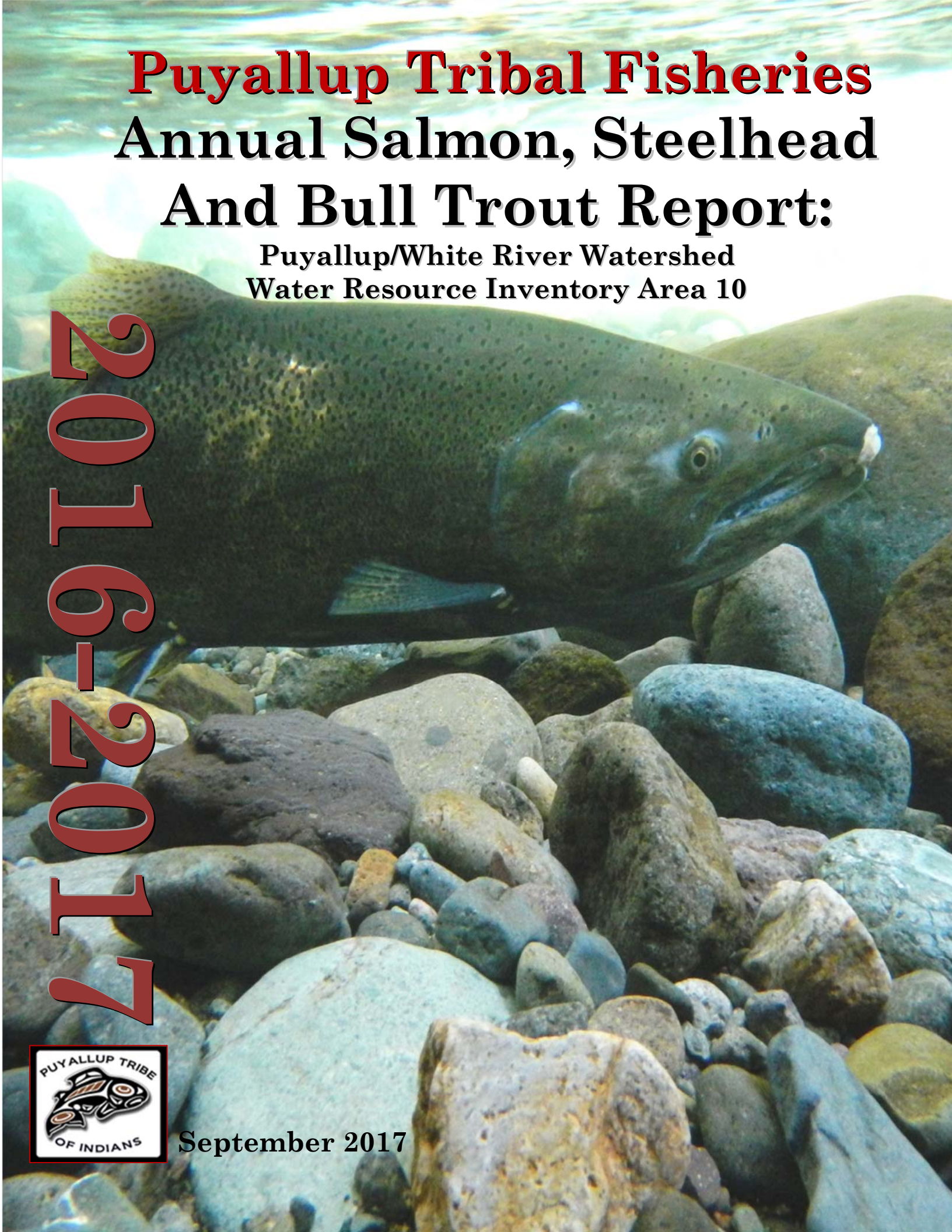
Puyallup Tribal Fisheries

Annual Salmon, Steelhead And Bull Trout Report:

Puyallup/White River Watershed
Water Resource Inventory Area 10

2016-2017



PUYALLUP TRIBE OF INDIANS

September 2017

The following annual report is the culmination of nearly a year of extensive field work and research. Project funding was provided though the Pacific Coast Salmon Recover Fund (PCSRF), B.I.A 638, Pacific Salmon Treaty, Forest and Fish, TFW, Puyallup Tribal Funding, King County Flood Control District cooperative watershed management grant and the Puget Sound Energy Electron settlement fund.

Additional data integrated into this report was provided by the National Park Service-Mt. Rainier (NPS-MORA), Washington Department of Fish and Wildlife (WDFW), and the U.S. Army Corps of Engineers (USACE).

The updated written material and data contained in this report supersedes and replaces all previous annual reports. Data represented may be revised as new or additional information becomes available. While the authors believe the contents of this report are accurate, readers should not presume and are encouraged to confirm the information in this report from other sources.

The availability and nature of fish and stream habitats are not static conditions and are frequently altered. The habitat descriptions in this report provide a general analysis of habitat conditions and are not intended to fulfill the requirements of a rigorous biological assessment/evaluation.

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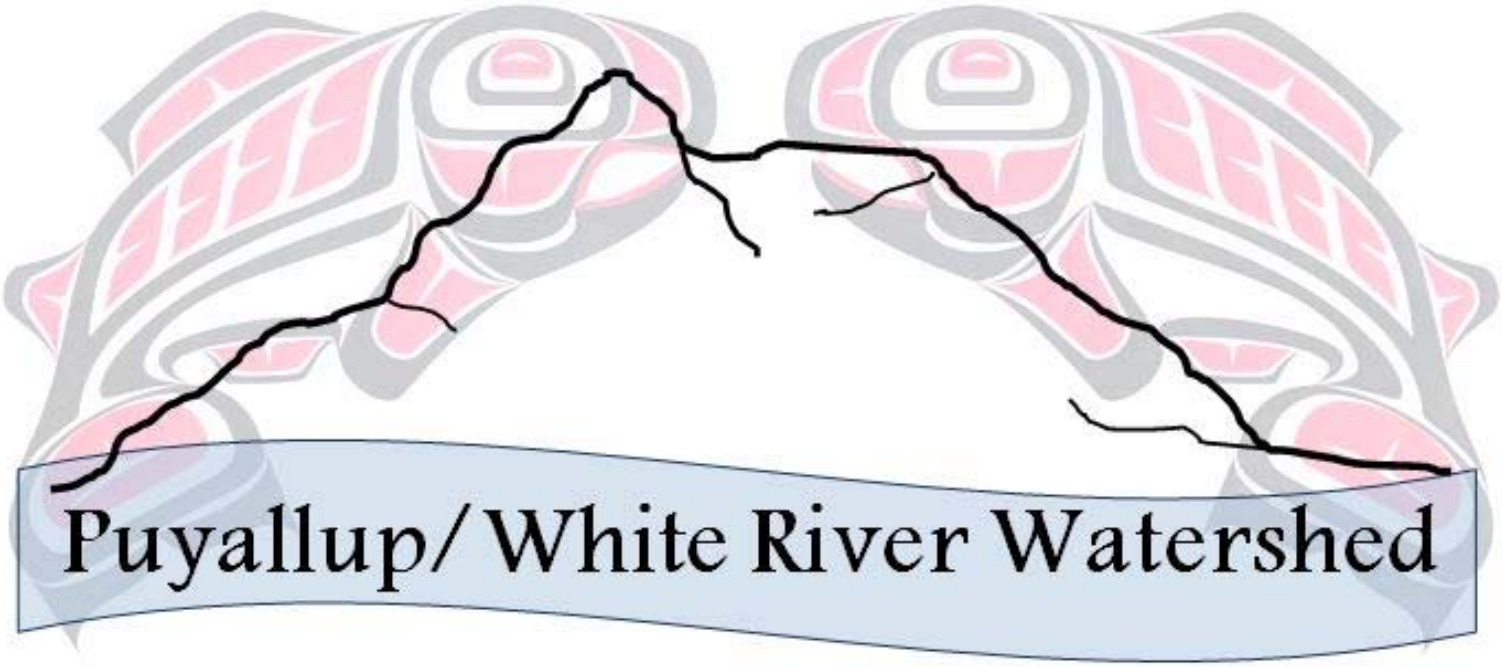

Suggested citation format:

Marks, E. L., R.C. Ladley, B.E. Smith, A.G. Berger, T.G. Sebastian and K. Williamson. 2017. 2016-2017 Annual Salmon, Steelhead And Bull Trout Report: Puyallup/White River Watershed--Water Resource Inventory Area 10. Puyallup Tribal Fisheries, Puyallup, WA.

2016-2017
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Water Resource Inventory Area 10

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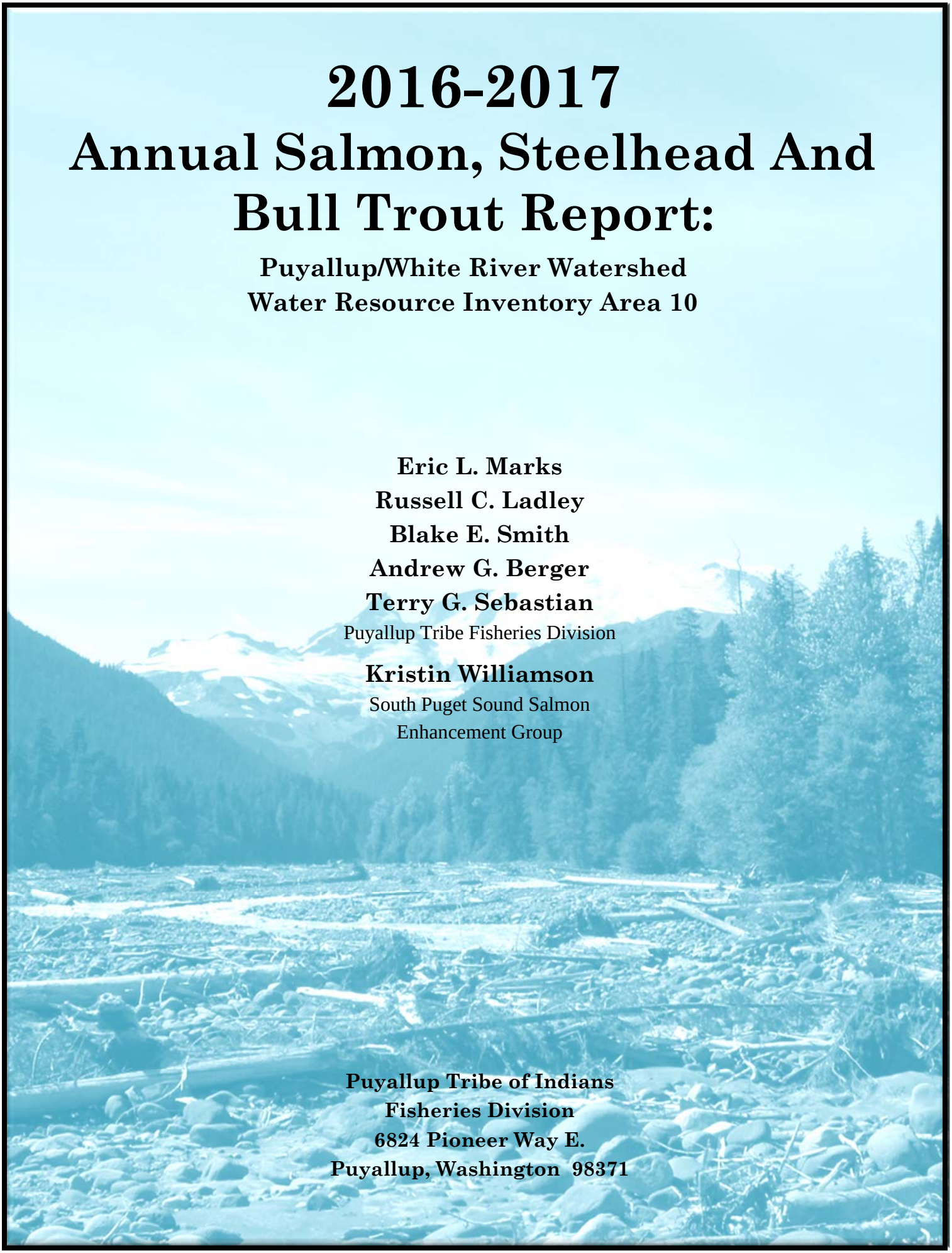

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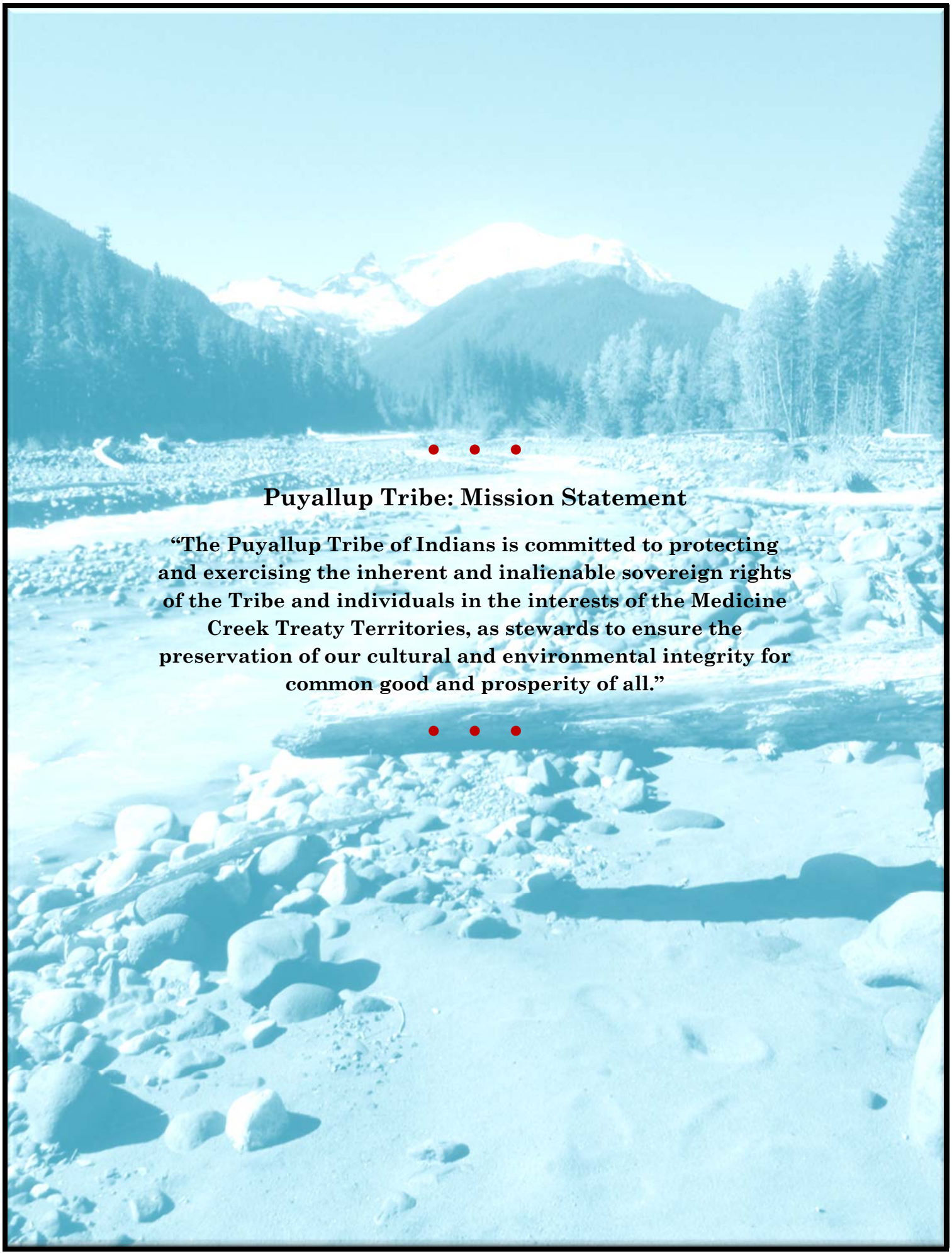

Puyallup Tribe: Mission Statement

"The Puyallup Tribe of Indians is committed to protecting and exercising the inherent and inalienable sovereign rights of the Tribe and individuals in the interests of the Medicine Creek Treaty Territories, as stewards to ensure the preservation of our cultural and environmental integrity for common good and prosperity of all."

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INTRODUCTION

About This Report

The updated written material and data contained in this report supersedes and replaces all previous annual reports. Data represented may be revised as new or additional information becomes available.

The adult salmonid (sal·mo·nid) escapement information and data contained within this report primarily focuses on stream and river habitat reaches known to support the majority of anadromous salmonids and adult spawners. This report is organized alphabetically by stream, project or facility name. If applicable, each includes river miles surveyed, the WRIA designation number, as well as a brief description. Spawning ground escapement data is graphically represented by species and illustrates the seasonal total(s) of live fish, dead fish, and redds observed; as well as Chinook carcass sampling results. In addition, annual species comparisons are presented when three or more years of survey data is available. However, if less than three years of data is available, raw survey data for each stream and river surveyed can be found in Appendix C. Also incorporated into this report is information and data collected from several other Puyallup Tribal Fisheries (PTF) projects including the U.S. Army Corps of Engineers (USACE) fish trap sampling on the White River (Buckley); Electron Hydro LLC's forebay fish collection facility monitoring; the Puyallup Tribal Fisheries Puyallup and White rivers juvenile salmonid production assessment projects (*smolt trap*); as well as, the Puyallup Tribe's salmon hatcheries located on Clarks and Diru creeks. Additional data integrated into this report was provided by the National Park Service-Mt. Rainier (NPS-MORA), Washington Department of Fish and Wildlife (WDFW), and the USACE.

Puyallup/White River Watershed Description

The availability and nature of fish and stream habitats are frequently altered. The habitat descriptions in this report provide a general analysis of habitat conditions and fish utilization; however, descriptions are not intended to fulfill the requirements of a rigorous biological assessment/evaluation.

The Puyallup/White River Watershed is identified as Watershed Resource Inventory Area 10 (WRIA 10) by the Washington State Department of Ecology. Hylebos and Wapato creeks are part of WRIA 10, yet are independent drainages that flow directly into Commencement Bay. The Puyallup/White River Watershed provides over 1,300 linear river miles (RM) of drainage over an area greater than 1,000 square miles. The Puyallup, White and Carbon river basins fall almost entirely within Pierce County; though, part of the White River drainage falls within South King County. All three river systems originate from north and west slope glaciers situated on Mt. Rainier. The Carbon and White rivers converge with the Puyallup River at approximately RM 17.8 and RM 10.4 respectively.

The White River is a significant tributary to the Puyallup River, with a drainage area larger than the Puyallup. However, the White and Puyallup drainages are often viewed and managed as two distinct entities. This management approach is due in part because prior to 1906, the White River did not flow into the Puyallup. Salo and Jagielo (1983) described that prior to 1906, the majority of the White River flowed north towards Elliot Bay. Despite this northern course, some of the water from the White often flowed south into the Puyallup through the Stuck River channel. In November of 1906, a flood event mobilized a tremendous amount of woody debris that blocked the north flowing channel in what is now downtown Auburn. The blockage forced the river to avulse and find a new channel. This newly created diversion sent nearly the entire White River flow down through the Stuck River channel into the Puyallup; more than doubling the size of the Puyallup River drainage. In 1915, a concrete diversion structure was constructed; thus, permanently diverting the White River into the Puyallup. The Puyallup River continues

flowing 10.4 miles west from its confluence with the White River until it reaches Commencement Bay in the city of Tacoma. An extensive system of levees, approximately 90 miles, was constructed along the Puyallup, White, and Carbon rivers from early, through mid 20th century. Several significant fish bearing tributaries feed these mainstem rivers including; the West Fork White River, Clearwater River, Greenwater River, Mowich River, Huckleberry Creek, Boise Creek, and South Prairie Creek.

The West Fork White River enters the White River at RM 49.2 on the left bank and is glacially driven as well, and is characterized by generally unconfined, anastomosing channel networks. Abundant spawning gravels are present in pool tail, as well as the margins and low velocity areas along the lower river. Woody debris is abundant although much of it has been deposited too high to interact with the regular seasonal flows. To a great extent, the overstory riparian zone is either second growth conifer or hardwoods; except for the zone through Mt. National Park with consist of mostly old growth. Several tributaries including Pinochle, Cripple and Wrong creeks; frequently support Chinook, coho and pink spawners. In addition, the clear headwater tributaries of the West Fork, specifically Lodi Creek, provide several key spawning and rearing opportunities for bull trout.

There is approximately 5 miles between Mud Mountain Dam and the USACE Buckley fish trap at RM 24.3. The U.S. Army Corps of Engineers' *(USACE)* operates a fish trapping facility located at RM 24.3 on the White River in the city of Buckley. Pacific salmon *(Onchorynchus spp.)*, bull trout *(Salvelinus confluentus)*, and other native fishes *(mountain whitefish -Prosopium williamsoni) and cutthroat (O. clarki)* migrating to the upper White River enter this trap and are transported above Mud Mountain Dam *(earthen flood control dam)*. The Corps' trapping facility is uniquely integrated into a diversion dam and flume intake that was, up until January 2004, used to divert water from the White River to generate power. Since PSE ceased power production; some measure of water has continued to be diverted from the White River by current project owner/operator Cascade Water Alliance (CWA). CWA is a water purveyor that continues to divert water to maintain the water levels and water quality in Lake Tapps; as well as, future consumer distribution. This project has been screen for fish since May, 1996.

The mean annual flow of the Puyallup River over the first 86 year gauged history was 2,922 cfs. The largest flood on record was 57,000 cfs and occurred in December 1933. Most of the large flood events have occurred in the months of November and December in response to heavy rains on a substantial snow pack. The minimum low flow defined as the 90%-exceedance level for the Puyallup was 1,156 cfs. Over the past couple of decades there has been a trend of decreasing low flows (Sumioka 2004). The Puyallup River at Puyallup flow gauge *(#12101500-link below)* was activated in 1915 and is located at RM 6.6. https://waterdata.usgs.gov/wa/nwis/uv/?site_no=12101500&PARAmeter_cd=00060,00065

The Puyallup, White, Carbon, and Mowich rivers originate from glaciers located on Mt. Rainier. Each of these river systems convey tremendous quantities of fluvial materials which extensively contributes to their dynamic structure. The high sediment loads are responsible for the anastomosing *(braided channel morphology)* characteristic of broad unconfined upper valley segments which are quite prevalent throughout the upper reaches. Channel gradients in the upper basins are typically moderate, with a high riffle-low pool character. River and stream bedding consists mainly of Tertiary sedimentary rock and other products created by ancient volcanic activity. Substrate size within active river channels is typically large; consisting primarily of large gravels, cobble and boulders. Significant quantities of LWD are present within channel migration zones; however, a considerable amount of the larger wood which is deposited during high flow events and settles on the higher bars is detached from, or perched well above active channels during average flow regimes, thereby reducing any habitat creating interactions. Headwater

tributaries are typically non-glacial and are characterized by confined, steep valley channels, with comparatively short anadromous reaches of low-to-moderate gradients.

The Puyallup River has been severely impacted by over a century of land and water resource exploitation, including damming and substantial water diversions; considerable riparian alterations; dewatering and low instream flow regimes; as well as, significant channel manipulation. These impacts have lead to a discernible deterioration in the land and hydrological behavior of this river system by causing water flow of poorer quality, quantity and timing. Several limiting factors have been recognized and accepted with regards to the healthy function of stream habitat and salmonid populations in the watershed. Limiting factors include lost or diminished habitat connectivity and migration corridors; fragmentation and reduction of habitat quality; diminished water quality; fish entrainment; entrapment; unknown species interactions and potential climate change impacts.

The river channel downstream of the National Park boundary courses through private and National Forest land. Most land bordering the river is primarily held by private timber and hydro power company ownership's. As a result, a prolific transportation network of roads extends throughout the basin. The transportation network within the Upper Puyallup Basin consists almost entirely of unimproved roads developed and utilized primarily for timber harvesting; as well as, hunting, recreational activities, hydroelectric operations, and wildlife/fisheries applications. Road density in timber production areas may approach as much as six lineal miles per square mile. Current road networks and bridge emplacements along the Puyallup and Mowich rivers directly interact or alter the hydrology within the upper basin. Roads have contributed many of their trademark problems such as landslides, slope failures, altered hydrology; as well as, culvert and bridge projects which can effect upstream migration and increase levels of sedimentation within effected drainages; however, improvements to bridge approaches and culverts have been made. Although timber management has contributed a great deal of habitat degradation, the greatest negative impact on fish has been the Electron hydroelectric project *(see Electron Hydro Fish Collection Facility section in this report).*

Approximately 26 miles of stream habitat located in the Upper Puyallup Basin *(upstream of RM 41.7)* was void of anadromous fish from1904-2000, due to the construction of the Electron Diversion Dam in 1904 *(formally owned/operated by Puget Sound Energy1904-2014).* Connectivity was reestablished in the fall of 2000 with the completion a 215 foot fishway *(ladder)* at the cost of 1.1 million dollars. The Electron Hydroelectric Project is the only human-made obstacle impacting survival and through-migration of salmon, steelhead and bull trout on the Puyallup River. The Electron project involves a channel spanning water diversion dam located at RM 41.7, a 10.1 mile of flume/flow line, a basin for sediment removal *(Lizard Lake)*, a forebay for water storage *(approximately 124 acre-ft)*, fish collocation facility *(fish trap)*, a power generation station *(power house)*, and transmission equipment. In 1997 the Puyallup Tribe entered into a Resource Enhancement Agreement *(REA)* with Puget Sound Energy (Puget Sound Energy and Puyallup Tribe of Indians 1997) http://wdfw.wa.gov/conservation/habitat/planning/energy/rea.pdf. The REA initiated fisheries restoration efforts within the project affected area.

