

Lake Chelan Kokanee Spawning Ground Surveys



Spawning kokanee (*Oncorhynchus nerka*) in Company Creek – Chelan County PUD, 2005.
(Photo by Brad Buchsieb)

Final Report 2009

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SECTION 1: INTRODUCTION

Annual kokanee (*Oncorhynchus nerka*) and Chinook (*Oncorhynchus tshawytscha*) salmon spawning ground surveys have been conducted within the Lake Chelan drainage by the Chelan County Public Utility District (District) since 1984. The District conducts these surveys as part of the Lake Chelan Fishery Plan (LCFP), which is included in Article 404 of the new Project License (FERC Project No. 637). The purpose of the District's spawning surveys within the basin is to document the annual trends of kokanee and Chinook spawning populations and the effects of management actions within the Lake Chelan drainage.

Kokanee were stocked into Lake Chelan in 1917 and became the dominant sport fish in the lake until the mid 1970s. Kokanee populations declined after introductions of opossum shrimp (*Mysis relicta*) in 1967 (Brown 1984). Mysids were introduced to provide additional forage for kokanee; however, they appeared to be competitors with younger age classes of kokanee for the limited food sources in the lake. Mysids are generally not available to kokanee as forage, because they prefer to inhabit deeper water during daylight hours while kokanee feed near the surface (Peven 1989).

Chinook were originally introduced into Lake Chelan by the Washington Department of Fisheries (WDF) in the mid 1970s and again in the 1990s to provide for a "trophy" fishery. The Chinook grew well for the first few seasons, but their growth appeared to be tied to the abundance of kokanee (Brown 1984). The Chinook have established an adfluvial population, with adult fish being observed on the spawning grounds and taken in the sport fishery.

SECTION 2: STUDY AREA AND METHODS

Most tributaries of Lake Chelan are generally steep and short (Figure 6-1). The Stehekin River is the principle tributary feeding the lake. The Stehekin is a relatively large glacial stream with the headwaters originating in the Cascade Mountains. The drainage covers an area of 321 square miles. The monthly mean flow for the Stehekin ranged between 528 and 3,910 cubic feet per second, based on data from water years 2000-2008 (*Water Watch*) courtesy of the U.S. Geological Survey. Kokanee spawn in the Stehekin River and primarily in two tributaries of the Stehekin: Company and Blackberry creeks (Figure 6-3). Except for the Stehekin River, kokanee do not travel far up the other Lake Chelan tributaries to spawn. The steep gradient of the streams usually confines kokanee spawning to the lower quarter mile. Kokanee run timing along Lake Chelan starts in the Stehekin Valley and progresses down lake throughout the spawning migration. The down lake streams included in the annual spawning ground surveys are Fish, Prince, Safety Harbor creeks (all on the north shore) and 25-Mile and First creeks on the south shore.

In 2009, District personnel conducted surveys between 10 September and 16 October every 7 days (Table 3-1). Surveys consist of walking in or along streams and counting all live kokanee and Chinook. Large masses of kokanee congregating in pools are estimated. Data collected during these surveys are used to determine spawner days and escapement.

Spawner days are the total number of days spent in a stream by a population of fish in order for them to spawn. The estimated number of spawner days for each stream is determined by graphing the number of live fish counted over time and then by calculating the area of the resulting polygons (McNeil 1964; Neilson and Geen 1981; Shepherd et al. 1986).

Escapement is the number of adult fish returning to a stream that escape mortality from harvest and natural attrition, and comprise a spawning population (WDFW 2000). Kokanee escapement is calculated by dividing the estimated number of spawner days by the average time of spawner residence in the stream. The average spawner residence for kokanee is estimated to be 15 days (Brown 1984). The escapement for Chinook spawners is estimated by using the same method used for kokanee (McNeil 1964; Neilson and Geen 1981; Shepherd et. al. 1986). The average spawner resident time for Chinook is estimated to be 13 days. According to Neilson and Geen (1981), a spawner resident time of 13 days is considered to be high and as a result, the escapement estimates are conservative.

