Ocean Stock Size Projections and Prospective Harvest Levels for Klamath River Fall Chinook, 2001 Season[1]

by

Klamath River Technical Advisory Team

SUMMARY

The year 2001 projected ocean abundance of Klamath River fall chinook salmon is 93,548 age-3 fish and 197,555 age-4 fish. The preliminary estimate of the 2000 abundance is 478,000 age-3 fish and 37,000 age-4 fish, contrasting with their preseason forecasts of 174,800 age-3 fish and 31,100 age-4 fish. The preliminary estimate of the 2000 ocean harvest rate on age-4 fish is 12%.

Under the current Pacific Fishery Management Council (PFMC) Framework Plan (Amendment 9), an average of 33 to 34 percent of each cohort, but no fewer than 35,000 fish for any year, are to be allowed to escape the fisheries to spawn in natural areas, with the remainder available for harvest.

Absent fisheries in 2001, the predicted stock strengths would be expected to result in a 2001 spawning population of 219,300 adult fish, of which 138,200 would be expected to spawn in natural areas. With fisheries operating under

(1) a maximum spawner reduction rate of 2/3;
(2) a natural spawner floor of 35,000;
(3) a 50% harvest share for the tribes; and
(4) 15% of the nontribal harvest allocated to the river recreational fishery,

the Harvest Rate Model (HRM) projects a spawning population of approximately 71,200 adults, of which 44,900 would be expected to spawn in natural areas. The total harvest projected by the HRM under this scenario would be 158,000 adults, to be allocated as follows: Tribes 79,000, River Sport 11,900, and Ocean Troll/Sport 67,200. The corresponding age-4 ocean and river harvest rates are 25.8% and 57.9%, respectively. These projections are provided for comparative purposes only; the Pacific Fisheries Management Council does not use the HRM to model Klamath River fall chinook fisheries.

[1] Prepared 9 February 2001

INTRODUCTION

This report presents ocean stock size projections for Klamath River fall-run chinook in 2001. The current Framework Plan of the PFMC (1988) specifies an average escapement rate of between 33 and 34 percent across all broods, and a minimum escapement of no fewer than 35,000 naturally spawning adult fish. Naturally spawning adult fish are defined as age-3 or older fall chinook that spawn outside of the hatchery environment, regardless of their origin. Prospective ocean and river harvest levels of Klamath River fall chinook are determined from the Klamath River Technical Advisory Team's (KRTAT) Harvest Rate Model (HRM) using age-specific ocean abundance projections (Prager and Mohr, 2000; Prager and Mohr, *In Press*).

DATA AND ANALYTICAL METHODS

Klamath River fall chinook contribute to ocean and river fisheries primarily as age-3 and age-4 fish and, to a lesser extent, as age-2 and age-5 fish. This report develops ocean abundance predictions for all adult age classes (age-3, -4, and -5). The age-composition of the year 2000 in-river run of Klamath fall chinook salmon utilized in this report is derived from an analysis by the KRTAT (2001).

Age-3 Fish

The age-3 ocean stock size prediction was based on a regression of age-3 ocean abundance estimates for calendar years 1982-1999 against age-2 river run-size estimates the year before (Table 1, Figure 1). The regression was fit using least-squares, with the y-intercept constrained to zero, which gives the biologically reasonable expectation that an age-2 river run-size of zero predicts an age-3 ocean abundance of zero. This procedure is consistent with recommendations of the PFMC Salmon Technical Team and the PFMC Scientific and Statistical Committee.

Age-3 stock sizes have been projected pre-season since 1985 using methods similar to those described above. Post-season ocean stock-size estimates for age-3 fish were calculated using cohort reconstruction methods that accommodate annual variation in maturity rates applied to both hatchery and natural components of the stock, as described in KRTAT (1990). The post-season estimates for 1999 and 2000 are preliminary, as the respective cohorts are incomplete (Table 1). The 2000 pre-season prediction was 37% of the post-season estimate (Table 2). Pre-season predictions have underestimated age-3 abundance in nine of the seventeen previous years, and have overestimated it in eight (Table 2).

Age-4 Fish

The same regression method used for predicting age-3 abundance was also used to predict the 2001 age-4 abundance (see Table 1 for data). The relationship between age-4 ocean abundance estimates and age-3 river run-size estimates within a cohort is shown in Figure 2. The age-4 post-season estimate for 2000 is preliminary, as the respective cohort is incomplete (Table 1). The 2000 age-4 preseason prediction was

less than the post-season estimate by a factor of 0.84 (Table 2). Preseason predictions have underestimated the actual age-4 abundance in eight of the seventeen previous years, and have overestimated it in nine (Table 2).

Age-5 Fish

The same regression method used for predicting age-3 and age-4 abundances was also used to predict the 2001 age-5 abundance. The relationship between age-5 ocean abundance estimates and age-4 river run-size estimates within a cohort is shown in Figure 3.