The current REA agreement is scheduled to expire by 2026. The REA includes provisions for the maintenance of minimum instream flows within the project bypass, or middle reach *(a 10.5-mile section of the Puyallup River from the diversion to the power house formerly subjected to extreme water withdrawal).* Currently, the project operates under a 400-cfs water right. The REA also provides for minimum instream flows which were not previously required despite established state law. Under the REA, Electron Hydro will provide 60-cfs year- round in the bypass reach. This increases to 80-cfs during the four-month period

from July 15 and November 15 to facilitate adult salmon migrating upstream. Depending on timing, manipulations in flow regimes through the bypass reach, created by the Electron project, can have negative effects on adult mainstem spawner by altering habitat availability or dewatering redds. Water spilled at the dam in conjunction with tributary and spring flow accretion will provide sufficient flow for upstream passage. Completion of the 215 foot roughened channel with chevron weirs fish ladder was the centerpiece of the REA. Viable fish habitat must be accessible to realize full production potential. The fishway is designed to operate with at least 40-cfs and incorporates a modified weir and rock design. Electron Hydro has effectively maintained fish passage through the ladder since purchasing the project in 2014.

Absence of anadromous fish above the Electron Dam prior to 2000 has in all likelihood biased the scrutiny and regulatory oversight of past land use, forest practice and road construction/maintenance actions. Hancock Forest Resource Group is the primary private landowner in this WAU but the federal government has considerable holdings as well. The bulk of the Forest Service ownership is contiguous with the Mount Rainier National Park and located on the east headwaters. Primary fish bearing tributaries to the upper Puyallup include: Niesson Creek, Kellogg Creek, LeDout Creek, Swift Creek, Deer Creek, Mowich River, Rushingwater Creek and the North/South Forks of the Puyallup River. In addition, numerous unnamed wall base tributaries parallel the Puyallup River, providing prime rearing habitat.

Electron Hydro's project *(non-FERC licensed)* directly diverts up to 400 cfs. of water *(unscreened)* from the Puyallup River at RM 41.7. This structure/operation contributes, in whole or in part, too many of the impact issues previously stated. For 96 years *(1904-2000)* the diversion dam completely severed access for anadromous salmon, and isolated the population(s) of bull trout established throughout the 26+ miles of habitat upstream of the structure; thereby, stemming the genetic flow from bull trout *(populations)* located elsewhere in the basin or watershed for multiple generations. There are no known barriers above the water diversion that prevent fish from migrating throughout the upper basin. Prior to 1998, no processes were established or employed to removing fish entrained in the project, and as a consequence, fish losses were colossal. However, in 1998, PSE began operating a fish collection facility *(fish trap)* to help address the fish losses associated with the project. Natural resource and Electron Hydro managers agree the project needs to be properly screened to prevent fish entrainment. Electron Hydro is currently planning and engineering the construction of fish screens to exclude fish from the flow line just downstream of the headworks/project intake.

The long-standing presence of private industry, primarily hydroelectric and commercial timber harvesting; in addition to, the repercussions of recreational usage and negative air and water quality, have all created lasting impacts on the upper watershed. These impacts include; loss of in-stream large woody debris and LWD recruitment; stream bank modifications; increased sedimentation issues and slope failures due to deforestation; unsatisfactory RMZ management; new road construction; road failures, and road decommissioning or abandonment. A great deal of the forestland throughout the Upper Puyallup Basin has been harvested at least once, and in many instances twice; leading to many of the wide-ranging issues common with deforestation and land degradation. Air and water quality issues vary from measurable levels of airborne contaminants which have been detected in Mt. Rainier National Park; including heavy metals and pesticides discovered in samples of snow, soil and fish (Landers et al. 2008).

Watershed Salmonids

The Puyallup/White River Watershed supports several species of native salmonids, including Chinook *(Oncorhychus tshawytscha)*, coho *(O. kisutch)*, chum *(O. keta)*, pink *(O. gorbuscha)*, sockeye *(O. nerka)*, steelhead/rainbow *(O. mykiss)*, cutthroat *(O. clarki)*, bull trout *(Salvelinus confluentus)*, mountain white-

fish (*Prosopium williamsoni*); as well as non-native brook trout *(S. fontinalis)* and brown trout (*Salmo trutta).* Puget Sound Chinook and coastal-Puget Sound bull trout are currently listed as "threatened" under the U.S. Federal Endangered Species Act (ESA). In May of 2007, after a year of investigation, the National Marine Fisheries Service (NMFS) announced the listing of Puget Sound Steelhead as "threatened" under ESA. The ESA listing of steelhead offers protection for naturally spawned steelhead; however, it does not offer protection for rainbow trout, the fresh water resident form of the species.

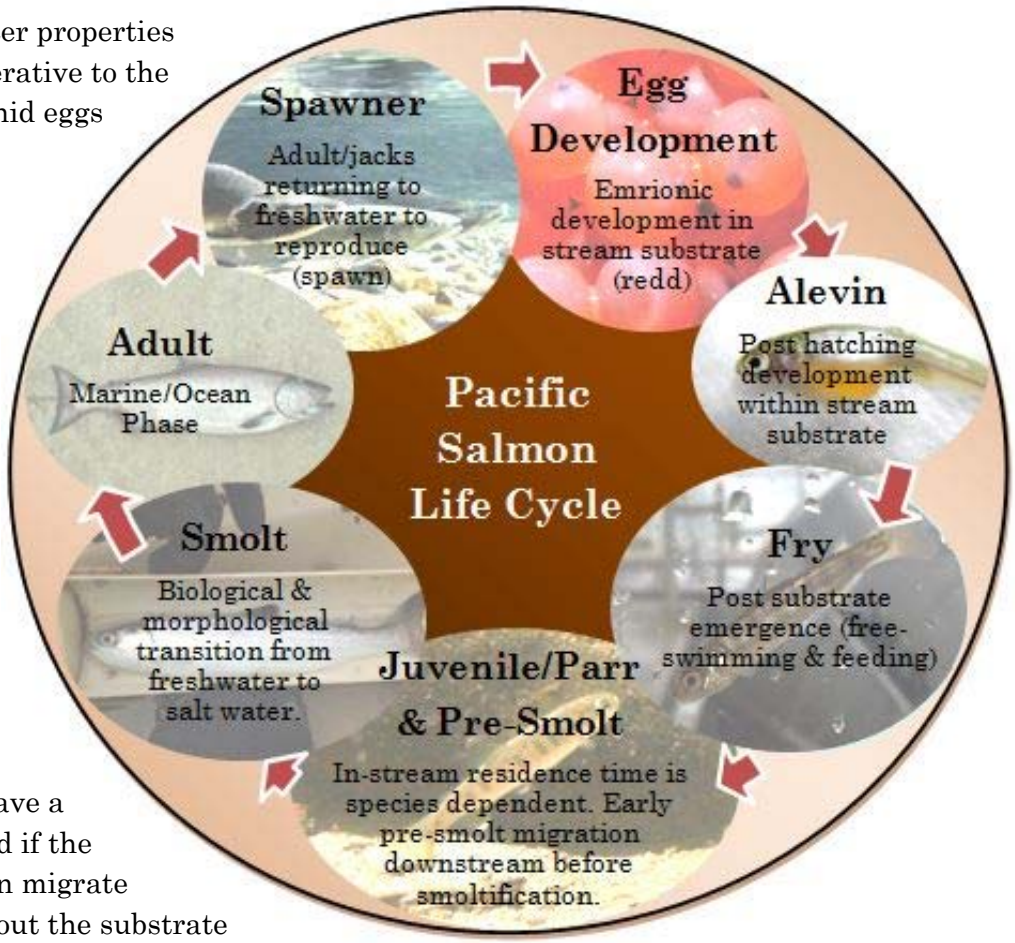
Each of the eight Pacific salmonid species present in the Puyallup/White River system exhibits unique life-history strategies. However, the five major Pacific salmon species *(Chinook, coho, chum, pink, and sockeye)* all share some common life-history characteristics. Pacific salmon are all anadromous; meaning, fish spawn and reside in fresh water; however, the instream residence time varies considerably by and within species. Salmon will eventually emigrate to marine waters *(smoltification)* where they will continue to forage and grow until they return to fresh water as mature adults *(or jacks)* to reproduce. Furthermore, these species will only reproduce once *(semelparous)* during their life cycle. This single reproductive event requires tremendous amounts of energy and effort, as well as proper spawning site selection to be successful. Therefore, the end result of this reproductive strategy is that all five major species of Pacific salmon will die as a result of this reproductive process. Nevertheless, this sole reproductive strategy is very successful due to the considerable degree of energy put into producing vast amounts of gametes *(eggs and sperm)*, thus ensuring the survival of at least some offspring. Other salmonid species; such as steelhead, cutthroat, and bull trout, may reproduce more than once *(iteroparous)* during their life cycle.

All female salmonids are oviparous *(producing eggs that hatch outside the body)*, and during the act of spawning the male and female will release gametes in a simultaneous effort. Eggs released by the female drift to the bottom and are actively buried in the substrate creating an egg pocket. A redd is the excavated site formed in the substrate from multiple spawning events and typically contains several egg pockets. The rate of development and growth varies between species and is greatly influenced by water temperature (Piper et al. 1986; Groot and Margolis 1991). As fish age, they lay down annual growth rings on their scales; these scales are often collected to determine age, as well as important growth, environmental and life history factors.

Early Salmonid Development

During the act of spawning, males and females release gametes *(eggs and sperm)* in a synchronized effort. The fertilization of eggs occurs rather quickly. The membrane surrounding each egg is gas permeable and is initially quite malleable. Penetration of a single spermatozoon into the egg *(through the micropyle)* will create a reactionary process preventing the infiltration of additional spermatozoa. However, once eggs exit the female and are exposed to water, each egg will begin to take up water causing the internal pressure of the egg to increase and swell (Alderdice et al. 1984). This process causes the outer membrane of the egg to firm up or "water harden"; whereby, closing the micropyle and preventing fertilization in as little as 30 seconds (Groot and Margolis 1991). Once an egg is fertilized it goes through three phases of development prior to hatching *(cleavage, epiboly, and organogenesis).* Some of the water properties influencing salmonid egg survival and development are temperature, dissolved oxygen, and velocity (McNeil 1966; Leman 1993; Peterson and Quinn 1996). The rate of development and growth varies between species, and is significantly influenced by water temperature (Piper et al. 1986; Beacham and Murray 1990; Groot and Margolis 1991). For example, coho salmon take 50 days to hatch in water that is 10°C *(50°F)*; other Pacific salmon species take between 47-65 days to hatch at the same temperature.

Stream bed characteristics and water properties are additional factors that are imperative to the survival and development of salmonid eggs and larvae.



Upon hatching, young salmonid larvae *(alevins)* are not fully developed and are unable to feed; therefore, they remain within the interstitial spaces of the gravel substrate while continuing to grow and further develop. Young alevins do, however, posses a considerable yolk sack necessary to fuel their prolonged growth and developmental needs. Alevins are also relatively tolerant of dewatering and low dissolved oxygen levels for several hours after hatching. Although buried, developing alevins have a sense of up and down *(geotaxis)*, and if the substrate size allows, they will often migrate vertically and horizontally throughout the substrate depending on light stimulus *(Phototaxis)* and the level of dissolved oxygen available in the water (Heard 1964; Carey and Noakes 1981; Groot and Margolis 1991; Quinn 2005). Alevins will migrate toward the surface of the substrate when their yolk sacks are absorbed *(buttoned-up)*. Emergence of the newly *(or nearly)* buttoned-up fry occurs during the late winter and early spring; however, this emergence point is dependent on the species; as well as the spawn timing of the parents.

The duration of time newly emerged fry spend instream varies by species and within species *(see species descriptions for more information)*. Depending on the species, salmon fry will emigrate to marine waters within days or weeks upon emergence, or may remain in fresh water for an extensive period of time to rear *(several months or years)*. Both adaptive strategies have advantages and disadvantages in regards to growth and survival. Fish that emigrate early to more productive, and possibly warmer marine waters, will grow faster; yet, they face a higher rate of mortality due to their smaller size, as well as the substantial increase in predation. Fish that rear in fresh water will grow slower *(less available food, colder water)*, but face a lower predation risk, and will be larger *(lower mortality risk)* when they emigrate to the marine environment.

Anadromous salmon and steelhead will inevitably emigrate to marine waters *(smolts)*. For young migrating salmon and steelhead this process of "smoltification" is complex. Smolts will undergo behavioral; as well as tremendous internal and/or external physiological changes including body metamorphosis, coloration and metabolic transformations. In addition, smolts must undergo the osmoregulation adaptations necessary to make the transition from a fresh water environment to a marine environment. The physiological process of osmoregulation involves the forceful governing of the osmotic pressure of bodily fluids in order to maintain internal stability, or homeostasis, of the body's water content. In the case of fish, it es-

sentially prevents a fish's bodily fluid from becoming too dilute or too concentrated with salt. Fish in freshwater actively expel excess water to conserve salt; whereas fish in marine waters actively excrete salt to maintain homeostasis. This process of osmoregulation is critical when making the transition from fresh water to salt water, or when undertaking the reverse procedure. Fish, such as salmonids, with this ability to tolerate and adapt to such a wide range of salinity are known as euryhaline species. Fish that make the transition to the marine environment successfully may spend several months, or years, foraging and growing in the more productive marine waters before returning to freshwater to spawn.

Spawning Site Selection

Spawning site selection for salmonids is critical to insure offspring survival. Stream bed characteristics and water properties are important factors in the survival and development of salmonids eggs and larvae. Some of the water properties influencing salmonid egg survival and development are temperature, dissolved oxygen, and velocity (McNeil 1966; Leman 1993; Peterson and Quinn 1996). Substrate size and density are primary factors involved in the permeability of bottom materials (Wicket 1958; McNeil and Ahnell 1964; McNeil 1966). Temperature dictates the rate of development and metabolic level of salmonids from earliest development through adulthood. Adequate levels of dissolved oxygen must be present in the water to support energetic demands of growing embryos and fry. Dissolved oxygen levels vary with stream topography (Peterson and Quinn 1996), as well as temperature and depth (Leman 1993). Survival depends on oxygenated water reaching the buried eggs and larvae within a redd site. Sources of intergravel water include ground water and surface water (McNeil 1966).

Having established the fact that oxygenated water is important for survival and development; velocity of delivery is also important (Leman 1993). Salmon may be able to detect variation in water velocity more readily than substrate quality (Witzel and MacCrimmon 1983). The variations in velocity are often influenced by different substrate types; salmonids may choose, indirectly, suitable substrate size for redd sites based on water velocity (Shirvell and Dungey 1983). The rate of oxygen utilization varies with development (McNril 1966; Peterson and Quinn 1996). As metabolic demands of developing salmon utilize the available oxygen; more must be supplied. The velocity *(rate)* at which oxygenated water can be delivered is largely governed by the general size and density of substrate materials. McNeil (1966) states: "The permeability of bottom materials is a function of particle compaction, arrangement, and size." According to McNeil and Ahnell (1964) the velocity of intergravel water is related to the size of the bottom materials. Smaller materials (fines) decrease the velocity of water through redds. Wicket (1958) showed that the survival of pink and chum salmon eggs and larvae increased with the increased permeability of the stream bed. All of the previously discussed issues are important factors to consider when addressing glacially driven river systems like the Puyallup, White, and Carbon rivers.

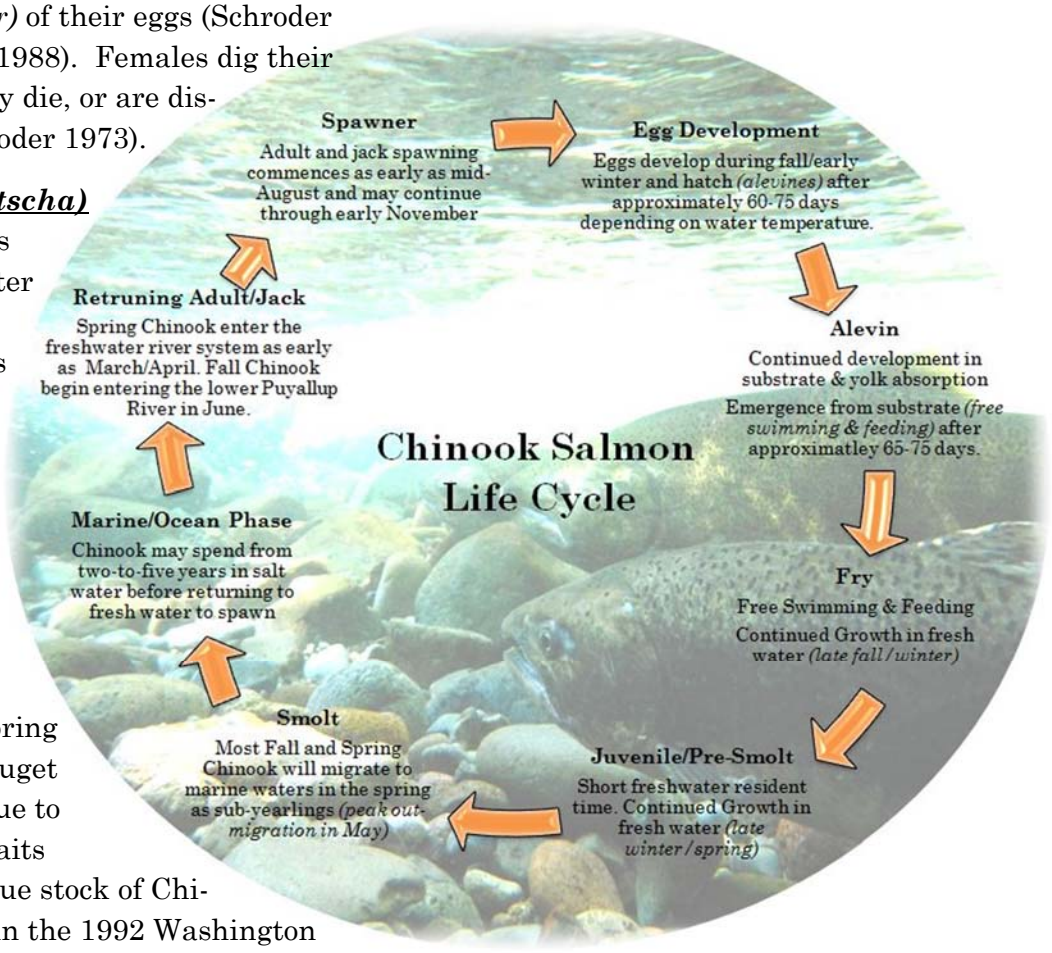
Spawning Behavior

Aggression is an integral aspect of spawning behavior in Pacific salmon *(Oncorhychus)* species (Chebanov et al. 1983; Keenley and Dupuis 1988; Quinn et al. 1996). Several factors influence the frequency and focus of male aggression, including the operational sex ratio *(OSR)* (Quinn et al. 1996), size of the male (Chebanov et al. 1983; Foote 1989; Keenleyside and Dupuis 1991), density of spawners (Chebanov 1991, 1994) and an individual's status (Schroder 1973; Chebanov et al. 1983). The OSR represents the number of ripe *(ready to reproduce)* male to the number of ripe females. Variations in the OSR affect the frequency of aggression in males; changes lead to an increase *(low OSR)* or decrease *(high OSR)* in aggressive behavior (Quinn et al. 1996). Aggression can be displayed in several forms (Mork 1995); including charging, chasing, biting, fighting, as well as, lateral and frontal displays. Mork (1995) reported that lateral movements, charging, chasing, and biting were often the preferred methods of aggression dis-

played by salmon under study. Aggression is not only focused towards the same species, but other species as well.

The size of the male affects his position in the hierarchal structure and his success in spawning (Chebanov 1983; Foote 1989). Larger males are more successful at securing females and are therefore more often in the position of dominance. Females prefer to mate with larger males (Foote 1989) and may delay spawning if courted by small males. Holding a dominate position leads to increased encounters with other males who are trying to displace him, or attempting to mate with the female (Chebanov et al. 1983; Chebanov 1994). A change in the density of spawners leads to changes in the frequency of aggression. As the densities of spawning fish increases, so will the number of aggressive actions (Schroder 1973; Parenskiy 1990); this holds true for both males and females. Furthermore, at lower densities, aggressive actions decrease.

An individual's status may also determine the frequency and focus of aggressive actions. Schroder (1973) describes how dominate or "Alpha" males take up positions just behind the females and shift from side to side defending their territory and females. Satellite males line up behind the dominate male. These sub-dominate males defend their positions in the chain. The natural drive to mate with females often leads to aggressive interactions between males. The success of males also depends on the level of aggression directed toward other males (Chebanov et al. 1983). Females compete with other females for nesting sites (Schroder 1973, 1981; Keenleyside and Dupuis 1988). Female's attempt to defend their nests *(redds)* against other female's attempts to overtake them, and guard sites to prevent superimposition *(displacing or covering over)* of their eggs (Schroder 1981; Keenleyside and Dupuis 1988). Females dig their nests and guard them until they die, or are displaced by another female (Schroder 1973).



Chinook Salmon *(O. tshawytscha)*

Puget Sound Chinook stocks were listed on the federal register of endangered species in 1999, and are currently designated as "threatened." Two distinct stocks of Chinook are present in the Puyallup/White River system. They include the White River Spring Chinook *(springer or spring-run)* and Puyallup River Fall Chinook *(fall or fall-run)*. White River Spring Chinook are the only Spring Chinook stock existing in the Puget Sound region and are unique due to their genetic and life-history traits (WDFW et al. 1996). This unique stock of Chinook was classified as distinct in the 1992 Washington State Salmon and Steelhead Inventory (WDFW et al. 1993). Microsatellite DNA analysis of Chinook from the White River shows a distinct mixture of spring and fall-run Chinook stocks (Spidle 2010; Shaklee and

Young 2003; Ford et al. 2004). Spidle (2010), analyzed 913 tissue samples collected by PTF from NOR Chinook captured in the USACE trap on the White River from 2004-2007. Genetic samples were evaluated to calculate the proportion of Spring and Fall Chinook returning to the upper White River. Results from the multilocus microsatellite genotypes analysis showed a range of 84.6% (2004) to 93.1% (2005) Spring Chinook *(95% confidence interval*). Spidle also stated in the report that, "In addition to mixture modeling, Bayesian lineage clustering was conducted to determine if there was evidence for multiple populations of Spring or Fall Chinook salmon, and also to look more closely at the separation of the spring and fall populations. There was no evidence of multiple populations within either run-time." Ford et al. (2004), reported that approximately 60% of Chinook smolts genetically sampled above the Buckley diversion were spring-run, and 40% were fall-run; whereas, smolts sampled below the dam were approximately 42% springers and 58% fall.

Spring Chinook enter the freshwater river system as early as April/May, and hold in the river until spawning commences as early as mid-August *(typically September).* Adults generally return as three-to-four-year-olds; however, the age of adult Chinook returning to spawn can range between two-to-five years. Although the majority of documented spawning occurs in the larger tributaries, such as the Greenwater and Clearwater rivers; mainstem spawning by Spring Chinook in the upper White River has been documented by PTF biologists via radio telemetry studies (Ladley et al. 1996). Spring Chinook spawning also occurs throughout the lower *(below RM 24.3)* White River. Egg to fry emergence of young Chinook takes approximately 90-110 days depending on water temperature. The majority of juvenile Spring Chinook (80%) migrate to salt water as sub-yearlings *(0 age- less than one year old)* (Dunston 1955). DNA and aging analysis of adult (NOR) Chinook collected from the USACE trap in Buckley and integrated into the Muckleshoot's White River Spring Chinook program, showed that 77% of the springers sampled migrated to salt water as sub-yearlings (Johnson unpublished work). Aging data from 2,879 readable scale samples taken by PTF biologists from Chinook captured in the USACE Fish trap *(1994-2008)*; revealed 91.73% of Chinook sampled *(springers & falls)* migrated as sub-yearlings.

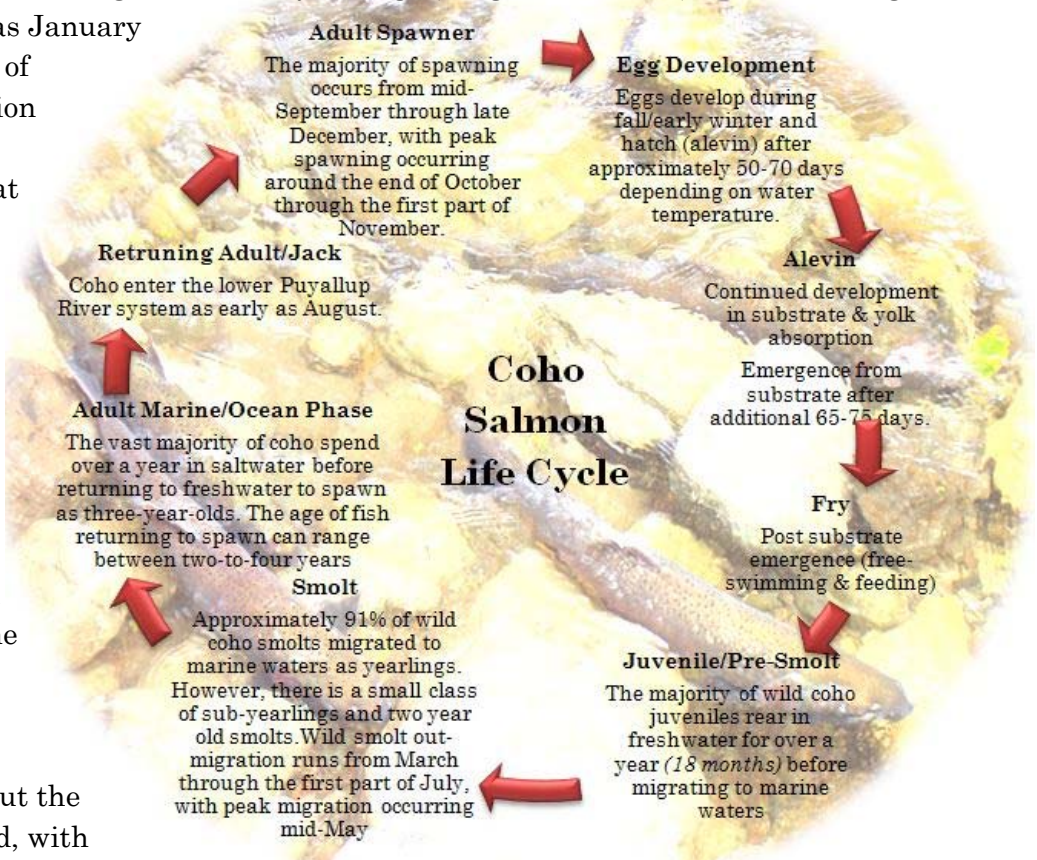
Escapement data for White River Spring Chinook has been collected from fish captured in the U.S. Army Corps of Engineers' (USACE) fish trap on the White River near the city of Buckley since 1941. After 1950, there was a steep decline in the number of Spring Chinook captured in trap. Spring Chinook escapements dropped under 1,000 fish annually after 1955; continued to drop to as few as 66 fish in 1977, and dipped down to only 6 fish in 1986. This precipitous decline prompted the State of Washington and South Puget Sound Tribes to implement a recovery plan in the mid 70s (WDFW et al. 1996). The recovery plan involved starting a program involving the artificial propagation of wild and captive brood stocks. Currently, there are two Spring Chinook programs in operation; the Muckleshoot Indian Tribe's hatchery on the White River and WDFW's Minter Creek program. The White River Spring Chinook Program the Minter Creek Program is going to be phased out. All fish produced at Minter will be transferred and reared at Puyallup Trout then marked by WDFW and transferred to the White River Acclimation Ponds. Currently, there is a three year moratorium transferring fish from Minter Creek Hatchery because on an IHN detection in the 2016 broodstock. The phasing out of the program will commence in 2020 unless there is another detection of a regulated pathogen. These artificial propagation programs in conjunction with the use of acclimation ponds, continues to be an integral part of restoring the run to near historic levels.