SECTION 3: RESULTS AND DISCUSSION

3.1 Kokanee Spawners

Escapement is considered to be a better indicator of run size than peak counts. Escapement indicates the total number of fish that spawn in a stream during the entire spawning season. Peak counts only indicate the maximum number of spawners observed in a stream at one time during the spawning season.

3.2 Stehekin Tributaries

Company Creek

In 2009, surveyors counted 2,775 kokanee in Company Creek during the first survey on 10 September, with a peak count of 5,473 kokanee occurring on 24 September (Tables 3-1 and 3-3). The estimated escapement for Company Creek is 8,185 kokanee (Table 3-4). In 2008 Company Creek had a peak count of 6,619 kokanee and an estimated escapement of 16,246. The number of kokanee spawners in Company Creek has declined since 2005 (Table 3-3).

Blackberry Creek

In 2009, Surveyors counted 763 kokanee in Blackberry Creek during the first survey on 10 September, with a peak count of 1,291 kokanee occurring on 24 September (Tables 3-1 and 3-3). The estimated escapement for Blackberry Creek is 2,440 kokanee (Table 3-4). In 2008, Blackberry Creek had a peak count of 1,605 kokanee with an estimated escapement of 4,622. The number of kokanee spawners in Blackberry Creek has declined since 2003 (Table 3-4).

Survey Dates					
Tributaries	10-Sep	17-Sep	24-Sep	1-Oct	8-Oct
Company Creek	2,775	4,500	5,473	4,580	3,111
Blackberry Creek	763	1,083	1,291	1,141	892

Table 3-1. Kokanee spawners observed in Stehekin River tributaries, 2009.

3.3 Down Lake Tributaries

Fish Creek

In 2009 no kokanee were observed in Fish Creek. In 2008, Fish Creek had a peak count Of 10 kokanee (Tables 3-2 and 3-3). The estimated escapement was 8 kokanee (Table 3-4). In 2007, the woody debris that had been blocking the mouth of Fish Creek in 2006 was no longer present and kokanee spawners were able to access the stream. In 2007, the peak count was 220 with an estimated escapement of 172. In 2006 due to the large amount of woody debris that collected at the mouth of Fish Creek during the 2006 spring runoff, returning kokanee spawners could not access the stream. Surveyors did observe kokanee congregating at the mouth but no kokanee were observed within the stream.

Prince Creek

In 2009 Prince Creek had a peak count of 14 kokanee which occurred on 24 September (Tables 3-2 and 3-3). The estimated escapement was 12 kokanee (Table 3-4). The access to kokanee spawners in 2009 was blocked a short distance from the mouth due to habitat improvement structures placed in the stream. No spawners were observed above these structures. For more information about the habitat improvement structures please refer to Stone and Fielder (2004).

Safety Harbor Creek

In 2009, Safety Harbor Creek had a peak count of 74 kokanee on 8 October (Tables 3-2 and 3-3). The estimated escapement was 84 kokanee (Table 3-4). Safety Harbor Creek experiences heavy recreational use by hikers and campers. Recreators create swimming holes by blocking the water flow with rock dams. These rock dams make it difficult for spawning kokanee to ascend upstream. In 2009, Chelan County PUD survey staff again removed parts of the rock dams to allow kokanee better access. In 2008, the peak count was 21 kokanee with an estimated escapement of 20 kokanee. In 2007, the peak count was 5 kokanee with an estimated escapement of 4 kokanee. During the 2006 spring runoff a log jam was dislodged making it easier for kokanee to ascend further up the stream. In 2006, the peak count was 119 kokanee with an estimated escapement of 149 kokanee.

25-Mile Creek

In 2009, 25-Mile Creek had a peak count of 110 kokanee which occurred on 2 October (Tables 3-2 and 3-3). The estimated escapement was 143 kokanee (Table 3-4). In 2009, kokanee spawners were observed a short distance above the culvert that passes under the South Lake Shore Road. The distance in drop from the culvert to the pool below has increased over the last several years. This and low water flow may make it difficult for some kokanee to travel further upstream. In 2008, the peak count was 320 kokanee with an estimated escapement of 519 kokanee. In 2008, kokanee spawners were observed a short distance above the culvert that passes under the South Lake Shore Road. In 2007, the peak count was 12 kokanee with an estimated escapement of 22 kokanee. No kokanee spawners were observed in 2007 above the culvert that passes under the South Lake Shore Road due to low water flow and blockage.

