Lake Chelan Kokanee Spawning Ground Surveys
2012
Final Report

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

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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 first 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 Fish and Wildlife 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.

Study Area and Methods

Most tributaries of Lake Chelan are generally steep and short (Figure 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 462 and 4,203 cubic feet per second, based on data from water years 2002-2011 (*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 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, Grade, Gold and Mitchell creeks (all on the north shore) and 25-Mile and First creeks on the south shore.

In 2012, district personnel conducted surveys between 20 September and 19 October approximately every 7 days (Table 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.

Results and Discussion

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.

Stehekin River Tributaries

Company Creek

In 2012, Company Creek had a peak count of 15,639 kokanee on 20 September (Table 1). The estimated escapement for Company Creek was 15,664 kokanee (Table 4). In 2011, Company Creek had a peak count of 21,176 kokanee and an estimated escapement of 33,341 (Tables 3 & 4).

Blackberry Creek

In 2012, Blackberry Creek had a peak count of 595 kokanee on 20 September (Table 1). The estimated escapement for Blackberry Creek was 769 kokanee (Table 4).
In 2011, Blackberry Creek had a peak count of 5,788 kokanee with an estimated escapement of 9,257 (Tables 3 & 4).

Table 1. Kokanee spawners in Stehekin River tributaries, 2012.

Survey Dates			
Tributaries	20-Sep	27-Sep	4-Oct
Company Creek	15,639	9,639	7,462
Blackberry Creek	595	576	439

Lake Chelan Tributaries

Fish Creek

In 2012, Fish Creek had a peak count of 5 kokanee on 20 September (Table 2). The estimated escapement was 5 kokanee (Table 4). In 2011, Fish Creek had a peak count of 397 kokanee with an estimated escapement was 340 kokanee (Tables 3 & 4).

Prince Creek

In 2012, Prince Creek had a peak count of 144 kokanee on 20 September (Table 2). The estimated escapement was 128 kokanee (Table 4). Prior to 2012, the access for kokanee spawners had been blocked a short distance from the mouth due to habitat improvement structures placed in the stream. The structures were modified with slots cut in the upper portion of the timbers. In 2012 spawners were observed above these structures. In 2011 Prince Creek had a peak count of 91 kokanee with an estimated escapement of 61 (Tables 3 & 4). No kokanee were observed above the structures in 2011. For more information about the habitat improvement structures please refer to Stone and Fielder (2004).

Safety Harbor Creek
In 2012, Safety Harbor Creek had a peak count of 117 kokanee on 20 September (Table 2). The estimated escapement was 116 kokanee (Table 4). In 2011, Safety Harbor Creek had a peak count of 139 kokanee with an estimated escapement of 202 (Tables 3 & 4).

25-Mile Creek
In 2012, 25-Mile Creek had a peak count of 426 kokanee on 26 September (Table 2). The estimated escapement was 353 kokanee (Table 4). As in 2011, kokanee spawners were again observed much further upstream of the culvert that passes under the South Lake Shore Road. Spawners returned to historic areas that had been used in the past. In 2011, 25-Mile Creek had a peak count of 1,115 kokanee with an estimated escapement of 1,991 kokanee (Tables 3 & 4). The larger size of kokanee in 2012 and 2011 allowed spawners to access the culvert in large numbers. No kokanee were observed above the culvert in 2010. In 2010, the returning kokanee spawners were smaller sized than in previous years. The distance in drop from the culvert to the pool below has increased over the last several years. During low water flow years, it may be more difficult for kokanee to enter the culvert and access spawning areas further upstream.

First Creek
In 2012, First Creek had a peak count of 125 kokanee on 26 September (Table 2). The estimated escapement was 181 kokanee (Table 4). In 2011, First Creek had a peak count of 348 with an estimated escapement of 605 (Tables 3 & 4).

Grade Creek
In 2012, no kokanee were observed in Grade Creek. In 2011, Grade Creek had a peak count of 3 kokanee with an estimated escapement of 2 kokanee (Tables 3 & 4). Prior to 2011, no kokanee had been observed in Grade Creek since 2005.

Gold Creek
In 2012, no kokanee were observed in Gold Creek. In 2011, Gold Creek had a peak count of 32 kokanee with an estimated escapement of 16 kokanee (Tables 3 & 4). Prior to 2011, no kokanee had been observed in Gold Creek since 2005.

