	0600	1	1	1.50	0.00	2.00	0.00	2.00	0.00
900723	0912	19	19	2.25	1.15	0.84	0.92	0.79	0.84
900728	0912	12	12	2.33	2.71	2.50	4.64	2.42	4.45
900728	1848	25	25	1.88	1.28	0.68	1.23	0.56	1.17
900808	0530	2	2	1.00	0.50	0.50	0.50	0.50	0.50
900808	1506	17	17	2.47	5.44	0.47	0.89	0.47	0.89
900809	0842	10	10	2.33	2.25	2.60	9.82	2.00	5.33
900809	1818	36	36	2.31	2.55	0.33	0.51	0.28	0.49
900811	0530	5	5	1.90	0.55	2.00	2.50	1.60	1.30
900811	1154	17	17	1.18	0.33	0.18	0.28	0.18	0.28
900818	0842	6	6	2.00	0.65	0.83	0.97	0.67	0.67
900818	1506	21	21	2.11	2.85	0.43	1.76	0.43	1.76
900822	0530	11	11	1.07	0.34	0.27	0.82	0.27	0.82
900822	1818	4	4	1.75	0.25	0.00	0.00	0.00	0.00
900905	0700	1	1	1.00	0.00	1.00	0.00	1.00	0.00
900905	1400	1	1	1.00	0.00	0.00	0.00	0.00	0.00
900909	0700	4	4	1.00	0.17	0.25	0.25	0.00	0.00
900909	1730	0	0	0.00	0.00	0.00	0.00	0.00	0.00

Appendix A3. Summary of sample statistics for angler effort, catch, and harvest for pink salmon at Thomas Basin, 1990.

Date	Time of sample	No. of anglers counted	No. of anglers interviewed	Mean effort (angler-hours)	Variance of mean effort	Mean catch of pink salmon	Variance of pink salmon catch	Mean harvest of pink salmon	Variance of mean harvest
900705	1536	5	5	1.35	0.99	0.00	0.00	0.00	0.00
900705	1848	12	12	2.79	1.93	0.00	0.00	0.00	0.00
900708	0600	5	5	2.10	0.30	0.00	0.00	0.00	0.00
900708	0912	4	4	2.00	0.17	0.00	0.00	0.00	0.00
900716	0600	2	2	3.75	10.13	0.00	0.00	0.00	0.00
900716	1848	13	13	1.02	0.42	0.00	0.00	0.00	0.00
900726	0600	1	1	0.50	0.00	0.00	0.00	0.00	0.00
900726	1224	11	11	1.84	1.10	0.09	0.09	0.00	0.00
900803	0530	0	0	0.00	0.00	0.00	0.00	0.00	0.00
900803	0842	5	5	0.90	0.14	0.20	0.20	0.20	0.20
900804	0842	2	2	2.00	2.00	0.00	0.00	0.00	0.00
900804	1154	5	5	1.45	0.01	1.00	1.50	0.40	0.30
900805	0530	2	2	1.00	0.50	0.00	0.00	0.00	0.00
900805	1154	15	15	1.70	0.48	1.67	8.81	0.27	0.35
900823	1506	3	3	0.83	0.02	0.67	1.33	0.67	1.33
900823	1818	1	1	1.00	0.00	1.00	0.00	0.00	0.00
900824	0530	1	1	0.50	0.00	0.00	0.00	0.00	0.00
900824	1818	8	8	1.69	0.26	2.13	8.41	0.25	0.21
900831	1030	5	5	2.30	0.58	5.80	18.70	0.80	0.70
900831	1400	6	6	1.71	0.71	4.50	9.10	0.00	0.00
900901	0700	1	1	1.50	0.00	0.00	0.00	0.00	0.00
900901	1400	8	8	1.00	0.79	2.75	5.93	0.25	0.21

Appendix A4. Summary of sample statistics for angler effort, catch, and harvest for pink salmon at Herring Cove, 1990.

Date	Time of sample	No. of anglers counted	No. of anglers interviewed	Mean effort (angler-hours)	Variance of mean effort	Mean catch of pink salmon	Variance of pink salmon catch	Mean harvest of pink salmon	Variance of mean harvest
900707	1536	1	1	8.00	0.00	0.00	0.00	0.00	0.00
900707	1848	1	1	2.50	0.00	0.00	0.00	0.00	0.00
900715	1224	5	5	2.50	2.75	0.00	0.00	0.00	0.00
900715	1848	2	2	4.00	0.00	0.00	0.00	0.00	0.00
900718	0600	0	0	0.00	0.00	0.00	0.00	0.00	0.00
900718	1224	1	1	4.00	0.00	0.00	0.00	0.00	0.00
900729	1224	0	0	0.00	0.00	0.00	0.00	0.00	0.00
900729	1848	1	1	1.50	0.00	0.00	0.00	0.00	0.00
900730	0530	0	0	0.00	0.00	0.00	0.00	0.00	0.00
900730	0842	0	0	0.00	0.00	0.00	0.00	0.00	0.00
900812	1154	7	7	1.50	0.73	1.57	2.29	1.29	2.57
900812	1818	6	6	1.29	0.36	0.17	0.17	0.17	0.17
900813	0842	3	3	1.50	0.00	3.67	0.33	3.67	0.33
900813	1154	8	8	1.69	0.28	1.50	5.14	1.25	3.64
900819	0530	4	4	1.31	0.72	8.00	42.00	4.25	5.58
900819	1154	1	1	1.00	0.00	6.00	0.00	0.00	0.00
900902	1030	2	2	1.75	0.13	4.00	18.00	0.00	0.00
900902	1400	8	8	1.56	0.25	7.38	36.55	0.00	0.00
900904	1030	1	1	0.50	0.00	1.00	0.00	0.00	0.00
900904	1400	0	0	0.00	0.00	0.00	0.00	0.00	0.00