First Creek

In 2009, First Creek had a peak count of 80, which occurred on 2 October (Tables 3-2 and 3-3). The estimated escapement was 56 kokanee (Table 3-4). In 2008, the peak count was 144 kokanee with an estimated escapement of 200 kokanee. No kokanee were observed in First Creek during the 2007 kokanee spawning surveys. In 2006, the peak count was 44 kokanee with an estimated escapement of 30 fish. In 2006, the upstream passage of kokanee was blocked by spring runoff debris. This blockage occurred downstream of the South Lake Shore Road bridge, within the Chelan State Park boundary.

Grade Creek

Grade Creek was not surveyed in 2009. No kokanee were observed in Grade Creek from 2006 through 2008 spawning surveys. However, in 2006 surveyors did observe kokanee

congregating at the mouth. In 2005, the peak count for Grade Creek was 13 kokanee with an estimated escapement of 7 fish (Tables 3-3 and 3-4).

Gold Creek

Gold Creek was not surveyed in 2009. No kokanee have been observed in Gold Creek from 2006 through 2008 spawning surveys. In 2005, the peak count for Gold Creek was 14 kokanee with an estimated escapement of 7 kokanee (Tables 3-3 and 3-4).

Mitchell Creek

Mitchell Creek was not surveyed in 2009. No kokanee were observed in Mitchell Creek during the 2007 and 2008 spawning surveys. In 2006 Mitchell Creek had a peak count of 10, with an estimated escapement of 7 (Tables 3-3 and 3-4). No kokanee were observed spawning in Mitchell Creek from 2003-2005.

Tributaries	Survey Dates								
	10-Sep	17-Sep	18-Sep	24-Sep	1-Oct	2-Oct	8-Oct	9-Oct	16-Oct
Fish Creek	0	0		0	0		0		
Prince Creek	0	0		14	11		2		
Safety Harbor	0	0		35	68		74		
25-Mile Creek			10	56		110		83	49
First Creek			0	0		80		46	14
Grade Creek	No surveys conducted								
Gold Creek									
Mitchell Creek									

Table 3-2. Kokanee spawners observed in Lake Chelan tributaries, 2009.

Spawning Area	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
Company Creek	19,841	10,058	16,388	26,320	35,445	26,951	14,649	7,149	6,619	5,473	
Blackberry Creek	18,214	6,966	13,046	20,596	17,100	13,158	6,437	4,841	1,605	1,291	
Safety Harbor	258		101		2	20	119	5	21	74	
25-Mile Creek	46	122	465	112	17	727	284	12	320	110	
First Creek	6	84	375	0	34	462	44	0	144	80	
Mitchell Creek	0		12	0	0	0	10	0	0		
Gold Creek	0		1	0	0	14	0	0	0		
Grade Creek	0		65	0	0	13	0	0	0		
Prince Creek	4		269	73	184	246	72	57	2		14
Fish Creek	16		359	49	261	351	0	220	10		0
Stehekin River (lower 6.5 miles)		7,032	5,148								
Total of Company, Blackberry, Safety-Harbor, 25-Mile, and First Creek	38,365	17,230	30,375	47,028	52,598	41,318	21,533	12,007	8,709	7,028	

Table 3-3. Peak kokanee spawner counts in the Lake Chelan drainage, 2000-2009.