Puyallup River Fall Chinook are endemic throughout the Puyallup River, Carbon River, Lower White River, plus many of the tributaries associated with these mainstem river systems. A large component of the adult fall spawners are hatchery origin from the WDFW Fall Chinook program operated on Voights

Creek. In 2004, the Puyallup Tribe began operation of its own Fall Chinook hatchery *(@RM 1)* on Clarks Creek, a tributary to the lower Puyallup River *(RM 5.8)*. The Puyallup River Fall Chinook Baseline Report (WDFW 2000) states that genetic testing has shown similarities in both hatchery and wild Puyallup River Fall Chinook, with those of Chinook stocks found in several other watersheds within the Puget Sound region. The similarities are likely due to significant numbers of Fall Chinook imported to these watersheds from the Green River hatchery. Although Spring Chinook are known to spawn in the Puyallup River system, the straying rate is significantly less than that of Puyallup River origin Fall Chinook. Additional evidence shows a significant number of Puyallup River Fall Chinook stray into the White River system to spawn. There is no Fall Chinook supplementation program on the a White River; however, carcass sampling from 2003 to 2011 on Boise Creek, a significant Chinook spawning tributary to the White *(RM 23.5)*, showed 47-80% of Chinook sampled to be of hatchery origin *(fall-run)* due to the presence of a coded-wire-tag and/or adipose fin clip.

Puyallup River Fall Chinook enter the Lower Puyallup River in June, and continue to move through the system as late as November. The majority of tributary spawning activity occurs from September through late October, with the exception of some lower tributaries which often have fish present through early November. Initial spawning generally commences in the upper watershed; while the lower river and tributaries commonly experience active spawning beyond the time that live fish are even observed in the upper watershed. The age of adult Fall Chinook returning to spawn can range between two-to-five years of age. However, the largest component of adult returns typically consists of four-year-olds; with a smaller proportion returning as three-year-olds.

The majority of post emergent fry spend a moderate period of time residing instream before migrating to marine waters. Trapping data from a rotary screw trap in the lower Puyallup River showed that 99.5% *(n=869)* of wild out-migrant Chinook caught were sub-yearlings (Berger et al. 2015). Chinook emigration in the Puyallup begins as early as January and runs well into the last week of August, with the peak of migration taking place at the end of May. Berger et al. (2015), reported that sub-yearling Chinook sampled varied in length from 32-115mm during the trapping season *(January 30- July 26)*, with significant size increases occurring throughout the season. The average fork length of Chinook measured from January through late July was 61mm; yet, the minimum size range did not exceed 50mm until after June 8th.



Coho Salmon *(O. kisutch)*

Coho are prevalent throughout the Puyallup/White River Watershed, with several of the lower and mid-range drainages experiencing some escapement. Coho are frequently ob-

served spawning as high as Silver Springs on the White River (RM 60.5), and a limited number make their way into the habitat available above Electron Hydro LLC's Electron Diversion Dam on the Puyallup River (RM 41.7). Although the majority of coho in the system are primarily tributary spawners, some mainstem spawning occurs along the peripheries of the main river channels and in the lower velocity side channels. Key spawning areas for coho include South Prairie Creek, Boise Creek, Clearwater River, Greenwater River, Huckleberry Creek; as well as Fox and Kapowsin creeks on the Puyallup. The WDFW hatchery on Voights Creek has artificially propagated coho since 1917, having in the past incorporated fry and smolts from other drainages, including Big Soos Creek, Minter Creek, Garrison Springs, George Adams Creek; as well as the Skagit and Washougal rivers. Voights Creek currently produces approximately 800,000, 100% mass marked *(adipose clip)* yearling pre-smolts annually, of which 100,000 *(decreased from 200K)* are transferred to acclimation ponds in the upper Puyallup Watershed when available *(see Salmon and Steelhead Hatchery Production; as well as Fish Enhancement and Restoration sections in this report).* Currently, approximately 300K coho reared at WDFW's Puyallup Trout Hatchery fish from Voights Creek are released in April and generally move rapidly downstream. The majority of wild coho juveniles rear in freshwater for over a year *(18 months)* before migrating to marine waters. Wild smolt out-migration runs from March through the first part of July, with peak migration occurring near mid-May. Smolt trapping data in 2005 on the Puyallup River indicated that approximately 91% of wild coho smolts migrated to marine waters as yearlings (Berger and Williamson 2005). However, there is a small class of sub-yearlings and two year old smolts.

The vast majority of coho spend over a year in saltwater before returning to freshwater to spawn as three-year-olds. A small component of coho return to spawn as two-year-olds; yet, the age of fish returning to spawn can range between two-to-four years. Adult coho enter the lower Puyallup River system in early August. Spawning surveys and USACE Buckley trap data show coho continue to move through the watershed as late as February/early March. The majority of spawning occurs from mid-September through late December, with peak spawning occurring around the end of October through the first part of November. The South Prairie Creek drainage has a unique late run of coho that spawn well into February and early March. Hundreds of adult coho are often observed holding in South Prairie Creek in December prior to moving into upper tributaries, such as Coal Mine *(Wilkeson Cr. Tributary)* and Spiketon creeks to spawn.

Chum Salmon *(O. keta)*

Chum salmon are most numerous and widespread throughout the lower and mid-river system. Chum have been observed spawning as high as Boise Creek on the White River (RM 23.5), Fox Creek on the Puyallup (RM 29.5), and as high as river mile 8.5 on the Carbon and

river mile 12 on South Prairie Creek. Chum are mass spawners, frequently utilizing the habitat found in the placid flows of primary side channels and secondary ephemeral side channels established along the major mainstem rivers. Also commonly utilized are the shallower outer margins of the mainstem rivers; nevertheless, most of the spawning efforts are focused in the numerous smaller tributaries located off the lower Puyallup and White rivers, as well as South Prairie Creek. A split stock of wild and hatchery origin chum are present in the Puyallup/White system. Genetic testing implies a difference between lower Puyallup River chum *(Clarks, Diru, Swan and Clear creeks*) and upper river chum *(Carbon River, White River, Salmon Tributary, South Prairie Creek, Fennel and Canyonfalls creeks)* (Ford and Schwenke 2004). The Puyallup Tribe began rearing and releasing chum from its Diru Creek Hatchery facility, a small tributary to Clarks Creek on the lower Puyallup River, in 1979. The Puyallup Tribe currently raises 1.5 to 2.7 million-chum smolts annually for release into the lower Puyallup River. This program significantly augments a tribal river fishery and All Citizen purse seine fishery in East and West Pass in Puget Sound. This stock originated initially from Chambers Creek. Eliminating the need to import chum from outside the Puyallup/White River Watershed, the Puyallup Tribe began propagating chum for its own program at Diru Creek in 1993. Currently, this is the only chum supplementation program operating in the Puyallup/White River Watershed.

Adult chum salmon enter the Puyallup River as early as October. An early run of chum in Fennel Creek and the Carbon River can be observed spawning in late October. In most of the rivers and tributaries, active spawning occurs from the middle of November through the end of January, with peak spawning occurring in mid-December. Scale data collected by Puyallup Tribal Fisheries (PTF) from commercial gill-net fisheries in the lower Puyallup and Diru Creek Hatchery returns, show most adult spawners returning as three-to-four-year-olds. During most years, adult spawners are predominately four-year-olds (>50%) with a small contingency of two and five-year-olds (< 4%). Instream residence time for newly emerged chum is short, emerging from the gravel in late winter to early spring, juveniles move quickly downstream to the marine waters of Commencement Bay. Since 2001, the Puyallup Tribal Fisheries Department has operated a rotary screw fish trap on the lower Puyallup (RM 10.6). Trapping data reports downstream migrating chum are captured in the trap as early as the first week of March, with peak outmigration occurring during the first quarter of May (Berger and Williamson 2005).

Pink Salmon *(O. gorbuscha)*

Pink salmon in the Puyallup/White River system return on odd years to spawn. The range and habitat utilized by pink salmon throughout the watershed has changed considerably over the past several spawning seasons. Washington Department of Fisheries biologists, in a 1975 publication, describe pink salmon utilization to be almost exclusively limited to the mainstem Puyallup River; the lower Carbon and White rivers; South Prairie Creek and Fennel Creek (Williams et al. 1975). This description of pink salmon utilization was generally accurate until 2003, when an unprecedented number of adult pink salmon returned to the Puyallup/White River Watershed. Washington Department of Fish and Wildlife escapement data from 1959 to 2001 shows the number of adult pinks returning to the Puyallup system ranged from 2,700 to 49,000, with an average seasonal return of 19,400. Pink escapement estimates obtained from WDFW reported an estimated pink return of 185,000 during the 2003 run; and in 2005 the escapement was estimated at over 466,000 (Scharpf 2006). The adult pink escapement for 2007 is estimated at well over 600,000, and just over 1.2 million in 2009. Pink escapement has fallen moderately since its peak in 2009.

Beginning in 2003, significant numbers of pink salmon have been transported above Mud Mountain Dam to spawn in the Upper White River, and the West Fork of the White. Substantial numbers of pinks

were observed in several key tributaries, including Huckleberry Creek, as well as the Greenwater *(past George Creek at RM 12)* and Clearwater rivers. In addition, several pink spawners have been documented in Cripple; Pinochle and Wrong creeks; in 2007, pinks were observed as high as Sunrise Creek at river mile 63. The Puyallup and Carbon River drainages have not experienced the same significant expansion of pink salmon as the White River. Even so, pink escapements have been exceedingly elevated throughout the mainstem Puyallup River below river mile 27.5; as well as the lower Carbon River, South Prairie, Wilkeson and Fennel creeks. The Puyallup and Carbon River drainages have not experienced the same significant expansion of pink salmon as the White River. Even so, pink escapements have been exceedingly elevated throughout the mainstem Puyallup River below river mile 27.5; as well as the lower Carbon River, South Prairie, Wilkeson and Fennel creeks.

All pink salmon in the Puyallup/White system are wild. Adult pink migration and spawning coincides closely with Chinook, with pinks entering the river as early as mid-July, and spawning from late August through mid-November. Like chum, pinks are mass spawners; frequently utilizing the habitat found in the placid flows of primary side channels and secondary ephemeral side channels established along the major mainstem rivers. Also commonly utilized are the shallower outer margins of the mainstem rivers, although, much of the spawning efforts are centered on the numerous main river tributaries. Peak spawning occurs from late September to early October, with fry emerging from late fall through winter. Residence time instream is limited, with smolt out migration running from February to June, with the peak out migration occurring at the end of March. The production estimate for the 2003 pink brood year, calculated 1,988,441 out-migrants (Berger and Williamson 2004); estimates for the 2005 brood year was 7,095,017 pink smolts (Berger et al. 2006); estimates for 2007 and 2009 pink smolt escapement is 14,936,007 and 11,148,303 (Berger et al. 2008; Berger et al. 2010). After two years in the marine environment, adults return to spawn as two-year-olds, hence the odd years only spawning. The unique life history of pink salmon does make the species more susceptible to stochastic events, which can have an immeasurable impact on an entire year class.

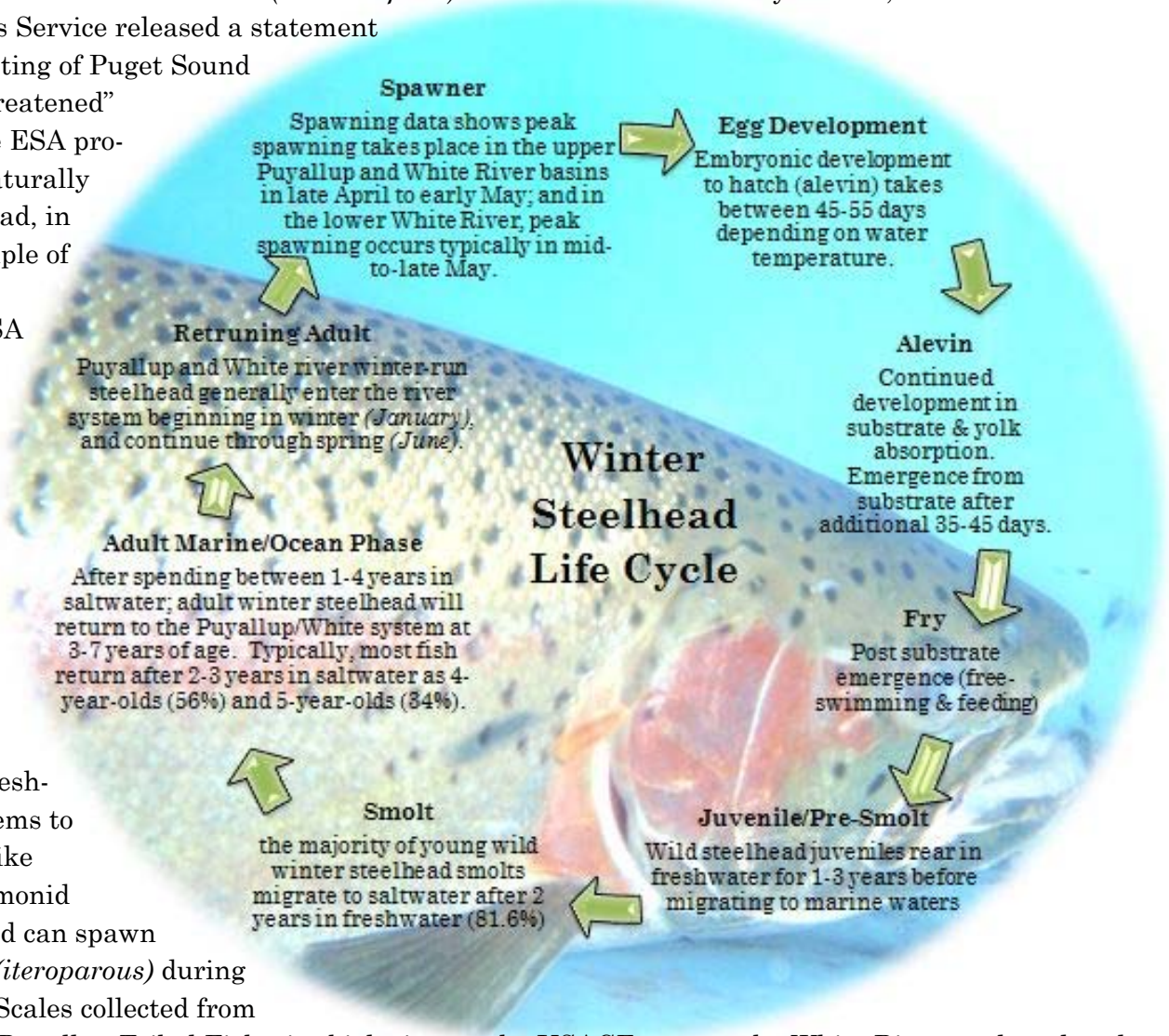
Sockeye Salmon *(O. nerka)*

Due to their diminutive numbers, sockeye are seldom encountered or documented throughout most of the Puyallup/White River basin. Thus, sockeye are generally considered insignificant and are treated with little regard. The exception to this generalization is the USACE trap on the White River in Buckley, which provides a rare opportunity to collect data on adult sockeye. Each year from 1983 to 2008, between 5 and 378 *(annual average of 42)* adult upstream migrants were captured and transported above Mud

Mountain Dam. It is currently undetermined how many, if any, of the adult sockeye are native to the system or are strays from other watersheds. Migrating adults are caught in the trap from mid-July through early September. Sockeye transported to the upper White are observed in several of the major tributaries, including the Greenwater River, Clearwater River, Huckleberry Creek and Silver Springs Creek. Spawn timing runs from mid-September through October, coinciding with Chinook, pink, and coho spawners. Sockeye often utilize similar spawning habitat as Chinook and coho, which is evident by the fact that sockeye are regularly seen spawning side-by-side with these other species. Spawning sockeye are easily distinguished from other salmon species by their distinctive bright red bodies and green heads. Post emergence, juvenile sockeye spend one-to-two years *(typically two years)* rearing in freshwater before migrating to marine waters. After two-to-three years in saltwater, the majority of adults return to spawn as four-year-olds.

Steelhead/Rainbow *(O. mykiss)*

Both steelhead and rainbow are present throughout the Puyallup/White River Watershed. The steelhead is simply an anadromous form of rainbow; offspring from either steelhead or rainbow can become anadromous, or remain in freshwater *(resident form*) their entire lives. In May of 2007, NOAA's National Marine Fisheries Service released a statement regarding the listing of Puget Sound steelhead as "threatened" under ESA. The ESA protection covers naturally spawned steelhead, in addition to a couple of hatchery stocks. However, the ESA protection does not pertain to rainbow.



Steelhead are generally categorized as *winter-run* or *summer-run*, depending on the time of the year they return to freshwater river systems to reproduce. Unlike other pacific salmonid species, steelhead can spawn more than once *(iteroparous)* during their life-cycle. Scales collected from 1984 to 2005 by Puyallup Tribal Fisheries biologists at the USACE trap on the White River, and analyzed by WDFW, show an average of 5% *(range 0-26.4%)* repeat spawners returning annually *(frequently females)*. Puyallup and White river winter-run steelhead generally enter the river system beginning in

winter *(January)*, and continue through spring *(June)*, whereas summers migrate during late spring and summer seasons. Summer and winter-run steelhead enter freshwater systems in various degrees of reproductive maturation (Pauley et al. 1986).

Summer steelhead enter river systems immature, and will not be ready to spawn until the following spring; whereas, winter steelhead will be ripe *(mature)* enough to spawn within a few months or less after entering freshwater (Pauley et al. 1986). The major distribution of winter-run steelhead includes many of the coastal and Puget Sound river systems such as the Humptulips, Quinalt, Chehalis, Hoh, Bogachiel, Soleduc, Skagit, Skykomish, Snoqualmie, Green, Puyallup and Nisqually rivers. Winter-run steelhead are also present in several river systems along the lower Columbia River. Summer-run steelhead distribution in the Puget Sound includes the Skagit, Stilliguamish, Skykomish and Green rivers.
The principal stock of steelhead returning to the Puyallup and White river system are winter-run. However, a few summer-run strays, likely from the Green or Skykomish rivers, are caught annually during August and September in the lower Puyallup; as well as the USACE trap on the White River. Therefore, steelhead are often present in the watershed throughout the year. The main run of hatchery origin winter steelhead *(Voights Creek production ceased in 2009)* enters the Puyallup River in November, with the peak of the run occurring in mid-December. On the White River, steelhead are occasionally caught in the USACE trap as early as late December. Although, most fish don't start migrating towards the upper reaches until March. The winter run continues through June, with peak migration occurring in mid-to-late April, through early May. Puyallup Tribal Fisheries spawning ground data shows peak spawning takes place in the upper Puyallup and White River basins in late April to early May; and in the lower White River, peak spawning occurs typically in mid-to-late May.

Steelhead spawners frequently utilize the mainstem Puyallup, White, and Carbon rivers; although, the majority of spawning takes place in many of the associated tributaries. Some of the major tributaries on the White River supporting winter steelhead include Boise Creek, in addition to the Clearwater and Greenwater rivers. Along the Puyallup River, the upper reach tributaries of Kellog, Niesson and LeDout creeks, support the majority of spawners. In addition, the roughly five miles of mainstem river channel below the Electron diversion dam (RM 41.7) consistently experiences a small number of spawners as well. The habitat above Electron has been accessible since the completion of a 215 foot fish ladder/fishway in the fall of 2000. Steelhead are known to be accessing habitat in the reach above the Electron Dam, yet limited data has been collected regarding spawning and rearing utilization, and distribution. Prior to 2015, the majority of information available was from aerial surveys conducted on the upper Puyallup and Mowich rivers during the spring of 2005 and 2006. Surveys conducted in 2006, revealed limited steelhead spawning activity in the mainstem Puyallup River, and no spawning activity in the Mowich. However, low flow conditions during the spring of 2015 allowed for several foot surveys to be conducted, and several redds were observed in the upper Puyallup and lower Mowich rivers; as well as Rushingwater Creek *(Mowich R. tributary)*.

The Carbon River mainstem, below river mile 11, has consistently supported steelhead spawners. Spawning ground survey data from 1995 to 2017, illustrates an average of 14 redds annually *(range 0-59)* in the mainstem Carbon; however, escapement has dropped significantly over the last decade. South Prairie Creek, a substantial tributary to the Carbon River, has long been the one of the most significant salmon and steelhead drainage in the Puyallup basin. Survey data obtained from WDFW shows the average number of steelhead redds observed in South Prairie from 1999 to 2017, was 170 *(range 32-585)*. Voights Creek, on the lower Carbon River, also experiences a small steelhead escapement.

After fertilized eggs are deposited in the gravel substrate, the embryonic development and emergence of fry takes between 4-8 weeks depending on water temperature. Juvenile steelhead will rear in freshwater for 1-4 years before migrating to marine waters in the spring. Scale data from 792 adult winter steelhead captured in the USACE trap from 1985 to 2004 shows the majority of young wild winter steelhead migrate to saltwater after 2 years in freshwater (81.6%). Approximately 2.5% of the steelhead sampled spent 1 year in freshwater, 15.6% three-years, and less than 0.25% four-years before out-migrating. None of the steelhead sampled spent more than 4 years residing in freshwater. Nearly all hatchery reared steelhead, if grown to a large enough size *(five fish-to-the-pound, or 90 grams each)*; will migrate to saltwater shortly upon release as yearlings *(one-year-old plus fish)*. After spending between 1-4 years in saltwater; adult winter steelhead will return to the Puyallup/White system at 3-7 years of age. Typically, most fish return after 2-3 years in saltwater as 4-year-olds (56%) and 5-year-olds (34%).

Prior to January, 2009, WDFW conducted the only long-term winter steelhead supplementation program in the basin. Each spring, the Washington Department of Fish and Wildlife's hatchery on Voights Creek released yearling fish into the system. In 2005, the Voights Creek facility released over 207,000 adipose clipped steelhead, and over 231,000 in 2004 (Berger and Williamson 2005). Brood-stock for this program had originated from several different drainages, including the Humptulips, Bogachiel, and Skagit rivers; as well as Chambers and Tokul creeks. From 1980 to 2000, the Puyallup Tribe operated a winter steelhead program at the Diru Creek facility *(located in the city of Puyallup)*. The brood-stock for this supplementation program came from the coastal Quinalt River system. During the 20 year span of the program, the Tribe released between 8,237 and 116,957 yearling smolts annually into the Puyallup system. The Diru Creek program was successful, with an average of 915 (*range 364-1,144*) adults returning annually from 1993 to 1999. Unfortunately, this earlier program was discontinued due the lack of water necessary to rear steelhead year round.

During the spring of 2006, in response to the declining number of winter steelhead, the Puyallup and Muckleshoot Tribes; as well as the Washington Department of Fish and Wildlife, began a steelhead supplementation pilot project developed for the White River. The primary goal of this project is to restore the run to a strong self-sustaining population. The pilot project utilizes captured wild brood stock from the USACE trap in Buckley to generate approximately 25K-35K+ yearling smolts. The 2010 season demonstrated the beginning of some measurable success from the program; out of 521 total steelhead captured, 298 *(57% of the run)* were program fish retuning to Buckley and 223 were unmarked/wild *(43% of run)*. The 2010 return to Buckley was also the second largest since 1992. The 2011 return saw 353 program fish return *(65%)* and 186 unmarked/wild steelhead *(35%)*. 2012 and 2013 experienced the best return since 1992 with over 561 and 574 steelhead captured. Of the steelhead captured in 2012, 202 were program fish *(36%)* and 359 were unmarked/wild *(64 %)*. 574 steelhead were captured in 2013, of which 36.2% *(208)* were program fish, and 63.8% *(366)* were unmarked/wild steelhead *(see appendix G for additional data)*.

Beginning in January of 2009, the Puyallup Tribe assumed the majority of responsibility for continuing this important restoration effort. Steelhead brood-stock collected from the White River USACE fish trap in Buckley are currently held, spawned, incubated, and reared at the Puyallup Tribe's Diru Creek hatchery for a year. From 2007-2013, after rearing for a year, and when the fish were of size *(approximately 17 fish per pound)*, the pre-smolts were transported to the Muckleshoot hatchery on the White River to acclimate before being released. Since 2014, the steelhead have been planted and released from one of the available acclimation ponds located in the upper White River ***(see map of current operational acclimation pond sites on page 41 or Appendix D)***. The success or failure of this project will likely

determine if an additional supplementation program will be implemented on the Puyallup River *(The Puyallup Tribe's Wilkeson Creek steelhead hatchery is currently under development).*

The winter steelhead stocks in the Puyallup basin have been declining since 1990. The precipitous decline within just the past several years has created serious concern among fisheries managers. Factor(s) responsible for the decline in steelhead escapement are unknown, especially when other salmon species are experiencing relatively good success. Escapement numbers for the USACE trap in Buckley during 2005 *(152 adults)* was the lowest ever recorded since 1941. Decreased numbers of redds have been observed in several other drainages as well; yet a few, such as Boise Creek on the White River, have experienced comparatively stronger returns in spite of the general basin-wide declines. The smolt trapping program operated by the Puyallup Tribe's Fisheries department on the Puyallup River observed a substantial decrease in the number of steelhead smolts captured from 2003 to 2005 (*average 62.6 [range 39-77] from 2003-2005 vs. average of 315 [range 156-539] from 2000-2002)* (Berger and Williamson 2005). However, significant increases in escapement were observed from 2008-2011 *(average 362 [range 189-579])* (Berger et al. 2011). The previous numbers don't include the steelhead escapement for the White River due to the traps location approximately 0.2 miles above the White/Puyallup confluence.

