

Emergence Timing Estimates from Temperature Units

River temperatures used for predicting the emergence timing of fall chinook and chum were based on the three year average (1999-2001) of temperatures collected from USFWS gauges at Ives Island.

Temperatures in the model are updated through the season with data taken from the USACE monitoring station at Warrendale from the website: http://www.nwd-wc.usace.army.mil/TMT/tdg_data/months.html for the period October 2001 through January 25th. On this date, the USFWS gauge 1 was back on line and river temperatures from this device were used for calculating emergence.

Calculating estimated emergence times from the worksheet goes as follows:

Worksheets for the three temperature profiles, “temps”, “temps + 2”, and “temps + 3” have TU and Cumulative TU columns for all each day of the development period. In the cumulative column, a zero is inserted on the date of the beginning, peak and completion of spawning. The cumulative column then adds up the daily Temperature units and I match up the various developmental stages with the date these are reached.

Fall Chinook and Chum Below Bonneville Dam Seining Summary, 2002

Date	total	CHINOOK		Ad clips	CHUM		Comments/Other
		# <50mm	# > 50mm	# length	# mean length		
22-Jan	16	14	2				
24-Jan	31	30	1				
28-Jan	24	23	1				
1-Feb	36	36	0				
8-Feb	87	79	8				
12-Feb	37	33	4				
15-Feb	57	57	0				
19-Feb	29	23	6		1 36		
22-Feb	46	30	16				
25-Feb	17	6	11		0		
1-Mar	168	38	130				chum seined at St. Cloud and Multnomah areas
4-Mar	12	5	7		3 41		
8-Mar	27	13	14				
12-Mar	107	3	104		91 40		spring creek release
15-Mar	104	16	88		12 41		
19-Mar	163	80	83		37 40		
26-Mar	94	28	66		63 40		
29-Mar	153	18	135	1 65			
2-Apr	111	52	59	1 71	30		
5-Apr	158	67	91	1 72	44 37.9		24 CHS
9-Apr	160	64	96	3 62	155		
11-Apr	50	22	28		15		
16-Apr	83	59	24	2 77.5	13		
19-Apr	75	60	15		1		
23-Apr	102	52	50		0		
25-Apr	74	33	41	1 77	1		
30-Apr	91	58	33		8		
totals:	2112	999	1113	9		474	

58
62
67
62.33333

COLUMBIA RIVER WATER TEMPERATURES (°F) AND TEMPERATURE UNITS (°C) BELOW BONNEVILLE DAM, 2001-2002.

(Data sources October 2001 through Jan 25 2002, USACE monitoring station at Warrendale; Jan 26 through present, Ives Island Gage 1)

