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The Natural Resources Agency
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## Summary Report: 1994 - 2010


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RBFO Technical Report No. 04-2012

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Cover Photo: *Image of a smolting rainbow trout captured in the Mill Creek rotary screw trap April, 2005.*

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This was a multi-year monitoring effort undertaken by the California Department of Fish and Game. Funding for this effort was obtained from the Sport Fish Restoration Act Grant F-51 Project 57 and several other sources. Cooperative assistance provided by the Pacific States Marine Fisheries Commission 2004-2010.

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# Introduction

The California Department of Fish and Game's Upper Sacramento River Salmon and Steelhead Assessment project located in Red Bluff, California monitored juvenile salmonids in Deer and Mill Creeks, Tehama County, California using rotary screw traps from 1994 through 2010. Deer and Mill Creeks are east side tributaries of the Sacramento River. Both creeks support runs of spring-run Chinook (*Oncorhynchus tshawytscha*) salmon. Spring-run Chinook from the Central Valley are listed as threatened under both the federal and state endangered species acts (ESA and CESA). Deer and Mill Creek also support resident and anadromous forms of *Oncorhynchus mykiss* (rainbow trout). The anadromous form of *O. mykiss*, (steelhead) belong to the Central Valley Distinct Population Segment which is listed as threatened under the federal ESA. In addition, both creeks support populations of fall-run Chinook salmon.

Data collected over the period 1994-2010 on Deer Creek, and 1996–2010 on Mill Creek presents a comprehensive record of juvenile spring-run Chinook and steelhead life history information, including overall trends in juvenile spring-run Chinook and steelhead abundance, and the out-migration timing of those juveniles in relation to environmental factors.

Funding for the program was obtained initially through the Sport Fish Restoration Act. In the later years of the study, funding for personnel to operate the screw traps was provided by a variety of sources and administered through the Pacific States Marine Fisheries Commission.

Adult spring-run Chinook migrate into Deer and Mill Creeks between late February and early July, with peak migration occurring in April and May (Johnson et al 2008, Killam 2008). Upon reaching their chosen tributary, spring-run Chinook quickly pass through the Valley floor to gain access to headwater reaches where water temperatures are cool enough to allow the adult fish to over-summer until spawning commences in late August through October. Adult steelhead ascend Deer and Mill Creeks October through April. Peak migration periods are characterized by fall entry (October through early December) and winter entry (late December through February). A smaller, less organized migration occurs in the spring, with fish trickling in through April and into early May during high water years (DFG Red Bluff unpublished data). Adult steelhead spawning has been observed late winter through spring in Deer and Mill Creeks (DFG Red Bluff unpublished data). Fall-run Chinook salmon enter in October through early December most years, with peak migration typically occurring with the onset of the first fall storm. Fall-run Chinook typically spawn within the lower 15 miles of Deer and Mill Creeks; soon after gaining entry (Harvey-Arrison 2007).

The Deer Creek rotary screw trap was operated beginning in the fall of 1994. The Mill Creek rotary screw trap was operated beginning January 1996. Both traps were operated through the spring of 2010. The traps sampled both spring and fall-run Chinook and *O. mykiss* juveniles as they out-migrated to the Sacramento River. Other non-salmonid species regularly occurring in the catch included: juvenile Pacific lamprey

(*Lampetra tridenta*), riffle sculpin (*Cottus gulosus),* hardhead (*Mylopharodon conocephalus),* Sacramento sucker (*Catostomus occidentalis),* Sacramento pikeminnow (*Ptychocheilus grandis),* speckled dace (*Rhinichthys osculus*), and California roach (*Hesperoleucus symmetricus).* A summary of non-salmonid catch data is not included in this report. Initially, rotary screw traps on Deer and Mill Creeks were operated to collect juvenile spring-run Chinook life history information. Over time, Mill and Deer Creek rotary screw trap data became incorporated in the Interagency Ecological Program's (IEP) spring-run protection process (Colleen Harvey-Arrison, personal communication). Bi-weekly Deer and Mill Creek rotary screw trap data summaries provided the IEP a real-time dataset signaling the out-migration of spring-run juveniles from Deer and Mill creeks and an early warning of their subsequent presence in the Sacramento-San Joaquin Delta system.

The traps were operated daily from October through May, and in most years, into the month of June. The traps were deployed in October when daily average water temperatures recorded at USGS Geological Gauging Stations (located above the rotary screw trap sites at river kilometer 9.3 on Mill Creek and river kilometer 20 on Deer Creek) dropped below 16$^{o}$C for a one-week period. The traps were removed at the end of the season when daily average water temperatures exceeded 16$^{o}$C for a one week period (Colleen Harvey-Arrison personal communication). The traps were not operated when flows exceeded 1,000 cfs, when the traps were damaged and removed for repairs, or during periods of limited staff availability.

Survey methods did not allow calculation of absolute abundance estimates of juvenile spring-run Chinook due to several factors. Consequently, the rotary screw traps were operated solely for the purpose of collecting life history information and providing real–time detection of spring run Chinook juveniles (Colleen Harvey-Arrison personal communication). No trap efficiency tests were possible due to wide flow variations and the limited availability of test fish. Because of equipment and personnel safety concerns, the traps were not operated when flows exceeded or were predicted to exceed 1,000 cfs.

Spring-run Chinook salmon in Deer and Mill spawn over a range of 366 to 1,586 m (DFG Red Bluff unpublished data). This wide variation in elevation has significant affect on egg incubation timing in the watershed. As a result, depending upon the elevation at which an adult female spawned, spring-run Chinook fry from a given brood year may emerge over a six month period, from November through the following May. Given the available option of ocean or stream-type life history expression, data collected from the Deer and Mill creek rotary screw traps show that each year class may emigrate over a 17-month period. While spring-run juveniles emigrate as both yearlings and fry, ratios are unknown and may vary annually between creeks, or between water years (dry vs. wet). Additionally, since the Deer and Mill Creek rotary screw traps were located below known fall-run Chinook spawning habitat, young-of-the-year fry from both races were present in unknown ratios in the rotary screw trap samples.

Electro-fishing studies were conducted throughout the year within spring-run Chinook spawning habitat during the period the Deer and Mill Creek rotary screw traps were in operation. Spring and fall-run stocks of Chinook are spatially separated in Deer and Mill Creeks. While the ratios of young-of-the-year fall and spring-run Chinook present in the rotary screw trap samples were unknown, these investigations allowed biologists to corroborate length-at-date records of co-mingled juvenile races obtained from the rotary screw trap samples with known spring-run samples from the upper watershed. These data are presented in this report.

In the Central Valley, juvenile Chinook salmon sampled in various locations throughout the Sacramento-San Joaquin River systems are classified by race using length-at-date charts based upon projected annual growth (Fisher and Greene 1992). Based upon the data collected at the rotary screw traps between 1994 and 2010, these charts incorrectly identify Deer and Mill Creek yearling Chinook as late-fall- and winter-run, and a significant portion of young-of-the-year spring-run as fall and late fall-run Chinook. Length-at-date growth charts specific to tributary spring-run Chinook in the Central Valley have not been developed. Due to the influence of spawning elevation on egg incubation and emergence timing, and the existence of variable juvenile life history options, spring-run Chinook captured in the Deer and Mill Creek rotary screw traps did not display a discernable logarithmic growth pattern. Therefore, a length-at-date growth chart for Deer and Mill juvenile Chinook would be speculative at best. A range of length frequencies that juvenile spring-run emigrating from Deer and Mill Creek may fall within at a given date is the best characterization of these populations.

## Study Area

Deer Creek and Mill Creek, Tehama County, California, are tributaries of the Sacramento River. Deer Creek joins the Sacramento River at river kilometer 352 near the town of Vina at an elevation of 52 m. Mill Creek meets the Sacramento River at river kilometer 368.5 at 64 m elevation near the town of Los Molinos. Both drainages are part of the lower Cascade mountain range, with geomorphologies largely influenced by the volcanic history of the area (Sato et al 1988). Mill Creek drains an area of 339 square kilometers, producing an annual runoff of 268,775,693 cubic meters. Deer Creek drains an area of 539 square kilometers, producing an annual runoff of 285,304,350 cubic meters. Deer Creek originates as snowmelt on Butt Mountain. The watershed is then fed by numerous tributaries and springs as it winds in a southwest direction for 88 kilometers through a steep-sided canyon before entering the Valley floor and ultimately the Sacramento River near Vina (Sato et al 1988). In contrast, with its origins in Lassen Volcanic National Park, Mill Creek is more influenced by snow-melt from Lassen Peak (Sato et al 1988). While Mill Creek receives additional water from tributaries and springs, more of the watershed receives precipitation in the form of snow versus rain. Deer Creek therefore often sees higher peak flows in the winter, while Mill Creek experiences higher flows in the spring from melting snow-pack. Both upper drainages are highly inaccessible, flowing through rugged canyons for much of their length.

The inaccessibility of the drainages has prevented major alteration of the surrounding land, leaving the upper watersheds in a nearly pristine condition. In the Deer Creek drainage, 53% of the land is owned by the Lassen National Forest, 1% by the Bureau of Land Management, and 46% by private individuals and organizations. The major uses of the surrounding land are timber and cattle grazing. In the Mill Creek drainage, 49% is owned and managed by the Lassen National Forest, with the headwaters originating within Lassen Volcanic National Park. Forty-one percent is privately owned, with the remainder of surrounding lands held within the Tehama Wildlife Area/ Ishi Wilderness managed by the Department of Fish and Game (Sato et al 1988). Upon entering the Valley floor, Deer Creek is bordered by private holdings, with typically large parcels devoted to grazing or orchard land. Mill Creek is bordered by large land holdings initially, then is partitioned into smaller properties near the town of Los Molinos.

Deer Creek has two diversion dams on its lower reaches, the Deer Creek Irrigation Diversion (DCID) at river kilometer 19.1 and the Stanford Vina Irrigation Company (SVRIC) at river kilometer 8.0 (Figure 2). Mill Creek also has two diversion dams on its lower reaches, Upper Dam at river kilometer 8.6 and Ward Dam at river kilometer 4.3 (Figure 1). A third diversion structure on lower Mill Creek, Clough Dam, washed away in 1997 during a flood. A siphon beneath the stream bed now carries diversion water to the Clough Service Area. Water rights totaling more than the average mean summer flow of both drainages are owned by the Deer Creek Irrigation District and Stanford Vina Irrigation District on Deer Creek, and the Los Molinos Mutual Water Company on Mill Creek.

The Mill Creek rotary screw trap was located immediately below Upper Dam at river kilometer 8.6 at an elevation of 119 m. The trap fished in the same location 1996-2010. During the study period, temperature monitoring and electro-fishing surveys were conducted in the upper Mill Creek watershed, including the campground at Black Rock located off of Ponderosa Way at river kilometer 47.9 and 645 m elevation, and Hole in the Ground Campground near the town of Mineral at river kilometer 73 and 1,288 m elevation. Additional temperature monitoring locations included the confluence of Little Mill and Mill Creeks, river kilometer 26 and 282 m elevation, and near the Highway 36 bridge crossing, at river kilometer 83 and 1,471 m elevation. In general, the confluence of Little Mill Creek and Mill Creek marks the downstream limit for adult spring-run Chinook holding and spawning on Mill Creek. The Highway 36 bridge crossing marks a generalized upper limit for spring-run spawning, although spring-run have been observed spawning above this point at an elevation of 1,585 m (Colleen Harvey-Arrison personal communication). Figure 1 is a Google Earth image of lower Mill Creek showing the location of the confluence of Mill Creek and the Sacramento River, Ward Dam, Upper Dam, the USGS Gauging Station, and the Mill Creek rotary screw trap site.

The Deer Creek rotary screw trap was located at river kilometer 18 at an elevation of 144 m. The trap fished in the same location for the years 1994-2010. During the study period, temperature monitoring and electro-fishing surveys were conducted in the upper Deer Creek watershed, including near the bridge crossing at Ponderosa Way at river kilometer 48 at 523 m elevation, near the A-Line bridge crossing at river kilometer 67 and 890 m elevation, and near the Highway 32 bridge crossing at river kilometer 71 and 979 m elevation. Upper Falls, located at river kilometer 77 and 1,110 m elevation is the upstream limit of anadromy on Deer Creek. Based on summer temperatures, an area known as “Dillon Cove” located at river kilometer 37 and 358 m elevation marks a generalized downstream limit for adult spring-run Chinook holding and spawning on Deer Creek (Colleen Harvey-Arrison personal communication). Figure 2 is a Google Earth image of lower Deer Creek showing the location of the confluence of Deer Creek and the Sacramento River, Stanford-Vina Dam, Upper Dam, the USGS Gauging Station, and the Deer Creek rotary screw trap site.

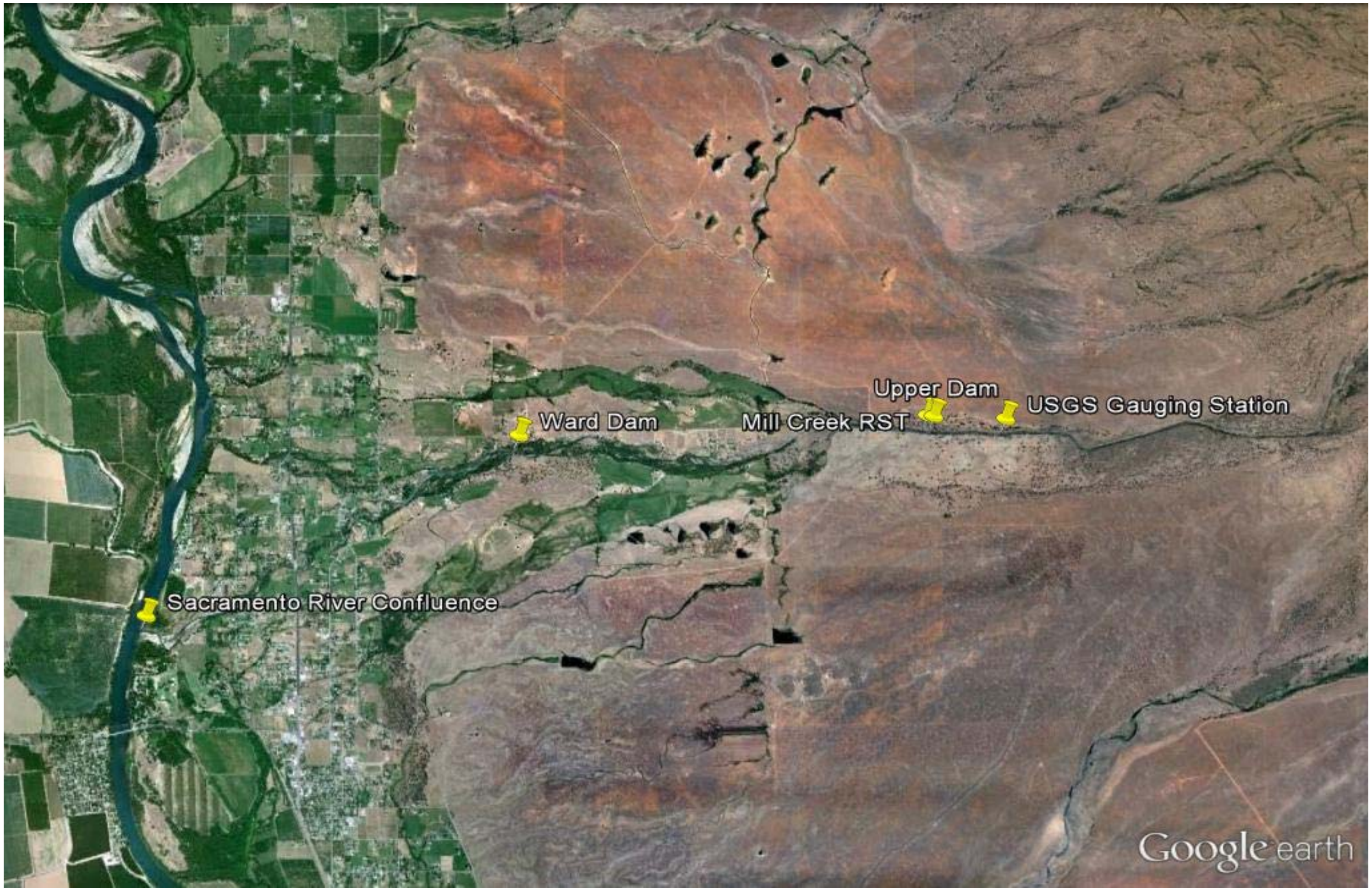


**Figure 1**.— Google Earth image of lower Mill Creek showing the location of the confluence of Mill Creek and the Sacramento River, Ward Dam, Upper Dam, the USGS Gauging Station, and the Mill Creek rotary screw trap site.


**Figure 2**.—Google Earth image of lower Deer Creek showing the location of the confluence of Deer Creek and the Sacramento River, Stanford-Vina Dam, Upper Dam, the USGS Gauging Station, and the Deer Creek rotary screw trap site

# Methods

**Sampling gear**— Sampling was conducted in Deer and Mill Creeks using 1.5 m diameter cone rotary screw traps (E.G. Solutions Corvallis, Oregon). The traps were standard in design and were not modified in any way during the study period. The traps were positioned in the stream using an over-head "high-line" stretched above the stream channel and secured using buried "dead-men" on each bank. The traps were then connected to this high line by rope or steel cable. The traps could be positioned longitudinally and laterally in the stream-channel from the fixed high line. The traps were accessed by personnel from the shore. The traps were re-positioned as needed at each site to maximize fishing efficiency and maintain personal safety based on stream discharge. The traps were continually positioned so that river depth, current speed, and concentration of flow were oriented into the cone during low-flow conditions. The reverse scenario occurred under high-flow conditions and the traps were positioned near the stream margin where velocities were lower, and the water shallower to enable personnel to access the trap.

**Sampling regimes**— In general, the rotary traps were operated seven days a week, sampling continuously throughout 24-hour periods. The traps were checked daily. Exceptions to this regime occurred during high flow events, low water conditions in the fall where water velocities were insufficient to turn the cone (such conditions plagued Deer Creek more than Mill Creek), and periods when personnel were not available to check the traps. The greatest interruption of sampling occurred during episodic high flow events when stream discharge exceeded or was expected to exceed 1,000 cfs. Under these conditions the traps were not fished to in order to prevent equipment from being damaged, minimize fish stress and mortality, and minimize risk of injury to personnel.

**Data collection**— Two-member crews accessed the traps by wading from the stream bank or by pulling the trap to the bank with a lead rope. Upon arrival at the trap site, the condition of the traps was evaluated and environmental conditions were recorded. Data collected at each trap visitation included: length of time trap sampled, trap condition, air temperature, water temperature, time for ten revolutions of the cone per second, turbidity, weather conditions, and stream discharge. In addition, a comments section on the data sheet provided a space to record data or observations related to trap operations but not regularly recorded on the datasheet. The trap was then boarded, and the contents of the live-box were sampled by scooping debris and fish out with dip-nets until the box was emptied. After being separated from the debris, fish samples were held in buckets of fresh water. All fish captured were identified to species. The first 50 Chinook and first 50 *O. mykiss* in the sample were anesthetized and measured to the nearest millimeter (mm) fork-length. Chinook salmon and *O. mykiss* with fork-lengths greater than or equal to 50 mm were weighed to the nearest 0.01 gram. After November 1998, life stage ratings of juvenile *O. mykiss* were assigned based on external morphology and pigmentation patterns according to the IEP Steelhead Project Work Team's "Juvenile Steelhead Life Stage Rating Protocol" (IEP Steelhead Project Work Team 1998, Colleen Harvey-Arrison personal communication.). This protocol classified juvenile *O. mykiss* to the following life stages: fry (stage 2), parr (stage 3), silvery parr (stage 4), or smolt (stage 5). After being measured on a wet measuring board with wet hands, the fish were placed in 5-gallon plastic buckets filled with fresh creek water to allow for recovery from the anesthetic effects before being released onsite. Water in the tubs was replaced as necessary with fresh creek water to maintain adequate temperature and oxygen levels. When the number of Chinook or *O. mykiss* in the sample exceeded 50 fish, the remainder were counted with out being anesthetized or measured, allowing expedited return to the stream. Other fish species captured were identified and the first 20 samples of each species were anesthetized and measured. Samples greater than 20 of a given species were enumerated without being measured. A copy of the datasheet used during all years of the rotary screw trap operations is provided in Appendix A.

# Results

### Rotary Screw Trap Catch Summary

**Mill Creek**— The rotary screw trap was operated for a total of **2,339** days between October 1996 and June 2010. During this time period a total of **63,529** juvenile Chinook salmon were sampled. In this total, **4,164** individuals were classified as "yearlings" (stream type life history) and **59,365** individuals were classified as "young-of-the-year" (ocean type life history). In addition, a total of **2,829** steelhead/rainbow trout (*O. mykiss*) were sampled.

Yearling Chinook out-migration occurred October through June, with peak out-migration occurring October-December. November was the peak month for yearling out-migration during the study period, representing 37% of the October through June total.

Young-of-the-year Chinook out-migration occurred November through June, with peak out-migration occurring in February and March. March was the peak month for young of the year out-migration, representing 38% of the November through June young-of-the-year out-migration period.

*O. mykiss* out-migration occurred October through June. The data illustrates peak out-migration in April and May, with a lesser, secondary peak in November, suggesting a bi-modal out-migration distribution. Table 1 presents a total catch summary from the Mill Creek rotary screw trap during the period 1996-2010, including days fished per month, yearling and young of the year juvenile Chinook totals, and juvenile *O. mykiss* totals. Additional summary tables of Mill Creek rotary screw trap catches, organized by month and year, are located in Appendix B.

**Table 1.**— Mill Creek rotary screw trap catch summary for years 1996-2010.

| Month | Days Fished Total | Yearling Chinook Total | YOY Chinook Total | O. mykiss Total |
|---|---|---|---|---|
| October | 208 | 946 | 0 | 149 |
| November | 382 | 1,533 | 2 | 417 |
| December | 316 | 927 | 240 | 127 |
| January | 281 | 268 | 6,837 | 59 |
| February | 219 | 127 | 15,161 | 122 |
| March | 233 | 171 | 22,460 | 302 |
| April | 256 | 156 | 5,797 | 796 |
| May | 274 | 32 | 8,328 | 632 |
| June | 170 | 4 | 540 | 225 |
| **Totals:** | **2339** | **4164** | **59365** | **2829** |

**Deer Creek**— The rotary screw trap was fished a total of **2,207** days between October 1994 and June 2010. During this time period a total of **89,526** juvenile Chinook salmon were sampled. In this total, **4,230** individuals were classified as "yearlings" (stream type life history) and **85,326** individuals were classified as "young-of-the-year" (ocean type life history). In addition, a total of **1,169** steelhead/rainbow trout (*O. mykiss*) were sampled.

Yearling Chinook out-migration occurred October through June, with peak out-migration occurring October-December. November was the peak month for yearling out-migration during the study period, representing 45% of the October through June total.

Young-of-the-year Chinook out-migration occurred November through June, with peak out-migration occurring in February and March. March was the peak month for young-of-the-year out-migration, representing 37% of the November through June total.

*O. mykiss* out-migration occurred October through June. The data shows a somewhat consistent out-migration period November through May, with lower catches in the month of February proving an exception. November represents the peak month, with 28% of the juvenile *O. mykiss* sampled. Table 2 presents a total catch summary from the Deer Creek rotary screw trap during the period 1994-2010, including days fished per month, yearling and young-of-the-year juvenile Chinook totals, and juvenile *O. mykiss* totals. Additional summary tables of Deer Creek rotary screw trap catches, organized by month and year, are located in Appendix C.

**Table 2.**—Deer Creek rotary screw trap catch summary for years 1994-2010.

| Month | Days Fished Total | Yearling Chinook Total | YOY Chinook Total | O. mykiss Total |
|---|---|---|---|---|
| October | 182 | 297 | 0 | 44 |
| November | 347 | 1,892 | 3 | 323 |
| December | 345 | 1249 | 675 | 212 |
| January | 284 | 343 | 13,478 | 145 |
| February | 183 | 111 | 17,486 | 30 |
| March | 251 | 202 | 31,668 | 132 |
| April | 276 | 126 | 13,543 | 151 |
| May | 241 | 10 | 8,333 | 113 |
| June | 98 | 0 | 140 | 19 |
| **Totals:** | **2207** | **4230** | **85326** | **1169** |

## Out-Migration Timing

**Yearling juvenile Chinook**—The "yearling" spring-run Chinook juvenile life history component represents individuals that have spent at least one summer in freshwater, typically in the upper watershed, before exiting the tributary fall through spring of the following year. These individuals are composed of a range of ages, based on when they emerged from the gravel, and time spent rearing in the watershed before undergoing smoltification. The Deer and Mill Creek rotary screw trap data set shows that these juveniles begin emigration from the watershed and are detected at the Valley floor with the onset of the first fall rains. The data shows that yearlings out-migrate in greatest numbers October through December. Emigration of yearlings continues at lesser rates through the winter and spring. Graphic depictions of catch and flow illustrate the relationship between fall freshets and appearance of yearlings at the screw trap. This data is presented in the Discussion section of this report.

Table 3 presents the date at which the first yearling Chinook were detected at the Deer and Mill Creek rotary screw traps in the fall during the study period. Detection of the first yearling Chinook varied considerably between trapping locations and between years during the study period. This is best explained by annual variation in the onset of the first fall rain event and variation in low flow trapping efficiency between the two trapping sites. Additionally, there was some annual variation in the timing of start date for the rotary screw trap season. This variation was influenced by water temperatures, low flows preventing effective trap operation, the timing of the on-set of the first fall storms, and availability of staff to operate the traps. The traps were not operated in fall of 2010.

**Table 3**.—Date at which the first yearling Chinook was detected at the Mill and Deer Creek rotary screw traps from 1994 through 2009.

| Year | Deer Creek | Mill Creek |
|---|---|---|
| 1994 | 3-Oct | n/a |
| 1995 | 29-Nov | n/a |
| 1996 | 19-Nov | 3-Nov |
| 1997 | n/a | 27-Nov |
| 1998 | 9-Nov | 2-Nov |
| 1999 | 16-Oct | 10-Oct |
| 2000 | 11-Oct | 11-Oct |
| 2001 | 31-Oct | 10-Oct |
| 2002 | 8-Nov | 8-Nov |
| 2003 | 13-Nov | 29-Oct |
| 2004 | 21-Oct | 20-Oct |
| 2005 | 9-Nov | 25-Oct |
| 2006 | 16-Dec | 24-Oct |
| 2007 | 14-Dec | 16-Oct |
| 2008 | 27-Feb | 24-Oct |
| 2009 | 27-Nov | 15-Oct |

Trends in out-migration timing for yearling juvenile Chinook were similar for Deer and Mill Creeks during the study period. Exceptions included greater catches of yearling Chinook on Mill Creek compared to Deer Creek in the month of October. This is likely explained by the stream characteristics of the individual trapping sites.

The Mill Creek trap site was a much better low flow trapping location due to the effect Upper Dam had on available stream flows. Stream flows in the fall are typically at base-line levels on Deer and Mill Creeks, with small freshets producing minor increases totaling 100-300 cfs. A fish ladder located on the Upper Dam concentrated the greatest volume of stream discharge into a confined area. Under low flow conditions, the Mill Creek rotary screw trap could be positioned at the out flow of the Upper Dam fish ladder, where the greatest volume of available water was directed squarely into the cone, increasing revolution speed and trap efficiency. In contrast, stream discharge was more evenly distributed across the creek channel at the Deer Creek trap site, resulting in lower stream velocities and subsequent lowered cone revolutions. Due to their strength and size, it can be assumed that larger, yearling size juveniles under low flow conditions in the fall were likely able to avoid a slowly rotating screw trap. This may explain the greater catch of yearlings in Mill Creek compared to Deer Creek in October. Figure 3 presents a comparison of yearling juvenile Chinook out-migration timing trends and catch statistics in Deer and Mill Creeks for the 1994-2010 rotary screw trap study period.

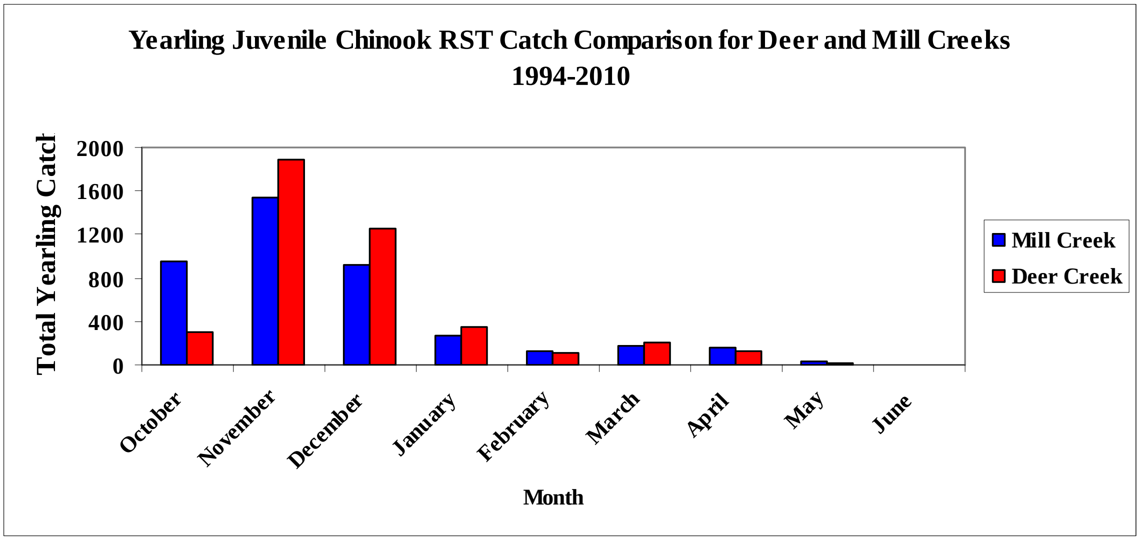


**Figure 3.**― A comparison of yearling juvenile Chinook out-migration timing and catch statistics based on the 1994-2010 Deer and Mill Creek rotary screw trap data.

**Young-of-the-year juvenile Chinook**― Young-of-the-year Chinook were captured in both creeks November through June during the 1994-2010 study period. The first young-of-the-year Chinook were detected as early as late November. However, during the majority of years, the first detection occurred sometime in mid to late December. Exact dates of spring-run Chinook egg deposition in the upper Deer and Mill Creek watersheds are unknown, and likely vary annually based on water temperature, individual genetic character of the female, and elevation at which a spawning pair is nesting.

Spring-run Chinook spawning occurs between a known range of 366-1585 m elevation in the Deer and Mill Creek watersheds. Temperature monitoring was conducted throughout a range of elevations within known spring-run spawning habitat locations on Deer and Mill Creek during the rotary screw trap study period. This data provided guidance for determining when to expect Chinook fry emergence based on daily temperature units (DTU's) at various elevations, and at what date the first spring-run fry would be encountered at the rotary screw traps (Harvey-Arrison 2003). However, a combination of spawning elevation, water temperature regimes, individual spawn timing, and frequency and intensity of winter storm events likely had a greater net influence on when the first spring-run fry annually appeared at the trapping sites.

Additionally, the rotary screw traps were operated downstream of fall-run Chinook spawning areas. The onset of spawning for fall-run Chinook populations in Deer and Mill Creeks during the study period varied annually based on agricultural diversion rates and fall weather patterns. For example, fall-run Chinook were able to access spawning areas upstream of the rotary screw trap sites as early as the beginning of October during some years of the study period (DFG Red Bluff, un-published data). On other years, fall-run Chinook were delayed entry until late October or early November. Therefore, the first fry annually detected at the traps could have been from a low elevation, early spawning spring-run pair, or an early entry fall-run pair that had spawned just upstream from the trap site.

It should be noted that in some years during the study period, the actual first Chinook fry present at the Valley floor were likely not detected by the traps because of high water or trap damage. For example, in the winter of 2007/2008, the first young-of-the-year in Deer Creek was not observed until 26-February. Table 4 lists the date at which the first young-of-the-year Chinook were detected at the Deer and Mill Creek rotary screw traps during the study period.

**Table 4.**—Date at which the first young-of-the-year Chinook was detected at the Deer and Mill Creek rotary screw traps1994 through 2009.

| Year | Deer Creek | Mill Creek |
|---|---|---|
| 1995 | 5-Dec | 14-Dec |
| 1996 | 2-Jan | 8-Feb |
| 1997 | 10-Dec | n/a |
| 1998 | 25-Nov | 23-Nov |
| 1999 | 2-Dec | 28-Dec |
| 2000 | 5-Jan | 18-Dec |
| 2001 | 6-Dec | 7-Dec |
| 2002 | 10-Jan | 10-Jan |
| 2003 | 8-Dec | 9-Dec |
| 2004 | 10-Dec | 17-Jan |
| 2005 | 3-Dec | 10-Dec |
| 2006 | 15-Dec | 25-Nov |
| 2007 | 1-Jan | 30-Dec |
| 2008 | 26-Feb | 15-Jan |
| 2009 | 26-Dec | 15-Dec |

Trends in young-of-the-year out-migration timing and catch rate were again similar when comparing rotary screw trap catches from Deer and Mill Creeks during the 1994-2010 study period. Exceptions were an overall trend in greater numbers of young-of-the-year caught in Deer Creek, and greater numbers of young-of-the-year caught in Mill Creek in April compared to Deer Creek. Figure 4 presents a comparison of young-of-the-year Chinook out-migration timing trends and catch statistics from the Deer and Mill Creek rotary screw traps during the 1994-2010 study period.

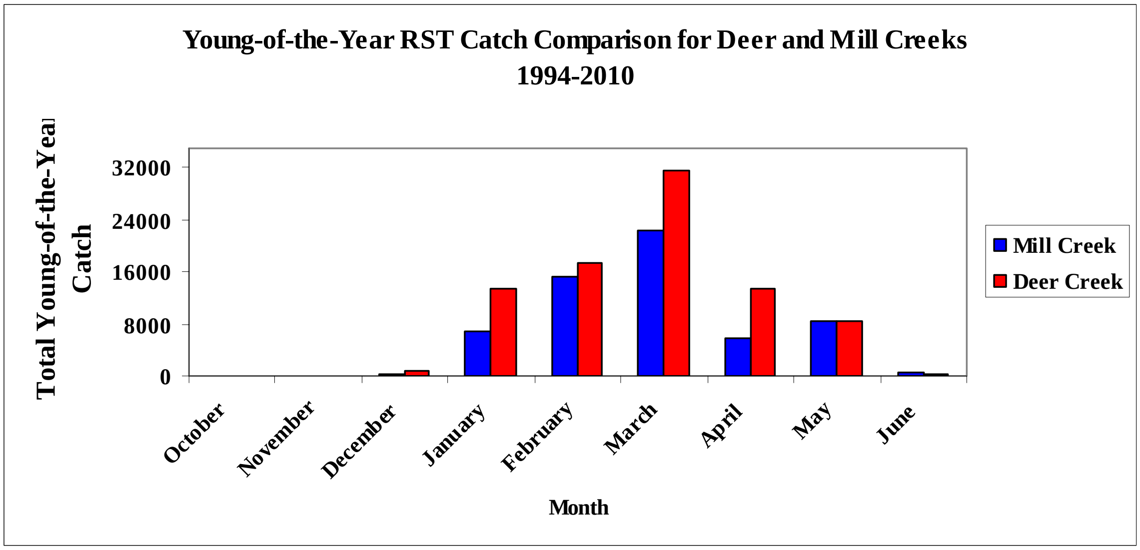


**Figure 4.**—A comparison of young-of-the-year juvenile Chinook out-migration timing and catch statistics based on the 1994-2010 Deer and Mill Creek rotary screw trap data.