Spawning Area	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Company Creek	41,814	23,255	33,349	54,376	58,231	63,256	32,927	19,182	16,246	8,185
Blackberry Creek	48,410	16,138	23,962	46,797	36,125	29,177	12,815	10,523	4,622	2,440
Safety Harbor	437		101		1	18	149	4	20	84
25-Mile Creek	46	162	654	136	15	1,022	319	22	519	143
First Creek	6	80	557	0	20	566	30	0	200	56
Mitchell Creek	0		14	0	0	0	7	0	0	
Gold Creek	0		1	0	0	7	0	0	0	
Grade Creek	0		73	0	0	7	0	0	0	
Prince Creek	4		269	73	235	245	93	45	2	12
Fish Creek	21		361	49	390	482	0	172	8	0
Total of Company, Blackberry, Safety-Harbor, 25-Mile, and First Creek	90,713	39,635	58,623	101,309	94,392	94,039	46,240	29,732	21,607	10,908

Table 3-4 Estimated kokanee escapement in the Lake Chelan drainage, 2000-2009.

3.4 Company Creek

In 2009, Company Creek had a peak count of 33 Chinook spawners with an estimated escapement of 49 (Table 3-5). In 2008, the peak count was 7 Chinook with an estimated escapement of 9. In 2007, the peak count was 2 Chinook with an estimated escapement of 3. No Chinook spawners were observed in Company Creek in 2006.

Blackberry Creek

In 2009, Blackberry Creek had a peak count of 5 Chinook spawners with an estimated escapement of 8 (Table 3-5). In 2008, the peak count was 5 Chinook with an estimated escapement of 8. In 2007, the peak count was 3 Chinook with an estimated escapement of 5. In 2006, the peak count was 3 Chinook with an estimated escapement of 5 fish.

Peak Counts	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Company Creek	6	6	3	2	2	18	0	2	7	33
Blackberry Creek	4	4	3	14	18	17	3	3	5	5

Escapement	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Company Creek	9	11	5	3	3	19	0	3	9	49
Blackberry Creek	7	7	5	20	41	17	5	5	8	9

Table 3-5. Peak Chinook spawner counts and estimated escapement in Company Creek and Blackberry Creek, 2000-2009.

SECTION 4: SUMMARY AND CONCLUSIONS

Company, Blackberry, Safety Harbor, 25-Mile, and First creeks have been surveyed consistently since 1981. Between 1984 and 1989, these creeks comprised approximately 97.1% to 99.6% of the kokanee escapement when all streams with spawning habitat were surveyed (Peven 1990). From 1981 to 2005, there has been an overall steady increase in the estimated kokanee escapement for Company, Blackberry, Safety Harbor, 25-Mile, and First creeks. However, the estimated kokanee escapement for 2006 decreased greatly possible due to a flood event that occurred in the fall of 2003 in the Stehekin valley (Figure 6-2), which likely scoured many of the kokanee redds in Company and Blackberry creeks. From 2005 through 2009 kokanee escapement in Company and Blackberry creeks has steadily decreased. The estimated escapement for these aforementioned streams in 2009 is 10,908 kokanee. This compares to the highest kokanee escapement in 2005 of 101,309. The majority of kokanee spawners are either 3 or 4 year old fish (2+ and 3+ fish) (Peven 1990).

Mysids are present in Lake Chelan. Mysids may compete with younger age classes of kokanee for food and can have a substantial impact on the kokanee population in the lake. Large predatory fish such as Chinook and lake trout can also adversely affect a kokanee population. Based on kokanee spawning surveys, the kokanee population in the Lake Chelan drainage has declined since 2003.

4.1 Fish Stocking

Article 6(d) and Section 4.6.3 of Chapter 6 of the Comprehensive Plan requires Chelan PUD to make available to the WDFW sufficient funding to rear annually the following resident fish at the Chelan Hatchery for stocking in Lake Chelan:

1. Approximately 5,000 pounds of salmonid fingerlings (for example: 500,000 fish at 100 fish/lb., presently kokanee).
2. Approximately 33,000 pounds of catchable-sized salmonids (for example: approximately 100,000 fish at 3 fish/lb., presently Westslope cutthroat trout and triploid rainbow trout).

Article 6(d) and Section 4.6.3 of Chapter 6 of the Comprehensive Plan provide that:

(1) the estimated cost to Chelan PUD of these activities is \$30,000 per year (in 2003 dollars).