DAY	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBURARY		MARCH		APRIL		MAY		JUNE	
	TEMP (°F)	TU's (°C)	TEMP (°F)	TU's (°C)	TEMP (°F)	TU's (°C)	TEMP (°F)	TU's (°C)	TEMP (°F)	TU's (°C)	TEMP (°F)	TU's (°C)	TEMP (°F)	TU's (°C)	TEMP (°F)	TU's (°C)	TEMP (°F)	TU's (°C)
1	64	18	56	13	50	9	42	5	39	4	39	4	43	6	50	10	57	14
2	64	18	56	13	50	9	42	6	39	4	39	4	43	6	50	10	57	14
3	64	18	56	13	50	9	42	6	39	4	39	4	43	6	50	10	58	14
4	64	18	56	13	50	9	42	6	39	4	39	4	43	6	50	10	59	15
5	64	18	56	13	50	9	42	6	39	4	41	5	45	7	50	10	59	15
6	64	18	56	12	50	9	42	6	39	4	39	4	45	7	50	10	59	15
7	64	18	56	12	50	8	42	6	39	4	39	4	45	7	48	9	59	15
8	63	17	54	12	50	8	42	6	39	4	39	4	45	7	50	10	59	15
9	63	17	52	11	49	8	42	6	39	4	39	4	45	7	50	10	59	15
10	63	17	52	11	48	8	42	6	39	4	39	4	45	7	50	10	59	15
11	63	17	54	11	48	8	42	6	39	4	41	5	45	7	50	10	59	15
12	61	16	54	11	48	8	42	6	39	4	41	5	45	7	50	10	59	15
13	61	16	54	11	48	8	42	6	39	4	41	5	45	7	52	11	59	15
14	61	16	54	11	48	7	42	6	39	4	41	5	48	9	52	11	59	15
15	61	16	54	11	47	7	42	6	39	4	41	5	48	9	52	11	59	15
16	61	16	54	11	47	7	42	5	39	4	41	5	48	9	52	11	59	15
17	59	15	53	11	47	7	42	5	39	4	41	5	48	9	52	11	59	15
18	59	15	53	11	47	7	42	5	39	4	41	5	48	9	52	11	59	15
19	59	15	53	10	47	7	42	6	39	4	41	5	48	9	54	12	59	15
20	60	15	53	10	47	7	42	6	39	4	41	5	48	9	54	12	59	15
21	60	15	52	10	47	7	42	5	39	4	41	5	48	9	55	12	61	16
22	60	15	52	10	47	7	42	5	39	4	41	5	48	9	55	12	61	16
23	60	14	52	10	47	7	42	5	39	4	41	5	48	9	56	12	61	16
24	59	14	51	10	46	6	42	5	39	4	41	5	48	9	57	12	61	16
25	58	14	51	10	46	6	42	5	39	4	41	5	48	9	57	13	61	16
26	58	14	51	10	46	6	42	5	39	4	43	6	48	9	57	13	63	17
27	58	14	51	10	45	6	42	5	39	4	43	6	48	9	57	13	64	18
28	57	13	51	10	44	5	42	5	39	4	43	6	48	9	57	13	64	18
29	56	13	50	9	44	5	39	4	39	4	43	6	48	9	57	13	64	18
30	56	13	50	9	44	6	39	4			43	6	50	10	57	13	64	18
31	56	13			44	6	39	4			43	6			57	13		
TOTAL	--	487.33	--	330.3	--	224.5	--	166.4	--	116.0	--	152	--	243.2	--	348	--	466
AVE.	60.7	15.7	53.2	11.0	47.5	7.2	41.7	5.4	39.2	4.0	40.8	4.9	46.6	8.1	52.9	11.2	60.0	15.5

REQUIRED TEMPERATURE UNITS (TU'S)

<u>FALL CHINOOK</u>	<u>(°C)</u>
EYE OUT	250
HATCHING	500
EMERGENCE	1000

<u>CHUM</u>	
EYE OUT	400
HATCHING	600
EMERGENCE	800

CUMULATIVE TU'S (°C) SINCE INITIATION AND END OF SPAWNING

<u>FALL CHINOOK</u>				<u>EMERGENCE</u>		
<u>EVENT</u>	<u>DATE</u>	<u>EYED OUT</u>	<u>HATCHING</u>	<u>T</u>	<u>+2°C</u>	<u>+3°C</u>
BEGIN SPAWNING	10/22	250 11/11	502 12/6	1000 3/11	1/25	1/13
PEAK SPAWNING	11/16	254 12/14	503 1/26	1008 4/26	3/23	3/7
END SPAWNING	12/10	252 1/20	505 3/19	1004 5/18	4/22	4/10

<u>CHUM</u>				<u>EMERGENCE</u>		
<u>EVENT</u>	<u>DATE</u>	<u>EYED OUT</u>	<u>HATCHING</u>	<u>T</u>	<u>+2°C</u>	<u>+3°C</u>
BEGIN SPAWNING	11/12	402 12/30	602 2/8	805 3/25	2/11	1/29
PEAK SPAWNING	11/26	401 1/23	602 3/14	802 4/16	3/12	2/25
END SPAWNING	12/20	402 3/15	607 4/14	805 5/6	4/12	3/31