Additionally, increased catches of young-of-the-year Chinook on Deer Creek compared to Mill Creek are likely explained by greater overall adult escapement on Deer Creek during the study period. Table 5 presents adult spring-run Chinook escapement estimates for Deer and Mill Creeks for years 1994-2010 as reported in GrandTab (Azat, 2011).

**Table 5.**— Deer and Mill Creek spring-run Chinook populations 1994-2010.

| Year | Deer Creek | Mill Creek |
|---|---|---|
| 1994 | 485 | 723 |
| 1995 | 1,295 | 320 |
| 1996 | 614 | 253 |
| 1997 | 466 | 202 |
| 1998 | 1,879 | 424 |
| 1999 | 1,591 | 560 |
| 2000 | 637 | 544 |
| 2001 | 1,622 | 1,104 |
| 2002 | 2,195 | 1,594 |
| 2003 | 2,759 | 1,426 |
| 2004 | 804 | 996 |
| 2005 | 2,239 | 1,150 |
| 2006 | 2,432 | 1,002 |
| 2007 | 644 | 920 |
| 2008 | 140 | 362 |
| 2009 | 213 | 220 |
| 2010 | 262 | 482 |

***Oncorhynchus mykiss*** — Based on the rotary screw trap data, the out-migration of juvenile *O. mykiss* began in October and extended into June on both Deer and Mill Creeks. Trends in out-migration timing for *O. mykiss* were similar when comparing Deer and Mill Creeks, although catch rates were much higher on Mill compared to Deer during the study period.

The higher catch rate on Mill Creek was likely due to one, or a combination of the three following factors: 1) Mill Creek's naturally higher turbidity increased fishing success rate. 2) The Mill Creek trap site was a more effective fishing location throughout the range of flows encountered in a given water year. 3) Mill Creek may have a larger population of steelhead than Deer Creek, or a higher proportion of *O. mykiss* juveniles expressing an anadromous life history. Figure 5 presents a comparison of juvenile *O. mykiss* out-migration timing trends and catch statistics in Deer and Mill Creeks for the 1994-2010 study period.

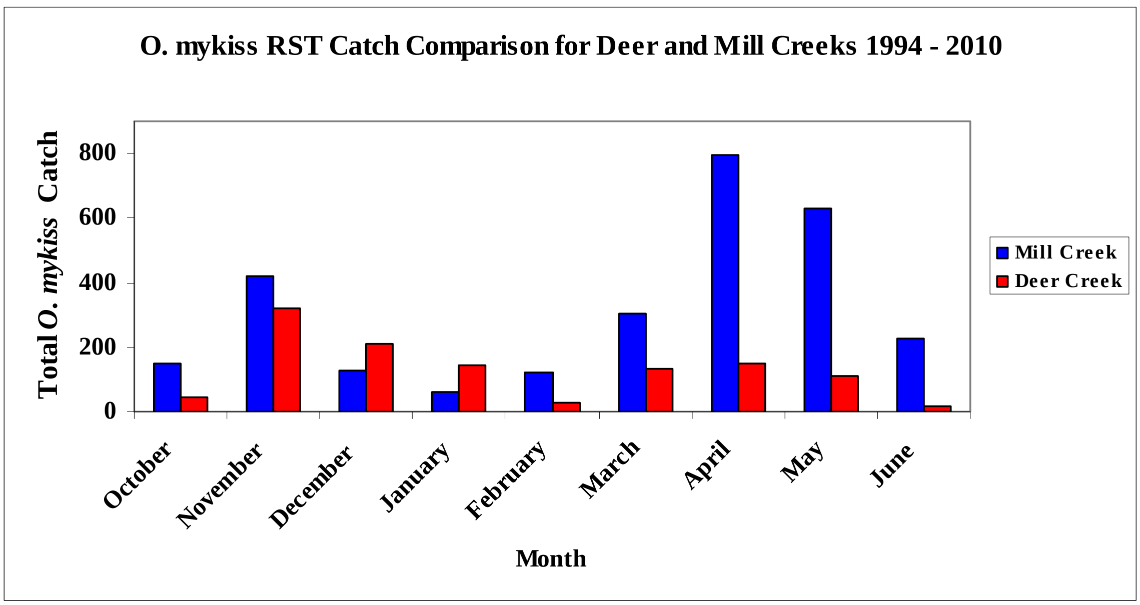


**Figure 5.** — A comparison of juvenile *O. mykiss* out-migration timing and catch statistics based on the 1994-2010 Deer and Mill Creek rotary screw trap data.

**Juvenile Chinook Length Frequencies**

As mentioned previously, rotary screw traps were initially operated on Deer and Mill Creeks for the purpose of obtaining juvenile *O. mykiss* and spring-run Chinook life history data. Over time, the Deer and Mill rotary screw trap catch data was incorporated into the IEP spring-run protection process. Information on length-at-date of juvenile Chinook from Deer and Mill Creek became increasingly important. Rotary screw trap operations provided a real-time dataset which signaled the presence of out-migrating

Deer and Mill Creek spring-run juveniles and their subsequent presence in the Sacramento San Joaquin Delta system.

Yearling juvenile Chinook were caught in the rotary screw traps October through June, with peak yearling emigration occurring November-January. During the study period, the minimum observed fork-length for Mill Creek yearlings was 59 mm. The maximum was 171 mm. The minimum observed fork-length for Deer Creek yearlings was 53 mm. The maximum was 153 mm. Young-of-the-year were detected as early as late November, with young-of-the-year showing from middle to late December on most years. Peak young-of-the-year out-migration occurred on both creeks in February and March, and continued into June. During the study period the minimum observed fork-length for Mill Creek young-of-the-year was 28 mm. The maximum was 101 mm. The minimum observed fork-length for Deer Creek young-of-the-year was 28 mm. The maximum was 91 mm. Further detail on the range of juvenile Chinook fork-lengths encountered by month and year at the Deer and Mill Creek rotary screw traps can be found in Appendix B and C.

Distinguishing yearling out-migrants from young-of-the-year by fork-length was easily accomplished October through January in the Deer and Mill Creek rotary screw trap samples. Using fork-lengths to segregate the two life history types becomes increasingly difficult February through June. This is was likely due to the overlap in growth rates between late-emerging sub-yearlings from the upper watershed and young-of-the-year born from early spawning, low elevation spring-run or fall-run Chinook parents. Figure 6 presents a length at date plot of all juvenile Chinook captured in the Deer and Mill Creek rotary screw traps October through June for Mill Creek (red) and Deer Creek (blue) for years 1994-2010.

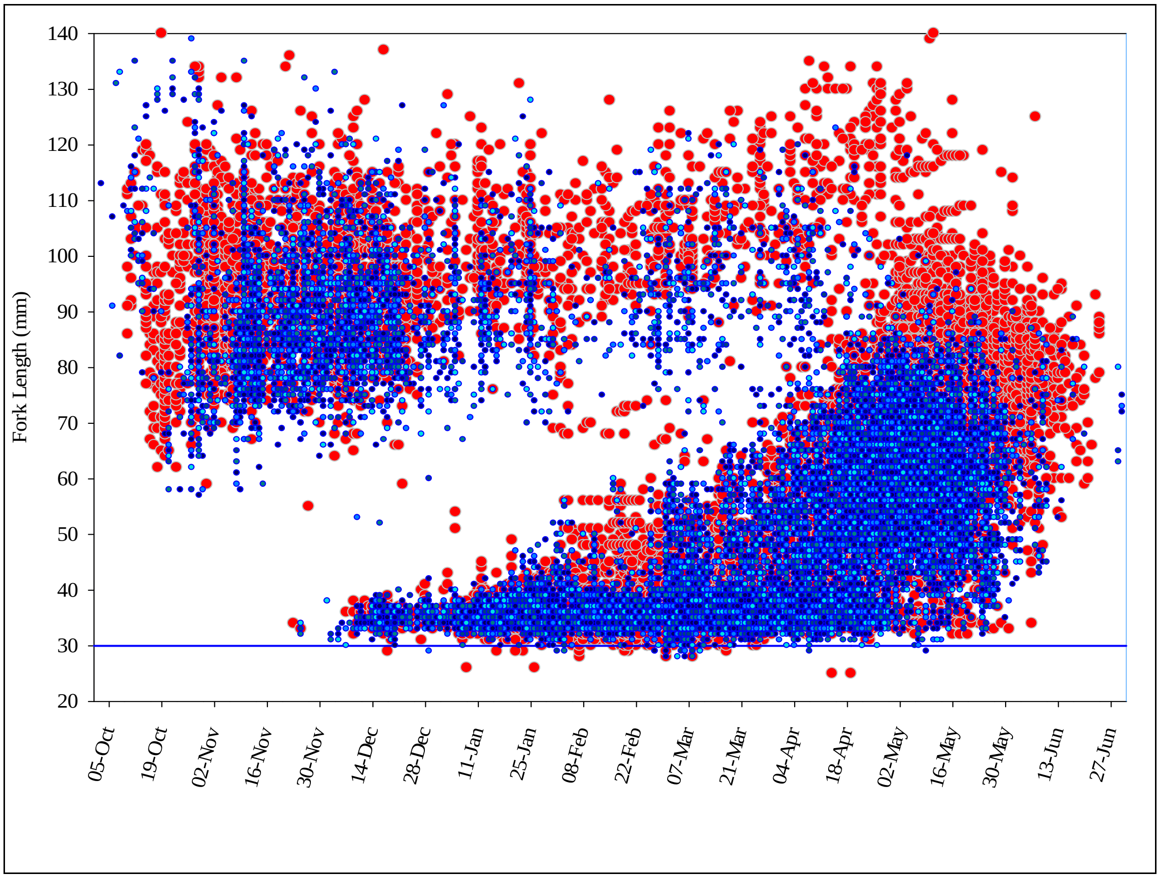


**Figure 6.**—Length at date plot of all juvenile Chinook caught in the Deer and Mill Creek rotary screw traps October through June during the 1994-2010 study period. Mill Creek is represented by red dots and Deer Creek by blue dots. This figure illustrates the close relationship of juvenile Chinook life history characteristics expressed by these "sister" Chinook populations.

Figure 6 shows two distinct "lobes" or length-at-date groupings of juvenile Chinook that represent out-migrants that have over-summered (yearlings) and young-of-the-year which are exiting the tributaries before summer begins. The diversity of length at date frequencies presented in Figure 5 reflects the influence of spawning elevation, length of time rearing in the tributary before emigrating, and the choice to spend zero or one or more summers in upper-elevation reaches before smolting. As mentioned previously, distinguishing yearling Chinook out-migrants from young of the year by size on Mill Creek was easily accomplished October through January. However, using length at date to segregate the two life history types becomes increasingly difficult February through June. Figure 7 comparatively illustrates stream and ocean type length frequencies of juvenile Chinook sampled at the Mill Creek rotary screw trap1996 through 2010.

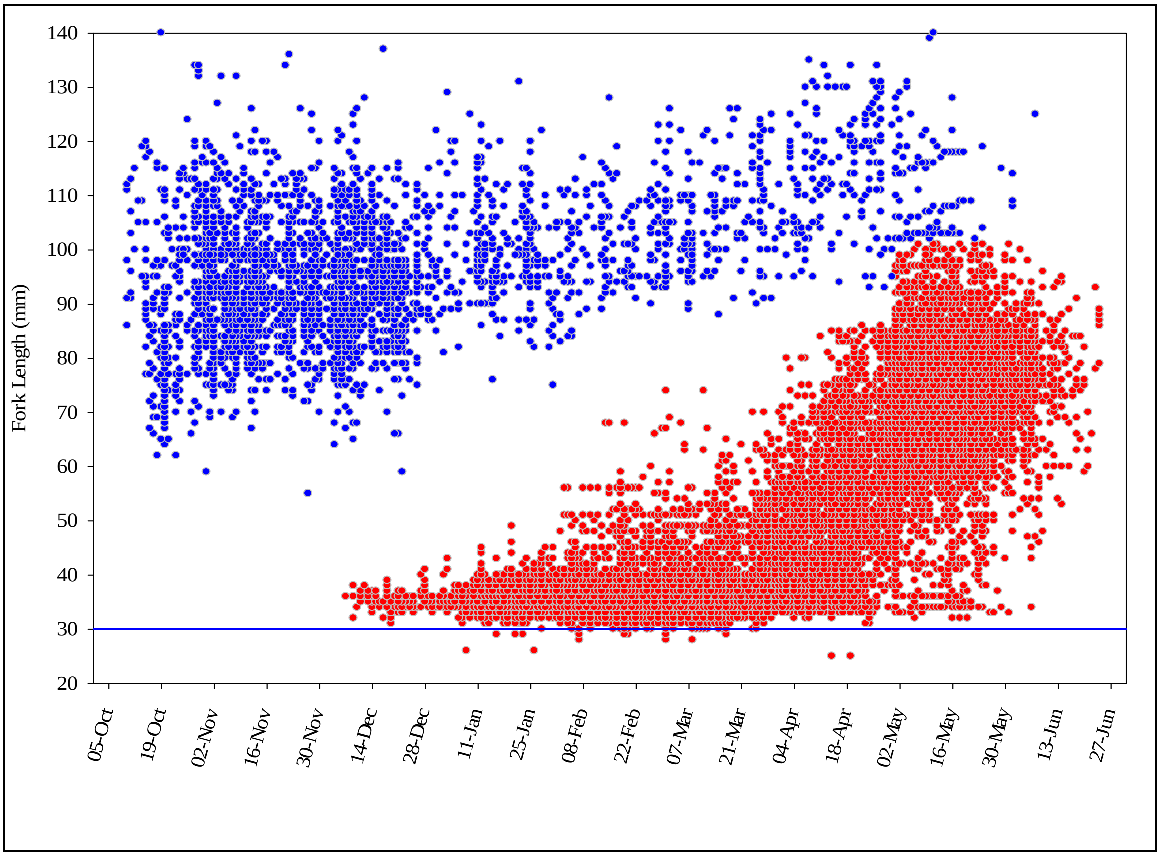


**Figure 7.**—Mill Creek yearling juvenile Chinook (blue) vs. young-of-the-year (red**)** October-June for years 1996-2010. This chart illustrates the distinction between "stream-type" and "ocean-type" juvenile life histories expressed by Mill Creek spring-run Chinook.

Figure 7 shows an "intersection" beginning in late April and extending into the middle of May where lengths at date of stream versus ocean type life histories begin to overlap. Care must be used in interpreting this data as categorizing an individual as "yearling" or "young of the year" during this time period is subjective.

Figure 8 comparatively illustrates stream and ocean type length-frequencies of juvenile Chinook sampled at the Deer Creek rotary screw trap from 1994 through 2010.

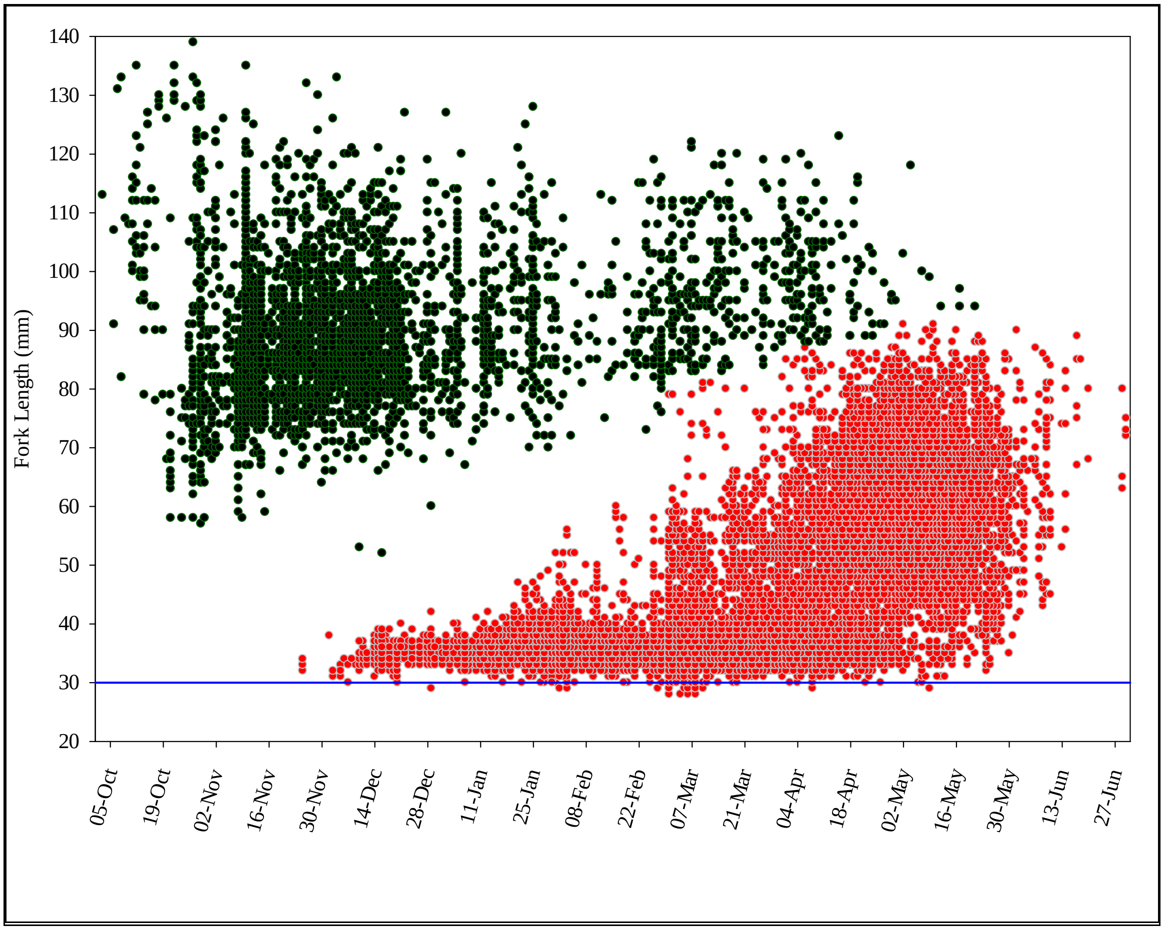


**Figure 8.**─Deer Creek "yearling" juvenile Chinook (green) vs. young-of-the-year (red) captured by rotary screw trap October-June at the Deer Creek rotary screw trap during the period 1994-2010. This chart illustrates the distinction between "stream-type" and "ocean-type" juvenile life histories expressed by juvenile Deer Creek spring-run Chinook.

During the years that the rotary screw traps were operated, a concurrent electro-fishing study was conducted year-round in the upper Deer and Mill Creek watersheds. This study examined spring-run emergence timing at various elevations and water temperature regimes and growth rates of over-summering juveniles. In the absence of genetic testing, comparing juvenile Chinook fork-lengths obtained from real time electro-fishing samples collected in the upper watershed with real time rotary screw trap fork-lengths was a useful tool which helped to verify that the rotary screw traps were indeed catching juvenile spring-run. Figures 9 and 10 present plots of fork-lengths from juvenile spring-run Chinook collected during electro-fishing investigations in the upper Mill Creek and Deer Creek watersheds respectively over the period 1994-2010.

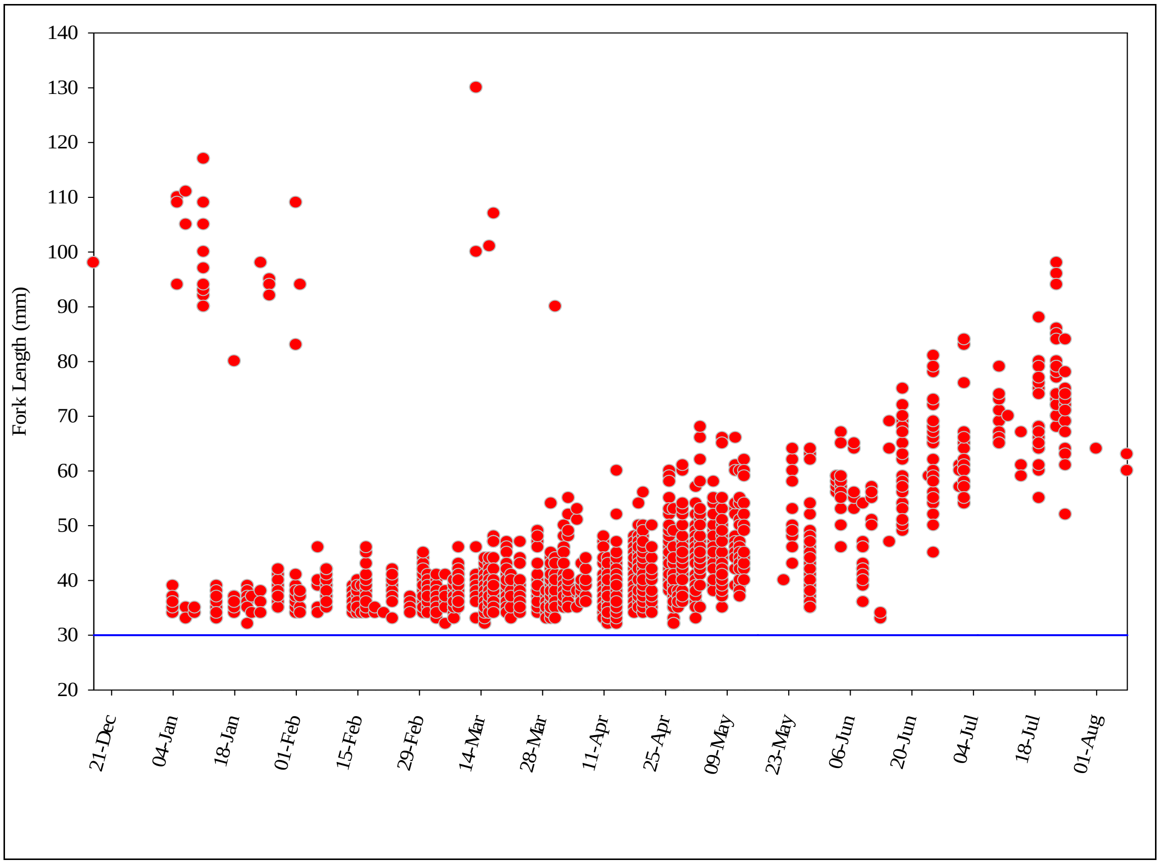


**Figure 9.**— Plot of fork-lengths from juvenile spring-run Chinook obtained by electro-fishing in the upper Mill Creek watershed 1996-2010.

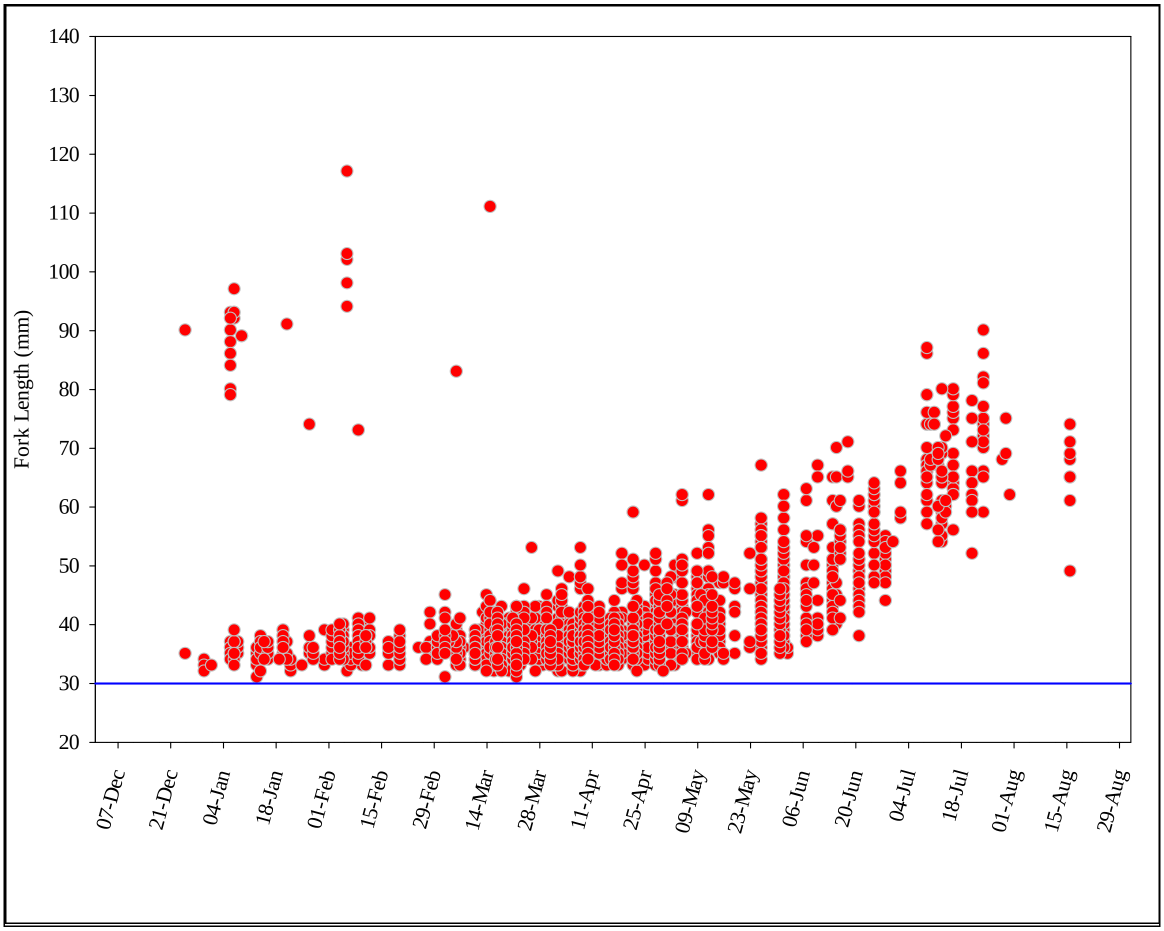


**Figure 10.**— Plot of fork-lengths from juvenile spring-run Chinook obtained by electro-fishing in the upper Deer Creek watershed 1994-2010.

Figures 11 and 12 present Mill and Deer Creek juvenile Chinook fork-lengths measured at the rotary screw traps and are plotted against upper watershed samples obtained by electro-fishing 1994-2010. The rotary screw traps on Deer and Mill Creeks were operated below fall run Chinook spawning areas. This graph shows the veracity of sampling spring-run juveniles isolated in the upper watershed to verify the presence of juvenile spring-run Chinook co-mingled in mixed stock rotary screw catches on the Valley floor.

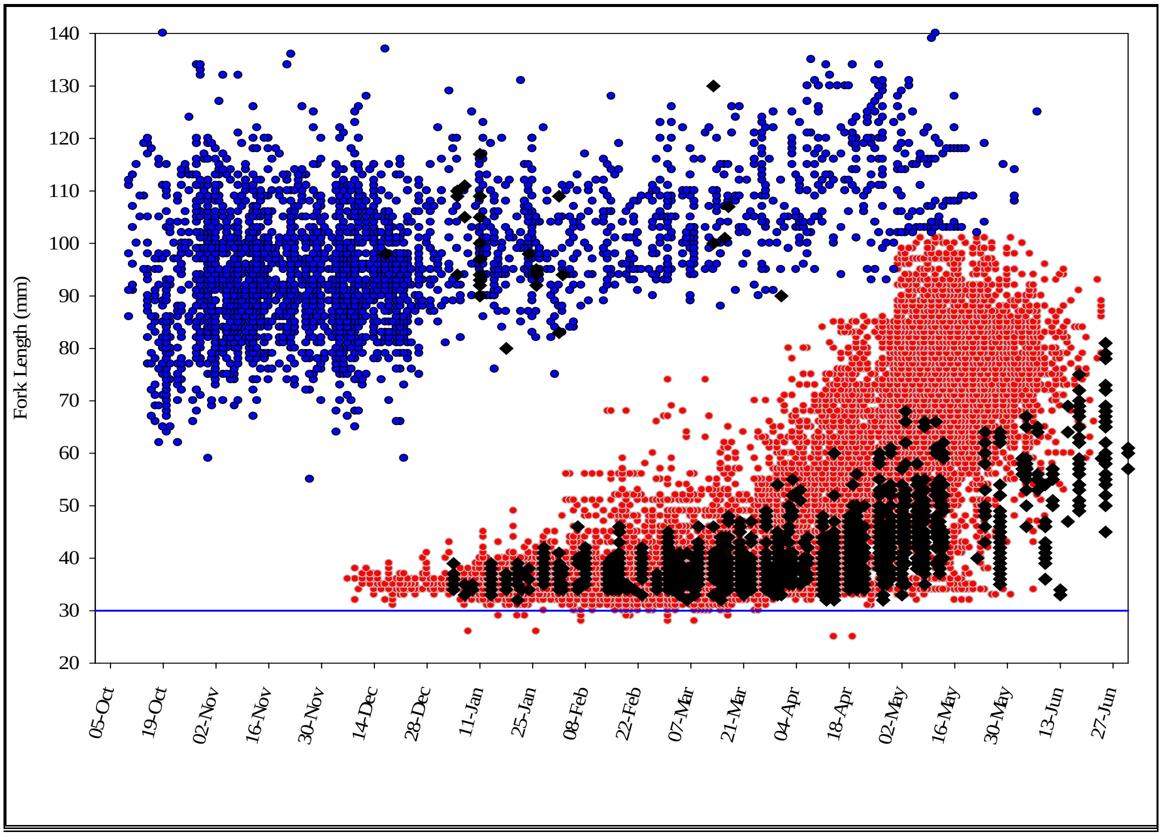


**Figure 11.**—Length at date fork-length plot of Mill Creek yearlings (blue) vs. Mill Creek young-of-the-year (red) obtained by rotary screw trapping vs. juvenile Chinook sampled by electro-fishing in the upper Mill Creek watershed (black) during the 1996-2010 study period. This graph compares real time length frequencies of mixed race juvenile Chinook sampled in the rotary screw trap located on the Valley floor with spring-run juvenile Chinook emerging and rearing in isolation in the upper Mill Creek watershed.

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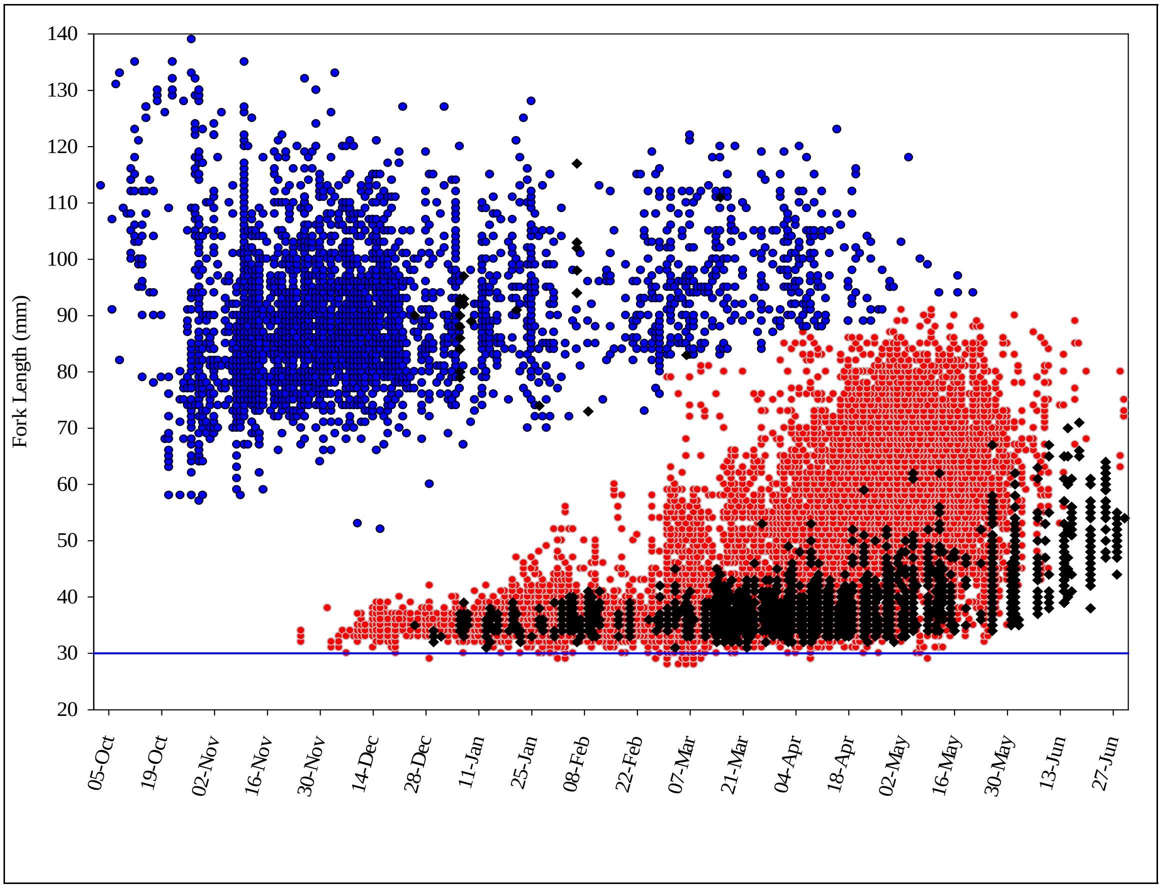


**Figure 12.**—Length at date fork-length plot of Deer Creek yearlings (blue) vs. Deer Creek young-of-the-year (red) obtained by rotary screw trapping vs. juvenile Chinook sampled by electro-fishing in the upper Deer Creek watershed (black) during the period1994-2010. This graph compares real time length frequencies of mixed race juvenile Chinook sampled in the rotary screw trap located on the Valley floor with spring-run juvenile Chinook emerging and rearing in isolation in the upper Deer Creek watershed.

### *O. mykiss* Juvenile Length Frequencies

*O. mykiss* juveniles were found in the rotary screw trap catch October through June on both Deer and Mill Creeks. These samples represented a range of age classes, including young-of-the-year, age-1 and age-2 juveniles, and likely small resident adults. *O. mykiss* length frequencies representing the various juvenile life stages encountered were very similar when comparing Deer Creek with Mill Creek. Figure 13 presents a combined length frequency plot of all *O. mykiss* sampled at the Deer and Mill Creek rotary screw traps during the 1994-2010 study period.