Also, Article 6(d) and Section 4.6.3 of Chapter 6 of the Comprehensive Plan provide that:

(2) If WDFW, after coordination with the National Park Service, United States Department of Agriculture Forest Service, and United States Fish and Wildlife Service, and after consultation with the Lake Chelan Fishery Forum, decides, at any time during the term of the New License or any subsequent annual licenses, to reduce or eliminate fish stocking into Lake Chelan, the resulting savings shall be available to WDFW for other Lake Chelan fish management activities. Funds to be made available from reductions in fish production shall be determined as equivalent to the proportion of fish production poundage reduced. The funds saved shall be calculated as follows: take the number of pounds of fish production reduced, divide by the 38,000 pounds of fish

initially to be produced, and multiply by the \$30,000 (as adjusted under section 19 of the Agreement up to the year of the decision to reduce production). For example, if 5,000 pounds of kokanee production was eliminated, \$3,950 would be available for other fish management activities ($5,000/38,000 \times \$30,000$ escalated = \$3,950 escalated). The historic stocking effort for kokanee stocking in Lake Chelan from 1994 to the present is shown below (Table 4-1).

Year	Number	Date released	Release location	Stock used
1994	756,315	April, May	25-Mile Ck	LW, OR
1995	452,400	May	25-Mile Ck	LW
1996	71,060	April	25-Mile Ck	LW
1997	505,659	May	25-Mile Ck	LW
1998	933,021	April, May	Lake & 25-Mile Ck	LW
1999	329,322	April	Lake	LW
2000	478,266	April	Lake	LW
2001	286,831	April	Lake	LW
2002	467,291	May 6, 21, 24	Lake	LW
2003	499,953	May 9, 17, 22	Lake	LW
2004	515,838	May, June	Lake	LW
2005	478,956	May 10, 17, June 13	Lakeside & Mill Bay	LW
2006	0	n/a	n/a	n/a
2007	91,643	May	Lake	LC, LW
2008	227,000	May	Yacht Club	LC
2009	189,524	June	Yacht Club	LC
Total	6,280,079			

Table 4-1. Numbers of kokanee stocked into Lake Chelan from 1994 to 2009.

Key for fish stock:

OR = Oregon (unspecified)

LW = Lake Whatcom (Washington)

LC = Lake Chelan (Washington)

SECTION 5: ACKNOWLEDGEMENTS

Several District employees assisted with spawning surveys this fall. Todd West assisted with manpower and administrative support. Bob Nielsen coordinated transportation arrangements for the field work in the Stehekin Valley. Fish and Wildlife personnel conducting the surveys included Steve Hemstrom, Barry Keesee, and Lance Keller.

SECTION 6: REFERENCES

- Brown, L.G. 1984. Lake Chelan Fisheries Investigations. Washington Department of Wildlife. Wenatchee, Wa.
- McNeil, W.J. 1964. Redd Superimposition and Egg Capacity of Pink Salmon Spawning Beds. J. Fish. Res. Bd. Canada. 21: 1385-1396.
- Neilson, J.D. and G.H. Geen. 1981. Enumeration of Spawning Salmon From Spawner Residence Time and Aerial Counts. Trans. Amer. Fish. Soc. 110: 554-446.
- Peven, C.M. 1989. Lake Chelan Spawning Ground Surveys. Chelan County Public Utility District. Wenatchee, Wa.
- Peven, C.M. 1990. Lake Chelan Spawning Ground Surveys. Chelan County Public Utility District. Wenatchee, Wa.
- Shepherd, B.G., J.E. Hillaby, and R.J. Hutton. 1986. Studies on Pacific Salmon (*Oncorhynchus* Spp.) In Phase 1 of The Salmonid Enhancement Program. Volume 1: Summary. Canada. Tech. Rep. Fish, Aquat. Sci. 1482: Vii + Pp 1-180 (Two Volumes).
- Stone, J.M. and P.C. Fielder. 2004. Lake Chelan Spawning Ground Surveys. Chelan County PUD. Wenatchee, Wa.
- Washington Department of Fish And Wildlife (WDFW). 2000. WDFW Summer Chum Salmon Conservation Initiative. www.wdfw.wa.gov