Proportion of Adult Spawners Using Natural Areas

The proportion of fish spawning in natural areas is forecast using an arithmetic average of the previous five years' observed proportions. The 2000 prediction was 70 percent natural spawners (PFMC, 2000). The post-season estimate was 46 percent (Table 3).

STOCK PROJECTIONS AND PROSPECTIVE FISHERY LANDING LEVELS

The ocean abundance projections for Klamath River fall chinook in 2001 are:

Age 3:	93,548 fish
Age 4:	197,555 fish
Age 5:	1,004 fish

Absent fisheries in 2001, the predicted stock strengths would be expected to result in a 2001 spawning population of 219,300 adult fish, of which 138,200 would be expected to spawn in natural areas. With fisheries operating under

(1) a maximum spawner reduction rate of 2/3;
(2) a natural spawner floor of 35,000;
(3) a 50% harvest share for the tribes; and
(4) 15% of the nontribal harvest allocated to the river recreational fishery,

the Harvest Rate Model (HRM) projects a spawning population of approximately 71,200 adults, of which 44,900 would be expected to spawn in natural areas. The total harvest projected by the HRM under this scenario would be 158,000 adults, to be allocated as follows: Tribes 79,000, River Sport 11,900, and Ocean Troll/Sport 67,200. The corresponding age-4 ocean and river harvest rates are 25.8% and 57.9%, respectively. These projections are provided for comparative purposes only; the Pacific Fisheries Management Council does not use the HRM to model Klamath River fall chinook fisheries (Appendix A).

Ocean landings of Klamath River fall chinook in 2000 late season (September-November) ocean fisheries totaled 3090 summer fishery equivalents, consisting of 3000 age-4 fish and 90 age-5 fish (Table 4). Late-season landings (in summer equivalent units) will be deducted from the ocean troll fishery's harvest allocation in 2001.

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APPENDIX A

QHRM: KLAMATH QUICK HARVEST RATE MODEL (ver 2.04) by M.H. Prager and M.S. Mohr, NMFS Santa Cruz; after work by USFWS Arcata

Klamath QHRM - 2001 Projection 9 Feb 2001 at 16:35:17

CONSTANTS AND CONSTRAINTS (Input by User)

Age	Ocean vulnerab rate	River vulnerab rate	Prop legal size	Prop mature	Shaker mortal rate	Ocean dropoff rate	Tribal dropoff rate	Riv-rec dropoff rate	Prop natural spawners	Prev fall harvest	May stock size
3	0.880	0.590	0.800	0.399	0.260	0.050	0.080	0.020	0.630	0.	93548.
4	1.000	1.000	1.000	0.939	0.260	0.050	0.080	0.020	0.630	3000.	197555.
5	1.000	1.000	1.000	1.000	0.260	0.050	0.080	0.020	0.630	90.	1004.
Sum	.	.	.	.	.	.	.	.	.	3090.	292107.

Minimum escapement in natural areas:		35000.
Minimum, maximum spawner-reduction rate:	0.000	0.667
Required tribal proportion of total harvest:		0.500
Required river-recreational proportion of non-tribal harvest:		0.150

OCEAN PROJECTIONS

Age	Summer contact rate	Summer ocean harvest	Summer shaker deaths	Summer dropoff deaths	Summer ocean impacts	Total ocean harvest	Total ocean impacts*	Post-season stock	River run
3	0.242	15960.	1037.	998.	17995.	15960.	17995.	75553.	30146.
4	0.242	47877.	0.	2394.	50270.	50877.	53270.	147285.	138300.
5	0.242	243.	0.	12.	255.	333.	345.	749.	749.
Sum	.	64080.	1037.	3404.	68521.	67170.	71611.	223586.	169194.

* Assumes fall impacts = fall harvest

RIVER PROJECTIONS (Recreational, Tribal, Total)

Age	Tribal dropoff deaths	Recreat dropoff deaths	Total dropoff deaths	Tribal harvest	River-recreat harvest	Total river harvest	Tribal impacts	River-recreat impacts	Total river impacts
3	779.	27.	807.	8962.	1344.	10306.	9741.	1372.	11113.
4	6060.	213.	6273.	69685.	10453.	80138.	75744.	10666.	86411.
5	33.	1.	34.	377.	57.	434.	410.	58.	468.
Sum	6872.	242.	7114.	79024.	11854.	90877.	85895.	12095.	97991.