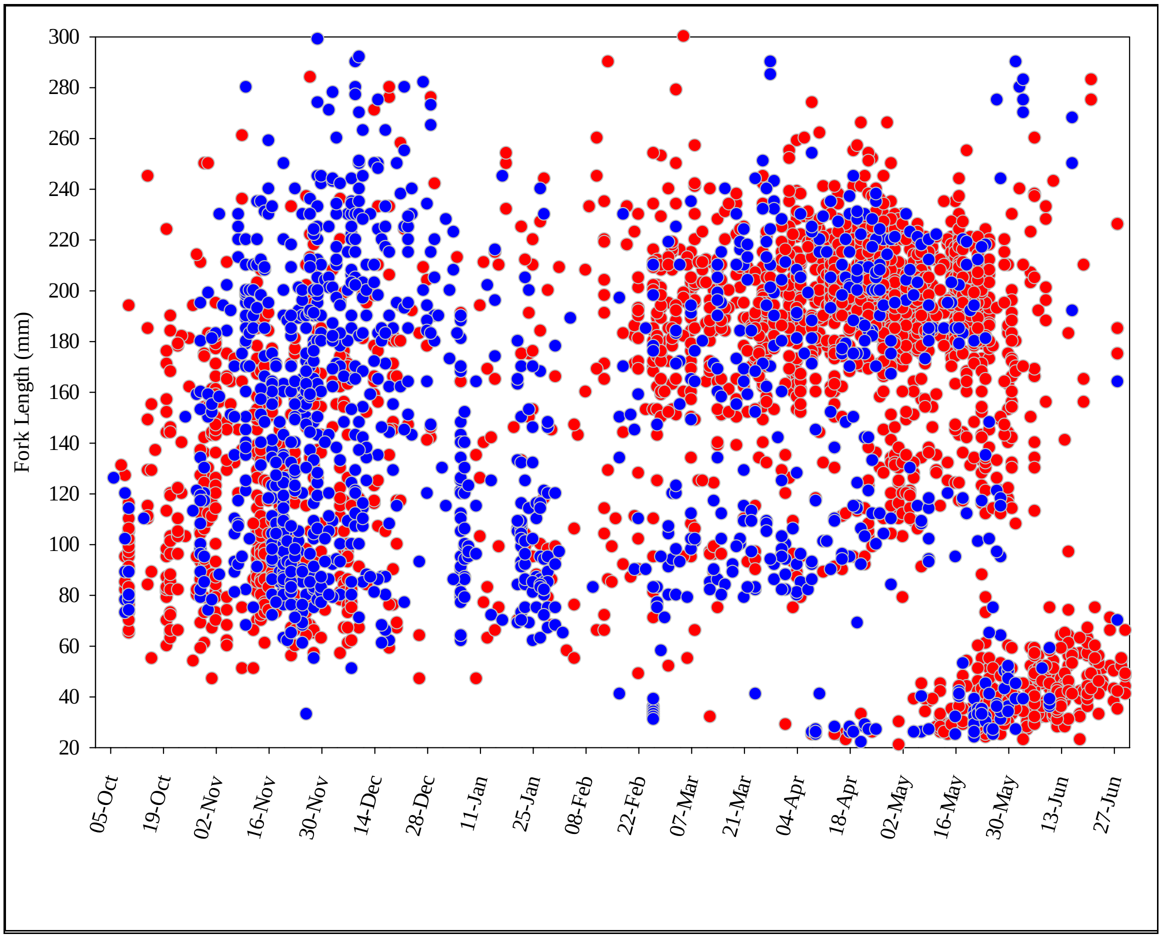


**Figure 13.**—Length frequency plots of all rotary screw trap samples of *O. mykiss* from Mill Creek (red) and Deer Creek (blue) for the 1994-2010 study period.

After November 1998, juvenile *O. mykiss* observed in the rotary screw trap samples were assigned life stage ratings based on external morphology and pigmentation patterns according to the IEP Steelhead Project Work Team's "Juvenile Steelhead Life Stage Rating Protocol" This protocol classified juvenile *O. mykiss* to the following life stages: fry (stage 2), parr (stage 3), silvery parr (stage 4), or smolt (stage 5). While these ratings are subjective, categorizing *O. mykiss* juveniles from the Deer and Mill RST catches to life stage enabled *O. mykiss* juveniles expressing smoltification to be segregated from the greater juvenile *O. mykiss* population**.** Table 6 lists minimum, maximum, and average fork lengths for *O. mykiss* fry, parr, silvery parr, and smolt sampled at Deer and Mill Creek rotary screw traps during the 1994-2010 study period.

**Table 6.**— Minimum, maximum, and average fork lengths in millimeters for *O. mykiss* fry (2), parr (3), silvery parr (4), and smolt (5) life stage categories encountered in the Mill and Deer Creek rotary screw trap catch 1994-2010.

| **Deer Creek *O. mykiss*** | | | | **Mill Creek *O. mykiss*** | | | |
|---|---|---|---|---|---|---|---|
| **Stage** | **Min** | **Max** | **Ave** | **Stage** | **Min** | **Max** | **Ave** |
| 2 | 22 | 52 | 34 | 2 | 21 | 82 | 41 |
| 3 | 41 | 292 | 115 | 3 | 33 | 253 | 115 |
| 4 | 70 | 263 | 180 | 4 | 54 | 380 | 181 |
| 5 | 153 | 283 | 210 | 5 | 110 | 284 | 204 |

Life stages of juvenile *O. mykiss* were classified and recorded on the datasheet as fry, parr, silvery parr, or smolt. These classifications were assigned by field technicians while samples were actively being processed at the screw trap sites. Since these life stage classifications were based on empirical observation alone, caution should be used when interpreting the data. Regardless, the regular occurrence of stage 4 and 5 *O. mykiss* in the rotary screw trap samples suggests that anadromy was being expressed in the Deer and Mill Creek juvenile *O. mykiss* population during the 1994-2010 rotary screw trap study period. According to the data, *O. mykiss* of 120 mm fork-length or less were most often classified as fry or parr. *O. mykiss* greater than 120 mm fork-length were most often classified as silvery parr or smolt. Figures 14 and 15 plot length frequencies of all Deer and Mill Creek *O. mykiss* samples obtained during the rotary screw trap study period and assigns them to two broad juvenile life stage categories, fry-parr (red) and silvery-parr-smolt (blue).

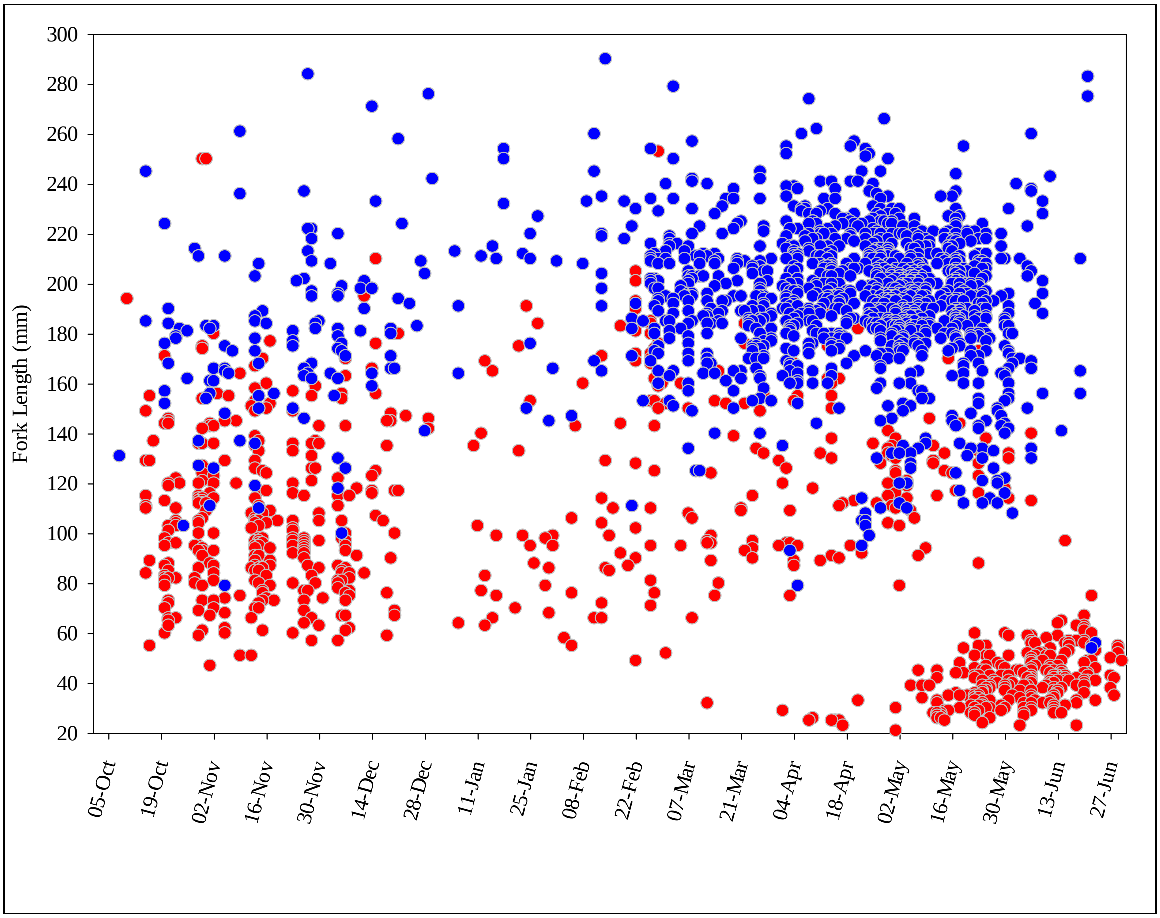


**Figure14.**— Length frequency plot of all Mill Creek *O. mykiss* samples obtained during the 1996-2010 rotary screw trap study period. Fry-parr are represented by red dots. Silvery-parr and smolt are represented by blue dots.

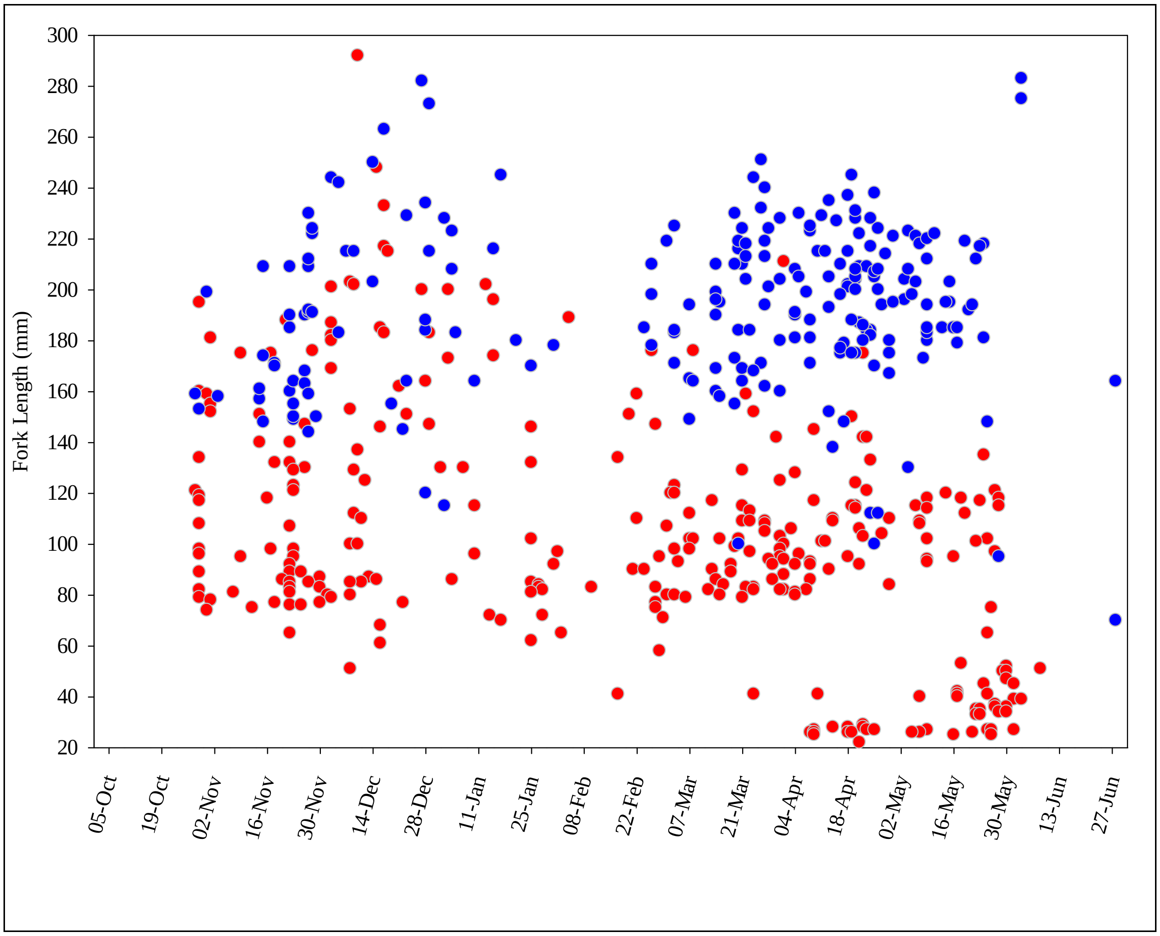


**Figure15.**— Length frequency plot of all Deer Creek *O. mykiss* samples obtained during the 1994-2010 rotary screw trap study period. Fry-parr are represented by red dots. Silvery-parr and smolt are represented by blue dots.

# Discussion

## Juvenile Production Estimates

The rotary screw trap data collected on Deer and Mill Creeks between 1994 and 2010 provides a definitive record of length-at-date distributions and out-migration timing for juvenile Chinook and steelhead for Mill and Deer Creeks. In addition, the data collected over the years from each creek has established an invaluable record of juvenile life history characteristics for Central Valley stocks of wild spring-run Chinook and steelhead. However, unlike many other rotary screw trap studies, the data collected were never intended to be used to estimate absolute abundance of juvenile salmonids. There are several compelling reasons why juvenile production estimates were never attempted.

The first and most significant reason was the limited ability to sample through high flow events which occurred annually during peak out-migration periods fall through spring. Discharge on Deer and Mill Creeks during storm events is “flashy” and unpredictable, with flows rising suddenly during severe storm events. Further adding to the unpredictability of stream discharge during storm events is the influence of a storms intensity and residency in the watershed. In addition, variable orographic effects within the watershed, the ratio of rain to snow in the event, and the speed at which a storm tracked through the watershed greatly affects the ability to predict high flow events on Deer and Mill Creek in the winter.

Rotary screw trap studies at the Red Bluff Diversion Dam on the Sacramento River show that trap efficiency was positively correlated to percent of river volume sampled by the traps, with higher efficiencies occurring as river discharge volumes decreased and the proportion of discharge volume sampled by the rotary screw traps increased. Regression analysis revealed a significant relationship between trap efficiency and the percent of river volume sampled by traps (Poytress and Carrillo 2008). Similarly, on Clear Creek, a nearby tributary of the Sacramento River, rotary screw traps are rarely operated at flows above 1,000 cfs (Early 2009). In addition, rotary screw trap efficiency trials (dyeing fish for mark and recapture) were not conducted on Clear Creek when flows were predicted to exceed 2,000 cfs (Early 2009). The anadromous portion of Clear Creek is contained within a rather short 29 km stream section which is controlled by releases from Whiskytown Reservoir. Deer and Mill Creeks are un-damned, and in comparison to Clear Creek, drain a much larger watershed. The potential for extreme winter flow events is much higher and on Deer and Mill, with flows in excess of 1000 cfs commonly occurring December through April. Figure 16 illustrates typical un-fishable high flow conditions following a storm on Mill Creek.

**Figure 16.**—The Mill Creek rotary screw trap riding out a typical high flow event.

A second reason for not conducting trap efficiency trials was the inability to regularly secure adequate sample sizes. On Clear Creek, during the 2008 through 2009 trapping season, screw trap efficiency trials conducted to generate juvenile production estimates relied on marking a minimum of 400 juvenile Chinook for each trial, with a goal of recapturing a minimum of 7 individuals. In order to meet a 7 fish minimum recapture goal, mark-recapture trials were not conducted when there were 200 fish or less in the daily rotary screw trap sample (Early 2009). On Deer Creek, between 1994 and 2010, there were a total of 1,378 individual rotary screw trap sampling events when juvenile Chinook were caught in the trap. "Sampling events" are referenced here instead of days, as the rotary screw traps were sometimes fished for more or less than a 24 hour period. A total of only 43 sampling events (3%) provided more than 400 Chinook in the sample and only 80 sampling events (6%) provided greater than 200 Chinook in the sample. Juvenile Chinook samples were regularly below statistical thresholds on Mill Creek as well. On only 58 sampling events out of 1,456 (4%) were there greater than 200 Chinook in the sample. On only 20 sampling events (1.4%) out of 1,456 were there greater than 400 Chinook in the sample.

Additionally, the data collected during the period 1994 – 2010 shows that spring-run cohorts from a single brood year could be caught in the Deer and Mill Creek rotary screw traps over a 17 month period due to the presence of stream and ocean type life history types. This fact would necessitate separate production estimates for young-of-the-year and yearlings for a given brood year. The data shows that relatively few yearlings were caught in the rotary screw traps on Deer Creek and Mill Creek, and a total catch of 200 or more yearlings in a single sample event never occurred during the study period. It is uncertain if these low numbers reflect limited expression of the yearling life history type relative to the total brood year population, or effective trap avoidance related to greater size. It is likely a combination of both. Holding yearlings at the trap site until sufficient numbers were collected for mark and recapture efficiency trials was never considered due to the potential for handling stress and mortality of this listed species (Colleen Harvey-Arrison personal communication).

Finally, fall-run Chinook were known to have spawned above both screw traps sites during all years of the study period. Since the Deer and Mill Creek rotary screw traps were located below fall-run Chinook spawning and juvenile rearing habitat, the young-of-the-year Chinook component of the rotary screw trap catch always had the potential to be composed of both fall and spring-run individuals. The Mill Creek rotary screw trap was located 8.3 river kilometers upstream of Mill Creek's confluence with the Sacramento River (Figure 1). This location is near the center of fall-run Chinook spawning habitat on Mill Creek (DFG Red Bluff unpublished data). Fall-run Chinook were often abundant in Deer Creek and Mill Creek during the study period, resulting in the presence of potentially large numbers of fall-run young-of-the-year above the trap sites. For example, in 2006, 62% of the estimated escapement of fall-run Chinook that entered Mill Creek spawned upstream of the trap site (Harvey-Arrison 2007).

While spring-run Chinook populations remain spatially isolated from fall-run Chinook at the time of spawning in Deer and Mill Creeks, their offspring can emerge at the same time due to the effect water temperature has on egg incubation rate (Harvey-Arrison 2003). Since separating fall-run Chinook young-of-the-year from spring-run Chinook young-of-the-year at the trap sites (genetically or otherwise) was not within the scope of the study, separate juvenile production estimates for each stock would have been impossible to obtain from the Deer and Mill rotary screw trap samples during the 1994 – 2010 study period.

## Problems Encountered With Central Valley Length-at-Date Charts

Incorrect classification of Chinook race often results when length-at-date growth charts developed by Fisher and Greene are applied to Deer and Mill Creek juvenile spring-run Chinook. Yearling spring-run Chinook are typically categorized as late-fall and winter-run and young-of-the-year spring-run are categorized as fall and late-fall run Chinook. However, these charts do accurately classify young-of-the-year fall-run Chinook on Deer and Mill Creeks. Length-at-date growth charts specific to Deer Creek and Mill Creek spring-run Chinook have not yet been developed. The length-at-date data obtained from Deer and Mill Creek rotary screw trap operations during the 1994-2010 study period shows highly variable rates of growth. Due to the broad range in elevation of spawning habitat adult spring-run Chinook have access to in Deer and Mill Creeks (366 to 1,585 m), and the resulting effects of variable water temperature regimes on egg incubation, spring-run fry are known to emerge continuously for a six month period in these systems. Additionally, the rotary screw trap data shows that spring-run cohorts may emigrate as fry or yearlings over a period totaling 17 months. Developing a length-at-date growth chart for Deer and Mill Creek juvenile spring-run Chinook would be very challenging indeed.

Figures 17 and 18 plot yearling Chinook fork-lengths, young-of-the-year Chinook fork-lengths, and fork-lengths of juvenile Chinook obtained by electro fishing in the upper watershed against length-at-date growth curves. These spline curves represent the maximum fork-lengths expected for each run by date, based upon tables of projected annual growth developed by the California Department of water Resources (Greene 1992). Figures 17 and 18 illustrate the resulting run misclassification which occurs when applying these growth curves to yearling and young-of-the-year spring-run from Deer and Mill Creeks.

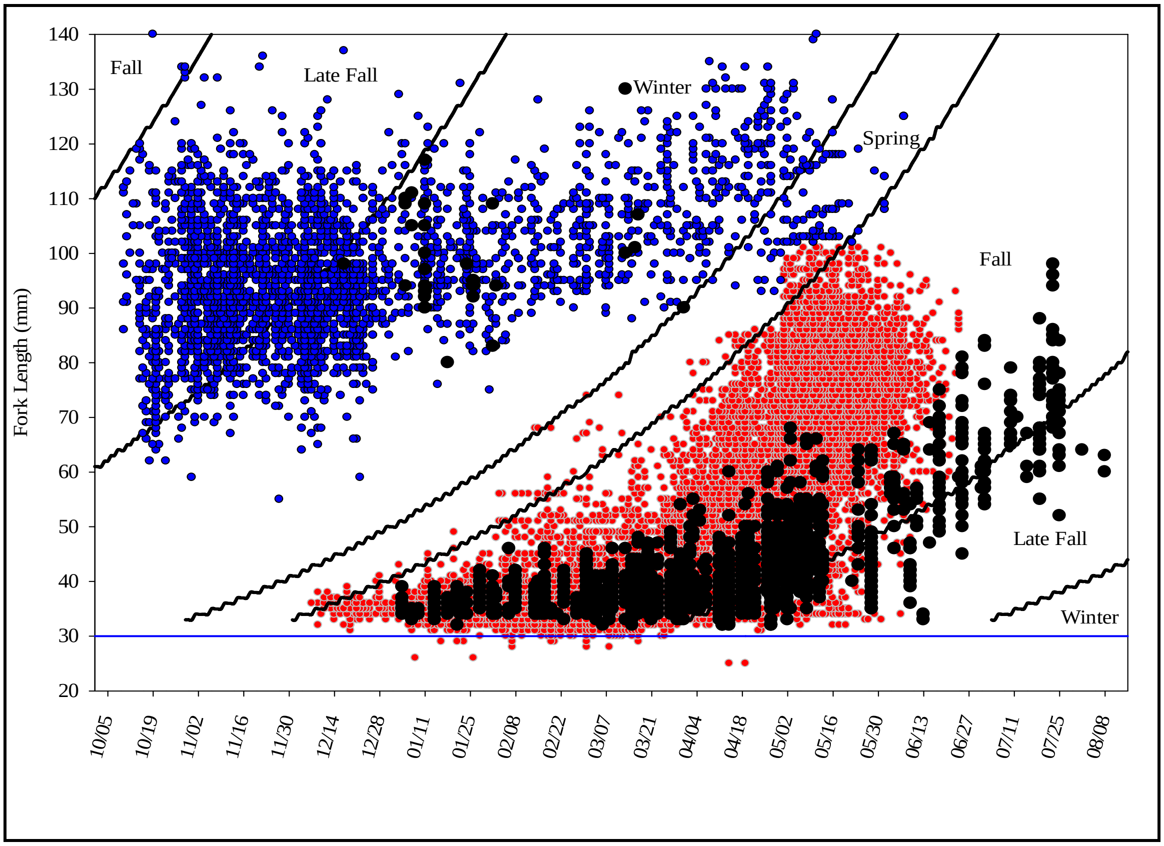


**Figure 17.**—This chart plots length at date fork-length measurements of yearling (blue) vs. young of year (red) Chinook sampled at the Mill Creek rotary screw trap vs. juvenile Chinook obtained by electro fishing in the upper Mill Creek watershed (black) during the period 1996-2010. The points are over-laid by spline Curves representing the maximum fork-lengths expected for each run by date, based upon tables of projected annual growth developed by the California Department of Water Resources.

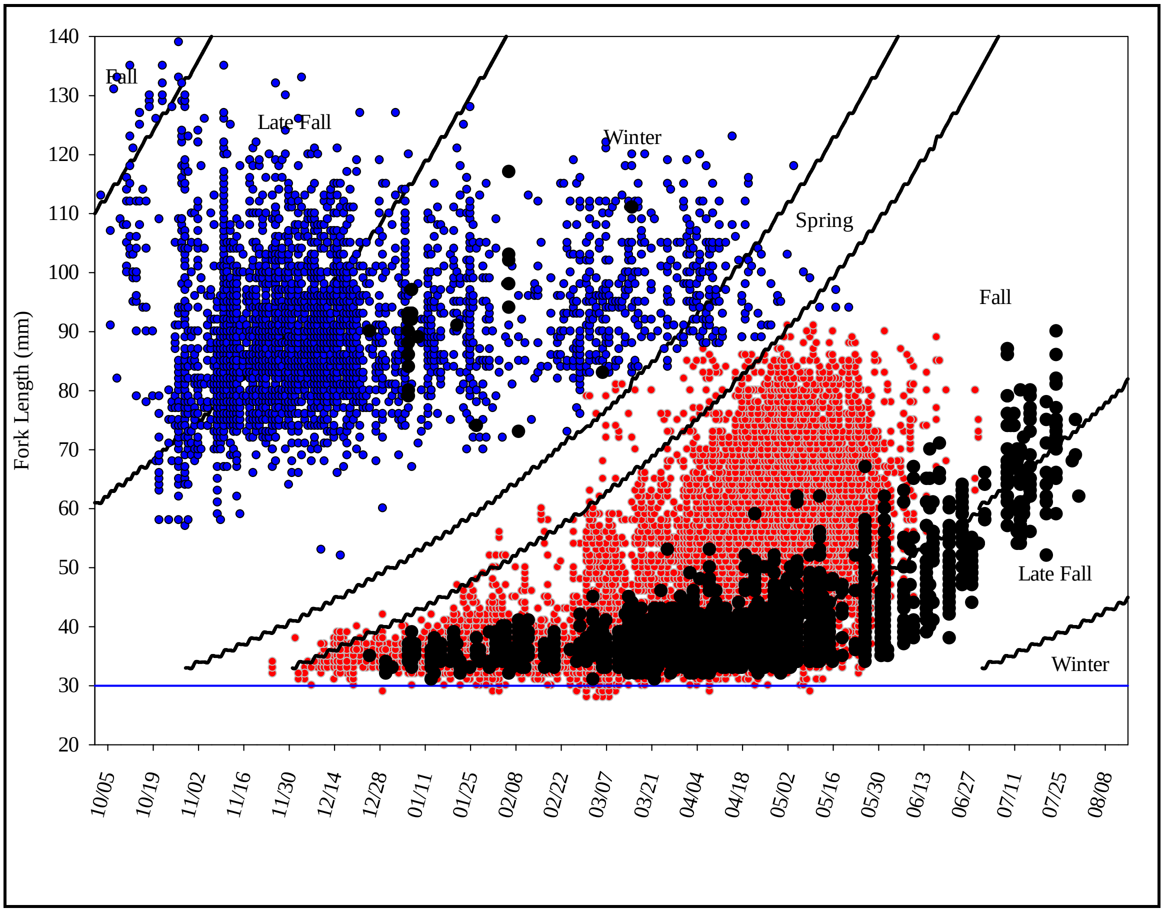


**Figure 18.**— This chart plots length at date fork-length measurements of yearling (blue) vs. young of year (red) Chinook sampled at the Deer Creek rotary screw trap vs. juvenile Chinook obtained by electro fishing in the upper Deer Creek watershed (black) during the period 1994-2010. The points are over-laid by spline Curves representing the maximum fork-lengths expected for each run by date, based upon tables of projected annual growth developed by the California Department of Water Resources.

During the course of the rotary screw trap study period, temperature loggers were deployed near the upper Deer and Mill Creek electro-fishing survey areas, including Black Rock and Hole in the Ground Campground on Mill Creek, and Ponderosa Bridge, A-Line Campground, and the Highway 32 Bridge crossing on Deer Creek. These locations were representative of the range of elevations characterizing spring-run Chinook spawning habitat in Deer and Mill Creeks. The temperature data acquired provided a means to predict spring-run fry emergence at these elevations using daily temperature units (DTU) (Harvey-Arrison 2001, 2003). A DTU is defined as the average daily water temperature (measured in $^{o}$ Fahrenheit) minus 32. From the time of fertilization, an average cumulative total of 1,550 DTU's is required for the egg to hatch and the fry to emerge (Armor 1991). Electro-fishing investigations in these same areas verified spring-run fry emergence based on presence absence, and provided length-at-date information of known spring-run juveniles (Figures 9 and 10). Table 7 provides a guideline for emergence timing at select elevations within upper Deer and Mill Creek spring-run spawning habitat. These are not exact dates, but are based on DTU's calculated using average temperatures monitored at these locations during the rotary screw trap study period (Harvey-Arrison 2003). Exact dates for the onset of spring-run Chinook spawning at the elevations given in Table 7 are not known and likely vary annually. These dates are based on field observation and are provided for guidance only (Colleen Harvey-Arrison personal communication).

**Table 7.**—Generalized emergence timing for spring-run Chinook fry at various elevations within upper Deer and Mill Creek watershed spawning habitat based on Daily Temperature Units.

| **Deer Creek** | | **Emergence** | | **Mill Creek** | | **Emergence** | |
|---|---|---|---|---|---|---|---|
| Elevation | Onset of Spawning | Earliest | Latest | Elevation | Onset of Spawning | Earlist | Latest |
| 979 m | 28-Aug - 5-Sep | 3-Dec | 3-Feb | 1,288 m | 22-Sep - 26-Sep | 3-May | 21-May |
| 890 m | 22-Sep - 26-Sep | 3-Feb | 3-Mar | 645 m | 27-Sep - 8-Oct | 3-Jan | 3-Mar |
| 523 m | 3-Oct - 9-Oct | 3-Feb | 3-Mar | 305 m | 12-Oct - 19-Oct | 3-Feb | 3-Mar |

Table 7 illustrates the potential variation in emergence timing experienced by spring-run Chinook fry in the upper watershed of Deer and Mill Creeks. Given the six month emergence timing of young-of-the-year spring-run November through May, followed by an extended emigration period of the cohort as yearlings the following year, real time juvenile length-at-date data obtained from the rotary screw traps did not show a logarithmic growth pattern for Deer and Mill Creek spring-run juveniles. Consequently, detecting juvenile spring-run Chinook downstream of Mill and Deer Creek using fork-lengths would be best accomplished by using a possible range of values. While this approach is generalized, it reflects the complexity of the situation. Based on the data collected from rotary screw trap operations 1994-2010, Tables 8 and 9 provide a range of monthly fork-length values representative of juvenile spring-run Chinook out-migrating from Deer and Mill Creek October through June.

**Table 8.**— Potential fork-lengths in millimeters of juvenile Chinook emigrating from Mill Creek by month. This table is based on data collected from rotary screw trap studies conducted 1996-2010.

| | Yearlings | | Young of Year | |
|---|---|---|---|---|
| **Month** | **Min Forklength** | **Max Forklength** | **Min Forklength** | **Max Forklength** |
| October | 59 | 158 | n/a | n/a |
| November | 67 | 171 | 33 | 34 |
| December | 59 | 137 | 29 | 38 |
| January | 69 | 131 | 29 | 45 |
| February | 83 | 128 | 28 | 59 |
| March | 81 | 141 | 28 | 67 |
| April | 91 | 135 | 31 | 86 |
| May | 100 | 147 | 32 | 101 |
| June | 108 | 125 | 34 | 100 |

**Table 9.**— Potential fork-lengths in millimeters of juvenile Chinook emigrating from Deer Creek by month. This table is based on data collected from rotary screw trap studies conducted 1994-2010.

| | Yearlings | | Young of Year | |
|---|---|---|---|---|
| **Month** | **Min Forklength** | **Max Forklength** | **Min Forklength** | **Max Forklength** |
| October | 57 | 153 | n/a | n/a |
| November | 58 | 135 | 32 | 34 |
| December | 53 | 149 | 29 | 42 |
| January | 67 | 128 | 30 | 52 |
| February | 72 | 119 | 29 | 60 |
| March | 83 | 122 | 28 | 81 |
| April | 87 | 123 | 29 | 87 |
| May | 93 | 118 | 29 | 91 |
| June | n/a | n/a | 41 | 90 |

## Stream Flow and Catch Relationships

The rotary screw trap data collected on Deer and Mill Creeks from 1994 through 2010 shows that increased stream discharge following storm and snow-melt events resulted in increased out-migration of juvenile salmonids. This phenomenon is particularly evident in the fall when Deer and Mill are flowing at base levels. The first fall storms signal the end of the long summer drought on Deer and Mill Creek, and the data shows significant numbers of juvenile salmonids that had over-summered respond to this event by emigrating from the watershed. In this region the first fall storm is often followed by another period of drought lasting weeks or a month. Few juvenile salmonids were detected at the traps during these periods. These drought periods are then disrupted by secondary freshets resulting in additional downstream pulses of juveniles as evidenced by increased catches at the rotary screw traps.

On Mill Creek, stream discharge was recoded at the USGS Gauging station located above the rotary screw trap sites at river kilometer 9.3. On Deer Creek, stream discharge was recorded at the USGS Gauging station located above the rotary screw trap site at river kilometer 20. These data were available from the internet using the California Department of Resource's California Data Exchange Center website (CDEC) for the period beginning 12-March, 1997 on Deer Creek and 11-March, 1997 on Mill Creek to the present.

Figure 19 illustrates the effect a fall freshet had on juvenile Chinook out-migration, using rotary screw trap catches on Deer Creek in November 2001 as an example. In this instance, six days of fall drought and baseline flows resulted in catches of one to two Chinook per day. Following a rain event on the 21st, the juvenile Chinook catch at the trap increased to nearly 200 individuals on the 22nd.

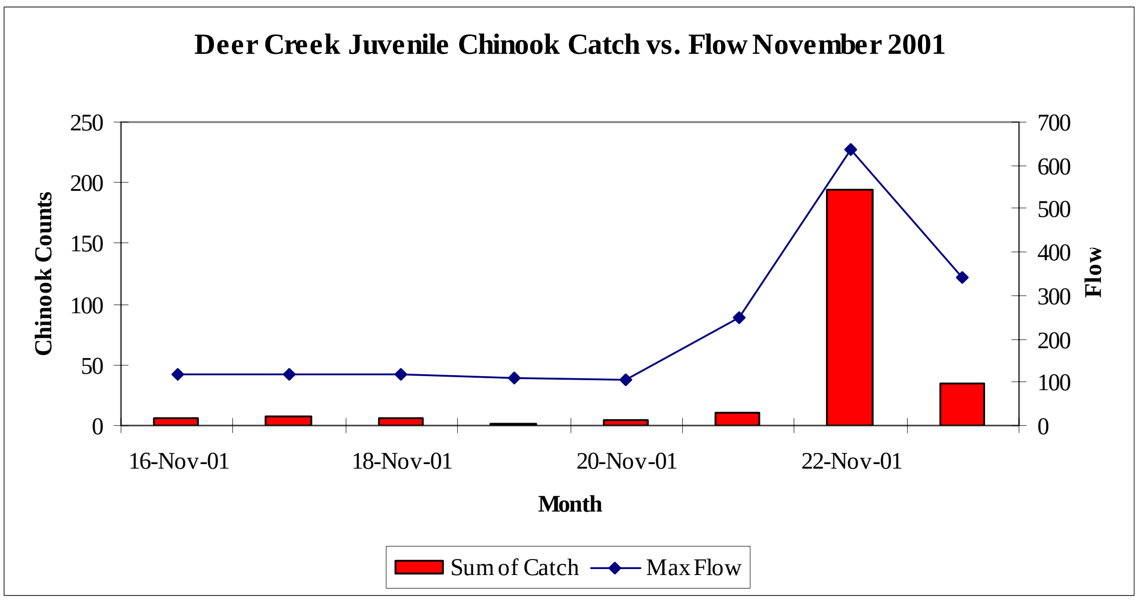


**Figure 19.**—Effect of increasing flow on catch rate at the Deer Creek rotary screw trap in November 2001.

Figure 20 presents another example of the relationship between increased flow and increased out-migration of juvenile salmonids in the fall as evidenced by rotary screw trap catch rates. In this example, juvenile Chinook catches at the Mill Creek rotary screw trap November-December of 2000 are plotted against flow. The highest catch rates in this period follow a fall freshet when stream discharge increases approximately 100 cubic feet per second.

