STATE OF ALASKA

SARAH PALIN, GOVERNOR

DEPARTMENT OF FISH AND GAME

DIVISION OF SPORT FISH
Charles O. Swanton, Director

P.O. BOX 115526
JUNEAU, AK 99811-5526
PHONE: (907) 465-4100
FAX: (907) 465-2332

Richard Yanusz, Area Research Biologist
David Rutz, Area Management Biologist

1800 Glenn Highway,
Suite 4
Palmer, AK 99645
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Deshka River King Salmon White Paper

Problem Statement: The Deshka River experienced an extremely low king salmon escapement in 2008 and the 2009 escapement is expected to be near the lower range of the escapement goal.

Introduction

Deshka River is a semi-remote system that can only be accessed via float plane or boat. This river system is a west side tributary to the Susitna River and is located within the Northern Cook Inlet Management Area (Figure 1). The Deshka River is the most productive king salmon system in the entire management area and annually supports about 25,000 angler-days of sport fishing effort. On average, approximately 7,800 Deshka River king salmon are harvested each year by a variety of user groups.

User Groups

Deshka River king salmon are harvested by three different user groups: sport, commercial, and subsistence. The majority of the harvest is attributed to the sport fishery.

Background

The estimated Deshka River king salmon total run of approximately 25,000 fish in 2007 ranked 25th out of 29 years. The preliminary total run in 2008 of 14,300 king salmon is estimated to be among the lowest on record for the Deshka River. During 2008, in response to the low return, restrictive actions were taken inseason to the sport and commercial fisheries in an effort to reduce the harvest of Deshka River king salmon. Despite restrictions to these fisheries, the 2008 escapement of Deshka River king salmon was the lowest on record since the weir was installed in 1995. The escapement of about 7,500 king salmon was below the Biological Escapement Goal (BEG) of 13,000 to 28,000 fish. The outlook for 2009 Deshka River king salmon contains an escapement very close to the minimum BEG. Given the performance history of the outlook (explained below), preseason restrictions have been taken in both the sport and commercial fisheries in an effort to increase the potential of achieving the BEG.

What is the Cause

The specific cause of the decline in the production of Deshka River king salmon is currently unknown. Possible factors of lower production in the 2008 and 2009 king salmon runs includes overescapement, poor spawning and/or juvenile rearing success, habitat and climatic changes that could affect marine and/or freshwater survival, and, to a lesser extent, invasive northern pike.

History

This is not the first time there has been a decline in king salmon production in the Deshka River. During the early 1990s, the Deshka River experienced several years of low king salmon escapements (Figure 2). It was thought that these low production years were in part driven by the severe flooding that took place during 1986. In response to poor king salmon production on the Deshka River, the sport fishery for king salmon was closed from 1995 to 1997 and the commercial fishery was restricted. Poor production of king salmon in the Deshka River also prompted the department to install a weir to enumerate the king salmon spawning escapement in the river. Although these restrictions were a social and economic hardship on sport and commercial users, the progeny from these low escapements contributed to some of the larger king salmon returns that the Deshka River has produced.

Development of the Deshka River King Salmon Outlook

An outlook for Deshka River king salmon has been developed and distributed as an internal departmental memo since 1999. The outlook is based on sibling regressions and spawner-recruit models of king salmon by age class. King salmon returns to the Deshka River comprises age-4, age-5, and age-6 salmon, or progeny from fish that spawned four to six years prior. Constructing the annual run projection requires the abundance and age composition of each run component each year: escapement, sport harvest, and marine harvest.

Placing a weir on the Deshka River in 1995 allowed enumerating the escapement with precision, and also allowed sampling to take place for the age composition of the escapement. Full weir counts were obtained every year from 1995 to 2008 with the exception of 1998, and the age composition was estimated every year. A small amount of the sport harvest occurs upstream of the weir, and this harvest is subtracted from the weir count to estimate the spawning escapement.

