

Fishery Related Aspects of Faulty Sonar Data, Over-Escapement and Impaired Habitat for Susitna Sockeye

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Summary

ADF&G is recommending to the BOF that Susitna River sockeye salmon remain classified as a stock of yield concern (RC 8). A stock of yield concern is defined as “a concern arising from a chronic inability, despite the use of specific management measures, to maintain specific yields, or harvestable surpluses, above a stock’s escapement needs.” Susitna River sockeye do not meet that definition. The “specific management measures” that have been used were based on faulty data or no data at all and they have had the opposite effect from their intent. If the Bendix sonar counter had been properly counting the actual number of returning salmon there would not be a stock of yield concern designation for Susitna sockeye.

For 30 years there was a perception that the sockeye returning to the Susitna River were not meeting the escapement goals. This was driven by the premise that the Bendix sonar counter and the fishwheel apportionment were accurately counting the sockeye escapements. The perception led to restrictions on the Central District drift fleet and Northern District setnets. The effectiveness of the restrictions was never examined. The 2006-2008 ADF&G escapement goal study revealed that the escapement counting methodology was grossly underestimating sockeye escapement into the Susitna River. From 1981 through 2008 escapement goals were being exceeded by an average of more than 100 percent, some years the goals were exceeded by 300-400 percent or more.

These chronic over-escapements have led to instability in the sockeye runs and have masked the growing in-river habitat problems. The restrictions placed unnecessarily on commercial fisheries had no demonstrated effectiveness, severely limited the department’s ability to manage the Cook Inlet salmon fishery and cost the industry many millions of dollars in lost harvest opportunity on Susitna and other sockeye stocks.

At this time the department cannot scientifically justify designating Susitna sockeye salmon as a stock of yield concern. Restrictions on commercial fisheries for sockeye conservation also have no legitimate justification. The Board should remove the stock of yield concern designation for Susitna sockeye. In addition, the Board should eliminate restrictions on Central District drift gillnetting during the July 9 through July 31 time period. The department should continue collecting data through the test boat fisheries in Cook Inlet and use genetic testing to scientifically inform future decisions.

Background

The purpose of an escapement goal is to ensure sustainability and maximize yield. State policy requires that escapements goals must be scientifically defensible. “Over-escapement, in general, is not sustainable....” Quote from ADF&G 2007 *Biological and Fishery-Related*

Aspects of Overescapement in Alaskan Sockeye Salmon, by Robert Clark, M Willette, S Fleischman and D Eggers.

An escapement goal for Susitna sockeye was established in 1979 based on non-system specific characteristics. The Bendix sonar counter was placed into service at that time to measure the escapement. (The counter was placed in a Susitna tributary, the Yentna River, and the SEG for that location was used to manage sockeye salmon throughout the Susitna River watershed.) In the late 1980's the goal was revised using system specific information on salmon production based on a euphotic volume study of 24 salmon producing lakes in the Susitna drainage and a 4:1 return per spawner ratio.

The escapement counts were periodically called into question, particularly after the 1989 season when the Exxon Valdez oil spill caused drift gillnetting to be closed in Cook Inlet - with no apparent effect on the Susitna escapement sonar count. Increasing uncertainty with the escapement assessment prompted ADF&G to initiate a 3-year study in 2006. The study utilized a DIDSON system, weir counts and a mark-recapture program to compare with the Bendix sonar counts.

In 2008, before the study was completed, the BOF designated Susitna sockeye a stock of yield concern due to a chronic inability to meet the Yentna SEG (range 90-160,000) as measured by sonar. In 2009 ADFG released a special report outside of the normal three year cycle of escapement goal review because the errors with the sonar enumeration were so significant. The results of the study suggested that both the Bendix and DIDSON were grossly underestimating the number of sockeye salmon spawning in the Yentna River. (*Fair, L. F., T. M. Willette, and J. Erickson. 2009. Escapement goal review for Susitna River sockeye salmon, 2009. Alaska Department of Fish and Game, Fishery Manuscript Series No. 09-01, Anchorage.*)

Data from pages 18 and 21 of the report indicate that the Bendix sonar count (dating back to 1981) was biased low by more than 100 percent. While it is not possible to go back and re-count the escapements, it is evident the escapement goals were being met and in all years, except for 2005, the upper end of the goal range was significantly exceeded (see Table 2).