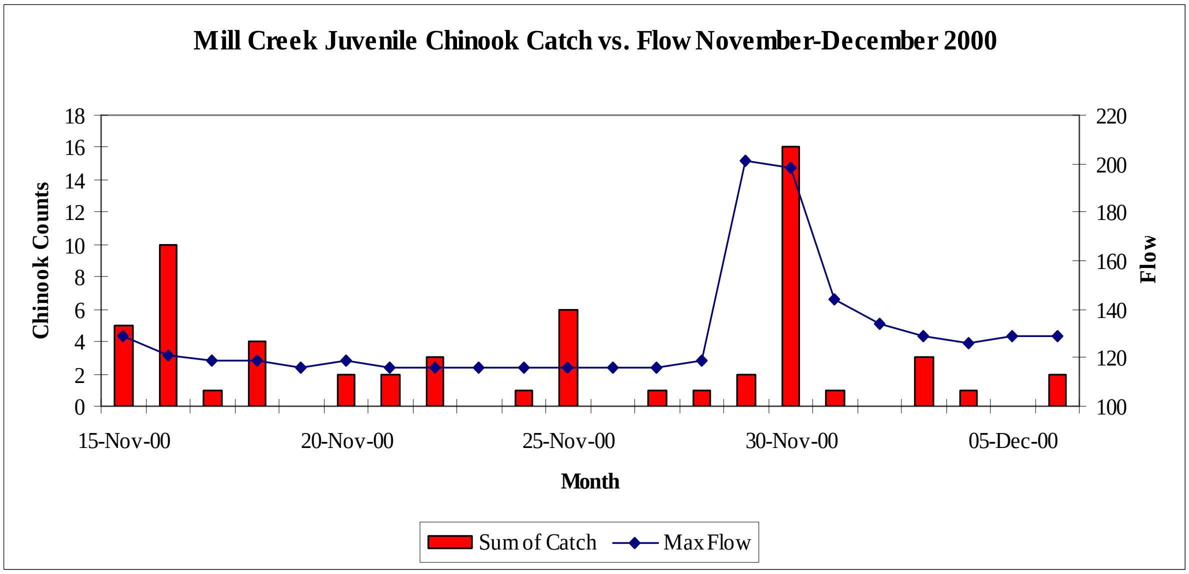


**Figure 20.**—Effect of increasing flow on catch rate at the Mill Creek rotary screw trap November-December 2000.

The Deer and Mill Creek watersheds receive their highest precipitation totals December through March. However, winter "droughts" frequently occur in the region. During these periods high pressure off the coast of California shunts storm systems to the north or south of the watersheds. This condition frequently persists for one to several weeks on end, resulting in low, cold, and clear conditions. During these periods rotary screw trap catches on Deer and Mill were much lower compared to periods following storm events. Figures 21 and 22 illustrate these trends.

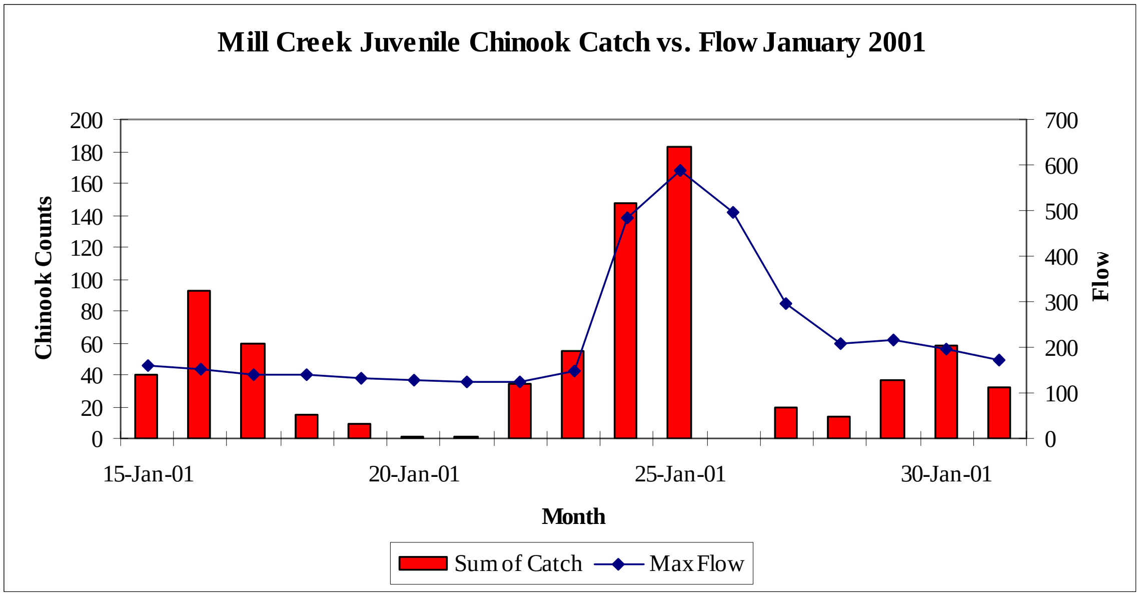


**Figure 21.**—Effect of increasing flow on catch rate at the Mill Creek rotary screw trap January 2001.

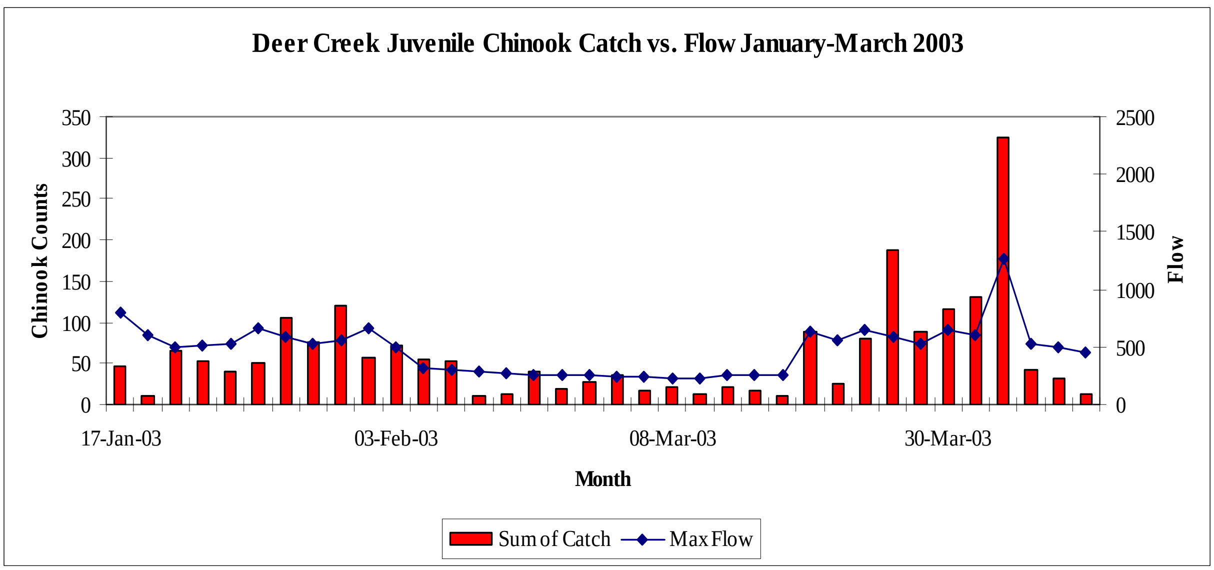


**Figure 22 .**—Relationship between flows and catch rate at the Deer Creek rotary screw trap January-March 2003.

## Recommendations

Deer and Mill Creek rotary screw trap studies conducted from 1994 to 2010 achieved the primary goal of understanding and describing juvenile life history characteristics of spring-run Chinook and steelhead populations in Deer and Mill Creeks. This is significant as awareness has increased of the status of these systems as population strongholds for wild spring-run Chinook and steelhead within the Central Valley ESUs.

Researchers and managers now have a readily available baseline juvenile life history dataset for wild Central Valley spring-run Chinook and steelhead.

In addition, data from the program were used from 1997 to 2010 in decisions on Delta water project operations. The Spring-run Protection Plan, implemented in the fall of 1997, included the use of data from the Deer and Mill Creek rotary screw trap studies in the decision process for Delta Cross Channel Gate closures. Real-time catch summaries from the rotary screw traps were used as a first alert of the presence of Deer and Mill Creek spring-run juveniles entering the Sacramento River and moving toward the Delta.

Spring-run protection measures were continued in the subsequent NOAA Fisheries Biological Opinions. The current *Biological Opinion on the Long-Term Operations of the Central Valley Project and State Water Project*, issued in 2009 and amended in 2011, requires funding for monitoring programs needed to provide real-time data for water project operations. Real-time data obtained from Deer and Mill Creek rotary screw trap operations were required for use as a “First Alert” for Delta Cross Channel Gate Operations. First Alert is defined as yearling spring-run Chinook detected at mouths of tributaries and/or average daily tributary flow increases by 50% or more (NOAA 2009).

The Deer and Mill Creek rotary screw trap program was discontinued in the spring of 2010 due to concerns over incidental mortality of juvenile spring-run in the sampling process. As stated earlier, the primary goal of understanding and describing juvenile life history characteristics of spring-run Chinook and steelhead populations in Deer and Mill Creek had been achieved by 2010. From 2011 on, there has been no real-time catch data available from Deer and Mill Creeks for use as a “First Alert” for the Delta Cross Channel Gate operations. To meet this need, data from the sampling period were analyzed for flow/yearling catch patterns to identify flows that could be used in lieu of real-time catch data.

December 1 is the currently the default closure date for the Delta Cross Channel Gates. Therefore, the months of October and November are the critical time periods when entrainment of Deer and Mill Creek yearling spring-run into the Delta Cross Channel may occur. Based on detailed analysis of the catch vs. flow data from 1994-2010, presented in Figures 19 and 20 and Appendix D and E, we recommend the following criteria for use as a “First Alert” for Delta Cross Channel Gate Operations:

- **Flows are greater than 110 cfs. in Deer or Mill Creeks, or**
- **Mean daily flow increases by more than 50% in Deer or Mill Creeks. (Flows measured at the USGS stream gauges.)**

Data indicate that yearlings are moving in small numbers when flows reach 110 cfs on either stream (Figures 1 and 2). Larger pulses of yearlings were typically observed following the first fall rain events. A 50% increase in flow on Deer or Mill Creek following a fall freshet typically resulted in the catch of large numbers of out-migrating yearlings. We therefore believe the above criteria will provide equivalent protection for out-migrating spring-run yearlings to the current requirements in the Biological Opinion (NOAA 2009).

## Acknowledgements

This report is dedicated to Colleen Harvey-Arrison, retired Department of Fish and Game Fisheries Biologist, Red Bluff, California. The data used in this report represents years of her work. This report is also dedicated to Bret Rohrer and Karl Wahler. Bret and Karl were part of the Deer and Mill screw trap program from the beginning. Special thanks to Stan Allen of the Pacific States Marine Fisheries Commission for his tireless work behind the scenes keeping the Deer and Mill Creek rotary screw traps going in the final years. Special thanks to Doug Killam for the Access tutorials and all the other support. Special thanks to Kate Merrick of PSMFC for her help with the graphs and charts. Special thanks to Mike Berry for his support of this project, especially for allowing me the extra time it took me to complete it. And finally, special thanks to all the Scientific Aides and Fisheries Technicians through the years who worked on these traps. Thank you for going out in the mud and high water and doing your best under all conditions to get the fish out of the live box and on their way.


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## Appendix A: Data sheet used at the Deer and Mill Creek Rotary Screw Traps 1994 - 2010

**Appendix A-1**.— Front of data sheet

# Screw Trap Data Sheet

initial
data input: _______
Q.C. : _______

Start Date & Time ____________________________ Location ____________________________________

End Date & Time _____________________________ Crew _______________________________________

Trap Condition Code ______
( 1= normal, 2= partial blockage, 3= total Block, 4= cone stopped)

Turbidity (ntu's) ____________

Flow from Internet (cfs) ___________

Guage (MLM or DCV) ______________

Nets of Debris ____________

Water Temperature ( C° or F° ) ________

Air Temperature ( C° or F° ) ________

Time for 10 Revolutions of Cone (sec.) __________

Weather ____________
( 1= clear, 2=part cloudy, 3=cloudy, 4=rain, 5=snow, 6=fog)

Trap Comments:

**Non-Chinook Catch Summary** (Indicate species and fork length (( & weight for Rainbows)))

| Species / Count | | | | | | | RAITRO length | weight | stage |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |
| # extra | | | | | | | | | |
| TOTAL | | | | | | | | | |

OTHER FISH COMMENTS: If no code written down, fish is assummed Code 1 ALIVE (see below)
***Codes*** for all fish: 1= Alive, 2= Mort (circle FL), 3= Recapture, 4= Samples taken, 5= Diseased, 6= Other
***Stages*** for RAITRO (write next to FL & wt.): 1= yolk-sac fry, 2= fry, 3= parr, 4= silvery parr, 5= smolt, 6= adult

NCNCR, Red Bluff

**Appendix A-2**.— Back of data sheet

| Chinook Salmon | | | | | | *Frequent Red Bluff tribtary Codes:* | |
|---|---|---|---|---|---|---|---|
| FL | **Salmon** Weight(s) other | FL | **Salmon** Weight | FL | **Salmon** Wt. | COMMON NAME | CODE |
| 25 | | 80 | | 135 | | bluegill | **BLUEGI** |
| 26 | | 81 | | 136 | | | |
| 27 | | 82 | | 137 | | brown trout | **BRWTRO** |
| 28 | | 83 | | 138 | | | |
| 29 | | 84 | | 139 | | California roach (western) | **CALROA** |
| 30 | | 85 | | 140 | | | |
| 31 | | 86 | | 141 | | chinook salmon (king) | **CHISAL** |
| 32 | | 87 | | 142 | | | |
| 33 | | 88 | | 143 | | dace spp. | **DACSPP** |
| 34 | | 89 | | 144 | | | |
| 35 | | 90 | | 145 | | FISH UNKNOWN | **FISUNK** |
| 36 | | 91 | | 146 | | | |
| 37 | | 92 | | 147 | | green sunfish | **GRESUN** |
| 38 | | 93 | | 148 | | | |
| 39 | | 94 | | 149 | | hardhead | **HARDHE** |
| 40 | | 95 | | 150 | | | |
| 41 | | 96 | | 151 | | lamprey spp. | **LAMSPP** |
| 42 | | 97 | | 152 | | | |
| 43 | | 98 | | 153 | | largemouth bass | **LARBAS** |
| 44 | | 99 | | 154 | | | |
| 45 | | 100 | | 155 | | minnows spp. | **MINSPP** |
| 46 | | 101 | | 156 | | | |
| 47 | | 102 | | 157 | | Pacific lamprey | **PACLAM** |
| 48 | | 103 | | 158 | | | |
| 49 | | 104 | | 159 | | prickly sculpin | **PRISCU** |
| 50 | | 105 | | 160 | | | |
| 51 | | 106 | | 161 | | rainbow trout (steelhead) | **RAITRO** |
| 52 | | 107 | | 162 | | | |
| 53 | | 108 | | 163 | | riffle sculpin | **RIFSCU** |
| 54 | | 109 | | 164 | | | |
| 55 | | 110 | | 165 | | river lamprey | **RIVLAM** |
| 56 | | 111 | | 166 | | | |
| 57 | | 112 | | 167 | | Sac. pikeminnow (squawfish) | **SACPIK** |
| 58 | | 113 | | 168 | | | |
| 59 | | 114 | | 169 | | Sacramento sucker (western) | **SACSUC** |
| 60 | | 115 | | 170 | | | |
| 61 | | 116 | | 171 | | sculpin spp. | **SCUSPP** |
| 62 | | 117 | | 172 | | | |
| 63 | | 118 | | 173 | | smallmouth bass | **SMABAS** |
| 64 | | 119 | | 174 | | | |
| 65 | | 120 | | 175 | | speckled dace | **SPEDAC** |
| 66 | | 121 | | 176 | | | |
| 67 | | 122 | | 177 | | splittail (Sacramento splittail) | **SPLITT** |
| 68 | | 123 | | 178 | | | |
| 69 | | 124 | | 179 | | sunfish spp. (Lepomis...) | **SUNSPP** |
| 70 | | 125 | | 180 | | | |
| 71 | | 126 | | other: | | threespine stickleback | **THRSTI** |
| 72 | | 127 | | | | | |
| 73 | | 128 | | | | western (Pacific) brook lamprey | **WEBLAM** |
| 74 | | 129 | | | | | |
| 75 | | 130 | | | | | |
| 76 | | 131 | | | | | |
| 77 | | 132 | | | | | |
| 78 | | 133 | | | | | |
| 79 | | 134 | | | | | |
| **Total Measured** ______ | | **Total Unmeasured** ______ | | **Total Caught** ______ | | | |

Notes:
**Measure up to 50 salmon/rainbow trout per trap (weigh 20) and at least 20 of other species, count remainder.**
Ensure that randomn lengths are measured (I.e. do not measure all big fish first).
***Codes*** for all fish: 1= Alive, 2= Mort (circle FL), 3= Recapture, 4= Samples taken, 5= Diseased, 6= Other

**Appendix B: Mill Creek Rotary Screw Trap Monthly Catch and Flow Summary Tables for Years 1996 - 2010**

**Table 1.**– Number of days the rotary screw trap fished, minimum and maximum recorded stream discharge, yearling Chinook catch total, young of the year Chinook catch total, *O. mykiss* catch total and minimum and maximum fork-lengths observed in the monthly totals of yearling Chinook, young of the year Chinook, and *O. mykiss* measured in millimeters at the Mill Creek rotary screw trap for the month of October for years 1996 – 2009.

| Year | Days Fished | Stream Discharge (cfs) | Yearling Chinook Total | Range of Fork-lengths (mm) | Young of the Year Total | Range of Fork-lengths (mm) | O. mykiss Total | Range of Fork-lengths (mm) |
|---|---|---|---|---|---|---|---|---|
| 1996 | 28 | n/a | 0 | n/a | 0 | n/a | 0 | n/a |
| 1997 | 30 | n/a | 0 | n/a | 0 | n/a | 28 | 65 - 150 |
| 1998 | 5 | 119 - 196 | 0 | n/a | 0 | n/a | 0 | n/a |
| 1999 | 23 | 112 - 731 | 18 | 68 - 140 | 0 | n/a | 23 | 61 - 250 |
| 2000 | 28 | 109 - 359 | 58 | 82 - 158 | 0 | n/a | 22 | 59 - 211 |
| 2001 | 20 | 88 - 218 | 55 | 59 - 120 | 0 | n/a | 5 | 100 - 183 |
| 2002 | 0 | 92 - 97 | 0 | n/a | 0 | n/a | 0 | n/a |
| 2003 | 7 | 107 - 126 | 1 | 106 | 0 | n/a | 0 | n/a |
| 2004 | 10 | 97 - 680 | 42 | 72 - 116 | 0 | n/a | 16 | 54 - 224 |
| 2005 | 7 | 100 - 134 | 38 | 78 - 134 | 0 | n/a | 0 | n/a |
| 2006 | 8 | 134 - 147 | 4 | 72 - 78 | 0 | n/a | 1 | 182 |
| 2007 | 15 | 98 - 319 | 708 | 62 - 118 | 0 | n/a | 42 | 55 - 100 |
| 2008 | 15 | 87 - 257 | 2 | 88 - 93 | 0 | n/a | 0 | n/a |
| 2009 | 12 | 77 - 290 | 20 | 77 - 120 | 0 | n/a | 12 | 84 - 245 |
| **Totals:** | **208** | | **946** | | **0** | | **149** | |

**Table 2.**— Number of days the rotary screw trap fished, minimum and maximum recorded stream discharge, yearling Chinook catch total, young of the year Chinook catch total, *O. mykiss* catch total and minimum and maximum fork-lengths observed in the monthly totals of yearling Chinook, young of the year Chinook, and *O. mykiss* measured in millimeters at the Mill Creek rotary screw trap for the month of November for years 1996 – 2009.

| Year | Days Fished | Stream Discharge (cfs) | Yearling Chinook Total | Range of Fork-lengths (mm) | Young of the Year Total | Range of Fork-lengths (mm) | O. mykiss Total | Range of Fork-lengths (mm) |
|---|---|---|---|---|---|---|---|---|
| 1996 | 30 | n/a | 9 | 97 - 119 | 0 | n/a | 13 | 68 - 145 |
| 1997 | 22 | 134 - 1302 | 1 | 55 | 0 | n/a | 11 | 75 - 210 |
| 1998 | 22 | 129 - 3831 | 0 | n/a | 1 | 34 | 10 | 65 - 157 |
| 1999 | 29 | 129 - 457 | 0 | n/a | 0 | n/a | 6 | 51 - 156 |
| 2000 | 30 | 116 - 201 | 62 | 76 - 136 | 0 | n/a | 3 | 115 - 156 |
| 2001 | 30 | 104 - 1718 | 812 | 70 - 126 | 0 | n/a | 330 | 47 - 233 |
| 2002 | 13 | 95 - 566 | 100 | 74 - 171 | 0 | n/a | 5 | 51 - 222 |
| 2003 | 30 | 109 - 267 | 49 | 79 - 132 | 0 | n/a | 0 | n/a |
| 2004 | 30 | 129 - 273 | 21 | 82 - 125 | 0 | n/a | 0 | n/a |
| 2005 | 26 | 116 - 2620 | 73 | 70 - 134 | 0 | n/a | 9 | 60 - 165 |
| 2006 | 30 | 136 - 270 | 5 | 93 - 134 | 1 | 33 | 4 | 87 - 133 |
| 2007 | 30 | 95 - 157 | 226 | 67 - 126 | 0 | n/a | 12 | 64 - 284 |
| 2008 | 30 | 95 - 480 | 166 | 69 - 113 | 0 | n/a | 11 | 79 - 195 |
| 2009 | 30 | 91 - 138 | 9 | 82 - 109 | 0 | n/a | 3 | 164 - 261 |
| **Totals:** | | | **1,533** | | **2** | | **417** | |

**Table 3.**— Number of days the rotary screw trap fished, minimum and maximum recorded stream discharge, yearling Chinook catch total, young of the year Chinook catch total, *O. mykiss* catch total and minimum and maximum fork-lengths observed in the monthly totals of yearling Chinook, young of the year Chinook, and *O. mykiss* measured in millimeters at the Mill Creek rotary screw trap for the month of December for years 1996 – 2009.

| Year | Days Fished | Stream Discharge (cfs) | Yearling Chinook Total | Range of Fork-lengths (mm) | Young of the Year Total | Range of Fork-lengths (mm) | O. mykiss Total | Range of Fork-lengths (mm) |
|---|---|---|---|---|---|---|---|---|
| 1996 | 6 | n/a | 1 | 93 | 0 | n/a | 0 | n/a |
| 1997 | 15 | 155 - 2351 | 0 | n/a | 0 | n/a | 6 | 67 - 152 |
| 1998 | 20 | 198 - 2462 | 2 | 113 - 122 | 5 | 33 - 37 | 4 | 47 - 192 |
| 1999 | 31 | 136 - 276 | 5 | 91 - 110 | 2 | 37 - 38 | 1 | 117 |
| 2000 | 31 | 116 - 193 | 48 | 86 - 137 | 70 | 31 - 36 | 2 | 180 - 276 |
| 2001 | 27 | 139 - 2406 | 138 | 70 - 115 | 53 | 29 - 36 | 41 | 67 - 258 |
| 2002 | 11 | 107 - 6390 | 6 | 87 - 114 | 0 | n/a | 1 | 155 |
| 2003 | 20 | 134 - 2890 | 87 | 75 - 121 | 22 | 32 - 41 | 4 | 84 - 224 |
| 2004 | 21 | 134 - 1710 | 24 | 85 - 120 | 0 | n/a | 0 | n/a |
| 2005 | 13 | 136 - 6760 | 18 | 82 - 104 | 1 | 34 | 7 | 156 - 276 |
| 2006 | 26 | 162 - 1040 | 26 | 79 - 128 | 78 | 32 - 38 | 10 | 105 - 210 |
| 2007 | 29 | 100 - 451 | 464 | 59 - 122 | 2 | 34 | 43 | 57 - 280 |
| 2008 | 30 | 85 - 824 | 34 | 75 - 118 | 0 | n/a | 4 | 174 - 233 |
| 2009 | 30 | 83 - 426 | 74 | 82 - 115 | 2 | 35 - 37 | 3 | 59 - 166 |
| **Totals:** | **316** | | **927** | | **240** | | **127** | |

**Table 4.**— Number of days the rotary screw trap fished, minimum and maximum recorded stream discharge, yearling Chinook catch total, young of the year Chinook catch total, *O. mykiss* catch total and minimum and maximum fork-lengths observed in the monthly totals of yearling Chinook, young of the year Chinook, and *O. mykiss* measured in millimeters at the Mill Creek rotary screw trap for the month of January for years 1996 – 2010.

| Year | Days Fished | Stream Discharge (cfs) | Yearling Chinook Total | Range of Fork-lengths (mm) | Young of the Year Total | Range of Fork-lengths (mm) | O. mykiss Total | Range of Fork-lengths (mm) |
|---|---|---|---|---|---|---|---|---|
| 1996 | 0 | n/a | 0 | n/a | 0 | n/a | 0 | n/a |
| 1997 | 0 | 153 - 3450 | 0 | n/a | 0 | n/a | 0 | n/a |
| 1998 | 9 | 153 - 3450 | 0 | n/a | 46 | 31 - 39 | 6 | 95 - 175 |
| 1999 | 31 | 175 - 1589 | 10 | 98 - 120 | 1,212 | 32 - 41 | 3 | 47 - 225 |
| 2000 | 29 | 134 - 1278 | 8 | 87 - 131 | 974 | 32 - 45 | 8 | 99 - 244 |
| 2001 | 31 | 119 - 1123 | 170 | 82 - 129 | 910 | 31 - 43 | 21 | 63 - 254 |
| 2002 | 22 | 169 - 2454 | 10 | 87 - 103 | 219 | 32 - 44 | 5 | 66 - 212 |
| 2003 | 0 | 291 - 2660 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2004 | 15 | 180 - 2050 | 4 | 85 - 105 | 2,005 | 29 - 45 | 1 | 227 |
| 2005 | 28 | 182 - 1230 | 15 | 88 - 119 | 879 | 29 - 42 | 0 | n/a |
| 2006 | 21 | 365 - 3970 | 6 | 90 - 116 | 130 | 32 - 38 | 2 | 169 - 191 |
| 2007 | 31 | 164 - 535 | 5 | 104 - 112 | 206 | 29 - 39 | 0 | n/a |
| 2008 | 16 | 115 - 3430 | 26 | 69 - 97 | 113 | 33 - 40 | 8 | 68 - 166 |
| 2009 | 31 | 111 - 1170 | 5 | 82 - 104 | 60 | 33 - 42 | 1 | 88 |
| 2010 | 17 | 129 - 4460 | 9 | 89 - 120 | 83 | 32 - 40 | 4 | 64 - 215 |
| **Totals:** | **281** | | **268** | | **6,837** | | **59** | |

**Table 5.**— Number of days the rotary screw trap fished, minimum and maximum recorded stream discharge, yearling Chinook catch total, young of the year Chinook catch total, *O. mykiss* catch total and minimum and maximum fork-lengths observed in the monthly totals of yearling Chinook, young of the year Chinook, and *O. mykiss* measured in millimeters at the Mill Creek rotary screw trap for the month of February for years 1996 – 2010.

| Year | Days Fished | Stream Discharge (cfs) | Yearling Chinook Total | Range of Fork-lengths (mm) | Young of the Year Total | Range of Fork-lengths (mm) | O. mykiss Total | Range of Fork-lengths (mm) |
|---|---|---|---|---|---|---|---|---|
| 1996 | 13 | n/a | 0 | n/a | 90 | 33 - 41 | 0 | n/a |
| 1997 | 0 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| 1998 | 0 | 387 - 4456 | n/a | n/a | n/a | n/a | n/a | n/a |
| 1999 | 0 | 255 - 4863 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2000 | 15 | 309 - 3769 | 8 | 94 - 113 | 516 | 32 - 59 | 3 | 58 - 110 |
| 2001 | 13 | 142 - 1278 | 19 | 87 - 128 | 339 | 31 - 44 | 2 | 147 - 220 |
| 2002 | 17 | 159 - 673 | 29 | 91 - 110 | 4,571 | 32 - 53 | 20 | 49 - 290 |
| 2003 | 12 | 264 - 589 | 3 | 84 - 109 | 50 | 30 - 43 | 13 | 55 - 260 |
| 2004 | 14 | 190 - 6320 | 8 | 85 - 105 | 2,225 | 30 - 46 | 1 | 219 |
| 2005 | 26 | 249 - 781 | 17 | 89 - 123 | 2,288 | 28 - 58 | 4 | 159 - 253 |
| 2006 | 22 | 279 - 8570 | 1 | 101 | 97 | 33 - 43 | 7 | 211 - 233 |
| 2007 | 24 | 155 - 3100 | 13 | 92 - 113 | 3,052 | 29 - 51 | 33 | 71 - 210 |
| 2008 | 24 | 200 - 2040 | 10 | 83 - 105 | 638 | 33 - 46 | 37 | 76 - 254 |
| 2009 | 15 | 124 - 2910 | 5 | 96 - 110 | 18 | 34 - 45 | 0 | n/a |
| 2010 | 24 | 232 - 2560 | 14 | 89 - 117 | 1,277 | 30 - 47 | 2 | 208 - 209 |
| **Totals:** | **219** | | **127** | | **15,161** | | **122** | |

**Table 6.**— Number of days the rotary screw trap fished, minimum and maximum recorded stream discharge, yearling Chinook catch total, young of the year Chinook catch total, *O. mykiss* catch total and minimum and maximum fork-lengths observed in the monthly totals of yearling Chinook, young of the year Chinook, and *O. mykiss* measured in millimeters at the Mill Creek rotary screw trap for the month of March for years 1996 – 2010.

| Year | Days Fished | Stream Discharge (cfs) | Yearling Chinook Total | Range of Fork-lengths (mm) | Young of the Year Total | Range of Fork-lengths (mm) | O. mykiss Total | Range of Fork-lengths (mm) |
|---|---|---|---|---|---|---|---|---|
| 1996 | 25 | n/a | 0 | n/a | 52 | 33 - 50 | 5 | 139 - 200 |
| 1997 | 0 | 246 - 758 | n/a | n/a | n/a | n/a | n/a | n/a |
| 1998 | 0 | 298 - 2725 | n/a | n/a | n/a | n/a | n/a | n/a |
| 1999 | 0 | 337 - 1601 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2000 | 31 | 328 - 1522 | 7 | 95 - 122 | 143 | 35 - 67 | 6 | 95 - 300 |
| 2001 | 21 | 207 - 1499 | 30 | 95 - 126 | 619 | 31 - 51 | 71 | 95 - 242 |
| 2002 | 17 | 226 - 1124 | 69 | 88 - 119 | 3,344 | 33 - 64 | 64 | 64 - 257 |
| 2003 | 16 | 209 - 4490 | 9 | 91 - 125 | 608 | 31 - 54 | 17 | 52 - 279 |
| 2004 | 0 | 334 - 888 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2005 | 21 | 185 - 1540 | 37 | 81 - 126 | 8,469 | 28 - 63 | 35 | 96 - 250 |
| 2006 | 11 | 394 - 6190 | 0 | n/a | 58 | 35 - 42 | 29 | 32 - 221 |
| 2007 | 31 | 240 - 410 | 6 | 104 - 122 | 4,902 | 29 - 66 | 36 | 80 - 234 |
| 2008 | 31 | 193 - 375 | 1 | 90 | 3,503 | 32 - 52 | 20 | 75 - 213 |
| 2009 | 0 | 206 - 5610 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2010 | 29 | 265 - 1290 | 12 | 95 - 141 | 762 | 31 - 64 | 19 | 96 - 245 |
| **Totals:** | **233** | | **171** | | **22,460** | | **302** | |

**Table 7.**—Number of days the rotary screw trap fished, minimum and maximum recorded stream discharge, yearling Chinook catch total, young of the year Chinook catch total, *O. mykiss* catch total and minimum and maximum fork-lengths observed in the monthly totals of yearling Chinook, young of the year Chinook, and *O. mykiss* measured in millimeters at the Mill Creek rotary screw trap for the month of April for years 1996 – 2010.

| Year | Days Fished | Stream Discharge (cfs) | Yearling Chinook Total | Range of Fork-lengths (mm) | Young of the Year Total | Range of Fork-lengths (mm) | O. mykiss Total | Range of Fork-lengths (mm) |
|---|---|---|---|---|---|---|---|---|
| 1996 | 26 | n/a | 0 | n/a | 11 | 33 - 55 | 2 | 180 - 190 |
| 1997 | 0 | 229 - 754 | n/a | n/a | n/a | n/a | n/a | n/a |
| 1998 | 0 | 407 - 922 | n/a | n/a | n/a | n/a | n/a | n/a |
| 1999 | 0 | 288 - 694 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2000 | 30 | 328 - 673 | 3 | 130 -132 | 16 | 34 - 84 | 14 | 113 - 230 |
| 2001 | 23 | 180 - 378 | 43 | 91 - 134 | 194 | 33 - 85 | 129 | 95 - 245 |
| 2002 | 16 | 279 - 649 | 21 | 95 - 122 | 394 | 31 - 81 | 255 | 75 - 262 |
| 2003 | 17 | 387 - 2240 | 9 | 99 - 112 | 120 | 32 - 83 | 29 | 96 - 255 |
| 2004 | 2 | 309 - 504 | 0 | n/a | 2 | 71 - 75 | 6 | 195 - 224 |
| 2005 | 29 | 235 - 440 | 9 | 93 - 129 | 1,120 | 32 - 86 | 38 | 23 - 266 |
| 2006 | 12 | 665 - 5000 | 0 | n/a | 10 | 34 - 49 | 32 | 170 - 254 |
| 2007 | 29 | 198 - 340 | 10 | 91 - 130 | 2,257 | 34 - 84 | 127 | 33 - 274 |
| 2008 | 30 | 213 - 474 | 3 | 100 - 116 | 1,453 | 33 - 61 | 72 | 91 - 257 |
| 2009 | 17 | 195 - 457 | 13 | 100 - 130 | 94 | 37 - 86 | 75 | 95 - 266 |
| 2010 | 25 | 259 - 1580 | 45 | 96 - 135 | 126 | 33 - 81 | 17 | 25 - 237 |
| **Totals:** | **256** | | **156** | | **5,797** | | **796** | |

**Table 8.**—Number of days the rotary screw trap fished, minimum and maximum recorded stream discharge, yearling Chinook catch total, young of the year Chinook catch total, *O. mykiss* catch total and minimum and maximum fork-lengths observed in the monthly totals of yearling Chinook, young of the year Chinook, and *O. mykiss* measured in millimeters at the Mill Creek rotary screw trap for the month of May for years 1996 – 2010.

| Year | Days Fished | Stream Discharge (cfs) | Yearling Chinook Total | Range of Fork-lengths (mm) | Young of the Year Total | Range of Fork-lengths (mm) | O. mykiss Total | Range of Fork-lengths (mm) |
|---|---|---|---|---|---|---|---|---|
| 1996 | 21 | n/a | 0 | n/a | 13 | 41 - 101 | 10 | 25 - 200 |
| 1997 | 0 | 255 - 443 | n/a | n/a | n/a | n/a | n/a | n/a |
| 1998 | 0 | 486 - 2791 | n/a | n/a | n/a | n/a | n/a | n/a |
| 1999 | 0 | 362 - 751 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2000 | 18 | 288 - 629 | 3 | 100 - 128 | 149 | 53 - 99 | 67 | 24 - 224 |
| 2001 | 19 | 136 - 390 | 5 | 115 - 129 | 1,025 | 45 - 100 | 54 | 28 - 230 |
| 2002 | 18 | 264 - 501 | 1 | 118 | 2,383 | 33 - 98 | 96 | 33 - 235 |
| 2003 | 16 | 473 - 1450 | 0 | n/a | 106 | 32 - 99 | 29 | 31 - 227 |
| 2004 | 23 | 334 - 629 | 2 | 105 - 125 | 135 | 37 - 92 | 51 | 25 - 223 |
| 2005 | 20 | 273 - 2360 | 4 | 100 - 130 | 1,159 | 34 - 98 | 82 | 26 - 226 |
| 2006 | 27 | 473 - 1150 | 0 | n/a | 25 | 55 - 96 | 39 | 147 - 235 |
| 2007 | 31 | 200 - 376 | 0 | n/a | 2,322 | 33 - 97 | 76 | 33 - 255 |
| 2008 | 29 | 227 - 628 | 6 | 101 - 128 | 408 | 32 - 94 | 56 | 30 - 221 |
| 2009 | 22 | 216 - 1450 | 4 | 110 - 124 | 97 | 41 - 95 | 35 | 26 - 227 |
| 2010 | 30 | 322 - 573 | 7 | 118 - 147 | 506 | 39 - 101 | 37 | 33 - 244 |
| **Totals:** | **274** | | **32** | | **8,328** | | **632** | |