PROJECTED IMPACT RATES (Relative to May 1 Population)

Age	Ocean total*	River Tribal	River recreat	River total	Non-Tribal*	All segments*
3	0.192	0.104	0.015	0.119	0.207	0.311
4	0.270	0.383	0.054	0.437	0.324	0.707
5	0.344	0.408	0.057	0.466	0.402	0.810
Pop	0.245	0.294	0.041	0.335	0.287	0.581

* Includes fall harvest, taken before May 1 population estimate

HARVEST AND ESCAPEMENT PROJECTIONS

Harvest regime:	Type 3	..... To meet maximum spawner-reduction rate	
Total harvest:	158048.		
Ocean harvest:	67170.		
River harvest:	90877.		
Tribal harvest:	79024.	..... which is 50.0% of total harvest.	
Non-tribal harvest:	79024.		
River-recreational harvest:	11854.	..... which is 15.0% of non-tribal harvest.	
Total spawning escapement:	71203.	|	
Spawning escapement in nat areas:	44858.	| Spawner survival rate (rel to no fishing):	0.325
Same, with no fishing:	138175.	| Spawner reduction rate (rel to no fishing):	0.675

- All results are subject to roundoff error. Totals may differ slightly.

Table 1. Estimated number of fall-run chinook salmon by age entering the Klamath River, 1981-2000 (in thousands of fish), including estimates of ocean harvest rates and ocean abundance. a/

Calendar Year	River Run				Total	Ocean Harvest Rate		Ocean Abundance		
	Age 2	Age 3	Age 4	Age 5	Adults	Age 3	Age 4	Age 3	Age 4	Total
1981	28.1	64.0	14.3	1.8	80.1	0.42	0.66	246.6	45.6	292.2
1982	39.4	30.0	33.9	2.6	66.5	0.57	0.65	344.5	106.7	451.2
1983	3.8	35.8	20.7	0.9	57.5	0.28	0.70	103.8	84.9	188.7
1984	8.3	29.6	15.2	2.3	47.1	0.14	0.43	103.0	29.1	132.1
1985	69.4	30.7	32.7	0.9	64.4	0.25	0.29	138.0	46.0	184.0
1986	44.5	167.9	26.9	0.1	194.8	0.30	0.52	604.1	56.1	660.2
1987	19.0	120.7	88.0	/b	208.7	0.36	0.53	415.4	192.9	608.4
1988	24.0	136.5	53.5	1.2	191.3	0.37	0.45	612.2	108.7	720.9
1989	9.1	15.2	105.6	3.2	124.0	0.21	0.44	129.7	190.0	319.7
1990	4.4	9.1	26.6	0.2	35.8	0.61	0.61	113.3	68.7	182.0
1991	1.8	14.4	18.1	0.1	32.6	0.10	0.21	43.8	24.8	68.7
1992	13.7	7.3	18.3	1.0	26.7	0.02	0.04	20.5	20.0	40.5
1993	7.6	48.7	7.8	0.6	57.1	0.11	0.11	98.0	10.1	108.2
1994	14.4	35.6	25.0	1.0	61.6	0.05	0.07	68.8	30.4	99.2
1995	22.8	194.0	17.3	2.4	213.7	0.10	0.21	457.2	23.4	480.6
1996	9.5	38.9	136.2	0.3	175.4	0.08	0.17	112.6	171.2	283.8
1997	8.0	34.9	44.2	4.6	83.7	0.08	0.10	86.2	51.4	137.6
1998	4.6	58.7	30.1	1.7	90.6	0.02	0.10	90.0	35.5	125.4
1999	19.1	29.4	20.2	1.3	50.9	0.03 c/	0.12	78.3 c/	23.8	102.1
2000	10.2	186.6	30.3	0.5	217.4	d/	0.12 c/	478.0 e/	37.0 c/	514.9

a/ Ocean harvest rate and ocean abundance of age 3 fish in 1981 and age 4 fish in 1981 and 1982 from CDFG 1989; all other years from KRTAT 1990.

b/ Fewer than 50 fish.
c/ Preliminary: incomplete cohort data (age 5 data unavailable).
d/ Not estimated: incomplete cohort data (age 4 and age 5 data unavailable).
e/ Preliminary: incomplete cohort data (age 4 and age 5 data unavailable).

Table 2. Comparisons of Pre- and Post-season ocean abundance estimates (rounded to the nearest 100) for age 3 and age 4 Klamath River fall chinook, 1985-2000 seasons.