The report recommended eliminating the Yentna SEG and replacing it with SEGs for 3 individual lakes (Chelatna, Judd and Larson) in the Susitna watershed. The new escapement goals became effective for the 2009 salmon runs.

During the decades that area restrictions were placed on the drift fleet to conserve northern sockeye stocks, no studies were ever done and no evidence or data was ever generated to show that the restrictions had any effect on escapements. The latest research incorporating genetic testing with Off-shore Test Fishing in the Central District has demonstrated that sockeye stocks are intermingled and dispersed, both spatially and temporally, throughout Cook Inlet as they migrate.

Genetic testing of commercially caught sockeye has also shown that the percentage of northern-bound sockeye caught by drift fishermen in restricted corridors is not significantly different than the percentage caught when the fishermen are dispersed throughout Cook Inlet. In

2011, drift fishermen caught 781,146 sockeye while restricted to the Corridor. Of these, 6.8% were genetically identified as Susitna fish. While not restricted to the Corridor in 2011, drift fishermen caught 2,261,582 sockeye of which 5.7% were identified as Susitna fish.

The department also reported in RC 8 that Susitna median yield (harvest) estimates in 2008–2013 were 26% larger than those from 2003–2007. This increase in yield occurred even though the drift fleet had additional area restrictions during that time period that were intended to reduce the yield.

What we have learned from the use of mandatory restrictions is that they prevent fishery managers from reacting to real-time information during the season and interfere with their ability to manage the whole fishery. Harvest opportunity has been lost due to the restrictions; not only the millions of sockeye that exceeded escapement goals in the Susitna, but also millions of sockeye that exceeded escapement goals in other Cook Inlet systems due to mandatory restrictions that were based on faulty sonar data and flawed assumptions.

Susitna Sockeye – Not a stock of yield concern

In their memorandum (RC 8) to the BOF dated October 3, 2013, the ADF&G recommended that Susitna River sockeye salmon remain classified as a stock of yield concern because:

- 1) Five of the escapements in 3 different lakes (out of 15 total) have been below the minimum goal, and
- 2) Harvests in Central and Northern districts from 2008 through 2013 were generally less than the long-term averages.

Their justification was that in the Central District drift fishery, Susitna median yield (harvest) estimates in 2008–2013 were 26% larger than those from 2003–2007, and about 75% of those from 1983–2002 and 1993–2002, the two time periods to which recent (2003–2007) yields (harvest) were compared when determining the stock of yield-concern in February 2008.

The first glaring error with this justification is that the Department has no reliable data for run size, escapement or yield from 1981-2013 as the sonar counters used until 2008 were so inaccurate. There is still no reliable method for counting all the salmon that return to Mat-Su streams. Without some reasonably accurate method for enumerating salmon escapement they have no way to determine the yield (harvest) as a percentage of run size.

The attempt to use reduced median yield (harvest) estimates as a justification for maintaining a stock of concern classification also fails as it does not recognize that there were new management regulations for the Central District drift fishery from 2008-2013 that were intended to reduce the yield (harvest). This application of circular logic has no business masquerading as science.

What does it mean? If the median yield (harvest) estimates from 2008-2013 were 26% larger than the 2003-2007 time period as the Department stated, then either the restrictions on the

drift fishery are not effective at conserving particular stocks, or, these stocks are much more robust than were assumed.

The methodology of using combined escapement counts from three different lakes does not fit the criteria for a Stock of Yield Concern. The escapement goals for these 3 lakes (Chelatna, Judd and Larson) do need to be re-evaluated as the returns to Chelatna and Judd are showing oscillating patterns in their sockeye populations from year to year, which can be an indicator of over-escapement. These escapement goals were based on returns to those lakes during years that we know the Susitna river goal was exceeded, so these goals are likely too high. In Judd Lake the fry size and weight suggest they are exceeding the rearing capacity of the lake and are near starvation (see Table 1). The Chelatna Lake escapement goal has been met four of the past five years, Judd Lake two of the past five years, and Larson Lake four of the past five years.

Again, a stock of yield concern is defined as “a concern arising from a chronic inability, despite the use of specific management measures, to maintain specific yields, or harvestable surpluses, **above a stock’s escapement needs**”. The department has a poor grasp of what the current sockeye escapement is or should be in the Susitna.