Mitchell Creek
In 2012, no kokanee were observed in Mitchell Creek. In 2011, Mitchell Creek had a peak count of 18 kokanee with an estimated escapement of 15 kokanee (Tables 3 & 4). Prior to 2011, no kokanee had been observed in Mitchell Creek since 2006.

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Table 2. Kokanee spawners in Lake Chelan tributaries by date, 2012.

Survey Dates							
Tributaries	20-Sep	26-Sep	27-Sep	04-Oct	05-Oct	12-Oct	19-Oct
Fish Creek	5		3	2			
Prince Creek	144		74	50			
Safety Harbor	117		99	52			
25-Mile Creek		426			184	75	12
First Creek	no	125			107	99	40
Grade Creek	surveys			0			
Gold Creek				0			
Mitchell Creek				0			

Table 3. Peak kokanee spawner counts in the Lake Chelan drainage, 2002-2012

Spawning Area	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Company Creek	16,388	26,320	35,445	26,951	14,649	7,149	6,619	5,473	29,991	21,176	15,639
Blackberry Creek	13,046	20,596	17,100	13,158	6,437	4,841	1,605	1,291	4,627	5,788	595
Safety Harbor	101		2	20	119	5	21	74	15	139	117
25-Mile Creek	465	112	17	727	284	12	320	110	63	1,115	426
First Creek	375	0	34	462	44	0	144	80	69	348	125
Mitchell Creek	12	0	0	0	10	0	0	no	0	18	0
Gold Creek	1	0	0	14	0	0	0	surveys	0	3	0
Grade Creek	65	0	0	13	0	0	0		0	32	0
Prince Creek	269	73	184	246	72	57	2	14	11	91	144
Fish Creek	359	49	261	351	0	220	10	0	393	397	5
Total	30,375	47,028	52,598	41,318	21,533	12,007	8,709	7,028	34,765	29,107	17,051

Table 4. Estimated kokanee escapement in the Lake Chelan drainage, 2002-2012.

Spawning Area	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Company Creek	33,349	54,376	58,231	63,256	32,927	19,182	16,246	8,185	52,824	33,341	15,664
Blackberry Creek	23,962	46,797	36,125	29,177	12,815	10,523	4,622	2,440	9,325	9,257	769
Safety Harbor	101		1	18	149	4	20	84	26	202	116
25-Mile Creek	654	136	15	1,022	319	22	519	143	86	1,991	353
First Creek	557	0	20	566	30	0	200	56	100	605	181
Mitchell Creek	14	0	0	0	7	0	0	no	0	15	0
Gold Creek	1	0	0	7	0	0	0	surveys	0	16	0
Grade Creek	73	0	0	7	0	0	0		0	2	0
Prince Creek	269	73	235	245	93	45	2	12	15	61	128
Fish Creek	361	49	390	482	0	172	8	0	551	340	5
Total	59,341	101,431	95,017	94,780	46,340	29,949	21,617	10,920	62,927	45,830	17,216

Chinook Spawners

Company Creek

In 2012, Company Creek had a peak count of 5 chinook spawners with an estimated escapement of 5. In 2011, Company Creek had a peak count of 28 chinook spawners with an estimated escapement of 32 (Table 5).

Blackberry Creek

In 2012, no chinook spawners were observed in Blackberry Creek. In 2011, Blackberry Creek had a peak count of 4 chinook spawners with an estimated escapement of 4 (Table 5).

Table 5. Peak chinook spawner counts and estimated escapement in Company Creek and Blackberry Creek, 2002-2012.

Peak Counts	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Company Creek	3	2	2	18	0	2	7	33	27	28	5
Blackberry Creek	3	14	18	17	3	3	5	5	2	4	0

Escapement	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Company Creek	5	3	3	19	0	3	9	49	28	32	5
Blackberry Creek	5	20	41	17	5	5	8	10	3	4	0

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).

As provided in Article 6(d) (1), the estimated cost to Chelan PUD of these activities is $30,000 per year (in 2003 dollars).

Article 6(d) (2) 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 x $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 6).

Table 6. Numbers of kokanee stocked into Lake Chelan from 1994 to 2012.