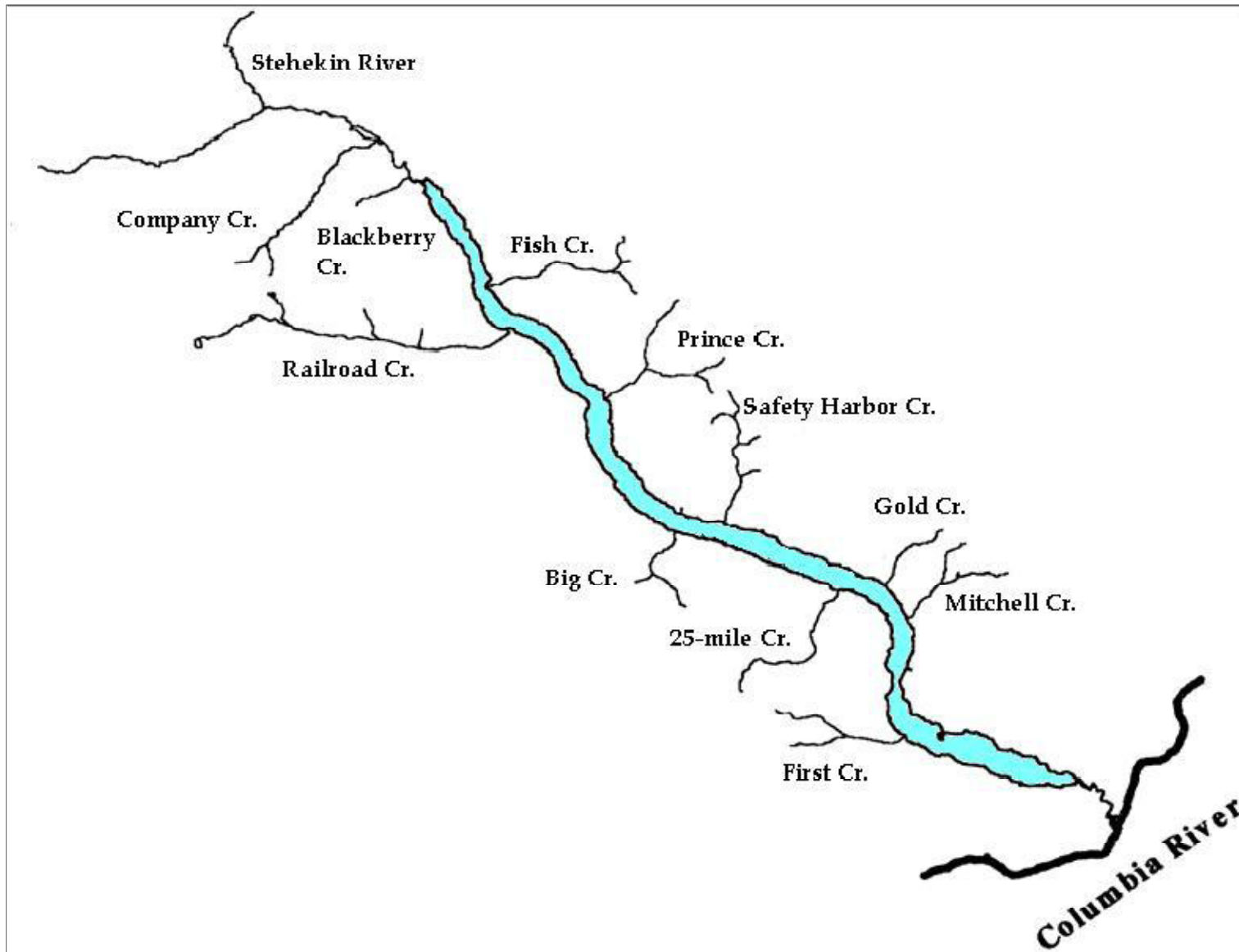


Figure 6-1. Lake Chelan drainage with associated kokanee and Chinook spawning streams.