After the annual Deshka River king salmon runs are reconstructed, several models are examined for the Deshka king salmon outlook. Two spawner-recruit models are used: one that includes all brood years and a second with the 1986-1991 brood years omitted to examine the effects of a 100-year flood that occurred in October 1986. The spawner-recruit models only project the total return from a given brood year, so the total return projection for each brood year contributing to a given run is multiplied by the average age composition to estimate the abundance of each age class returning in the year of interest. Sibling regressions are also used to project the age-5 and age-6 abundances each year. A sibling regression cannot be used for the age-4 component because the weir does not effectively stop age-3 fish. Instead, a spawner-recruit/average age composition model is used as the projection for age-4 fish. This component is combined with the sibling regressions for the age-5 and -6 components to project the entire run, and is used as the basis for the outlook. These three age classes have historically made up 97% of the annual runs.

In runs exceeding the minimum BEG of 13,000 fish, the yield (fish available for harvest) can be calculated for the various models. The projected marine harvest of Deshka River king salmon has been the average marine harvest, as calculated below (Table 1). Two different starting points have been used for calculating the average. Prior to 1993, commercial set netters were allowed to fish in multiple areas, and Northern District directed king salmon harvests averaged 9,400 fish. Since 1993, commercial set netters could only register to fish in one area. The Northern District directed king salmon fishery has averaged 2,500 fish since then. The projected sport harvest each year is the average from the ADF&G survey, starting with the year 2000 (Table 1). The first year bait was allowed in the sport fishery is 2000, and the use of bait is generally thought to approximately double the success rate of anglers. Given that, this time period represents recent, stable regulations and participation.

The marine harvest of Deshka River king salmon is the most uncertain component of the total run, but it is also the smallest. The total harvest in the marine fisheries described above is relatively small compared to the observed total runs for the Deshka River, suggesting the marine harvest component would not change the general situation regardless of how it is calculated. From 1999-2008, the outlook has ranged from about 13,000 fish over the observed run to 8,900 fish under the observed, for the three major age classes combined (Table 2). The outlook has been consistently over-projecting the total run from 2005 to 2008, however, similar magnitude over-projections also occurred in 2001 and 2002, while similar magnitude under-projections occurred in 1999 and 2000. The outlook has greatly over-projected age-1.2 fish in 2007 and 2008, but an even greater under-projection occurred in 2003. The sport harvest projections have ranged from about 2,600 fish over the observed sport harvest to 3,500 under the observed (Table 1). The marine harvest projections have ranged from about 1,000 fish over the observed marine harvest to 500 under the observed (Table 1). While the errors in the projected harvests are relatively large compared to the observed harvests, the errors are relatively small when compared to the observed total run.

Sport Harvest Apportionment

The sport harvest is estimated annually by a mail-out survey conducted by ADF&G. The majority of the sport harvest takes place at the confluence of the Deshka and Susitna rivers, making it possible that some interception of other, passing Susitna River king salmon stocks are harvested, which may bias the sport harvest estimate high to an unknown degree. No sampling of the sport fishery occurred from 1995 to 2008 to estimate the age composition of the sport harvest. Instead, the age composition of the escapement each year is used to construct the sport harvest by age class each year.

Commercial Harvest Apportionment

The commercial harvest of Deshka River king salmon has never been directly estimated. A project to mark Deshka River king salmon smolt with coded wire tags took place in the 1990s, but sufficient numbers of smolt could not be captured and marked to allow estimation of the contribution of Deshka River king salmon to marine fisheries. Instead, the outlook uses a fraction of selected marine fisheries in Cook Inlet as the estimate of the marine harvest of Deshka River king salmon. The marine fisheries assumed to harvest Deshka River king salmon are the Kustatan Subdistrict setnet commercial, Tyonek setnet subsistence, and Northern District setnet commercial fisheries, based on the dates of the fisheries and the suspected migration path of Deshka River king salmon. The sum of the harvests of these marine fisheries is multiplied by

the contribution of the Deshka River escapement survey to all escapement surveys, to estimate the number of Deshka River king salmon harvested in marine fisheries each year (Table 3). The 1979-2007 average contribution has been 23% Deshka River king salmon. The Northern District setnet commercial harvest was sampled from 1995 to 2002 to estimate the age composition of all marine harvests. From 2002 to 2008 no marine harvests were sampled, and the age composition of the escapement each year was used as the estimate of the age composition of the marine harvest each year. Because marine harvests are small, not collecting age composition from this segment does not compromise the spawner-recruit model.