DAY	OCT.		NOVEMBER		DEC		JAN		FEB		MAR		APRIL		MAY		JUNE	
	TU's (C)	CUM.	TU's (C)	CUM.	TU's (C)	Cum.	TU's (C)	Cum.	TU's (C)	Cum.	TU's (F)	Cum.	TU's (C)	Cum.	TU's (C)	Cum.	TU's (C)	Cum.
1	18		13	137	9	47	5	268	4	433	4	544.5	6	698.5	10	945.7	14	1297.7
2	18		13	150	9	56	6	273	4	436.5	4	548.5	6	704.5	10	955.7	14	1311.7
3	18		13	163	9	64	6	279	4	440.5	4	552.5	6	710.5	10	965.7	14	1325.7
4	18		13	177	9	73	6	284	4	444.5	4	556.5	6	716.5	10	975.7	15	1340.7
5	18		13	190	9	81	6	290	4	448.5	5	561.5	7	723.7	10	985.7	15	1355.7
6	18		12	202	9	90	6	295	4	452.5	4	565.5	7	731.0	10	995.7	15	1370.7
7	18		12	214	8	98	6	301	4	456.5	4	569.5	7	738.2	9	1004.7	15	1385.7
8	17		12	226	8	106	6	307	4	460.5	4	573.5	7	745.4	10	1014.7	15	1400.7
9	17		11	237	8	114	6	312	4	464.5	4	577.5	7	752.7	10	1024.7	15	1415.7
10	17		11	248	8	122	6	318	4	468.5	4	581.5	7	759.9	10	1034.7	15	1430.7
11	17		11	259	8	130	6	323	4	472.5	5	586.5	7	767.1	10	1044.7	15	1445.7
12	16		11	0	8	138	6	329	4	476.5	5	591.5	7	774.4	10	1054.7	15	1460.7
13	16		11	11	8	146	6	335	4	480.5	5	596.5	7	781.6	11	1065.7	15	1475.7
14	16		11	22	7	153	6	340	4	484.5	5	601.5	9	790.6	11	1076.7	15	1490.7
15	16		11	33	7	160	6	346	4	488.5	5	606.5	9	799.6	11	1087.7	15	1505.7
16	16		11	44	7	167	5	351	4	492.5	5	611.5	9	808.6	11	1098.7	15	1520.7
17	15		11	55	7	174	5	357	4	496.5	5	616.5	9	817.6	11	1109.7	15	1535.7
18	15		11	66	7	181	5	362	4	500.5	5	621.5	9	826.6	11	1120.7	15	1550.7
19	15		10	76	7	188	6	368	4	504.5	5	626.5	9	835.6	12	1132.7	15	1565.7
20	15		10	86	7	195	6	373	4	508.5	5	631.5	9	844.6	12	1144.7	15	1580.7
21	15		0	96	7	202	5	379	4	512.5	5	636.5	9	853.6	12	1156.7		
22	15		0	106	7	209	5	384	4	516.5	5	641.5	9	862.6	12	1168.7		
23	14	14	10	116	7	216	5	390	4	520.5	5	646.5	9	871.6	12	1180.7		
24	14	28	10	126	6	222	5	395	4	524.5	5	651.5	9	880.6	12	1192.7		
25	14	42	10	136	6	228	5	400	4	528.5	5	656.5	9	889.6	13	1205.7		
26	14	56	10	0	6	234	5	406	4	532.5	6	662.5	9	898.6	13	1218.7		
27	14	70	10	10	6	240	5	411	4	536.5	6	668.5	9	907.6	13	1231.7		
28	13	83	10	20	5	245	5	417	4	540.5	6	674.5	9	916.6	13	1244.7		
29	13	97	9	29	5	250	4	421	4		6	680.5	9	925.6	13	1257.7		
30	13	110	9	38	6	256	4	425			6	686.5	10	935.7	13	1270.7		
31	13	123			6	262	4	429			6	692.5			13	1283.7		