Bull Trout *(Salvelinus confluentus)*

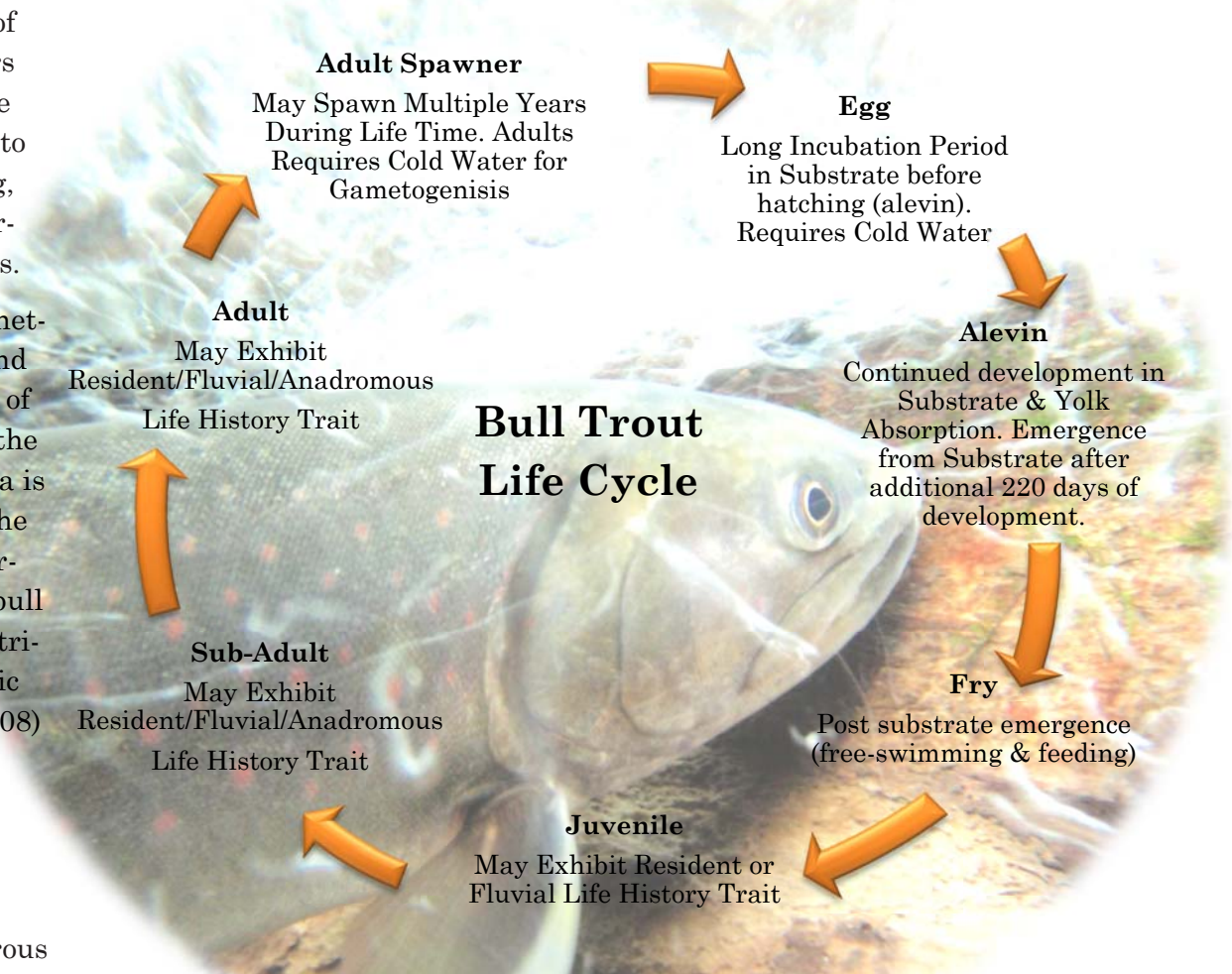
Bull trout have existed historically throughout many Pacific Northwest coastal and inland rivers, streams, lakes, reservoirs and marine waters; from southern Alaska to northern California, and inland to Idaho, western Montana and northern Nevada (Fraley and Shepard 1989, Buchanan et al. 1997, Rieman et al. 1997, High et al. 2008). On November 1, 1999, all bull trout in the coterminous United States were listed as "threatened" on the federal register of endangered species by the U.S. Fish and Wildlife Service (USFWS 1999). The USFWS finalized bull trout recover plan (2015) is available at: www.fws.gov/pacific/bulltrout/pdf/Final_Bull_Trout_Recovery_Plan_092915.pdf
Bull trout are a cold water species sensitive to deleterious changes in water quality (Selong et al. 2001, Dunham et al. 2003); as well as the fragmentation and loss of habitat (Rieman and McIntyre 1995). Bull trout require unobstructed migration corridors and connectivity of rivers, streams, and other water bodies (Rieman and McIntyre 1993) in order to provide access to spawning, rearing, foraging, and overwintering habitats.

Bull trout belong to a group of fishes called char *(genus Salvelinus)*, a subgroup of the family Salmonidae. Char include dolly varden *(S. malma)*; white spotted char *(S. leucomaenis)*; Arctic char *(S. alpinus)*; brook trout (*S. fontinalis)*, and lake trout *(S. namaycush)*. Morphologically, bull trout and dolly varden are nearly indistinguishable; however, genetic and morphometric analysis in the late 1970s distinguished that bull trout and dolly varden are in fact different species (Cavender 1978). The bull trout is actually more closely related to the Asiatic white-spotted char (Cannings and Ptolemy 1998). In addition, regional research has established that both bull trout and dolly varden reside sympatrically in several Western Washington rivers and streams (Leary and Allendorf 1997).

To determine the specie(s) of char present in the Puyallup/White River system, tissue samples from over 110 char were collected by Puyallup Tribal Fisheries *(PTF)* biologists for genetic analysis. Most of the samples collected were from char captured in the US Army Corps of Engineers *(USACE)* fish trap on the White River, as well as a limited number collected from Electron Hydro LLC's *(Formally Puget Sound Energy)* Electron forebay on the Puyallup River, and one sample came from the Lower Puyallup River near Commencement Bay. Results from the genetic analysis disclosed that all samples collected were bull trout, with no indication of hybridization (Baker et al. 2003). To date, there has been no verification

of dolly varden in the Puyallup River Watershed. Bull trout are endemic to the Puyallup, Carbon, and White River drainages in which they exhibit primarily residential and fluvial life history traits. Although diminished, the Puyallup Watershed also supports the anadromous life history form of bull trout. Resident bull trout reside in smaller headwater tributaries, while fluvial bull trout frequently utilize mainstem rivers and tributaries to forage and overwinter.

During the fall, migratory bull trout journey from spawning and foraging habitats in the upper watershed to foraging and overwintering habitats located lower in the river system. From spring through early summer, migrant bull trout commence their upstream journey to cooler spawning, rearing, and foraging refugium high in the watershed where spawning will occur primarily during the month of September (Ladley et al. 2008, Marks et al. 2009). In response to changing habitat and reproductive needs, migratory bull trout in the White River travel up to 75 miles or more between the lower river, and headwaters located in or near Mt. Rainier N.P. To accomplish this, bull trout require unobstructed migration corridors and connectivity of streams and rivers in order to provide them with access to spawning, rearing, foraging, and overwintering habitats.



Currently, the genetic relationships and population(s) size of bull trout within the Puyallup core area is undetermined. The National Park Service has ongoing bull trout surveys, distribution, and genetic (DeHaan et al. 2008) efforts being conducted within the park.

Bull trout are primarily piscivorous *(fish eaters)*. However, they are opportunistic feeders, feeding on a variety of prey items depending on their particular life history strategy and stage of development. Adults feed almost exclusively on other fish, including a range of salmon and trout species; as well as other resident fish species. Juveniles feed on aquatic invertebrates, including stoneflies *(Plecoptera)*, caddisflies *(Trichoptera)*, and mayflies *(Ephemeroptera)*. Bull trout require a healthy aquatic environment in order to survive and prosper. They need an environment that provides the prey base; in addition to the rearing and reproductive habitat necessary to ensure their continued survival and reproductive success. Bull trout are endemic to the Puyallup, Carbon, and White River drainages. Currently the population dynamics of bull trout within the watershed is unknown. However, since the Coastal Puget Sound listing in 1999, the Puyallup Tribal

Fisheries department has made a focused effort on collecting biological data; as well as spacial information on bull trout distribution and utilization. Documented areas of utilization include the lower and upper mainstem of the Puyallup, White, Carbon and Mowich rivers. Currently, the best documentation of bull trout utilization exists on the White River. The Upper White River provides some of the preeminent critical habitat for bull trout spawning and rearing. Surveys of numerous headwater tributaries along the White River and the West Fork White within Mt. Rainier National Park during the summer of 2000, revealed the presence of adult and juvenile bull trout in several of the drainages (Marks unpublished work).

Each year, since 1999, adult upstream migrants were captured and sampled in the USACE trap on the White River and transported above Mud Mountain Dam. This trap and haul operation conducted by the U.S. Army Corps of Engineers has been functioning since 1941. The abundance of upstream migrants captured in the USACE trap has increased precipitously since 2009. From 1999-2008, an average of 36 *(range 14-49)* bull trout were captured and sampled annually. From 2009-2016, an average of 219 *(range 68-406)* bull trout were captured and sampled, a significant increase over the previous decade+. The Potential contributing factors as to why the White River bull trout population size has increased significantly over the past several years is currently under investigation. Data gathered by PTF on these captured fish strongly indicates both *fluvial* and *anadromous* life history traits. Fluvial bull trout utilize the main river system and tributaries to forage as adults; yet, migrate to their natal streams or other spawning tributaries to reproduce. Anadromous fish migrate downstream to forage in more productive marine waters.

Spawning ground surveys conducted by Puyallup Tribe Fisheries biologists on Klickitat Creek during the 2002 through 2006 seasons, observed floy tagged adult fish previously captured in the USACE trap, spawning with non-tagged fish. In view of the fact that adults are rarely observed in the smaller spawning tributaries pre-or-post spawning, it is surmised that most of the unmarked fish observed were fluvial bull trout entering from the mainstem river. However, it is undetermined what component of adults spawners, if any, are residents. Further research is needed to understand and identify the life history patters and population dynamics of bull trout in the White River. Addressing this issue, in 2006 and 2007, Puyallup Tribe Fisheries biologists conducted extensive bull trout migration telemetry studies and redd surveys along the upper White River and West Fork White River, focusing heavily on the headwaters located within Mt. Rainier National Park.

Telemetry study results showed the cold high elevation mountain streams located within the National Park provide the majority of the critical bull trout spawning habitat in the basin. The study involved surgically implanting bull trout captured in the USACE trap with LOTEC radio transmitters *(10 fish in 2006, 19 in 2007).* The radio tagged bull trout were then tracked for 6 months as they made their upstream migrations to spawning sites in the upper White River; as well as their post-spawning migrations downstream. During the 2006 study, seven of the ten bull trout spawned in tributaries located on the mainstem of the White River within Mt. Rainier National Park; one spawned in Lodi Creek on the West Fork within the park, and another in Silver Creek *(lowest observed spawning elevation @2600')*just a half mile outside of the National Park. In 2007, 8 radio tagged bull trout were observed spawning in tributaries located on the White River inside the National Park. Two other bull trout were tracked up the West Fork White near Lodi Creek. Additional telemetry studies have been conducted by USFWS since 2007 *(2014-2017)*. Far less is known about bull trout utilization in the Puyallup, Carbon and Mowich rivers.

The Upper Puyallup Basin encompasses the Mowich River; North and South Forks of the Puyallup; as well as the mainstem Puyallup River. The upper basin supports several species of salmonids including bull trout, Chinook *(Oncorhychus tshawytscha)*, coho *(O. kitsutch)*, pink *(O. gorbuscha)*, sockeye *(O. nerka)*, steelhead/rainbow *(O. mykiss)*, and cutthroat *(O. clarki)*. Bull trout have been observed in all three river systems, yet spawning has only been documented in the upper Carbon River within Mt. Rainier National Park. Bull trout spawning throughout the watershed occurs primarily during the first three weeks in September, however, spawning has been observed taking place from the last week of August through the first week of October. Bull trout are iteroparous *(have the ability to spawn more than once)*; therefore, recovering pre-or-post spawn mortalities for examination is extremely rare. Spawners in the upper White River tributaries are observed utilizing various sized substrate from small gravels to small cobble. Redds are often constructed in the tail-out of pools and along the channel margins. Embryonic development is slow *(depending on water temperatures)*; it may take between 165-235 days for eggs to hatch and for alevin to absorb their yolk (Pratt 1992). Bull trout fry emerge in late winter and early spring. Young fry can often be seen by mid-March foraging in the lateral habitat along the upper mainstem White River and associate tributaries.

Several tributaries within the Upper Puyallup River Basin have been identified as potential or known bull trout occupied habitats (USFWS 2004a, Marks et al. 2010). However, several seasons of bull trout spawning surveys and telemetry studies conducted on the White River have shown that in addition to well established occupied habitats; bull trout frequently exploit small, often unknown or unidentified tributaries of ephemeral or intermittent flow (Marks et al. 2010). Unlike the Upper White River, much of the headwater habitat located within the Upper Puyallup Basin falls outside of the National Park boundary; where land use is intensive and natural resource protections are diminished. Bull trout habitat throughout the Puyallup and White rivers has been severely impacted by over a century of land and water resource exploitation; including, damming and substantial water diversions, considerable riparian alterations *(deforestation)*, dewatering and low instream flow regimes, as well as significant channel manipulation. Impacts have lead to marked habitat deterioration and hydrological modifications within these river systems. Several limiting factors are involved with regards to the healthy function of stream habitat and bull trout populations in the watershed; including lost or diminished habitat connectivity and migration corridors *(human-made fish passage barriers)*, fragmentation and reduction of habitat quality *(entrainment, transportation networks, forest management practices and operations, direct water withdrawal)*; in addition to, water quality, fish entrainment and entrapment, unknown species interactions, and potential climate change impacts *(changes in flow regimes, scour effects, thermal variations, changes in water chemistry)*.

Point specific areas of human-made fish migration barriers or obstacles include Electron Hydro LLC's *(formally owned/operated from 1904-2014 by Puget Sound Energy)* Electron hydroelectric facility *(Puyallup River)*; the operation diverts up to 400 cfs. from the Puyallup River at RM 41.7. For 96 years *(1904-2000)* the diversion dam completely isolated the population(s) of bull trout established throughout the 26+ miles of habitat upstream of the structure; thereby, stemming the genetic flow from bull trout *(populations)* located elsewhere in the basin, or watershed, for several generations. A similar diversion dam and flume intake is located on the White River near the city of Buckley. In addition, Mud Mountain Dam, an impassable man-made earthen dam designed for flood control, is located on the White River just over 5 miles upstream of the diversion dam. These three structures/operations contribute, in whole or in part, to many of the issues stated above.

To summarize, based on White River studies and information collected from other Puyallup and Carbon River basin projects we can make the following general inferences regarding movement timing information, both upstream *(adults)* and downstream *(adults, juveniles/sub-adults, fry)*.

Adults: Fluvial adults are consistently moving throughout the watershed. Fluvial adults frequently overwinter in the lower and mid watershed habitats *(mainstem & tributaries)*; whereas anadromous fish may go to marine waters to overwinter. It is currently hypothesized larger anadromous adults may retire from anadromy in later life stages. Upstream migrations to spawn/forage in upper watersheds typically occurs from May-to-late August, with peak migration occurring in June/July *(peak month may alternate)*. Little is known about adult resident bull trout life history.

In general, upstream spring/summer migrants continue moving upstream at fluctuating intervals; however, some do fall back downstream. Fish tend to stage in mainstem habitats for periods of days-to-several weeks at a time before eventually entering spawning habitats. However, not all fish migrating/moving upstream spawn; a significant number of upstream migrants are unaccounted for on spawning grounds *(White River study results)*. Commencement of spawning is frequently correlated to a drop in stream temperature; typically below 8°C *(spawning temp. range 5.7-12°C)*. Spawn timing is similar in each basin *(White, Carbon & Puyallup)*; transpiring approximately late August-to-Mid October, with peak spawning activity typically occurring during the latter half of September.

Spawners are extremely opportunistic; in addition to regularly available spawning habitat, fish will frequently utilize new/provisionally existing habitat. Due the dynamic nature of glacial river systems, habitat availability is constantly changing. Downstream migration post-spawning occurs from approximately late August-to-early November, is often rapid for females, yet more prolonged for males which often move around searching for females to spawn with. Adults are also observed in tributaries throughout the watershed year-round *(foraging/overwintering)*. Little is known about adult resident bull trout life history.

Sub-adults (Juveniles): Similar to adults, juveniles are consistently moving throughout the watershed and frequently overwinter in the lower and mid watershed habitats *(mainstem & tributaries)*; whereas anadromous fish may go to marine waters. Upstream migrations to forage in upper watersheds also typically occurs from May-to-late August, with peak migration occurring in June/July. Downstream movement to overwinter in lower/mid river habitats occurs approximately late August-to-early November. In addition sub-adults are also observed in tributaries throughout the watershed year-round *(foraging/overwintering)*. Little is known about juvenile resident bull trout life history.

Fry: Downstream movement can occur from late winter *(emergence)*, through spring/early summer. Downstream movement can be volitional or non-volitional. Fry have been observed/captured (<50mm) throughout the upper and lower White River during the spring and early summer *(steelhead surveys, seining)*. Fry will utilize lower velocity habitat along Mainstem Rivers *(margins/edges & pools)*. The few fry captured in the fish collection facility at Electron were captured during April/May/June.

A prolific transportation network of paved and unimproved roads extends throughout both watersheds. Additionally, the upper White River Watershed has a network of trails utilized by hikers, horseback riders and mountain bikers. The transportation network within the Upper Puyallup Basin consists almost entirely of unimproved roads developed and utilized primarily for timber harvesting; as well as, hunting, recreational activities, hydroelectric operation. The transportation networks within the Upper White River basin consist of both paved and unimproved roadways. Lands in timber production areas are

densely roaded with some sections approaching six lineal miles per square mile. Roads have contributed many of their trademark problems such as landslides, slope failures, altered hydrology, as well as culvert and bridge projects which can effect upstream migration, and increased levels of sedimentation within effected drainages. Current, as well as former major transportation lines such as highway 410, Sunrise Park Road and the USFS access road #74, in addition to several other road networks and bridge emplacements along the Puyallup and White rivers, all directly interact or alter the hydrology within both upper watersheds. Like the Puyallup, The Upper White River Basin has a vast network of unpaved roads developed and utilized primarily for timber harvesting; as well as recreational activities. There is no direct fishery on bull trout in the Puyallup/White drainage; however, they are legal to catch, but must be released.

The long-standing presence of private industry, primarily hydroelectric and commercial timber harvesting; in addition to recreational uses and the repercussions of negative air and water quality issues, have all produced lasting impacts on the upper watersheds. These impacts include; loss of in-stream large woody debris and LWD recruitment, stream bank modifications, increased sedimentation issues and slope failures due to deforestation, unsatisfactory RMZ management; in addition to, new road construction, road failures, and road decommissioning. A great deal of the aforementioned forestland has been harvested at least once, and in many cases twice; leading to many of the wide-ranging issues common with deforestation. Air and water quality issues vary from measurable levels of airborne contaminants which have been detected in Mt. Rainier National Park; including heavy metals and pesticides discovered in samples of snow, soil and fish (Landers et al. 2008). Additional private industrial impacts include the substantial 2006 diesel fuel spill *(estimated @18,000 gal.)* into Silver Creek, a documented bull trout spawning stream. The spill emanated from Puget Sound Energy's back-up electrical generation station on Crystal Mountain.

Harvest

For thousands of years the native populations looked to the Puyallup River as a critical resource. In December of 1854, the Puyallup Tribe along with several other Western Washington Tribes, signed the Treaty of Medicine Creek with territorial governor Isaac Stevens *(March 25, 1818 – September 1, 1862).* In accordance with the treaty of Medicine Creek, the Tribes agreed to reside on appointed reservations, which further required them *(the treaty Tribes)* to relinquish much of their historic fishing and hunting lands. However, fishing and hunting rights were addressed in ARTICLE 3 of the treaty which states in part: The rights of natives to fish would be protested and challenged many times, yet the Tribe's treaty right to fish their usual and accustomed areas *(U&A)* was reaffirmed in February 1974, by Judge George Boldt *(Case number C70-9213; U.S. vs. Washington, also known as "The Boldt Decision").* This historic decision allowed treaty member Tribes a right to take 50% of the annual harvestable returns.

As a result of the Boldt decision, treaty Tribes also became responsible for managing their own fisheries. Today, the Puyallup Tribe continues to view the Puyallup and White rivers as a valuable cultural and economical resource to be protected. In a cooperative effort with state and federal regulatory agencies, the Puyallup Tribe has become an integral link in "Co-Managing" the fisheries and water resources of the Puyallup/White River Watershed. The Puyallup Tribe currently targets Fall Chinook, coho and chum in its net fishery on the Lower Puyallup River. As a protection and enhancement measure, the Puyallup Tribe has not targeted Spring Chinook in its commercial fishery for over 30 years. In addition, the Puyallup Tribe releases all wild steelhead caught incidentally in its fisheries.

The goal for all target species is to maintain a harvestable stock by ensuring that a sizable escapement component successfully makes it to the spawning grounds to reproduce. Timing and fishing efforts

are focused on harvesting the stronger hatchery stocks of Fall Chinook, coho and chum, while protecting the more vulnerable stocks of wild fish. A harvest biologist with the Puyallup Tribe manages the fishery to prevent overharvest and to protect species of concern. The Puyallup Tribal Fisheries Department works closely with biologists from other state, federal, and tribal agencies to determine the tribal fishing regulations for each season. The Puyallup Tribe employs a rigorous monitoring and evaluation program to monitor and assess effects of in-river harvest management actions. Monitoring and evaluation efforts include extensive spawning ground escapement surveys for Chinook, coho, pink, chum and steelhead; as well as, sampling adult anadromous salmonid returns at the USACE fish trap on the White River.

In conjunction with tribal fishing, the Puyallup River system has long supported a significant sport fishery. Sport fishing regulations and laws are managed and enforced by the Washington Department of Fish and Wildlife. The sport anglers in the Puyallup basin target several species, including Chinook, coho, pink, chum, and steelhead. Seasons and limits *(quantity, size, origin: wild or hatchery, type of gear used, fishing areas)* are specifically set for each target species to prevent overharvesting and to protect threatened or depressed stocks such as bull trout, Spring Chinook, and wild winter steelhead.

In addition to in-river sport fishing and local tribal harvests, salmon produced in the Puyallup/White River system are harvested outside of the watershed by commercial, sport, and other tribal fisheries. Significant numbers of Puyallup/White River produced salmon are caught annually in the Puget Sound, and fisheries ranging from Oregon to Alaska. Coded wire tag *(CWT)* recovery data shows that out of 448 tags recovered from Voights and Diru Creek Fall Chinook releases *(1997 brood-year)*, approximately 36% were harvested in the tribal net fishery in the Puyallup, 17.4% were recovered from hatchery returns, 20% were caught in Puget Sound and Washington ocean fisheries, 0.4% in Oregon marine waters, 25% in Canadian fisheries, and 0.4% in Alaskan fisheries.

Tags recovered from 1,063 White River Spring Chinook *(1993-1994, zero age brood-years)*, which generally reside in Puget Sound waters as adults, shows 78% of tags recovered were from hatchery returns, 16% were from the Puget Sound sport fishery, and 4% from Canadian sport and commercial fisheries. Tag recovery data for 1994 through 1996 coho brood-years show out of 450 tags recovered, 23% were from coho caught in the Puget Sound sport fishery, 3% in Washington ocean sport fishing, 3% in the Canadian ocean sport fishery, 15% were caught in the tribal net fishery in the Puyallup, and 55% were recovered from hatchery returns. For additional information on Puget Sound salmon and steelhead harvest and management, go to:

- http://wdfw.wa.gov/conservation/fisheries/salmon_steelhead.html
- http://wdfw.wa.gov/publications/00854/wdfw00854.pdf *(revised version expected October 2017)*

Limiting Factors Affecting Fish Populations

The following pages addressing limiting factors (through flood control history) was written by Russ Ladley, and was originally printed in the 2000 Puyallup River Fall Chinook Baseline Report. The following version has been edited since originally drafted in 1999.

Over 96 miles of levee exists along the Puyallup, White and Carbon rivers. As a result, habitat restoration and enhancement actions must emphasize the need to promote freedom for stream channel movement and natural floodplain processes. Within the Salmon Recovery Planning Act, limiting factors are defined as "conditions that limit the ability of habitat to fully sustain populations of salmon." Clearly, levees which block access to peripheral habitat and reduce the available area of active channel have had a limiting affect on the fish production. Channel confinement by levees has dramatically reduced availability of suitable spawning habitat. Setback levees are one of the solutions to mitigating this problem. The

first setback levee project on the Puyallup River *(RM 24-26)* is an outstanding example of what can be accomplished and the many benefits that are possible. In the period since the completion of the Ford setback levee in 1998, the river has braided and migrated forming a natural meander pattern that has reduced gradient. The lower average velocity has permitted retention of gravel material that was previously scoured away under high velocity flows. Channel braiding and large woody debris recruitment has added channel complexity and established productive spawning and rearing habitat where it did not previously exist. Additional setback levee projects include the Old Soldiers Home levee setback *(2006)* on the Puyallup River between river mile 21.3 and 22.3; the Calistoga setback levee *(City of Orting)* on the Puyallup River *(2014)*, and the County Line setback levee on the White River *(2017)* between river mile 5 and 6.3. For additional information, go to:
https://www.co.pierce.wa.us/AgendaCenter/ViewFile/Item/501?fileID=566

Development is the greatest threat to habitat restoration and enhancement. Development within both Sumner and Puyallup has, in many cases, encroached so close to the levee that any setback opportunity has either been lost or is so costly to be prohibitive. Further "infilling" will diminish restoration opportunities and at the same time increase dependency upon structural flood management alternatives.