**Table 9.**—Number of days the rotary screw trap fished, minimum and maximum recorded stream discharge, yearling Chinook catch total, young of the year Chinook catch total, *O. mykiss* catch total and minimum and maximum fork-lengths observed in the monthly totals of yearling Chinook, young of the year Chinook, and *O. mykiss* measured in millimeters at the Mill Creek rotary screw trap for the month of June for years 1996 – 2010.

| Year | Days Fished | Stream Discharge (cfs) | Yearling Chinook Total | Range of Fork-lengths (mm) | Young of the Year Total | Range of Fork-lengths (mm) | O. mykiss Total | Range of Fork-lengths (mm) |
|---|---|---|---|---|---|---|---|---|
| 1996 | 28 | n/a | 0 | n/a | 3 | 71 - 89 | 8 | 43 - 75 |
| 1997 | 0 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| 1998 | 0 | 483 - 1302 | n/a | n/a | n/a | n/a | n/a | n/a |
| 1999 | 0 | 288 - 613 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2000 | 16 | 215 - 378 | 0 | n/a | 12 | 54 - 95 | 36 | 32 - 226 |
| 2001 | 1 | 102 - 180 | 0 | n/a | 2 | 79 - 80 | 1 | 180 |
| 2002 | 12 | 159 - 504 | 0 | n/a | 191 | 34 - 93 | 80 | 28 - 166 |
| 2003 | 0 | 312 - 751 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2004 | 0 | 235 - 443 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2005 | 15 | 288 - 535 | 0 | n/a | 84 | 46 - 96 | 14 | 31 - 60 |
| 2006 | 23 | 433 - 710 | 0 | n/a | 10 | 60 - 98 | 11 | 31 - 283 |
| 2007 | 15 | 118 - 216 | 0 | n/a | 102 | 51 - 94 | 23 | 31 - 205 |
| 2008 | 13 | 141 - 257 | 0 | n/a | 7 | 47 - 80 | 4 | 35 - 170 |
| 2009 | 20 | 138 - 311 | 0 | n/a | 8 | 63 - 82 | 10 | 23 - 243 |
| 2010 | 27 | 370 - 814 | 4 | 108 - 125 | 121 | 45 - 100 | 38 | 29 - 260 |
| **Totals:** | **170** | | **4** | | **540** | | **225** | |

## Appendix C: Deer Creek Rotary Screw Trap Monthly Catch and Flow Summary Tables for Years 1994 – 2010

**Table 1.**— Number of days the rotary screw trap fished, minimum and maximum recorded stream discharge, yearling Chinook catch total, young of the year Chinook catch total, *O. mykiss* catch total and minimum and maximum fork-lengths observed in the monthly totals of yearling Chinook, young of the year Chinook, and *O. mykiss* measured in millimeters at the Deer Creek rotary screw trap for the month of October for years 1994 – 2009.

| Year | Days Fished | Stream Discharge (cfs) | Yearling Chinook Total | Range of Fork-lengths (mm) | Young of the Year Total | Range of Fork-lengths (mm) | O. mykiss Total | Range of Fork-lengths (mm) |
|---|---|---|---|---|---|---|---|---|
| 1994 | 31 | n/a | 20 | 91 - 133 | 0 | n/a | 2 | 150 |
| 1995 | 31 | n/a | 0 | n/a | 0 | n/a | 1 | 126 |
| 1996 | 14 | n/a | 0 | n/a | 0 | n/a | 0 | n/a |
| 1997 | 31 | 105 - 216 | 0 | n/a | 0 | n/a | 13 | 73 - 120 |
| 1998 | 5 | 118 - 185 | 0 | n/a | 0 | n/a | 3 | 68 - 120 |
| 1999 | 16 | 118 - 463 | 63 | 74 - 153 | 0 | n/a | 10 | 88 - 183 |
| 2000 | 26 | 101 - 320 | 129 | 58 - 135 | 0 | n/a | 14 | 74 - 180 |
| 2001 | 15 | 75 - 161 | 6 | 73 - 100 | 0 | n/a | 1 | 199 |
| 2002 | 3 | 79 - 84 | 0 | n/a | 0 | n/a | 0 | n/a |
| 2003 | 0 | 98 - 126 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2004 | 9 | 79 - 339 | 79 | 57 - 130 | 0 | n/a | 0 | n/a |
| 2005 | 0 | 92 - 124 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2006 | 1 | 126 - 137 | 0 | n/a | 0 | n/a | 0 | n/a |
| 2007 | 0 | 88 - 156 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2008 | 0 | 75 - 125 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2009 | 0 | 71 - 235 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2010 | 0 | 85 - 104 | n/a | n/a | n/a | n/a | n/a | n/a |
| **Totals:** | **182** | | **297** | | **0** | | **44** | |

**Table 2.**— Number of days the rotary screw trap fished, minimum and maximum recorded stream discharge, yearling Chinook catch total, young of the year Chinook catch total, *O. mykiss* catch total and minimum and maximum fork-lengths observed in the monthly totals of yearling Chinook, young of the year Chinook, and *O. mykiss* measured in millimeters at the Deer Creek rotary screw trap for the month of November for years 1994 – 2009.

| Year | Days Fished | Stream Discharge (cfs) | Yearling Chinook Total | Range of Fork-lengths (mm) | Young of the Year Total | Range of Fork-lengths (mm) | O. mykiss Total | Range of Fork-lengths (mm) |
|---|---|---|---|---|---|---|---|---|
| 1994 | 30 | n/a | 771 | 67 -135 | 0 | n/a | 94 | 68 - 299 |
| 1995 | 30 | n/a | 0 | n/a | 0 | n/a | 0 | n/a |
| 1996 | 30 | n/a | 103 | 66 - 118 | 0 | n/a | 17 | 76 - 190 |
| 1997 | 30 | n/a | 0 | n/a | 0 | n/a | 91 | 55 - 164 |
| 1998 | 30 | 125 - 4732 | 97 | 67 - 122 | 3 | 32 - 34 | 42 | 71 - 200 |
| 1999 | 28 | 131 - 468 | 27 | 73 - 119 | 0 | n/a | 6 | 77 - 183 |
| 2000 | 30 | 109 - 217 | 169 | 64 - 130 | 0 | n/a | 6 | 77 - 191 |
| 2001 | 30 | 74 - 1330 | 457 | 62 - 114 | 0 | n/a | 60 | 65 - 230 |
| 2002 | 14 | 98 - 2953 | 166 | 59 - 108 | 0 | n/a | 4 | 75 - 224 |
| 2003 | 18 | 105 - 224 | 16 | 59 - 109 | 0 | n/a | 1 | 170 |
| 2004 | 30 | 115 - 188 | 1 | 74 | 0 | n/a | 0 | n/a |
| 2005 | 0 | 100 - 773 | 84 | 58 - 101 | 0 | n/a | 2 | n/a |
| 2006 | 0 | 132 - 327 | n/a | n/a | 0 | n/a | n/a | n/a |
| 2007 | 0 | 73 - 97 | n/a | n/a | 0 | n/a | n/a | n/a |
| 2008 | 0 | 87 - 576 | n/a | n/a | 0 | n/a | n/a | n/a |
| 2009 | 17 | 83 - 117 | 1 | 85 | 0 | n/a | 0 | n/a |
| **Totals:** | **347** | | **1,892** | | **3** | | **323** | |

**Table 3.**— Number of days the rotary screw trap fished, minimum and maximum recorded stream discharge, yearling Chinook catch total, young of the year Chinook catch total, *O. mykiss* catch total and minimum and maximum fork-lengths observed in the monthly totals of yearling Chinook, young of the year Chinook, and *O. mykiss* measured in millimeters at the Deer Creek rotary screw trap for the month of December for years 1994 – 2009.

| Year | Days Fished | Stream Discharge (cfs) | Yearling Chinook Total | Range of Fork-lengths (mm) | Young of the Year Total | Range of Fork-lengths (mm) | O. mykiss Total | Range of Fork-lengths (mm) |
|---|---|---|---|---|---|---|---|---|
| 1994 | 31 | n/a | 265 | 68 - 126 | 0 | n/a | 67 | 109 - 310 |
| 1995 | 31 | n/a | 4 | 107 - 149 | 272 | 30 -42 | 15 | 62 - 260 |
| 1996 | 6 | n/a | 17 | 78 - 107 | 0 | n/a | 2 | 93 - 109 |
| 1997 | 20 | 146 - 1044 | 0 | n/a | 1 | 34 | 42 | 66 - 271 |
| 1998 | 25 | 187 - 1146 | 174 | 52 - 121 | 178 | 30 -38 | 16 | 81 - 230 |
| 1999 | 31 | 105 - 335 | 2 | 91 - 114 | 21 | 36 - 39 | 0 | n/a |
| 2000 | 31 | 76 - 965 | 275 | 66 - 120 | 0 | n/a | 13 | 180 - 273 |
| 2001 | 25 | 173 - 3130 | 200 | 70 - 127 | 4 | 33 - 37 | 11 | 93 - 203 |
| 2002 | 12 | 98 - 736 | 5 | 81 - 93 | 0 | n/a | 1 | 79 |
| 2003 | 23 | 132 - 3540 | 97 | 60 - 112 | 10 | 34 - 40 | 17 | 51 - 215 |
| 2004 | 27 | 118 - 2180 | 103 | 53 - 105 | 5 | 35 - 37 | 2 | 68 - 183 |
| 2005 | 18 | 118 - 1030 | 86 | 73 - 104 | 3 | 31 - 32 | 5 | 169 - 292 |
| 2006 | 17 | 148 - 1740 | 1 | 103 | 180 | 29 - 39 | 8 | 120 - 234 |
| 2007 | 17 | 75 - 376 | 20 | n/a | 0 | n/a | 12 | 145 - 282 |
| 2008 | 0 | 50 - 822 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2009 | 31 | 76 - 481 | 0 | n/a | 1 | 36 | 1 | 87 |
| **Totals:** | **345** | | **1,249** | | **675** | | **212** | |

**Table 4.**— Number of days the rotary screw trap fished, minimum and maximum recorded stream discharge, yearling Chinook catch total, young of the year Chinook catch total, *O. mykiss* catch total and minimum and maximum fork-lengths observed in the monthly totals of yearling Chinook, young of the year Chinook, and *O. mykiss* measured in millimeters at the Deer Creek rotary screw trap for the month of January for years 1995 – 2010.

| Year | Days Fished | Stream Discharge (cfs) | Yearling Chinook Total | Range of Fork-lengths (mm) | Young of the Year Total | Range of Fork-lengths (mm) | O. mykiss Total | Range of Fork-lengths (mm) |
|---|---|---|---|---|---|---|---|---|
| 1995 | 6 | n/a | 35 | 76 - 114 | 0 | n/a | 0 | n/a |
| 1996 | 28 | n/a | 10 | 101 - 118 | 2,540 | 32 - 49 | 7 | 80 - 230 |
| 1997 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| 1998 | 14 | 144 - 2614 | 0 | n/a | 225 | 31 - 42 | 104 | 62 - 190 |
| 1999 | 30 | 155 - 1741 | 64 | 80 - 128 | 6,731 | 33 - 41 | 7 | 70 - 170 |
| 2000 | 25 | 101 - 1331 | 14 | 87 - 125 | 1,336 | 34 - 52 | 3 | 92 - 125 |
| 2001 | 29 | 74 - 606 | 120 | 70 - 116 | 277 | 31 - 38 | 5 | 146 - 245 |
| 2002 | 16 | 178 - 3234 | 12 | 83 - 103 | 126 | 32 - 41 | 4 | 72 - 164 |
| 2003 | 10 | 363 - 2290 | 7 | 75 - 93 | 452 | 30 - 40 | 3 | 70 - 178 |
| 2004 | 19 | 196 - 3030 | 5 | 80 -103 | 704 | 31 - 42 | 1 | 72 |
| 2005 | 27 | 228 - 1160 | 69 | 67 - 115 | 714 | 30 - 38 | 6 | 86 - 228 |
| 2006 | 0 | 409 - 5660 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2007 | 30 | 141 - 451 | 1 | 120 | 169 | 30 - 39 | 2 | 130 - 183 |
| 2008 | 3 | 100 - 3260 | 0 | n/a | 0 | n/a | 0 | n/a |
| 2009 | 25 | 104 - 816 | 6 | 74 - 102 | 66 | 32 - 38 | 1 | 130 |
| 2010 | 22 | 115 - 5450 | 0 | n/a | 138 | 30 - 40 | 2 | 174 - 196 |
| **Totals:** | **284** | | **343** | | **13,478** | | **145** | |

**Table 5.**— Number of days the rotary screw trap fished, minimum and maximum recorded stream discharge, yearling Chinook catch total, young of the year Chinook catch total, *O. mykiss* catch total and minimum and maximum fork-lengths observed in the monthly totals of yearling Chinook, young of the year Chinook, and *O. mykiss* measured in millimeters at the Deer Creek rotary screw trap for the month of February for years 1995 – 2010.

| Year | Days Fished | Stream Discharge (cfs) | Yearling Chinook Total | Range of Fork-lengths (mm) | Young of the Year Total | Range of Fork-lengths (mm) | O. mykiss Total | Range of Fork-lengths (mm) |
|---|---|---|---|---|---|---|---|---|
| 1995 | 11 | n/a | 7 | 84 - 115 | 10 | 33 - 36 | 0 | n/a |
| 1996 | 7 | n/a | 1 | 105 | 584 | 33 - 60 | 4 | 150 - 230 |
| 1997 | 0 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| 1998 | 0 | 976 - 8422 | n/a | n/a | n/a | n/a | n/a | n/a |
| 1999 | 0 | 276 - 2984 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2000 | 12 | 324 - 7264 | 3 | 85 - 119 | 1,660 | 32 - 58 | 0 | n/a |
| 2001 | 12 | 132 - 1703 | 15 | 75 - 112 | 170 | 31 - 45 | 3 | 77 - 95 |
| 2002 | 14 | 137 - 648 | 11 | 82 - 103 | 2,363 | 32 - 54 | 4 | 110 - 159 |
| 2003 | 5 | 273 - 2370 | 2 | 77 - 108 | 354 | 29 - 48 | 5 | 65 - 178 |
| 2004 | 14 | 209 - 8210 | 1 | 104 | 831 | 31 - 46 | 0 | n/a |
| 2005 | 26 | 180 - 773 | 56 | 72 - 116 | 2,271 | 29 - 44 | 0 | n/a |
| 2006 | 9 | 280 - 8250 | 1 | 95 | 34 | 32 - 43 | 3 | 83 - 185 |
| 2007 | 25 | 143 - 3080 | 1 | 115 | 8,345 | 30 - 50 | 5 | 41 - 210 |
| 2008 | 4 | 194 - 3400 | 2 | 88 - 95 | 363 | 32 - 40 | 4 | 58 - 198 |
| 2009 | 18 | 123 - 4140 | 10 | 82 - 109 | 39 | 32 - 39 | 0 | n/a |
| 2010 | 26 | 278 - 3490 | 0 | n/a | 462 | 30 - 51 | 2 | 176 - 189 |
| **Totals:** | **183** | | **111** | | **17,486** | | **30** | |

**Table 6.**— Number of days the rotary screw trap fished, minimum and maximum recorded stream discharge, yearling Chinook catch total, young of the year Chinook catch total, *O. mykiss* catch total and minimum and maximum fork-lengths observed in the monthly totals of yearling Chinook, young of the year Chinook, and *O. mykiss* measured in millimeters at the Deer Creek rotary screw trap for the month of March for years 1995 – 2010.

| Year | Days Fished | Stream Discharge (cfs) | Yearling Chinook Total | Range of Fork-lengths (mm) | Young of the Year Total | Range of Fork-lengths (mm) | O. mykiss Total | Range of Fork-lengths (mm) |
|---|---|---|---|---|---|---|---|---|
| 1995 | 7 | n/a | 2 | 94 - 112 | 28 | 32 - 39 | 6 | 91 - 210 |
| 1996 | 26 | n/a | 0 | n/a | 1,538 | 32 - 75 | 13 | 170 - 290 |
| 1997 | 0 | 401 - 770 | n/a | n/a | n/a | n/a | n/a | n/a |
| 1998 | 0 | 280 - 3085 | n/a | n/a | n/a | n/a | n/a | n/a |
| 1999 | 0 | 592 - 2367 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2000 | 30 | 433 - 4553 | 8 | 88 - 118 | 2,159 | 31 - 73 | 11 | 80 - 380 |
| 2001 | 20 | 239 - 2509 | 17 | 88 - 110 | 482 | 31 - 81 | 17 | 86 - 251 |
| 2002 | 16 | 242 - 1040 | 18 | 83 - 120 | 2,940 | 31 - 76 | 10 | 90 - 210 |
| 2003 | 19 | 220 - 8190 | 11 | 92 - 105 | 951 | 30 - 80 | 13 | 41 - 210 |
| 2004 | 12 | 405 - 1080 | 2 | 90 - 95 | 3,978 | 32 - 76 | 4 | 82 - 125 |
| 2005 | 22 | 215 - 2100 | 134 | 83 - 122 | 3,606 | 28 - 82 | 17 | 82 - 244 |
| 2006 | 7 | 397 - 6840 | 2 | 89 - 90 | 1 | 36 | 12 | 83 - 230 |
| 2007 | 29 | 238 - 460 | 4 | 100 - 114 | 14,451 | 32 - 57 | 26 | 79 - 240 |
| 2008 | 18 | 203 - 392 | 3 | 83 - 94 | 812 | 33 - 52 | 3 | 80 - 196 |
| 2009 | 16 | 254 - 5970 | 0 | n/a | 119 | 34 - 43 | 0 | n/a |
| 2010 | 29 | 298 - 1200 | 1 | 105 | 603 | 28 - 72 | 0 | n/a |
| **Totals:** | **251** | | **202** | | **31,668** | | **132** | |

**Table 7.**— Number of days the rotary screw trap fished, minimum and maximum recorded stream discharge, yearling Chinook catch total, young of the year Chinook catch total, *O. mykiss* catch total and minimum and maximum fork-lengths observed in the monthly totals of yearling Chinook, young of the year Chinook, and *O. mykiss* measured in millimeters at the Deer Creek rotary screw trap for the month of April for years 1995 – 2010.

| Year | Days Fished | Stream Discharge (cfs) | Yearling Chinook Total | Range of Fork-lengths (mm) | Young of the Year Total | Range of Fork-lengths (mm) | O. mykiss Total | Range of Fork-lengths (mm) |
|---|---|---|---|---|---|---|---|---|
| 1995 | 23 | n/a | 0 | n/a | 10 | 33 - 35 | 6 | 175 - 220 |
| 1996 | 22 | n/a | 6 | 91 - 123 | 462 | 32 - 87 | 10 | 170 - 230 |
| 1997 | 0 | 295 - 655 | n/a | n/a | n/a | n/a | n/a | n/a |
| 1998 | 0 | 513 - 909 | n/a | n/a | n/a | n/a | n/a | n/a |
| 1999 | 0 | 508 - 916 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2000 | 29 | 354 - 902 | 5 | 89 - 104 | 854 | 32 - 87 | 7 | 80 - 175 |
| 2001 | 26 | 181 - 430 | 18 | 88 - 120 | 255 | 32 - 77 | 10 | 81 - 228 |
| 2002 | 16 | 266 - 501 | 13 | 89 - 112 | 2,267 | 31 - 82 | 8 | 148 - 230 |
| 2003 | 17 | 405 - 2440 | 0 | n/a | 647 | 30 - 84 | 15 | 22 - 211 |
| 2004 | 29 | 308 - 474 | 3 | 89 - 109 | 1,952 | 29 - 84 | 23 | 28 - 237 |
| 2005 | 30 | 250 - 631 | 73 | 87 - 119 | 2,002 | 30 - 86 | 44 | 26 - 254 |
| 2006 | 1 | 1080 - 6190 | 2 | 97 - 105 | 3 | 35 - 36 | 0 | n/a |
| 2007 | 30 | 145 - 331 | 0 | n/a | 4,929 | 32 - 85 | 23 | 86 - 234 |
| 2008 | 0 | 225 - 397 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2009 | 30 | 177 - 282 | 1 | 95 | 63 | 34 - 62 | 1 | 69 |
| 2010 | 23 | 302 - 2350 | 5 | 92 - 116 | 99 | 34 - 79 | 4 | 198 - 231 |
| **Totals:** | **276** | | **126** | | **13,543** | | **151** | |

**Table 8.**— Number of days the rotary screw trap fished, minimum and maximum recorded stream discharge, yearling Chinook catch total, young of the year Chinook catch total, *O. mykiss* catch total and minimum and maximum fork-lengths observed in the monthly totals of yearling Chinook, young of the year Chinook, and *O. mykiss* measured in millimeters at the Deer Creek rotary screw trap for the month of May for years 1995 – 2010.

| Year | Days Fished | Stream Discharge (cfs) | Yearling Chinook Total | Range of Fork-lengths (mm) | Young of the Year Total | Range of Fork-lengths (mm) | O. mykiss Total | Range of Fork-lengths (mm) |
|---|---|---|---|---|---|---|---|---|
| 1995 | 22 | n/a | 0 | n/a | 2 | 59 - 60 | 5 | 180 - 220 |
| 1996 | 11 | n/a | 1 | 97 | 209 | 36 - 89 | 17 | 24 - 244 |
| 1997 | 0 | 177 - 411 | n/a | n/a | n/a | n/a | n/a | n/a |
| 1998 | 0 | 554 - 3085 | n/a | n/a | n/a | n/a | n/a | n/a |
| 1999 | 0 | 316 - 739 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2000 | 20 | 160 - 403 | 1 | 94 | 288 | 32 - 84 | 0 | n/a |
| 2001 | 18 | 99 - 244 | 1 | 118 | 470 | 40 - 89 | 3 | 173 - 223 |
| 2002 | 20 | 137 - 266 | 0 | n/a | 549 | 33 - 90 | 9 | 36 - 195 |
| 2003 | 11 | 384 - 1970 | 0 | n/a | 296 | 33 - 85 | 18 | 25 - 203 |
| 2004 | 29 | 168 - 335 | 0 | n/a | 1,939 | 31 - 88 | 7 | 34 - 198 |
| 2005 | 20 | 280 - 1650 | 3 | 94 - 100 | 2,122 | 29 - 93 | 31 | 26 - 275 |
| 2006 | 21 | 396 - 1500 | 0 | n/a | 61 | 47 - 84 | 9 | 112 - 219 |
| 2007 | 18 | 132 - 630 | 0 | n/a | 2,250 | 35 - 91 | 9 | 25 - 208 |
| 2008 | 0 | 155 - 1120 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2009 | 27 | 150 - 1120 | 0 | n/a | 3 | 59 - 63 | 0 | n/a |
| 2010 | 24 | 342 - 741 | 4 | 94 - 103 | 144 | 35 - 93 | 5 | 26 - 222 |
| **Totals:** | **241** | | **10** | | **8,333** | | **113** | |

**Table 9.**— Number of days the rotary screw trap fished, minimum and maximum recorded stream discharge, yearling Chinook catch total, young of the year Chinook catch total, *O. mykiss* catch total and minimum and maximum fork-lengths observed in the monthly totals of yearling Chinook, young of the year Chinook, and *O. mykiss* measured in millimeters at the Deer Creek rotary screw trap for the month of June for years 1995 – 2010.

| Year | Days Fished | Stream Discharge (cfs) | Yearling Chinook Total | Range of Fork-lengths (mm) | Young of the Year Total | Range of Fork-lengths (mm) | O. mykiss Total | Range of Fork-lengths (mm) |
|---|---|---|---|---|---|---|---|---|
| 1995 | 21 | n/a | 0 | n/a | 2 | 60 - 85 | 3 | 192 - 280 |
| 1996 | 28 | n/a | 0 | n/a | 16 | 59 - 89 | 4 | 36 - 59 |
| 1997 | 0 | 140 - 246 | n/a | n/a | n/a | n/a | n/a | n/a |
| 1998 | 0 | 358 - 2044 | n/a | n/a | n/a | n/a | n/a | n/a |
| 1999 | 0 | 174 - 375 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2000 | 30 | 105 - 176 | 0 | n/a | 27 | 44 - 87 | 2 | 70 - 164 |
| 2001 | 0 | 86 - 141 | 0 | n/a | 0 | n/a | 0 | n/a |
| 2002 | 0 | 92 - 137 | 0 | n/a | 0 | n/a | 0 | n/a |
| 2003 | 0 | 163 - 384 | 0 | n/a | 0 | n/a | 0 | n/a |
| 2004 | 3 | 111 - 168 | 0 | n/a | 10 | 45 - 90 | 0 | n/a |
| 2005 | 9 | 188 - 439 | 0 | n/a | 80 | 41 - 86 | 6 | 39 - 290 |
| 2006 | 7 | 215 - 392 | 0 | n/a | 5 | 60 - 83 | 4 | 27 - 283 |
| 2007 | 0 | 80 - 141 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2008 | 0 | 79 - 158 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2009 | 0 | 98 - 194 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2010 | 0 | 147 - 408 | n/a | n/a | n/a | n/a | n/a | n/a |
| **Totals:** | **98** | | **0** | | **140** | | **19** | |

**Appendix D: Yearling Chinook catch vs. flow charts for the months of October and November for Mill Creek**

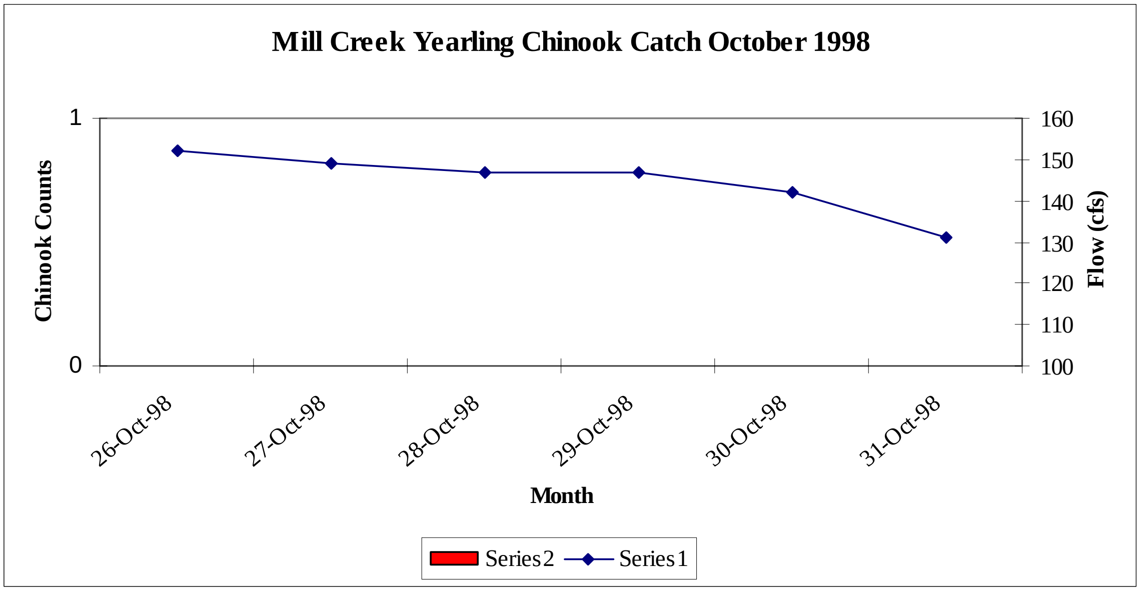


**Figure 1**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for October 1998. The trap was set on 25-October and fished through the rest of the month. Zero yearling Chinook were caught during this time period.

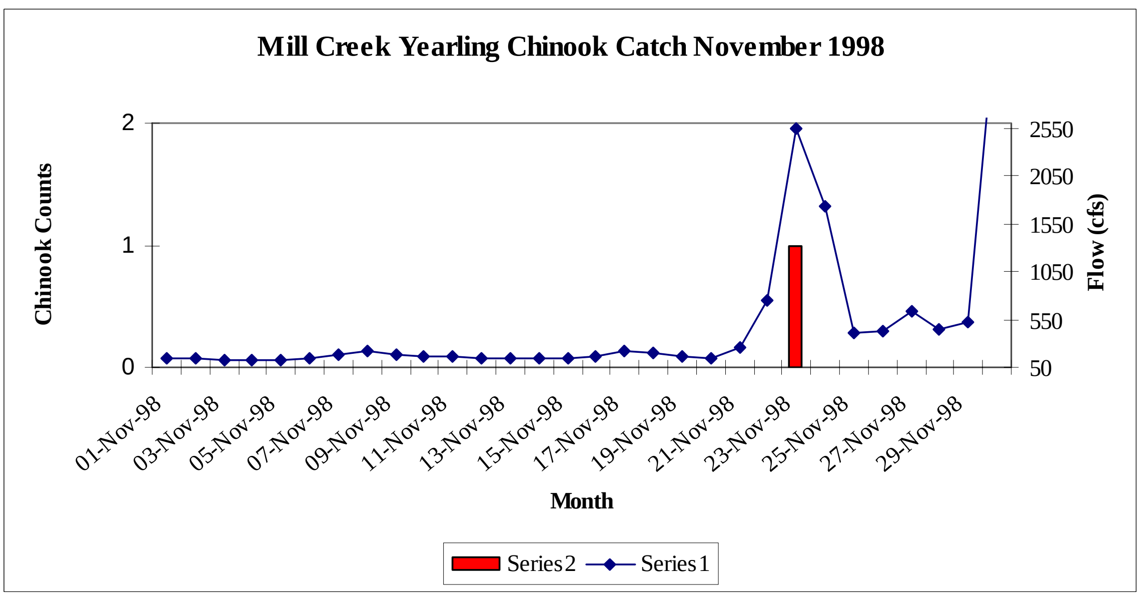


**Figure 2**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for November1998. The trap sampled continuously for the month. A total of one yearling Chinook was sampled during this period.

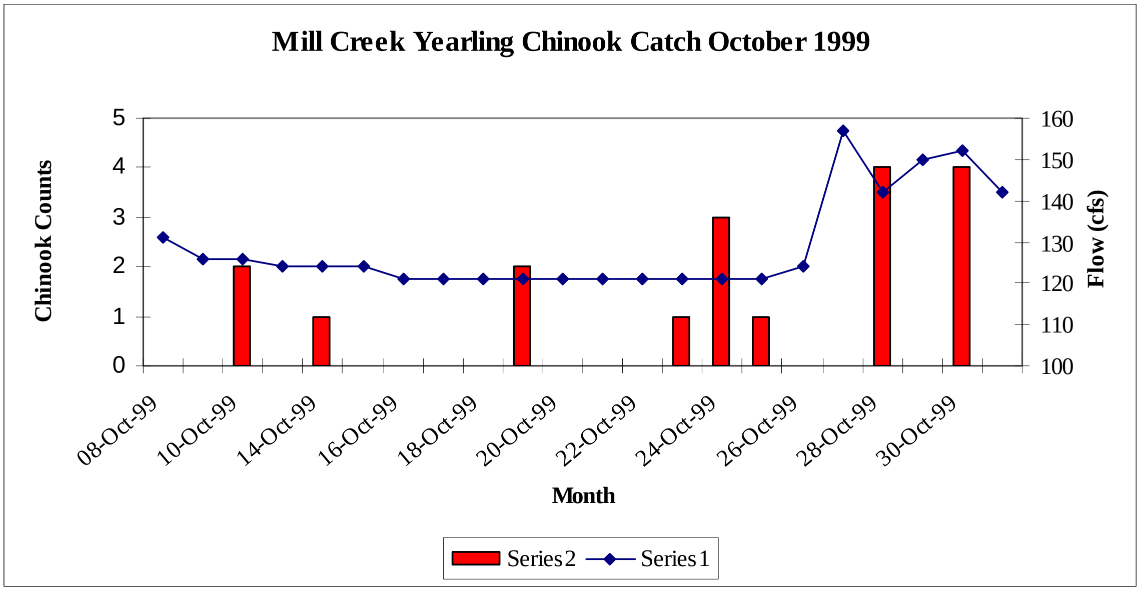


**Figure 3**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for October1999. The trap was set on 7-October. The cone was raised on 11-October and re-set on 13-October. The trap sampled through the remainder of the month. A total of 18 yearling Chinook were sampled during this period.

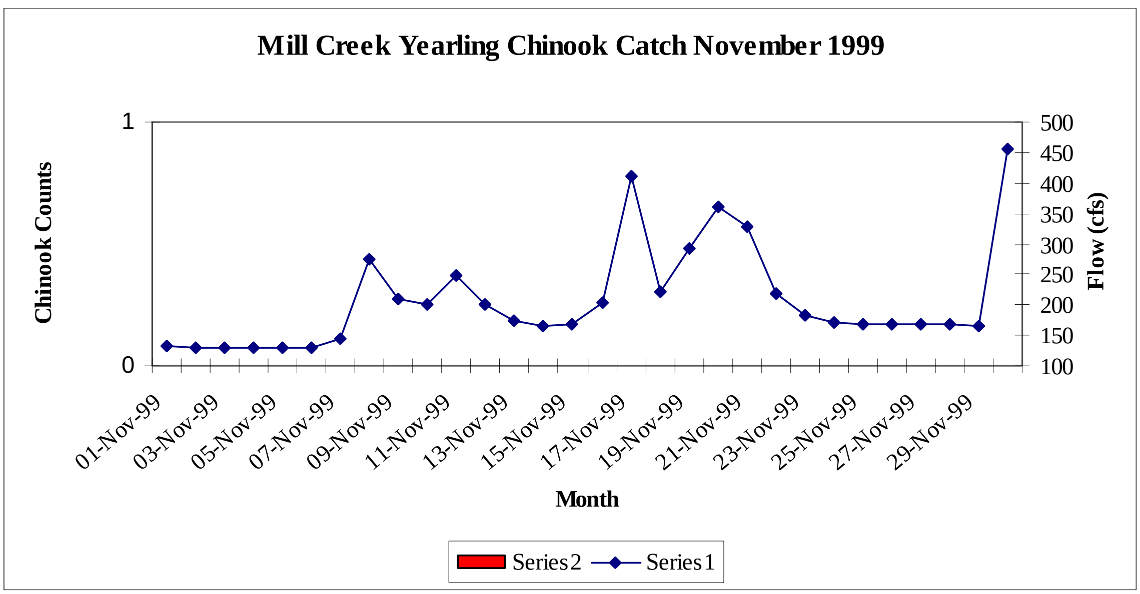


**Figure 4**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for November 1999. The trap was in operation the entire 30 day period. Zero yearling Chinook were caught during this time period

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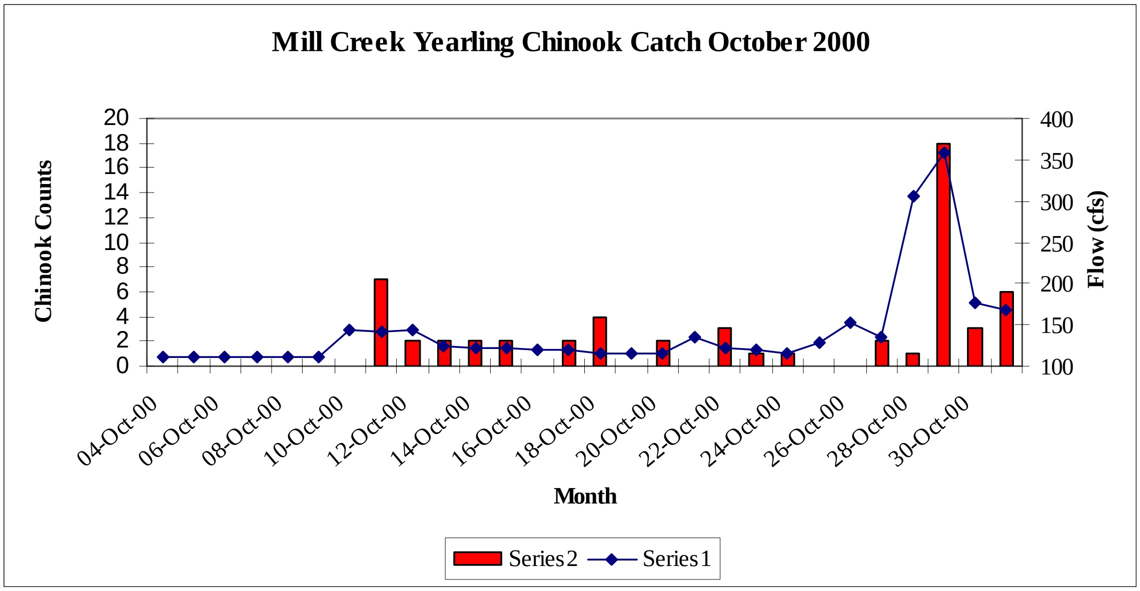


**Figure 5**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for the period October 2000. The trap was set on 3-October and fished throughout the remainder of the month. A total of 58 yearling Chinook were sampled.