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
2010	83,070	May 6	Yacht Club	LC
2011	0	n/a	n/a	n/a
2012	0	n/a	n/a	n/a
Total	**6,363,149**			

Key for fish stock:

OR = Oregon (unspecified)

LW = Lake Watcom (Washington)
LC = Lake Chelan (Washington)

Summary and Conclusions

Company, Blackberry, Safety Harbor, 25-Mile, and First creeks have been surveyed consistently since 1984. The estimated escapement for these aforementioned streams in 2009 was 10,908 kokanee. In 2010, the escapement increased substantially to 62,361. In 2011, the escapement dropped to 45,396. In 2012, escapement was considerably lower at 17,216. 2011 also saw the highest escapement since 2005 for 25-Mile and First creeks with a combined escapement of 2,596. In 2012 both streams recorded a much lower escapement of 534 (Table 4). While kokanee escapement numbers were considerable lower in 2012, the majority of the spawners were some of the largest ever observed since the District has conducted surveys. The majority of kokanee spawners are either 3 or 4 year old fish (2+ and 3+ fish) (Peven 1990).

Surveys conducted by District staff were limited this year due to time constraints. Surveys were conducted one week before, during, and one week after the historic date of peak kokanee spawner counts. In future years, if the same situation arises, other entities may be able to assist in spawner surveys.

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 may also adversely affect a kokanee population.

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: Barry Keesee, Thad Mosey, Lance Keller and Jeff Osborn.

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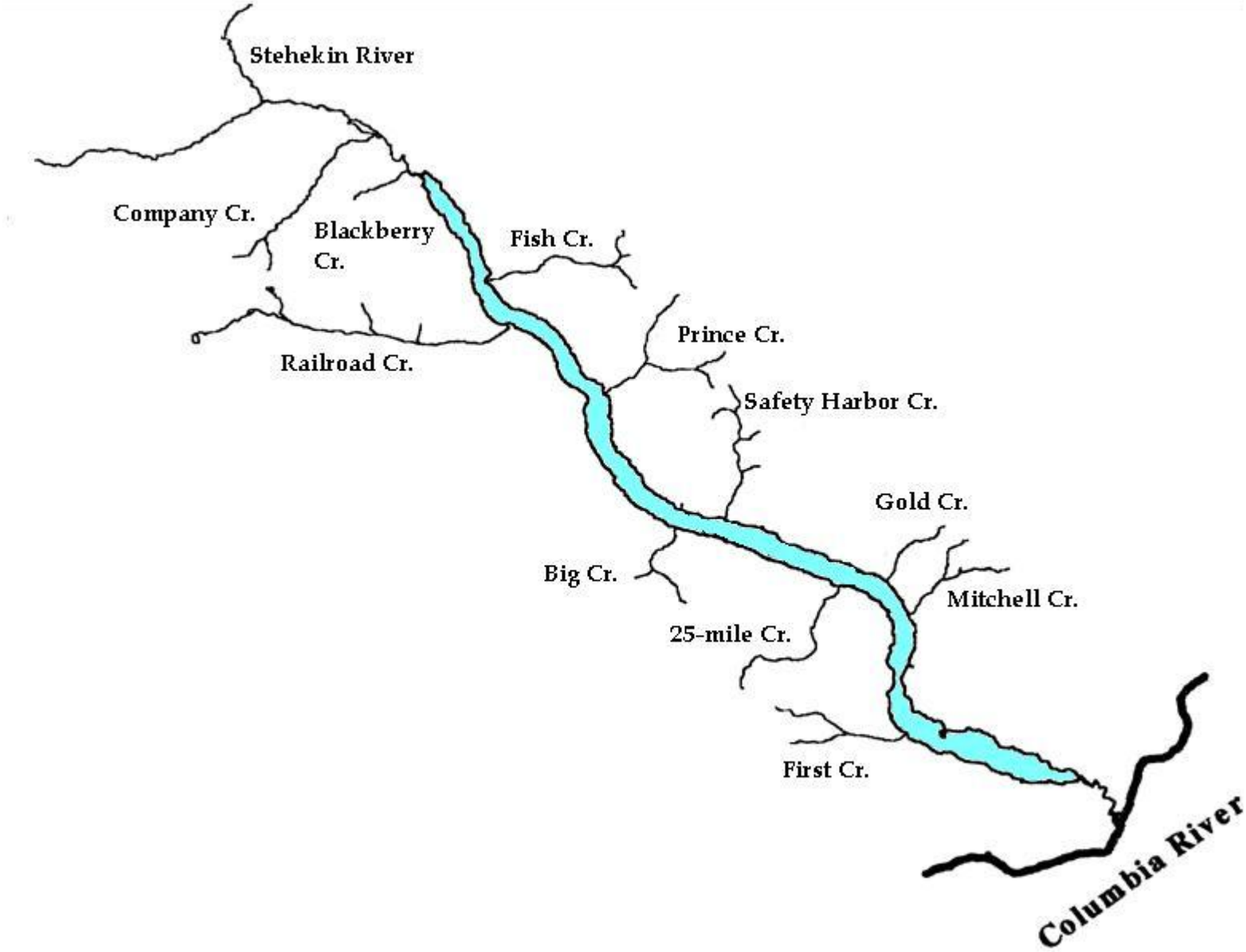