DAY	OCT.		NOVEMBER		DEC		JAN		FEB		MAR		APRIL		MAY		JUNE	
	TU's (C)	CUM.	TU's (C)	CUM.	TU's (C)	Cum.	TU's (C)	Cum.	TU's (C)	Cum.	TU's (F)	Cum.	TU's (C)	Cum.	TU's (C)	Cum.	TU's (C)	Cum.
1	usace		usace		usace													
2	20		15	157	11	231	7.4	514	6	741	6	908.5	8	1124.5	12	1431.7	16	1845.7
3	20		15	172	11	242	7.5	521	6	746.5	6	914.5	8	1132.5	12	1443.7	16	1861.7
4	20		15	187	10.5	252	7.6	529	6	752.5	6	920.5	8	1140.5	12	1455.7	16	1877.7
5	20		15	203	10.5	263	7.6	536	6	758.5	6	926.5	8	1148.5	12	1467.7	17	1894.7
6	20		15	218	10.5	273	7.6	544	6	764.5	7	933.5	9	1157.7	12	1479.7	17	1911.7
7	20		14	232	10.6	284	7.6	551	6	770.5	6	939.5	9	1167.0	12	1491.7	17	1928.7
8	20		14	246	10.4	294	7.6	559	6	776.5	6	945.5	9	1176.2	11	1502.7	17	1945.7
9	19		14	260	10	304	7.6	567	6	782.5	6	951.5	9	1185.4	12	1514.7	17	1962.7
10	19		13	273	10	314	7.6	574	6	788.5	6	957.5	9	1194.7	12	1526.7	17	1979.7
11	19		13	286	10	324	7.6	582	6	794.5	6	963.5	9	1203.9	12	1538.7	17	1996.7
12	19		13	299	10	334	7.6	589	6	800.5	7	970.5	9	1213.1	12	1550.7	17	2013.7
13	18		13	0	10	344	7.6	597	6	806.5	7	977.5	9	1222.4	12	1562.7	17	2030.7
14	18		13	13	10	354	7.6	605	6	812.5	7	984.5	9	1231.6	13	1575.7	17	2047.7
15	18		13	26	9	363	7.6	612	6	818.5	7	991.5	11	1242.6	13	1588.7	17	2064.7
16	18		13	39	9	372	7.6	620	6	824.5	7	998.5	11	1253.6	13	1601.7	17	2081.7
17	18		13	52	9	381	7.4	627	6	830.5	7	1005.5	11	1264.6	13	1614.7	17	2098.7
18	17		13	65	9	390	7.4	635	6	836.5	7	1012.5	11	1275.6	13	1627.7	17	2115.7
19	17		13	78	9	399	7.4	642	6	842.5	7	1019.5	11	1286.6	13	1640.7	17	2132.7
20	17		12	90	9	408	7.6	650	6	848.5	7	1026.5	11	1297.6	14	1654.7	17	2149.7
21	17		12	102	9	417	7.7	657	6	854.5	7	1033.5	11	1308.6	14	1668.7	17	2166.7
22	17	0	12	114	9	426	7.4	665	6	860.5	7	1040.5	11	1319.6	14	1682.7		
23	17	0	12	126	9	435	7.4	672	6	866.5	7	1047.5	11	1330.6	14	1696.7		
24	16	16	12	138	9	444	7.4	680	6	872.5	7	1054.5	11	1341.6	14	1710.7		
25	16	32	12	150	8	452	7.4	687	6	878.5	7	1061.5	11	1352.6	14	1724.7		
26	16	48	12	162	8	460	7.4	694	6	884.5	7	1068.5	11	1363.6	15	1739.7		
27	16	64	12	174	8	468	7.4	702	6	890.5	8	1076.5	11	1374.6	15	1754.7		
28	16	80	12	186	8	476	7.4	709	6	896.5	8	1084.5	11	1385.6	15	1769.7		
29	15	95	12	198	7	483	7.4	717	6	902.5	8	1092.5	11	1396.6	15	1784.7		
30	15	111	10.8	209	7	490	6	723	8	1100.5	11	1407.6	15	1799.7				
31	15	126	10.8	220	8	498	6	729	8	1108.5	12	1419.7	15	1814.7				
		141			8	506	6	735				1116.5	15	1829.7				