At least 14 of the original 24 sockeye producing lakes studied in 1989 now contain invasive northern pike. Six of those lakes with pike no longer produce salmon, five more lakes with pike have severely reduced production. Shell Lake, one of the largest producers, had nearly 70,000 spawners in 2006 and now it has none due to pike and disease.

The October 3, 2013 memo (RC 8) from ADF&G to the BOF also failed to factor the increasing sport fish harvest into the yield (harvest). During the same time period, 2008-2013, while restrictions were placed on the commercial fisheries (both Central and Northern District) for conservation purposes, the sport fishery yield (harvest) had no similar restrictions and continued to increase. Quote from ADF&G *2011 Fisheries Management Report 10-50*: “The action plan states sport harvest will not be used to determine escapements or in developing escapement goals. Further, the Susitna sport fisheries will remain open with a three fish bag limit unless otherwise directed by the BOF and any harvest restrictions will be realized in the commercial fisheries...”

Conclusion - Stock of Habitat Concern

ADF&G has not assessed and updated escapement goals for the Susitna river system. Sockeye production capacity has been significantly reduced by invasive northern pike and migration impedances. Maintaining escapement levels without accounting for the decreases in production capacity will inevitably cause adverse density-dependent effects in the systems that are still productive. As mentioned in the previous section, Judd Lake is showing effects symptomatic of over-escapement – oscillating returns and dangerously low fry size and weight.

Decades of escapements that routinely exceeded the goals by an average of 200% flooded the system with spawners. This masked and obscured the habitat issues that were gradually reducing production during this time.

Restrictions placed on commercial fisheries over the past 30 years were not necessary and were never supported by any assessment of effectiveness. The negative consequences of the mandatory restrictions include preventing fishery managers from doing their jobs and lost harvest opportunity for the commercial industry on the scale of tens of millions of dollars. Intensive management of saltwater fisheries cannot solve habitat-related production problems.

The Sustainable Salmon Fisheries Policy defines three levels to the stock of concern - yield, management and conservation - with yield being the lowest level of concern and conservation the highest level of concern. All three levels use the measurement of returning salmon, or escapement, as a threshold or trigger to determine the status of a stock. In the case of Susitna salmon stocks these levels of concern address the wrong end of the equation. The habitat for spawning and rearing salmon in the Susitna watershed is so affected by invasive northern pike, beaver dams, disease, culverts and the effects of urbanization that salmon production is the overriding problem, not the number of returning salmon.

ADF&G's 2012 *Upper Cook Inlet Management Report 2012* clearly stated that: "...unless the impacts from pike predation, disease and beaver dams can be significantly reduced, the total sockeye salmon production in the Susitna River drainage will continue to suffer, regardless of the amount of restrictions placed on commercial fisheries."

In 2013 ADF&G published *A Comprehensive Inventory of Impaired Anadromous Fish Habitats in the Matanuska-Susitna Basin, with Recommendations for Restoration* wherein the Habitat Research and Restoration Staff described habitat problems affecting salmon production and recommended restoration and research projects totaling over \$8.5 million. Many of these projects are only assessing damage or will require annual funding so the actual cost of restoration is yet to be determined.

Within the Sustainable Salmon Fisheries Policy, a new level of concern needs to be added - "a stock of habitat concern" - defined as "a concern arising from the inability of salmon to successfully spawn and rear in their freshwater habitats as a result of invasive species, parasites, pollution, migration impedances or other habitat disturbances." This would enable the Board of Fisheries and ADF&G to focus their efforts on the cause of declining salmon runs, not just the effects. A new action plan should be developed that will help stabilize salmon production in systems that are still functioning, work towards eliminating pike from other systems, set goals for removal of migration impedances and develop a restocking program.

At this time the department cannot scientifically justify designating Susitna sockeye salmon as a stock of yield concern. Restrictions on commercial fisheries for sockeye conservation also have no legitimate justification. Therefore the Board should eliminate restrictions on Central District drift gillnetting during the July 9 through July 31 time period. The department should continue collecting data through the test boat fisheries in Cook Inlet and use genetic testing to scientifically inform future decisions.

- Sonar counts from 1981-2008 were inaccurate and biased low by more than 100%
- Stock of Yield Concern for Susitna sockeye was based on this faulty data.
- Restrictions placed on the Drift Fleet and Northern District set nets for over 20 years were based on this faulty data.
- Restrictions placed on commercial fisheries under the guise of conservation were not paired with restrictions on the sport fishery.
- Problems with Susitna salmon production have been identified and are the result of freshwater habitat issues.
- Intensive management of saltwater fisheries will never solve the problems found in the freshwater habitats of spawning and rearing salmon.