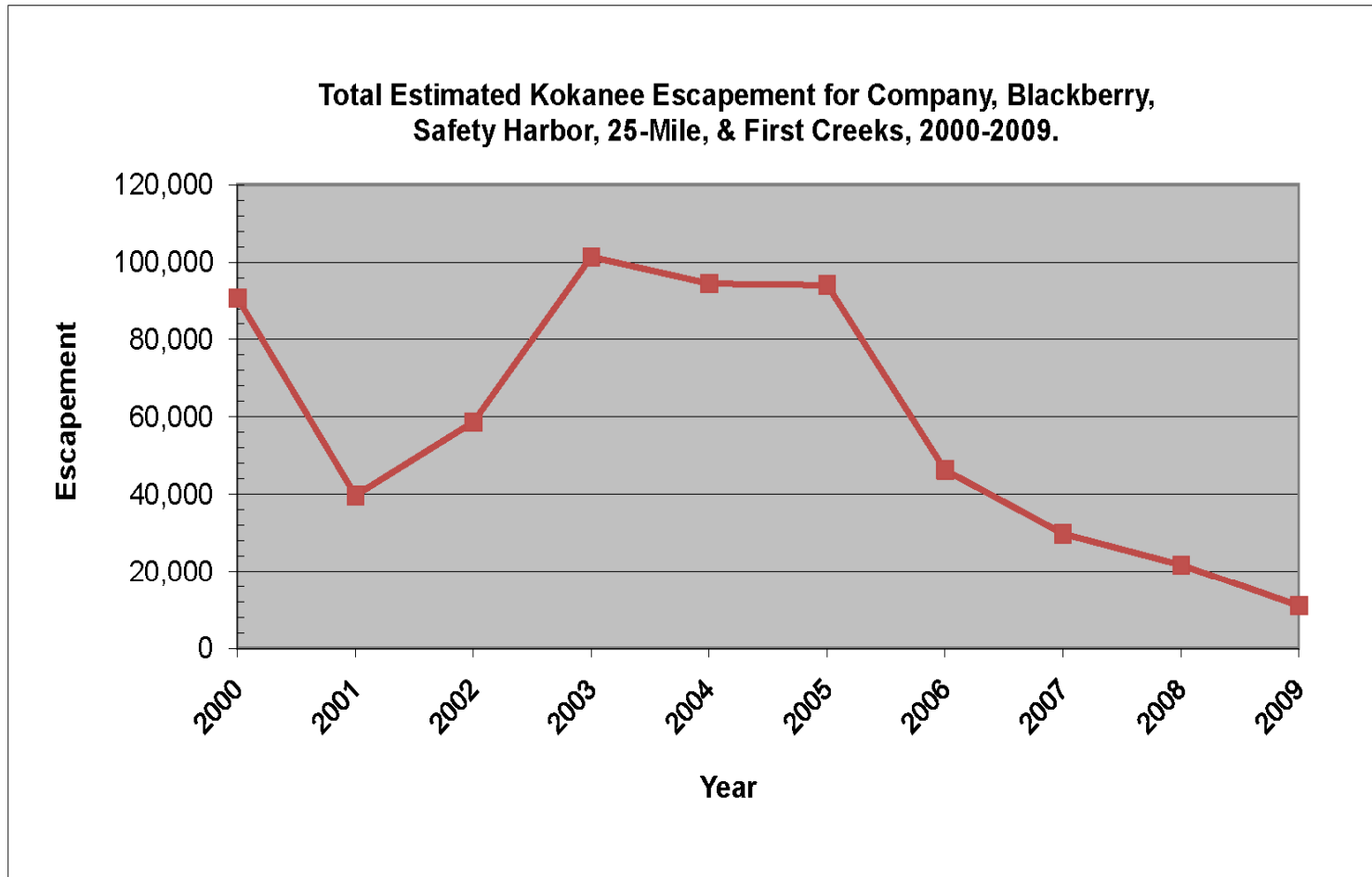


Figure 6-2 Total estimated kokanee escapement for Company, Blackberry, Safety Harbor, 25-Mile, and First Creeks, 2000-2009.