Commencement Bay/Puyallup River Estuary

The Port of Tacoma is today the third largest commercial shipping terminus in the western U.S. Since 1880, a wide variety of activities associated with industrialization and commerce have affected the physical, chemical and biological functions of the Puyallup River estuary. The physical change involves the transformation of 5,700 acres of intertidal wetlands and mudflats into uplands suitable for commercial and industrial development. In 1982, the federal government ranked Commencement Bay amongst the most hazardous waste sites in the U. S. and portions of the area were officially designated as Superfund sites under CERCLA. The Commencement Bay/Nearshore Tide flats (CB/NT) was later added to the National Priorities List (NPL) after fish, shellfish and sediments were found to contain elevated levels of harmful substances.

Commencement Bay is surrounded by industrial, commercial and residential development and is one of the most highly modified and stressed estuaries in Puget Sound (Shreffler et al. 1992). The Tacoma Pierce County Health Department has identified approximately 480 point and non-point sources that discharge into Commencement Bay (Rogers et al. 1983). The first step in cleanup actions involves source control. The industries that have contributed to this dubious distinction include, shipbuilding, coal gasification, petroleum storage and refining, ore handling and smelting, wood products storage, burning, and manufacturing, including Kraft pulp bleaching, chemical storage and manufacturing, solvent processing and many others. The chemical and biological impacts associated with industrial process contamination have proven the most difficult and costly to assess. For additional information, go to:
https://yosemite.epa.gov/r10/cleanup.nsf/webpage/Commencement+Bay-Nearshore+Tideflats

After numerous years of study, natural resource managers are just beginning to understand the full extent of contamination. Although some sites have been remediated, cleanup in many areas is still years away. Research related to fish health and/or injury resulting from contamination is far from conclusive. However, work by Varanasi et al. (1993) indicates juvenile Chinook are susceptible to PCB uptake in polluted estuaries. Furthermore, this contamination has been linked to suppression of the immuno-response system in these fish. Ongoing research is being conducted concerning impacts of contamination of Tidal and Nearshore habitats on Chinook salmon.

Restoration planning of the CB/NT area is the responsibility of the Natural Resource Damage Trustees. This group includes the NOAA, USFWS, DOE, DNR, WDFW, and the Puyallup and Muckleshoot Tribes. The Trustees are charged with restoring injured natural resources. The approach they will use is outlined in the Commencement Bay Restoration Plan and Final Programmatic Environmental Impact Statement (1997). Because of the dramatic loss of intertidal wetland and salt marsh habitat during the last 120+ years, restoration planning and CB/NT mitigation projects will require the conversion of subtidal or upland habitat into intertidal habitat. As result of settlement agreements with the Port of Tacoma; several habitat restoration and preservation efforts along the Hylebos watershed/waterway and Commencement Bay have been completed. The restoration of this waterway provides potential environmental, cultural and economic benefits.

Sewage Treatment Facilities (Waste Water Treatment)

At the present time there are six wastewater treatment plants (WWTP) which discharge directly to the Puyallup and Carbon rivers. These are Carbonado, Wilkeson, South Prairie, Orting, Sumner, and Puyallup. For additional information access the links below:

- http://www.cityofpuyallup.org/376/Water-Pollution-Control-Plant
- http://www.townofsouthprairie.com/stepinfo.htm
- file:///H:/e's%20machine/Wilkeson%20Wastewater%20Treatment%20Plant%20Final%202nd%20Statement%20of%20Basis%20-%2012-22-14.pdf
- https://fortress.wa.gov/ecy/wqreports/public/f?p=110:1000:1115854400608296::NO:RP:P1000_FACILITY_ID,P1000_FACILITY_NAME:2391549,CARBONADO%20STP

The outfall from the City of Tacoma's WWTP was moved from the Puyallup River to Commencement Bay in 1990. That outfall extends 1200-feet offshore and discharges 38 MGD at a depth of 150-feet. Most of the existing WWTP's provide secondary treatment. Both Puyallup and Orting plants were expanded to provide both increased capacity as well as advanced treatment. The Wilkeson plant and South Prairie plant are undersized for current capacity. The City of Sumner WWTP has a permitted capacity of 2.62 MGD. Sumner employs chlorine disinfection and sulfur dioxide dechlorination. The actual outfall diffuser is located on the White River 0.4 mile upstream of the confluence with the Puyallup River.

Pierce County is presently evaluating its sewer system within the context of a programmatic EIS. This is being done as part of Comprehensive Plan requirements to prepare and update a long-range service plan. The concepts under review include centralized treatment where all potential sewer service areas will route to the Chambers Creek Regional WWTP. This concept differs from the current decentralized treatment that utilizes facilities based on watershed or sub-watershed proximity and maximizes gravity flow. One of the major concerns with this alternative relates to instream flow loss resulting from the transfer of water out of basin. Storm water in upper Leach Creek has been pumped out of basin and discharged into city waterway since the late 60's. Given low instream summer/fall flows, this practice should be discontinued. All of the alternatives under consideration have controversial impacts as does the no-action alternative. Defining the impacts of increased wastewater discharge on fisheries, fish habitat, and the state's antidegradation policy for groundwater are significant and complex matters. Although these issues apply to both centralized and decentralized systems, fisheries impacts are probably greater with a decentralized system because of required plant capacity increases necessary to accommodate future growth.

Upper Puyallup River

The Upper Puyallup Basin had been void of anadromous fish between the construction of the Electron Dam in 1904 and the completion of the 215 foot roughened channel fish ladder in 2000. The Electron Hydro-project *(formally Puget Sound Energy)* involves a water diversion dam located at RM 41.7, 10.1 miles of flume, a forebay for sediment removal, power generation station and transmission equipment. The project operates under a 400-cfs water right but typical operating flows utilize about 350-cfs withdrawal. In 1997 the Puyallup Tribe entered into a Resource Enhancement Agreement (REA) with Puget Sound Energy, the project owner/operator, to begin fisheries restoration efforts within the project affected area. The REA includes provisions for the maintenance of minimum instream flows within the project bypass *(a 10.1-mile reach of the Puyallup River formerly subject to withdrawal of all water save for tributary inflow).* The Electron project was sold and ownership transferred to Electron Hydro LLC in the fall of 2014; however, the project continues to operate under the REA agreement and Puget Sound Energy since no sale or transfer agreement was made with the Puyallup Tribe.

Excellent spawning habitat exists throughout the Upper Puyallup Watershed, including upstream of Electron Hydro's diversion structure *(RM 41.7).* Adult Chinook were reintroduced to the Upper Puyallup River in 1999. Surplus Chinook from the WDFW Voights Creek Hatchery were trucked and released at three different locations to maximize disbursement. Subsequent spawning redds surveys revealed excellent results. Additional adult Chinook plants have been made annually when surplus fish were available. Low spring flows in 2015 provided a rare opportunity to survey habitat upstream of the Electron diversion. Several steelhead redds were documented on the North Fork and mainstem Puyallup River, Mowich River, and Rushingwater Creek. The REA also provided for construction and operation of rearing ponds for coho and Chinook supplementation. The fish production potential of the upper Puyallup is unknown. However, over 26 miles of stream habitat exists above the dam which becomes accessible following completion of the Electron Dam fish ladder in the fall of 2000. The ladder is designed to operate with at least 40-cfs and incorporates a modified weir and rock design. The REA also provides for minimum instream flows which were not previously required despite established state law. Under the REA, Electron Hydro will provide 60-cfs year-round in the bypass reach. This will increases to 80-cfs during the four-month period from July-15 and November-15 to facilitate adult salmon migrating upstream. Water spilled at the dam in conjunction with tributary and spring flow accretion will provide sufficient flow for upstream passage.

Completion of the fish ladder was the centerpiece of the REA. Viable fish habitat must be accessible to realize full production potential. The absence of anadromous fish above Electron Dam prior to 2000 has in all likelihood biased the scrutiny and regulatory oversight of past land use, forest practice and road construction/maintenance actions. Hancock Forest Resource Group *(formally Camble Group L.L.C.)* is the primary private landowner in this WAU but the federal government has considerable holdings as well. The bulk of the Forest Service ownership is contiguous with the Mount Rainier National Park and located on the east headwaters. Primary tributaries to the upper Puyallup include: Neisson Creek, Kellogg Creek, LeDout Creek, Swift Creek, Deer Creek, Mowich River and the North Fork Puyallup River. In addition, numerous small-unnamed wall base channels parallel the Puyallup River and provide prime rearing habitat. Because of the large basin size (110,080 acres) and the quality of habitat available, recovery efforts are a high priority for the Tribe.

Carbon River

The Carbon River flows 33 miles before reaching the Puyallup River near the City of Orting and has a mean annual flow of 664-cfs. The Carbon supports all five species of salmon as well as steelhead/rainbow, cutthroat and bull trout. Hancock Forest Resource Group and the US Forest Service have roughly equal

land ownership in this 92,000-acre WAU. Approximately 66,000-acres are in federal ownership, including National Park designation. The upper 12 miles of the Carbon River in the vicinity of Carbonado and Fairfax are deeply incised in a bedrock gorge which restricts human access. A number of small tributaries enter in this reach but plunge vertically into the river and hence, are not fish bearing. The lower 8.5 miles of the river are artificially confined with a network of levees built and maintained by Pierce County for flood control purposes. This reach of the Carbon also supports a number of naturally spawning Chinook, chum, and steelhead. Productive habitat is severely limited due to confinement between levees and levee/culvert blockages of wall base channels.

South Prairie Creek

South Prairie Creek has long been considered the heart of the Puyallup River fisheries resource. Although returns have declined over the past twenty-plus years, it remains one of the top salmon and steelhead producers in the Puyallup/White River system. No other stream in the Puyallup/White basin, with the exception of Boise Creek on the White River, is as productive in terms of both spawning density *(number of spawners per mile)* and total escapement. The 15.4-miles of anadromous habitat in South Prairie Creek support more Chinook, pink, coho, chum and steelhead than the entire 68 miles of the mainstem Puyallup River. South Prairie is also provides critically important bull trout habitat. Resource protection within this drainage is therefore paramount. Land use policy, increasing development and water allocation are three issues that will play a critical role in the long-term viability of this unique and vital drainage. South Prairie Creek was placed on the state 303-(d) list in 1997 for water temperature excursions. This is alarming particularly because the causal mechanism is not evident. South Prairie Creek flows westward within a steep valley and is bordered by a relatively healthy RMZ throughout much of its course. The fact that the excursion was measured on private timberlands is all the more mysterious. Perhaps ambient water temperatures are naturally warm in this system. Further monitoring will hopefully help edify this enigma.

Lower Puyallup River

Two primary landform processes are responsible for the current configuration of the Puyallup River valley; glaciation and deposition of alluvial materials. The valley is bordered by uplands made up of unstratified till deposits that were carried by moving ice. They consist of clay, sand and gravel and boulders. Tills are generally stable and well compacted from the weight of glacial ice they once supported. The valley walls often lack the same compaction and consist primarily of sand and gravel. This material is open and loose. This geological makeup makes them prime candidates for aggregate materials commonly used for Portland cement and structural fill. This high demand resource explains the proliferation of gravel mines in such areas. The primary component of the floodplain is alluvial deposits from streams and rivers. This material is made up of fine sand, silt and clay. These are the nutrient rich soils that brought agricultural fame to the Puyallup valley. Prior to flood control projects, alluvial materials were deposited on the valley floor during seasonal flood events.

The "Limiting Factors Analysis" for the Puyallup River Basin completed by the Washington State Conservation Commission (WCC 1999) found the lower section of the Puyallup River to function primarily as a transportation corridor having lost most of its riparian habitat, spawning habitat, and rearing habitat. Tidal influence can extend upstream to approximately RM 6.0. The salinity halocline has been observed as far upstream as Interstate 5 (WDOT). Solutions to today's absence of estuarine habitat focus on introducing historical processes, functions and conditions where possible. Although the Commencement Bay tide-flats area may never again resemble pre-European settlement conditions, many opportunities remain to improve upon current conditions. In the fall of 2008, the Puyallup Tribe completed construc-

tion of one of its most prevalent watershed restoration projects to date. The Sha Dadx *(Frank Albert Road)* wetland restoration project is located on the lower Puyallup River *(see Habitat Restoration section in this report).*

Flood Control History

The flood control history described in the White River Spring Chinook Recovery Plan also applies to much of the Puyallup and Carbon rivers. Essentially, flood control was achieved through a combination of practices such as dredging, straightening, revetment and levee construction. The most intensive application of these methods was directed toward the lower Puyallup River from the confluence of the White River to Commencement Bay. In this 10.4-mile stretch, the river is channeled and constrained within a concrete trapezoidal revetment. This effort was initiated by a legislative Act in 1913 which created the Inter-County River Improvement District. This entity was a joint King and Pierce County entity was established to address flooding problems that primarily originated on the White River but which have the greatest impact on the lower Puyallup River.

The bulk of the gravel mining has traditionally taken place in the vicinity of Orting both on the Carbon and Puyallup rivers. Both rivers are tightly confined by levees, which further fuels the perceived need for gravel removal. When a gravel bar is deposited after high flow events, the obvious perception is that it is blocking the channel and must be removed. Many local residents believe gravel mining is an essential component of flood prevention. Public visibility has been an important factor in siting gravel removal operations. The problem with this is that we are recruiting and familiarizing more and more people to the practice who will likely acquire the sentiment that gravel extraction is necessary for flood safety. Gravel removal operations have ceased since the ESA listing of Chinook. Surprisingly, there is little if any scientific data that supports gravel removal as a viable means of flood protection. On the other hand, if residents understood the fact that the flood carrying capacity of the Carbon and Puyallup rivers is less than the 100-year flood at numerous locations (Prych 1988) then they might acknowledge the need for additional land acquisitions and/or setback levee construction. They might also be less willing to purchase homes located in close proximity to the floodway.

The annual volume of gravel material removed from the Puyallup and Carbon rivers has not been well documented. However, most recently, HPA data reveal a trend toward diminishing volumes. Part of this relates to increased concerns about impacts to fish habitat and related difficulties in permitting. Pierce County Water Programs *(formerly River Improvement)* targets gravel removal sites in proximity to public facilities. Bridges and levees that are prone to material buildup *(aggradation)* are typically at the top of the list for gravel removal. The Department of Natural Resources had the option of charging royalties on aggregate materials mined from waters of the state. The term waters of the state apply to navigable waters which have been determined to be the Puyallup River downstream of the confluence with the Carbon River (RM 17.3). Ideally, mining royalties could be collected and applied to WRIA based mitigation, enhancement and/or land acquisition programs.

On the Puyallup River upstream of Orting, RM 21-25, Pierce County has emphasized property acquisition in lieu of costly maintenance repairs and reconstruction. For additional information on the Pierce County Land Acquisition Program, go to: https://www.co.pierce.wa.us/1600/Property-Acquisition-Program. This approach was taken to reduce maintenance expenditures associated with repetitive losses of high-risk levee facilities. In 1997 a 2-mile long setback levee was constructed on the right-bank of the Puyallup between RM 23 and 25. Over 123 acres of public land was added to the floodplain as part of the levee setback. The expanded floodplain will allow flood flow energy to dissipate over a greater area

thereby reducing scour depth and providing greater channel stability. In 2006, a 6000 foot levee set-back was completed upstream of the Calistoga Bridge in the town of Orting. This new set-back added over 55 acres to the floodplain within this reach. Freedom from levee confines has permitted natural fluvial processes to reengage the surrounding landscape. Already significant and beneficial changes are apparent. The wooded bottom lands are being flooded, scoured and are forming a diverse floodplain providing characteristic physical and biological features and functions that have been absent since the levees were constructed over 50 years ago. In 2016, King County initiated a levee setback project on the lower White River to help address flooding issues. The levee project will install a new 6,000 foot setback. For additional information, go to: http://www.kingcounty.gov/depts/dnrp/wlr/sections-programs/river-floodplain-section/capital-projects/lower-white-river/lower-white-river-countyline-a-street.aspx

Property buyout and setback programs must be encouraged. Although expensive, this approach represents the best opportunity for reestablishing natural production. The levee setbacks should be considered only the first in a long list of habitat recovery projects. Additional restoration opportunities offering flood protection benefits are discussed in the Puyallup Tribes, Restoration Site Catalog (Ladley and Smith, 1999). However, there are many more sites that can be added to this list to provide significant habitat additions. Language governing take propose significant restrictions to current land use policies. For example, the recognition of channel migration zone (CMZ) will be a key element within the evolving ESA § 4(d) rule now being packaged by the Tri-County governments. It is possible that levee repairs in repetitive loss locations may conflict with CMZ management principles currently under development. This issue is also pertinent to the NMFS concept of properly functioning conditions (PFC). Rule language in the Federal Register reads: properly functioning conditions is the sustained presence of natural habitat forming processes in a watershed (*e.g. riparian community succession, bedload transport, precipitation runoff pattern, channel migration*) that are necessary for the long term survival of the species through the full range of environmental variation. Gravel mining operations clearly affect three of the four italicized elements.

In 1997, at the request of the Puyallup Tribe, Pierce County formed an ad hoc committee on gravel mining. After the February 8, 1996 flood event, a renewed interest in flood protection and gravel removal arose. Pierce County went as far as to prepare a public bid package for the removal of 1-million cubic yards of gravel from the Puyallup River system. Fortunately, no action was taken. The committee addressed local demand for riverine aggregate materials while at the same time recognized the need to protect fish and their habitat. The group was instrumental in approving gravel removal proposals and for the first time used current spawning survey data to minimize adverse impacts to significant spawning habitat. Vegetation management is another important component of flood management in the Puyallup River, particularly on levees and/ or revetment. For over 65 years vegetation was actively managed to limit size and distribution. The general theory follows that any vegetation that covers revetments may hide obvious signs of structural weakness or potential problems. Root structures from trees were also perceived as a threat to levee integrity. Root balls torn out by flooding or high wind may expose the underlying levee fill material. Without the armor layer to provide protection a levee can rapidly unravel and is susceptible to catastrophic failure.

The Puyallup Tribe has entered in to a levee vegetation management agreement with both Pierce County and the Corps of Engineers. The Corps has flood facility jurisdiction on the lower Puyallup River from RM 3.0 to the mouth. Pierce County has jurisdiction upstream of RM 3.0 to RM 8.26 on the Carbon and to RM 27 on the Puyallup. These agreements were designed to reform levee management practices and reduce habitat injury associated with levee maintenance. The agreements specify where and what

vegetation is permissible both on and/or near revetment structures. The arrangement provides for both structural inspection needs and a modicum of fisheries habitat requirements. Since the agreements were adopted, levee vegetation has flourished. Although riparian conditions are still far from ideal, the existing vegetation does provide an important shading function.

Salmonid Escapement Monitoring and Evaluation Program

Project Description

The project involves rigorous watershed monitoring and evaluation efforts to determine the status, trends, responses and uses by various life history stages of ESA listed Chinook and winter steelhead; as well as non-listed coho, pink, sockeye and chum salmon within the Puyallup/White River Watershed *(Puget Sound ESU)*. Project elements include: monitoring and evaluating adult and juvenile escapements and survival; migration; distribution; habitat utilization; as well as, monitoring and assessing effects of in-river harvest management actions. The monitoring program is an ongoing annual program supported through several funding sources. Monitoring and evaluation efforts involve extensive spawning ground escapement surveys for salmon and steelhead; escapement monitoring and biological sampling of adult steelhead and Chinook returns to the U.S. Army Corps of Engineers' *(USACE)* fish trap on the White River; adult and juvenile salmonid migrant and mortality monitoring at the Electron hydroelectric project forebay fish collection facility *(Electron Hydro LLC)*; juvenile salmonid escapement by the use of a rotary screw trap operated on the Puyallup and White Rivers *(Puyallup Tribe)*; examination of significant fisheries impact related projects that arise; continuous monitoring of the watershed for deleterious habitat, water quality and hydraulic violation issues affecting salmonids; as well as surveying and sampling habitat restoration sites for salmonid utilization.

Goals, Tasks and Expected Benefits

Recovery and sustainability of ESA listed Spring/Fall Chinook, and winter steelhead stocks; as well as non-listed coho, pink, chum and sockeye. The RM&E project is vital for constructing informative and adaptive management decisions leading to effective actions in support of maintaining and improving fisheries stocks for implementation of tribal treaty and subsistence fishing rights. The monitoring and evaluation project is a high priority for the Puyallup Tribe and is vital towards assessing the status and trends of Natural Origin Recruits (NORs) and hatchery salmonids and their environments; as well as, investigating factors affecting salmonid population viability and providing information essential for resolving existing and potential habitat, water quality and hydraulic violation issues through corrective and/or mitigatory actions. The following project tasks/objectives *(following page)* addresses and supports the needs presented in the WDFW, Puyallup and Muckleshoot Tribes Recovery Plan for White River Spring Chinook Salmon[1]; WDFW's Statewide Steelhead Management Plan: Statewide Policies, Strategies, and Action[2]; the National Marine Fisheries Service Recovery Plan for the Puget Sound Chinook Salmon (*Oncorhynchus tshawytscha*)[3] and the National Marine Fisheries Service Puget Sound Salmon Recovery Plan - Volume 1[4].

[1]Washington Department of Fish and Wildlife, Puyallup Indian Tribe and Muckleshoot Indian Tribe. 1996. Recovery Plan for White River Spring Chinook Salmon. WDFW, Olympia WA.
[2]Washington Department of Fish and Wildlife. 2008. *Statewide Steelhead Management Plan*: *Statewide Policies, Strategies, and Action.* WDFW, Olympia WA.
[3]National Marine Fisheries Service. 2006. Recovery Plan for the Puget Sound Chinook Salmon (*Oncorhynchus tshawytscha*). National Marine Fisheries Service, Northwest Region. Seattle, WA.
[4]National Marine Fisheries Service. 2007. Puget Sound Salmon Recovery Plan - Volume 1. Plan adopted by the National Marine Fisheries Service (NMFS) and Submitted by the Shared Strategy Development Committee. Seattle, WA.

Monitoring and Evaluation Program Tasks/Objectives, Deliverables and Expected Benefits	
Species: Pacific salmon, steelhead and bull trout	➢ Winter Steelhead *(Oncorhynchus mykiss)* ➢ Fall Chum *(Oncorhynchus keta)* ➢ Spring & Fall Chinook *(Oncorhynchus tshawytscha)* ➢ Coho *(Oncorhynchus kisutch)* ➢ Pink Salmon *(Oncorhynchus gorbuscha)* ➢ Sockeye Salmon *(Oncorhynchus nerka)* ➢ Bull Trout *(Salvelinus confluentus)*
Species Federal ESA listed status.	➢ Steelhead (Winter): **Threatened** ➢ Chum Salmon (Fall): **Non-Listed** ➢ Chinook Salmon (Spring & Fall): **Threatened** ➢ Coho Salmon (Fall): **Non-Listed** ➢ Pink Salmon: **Non-Listed** ➢ Sockeye Salmon: **Non-Listed** ➢ Bull Trout: **Threatened**
Tasks/Objectives that will be achieved by the project.	➢ Determine spatial and temporal distribution, annual escapement and composite of NORs and hatchery origin Spring/Fall Chinook and coho spawners. ➢ Determine spatial and temporal distribution, and annual escapement of adult steelhead. ➢ Estimate annual Puyallup River escapement for juvenile Spring/Fall Chinook, coho, steelhead, chum and pink salmon. ➢ Assess the status of ESA threatened Puget Sound Spring/Fall Chinook and Steelhead, to determine if current recovery actions are working. ➢ Monitor ecological interactions. ➢ Monitor genetic stock compositions of Chinook and steelhead. ➢ Estimate fry/smolt survival and run forecasts. ➢ Develop and institute harvest management plans for the Puyallup Tribe's commercial, subsistence and ceremonial in-river fisheries actions provided under treaty rights. ➢ Support federal, state and tribal managers in their development and establishment of harvest management actions for commercial and sport fisheries. ➢ Monitor escapement of ESA listed Chinook and steelhead; as well as non-listed coho entrained in Electron Hydro LLC's Hydroelectric Project on the Puyallup River. ➢ Ascertain escapement of ESA listed Chinook and steelhead through the U.S. Army Corps of Engineers' (USACE) adult fish trapping project on the White River. ➢ Determine salmonid utilization within site specific habitat restorations sites. ➢ Identify deleterious habitat, water quality and hydraulic violation issues affecting salmonids or salmon ecology.