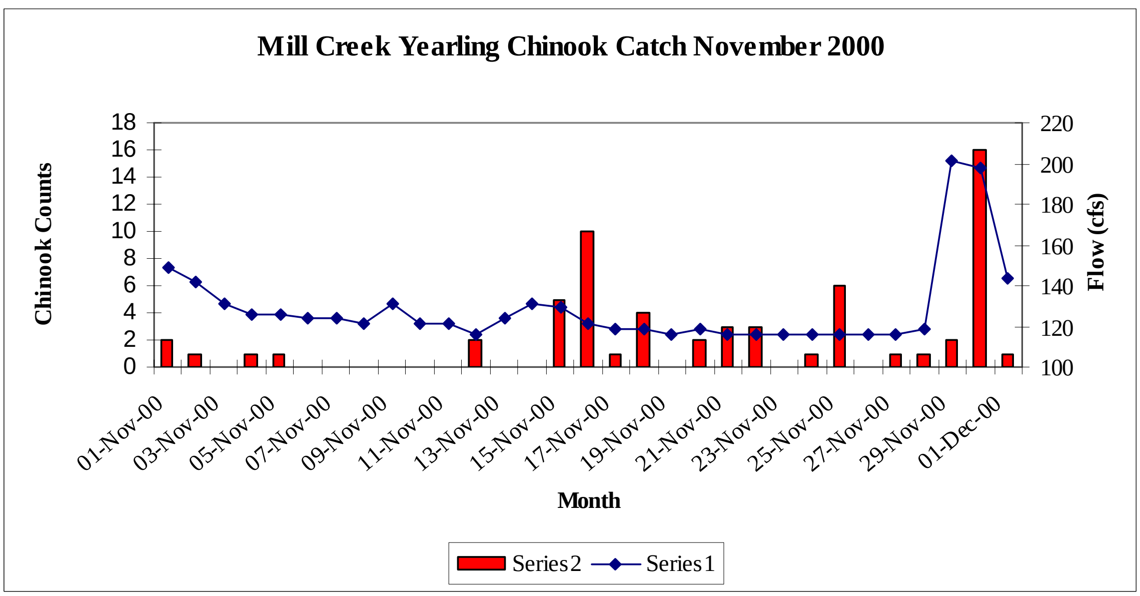


**Figure 6**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for the period November 2000. The trap fished for the entire 30 day period. A total of 62 yearling Chinook were sampled.

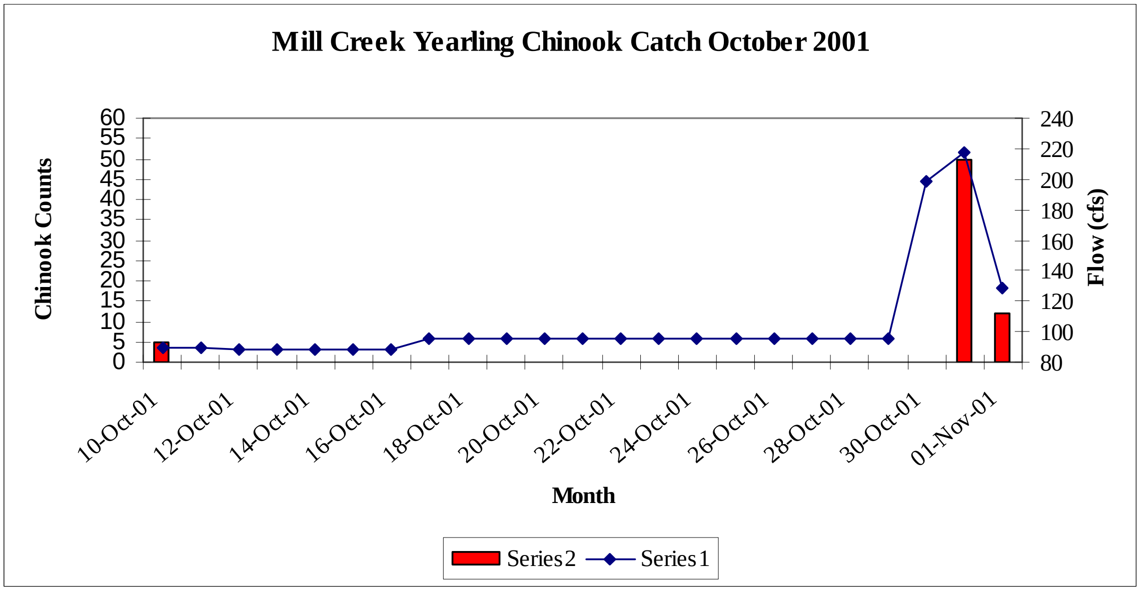


**Figure 7**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for the month of October, 2001. The trap was set on 9-October and fished through the remainder of the month. A total of 55 yearling Chinook were sampled in this time period.

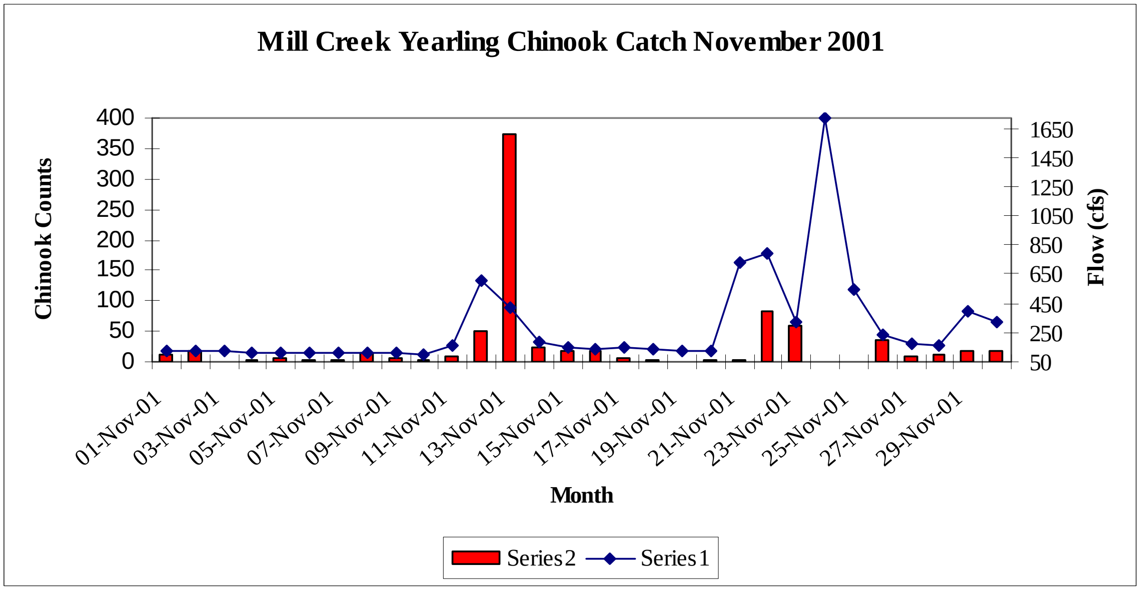


**Figure 8**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for the month of November, 2001. The cone was raised on 23-November in anticipation of high flows. The cone was re-set on 25-November. A total of 812 yearling Chinook were sampled during this time period.

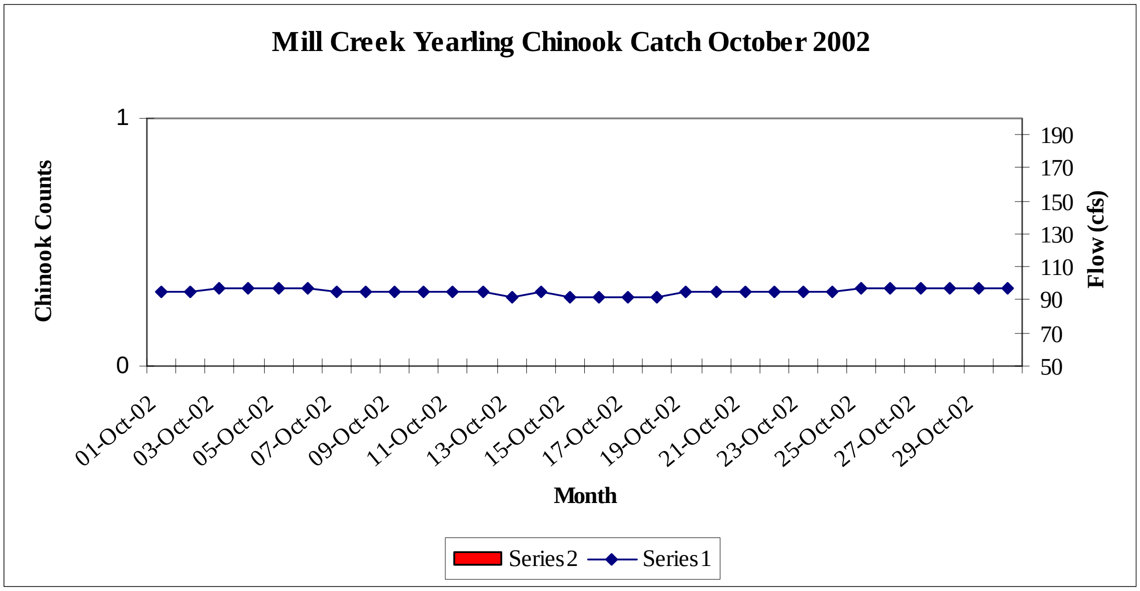


**Figure 9**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for the month of October, 2002. The Mill Creek rotary screw trap was not fished during the month of October, 2002. No catch data is available.

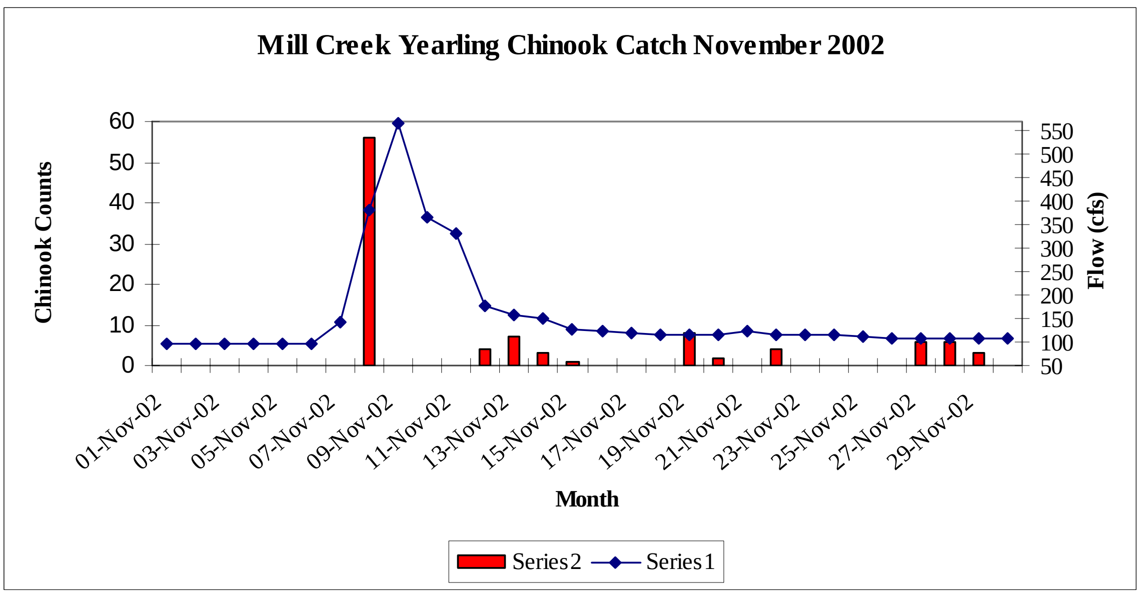


**Figure 10**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for the month of November, 2002. The trap was set on 7-November. The cone was raised on 8-November. The trap was re-set on 12-November. The cone was raised on 15-November. The trap was re-set on 18-November. The cone was raised on 22-November. The trap was re-set on 26-November. The cone was raised on 29-November. The trap was not fished the remainder of the month. A total of 100 yearling Chinook were sampled during this period.

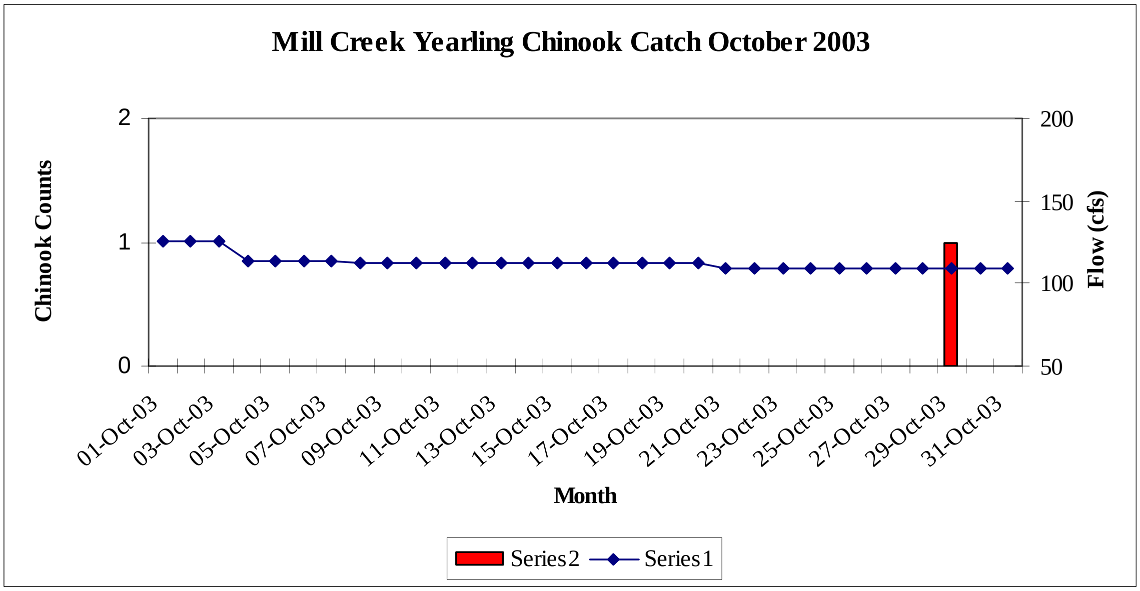


**Figure 11**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for the month of October, 2003. The trap was set on 23-October and fished through the remainder of the month. A total of one yearling Chinook was sampled during this period.

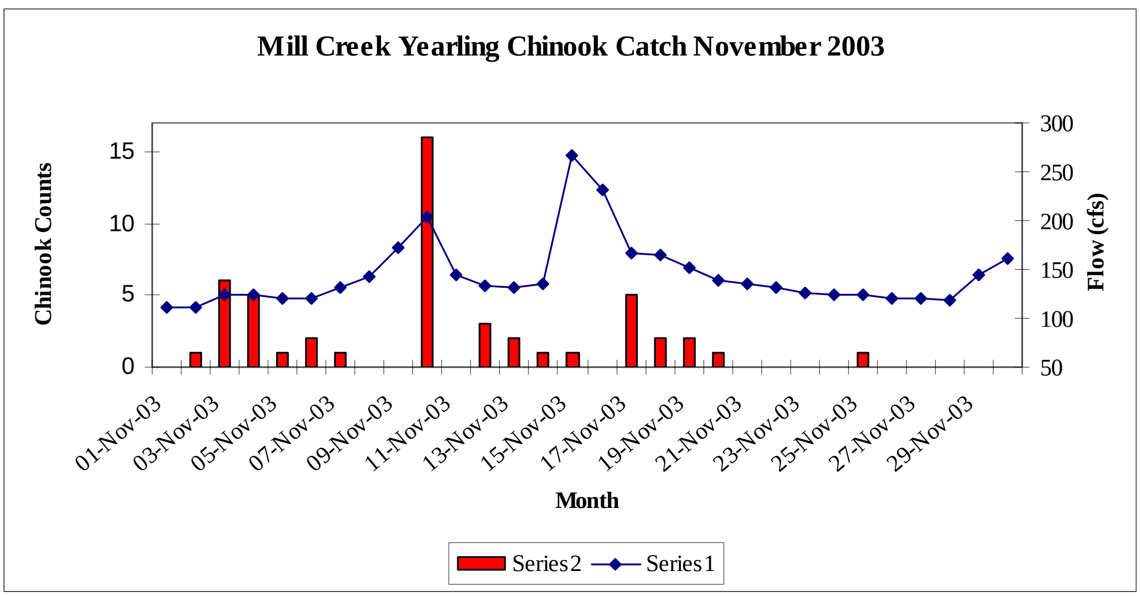


**Figure 12**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for the month of November, 2003. The trap fished every day of the month. A total of 50 yearling Chinook were sampled during this time period.

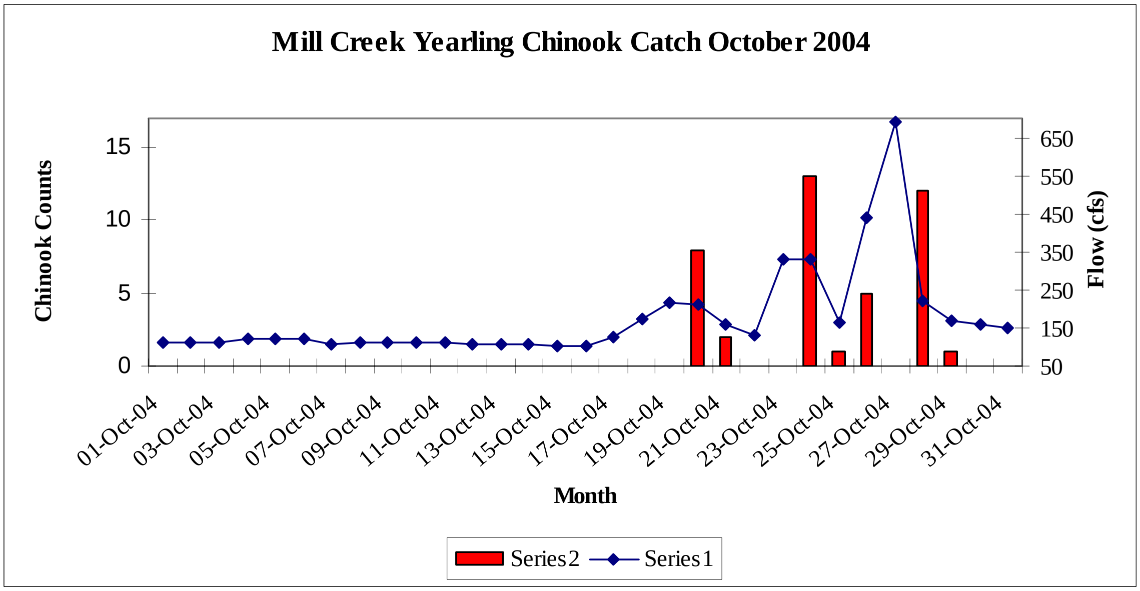


**Figure 13**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for the month of October, 2004. The trap was first set on 19-October. A log stopped the cone sometime after the trap was checked on 26-October. The log was cleared on 27-October. The cone was raised on 29-October. The trap was not fished the remainder of the month. A total of 42 yearling Chinook were sampled during this period.

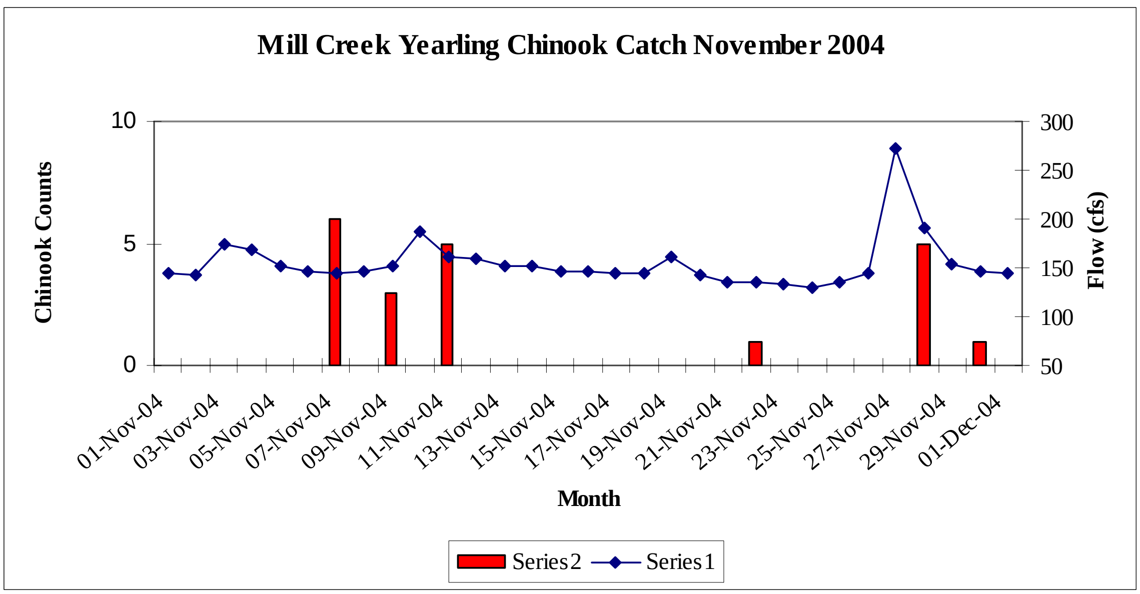


**Figure 14**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for the month of November, 2004. The trap was set on 1-November and fished throughout the remainder of the month. A total of 21 yearling Chinook were sampled.

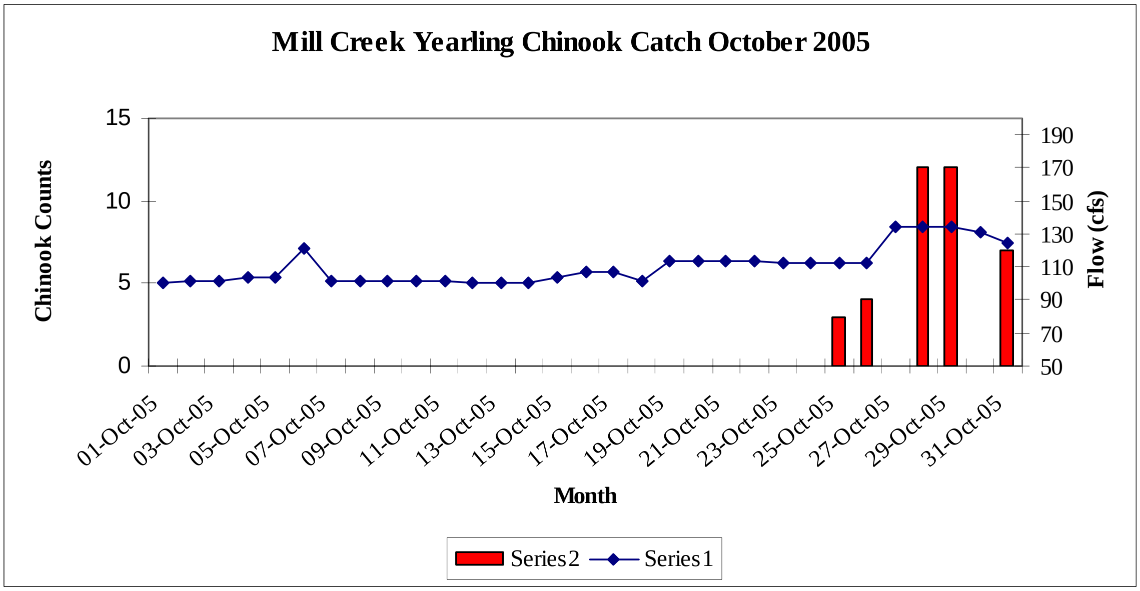


**Figure 15**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for the month of October, 2005. The trap was set on 24-October and was fished through the remainder of the month. A total of 38 yearling Chinook were sampled during this period.

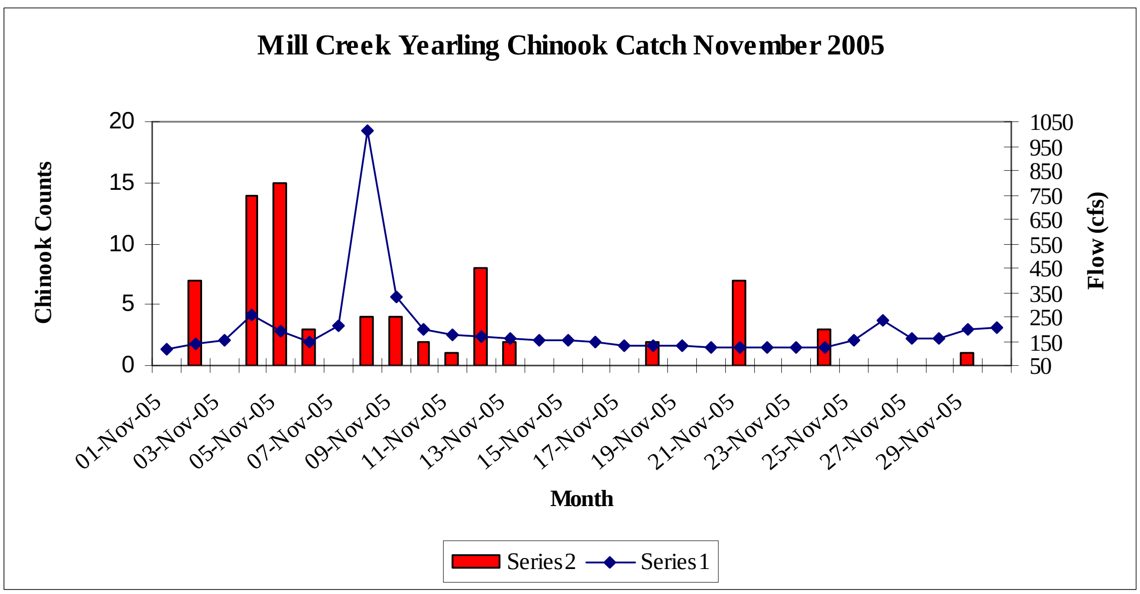


**Figure 16**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for the month of November, 2005. The cone was jammed by a log sometime during the evening of 7-November. The trap was vandalized on 25-November and was re-set on 28-November. A total of 73 yearling Chinook were sampled during this time period.

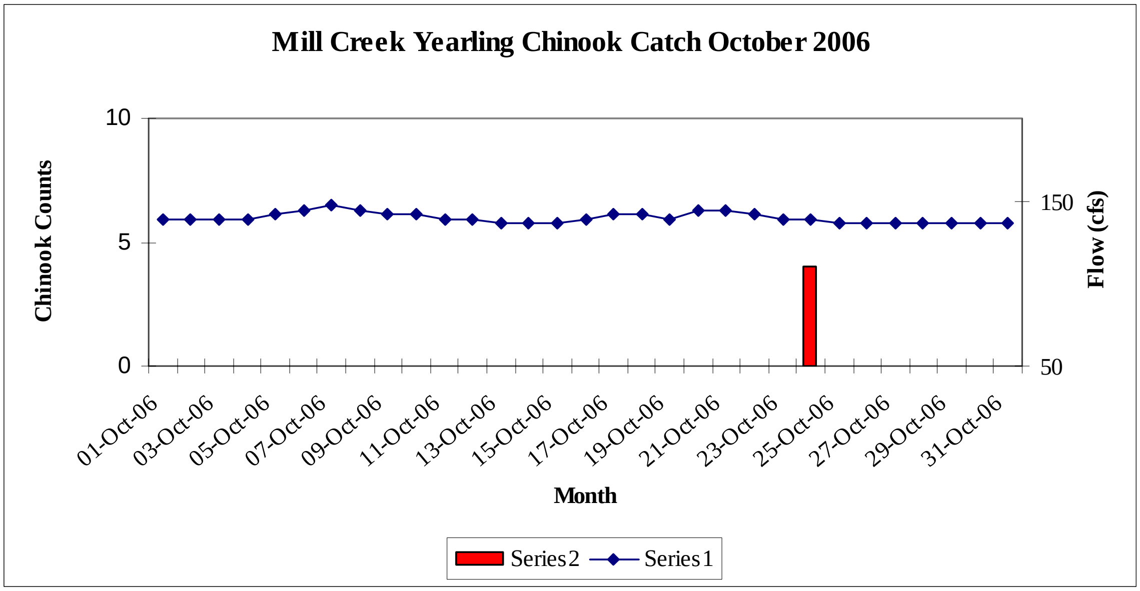


**Figure 17**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for the month of October, 2006. The trap was set on 23-October and fished through the remainder of the month. A total of 4 yearling Chinook were sampled during this time period.

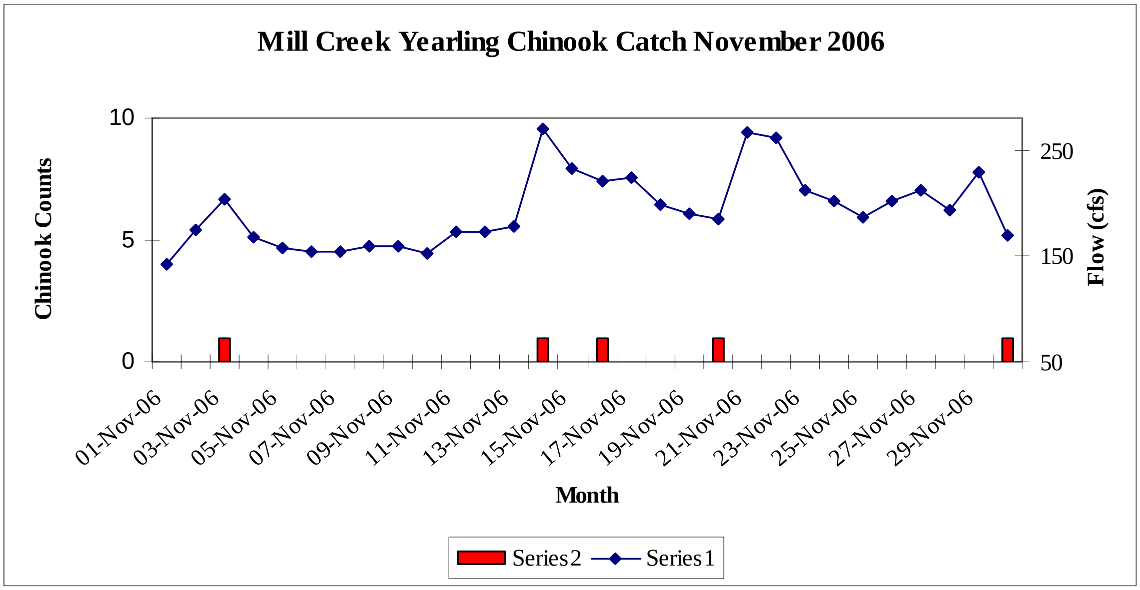


**Figure 18**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for the month of November, 2006. The trap sampled without interruption through the month. A total of 5 yearling Chinook were sampled in this period.

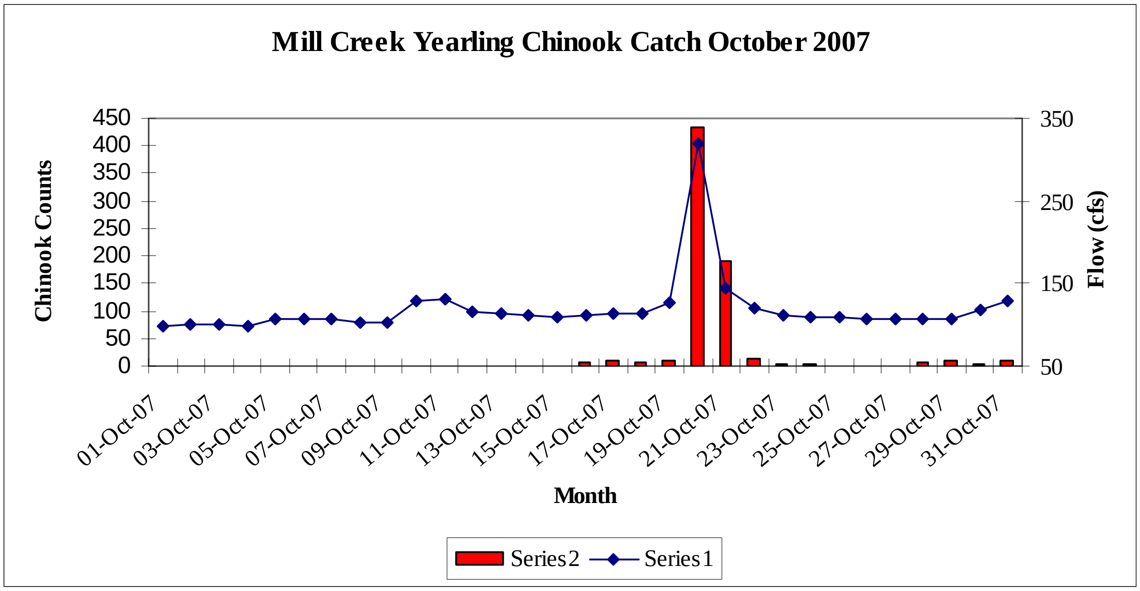


**Figure 19**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for the month of October, 2007. The trap was set on 15-October and fished throughout the remainder of the month. A total of 707 yearling Chinook were sampled during this period.