Figure 1. Lake Chelan drainage with associated kokanee and chinook spawning streams.

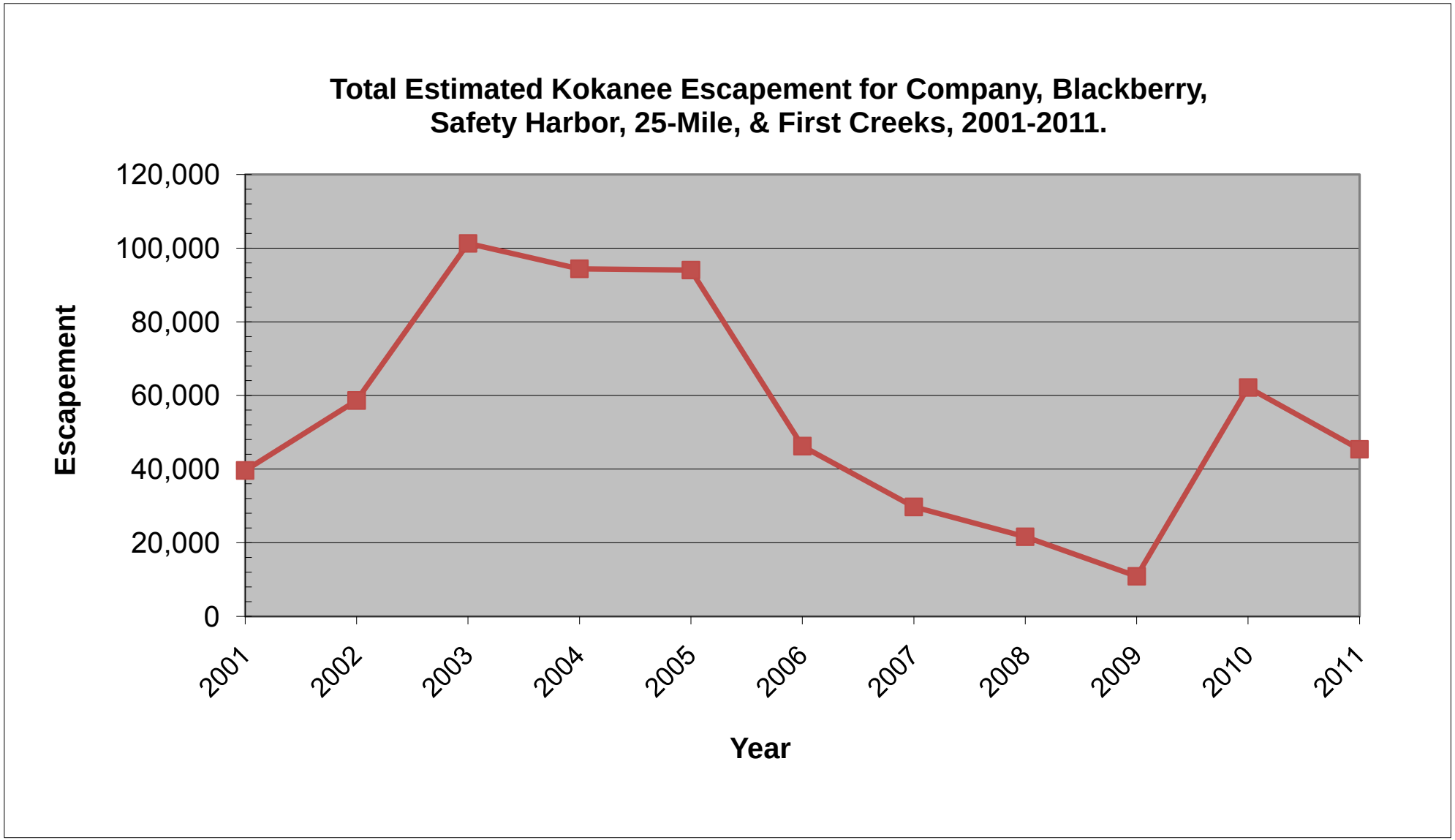

Figure 2. Total Estimated Kokanee Escapement for Company, Blackberry, Safety Harbor, 25-Mile, and First Creeks, 2001-2011.