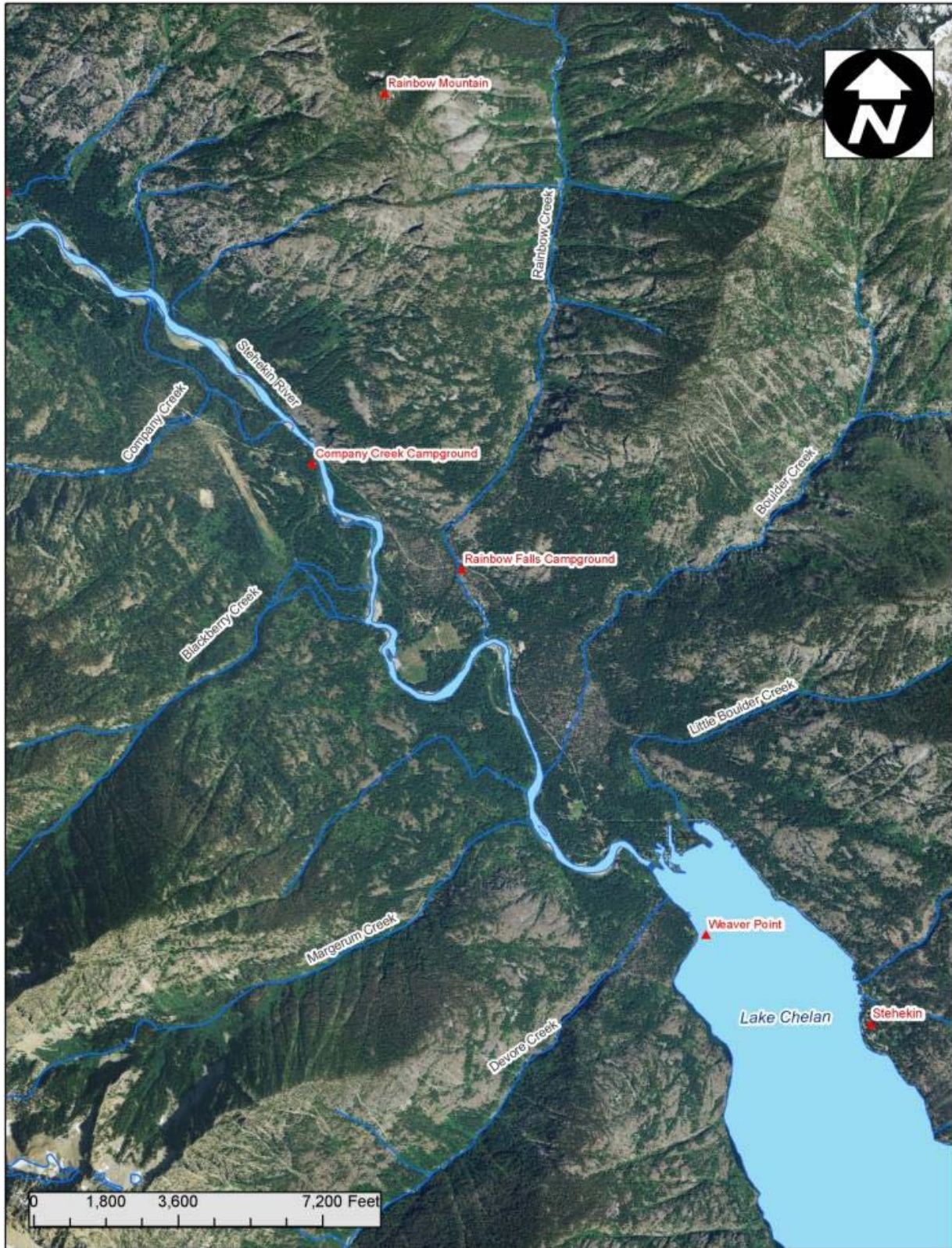


Figure 6-3. Stehekin Area drainage with associated kokanee and Chinook spawning streams.