Monitoring Relative to the 2009 Season

In 2009, the Department will continue to monitor the daily adult king salmon escapement past the Deshka River weir at river mile seven. As anglers pass downstream through the weir, the department will conduct interviews to obtain king salmon harvest information upstream of the weir. An associated in-season run projection will be conducted daily, based on prior years run timing information. If a weaker than expected run should occur, the fishery will likely be further restricted by emergency order, conversely, if the king salmon run materializes at higher than expected, current restrictions may be relaxed. The recreational harvest of northern Cook Inlet king salmon will be monitored through the Statewide Harvest Survey program, although that is post-season.

Additionally, the spawning escapement will be enumerated by aerial survey to further describe the relationship between aerial survey counts and total escapement, as monitored through the weir.

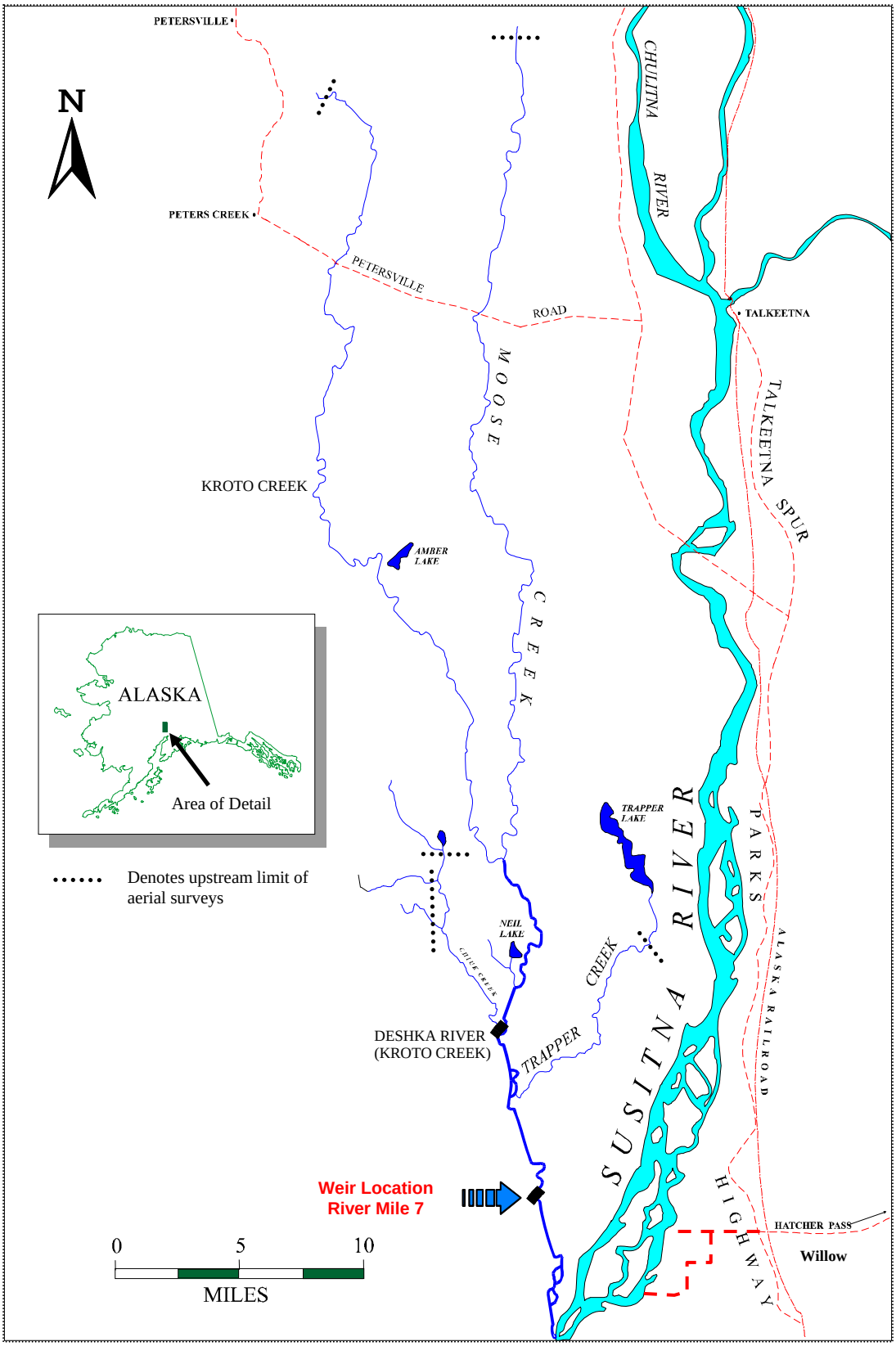

Figure 1.-The Deshka River drainage and locations of the weir site and aerial survey reaches.