Year	Age 3 Klamath Fall Chinook			Age 4 Klamath Fall Chinook		
	Preseason Estimate	Postseason Estimate	Pre/Post	Preseason Estimate	Postseason Estimate	Pre/Post
1985	56,500	138,000	0.41	45,500	46,000	0.99
1986	213,000 a/	604,100	0.35	53,000	56,100	0.94
1987	255,900	415,400	0.62	164,900	192,900	0.85
1988	185,400	612,200	0.30	149,100	108,700	1.37
1989	225,300	129,700	1.74	172,400	190,000	0.91
1990	239,500	113,300	2.11	40,100	68,700	0.58
1991	88,100	43,800	2.01	35,700	24,800	1.44
1992	25,000	20,500	1.22	35,800	20,000	1.79
1993	147,200	98,000	1.50	31,300	10,100	3.10
1994	69,000	68,800	1.00	68,900	30,400	2.27
1995	134,500	457,200	0.29	37,600	23,400	1.61
1996	239,900	112,600	2.13	214,800	171,200	1.25
1997	112,300	86,200	1.30	43,100	51,400	0.84
1998	88,000	90,000	0.98	36,800	35,500	1.04
1999	42,400	78,300 b/	0.54	63,000	23,800	2.65
2000	174,800	478,000 b/	0.37	31,100	37,000 b/	0.84

a/ A 75% jack count adjustment was applied because (1) most of the jacks were in the Trinity River and (2) the basin jack count was outside the database.

b/ Preliminary: incomplete cohort data.

Table 3. Numbers of Natural and Hatchery Adult Fall Chinook Spawners in the Klamath Basin, 1985-2000.

Year	Hatchery	Natural	Percent Natural
1985	22,500	25,700	53%
1986	32,900	113,400	78%
1987	29,100	101,700	78%
1988	33,500	79,400	70%
1989	22,000	43,900	67%
1990	8,100	15,600	66%
1991	6,500	11,600	64%
1992	7,400	12,000	62%
1993	21,600	21,900	50%
1994	14,700	32,300	69%
1995	28,900	161,800	85%
1996	20,000	81,300	**80%**
1997	18,700	46,100	**71%**
1998	29,200	42,500	**59%**
1999	14,400	18,600	**56%**
2000	97,600	82,600	**46%**
1996 - 2000 unweighted average			**63%**

Table 4. Calculations of September-November, 2000, Ocean Fishery Landings of Klamath River Fall Chinook (in summer equivalent units

Brood Year (age class)	Number Ocean CWT's	Summer Equivalent CWTs	River CWTs	Total River Run	Brood Year CWT Expansion Factor	Ocean Landings
1998 (3)	0	0.00	534	10,202	19.10	0
1997 (4)	245	196.00	12,192	186,602	15.31	3000
1996 (5)	4	3.20	1,077	30,287	28.12	90
Total 2000 Fall Ocean Landings						3090

Figure 1. Age 3 ocean abundance predictor

(1979-1996 brood years)

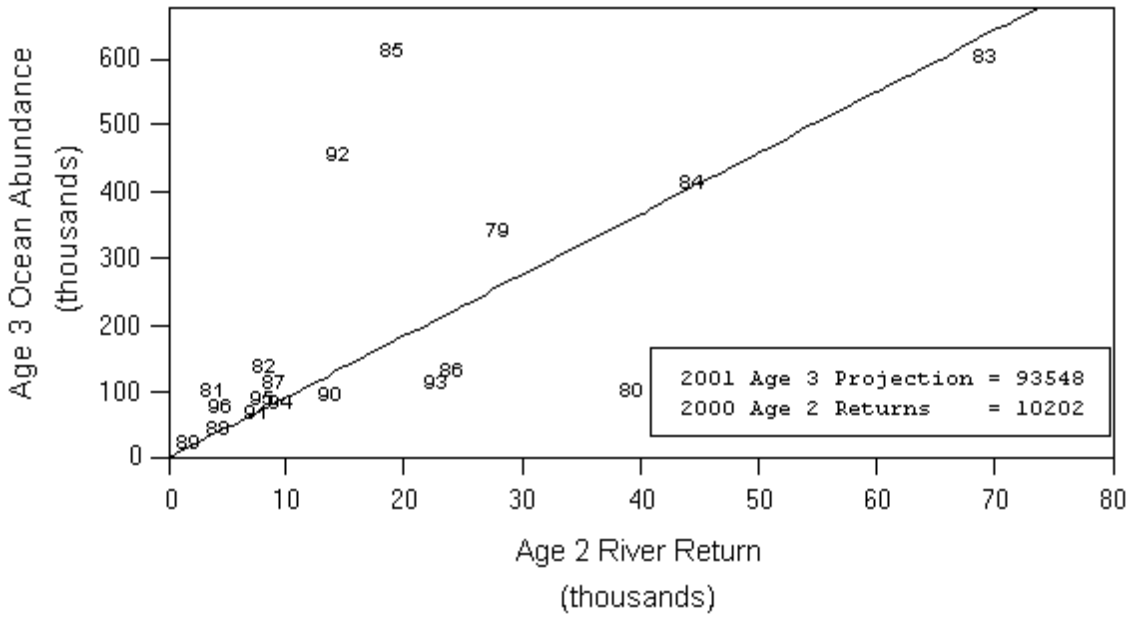

Figure 2. Age 4 ocean abundance predictor

(1979-1996 brood years)

Figure 3. Age 5 ocean abundance predictor

(1979-1995 brood years)