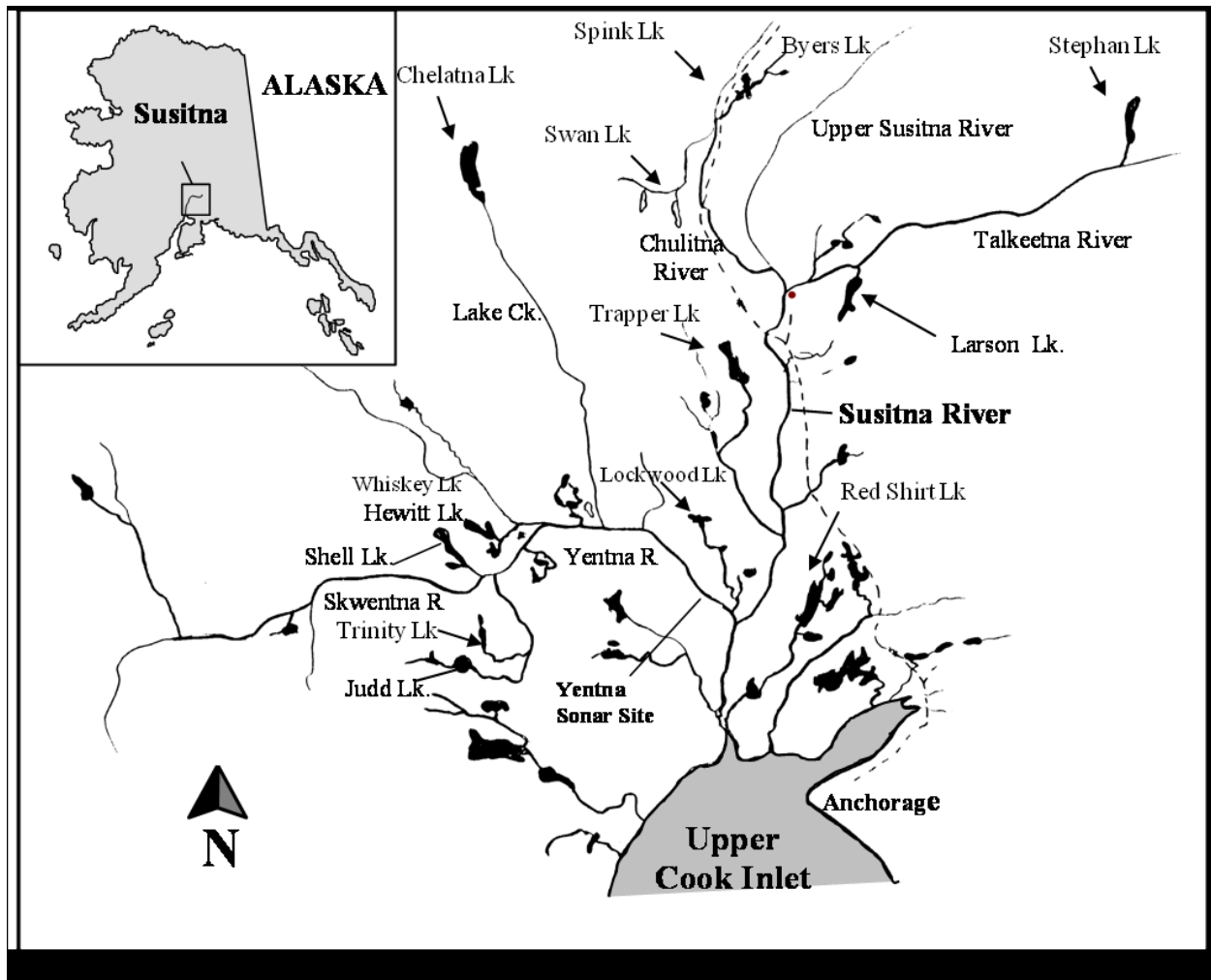


Table 1
Susitna Sockeye Fry Size Relative to Escapement

Chelatna Lake	SEG range 20-65		
Year	Escapement*	Age 0 Fry Length (mm)	Age 0 Fry Weight (g)
2005		57.5	2.7
2006		50.8	1.7
2007	18,433*	68.1	4.0
2008	41,290*	45.6	1.3
2009	73,469*	60.6	2.8
2010	17,865*	48.2	1.7
2011	37,784*	52.2	2.0
2012	70,353*	46.9	1.3
2013	36,577*		
2014	70,555*		
*Weir count from previous year			
Judd Lake	SEG range 25-55		
Year	Escapement*	Age 0 Fry Length (mm)	Age 0 Fry Weight (g)
2005		43.8	1.0
2006		53.8	2.1
2007	40,633*	47.6	1.3
2008	58,134*	37.6	0.7
2009	54,304*	41.2	0.8
2010	43,153*	38.0	0.7
2011	18,361*	50.3	1.4
2012	39,997*	39.0	0.6
2013	18,303*		
2014	14,021*		
*Weir count from previous year			
Larson Lake	SEG range 15-50		
Year	Escapement*	Age 0 Fry Length (mm)	Age 0 Fry Weight (g)
2005		58.9	2.5
2006	9,751*	62.4	2.9
2007	57,411*	61.5	3.0
2008	47,736*		
2009	35,040*	64.2	3.1
2010	41,929*	59.9	2.9
2011	20,324*	71.9	4.4
2012	12,413*	61.7	2.9
2013	16,708*		
2014	21,813*		
*Weir count from previous year			

Judd Lake average fry weight in 4 of the last 5 years indicates they were near starvation. Salmon fry at .6 grams or less in weight do not have enough body mass and/or fat reserves to survive the winter. Fry with decreasing weights of less than 1 gram have increasing higher mortality rates when compared to healthy fry.

Description of information in Table 2 Historic Yentna Escapement Data

Column

1. Year 1982 through 2008 (27 years).
2. Original Bendix sonar escapement number. ADFG reports.