Figure 2. Deshka River King Salmon Escapement Counts for 1974-2008 (1974-1994 Aerial counts are expanded to weir counts, 1995-2008 are actual weir counts)

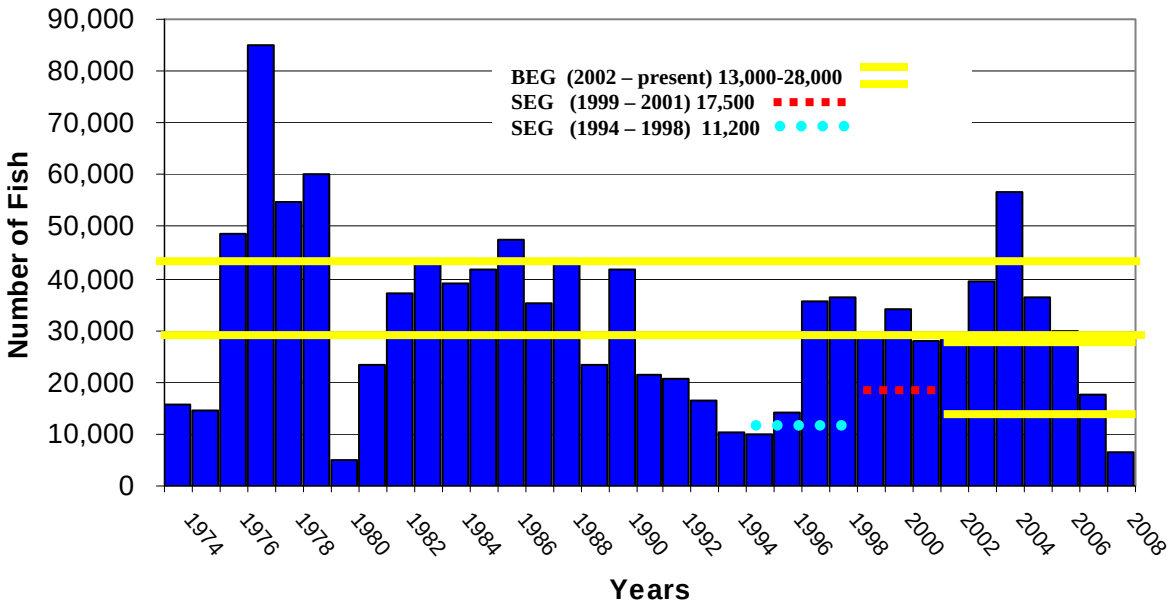

Table 1.-Comparison of the projected and observed harvests of Deshka River king salmon. Harvests were not projected prior to 2002.

Run	Sport Harvest				Marine Harvest			
Year	Projection	Observed	Projection Difference[a]	Method	Projection	Observed	Projection Difference	Method
2002	7,076	4,508	2,568	2000 harvest	1,424	428	996	1979-2001 average
2003	6,042	6,605	-563	2000-2001 average	1,279	746	533	1979-2002 average
2004	5,530	9,050	-3,520	2000-2002 average	1,299	1,200	99	1979-2003 average
2005	5,800	7,332	-1,532	2000-2003 average	1,414	833	581	1979-2004 average
2006	6,936	7,753	-817	2000-2004 average	1,397	757	640	1979-2005 average
2007	6,596	5,696	900	2000-2005 average	1,359	729	630	1979-2006 average
2008	6,762	[b]		2000-2006 average	752	1,215	-463	1993-2007 average

[a] calculated as projection minus observed

[b] not yet available

Table 2.-Amount the Deshka River king salmon projection has varied from the observed total run (number of fish).