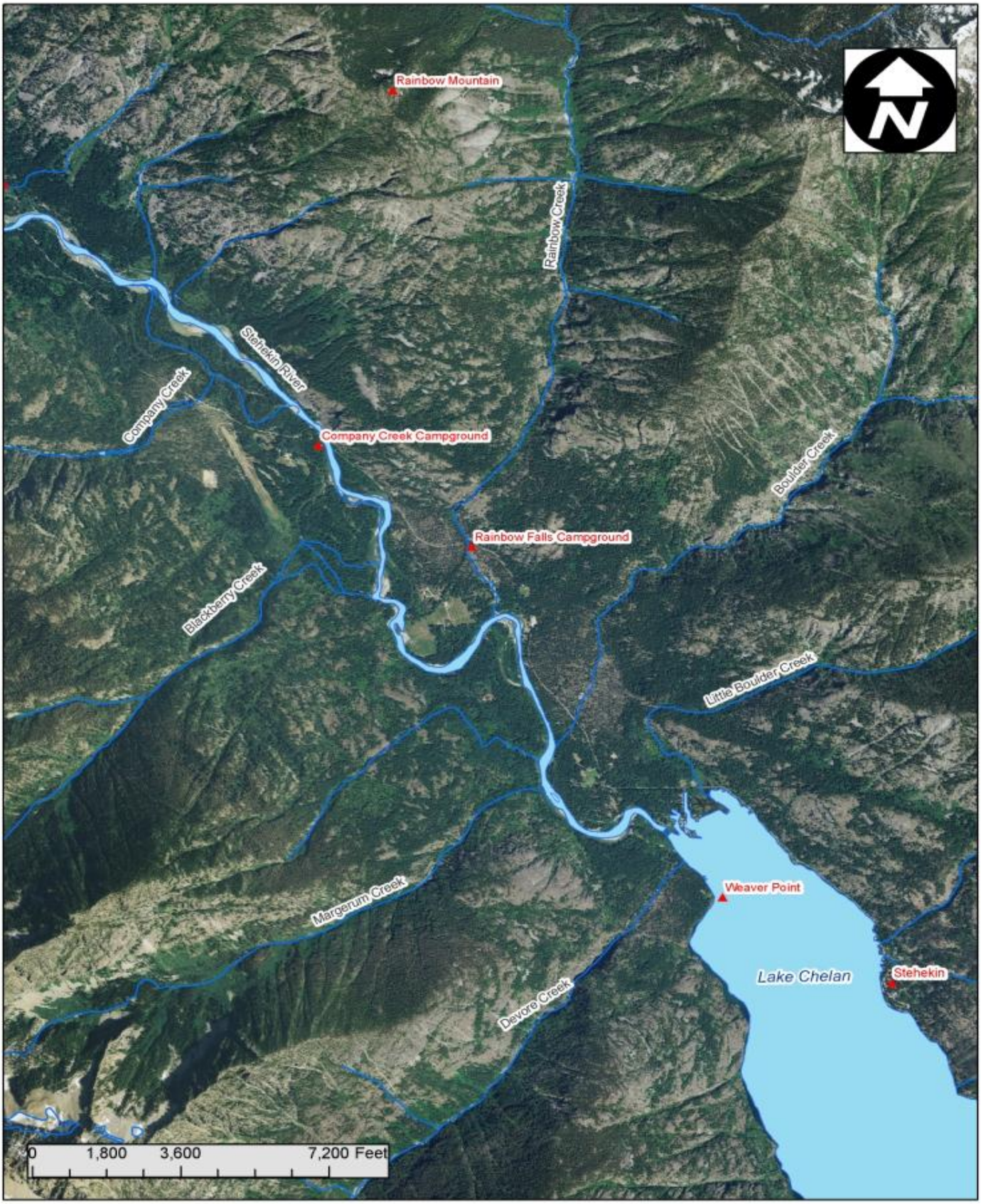

Figure 3. Stehekin Area drainage with associated kokanee and chinook spawning streams.