3. DIDSON equivalent escapement number, based on a three year comparison with Bendix and DIDSON systems running concurrently in the Yentna River. ADFG reports.
4. Upper end of Yentna escapement goal. ADF&G reports.
5. DIDSON adjusted for fish wheel selectivity. Calculated using fish wheel selectivity coefficients and adjusted to provide the lowest possible Mean Absolute - Percentage Error (MAPE) compared with mark-recapture abundance estimates. ADF&G data.
6. Escapement goal exceeded, percentages are calculated by first subtracting the number in column 4 from the number in column 5, then dividing the remainder by the number in column 4. The number in this column is the percentage that is over and above the upper end of the escapement goal.
7. DIDSON adjusted for mark-recapture based on a 5 year average ratio. ADF&G data
8. Escapement goal exceeded, percentages are calculated by first subtracting the number in column 4 from the number in column 7, then dividing the remainder by the number in column 4. The number in this column is the percentage that is over and above the upper end of the escapement goal.
9. Average goal exceeded number, calculated by subtracting the number in column 4 from the average of column 5 and column 7. The number in this column is the average number of salmon over and above the upper end of the escapement goal. Total number at the bottom, multiplied by a 6 pound average for total weight.

The escapement numbers listed in columns 5 and 7 are intended to represent the approximate escapement. These numbers are mathematically derived and not actual fish counts.