	➢ Provide Coded-Wire Tags *(CWT)* collected from Chinook and coho for inclusion in the RMIS database. ➢ Exchange and communicate pertinent data and information with watershed co-managers and regulating agencies.
Time period tasks occurred:	➢ August 2016-to-September of 2017.
Deliverables that will be produced by completing tasks/objectives.	➢ Conduct comprehensive monitoring of native anadromous salmonids which is essential for exercising tribal-treaty fishing and native subsistence fishing rights; as well as, the regulation of non-tribal harvest management actions affecting ESA listed and non-listed salmonids. ➢ Provide future tribal harvest opportunities. ➢ Provide extensive and statistically rigorous data and information on the status and trends of ESA listed and non-listed salmonids within the Puyallup/White River Watershed. ➢ Provide data addressing factors significant to natural events or human activities that impact the viability and ecology of anadromous salmonids. ➢ Disseminate monitoring and evaluation program discoveries to resource managers. ➢ A comprehensive annual report on the final project findings.
Species benefits that will be achieved.	➢ Develop adaptive management plans resulting in effective enhancement, and protection of ESA listed (Chinook & steelhead) and non-listed salmonids present in the Puyallup/White River Watershed. ➢ Provide account of genetic makeup of Chinook and steelhead present in the Puyallup/White River basin to distinguish and preserve genetic diversity and gene flow among local populations. ➢ Protection and maintenance of pacific salmon and steelhead habitat may benefit other ESA listed salmonid species including bull trout. ➢ Recommendation of potential restoration or recovery projects, including additional research, assessment or monitoring needs. ➢ Protection and maintenance of existing salmonid occupied habitats. ➢ Monitoring of additional salmonid local populations. ➢ Comprehensive index of spawning reaches necessary for monitoring reproductive salmonid abundance and productivity trends. ➢ Formulate and institute plans to insure that operations can be adaptively managed to optimize hatchery and natural production, sustain harvest, and minimize ecological impacts. ➢ Provide statistically analyzable data to establish relationship between adult and juvenile escapements and subsequent smolt production. ➢ Resolve existing or potential habitat, water quality and hydraulic violation issues through corrective and/or mitigatory actions.

The Washington Department of Fish and Wildlife regularly conducts surveys on several key drainages, including the Clearwater River and Wilkeson Creek for steelhead; as well as South Prairie Creek for Chinook and steelhead. Precise escapement for the upper White River drainage is known, given that all adult salmon and steelhead that spawn in the upper White are first captured in the USACE fish trap, then transported and released above Mud Mountain Dam *(MMD @ RM 29.6)*. Therefore, surveys conducted on the upper White River are done primarily to determine fish distribution and spawning success. Adult spawning data is especially important regarding Spring Chinook, since adult production monitoring is an integral part of the White River Spring Chinook Recovery Plan.

Fall and early winter river conditions are often marked by extremely low, turbid flows. Early in the Chinook run, flows in the main stem river side channels and tributaries are often too low to allow fish access to these key spawning habitat areas. The resulting focus by Chinook on mainstem spawning is therefore extremely difficult to document due to highly turbid conditions in the Puyallup, White, and Carbon Rivers. Low water visibility during the spring often affects the late steelhead surveys in the mainstem rivers as well. Most of this report summarizes spawning ground data gathered from August through June of each spawning season. Chinook *(pink in odd years)* surveys commence in mid-August and continue through the first week of November, with peak spawning occurring around the later part of September into early October. The window for bull trout reproduction is quit brief; with the majority of spawning taking place during September and continuing into early October. Coho are observed on the spawning grounds the mid-part of September through late December, peaking around the end of October through the first part of November *(upper South Prairie Creek experiences a late run into February/March)*. Chum spawn as early as the end of October *(Fennel Creek)*, continuing through the first half of February, hitting their spawning peak in mid-to-late December. Steelhead *(winter run)* surveys begin in mid-March and conclude in mid-June. However, do to the occurrence of both summer and winter steelhead, adult steelhead are often present in the Puyallup/White River Watershed year round. Most streams are surveyed by foot, with the exception of the Puyallup, White and Carbon Rivers, as well as South Prairie Creek, which are floated by raft. Peak spawning in the upper watershed occurs in late April to early May; while peak spawning in the lower river system occurs mid-to-late May.

Data collected for all species during spawning surveys include the number of live and dead fish observed throughout the survey reach. With respect to Chinook, steelhead, and bull trout; the number and locations of redds are also documented. Redds are marked with flagging, and the redd locations are collected using a hand held GPS unit. Maps are generated from the GPS data collected, showing the redd locations for Chinook, bull trout, and steelhead *(Appendix B)*. Significant carcass sampling is conducted for adult Chinook and coho throughout the watershed. Carcasses are examined for fin clips *("marked fish" removal of adipose or left/right ventral fin-see Appendix I)* and checked for coded wire tags *(CWT's)* with a metal detecting wand. Chinook carcasses with a left or right ventral clip are White River Spring Chinook from acclimation ponds located above Mud Mountain Dam. Carcasses with an adipose clip or a combination adipose clip and CWT, are hatchery origin Fall Chinook. Adult coho carcasses are examined for adipose clips and CWT's. Coho carcasses with no marks or CWT's are considered wild, whereas coho with a missing adipose, and/or CWT's, are considered hatchery origin fish. The snouts are removed from carcasses with detectable CWT's, labeled, and then forwarded to the WDFW for identification and entry into the Regional Mark Processing Center's RMIS database accessible at http://www.rmpc.org/.

Despite continuing efforts to collect fish and habitat data upstream of the Electron diversion, a void continues to exist pertaining regarding bull trout and other salmonid species distribution and utilization

within the Upper Puyallup *(above Electron Diversion @RM 41.7)*. Identifying and assessing the tributary and mainstem habitat available along more than 26 miles of the Upper Puyallup River Basin supporting bull trout, Chinook, coho, and steelhead will provide an invaluable foundation for future conservation, restoration, and recovery actions. Evaluating physical and biological data collected on salmonids in the Upper Puyallup will assist in differentiating genetic diversity among basin populations and aid in recovery planning and implementation. However, such extensive undertakings require additional funding to accomplish. Yet, continuing efforts are being made by the Puyallup Tribe to increase and expand the survey coverage area in order to improve escapement estimates. Improved effort is especially needed in expanding bull trout and steelhead survey areas.

To date, only modest effort has been applied toward surveying the habitat above the Electron diversion dam on the Puyallup River, as well as the mainstem White above Mud Mountain Dam, or the habitat above the upper Carbon River Gorge. Through spawning survey observations and data collected from adult and juvenile fish caught in the Electron forebay; it is know that Chinook, coho, steelhead and bull trout are accessing and spawning in the upper reach of the Puyallup, as well as the Mowich River. Unfortunately, limited data has been collected on escapement and spawning distribution of fish in the upper Puyallup River basin.

Adult Salmon and Steelhead Escapement Estimates

It is important to note that the numbers of live fish observed and represented in the graphs are an accumulation of all fish seen throughout the survey season. The total number of live fish observed does not depict the actual estimated escapement which is derived through either statistical analysis (AUC method) or by expanding the number of redds observed by a pre-established number of fish per redd. The area-under-the-curve method used for most of the salmon escapement estimates is the trapezoidal approximation (English et al. 1992, Bue et al. 1998).

Currently, adult Chinook escapement during non-pink years is typically determined by expanding the number of redds observed by 2.5 fish per redd (Smith and Castle, 1994). Due to the tremendous volume of pink salmon during odd years, the success of determining Chinook redds from pinks is vastly reduced. Therefore, the AUC method is used to determine escapement during pink runs. Currently, instead of using the AUC method to determine steelhead escapement, the Puyallup Tribal Fisheries Department and WDFW determine steelhead escapement based on redd counts. Since the mid 1980's, state biologists have derived steelhead escapement from data obtained through WDFW's *(formally Washington Department of Game)* Snow Creek Research Project (Freymond and Foley 1985). Researchers placed a weir on Snow Creek, and over several years were able to count the number of steelhead passed above, as well as the number of redds produced by spawners. A final factor of 0.81 females per redd was calculated. Furthermore, a ratio of 1 male to 1 female is used when no sex ratio is known; which is the case throughout the Puyallup/White River system. Therefore, to determine the total escapement for steelhead, each redd is typically multiplied by a factor of 1.62 *(i.e. 42 redds x 1.62 steelhead per redd = total escapement of 68 steelhead)*. Addition biological expansion factors are applied to some rivers and streams to estimate escapement for suitable habitat reaches that are often unsurveyable *(i.e. South Prairie & Carbon River)*. This system; however, is not applied to steelhead redds observed in the upper White River drainage. Accurate escapement numbers for the upper White River drainage are derived from the USACE trap counts. Adult salmon and steelhead that spawn in the upper White are first captured in the U.S. Army Corps of Engineers' fish trap, then transported and released above Mud Mountain Dam. Therefore, surveys conducted on the upper White River are done primarily to determine fish distribution and spawning success.

Juvenile Salmon and Steelhead Production Estimation

The Puyallup Tribe began monitoring marine-migrating salmonids *(smolts)* on the lower Puyallup River *(RM 10.6)* in 2000, and the White River *(RM 3.6)* in 2016. The principal objectives of the Puyallup and White Rivers Juvenile Salmonid Production Assessment Projects are to obtain juvenile production estimates, run-timing, survival; as well as growth and species composition indices on Chinook, coho, chum, pink and steelhead out-migrants *(wild and hatchery for Chinook, coho, and steelhead).* Fisheries managers can correlate these indices with the estimated adult escapements obtained through spawning surveys to produce juvenile survival rates, along with forecasting future adult returns. The "smolt trapping" mechanism utilized on both traps is an E.G. Solutions' 8-foot diameter rotary screw mounted on two 40-foot pontoon floats *(see Puyallup and White Rivers Juvenile Salmonid Production Assessment Project sections in this report).* Depending on river conditions, the traps are generally operated on a continuous basis from February/March, through August/September. To obtain copies of report findings, contact the Puyallup Tribal Fisheries Department.

Salmon and Steelhead Hatchery Production

There are five salmon hatcheries facilities located within the Puyallup/White River Watershed producing and/or rearing; Spring Chinook, Fall Chinook, fall coho, winter chum and winter steelhead *(see Appendix D).* Currently, there are two White River Spring Chinook programs in operation; the Muckleshoot Indian Tribe's hatchery on the White River and WDFW's Minter Creek program. Due to the success of the White River Spring Chinook Program the Minter Creek Program is going to be phased out. All fish produced at Minter will be transferred and reared at Puyallup Trout then marked by WDFW and transferred to the White River Acclimation Ponds. Currently, there is a three year moratorium transferring fish from Minter Creek Hatchery because on an IHN detection in the 2016 broodstock. The phasing out of the program will commence in 2020 unless there is another detection of a regulated pathogen. Spring Chinook from the White River hatchery are reared and marked at WDFW's Clarks Creek hatchery facility *(funded by WDFW),* and transported by PTF to acclimation ponds on the White River. WDFW also operates a facility on Voights Creek *(Fall Chinook & coho)*, a tributary to the Carbon River; as well as rearing 300k coho WDFW's Puyallup Trout Hatchery. The Puyallup Tribe operates two salmon hatcheries on the lower Puyallup. The Puyallup Tribe's salmon hatcheries on the lower Puyallup are located on Clarks Creek *(Fall Chinook)* and Diru Creek *(chum & winter steelhead).* Clarks Creek Salmon Hatchery is located at RM 1 on Clarks Creek *(10.0027).* The Tribe's Clarks Creek hatchery facility was constructed in order to address several fish management, and water supply issues; including minimizing the straying of adult Fall Chinook reared by the Tribe; providing space for rearing and acclimating White River Spring Chinook, chum and winter steelhead if necessary; creating an independent and self-sustaining Fall and Spring Chinook program for the Tribe; as well as providing a reliable water supply to rear and expand fish production.

In 2004, the Puyallup Tribal Fisheries Department began acclimating and releasing Fall Chinook from the Clarks Creek salmon hatchery facility, thereby discontinuing all Chinook releases from the Diru Creek hatchery. In early 2005, construction of a new incubation building was completed at Clarks Creek. The incubation building houses 32 incubator stack; each stack is capable of holding up to 77,000 Chinook eggs. This provides for a total capacity of approximately 2.5 million eggs. Once fish are ready to be moved from the incubators, they are transferred to one of the cement lined raceways. Holding the Chinook in the raceways is only temporary until they are up to a large enough size, usually sometime during late March to early April, to be massed marked with an automated tagger and transferred to one of two natural ponds. Once tagged, the fish are planted in one of the two natural in situ acclimation ponds until they are released in late May or early June.

Diru Creek Hatchery is primarily a chum facility *(Diru Creek is a tributary to Clarks Creek)*; however, the Puyallup Tribe is currently rearing around 25,000+ winter steelhead pre-smolts as well. The Puyallup Tribe currently raises 1.5-to-2.3 million chum smolts for release into the lower Puyallup River. This program significantly augments a tribal river fishery and All Citizen purse seine fishery in East and West Pass in Puget Sound. This stock originated initially from Chambers Creek. Puyallup Tribal Fisheries releases 1,000-to-3,000 pounds annually based on available brood stock returns to Diru Creek hatchery. The program was started in 1991 and has become self-sustaining.

In 2006, the Puyallup Tribe, in partnership with WDFW and the Muckleshoot Tribe, began artificially propagating White River winter steelhead. Rearing young steelhead is an integral part of the White River winter steelhead pilot project, a program designed to increase winter steelhead escapement in the White River. With the temporary closure of WDFW's Voights Creek hatchery in January of 2009, the Puyallup Tribe has since assumed the majority of responsibility for continuing this important enhancement effort. Steelhead brood-stock collected from the White River USACE fish trap in Buckley are currently held, spawned, incubated, and reared at the Puyallup Tribe's Diru Creek hatchery for a year. After rearing for a year and fish are of size *(approximately 11-17 fish per pound)*, the pre-smolts are currently transported to one of the acclimation ponds located on the White River to imprint before being released *(Appendix G)*.

The Muckleshoot Tribe operates a Spring Chinook hatchery on the White River near the City of Buckley. Since 1994, the Puyallup Tribe has operated ponds used for acclimating Spring Chinook, which are planted in March, and released in May or early June. The Spring Chinook plants are an integral part of the White River Spring Chinook Recovery Plan. The juvenile Spring Chinook originated from the Muckleshoot White River Hatchery and WDFW's hatchery on Minter Creek *(this program is being phased out)*. Depending on availability, between 100,000-to-900,000+ Spring Chinook program fish are transported to the acclimation ponds in early spring and released in late spring *(approximately a 3 month acclimation period)*. Spring Chinook are mass marked with left or right ventral fin clips before being planted in acclimation ponds. Odd brood years *(year the fish were spawned)* are marked with left ventral fin clips *(see Appendix I)*, and even brood years with right ventral clips. These fish can later be immediately identified and aged when caught at the USACE fish trap in Buckley, and then transported above Mud Mountain dam to spawn naturally.

The four functional acclimation ponds ***(see map of current operational acclimation pond sites on page 41 or Appendix D)*** the Puyallup Tribe currently operates are satellite facilities to the White River Spring Chinook hatchery *(Muckleshoot Tribe)* and the White River winter steelhead enhancement program *(Puyallup Tribe)*. The acclimation ponds are located in the upper White River Watershed on the Clearwater River *(Jensen Creek)*; Cripple Creek *(currently non- operational)*; Huckleberry Creek; Greenwater River *(George Creek)* and Twentyeight Mile Creek *(Greenwater R.)*. Chinook production levels for planting in the acclimation ponds vary, but average around 400,000+ pre-smolts; however, numbers of available fish fluctuates based on available brood stock and survival through early developmental stages.

Fish Enhancement and Restoration

Project Description

Currently, the Puyallup Tribe operates up to six acclimation ponds in the Puyallup/White River Watershed designed to reestablish and enhance Spring/Fall Chinook, winter steelhead and coho stocks ***(see map of current operational acclimation pond sites on page 41 or Appendix D).*** Each of two acclimation ponds *(Cowskull & Rushingwater)* on the Puyallup River receive as many as 100K+ hatchery origin Spring/Fall Chinook and/or coho. Four additional acclimation ponds located in the Upper White River

drainage *(George Creek (Greenwater River), Huckleberry, Jensen and Twentyeight Mile creeks)* can be planted collectively with up to 900K+ White River Spring Chinook and 25K+ White River winter steelhead pre-smolts. The newest pond located on Twenty-eight Mile Creek *(Greenwater River)* was completed in the fall of 2015. The Jensen Creek acclimation pond *(Clearwater River*) was completed in the fall of 2012.

When obtainable, the Puyallup Tribe will collect, haul and plant surplus adult hatchery Fall Chinook and coho from WDFW's Voights Creek hatchery to spawn naturally in minor spawning or underutilized areas in the upper Puyallup River basin. Also when available, the Puyallup Tribe will in-stream plant juvenile hatchery Fall Chinook and chum from the Tribe's Clarks and Diru Creek hatchery facilities to underutilized habitat areas. Steelhead pre-smolts would come from the White River steelhead enhancement project the Puyallup Tribe has conducted since 2006.

In 2006, the Puyallup Tribe, in partnership with WDFW and the Muckleshoot Tribe, began artificially propagating White River winter steelhead. Rearing young steelhead is an integral part of the White River winter steelhead pilot project; a program designed to increase winter steelhead escapement in the White River. Beginning in 2009, the Puyallup Tribe assumed the majority of responsibility for the continuance of this vital fish enhancement project. Steelhead brood stock collected from the White River are currently held, then live spawned and released back into the river. Fertilized eggs are incubated and developing fish are reared at the Puyallup Tribe's Diru Creek hatchery for a nearly a year before being transported to one of the acclimations ponds in the White River basin to acclimate *(imprinting)*. Steelhead are acclimated and released in late May *(3 months acclimation period)*; at which time they have reached approximately 11 fish per pound.

Goals

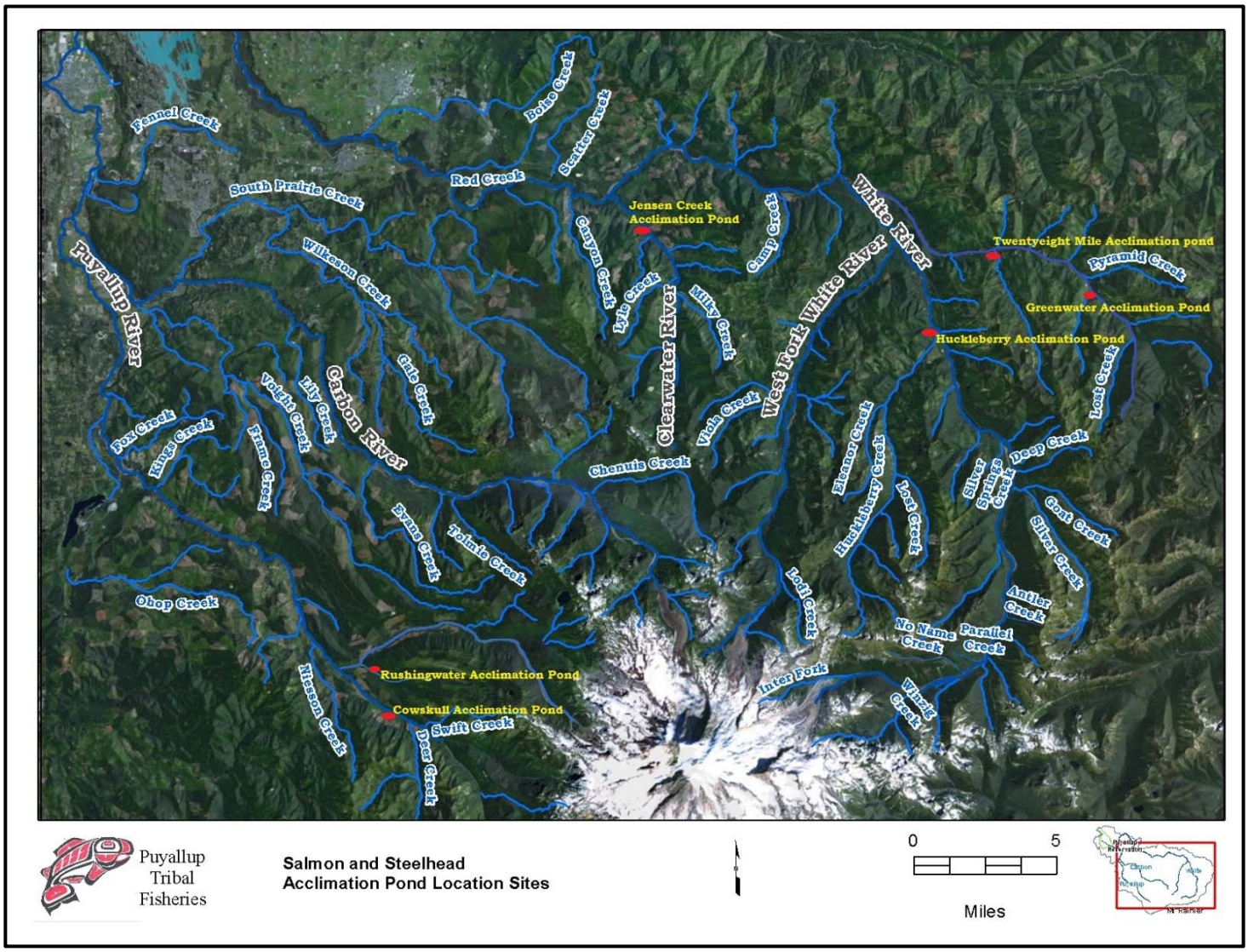
One of the Puyallup Tribe's most significant restoration goals is to rebuild depressed Chinook and steelhead stocks and remove them from ESA listing. Acclimation ponds, juvenile in-stream plants and adult surplus fish plants are a proven method for increasing fish stocks, and are key component to restoration goals. Using acclimation ponds, limiting harvest and creating substantial gains in habitat restoration, the Tribe will be able to accomplish restoration/recovery goals. Levee setbacks, oxbow reconnections both inter tidal and upland, Commencement Bay cleanup, and harvest cutbacks have already been initiated.

Purpose

- Produce Spring/Fall Chinook, winter steelhead and coho for the Puyallup/White River salmon conservation and harvest programs.
- Establish a total annual return of Spring Chinook Natural Origin Recruits (NORs) that meets the escapement goals for White River Spring Chinook recovery.
- Provide sustainable harvest for tribal and non-tribal fisheries on Fall Chinook and non ESA listed coho.
- Optimize hatchery and natural production consistent with the conservation of naturally produced native fish.
- Maintain genetic makeup of Chinook and steelhead populations spawned or reared in captivity.

Benefits

- Reestablish and enhance ESA listed Spring/Fall Chinook and steelhead; as well as non-listed coho into their endemic range.
- Increased total abundance of the composite natural/hatchery populations.
- Increased spawning ground escapement and trend of Natural Origin Recruits (NORs).
- Improve distribution of salmon to minor spawning and underutilized rearing habitat areas
- Provide future tribal and sport harvest opportunities.
- Nutrient enhancement in oligotrophic *(nutrient poor)* streams.



Habitat Restoration

Sha Dadx (Lower-Puyallup River)

In the fall of 2008, at the cost of over $4 million dollars, the Puyallup Tribe completed construction of one of its most prevalent watershed restoration projects to date. The Sha Dadx *(Frank Albert Road)* wetland restoration project, located on the lower Puyallup River, created a 17-acre off-channel wetland habitat for salmonids and other freshwater resident fish. The project was instrumental in reestablishing an old disconnected oxbow; in addition to a low lying wetland back into the mainstem river. The reclaimed habitat was originally lost during the construction of the lower river levee system in the early twentieth century. In response to the loss of nearly an entire estuarine ecosystem that once existed, the creation of this critical and necessary lower river environment will provide overwintering; as well as foraging opportunities for young juvenile salmon. In addition, this habitat will offer some of the benefits that the estuary once provided to out migrating *(smolting)* salmon during the transition from fresh water to salt water. For more information about this site/project go to:

- https://www.estuaries.org/pdf/2010conference/tuesday16/harbor/session3/hilgart-m.pdf
- http://nwtreatyTribes.org/puyallup-Tribe-looking-for-new-residents-in-sha-dadx/
  http://www.activeconstruction.com/08-011-sha-dadx/

Clearwater River Floodplain Restoration Project (White River)

Kristin Williamson -South Puget Sound Salmon Enhancement Group *(Reprinted with Permission)*
http://nwifc.org/puyallup-Tribe-tracking-salmon-making-way-newly-restored-habitat/

Project Description (Completed 2015)

The Clearwater River Floodplain Restoration Project is planned to address major limiting habitat factors and impaired processes on the Clearwater River through strategic placement of large wood structures and removal of nearly a mile of road from the historic floodplain. Historically, the Clearwater River meandered through a forested valley floor with large trees, a dense canopy, and a system of branching channels. The advent of timber harvest in the watershed and construction of a rail line (now road) in the Clearwater River floodplain for transport of timber in the early 1900s removed critical riparian structure from the valley floor and confined the floodplain. Loss of the riparian buffer has resulted in easily erodible banks due to root loss and associated soil cohesion, dramatic reductions in large wood debris recruitment to the stream channel, and loss of overhanging vegetation.

Project efforts would install up to 39 wood structures of varying types and sizes to meter natural wood through the system, trap sediment, and aggrade incised sections of the channel for the long term reconnection of a network of 19 side channels in the floodplain. The project would also decommission nearly a mile of road and remove 10 associated culverts. Removal of three of the culverts would provide immediate improved passage to wall-based wetland channels, and the removal of the other 7 would provide long term access to spring fed channels and alluvial fans currently impounded by the road.

The Puyallup and White River Salmon Recovery Strategy specifically identifies the Clearwater River as a high priority geographic area for White River Spring Chinook recovery, as determined by Mobrand EDT modeling. By extension, this project will also benefit other native stocks, including coho and pink salmon, steelhead, and bull trout. This project will specifically address strategic priorities identified within the strategy including: increasing the quantity and quality of instream habitat through input of wood structures and improving the riparian conditions in the watershed through abandonment and decompaction of a stream adjacent road prism and active plantings.

Watershed and Aquatic Benefits

The overall goal of the project is to increase spawning and rearing capacity of the watershed for Spring Chinook, steelhead, coho, pink, and coastal and resident cutthroat trout species. Realized benefits from project actions will include:

- Activate 14.5 acres of historic floodplain through road decommissioning and removal of 10 culverts.
- Active 70 acres of floodplain through placement of wood structures and subsequent aggradations of the channel bed.
- Activate 19 existing side channels and promote the formation of new side channels through channel migration.
- Dissipate flood energy through placement of wood structures to partition sheer stress.
- Increase quantity and quality of instream, pool, and refuge habitat via placement of wood structures.
- Improve riparian function through abandonment/ripping of a stream adjacent road.
- Establish a riparian corridor on former road prism through planting of 2,500 native trees.