Run	Projection Total	Observed Total	Projection	Difference by Age Class		
Year	Run	Run[a]	Difference	4	5	6
1999	26,810	33,392	-6,582	-4,382	-373	-1,827
2000	33,337	42,253	-8,916	3,512	-17,934	5,506
2001	40,753	33,204	7,549	388	-5,766	12,927
2002	43,805	32,938	10,867	999	5,648	4,220
2003	41,041	46,131	-5,090	-8,502	-938	4,350
2004	60,833	66,240	-5,407	-2,511	-838	-2,058
2005	48,687	44,054	4,633	-4,669	2,971	6,331
2006	49,071	38,432	10,639	-624	12,066	-803
2007	37,007	24,019	12,988	6,593	4,126	2,269
2008	20,268	14,260 [b]	6,009	5,707	312	-10

[a] only ages 4, 5, and 6

[b] preliminary, is the sum of the anticipated escapement (7,533 weir count minus average harvest above weir of 1,117), the 2000-2007 average sport harvest (6,628), and the average marine harvest (1,215).

Table 3.-Calculation of the marine harvest of Deshka River king salmon.

Run Year	Marine Harvest (fish) Tyonek Subsistence	Northern District Setnet Commercial	Kustatan Subdistrict Setnet Commercial	Total Marine Harvest	Escapement Survey (fish) All[a]	Deshka River		Proportion Deshka River	Estimated Deshka River Marine Harvest
1979	-	1,714	142	1,856	51,727	27,385		0.53	983
1980	1,757	993	166	2,916	57,305	14,965		0.26	762
1981	2,002	725	38	2,765	31,498	9,155		0.29	804
1982	1,590	2,716	386	4,692	45,520	16,000		0.35	1,649
1983	2,665	933	163	3,761	70,027	19,237		0.27	1,033
1984	2,200	1,004	136	3,340	67,305	16,892		0.25	838
1985	1,472	1,890	195	3,557	64,759	18,151		0.28	997
1986	1,676	15,488	290	17,454	75,718	21,080		0.28	4,859
1987	1,610	12,701	175	14,486	65,766	15,028		0.23	3,310
1988	1,587	12,836	120	14,543	83,098	19,200		0.23	3,360
1989	1,250	12,731	1,144	15,125	57,060	9,196		0.16	2,438
1990	781	9,582	1,082	11,445	56,723	18,166		0.32	3,665
1991	902	6,859	922	8,683	44,655	8,112		0.18	1,577
1992	907	4,554	963	6,424	41,654	7,736		0.19	1,193
1993	1,370	3,307	424	5,101	36,937	5,769		0.16	797
1994	770	3,185	449	4,404	25,799	2,665		0.10	455
1995	1,317	4,130	198	5,645	42,401	5,150		0.12	686
1996	1,039	1,958	148	3,145	41,839	6,343		0.15	477
1997	639	1,133	105	1,877	82,232	19,047		0.23	435
1998	978	2,547	83	3,608	62,327	15,556		0.25	901
1999	1,230	2,812	776	4,818	65,243	12,904		0.20	953
2000	1,157	2,307	778	4,242	52,282	14,983	b	0.29	1,216
2001	976	1,811	651	3,438	56,959	11,897	b	0.21	718
2002	898	1,895	537	3,330	68,011	8,749		0.13	428
2003	973	1,670	504	3,147	73,246	17,370	b	0.24	746
2004	1,080	2,058	430	3,568	85,575	28,778		0.34	1,200
2005	720	3,452	93	4,265	58,836	11,495		0.20	833
2006	904	4,418	238	5,560	47,761	6,499		0.14	757
2007	1,275	3,822	43	5,140	47,312	6,712		0.14	729
2008	995	4,027	231	5,253	24,915	none		0.23	c 1,215
Average								0.23	

[a] Sum of the single, aerial or foot escapement surveys of approximately 27 king salmon stocks in the Susitna, Matanuska, and Little Susitna rivers, the Anchorage area, and northwestern Cook Inlet.

[b] Used aerial:weir regression as water conditions precluded an aerial survey on the Deshka River.

[c] Used 1979-2007 average as water conditions precluded an aerial survey and weir count was outside the aerial:weir regression.