Table 2 Historic Yentna Escapement Data from ADF&G data and reports									
1	2	3	4	5	6	7	8	9	
	Original		Upper End	DIDSON	Escapement	DIDSON	Escapement	Average	
	Bendix		of	Adjusted for	Goal	Adjusted	Goal	Goal	
	Escapement	DIDSON	Escapement	Fish Wheel	Exceeded	for	Exceeded	Exceeded	
Year	Number	Equivalent*	Goal	Selectivity	Percentage	Mark/Recapture	Percentage	Number	
1982	113,847	253,982	100,000	667,733	568%	523,203	423%	495,468	
1983	104,414	210,105	100,000	323,461	223%	432,816	333%	278,139	
1984	149,375	298,383	100,000	773,450	673%	614,669	515%	594,059	
1985	107,124	211,806	100,000	417,147	317%	436,320	336%	326,734	
1986	92,076	169,048	150,000	974,513	550%	348,239	132%	511,376	
1987	66,054	130,040	150,000	291,897	95%	267,882	79%	129,890	
1988	52,330	101,854	150,000	286,421	91%	209,819	40%	98,120	
1989	96,269	189,554	150,000	491,489	228%	390,481	160%	290,985	
1990	140,290	259,729	150,000	682,631	355%	535,042	257%	458,836	
1991	109,632	217,158	150,000	347,900	132%	447,345	198%	247,623	
1992	66,074	130,966	150,000	463,272	209%	269,790	80%	216,531	
1993	141,694	282,837	150,000	593,576	296%	582,644	288%	438,110	
1994	128,032	251,856	150,000	413,317	176%	518,823	246%	316,070	
1995	121,220	232,856	150,000	416,842	178%	479,683	220%	298,263	
1996	90,660	172,882	150,000	308,169	105%	356,137	137%	182,153	
1997	157,822	308,949	150,000	379,445	153%	636,435	324%	357,940	
1998	119,623	211,500	150,000	445,538	197%	435,690	190%	290,614	
1999	99,029	186,981	150,000	280,900	87%	385,181	157%	183,040	
2000	133,094	291,848	150,000	409,266	173%	601,207	301%	355,236	
2001	83,532	153,847	150,000	376,228	151%	316,925	111%	196,576	
2002	78,591	158,564	160,000	479,228	200%	326,642	104%	242,935	
2003	180,813	344,224	160,000	609,591	281%	709,101	343%	499,346	
2004	71,281	142,187	160,000	347,900	117%	292,905	83%	160,403	
2005	36,921	71,264	160,000	131,541	-18%	146,804	-8%		
2006	92,051	166,697	160,000	390,567	144%	343,396	115%	206,981	
2007	79,901	125,146	160,000	206,146	29%	257,801	61%	71,973	
2008	90,146	131,772	160,000	252,804	58%	271,450	70%	102,127	
Average	103,774	200,224		435,592	214%	412,460	196%		
							Total fish over goal	7,549,530	
							Total weight	45,297,178	
							Loss of direct revenue	\$45-\$90 million	

Table 3. Susitna River sockeye salmon studies, 2006-2012.

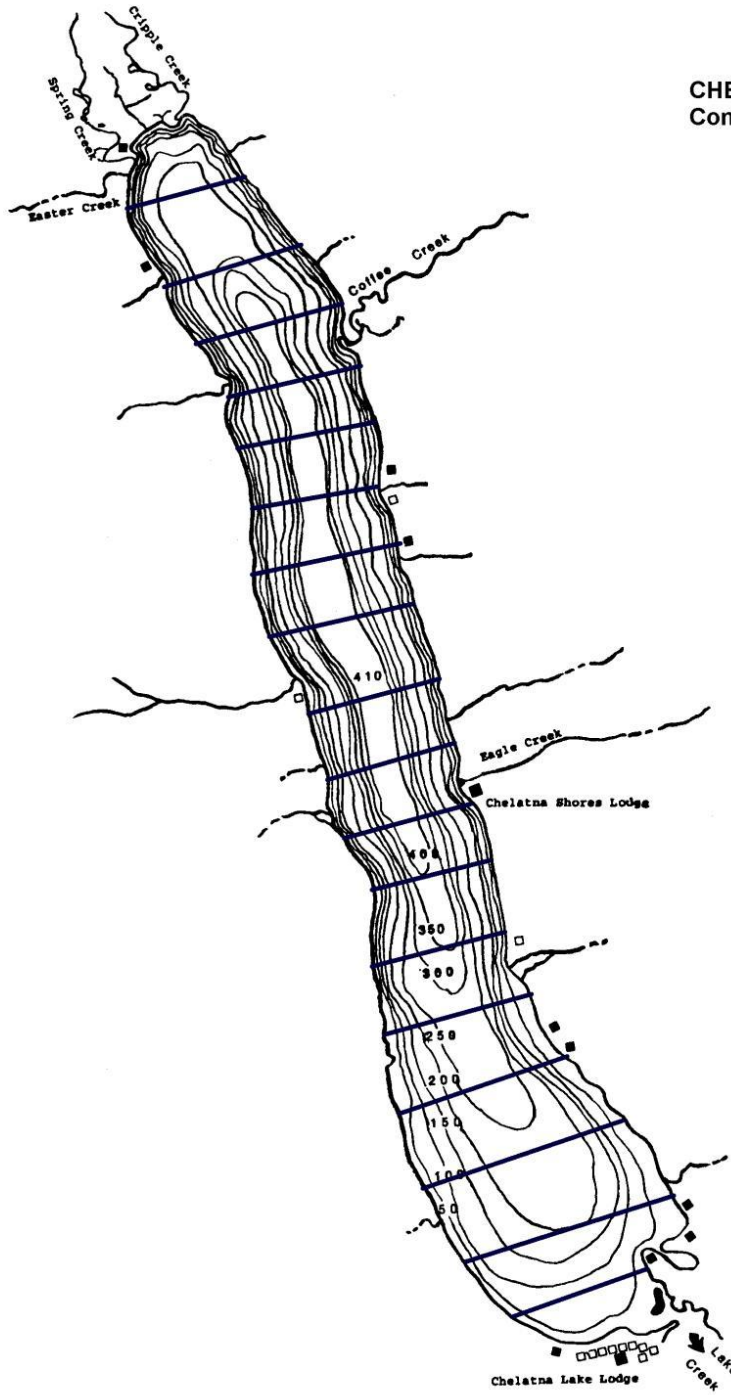
Yentna River Passage	2006	2007	2008	2009	2010	2011	2012
Bendix	92,051	79,901	90,146	28,428			
DIDSON-adjusted	166,697	125,146	131,772	43,972– 153,910	53,399– 144,949	62,231– 140,445	30,462– 89,957