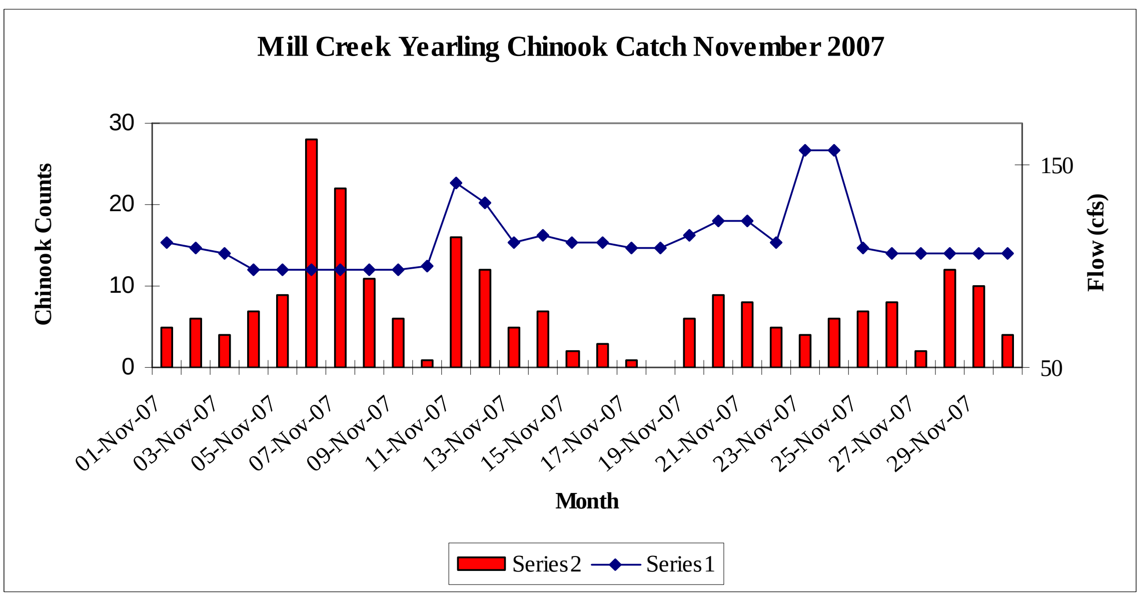


**Figure 20**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for the month of November, 2007. The trap was fished throughout the 30 day period. A total of 226 yearling Chinook were sampled.

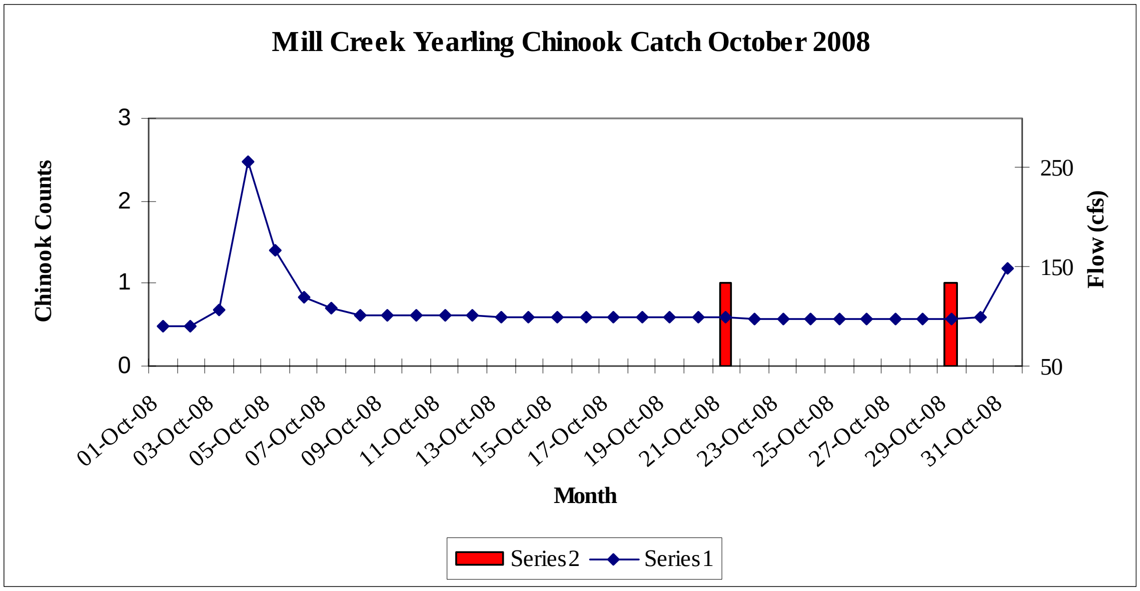


**Figure 21**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for the month of October, 2008. The trap was set on 16-October and was fished throughout the remainder of the month. A total of 2 yearling Chinook were sampled during this period.

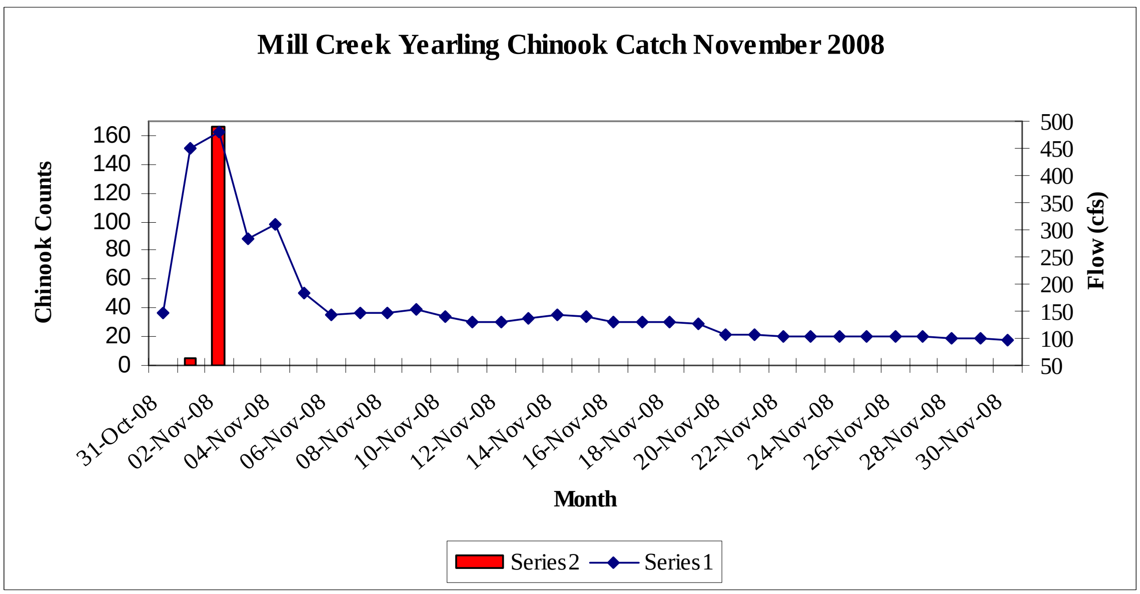


**Figure 22**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for the month of November, 2008. The cone was raised on 2-November. The trap was re-set on 4-November and fished without interruption through the remainder of the month. A total of 171 yearling Chinook were sampled during this period.

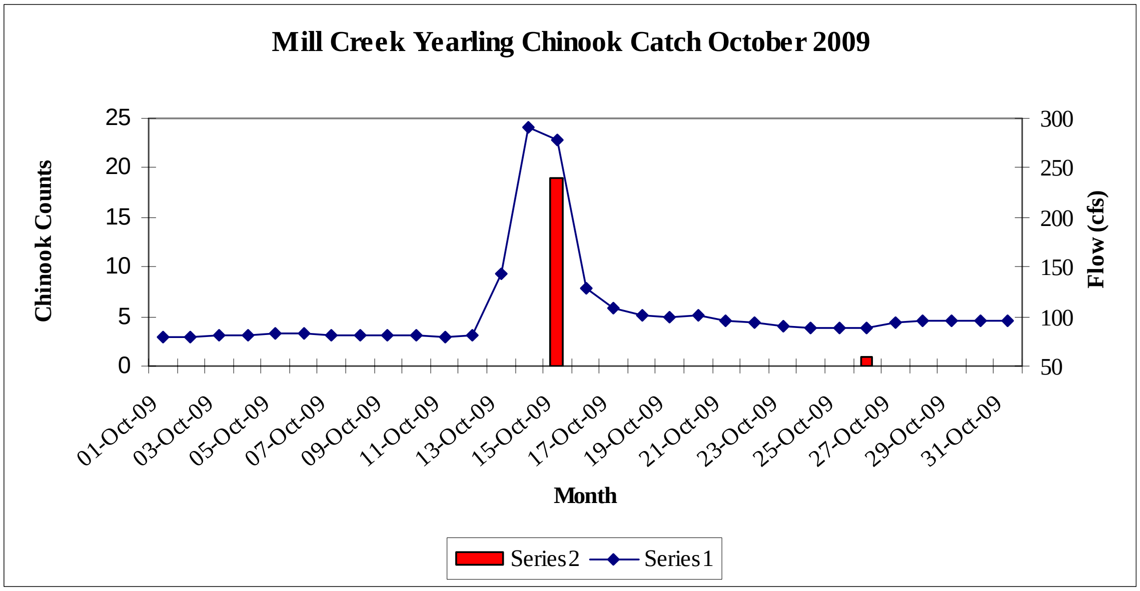


**Figure 23**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for the month of October, 2009. The trap was re-set on 14-October and fished without interruption through the remainder of the month. A total of 20 yearling Chinook were sampled during this period.

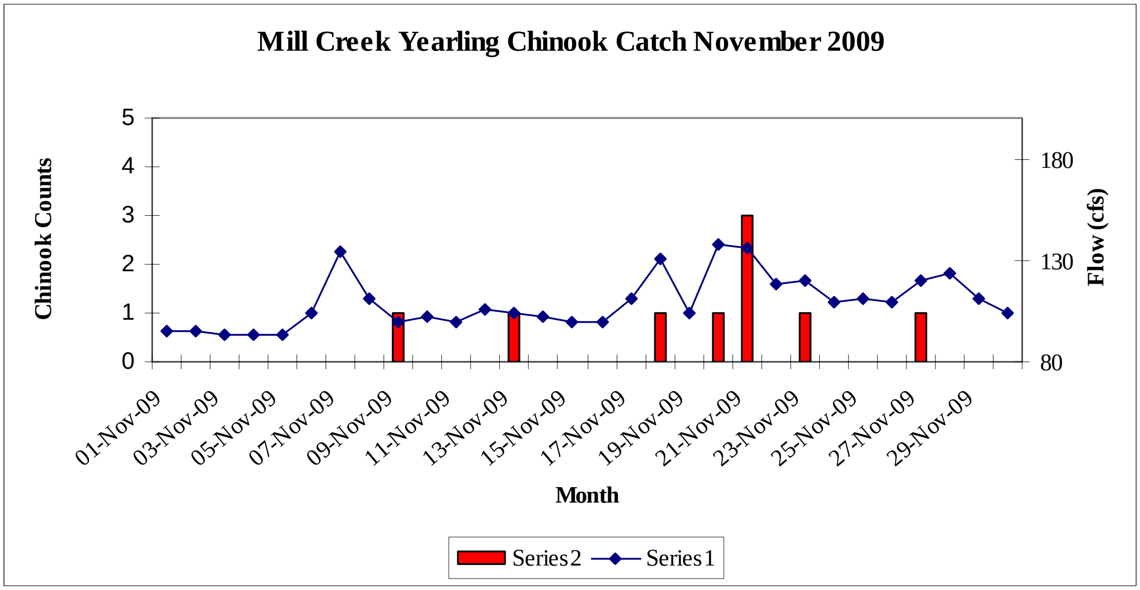


**Figure 24**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the MLM gauging station for the month of November, 2009. The trap was fished without interruption throughout the month. A total of 9 yearling Chinook were sampled during this period.

**Appendix E: Yearling Chinook catch vs. flow charts for the months of October and November for Deer Creek**

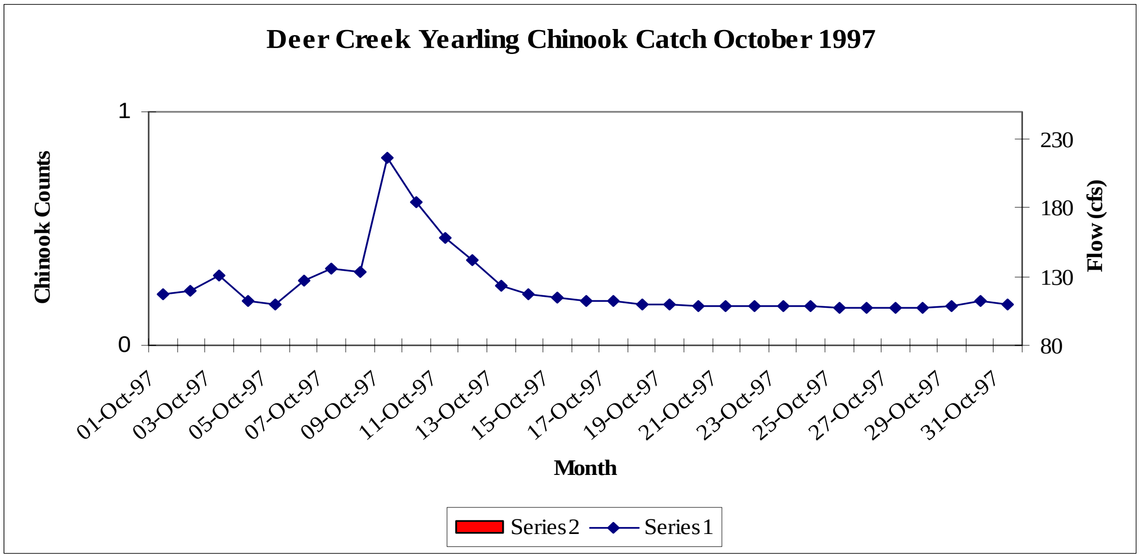


**Figure 1**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for October 1997. The trap was set on 30-September and fished through 9-October. The trap was re-set on 13-October and fished through 19-October. The trap was re-set on 23-October and fished through the remainder of the month. Zero yearling Chinook were sampled during this period. Zero yearling Chinook were caught during this time period.

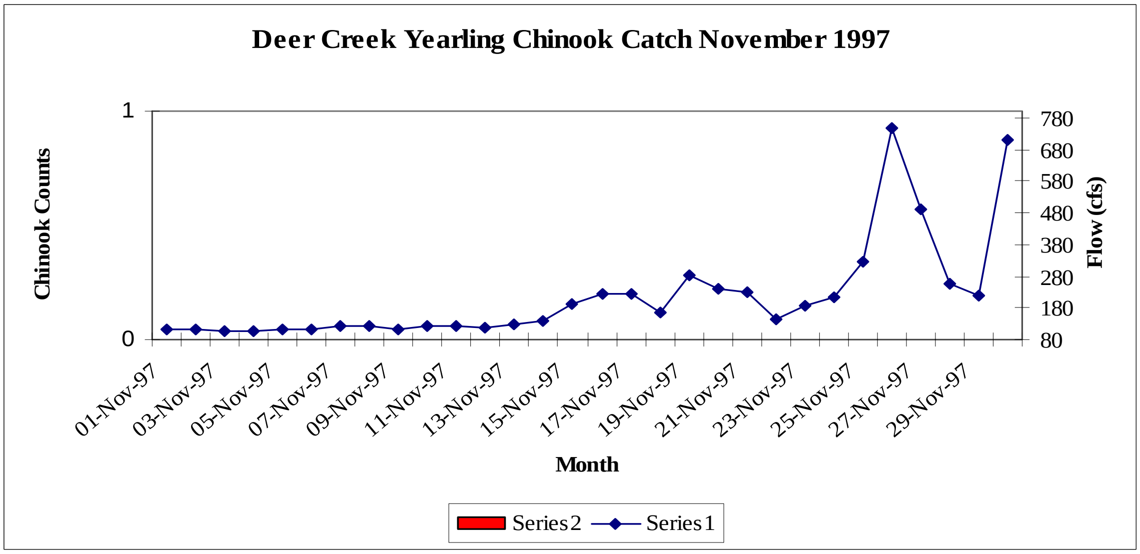


**Figure 2**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for November 1997. The trap was set on 3-November and removed 7-November. The trap was re-set 10-November and removed 26-November. The trap was re-set 27-November and removed 30-November. Zero yearling Chinook were sampled during this period.

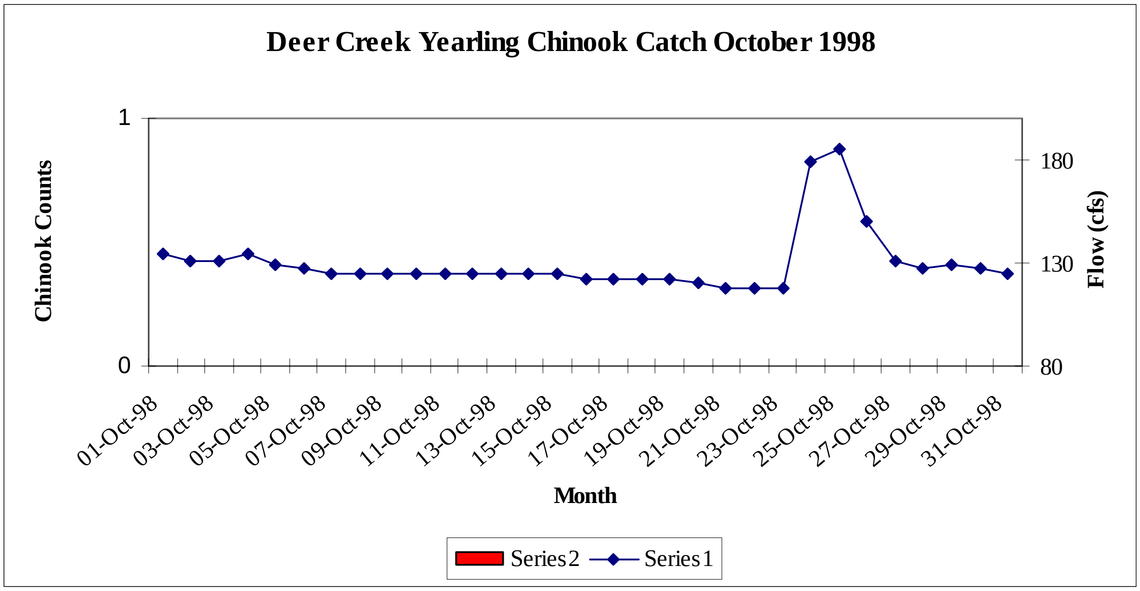


**Figure 3**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for October 1998. The trap was set on 26-October and fished through the remainder of the month. Zero yearling Chinook were sampled during this period.

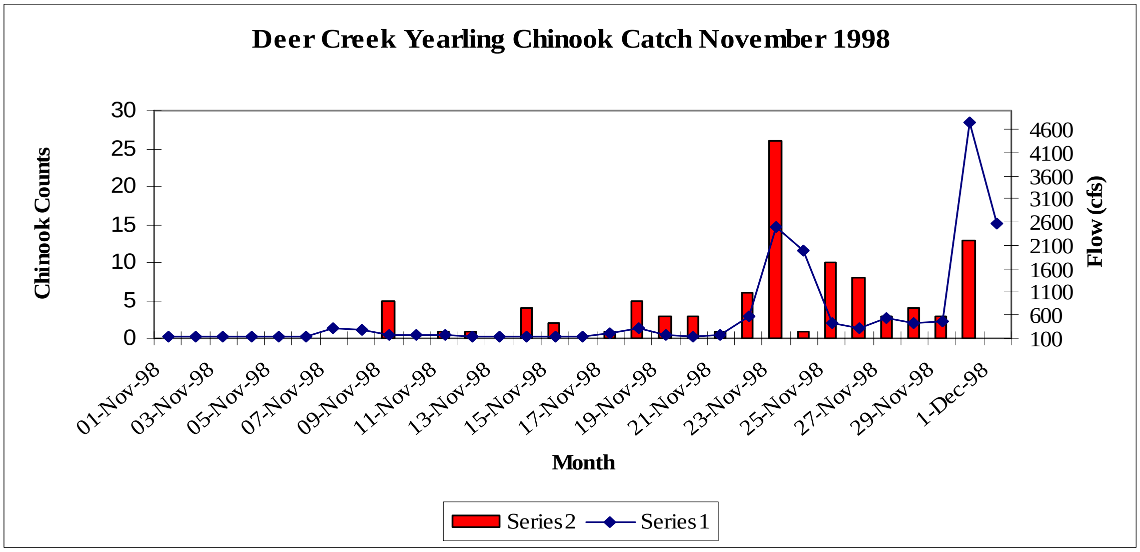


**Figure 4**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for November 1998. On 24-November it was discovered that a log had stopped the cone. The trap was heavily damaged on evening of 30-November due to high flows. A total of 100 yearling Chinook were sampled during this period.

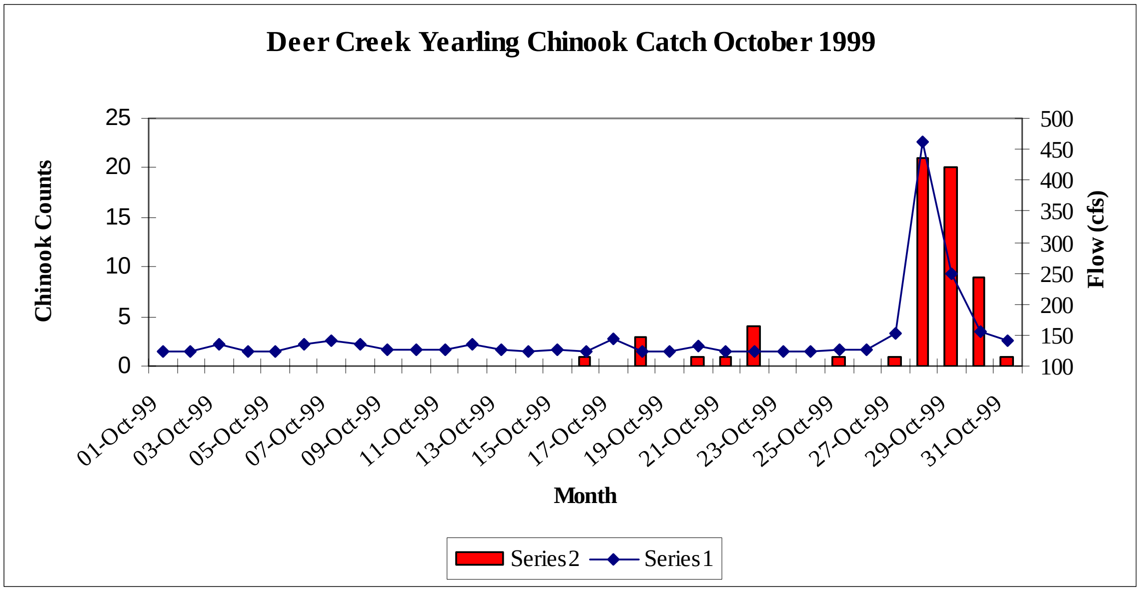


**Figure 5**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for October 1999. The trap was set on 15-October and operated without interruption for the remainder of the month. A total of 63 yearling Chinook were sampled during this period.

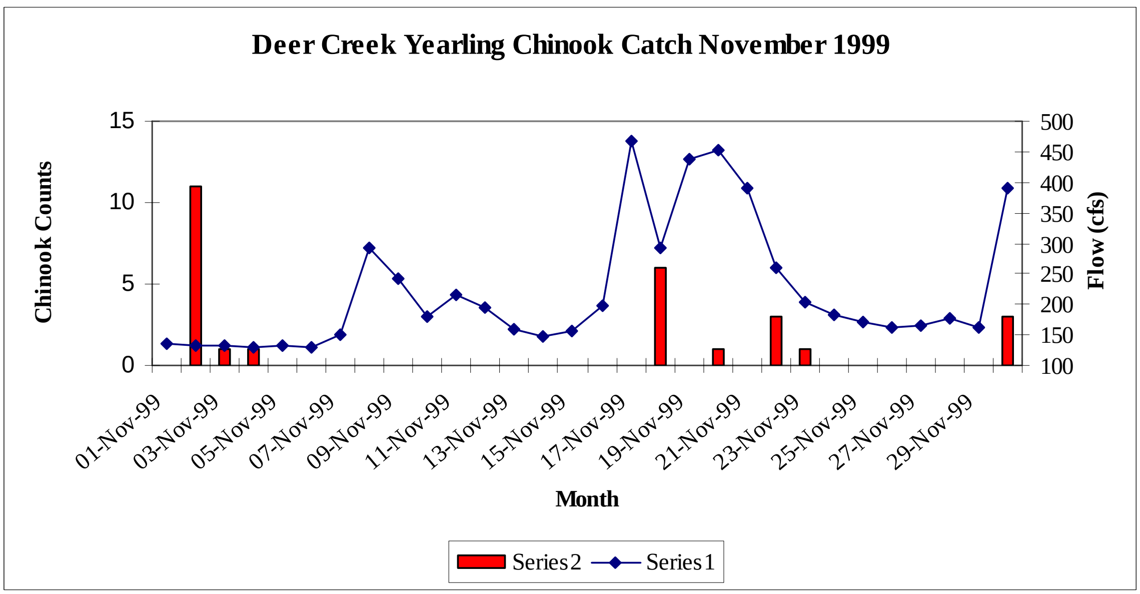


**Figure 6**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for November 1999. The trap operated without interruption for the entire month. A total of 27 yearling Chinook were sampled during this period.

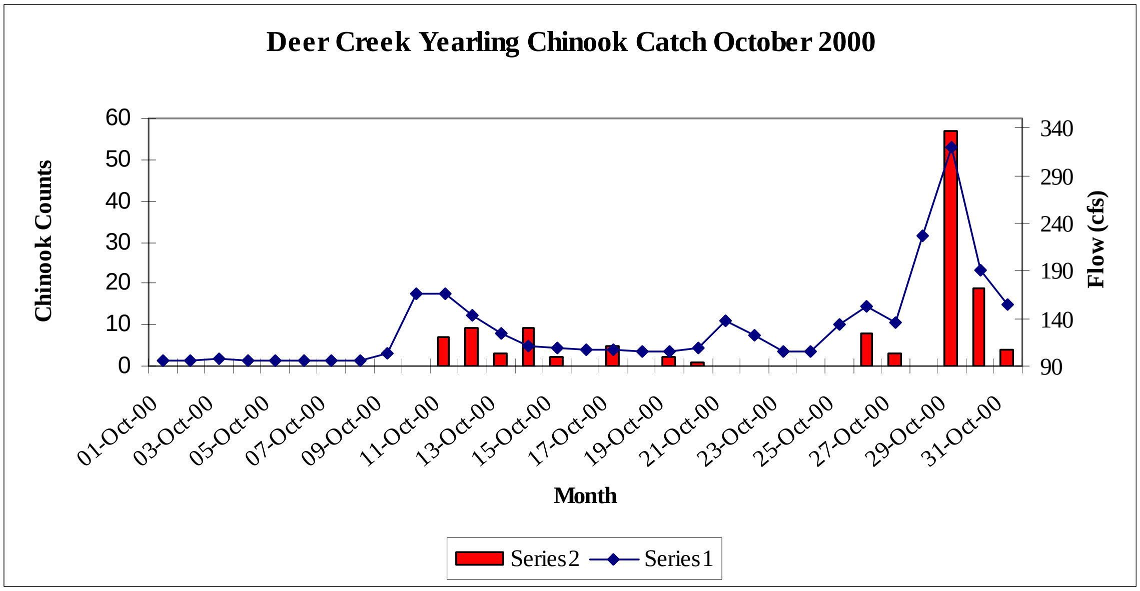


**Figure 7**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for October 2000. The trap was set on 3-October and was operated without interruption for the remainder of the month. A total of 129 yearling Chinook were sampled during this period.

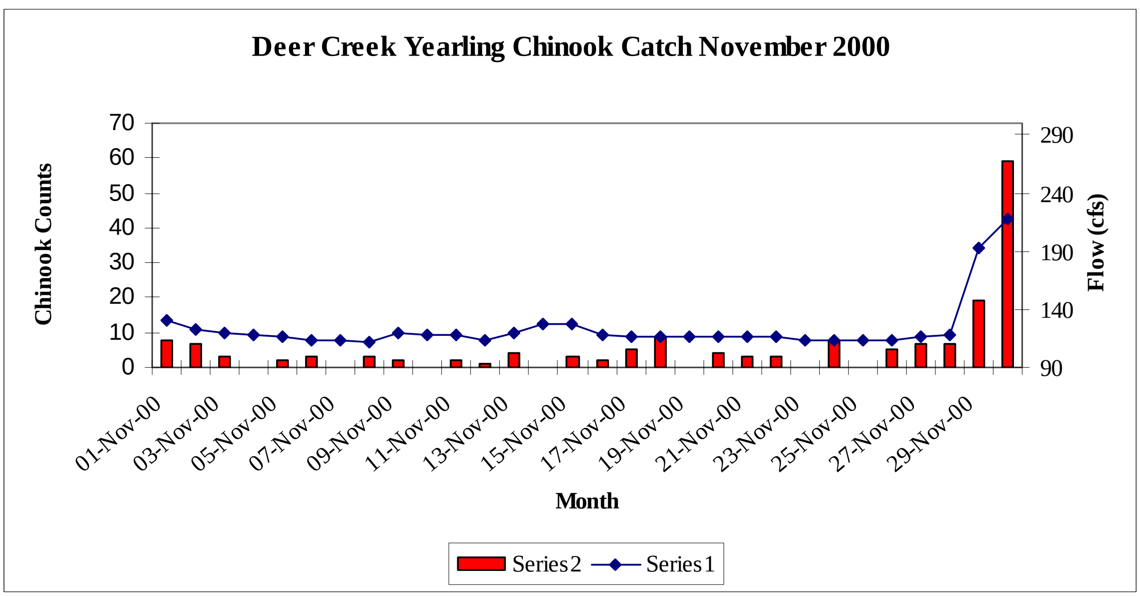


**Figure 8**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for November 2000. The trap was operated without interruption for the entire month. A total of 169 yearling Chinook were sampled during this period.

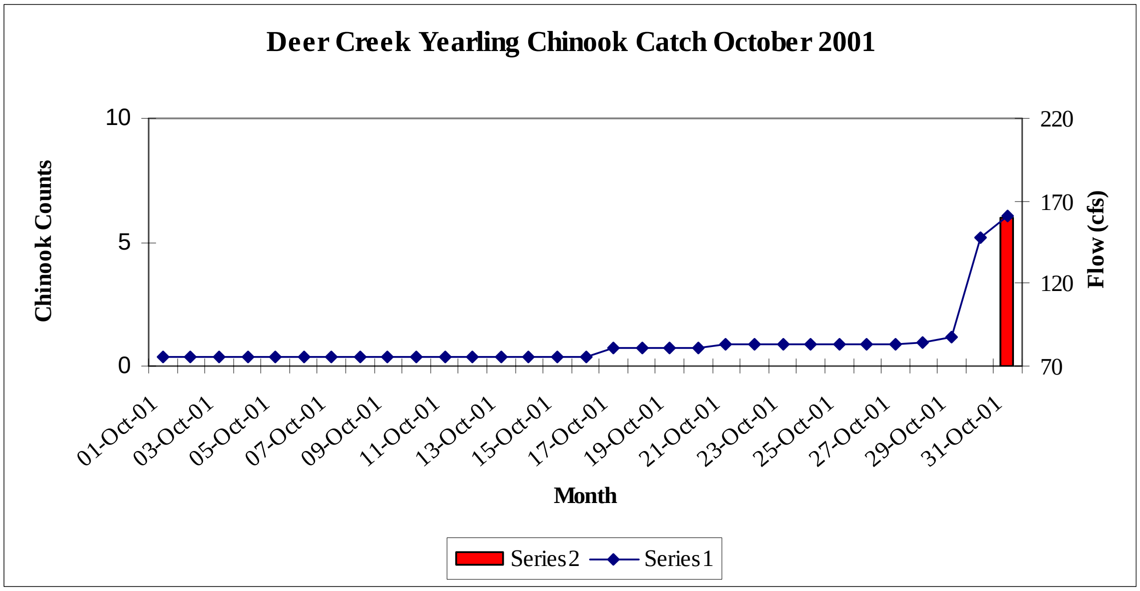


**Figure 9**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for October 2001. The trap was set on 15-October and was operated without interruption for the remainder of the month. A total of 6 yearling Chinook were sampled during this period.

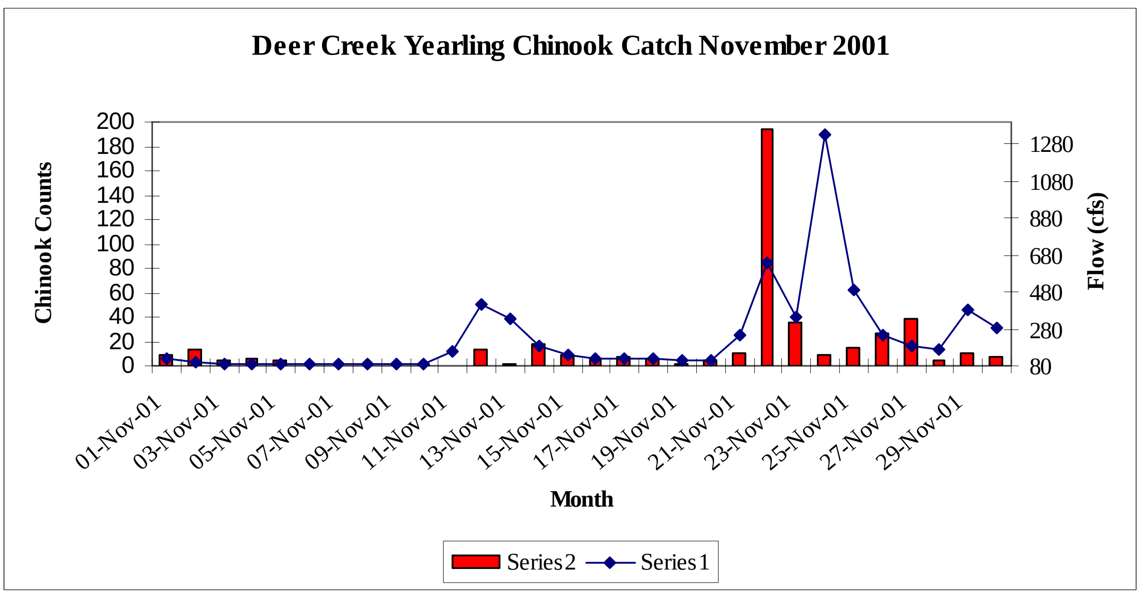


**Figure 10**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for November 2001. The trap was operated without interruption for the entire month. A total of 457 yearling Chinook were sampled during this period.

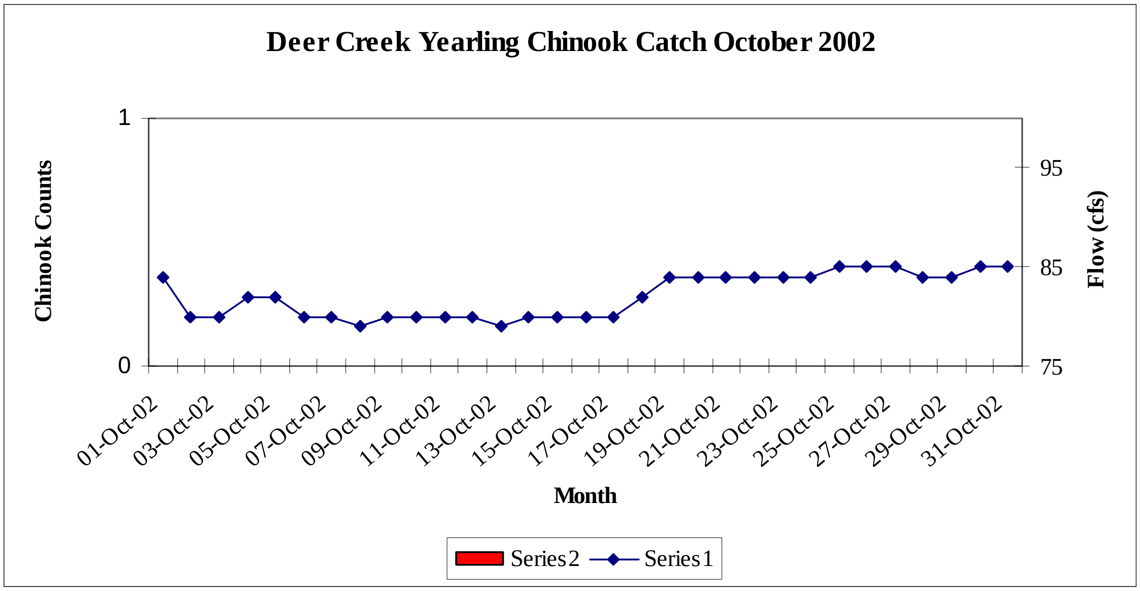


**Figure 11**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for October 2002. The trap was set on 15-October. The trap was removed on 18-October due to insufficient flows. A total of 0 yearling Chinook were sampled during this period.