A total of 18 large and small engineered log jams were installed in the Clearwater River between river mile 2.3 and 3.1 in summer 2013. Placement of these log jams will activate flows to a network of 11 existing side channels, dissipate flood flows, and increase instream structure and cover in the river. This work completed about half of the proposed work plan. An additional 10 ELJ's were installed during the summer of 2015; as well as the decommissioning of the old roadway from the 6000 bridge to the lower washout *(phase 2&3)*

Greenwater River Floodplain Restoration Project (White River)

Written by: Kristin Williamson
South Puget Sound Salmon Enhancement Group - *(Reprinted with Permission)*
http://spsseg.org/whats-new/wria-10-puyallup-white-rivers/

Project Description (Completed 2014)

The objective of the Greenwater River Floodplain Restoration Project is to restore aquatic and riparian habitat within a 2 mile reach of the Greenwater River. The project reach is River Mile 5.0 to 7.0 within the Mount Baker-Snoqualmie National Forest, adjacent to Forest Service Road 70. Restoration is focused on the re-introduction of functional wood and the removal of .8miles/4,500 linear feet of the abandoned Forest Service Road 7000 located within the Greenwater River Floodplain.

Historically, the Greenwater River was one of the principle spawning and rearing areas in the White River watershed for Spring Chinook, bull trout, steelhead and coho. Based upon the old-growth forest in the Greenwater Valley floor, evident in the 1956 aerial photographs, recruitment of large trees to the floodplain was likely the primary factor maintaining salmon habitat in the River. Early photos show the River to be in pristine condition, characterized by sinuous channels with many large, deep pools associated with log jams. Pool habitat is critical for rearing salmon, bull trout, and other resident fishes to provide cool places for forage and refuge from predators.

A legacy of timber harvest altered the Greenwater River between the late 1950s and mid 1980's. During this period, the majority of the trees in the Greenwater River were removed from the valley all the way to the banks of the River. These practices effectively stripped the Greenwater River of all instream wood, removed the forest structure from the floodplain, and subsequently increased channel incision, stream velocities, and river bed scour. The current channel is incised with very few pools, little holding and rearing habitat available to salmonids, and almost no functional stream side cover to provide shade, structure, input of nutrients, and recruitment of woody debris.

Given these impacts and the current lack of large woody debris, the young age of the existing stream-side forest, and large volumes of sediment available in the Greenwater River, it could take centuries for the system to return to a river sustained by natural processes. To help reestablish the natural conditions needed to sustain salmon and other species utilizing the system, a restoration plan was developed to rehabilitate the lost processes of wood recruitment, forest canopy, and floodplain connection through strategic placement of Engineered Log Jams (ELJs) and removal of road fill and armor from the floodplain.

Watershed and Aquatic Benefits

Overall, project efforts will increase flood storage within the project reach and reduce downstream peak flows, thereby providing greater stability and balance to the watershed. The proposed log jam structures will accelerate and maintain system-wide natural processes while reducing sediment loading, stabilizing banks for establishment of stream-side forest, and providing habitat for salmon and other fish. The species benefiting from this project include: White River Spring Chinook, Puget Sound steelhead, pink salmon, coho salmon, bull trout, and coastal and resident cutthroat.

Specifically, project efforts will:

- Create large, persistent structures that will trap mobile wood and sediment
- Reduce erosion and sediment sources within the project reach by dampening peak flow velocities
- Aggrade the existing river bed elevation to reconnect stream flows to the floodplain to increase flood storage, and provide back-water, flood refuge for rearing juvenile fish
- Increase side channel rearing capacity and spawning opportunity for juvenile and adult salmon

- Encourage trapping and sorting of spawning gravels within the main stream channel to increase spawning opportunity
- Improve salmon egg retention and survival by reducing scour stress of the river
- Increase the quantity and quality of pools with lots of overhead, woody cover for predator avoidance for juvenile salmon, and for staging of upstream-migrating adult salmon.
- Provide interim, instream structure and stability to allow the Greenwater valley forest to regenerate to a size that will naturally stabilize the river.

South Fork Channel Restoration (Puyallup River)

An extensive side channel restoration project conducted by Pierce County near the community of Alderton, added over 4,000 linear feet of off channel fish habitat and flood protection. For more information about this restoration project, go to: www.co.pierce.wa.us/southfork

Upper Clear Creek Mitigation Site (Lower-Puyallup River)

In 2016, Port of Tacoma finished constructed of a roughly 40-acre restoration project on upper Clear Creek. The project created a floodplain wetland and a new, more naturalized stream channel. The project was created as a result of a mitigation settlement with the EPA, at a cost of $9 million dollars. For more information about this restoration project, go to:
http://www.portoftacoma.com/community/environment/habitat

Boise Creek Restoration (White River)

In the spring of 2013, the King County Water and Land Resources Division initiated a channel enhancement project along the middle Boise Creek channel above 268th St. in Enumclaw. In 2010, the establishment of a new lower channel restoration was completed; starting from Mud Mountain Dam Road, downstream to the White River. The new lower channel restoration provides improved rearing and spawning habitat. The project is designed to improve instream and surrounding wetland complexity, as well as fish and wildlife utilization. For more information about this restoration project, go to:

- http://www.kingcounty.gov/services/environment/animals-and-plants/restoration-projects/boise-creek/lower-boise-creek-restoration.aspx
- http://www.kingcounty.gov/services/environment/animals-and-plants/restoration-projects/boise-creek/middle-boise-creek-restoration.aspx

Meeker Creek Restoration Project (Clarks Creek-Lower Puyallup River)

Meeker Creek is a small tributary to Clarks Creek located in the city of Puyallup. The restoration project created floodplain wetland and a new, more naturalized stream channel with the goal of improving water quality and salmon habitat. For more information about this restoration project, go to:
http://www.geoengineers.com/project/meeker-creek-channel-restoration

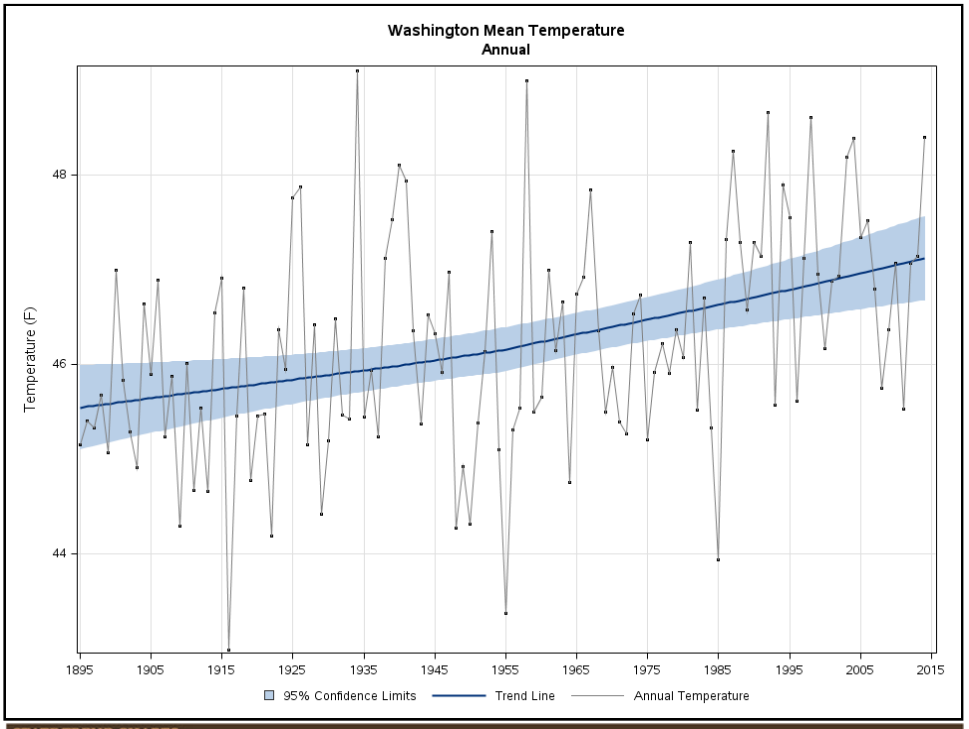
Gog-le-hi-te Wetlands1 &2 (Lower-Puyallup River)

The Gog-le-hi-te wetlands (1&2) are located near the mouth of the Puyallup River. The two lower river wetlands sites were constructed as a result of a mitigation settlement with the Port of Tacoma for filling in tidal wetlands. The Gog-le-hi-te wetlands currently sustain a diverse ecosystem of plants, mammals, fish and amphibians. For more information about these restoration sites/projects, go to:

- http://www.portoftacoma.com/community/explore-port
- http://www.metroparkstacoma.org/gog-le-hi-te-wetlands
- https://www.eopugetsound.org/sites/default/files/features/resources/TheGog-Le-Hi-TeWetlandSysteminthePuyallupRiverEstuary.pdf
- https://casedocuments.darrp.noaa.gov/northwest/cbay/pdf/restplan.pdf

Climate Change Impacts and the Puyallup/White River Watershed

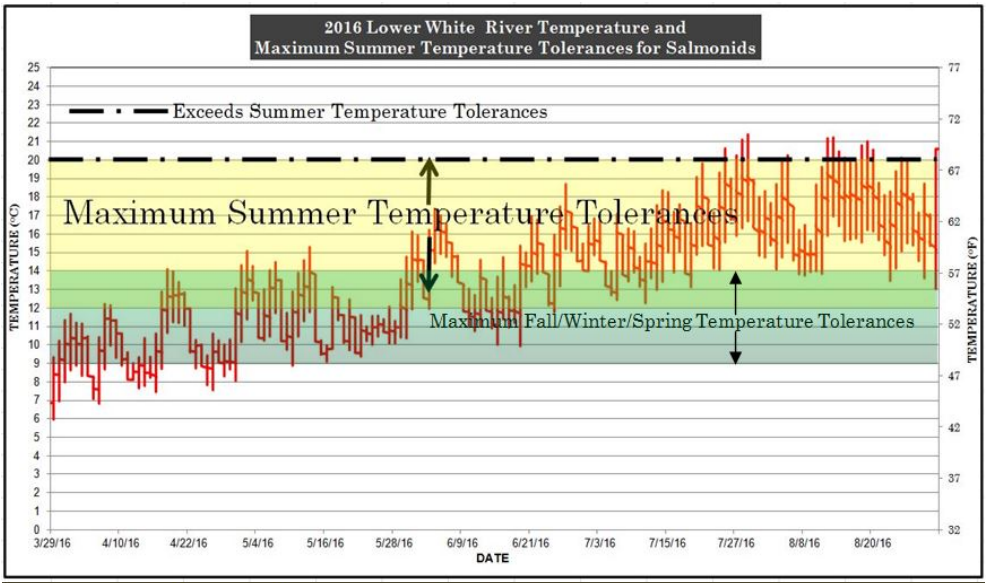
Despite skepticism and conjecture, an overwhelming scientific consensus prevails regarding the anthropogenic climate change hazards on our oceans, watersheds and natural resources as a result of a warming earth. Unfortunately, it is widely expected salmonid populations will decline due to anthropogenic hazard impacts over the next century. Annual and seasonal climate variances throughout the Pacific Northwest have shifted over the past century. As the mean annual temperature graph *(top right figure)* taken from NOAA's National Climate Change Data Center shows, from 1895-to-2011, the average annual atmospheric temperature in the Pacific Northwest has risen by about 1.3°F *(2.3°C)* (Kunkel et al. 2013), and stream temperatures have increased by approximately 0.2°C *(0.36°F)* per decade since 1980 (Isaak et al. 2011). Salmonids subjected to, or exceeding thermal tolerances *(bottom right figure)* can experience several deleterious effects including: elevated levels of stress; increased vulnerability to diseases, toxins and parasites; face greater risk of mortality; alteration of emergence timing; as well as, adverse effects on growth and reproduction.



STATE TREND CHARTS **Source**: https://www.ncdc.noaa.gov/temp-and-precip/state-temps/

These charts present three color-coded time series. The gray line represents the annual (or seasonal) temperature value. The blue line shows the overall trend in a fashion that smoothes out the year-to-year variability in temperature. The light blue shaded area represents the 95% confidence interval for the trend. The smoothed temperature is constructed using a locally estimated scatterplot methodology known as LOESS.

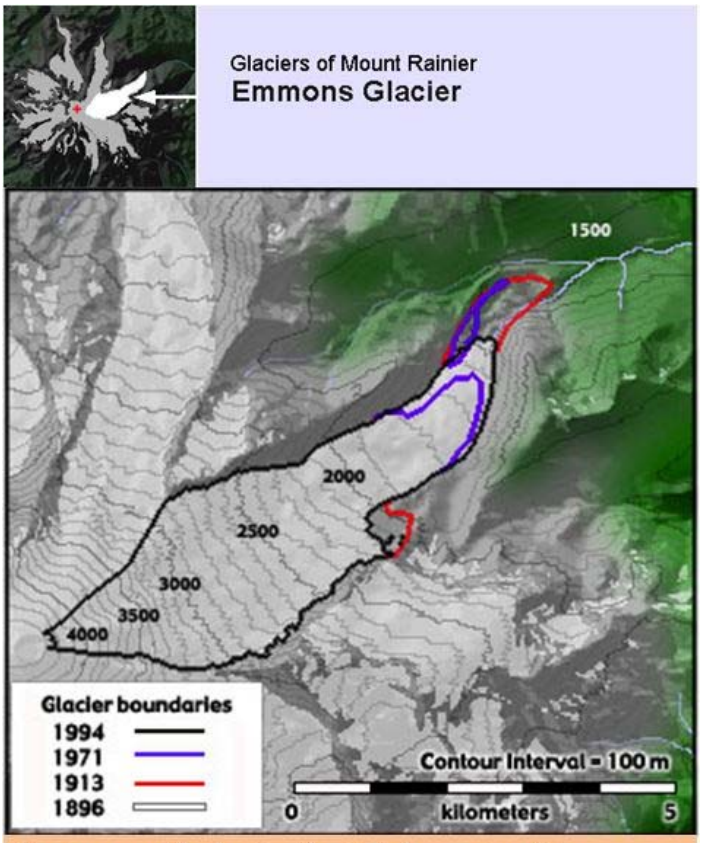
Annual temperatures throughout the northwest and Puget Sound region are predicted to increase by approximately 3°F-to-10°F *(5.4°C-18°C)* by the end of the century; with the largest increases expected to occur during the summer seasons (Kunkel et al. 2013). Future annual precipitation is projected to fall more in the form of rain rather than snow, leading to increased flooding and high flow events in both frequency and intensity; as well as, an anticipated decrease in spring and summer flow regimes *(average annual precipitation expected to*



Recommended Maximum Temperature Criteria for Salmonids

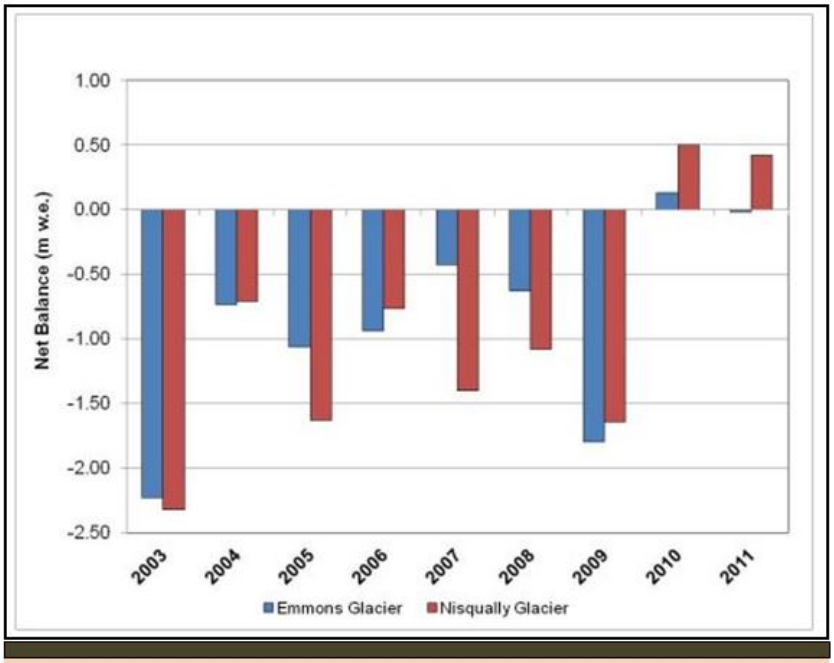
Graph showing temperature range of lower White River from March 29, 2016-to-August 25, 2016. The yellow shaded area was added to illustrate EPA's recommended maximum temperature criteria to protect salmon and trout (2003) based on7 day average of the daily maximum. River temperature exceeded maximum upper limits several times in 2016 as well as 2015.
Summer maximum temperature tolerances (Yellow):12°C (55°F)-to-20°C (68°F)
Fall/winter/spring maximum temperature tolerances: 9°C (48°F)-to-14°C (57°F)

remain the same). This shift has, and will continue to generate consequential alterations of river and stream hydrology and is expected to be a major factor in the decline of salmonid populations through the end of century or beyond.



Contour map illustrating the glacial recession of the Emmons Glacier (White River) on Mt. Rainier (1896-1994.) Source: National Park Service Glaciers and Change: http://glaciers.pdx.edu/Projects/LearnAboutGlaciers/MRNP/Glc08.html

Prominent glaciers on Mt. Rainier continue to retreat at an alarming rate *(top right figure)*; contributing heavily to the aggradation of mainstem river channels and the elevated probability of glacial outburst events. Aggradation can lead to increased flooding risks, higher peak river flows and channel widening. Geologists reported glacial volume on Mt. Rainier has likely decreased by as much as 18% from 2003-to-2009, a loss of approximately 3% per year, which is a rate loss of nearly 10 times that of any past scientific reporting (Beason et al. 2009). A study of the Emmons glacier's *(White River)* mass balance in 2011, conducted by Jon Riedel and Michael Larrabee (2015), showed a glacial mass net loss of 89.4 million m^3 *(lower right figure)*. The study also determined during the summer of 2011 *(May1-to-September 30)*, glacial melt water contributed approximately 9% *(65.2 million m^3)* of the total flows; the lowest flow contribution recorded since 2003. Aggradation levels of rivers located within Mt. Rainier National Park were reported to have increased an average of 1 foot *(0.3m)* from 1997 to 2006; however, some rivers recorded significantly higher levels of aggradation (Beason 2007). Aggradation rates have reportedly increased since the 1980s along the lower reaches of Puyallup and White Rivers; with the White River channel near Auburn reportedly accumulating up to1.8 inches per year; however, less aggradation was recorded on the lower Puyallup River and the White River reach downstream of Mud Mountain Dam at RM 29.6 (Czuba et al. 2010).

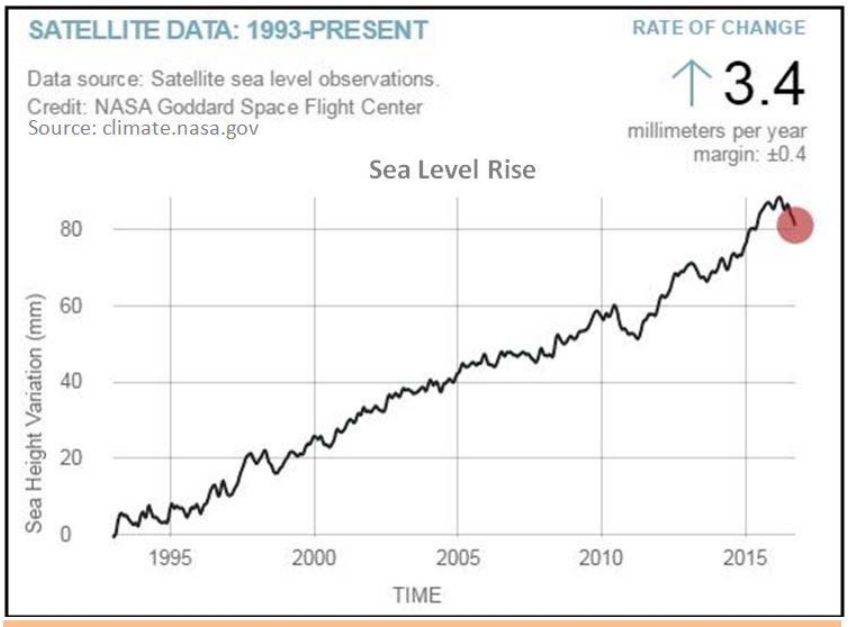


Net mass balance comparisons of Nisqually and Emmons Glaciers by water year. Source: Riedel et al. (2015)

Ocean and marine conditions play a major role in salmonid survival since species typically spend from 1-to-5 years in the marine environment. The temperature of the upper 75m *(246 feet)* of ocean surfaces have experiences an increased of >0.1°C *(0.18°F)* per decade over the last 39 years (Pörtner et al. 2014). Ocean acidification *(OA)* has increased with the elevated absorption of CO_2, and seawater pH is expected to continue declining over the next century. Oceanic pH levels are currently around 8.1*(down from 8.2)*, which is

slightly basic. Unabating global sea rise over the next century due to glacial and polar ice melt *(right figure)* is projected to have acute deleterious impacts on marine ecosystems in the Puget Sound.

The decline of salmonid populations over the next century seems inevitable despite possible natural adaptations that may occur, or any human interventions employed to combat climate change. The following is a summary of expected anthropogenic hazard impacts on watershed salmonids and their habitat; as well as, proposed adaptive actions that may be taken to abate the prognosticated consequences of a warming Puget Sound climate.



NASA satellite data illustrating the rate of global sea level rise since 1993.

Climate Change and Potential Impacts on Watershed Salmonids and Stream Habitat

- The Puget Sound Region has faced annual/seasonal temperature increases and declines in annual snowpack over the past several decades.
  - Decreases in spring stream flows which are critical for out-migrating salmon *(smolts)*.
  - Earlier shifts in peak spring flows can alter downstream migration queues of smolts.
- Significant and rapid loss of glacial volume and increased aggradation of river channels.
  - Increased flood risks, higher peak river flows and channel widening.
  - Elevated risk of losing critical fish habitat, especially in headwater streams due to channel widening, glacial outburst and high flow *(scour)* events.
- Winter precipitation is projected to fall more in the form of rain rather than snow; leading to increased flood and high flow events in both frequency and intensity *(average annual precipitation expected to remain the same)*.
  - Escalated risk of early developmental fish stage losses *(eggs and alevins)* due to streambed scour and fine sediment deposition *(redd smothering)* caused by flood/high flow events.
- Loss/decline of streamside riparian habitat and surrounding established/mature forest lands.
  - Reduced solar protection of river and streams resulting in increased water temperatures.
  - Decreased terrestrial retention/regulation of rain fall and snow melt.
  - Increased sedimentary input caused by erosion, surface water runoff and land slide activity.
  - Diminished recruitment of in-stream large woody debris *(LWD)*, which is fundamental for creating vital salmonid habitat (i.e. cold water refugia); in addition to dissipating flood/high flow forces.
- Elevated stream temperatures, declining annual snowpack, lower spring/summer stream flows and increasing flood/high flow events are anticipated to result in the following deleterious effects on salmonid populations:
  - Low river and stream flows can altered migration queues and run timing; increase the inability of fish to access spawning habitat; decreased the amount of habitat available for spawning, rearing and foraging; as well as, the dewatering of redds post spawning.

- Salmonids subjected to, or exceeding higher thermal tolerances *(natural and hatchery environments)*, can experience several detrimental effects including: increased levels of stress; are more vulnerability to diseases, toxins and parasites; face greater risk of mortality; alteration/shift of emergence timing; as well as, adverse effects on growth and reproduction. Cold-water temperatures are crucial for salmonid gametogenesis *(i.e. egg development in female salmon)* and early instream development of larvae.
- The metabolic activity/state of salmonids increases with ambient water temperature, resulting in an increased requirement for oxygen; however, the amount of dissolved oxygen available in water decreases with temperature.
- Salmon hatcheries lacking alternate sources of cold water *(i.e. well water or other ground water resources)* may encounter difficulties with incubating and rearing young salmon; as well as holding adult salmon prior to spawning *(effects of general water quality & thermal tolerances).*
- Warmer stream temperatures will favor non-salmonids such as largemouth bass, yellow perch, rock bass, black crappie, bluegill, pumpkin seed sunfish, walleye, and bullhead catfish.
- Warmer stream temperatures will reduce or extirpate benthic stream invertebrates *(i.e. insects)* which are an essential food source for salmonids.

Adaptive Actions Regarding Climate Change Impacts on Salmonids and Stream Habitat

Developing and implementing adaptation plans will be essential for the management, enhancement and protection of salmonids in the future. Maintaining effective research, monitoring and evaluation programs to look for deviations from current baseline conditions will provide resource protection managers with the essential tools necessary to achieve effective strategies towards assisting salmonids adjust to a warming climate. The following are several adaptive options/actions to consider:

- Sustain the availability of cold-water refugia through aquatic and forest habitat protection, enhancement and recovery to insure the stability and persistence of Pacific salmon, steelhead and bull trout populations.
- Support collaborative strategies among resource managers regarding the development and implementation of fisheries policies, strategies, procedures, programs and projects.
- Identifying and cataloging essential salmonid spawning, rearing and foraging areas highly vulnerable to anthropogenic hazard impacts and developing protection measures.
- Categorize known and potential fish limiting factors *(i.e. diminished habitat connectivity and migration corridors; fragmentation and reduction of habitat quality; water quality; hydro and logging).*
- Identify and inventory priority sites where habitat restoration or protection projects will help mitigate anticipated anthropogenic hazard impacts; in addition to addressing current recovery needs.
- Protect current cold water sources and develop additional/supplementary resources of cold water.
- Execute restoration, enhancement, protection and recovery projects identified by resource managers; as well as conducting additional research, assessment and monitoring needs.
- Improve river flows through by-pass reaches; as well as, increasing minimum in-stream flow requirements *(improve thermal refugia available during lower summer flows; in addition to habitat and migratory connectivity).*
- Reduce or eliminated surface water withdrawals, water impoundment and anthropogenic instream flow manipulations/alterations *(improve water quality, prevent fish entrainment and stranding).*
- Diminish causes of environmental degradation through improve protection and resource management.
- Improve and maintain riparian buffer zones and forested areas to better retain/regulate rain fall and snow melt; as well as reducing sedimentary input and water temperatures. Cooling of smaller and moderate streams through natural shading would benefit salmonid species since a significant amount of spawning and rearing occurs in tributary habitats.