DAY	OCT.		NOVEMBER		DEC		JAN		FEB		MAR		APRIL		MAY		JUNE			
	TU's (C)	CUM.	TU's (C)	CUM.	TU's (C)	Cum.	TU's (C)	Cum.	TU's (C)	Cum.	TU's (F)	Cum.	TU's (C)	Cum.	TU's (C)	Cum.	TU's (C)	Cum.		
1	usace	21	usace	16	167	usace	12	250	8	564	7	822	7	1017.5	9	1264.5	13	1601.7	17	2046.7
2		21		16	183		12	262	9	572	7	828.5	7	1024.5	9	1273.5	13	1614.7	17	2063.7
3		21		16	199		12	273	9	581	7	835.5	7	1031.5	9	1282.5	13	1627.7	17	2080.7
4		21		16	216		12	285	9	589	7	842.5	7	1038.5	9	1291.5	13	1640.7	18	2098.7
5		21		16	232		12	296	9	598	7	849.5	8	1046.5	10	1301.7	13	1653.7	18	2116.7
6		21		15	247		12	308	9	606	7	856.5	7	1053.5	10	1312.0	13	1666.7	18	2134.7
7		21		15	262		11	319	9	615	7	863.5	7	1060.5	10	1322.2	12	1678.7	18	2152.7
8		20		15	277		11	330	9	624	7	870.5	7	1067.5	10	1332.4	13	1691.7	18	2170.7
9		20		14	291		11	341	9	632	7	877.5	7	1074.5	10	1342.7	13	1704.7	18	2188.7
10		20		14	305		11	352	9	641	7	884.5	7	1081.5	10	1352.9	13	1717.7	18	2206.7
11		20		14	319		11	363	9	649	7	891.5	8	1089.5	10	1363.1	13	1730.7	18	2224.7
12		19		14	0		11	374	9	658	7	898.5	8	1097.5	10	1373.4	13	1743.7	18	2242.7
13		19		14	14		11	385	9	667	7	905.5	8	1105.5	10	1383.6	14	1757.7	18	2260.7
14		19		14	28		10	395	9	675	7	912.5	8	1113.5	12	1395.6	14	1771.7	18	2278.7
15		19		14	42		10	405	9	684	7	919.5	8	1121.5	12	1407.6	14	1785.7	18	2296.7
16		19		14	56		10	415	8	692	7	926.5	8	1129.5	12	1419.6	14	1799.7	18	2314.7
17		18		14	70		10	425	8	701	7	933.5	8	1137.5	12	1431.6	14	1813.7	18	2332.7
18		18		14	84		10	435	8	709	7	940.5	8	1145.5	12	1443.6	14	1827.7	18	2350.7
19		18		13	97		10	445	9	718	7	947.5	8	1153.5	12	1455.6	15	1842.7	18	2368.7
20		18		13	110		10	455	9	726	7	954.5	8	1161.5	12	1467.6	15	1857.7	18	2386.7
21		18	0	13	123		10	465	8	735	7	961.5	8	1169.5	12	1479.6	15	1872.7		
22		18	0	13	136		10	475	8	743	7	968.5	8	1177.5	12	1491.6	15	1887.7		
23		17	17	13	149		10	485	8	752	7	975.5	8	1185.5	12	1503.6	15	1902.7		
24		17	34	13	162		9	494	8	760	7	982.5	8	1193.5	12	1515.6	15	1917.7		
25		17	51	13	175		9	503	8	768	7	989.5	8	1201.5	12	1527.6	16	1933.7		
26		17	68	13	188		9	512	8	777	7	996.5	9	1210.5	12	1539.6	16	1949.7		
27		17	85	13	201		9	521	8	785	7	1003.5	9	1219.5	12	1551.6	16	1965.7		
28		16	101	13	214		8	529	8	794	7	1010.5	9	1228.5	12	1563.6	16	1981.7		
29		16	118	11.8	226		8	537	7	801			9	1237.5	12	1575.6	16	1997.7		
30		16	134	11.8	238		9	546	7	808			9	1246.5	13	1588.7	16	2013.7		
31		16	150				9	555	7	815			9	1255.5			16	2029.7		