Weir Data	2006	2007	2008	2009	2010	2011	2012
Chelatna	18,433	41,290	73,469	17,865	37,784	70,353	36,577
Judd	40,633	58,134	54,304	43,153	18,361	39,997	18,303
Larson	57,411	47,736	35,040	41,929	20,324	12,413	16,708
Weir Totals	116,477	147,160	162,813	102,947	76,469	122,763	71,588

Susitna Population Estimates	2006	2007	2008	2009	2010	2011	2012 ^b
Mark Recapture	418,197	327,732	359,760	219,041	190,460	314,447	141,804
MR : Weirs ratio	3.6	2.2	2.2	2.1	2.5	2.6	2.0
MR : Bendix ratio	4.5	4.1	4.0	9.7	ND	ND	ND

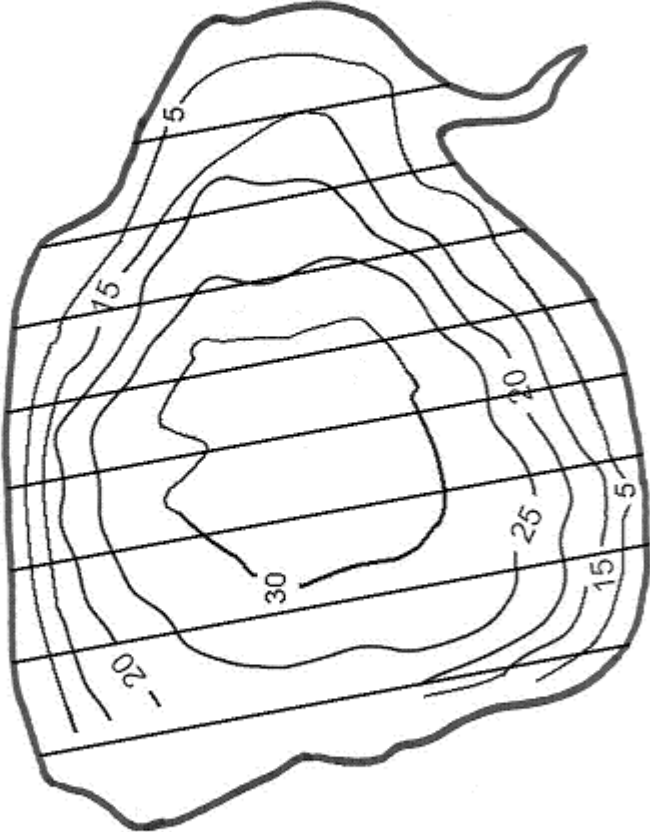
^a Mark recapture estimates from 2009 to 2011 are preliminary values

This table shows the escapement estimate data from 2006 - 2012. The bottom line showing the Mark-Recapture to Bendix ratio clearly correlates with the historic escapement data in Table 2. ADFG Annual Management Report 2012.



CHELATNA LAKE
Contours in feet

JUDD LAKE
Contours in meters



LARSON LAKE
Contours in feet