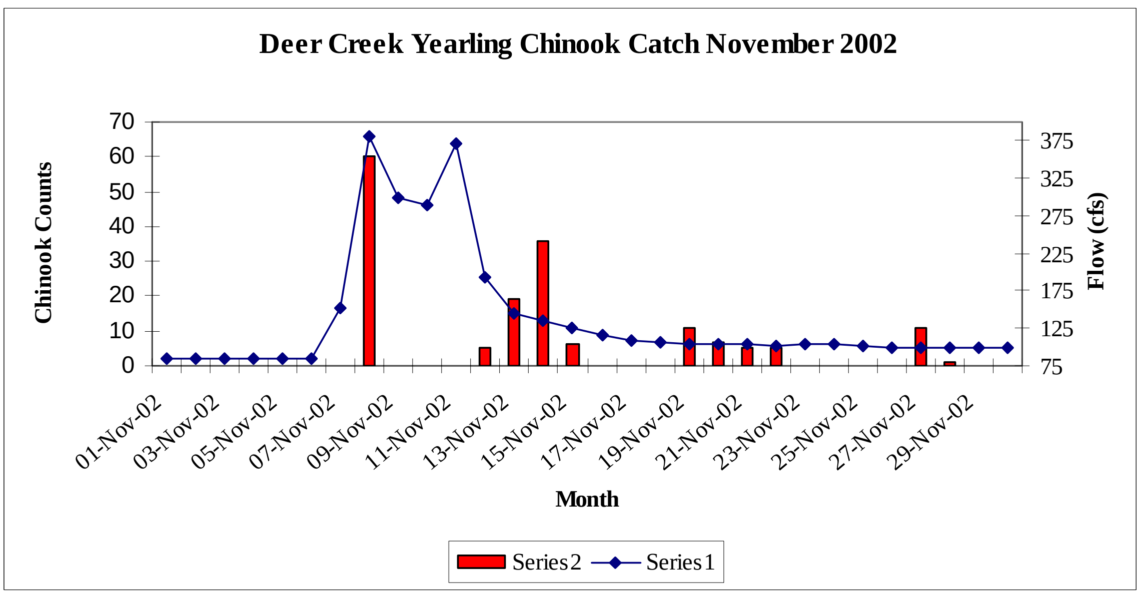


**Figure 12**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for November 2002. On 9-November it was discovered that the trap had been stopped by a log. On 15-November the trap was removed for the weekend. The trap was re-set on 18-November. The trap was again removed on 22-November and re-set on 25-November. The trap was then fished without interruption for the remainder of the month. A total of 166 yearling Chinook were sampled during this period.

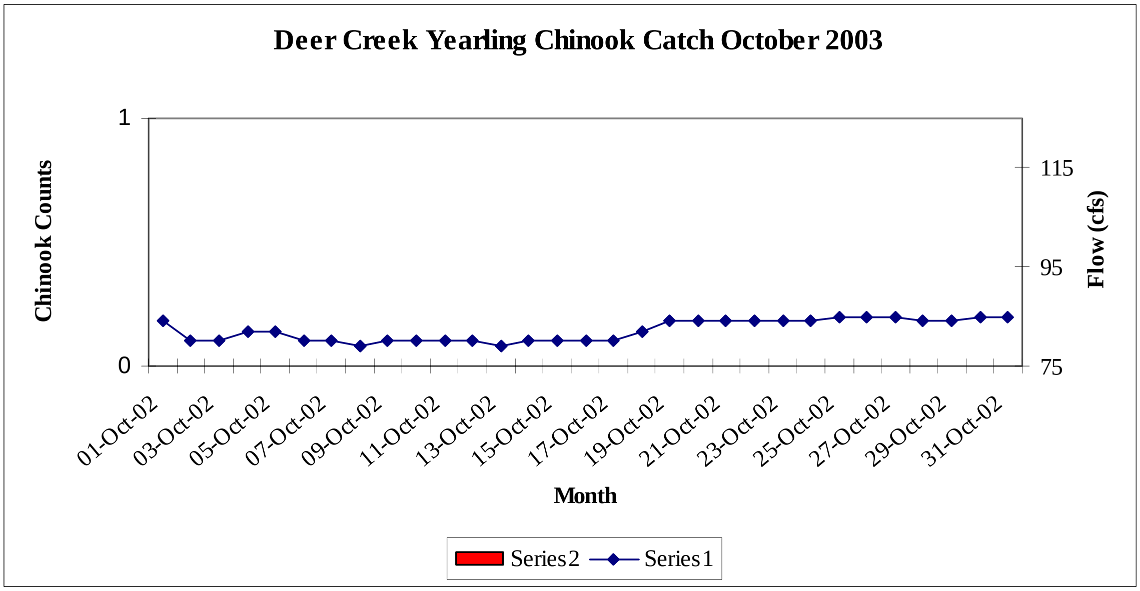


**Figure 13**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for October 2002. The trap was operated in October, 2003 due to insufficient flows. A total of 0 yearling Chinook were sampled during this period.

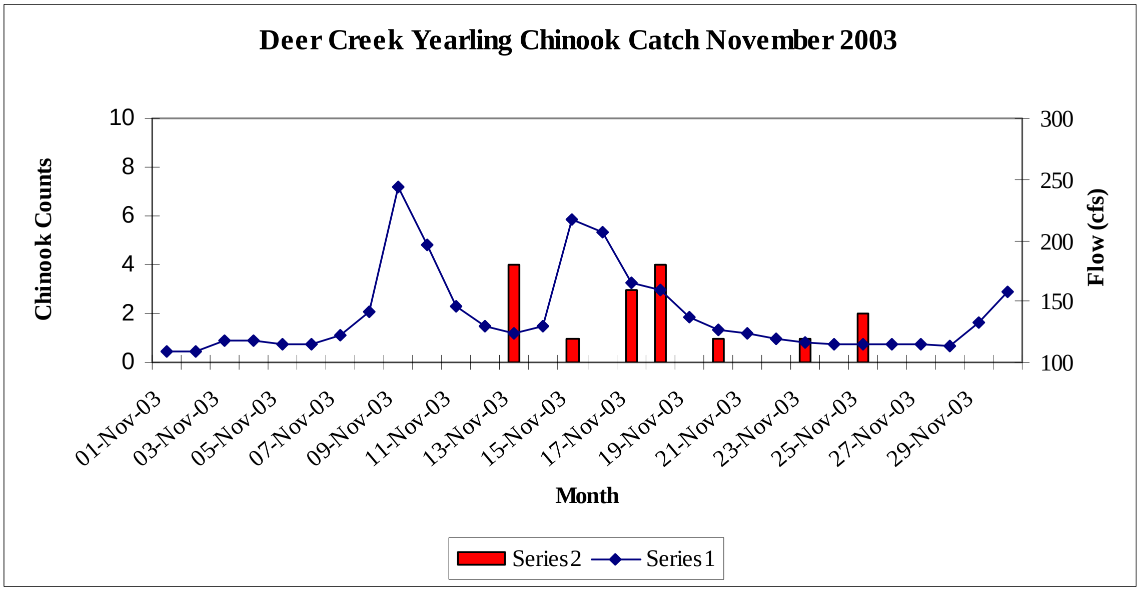


**Figure 14**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for November 2003. The trap was set on 10-November and operated without interruption for the remainder of the month. A total of 16 yearling Chinook were sampled during this period.

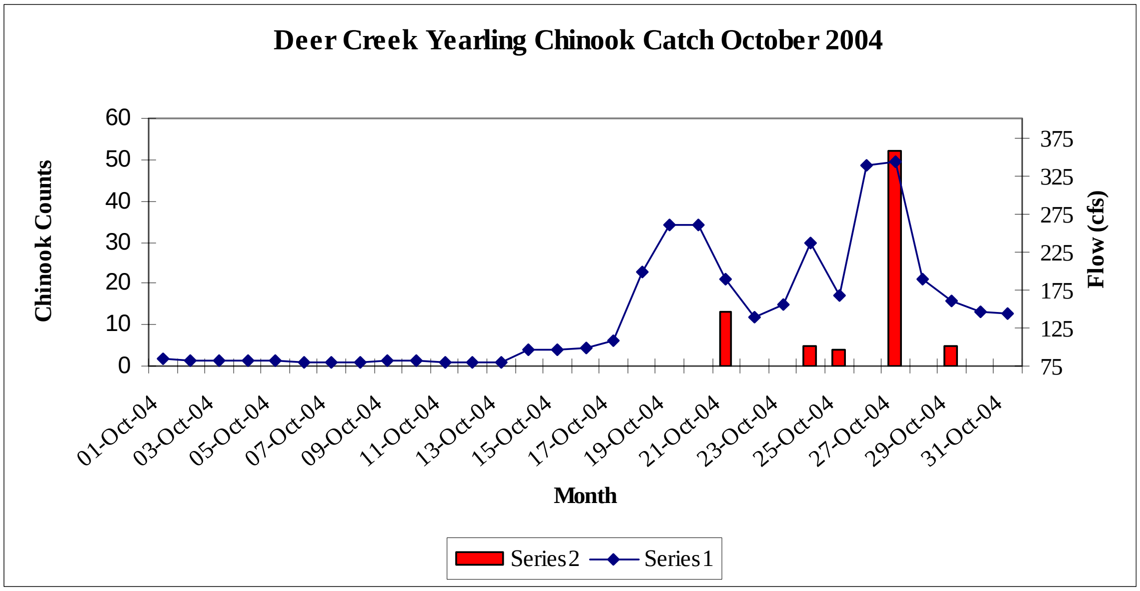


**Figure 15**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for October 2004. The trap was set 20-October. The trap was removed for the weekend on 29-October and was not fished for the remainder of the month. A total of 79 yearling Chinook were sampled during this period.

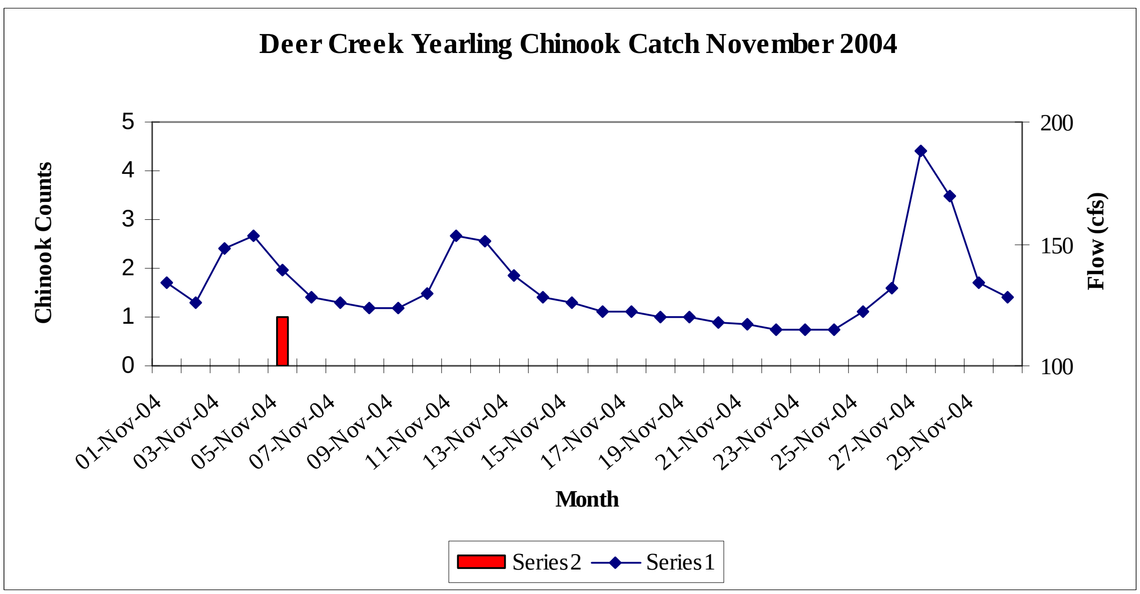


**Figure 16**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for November 2004. The trap operated without interruption for the entire month. A total of 1 yearling Chinook were sampled during this period.

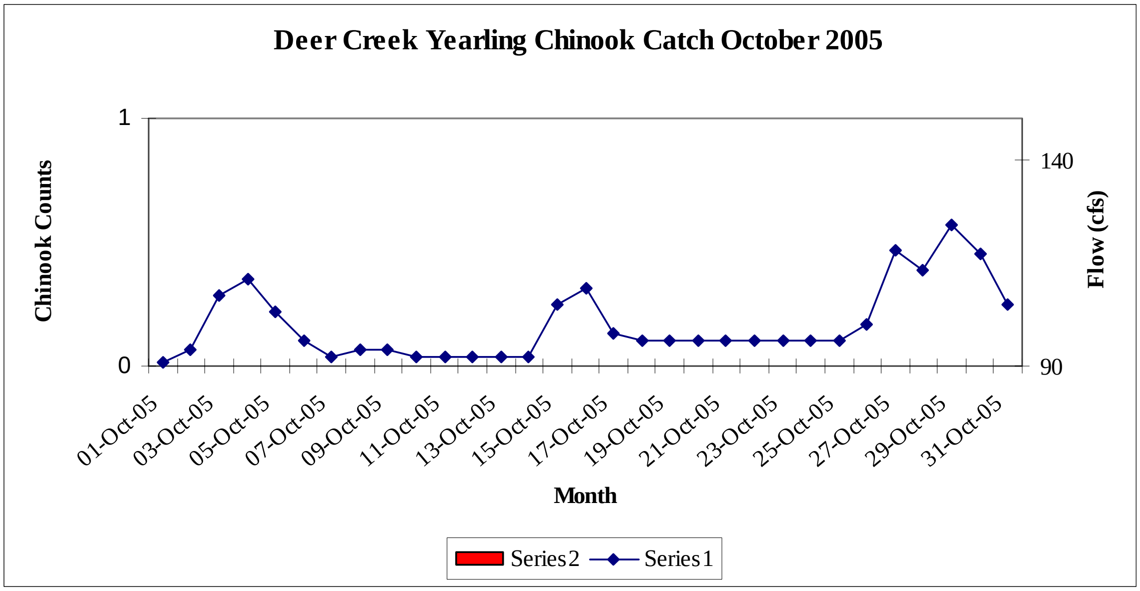


**Figure 17**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for October 2005. The Deer Creek rotary screw trap was not fished in October, 2005. Zero yearling Chinook were sampled.

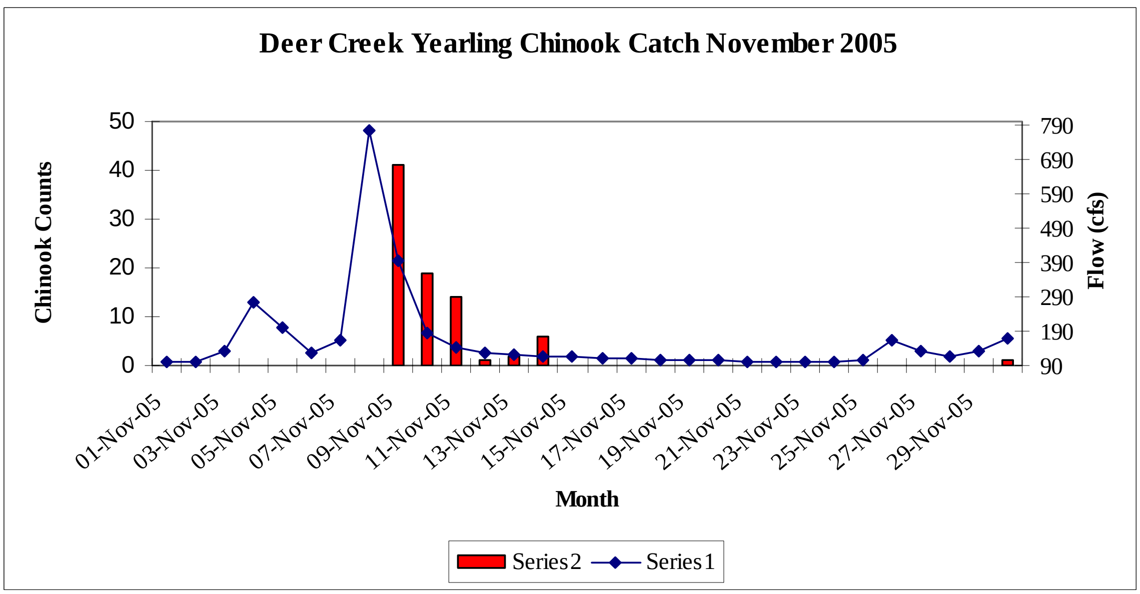


**Figure 18**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for November 2005. The trap set on 8-November and fished until 14-November when it was removed due to insufficient flows. The trap was re-set on 29-November and was operated through the remainder of the month. A total of 84 yearling Chinook were sampled during this period.

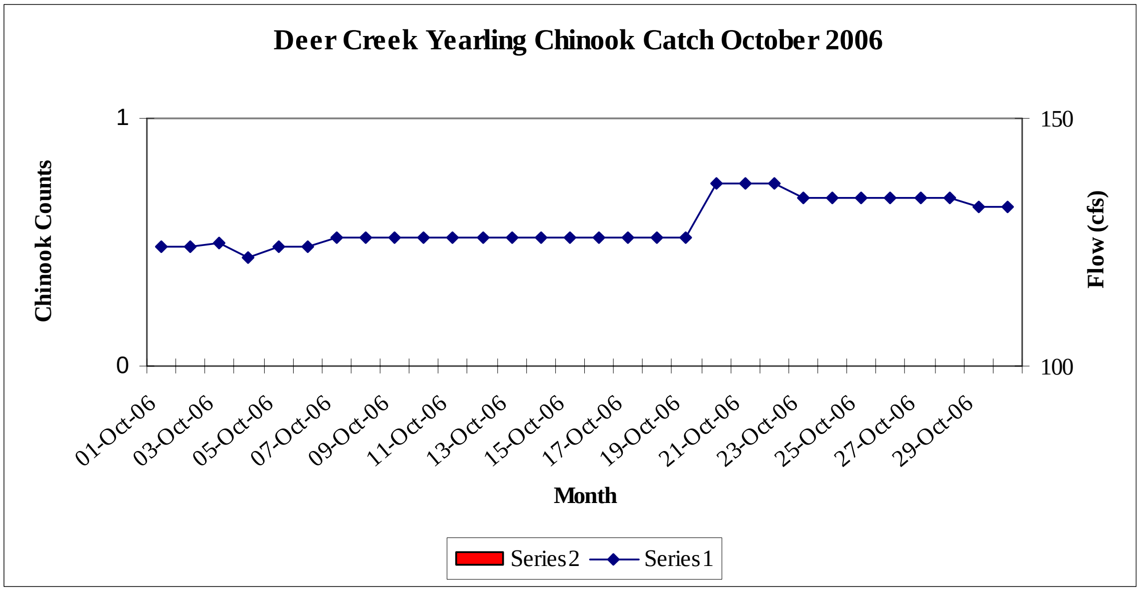


**Figure 19**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for October 2006. The Deer Creek rotary screw trap was not fished in October, 2006 due to insufficient flows at the trap site. Zero yearling Chinook were sampled.

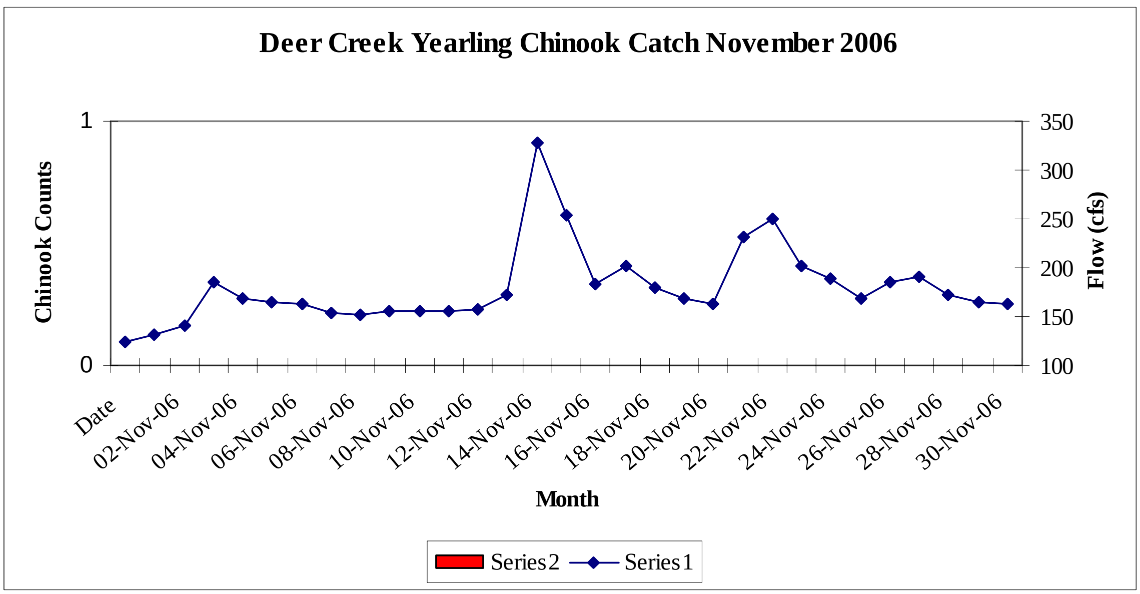


**Figure 20**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for November 2006. The Deer Creek rotary screw trap was not operated in November, 2006. Zero yearling Chinook were sampled.

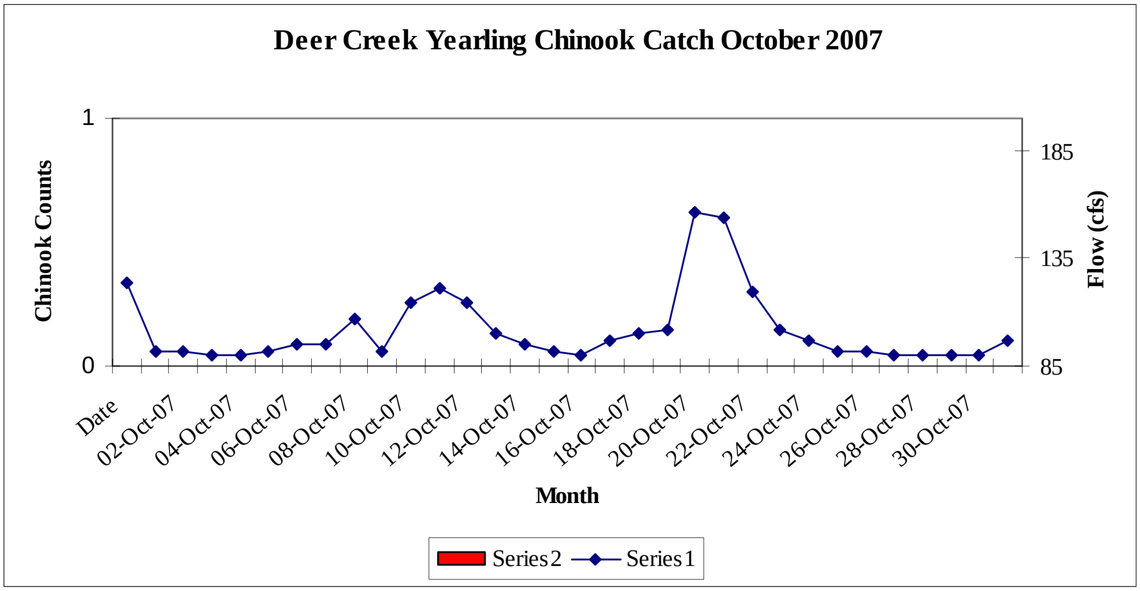


**Figure 21**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for October 2007. The Deer Creek rotary screw trap was not operated in October, 2007. Zero yearling Chinook were sampled.

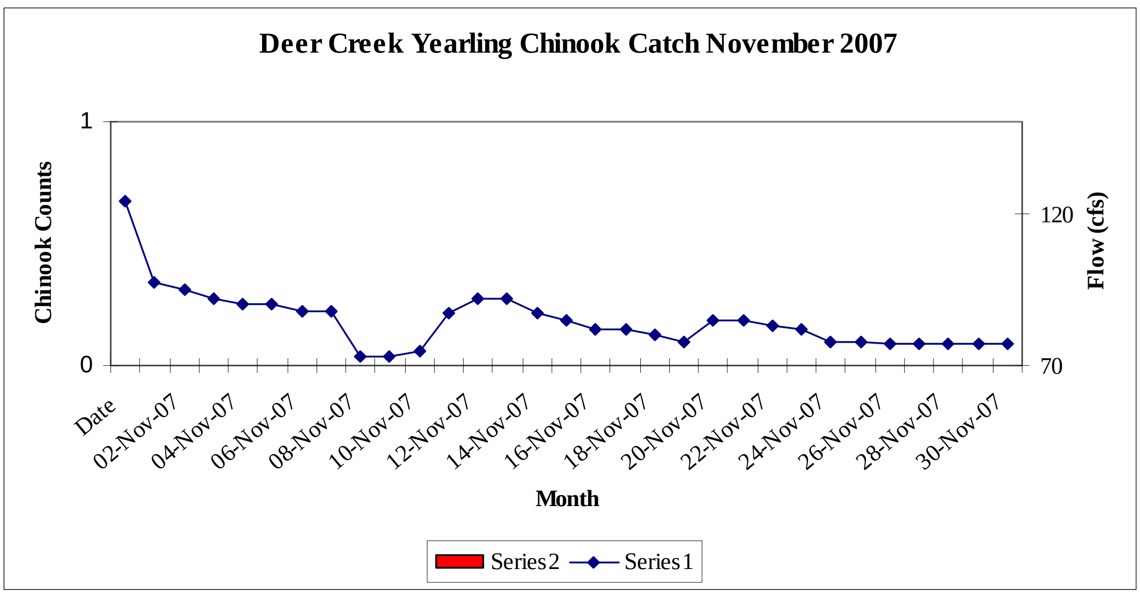


**Figure 22**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for November 2007. The Deer Creek rotary screw trap was not operated in November, 2007. Zero yearling Chinook were sampled.

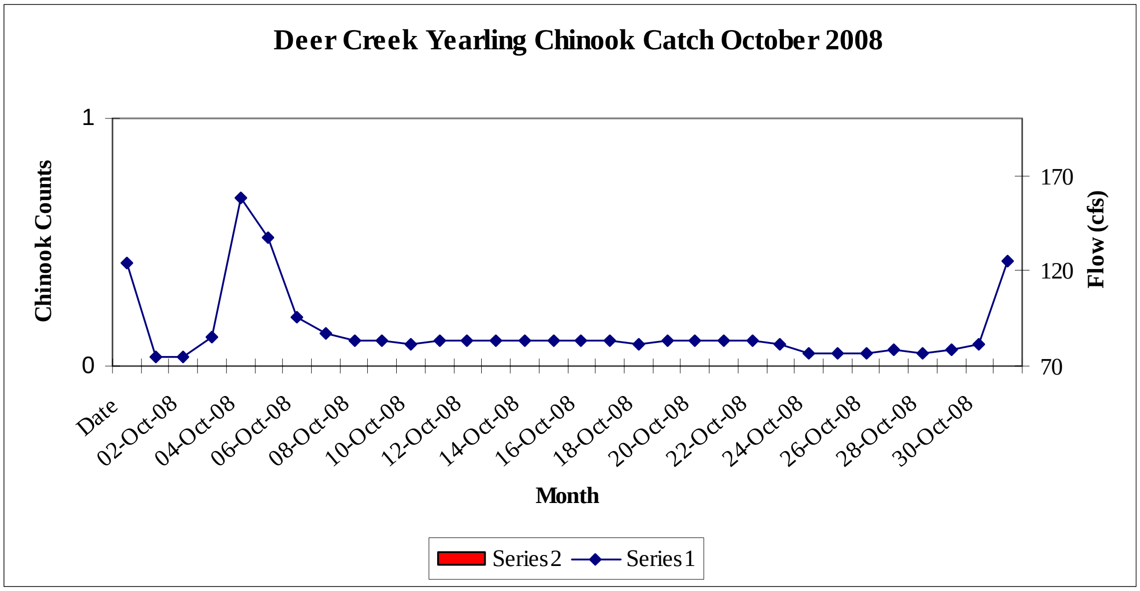


**Figure 23**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for October 2008. The Deer Creek rotary screw trap was not operated in October, 2008. Zero yearling Chinook were sampled.

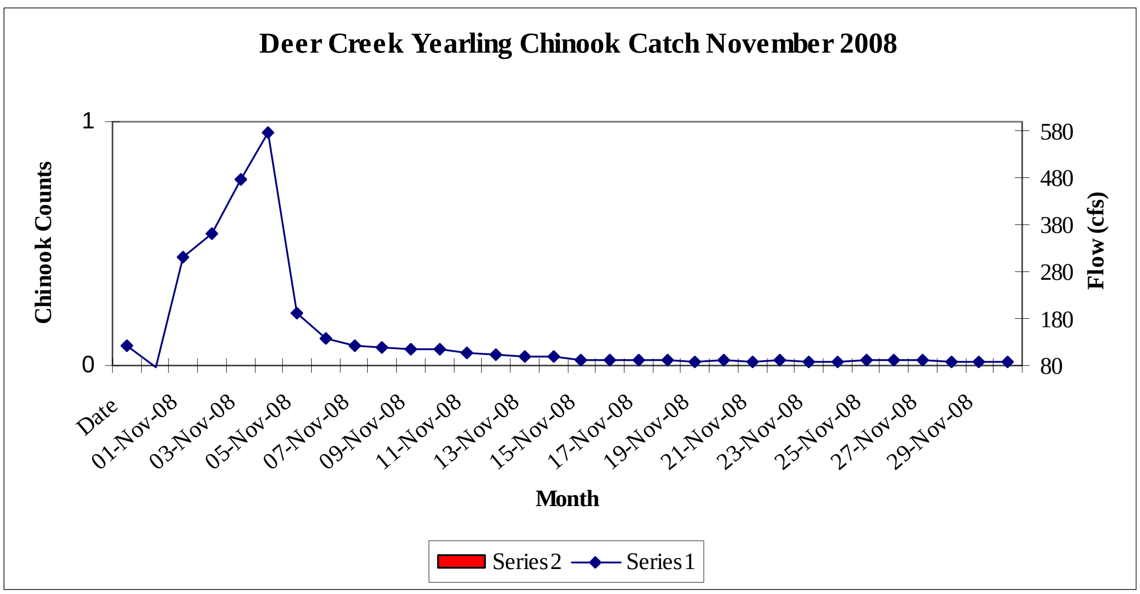


**Figure 24**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for November 2008. The Deer Creek rotary screw trap was not operated in November, 2008. Zero yearling Chinook were sampled.

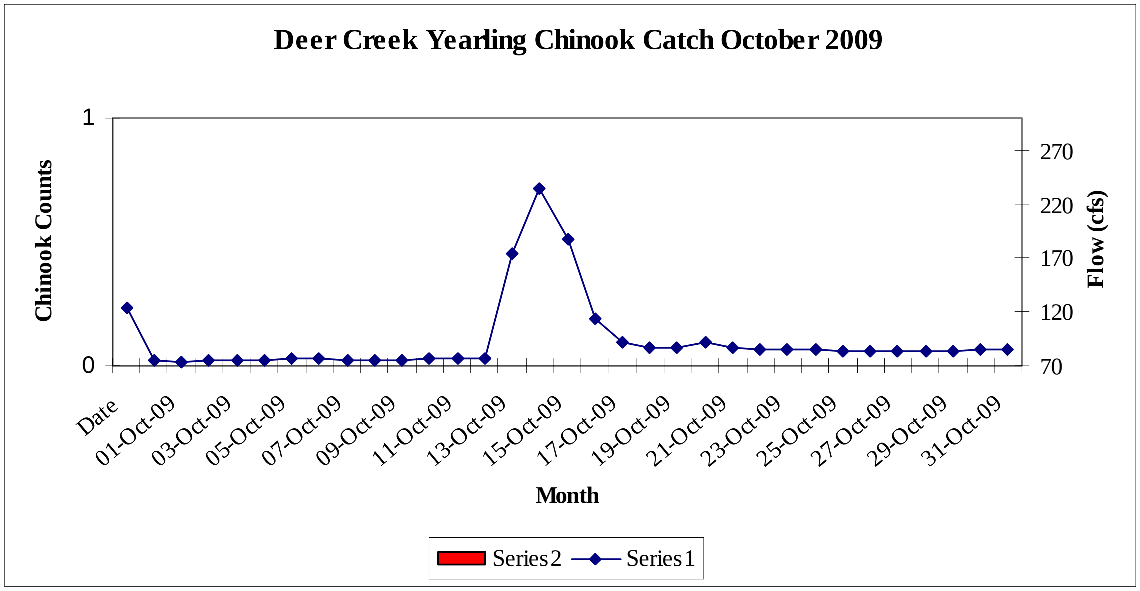


**Figure 25**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for October 2009. The Deer Creek rotary screw trap was not operated in October, 2009. Zero yearling Chinook were sampled.

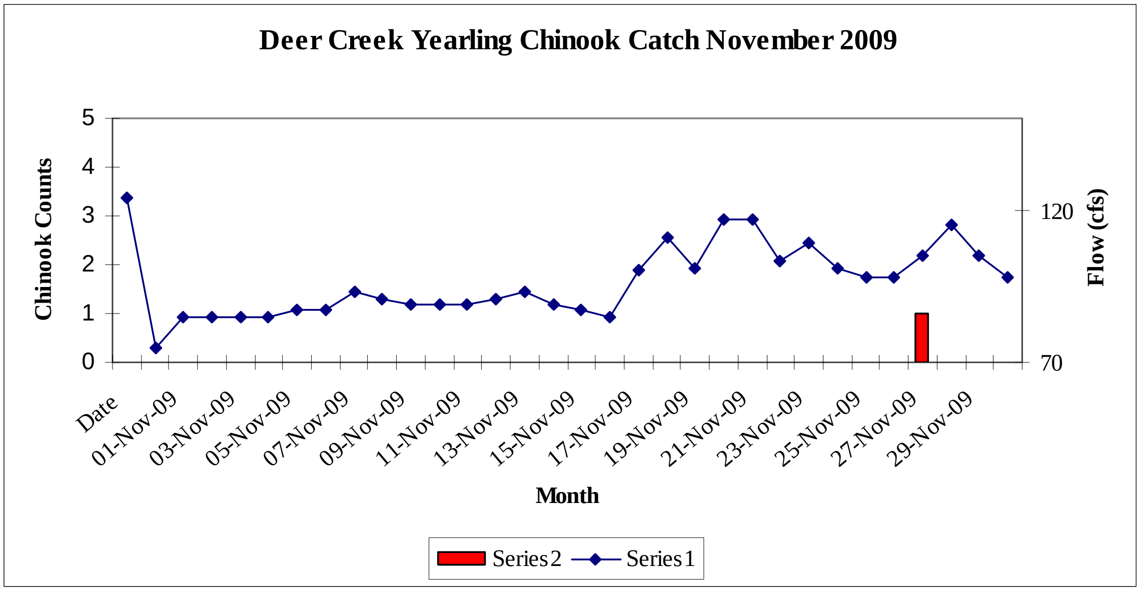


**Figure 26**.— Plot of yearling Chinook sampled by date and maximum flow recorded at the DCV gauging station for November 2009. The Deer Creek rotary screw trap was set on 12-November and was operated without interruption through the remainder of the month. A total of one yearling Chinook was sampled during this period. Zero yearling Chinook were sampled.