DAY	OCT.		NOVEMBER		DEC		JAN		FEB		MAR		APRIL		MAY		JUNE	
	TU's (C) usace	CUM.	TU's (C) usace	CUM.	TU's (C) usace	CUM.	TU's (C)	CUM	TU's (C) 3yr average	CUM	TEMP (F) 3yr average	CUM	TU's (C) 3yr average	CUM	TU's (C) 3yr average	CUM	TU's (C) 3yr average	CUM.
1	18		13.3	153	10.0	128	10.0	260	10.0	570	7	845.0	9	1092.0	13	1429.2	17	1874.2
2	18		13.3	166	10.0	138	10.0	270	10.0	580.0	7	852.0	9	1101.0	13	1442.2	17	1891.2
3	18		13.3	179	10.0	148	10.0	280	10.0	590.0	7	859.0	9	1110.0	13	1455.2	17	1908.2
4	18		13.3	193	10.0	158	10.0	290	10.0	600.0	7	866.0	9	1119.0	13	1468.2	18	1926.2
5	18		13.3	206	10.0	168	10.0	300	10.0	610.0	8	874.0	10	1129.2	13	1481.2	18	1944.2
6	18		12.0	218	10.0	0	10.0	310	10.0	620.0	7	881.0	10	1139.5	13	1494.2	18	1962.2
7	18		12.0	230	10.0	10	10.0	320	10.0	630.0	7	888.0	10	1149.7	12	1506.2	18	1980.2
8	17		12.0	242	10.0	20	10.0	330	10.0	640.0	7	895.0	10	1159.9	13	1519.2	18	1998.2
9	17		11.0	253	10.0	30	10.0	340	10.0	650.0	7	902.0	10	1170.2	13	1532.2	18	2016.2
10	17		11.0	264	10.0	40	10.0	350	10.0	660.0	7	909.0	10	1180.4	13	1545.2	18	2034.2
11	17		11.0	275	10.0	50	10.0	360	10.0	670.0	8	917.0	10	1190.6	13	1558.2	18	2052.2
12	16		11.0	286	10.0	60	10.0	370	10.0	680.0	8	925.0	10	1200.9	13	1571.2	18	2070.2
13	16		11.0	297	10.0	70	10.0	380	10.0	690.0	8	933.0	10	1211.1	14	1585.2	18	2088.2
14	16		11.0	308	10.0	80	10.0	390	10.0	700.0	8	941.0	12	1223.1	14	1599.2	18	2106.2
15	16		11.0	319	10.0	90	10.0	400	10.0	710.0	8	949.0	12	1235.1	14	1613.2	18	2124.2
16	16		11.0	330	10.0	100	10.0	410	10.0	720.0	8	957.0	12	1247.1	14	1627.2	18	2142.2
17	15		11.0	341	10.0	110	10.0	420	10.0	730.0	8	965.0	12	1259.1	14	1641.2	18	2160.2
18	15		11.0	0	10.0	120	10.0	430	10.0	740.0	8	973.0	12	1271.1	14	1655.2	18	2178.2
19	15		10.0	10	10.0	130	10.0	440	10.0	750.0	8	981.0	12	1283.1	15	1670.2	18	2196.2
20	15		10.0	20	10.0	140	10.0	450	10.0	760.0	8	989.0	12	1295.1	15	1685.2	18	2214.2
21	15	0	10.0	30	10.0	150	10.0	460	10.0	770.0	8	997.0	12	1307.1	15	1700.2		
22	15	16	10.0	40	10.0	160	10.0	470	10.0	780.0	8	1005.0	12	1319.1	15	1715.2		
23	14	30	10.0	50	10.0	170	10.0	480	10.0	790.0	8	1013.0	12	1331.1	15	1730.2		
24	14	44	10.0	60	10.0	180	10.0	490	10.0	800.0	8	1021.0	12	1343.1	15	1745.2		
25	14	58	10.0	70	10.0	190	10.0	500	10.0	810.0	8	1029.0	12	1355.1	16	1761.2		
26	14	72	10.0	80	10.0	200	10.0	510	10.0	820.0	9	1038.0	12	1367.1	16	1777.2		
27	14	86	10.0	90	10.0	210	10.0	520	10.0	830.0	9	1047.0	12	1379.1	16	1793.2		
28	13	99	9.3	99	10.0	220	10.0	530	10.0	838.0	9	1056.0	12	1391.1	16	1809.2		
29	13	113	9.1	108	10.0	230	10.0	540			9	1065.0	12	1403.1	16	1825.2		
30	13	126	9.1	118	10.0	240	10.0	550			9	1074.0	13	1416.2	16	1841.2		
31	13	139			10.0	250	10.0	560			9	1083.0			16	1857.2		