- Increase/improve storm water *(and wastewater)* catchment and treatment before releasing into rivers and streams.
- Increase and improve flood capacity of rivers through capital projects including creating levee set-backs, reconnecting floodplains and increasing off channel storage habitats.

For additional information on regional anthropogenic hazard impacts, adaptation plans and options check out the links listed below.

- State of Knowledge Report Climate Change Impacts and Adaptation in Washington State: Technical Summaries for Decision Makers (2013). http://cses.washington.edu/db/pdf/snoveretalsok816.pdf
- Climate Change Impact Assessment and Adaptation Options Puyallup Tribe of Indians (2016). http://www.puyallupTribe.com/tempFiles/PuyallupClimateChangeImpactAssessment_2016_FINAL_pages.pdf
- Climate Change and Our Natural Resources A Report from the Treaty Tribes in Western WA. http://nwifc.org/w/wp-content/uploads/downloads/2017/01/CC_and_Our_NR_Report_2016-1.pdf
- IPCC Intergovernmental Panel on Climate Change https://www.ipcc.ch/report/ar5/wg2/
- Ocean ecosystem indicators of salmon marine survival in the Northern California Current https://www.nwfsc.noaa.gov/research/divisions/fe/estuarine/oeip/
- Regional Climate Trends and Scenarios for the U.S. National Climate Assessment: Part 6. Climate of the Northwest U.S. NOAA Technical Report NESDIS 142-6. https://data.globalchange.gov/report/noaa-techreport-nesdis-142-6
- Impacts of Climate Change on Salmon of the Pacific Northwest.
  - https://www.nwfsc.noaa.gov/assets/4/8466_12112015_134746_Literature_Review_%20Impacts_of_Climate_Change_on_Salmon_2014.pdf

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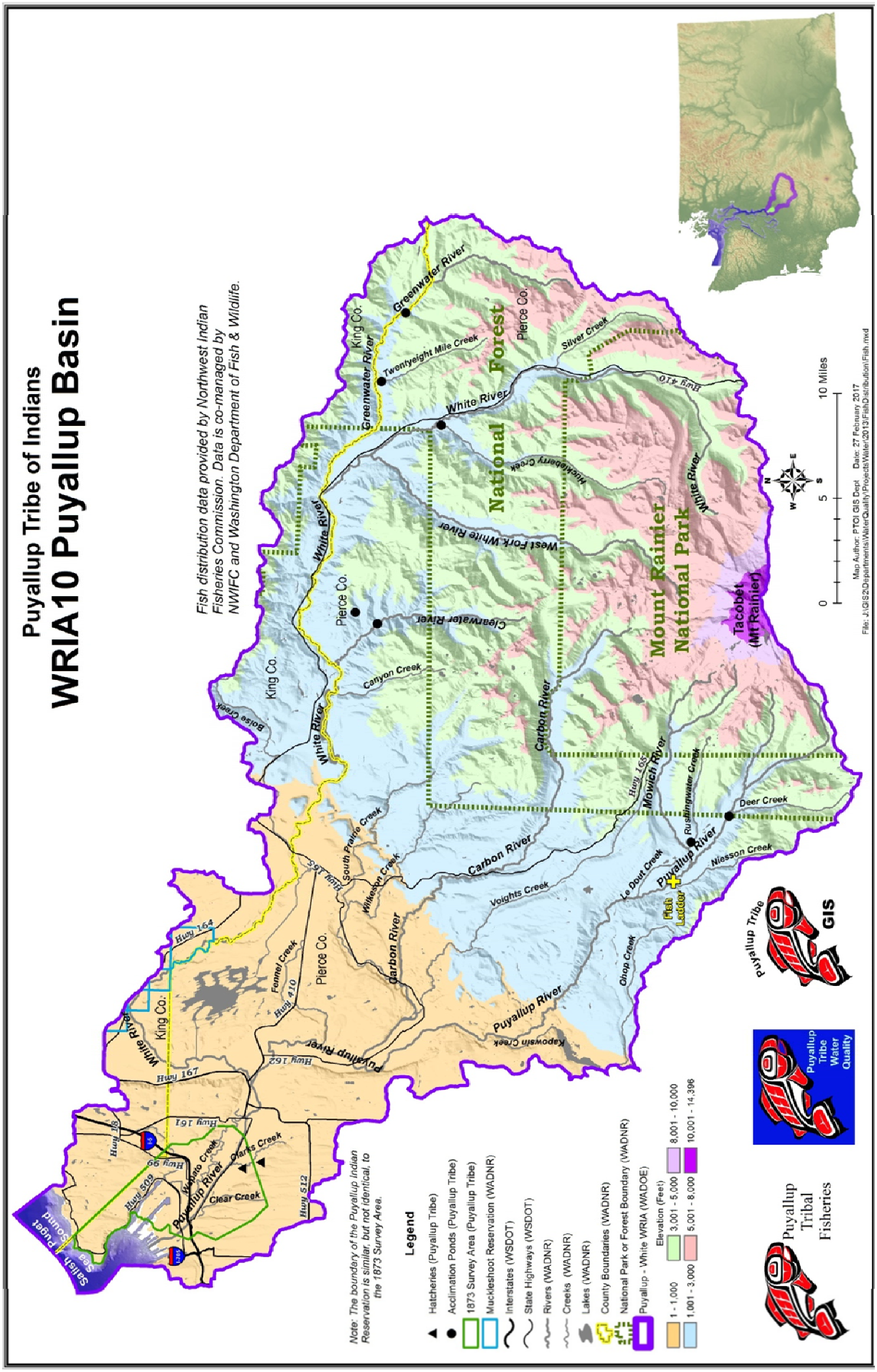
SUMMARY OF 2016-2017 ACCOMPLISHMENTS

Several fisheries escapement and enhancement projects were continued or completed during the 2016-2017 season. Most of the following projects or studies are covered in more detail in this report. Other Puyallup tribal fisheries projects involving harvest, TFW, environmental, management, and habitat are covered in separate reports.

- Spring Chinook spawning surveys in the upper White River above Mud Mountain Dam.
- Spring/Fall Chinook spawning surveys in the Puyallup/lower White River Watershed.
- Upper White and Puyallup Rivers bull trout spawning surveys.
- Coho spawning surveys in the Puyallup/White River Watershed.
- Chum spawning surveys in the Puyallup/lower White River Watershed.
- Winter steelhead spawning surveys in the Puyallup/White River Watershed.
- Juvenile salmonid production assessment projects on the lower Puyallup and White Rivers.
- Sampled and monitored adult salmonids at the USACE trapping facility on the White River.
- Monitored, sampled and evaluated the migration and survival of salmonids at Electron Hydro's *(formally owned/operated by PSE)* Electron fish collection facility *(Puyallup River)*.
- Spring Chinook acclimation project on upper White River tributaries.
- Fall Chinook juvenile/pre-smolt plants in Hylebos Creek.
- Coho acclimation project on the Upper Puyallup River.
- Fall Chinook production at Puyallup Tribe's hatchery facility on Clarks Creek.
- Chum production at Puyallup Tribe's hatchery facility on Diru Creek.
- Collected and live-spawned adult steelhead wild brood-stock for the White River winter steelhead supplementation project *(project initiated in 2006)*.
- White River Winter steelhead pre-smolt acclimation pond plants on the Upper White River.

ABBREVIATIONS & ACRONYMS

AUC: Area under the curve
AP: Acclimation Pond
BWT: Blank Wire Tag
CB/NT: Commencement Bay/ Nearshore Tideflat
CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act
CFS: Cubic Feet per Second
CMZ: Channel Migration Zone
CWT: Coded Wire Tag
DIDSON: Dual Frequency Identification Sonar
DNA: Deoxyribonucleic acid (genetic sample)
DNR: Department of Natural Resources
EIS: Environmental Impact Statement
ELJ: Engineered Log Jam
ESA: Endangered Species Act
FERC: Federal Energy Regulatory Commission
GIS: Geographic Information Systems
GPM: Gallons per Minute
GPS: Global Positioning System
HOR: Hatchery Origin Return
IHN: Infectious Haematopoietic Necrosis (infectious viral disease)
LP: Lower Pond
LWD: Large Woody Debris
M: Marked fish (internal/external tags or fin clipped), Hatchery origin
MMD: Mud Mountain Dam (USACE Facility)
MGD: Million Gallons per Day
MS-222: Tricaine methanesulfonate (anesthetic)
N/O: None Observed
NOAA: National Oceanic & Atmospheric Administration
NOR: Natural Origin Recruit (Wild)
NPS: National Park Service
NTU: Nephelometric Turbidity Units
NWIFC: Northwest Indian Fisheries Commission
PCSRF: Pacific Coast Salmon Recovery Funding
RM: River Mile
RMIS: Regional Mark Information System
RMZ: Riparian Management Zone
PIT: Passive Integrated Transponder (internal)
PSE: Puget Sound Energy
PTF: Puyallup Tribal Fisheries
TFW: Timber, Fish and Wildlife
U: Unmarked fish (no internal/external tags or fin clips), Wild
UP: Upper Pond
USACE: United States Army Corps of Engineers
USFS: United States Forest Service
USFWS: U.S. Fish and Wildlife Service
WDFW: Washington Department of Fish and Wildlife
WRIA: Water Resource Inventory Area
0 (age): Sub-yearling, zero aged fish (less than one year old), young of the year
Yearling: (1 year + age fish)


Puyallup Tribe of Indians
WRIA10 Puyallup Basin
Fish distribution data provided by Northwest Indian Fisheries Commission. Data is co-managed by NWIFC and Washington Department of Fish & Wildlife.
Note: The boundary of the Puyallup Indian Reservation is similar, but not identical, to the 1873 Survey Area.
Legend
Hatcheries (Puyallup Tribe)
Acclimation Ponds (Puyallup Tribe)
1873 Survey Area (Puyallup Tribe)
Muckleshoot Reservation (WADNR)
Interstates (WSDOT)
State Highways (WSDOT)
Rivers (WADNR)
Creeks (WADNR)
Lakes (WADNR)
County Boundaries (WADNR)
National Park or Forest Boundary (WADNR)
Puyallup - White WRIA (WADOE)
Elevation (Feet)
1 - 1,000
1,001 - 3,000
3,001 - 5,000
5,001 - 8,000
8,001 - 10,000
10,001 - 14,396
Mount Rainier National Park
Tacobet (Mt Rainier)
Greenwater River
Twentyeight Mile Creek
White River
Silver Creek
Huckleberry Creek
West Fork White River
Clearwater River
Canyon Creek
Boise Creek
Carbon River
Mowich River
Rushingwater Creek
Deer Creek
Nisson Creek
Le Dout Creek
Voights Creek
Chop Creek
Kapowsin Creek
Puyallup River
Fish Ladder
Wilkeson Creek
South Prairie Creek
Fennel Creek
Wapato Creek
Clarks Creek
Clear Creek
Salish Sea
Puget Sound
Hwy 410
Hwy 162
Hwy 165
Hwy 164
Hwy 167
Hwy 161
Hwy 99
Hwy 509
Hwy 512
King Co.
Pierce Co.
0
5
10 Miles
Map Author: PTOI GIS Dept Date: 27 February 2017
Files: J:\GIS\2Departments\WaterQuality\Projects\Water\2013\Fish\Distribution\Fish.mxd
Puyallup Tribe GIS
Puyallup Tribe Water Quality
Puyallup Tribal Fisheries

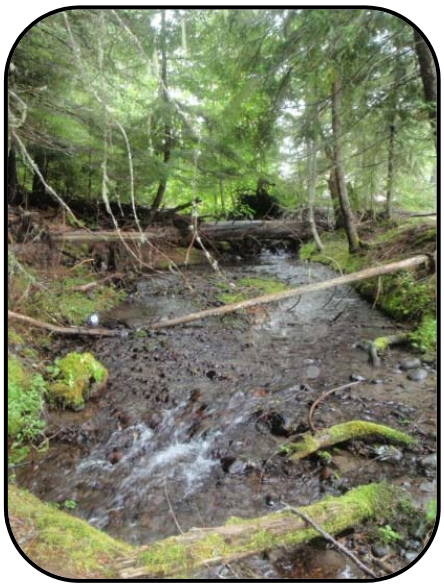
ANTLER CREEK

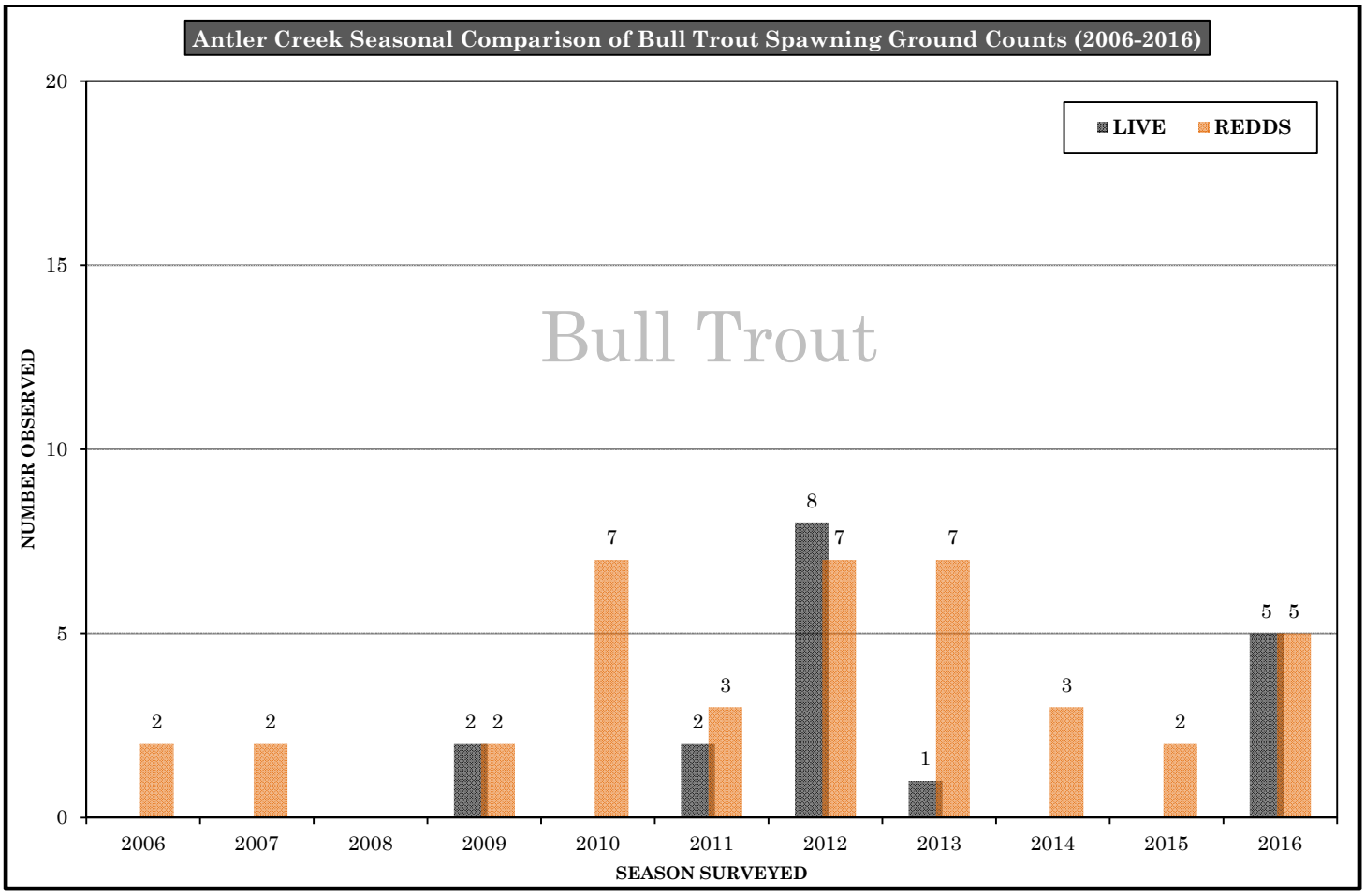
WRIA 10.0352

Antler Creek is not officially named by the Washington State Board on Geographic Names; however, for easy identification the creek is referred to as "Antler" by PTF staff. Antler is a small, short run *(1.2+ miles total length)*, west facing right bank headwater tributary to the White River. Primarily supporting bull trout, Antler Creek is a small stream located entirely within Mt. Rainier National Park. Despite its lack of habitat accessibility by salmon and steelhead, the lower reach of Antler does provide suitable habitat conditions for bull trout rearing and spawning. Since 2006, the Puyallup Tribe has surveyed the creek for bull trout spawning activity from late August through early October, with peak spawning occurring around the third week in September *(see Appendix C for survey data)*. Unfortunately, Antler Creek's elevation *(mouth @ 2950')* is likely too high for other salmon species. Originating along the slopes of Crystal Mountain Ridge, the creek flows entirely within Mt. Rainier National Park *(NPS stream designation w09-00a),* entering the White River at approximately RM 65.9; which is 0.4 miles downstream of Crystal Creek.

Characteristic of many headwater tributaries, the mouth of the creek frequently drifts due to its position within the open channel migration zone of the White River. As a result of mainstem river incursions, the creeks lower channel *(100'+)* and riparian habitat are frequently impacted. The habitat within this section is the least conducive to spawning due to a primarily sand/silt substrate. In addition, this reach of the creek is highly subjected to the possibility of redd scouring or heavy silt deposition due to the influences of the mainstem White River.

Nearly the entire accessible reach of the creek *(approximately 400')* is low gradient. Although spawning does occur within this small stretch *(depending on mainstem influence),* it is often limited due the lack of quality spawning substrate created by the fine alluvial deposits *(sand & silt)* from the White River. In addition, bull trout spawning has been less consistent and frequent in this tributary compared to that observed in more significant headwater tributaries located along the White River, such as Klickitat Creek *(elev. 3300')* located 2 miles upstream. There are small quantities of in-stream LWD present, as well as a beneficial riparian buffer zone of primarily conifers along the majority of the creek. Upstream of the accessible reach, the creek enters the heavily forested lower slope of the valley floor as it begins to climbs up the valley wall. From this point, the creek assumes a pool-riffle-cascade configuration up the steep basin wall. At approximately RM 0.2, the creek passes under Hwy 410, near mile marker 61. For more information on bull trout, refer to the Klickitat Creek section in this report. The USFWS finalized bull trout recovery plan is available at the following site: *https://www.fws.gov/pacific/bulltrout/pdf/Final_Bull_Trout_Recovery_Plan_092915.pdf*





See Appendix B for bull trout redd locations.

BOISE CREEK

WRIA 10.0057

Chinook spawning in Boise Creek

Boise Creek is a significant tributary to the White River, converging with the White River at RM 23.5, just upstream of where highway 410 crosses the river north of the city of Buckley. In contrast to most of the Puyallup/White River Watershed which falls within Pierce County, Boise Creek lies within South King County, with much of the lower creek flowing just south of the city of Enumclaw. With its headwaters located in a well forested area of the Grass Mountain Range; Boise creek drains an area of approximately 15.4 mi^2. Despite its numerous impairments, Boise Creek has often proven to be a highly productive tributary over the past decade. The majority of the lower 4.5 miles of the creek provides suitable spawning, rearing and foraging habitat for several salmonid species including Spring and Fall Chinook *(top)*, coho, pink, chum, sockeye, steelhead/rainbow, bull trout and cutthroat.

A 12-ft bedrock falls at RM 4.5 marks the upper extent of adult salmon and steelhead migration. Cutthroat and rainbow have been observed above the falls; although, no data is available on the size or range of the population(s). Above the falls, the gradient increases, becoming a small cascade/step-pool configuration. The channel upstream of the falls, to where Boise crosses under highway 410, was altered back in the mid 1930's to accommodate for the construction of the highway. Upstream of 410, the creek passes through the old Weyerhaeuser mill site, which continues to be a source of sedimentary input. For approximately 0.2 miles below the falls, Boise flows through a lower gradient riffle-pool channel bordered by a dense second growth forest; there are several spawning opportunities throughout this forested stretch. Continuing downstream of the forested area is a low gradient reach flowing for approximately 0.5 miles within the golf course in the city of Enumclaw. The riparian zone alongside this section is exceptionally sparse; the banks are merely riprapped and bordered by maintained turf grass, blackberry, and small deciduous trees. There is, however, a short section located within the golf course below RM 4.0 with an intact hardwood riparian zone. Spawning is noticeably reduced throughout the entire reach of the creek flowing within the open range of the golf course. Downstream from the golf course, Boise Creek begins to flow through residential and agricultural lands. This more developed reach extends from approximately RM 3.7 down to RM 0.3; much of the stream along this stretch is incised to depths of 20 feet or more. Extensive tracts of land bordering Boise Creek below RM 3.5 are primarily used for maintaining cattle and other livestock.

Spawning activity for all species, except bull trout, occurs throughout the entire 4.5 miles. Boise has continued to support a significant number of Chinook spawners over the past several seasons, as well as pinks on odd years. Carcass sampling data shows that a significant number of Chinook, as high as 80% *(in 2011)*, that spawn in Boise Creek are hatchery origin Fall Chinook. DNA sampling studies of Chinook in the White River, Ford et al. (2004), showed an approximately 60% fall and 40% Spring Chinook component in the lower river *(below RM 24.3)*. The pink salmon returns to Boise in 2005, 2007 and 2009 were unprecedented. Estimate calculations put the escapement at nearly 16,000 fish in 2005, nearly 28,000 in 2007, and over 100,000 in 2009 *(peak escapement year)*. Although still significant, pink

Mid-channel restoration site at 268th

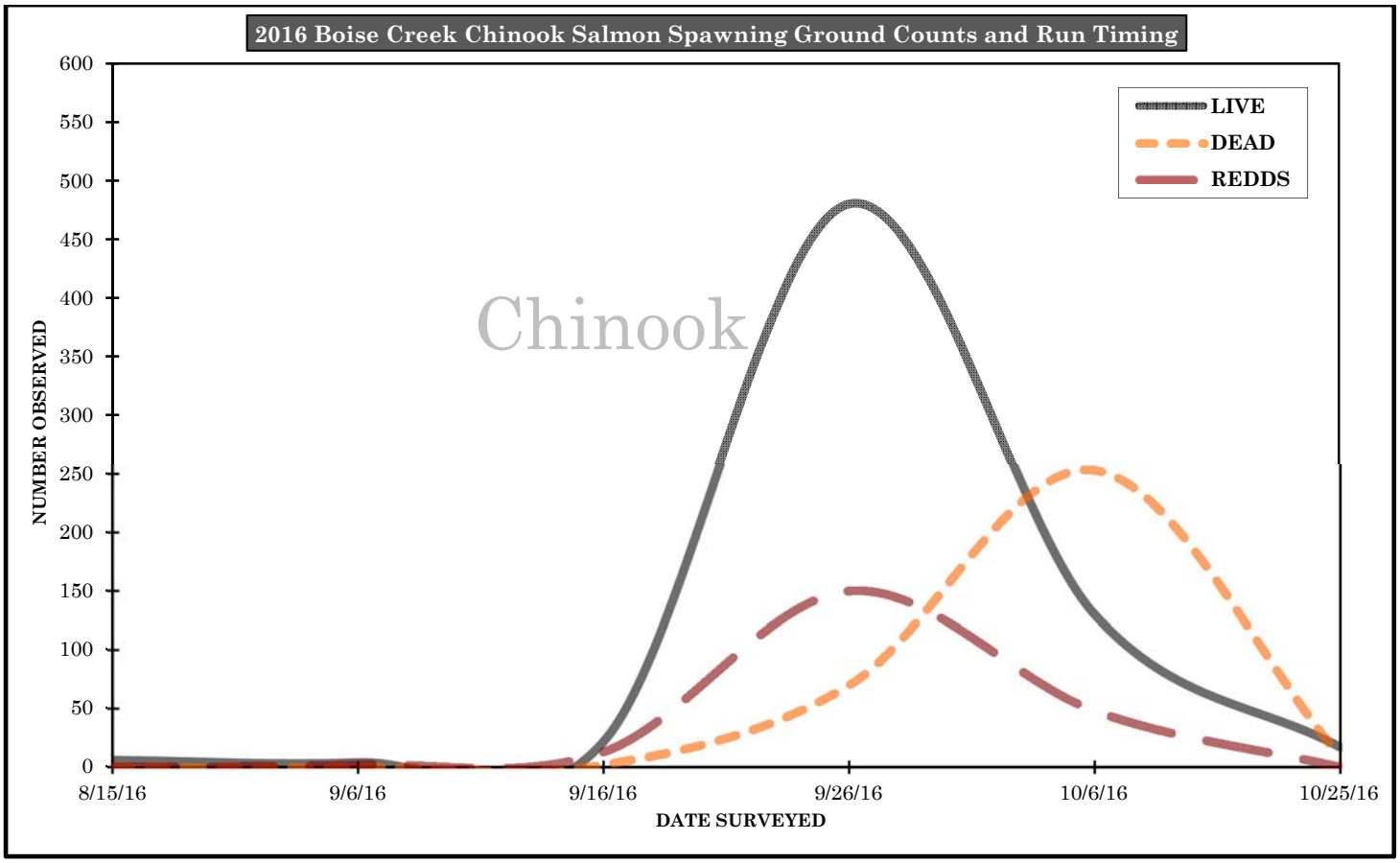
returns since 2009 have been considerably less. During the 2005 season, the first significant numbers of chum salmon were observed as high as RM 1.5. Chum were observed in the lower 2.5 miles of the creek during the 2008 through 2010 seasons. However, chum have not been observed since 2010. Despite its many habitat related shortcomings, Boise Creek continues to support returns of wild steelhead, a remarkable fact in light of the basin-wide declines since the late 80's. In fact, Boise has exhibited some of the highest steelhead redd densities found anywhere in the watershed, including South Prairie creek. Spawning opportunities for all species is considerably reduced in the lower 0.1-to-0.3 miles of the creek *(upstream of Mud Mountain Dam Road)*. The gradient throughout this short stretch is steeper, the banks are confined by high sheer walls, and the substrate consists of mostly boulders and large cobble with some isolated pockets of gravel.

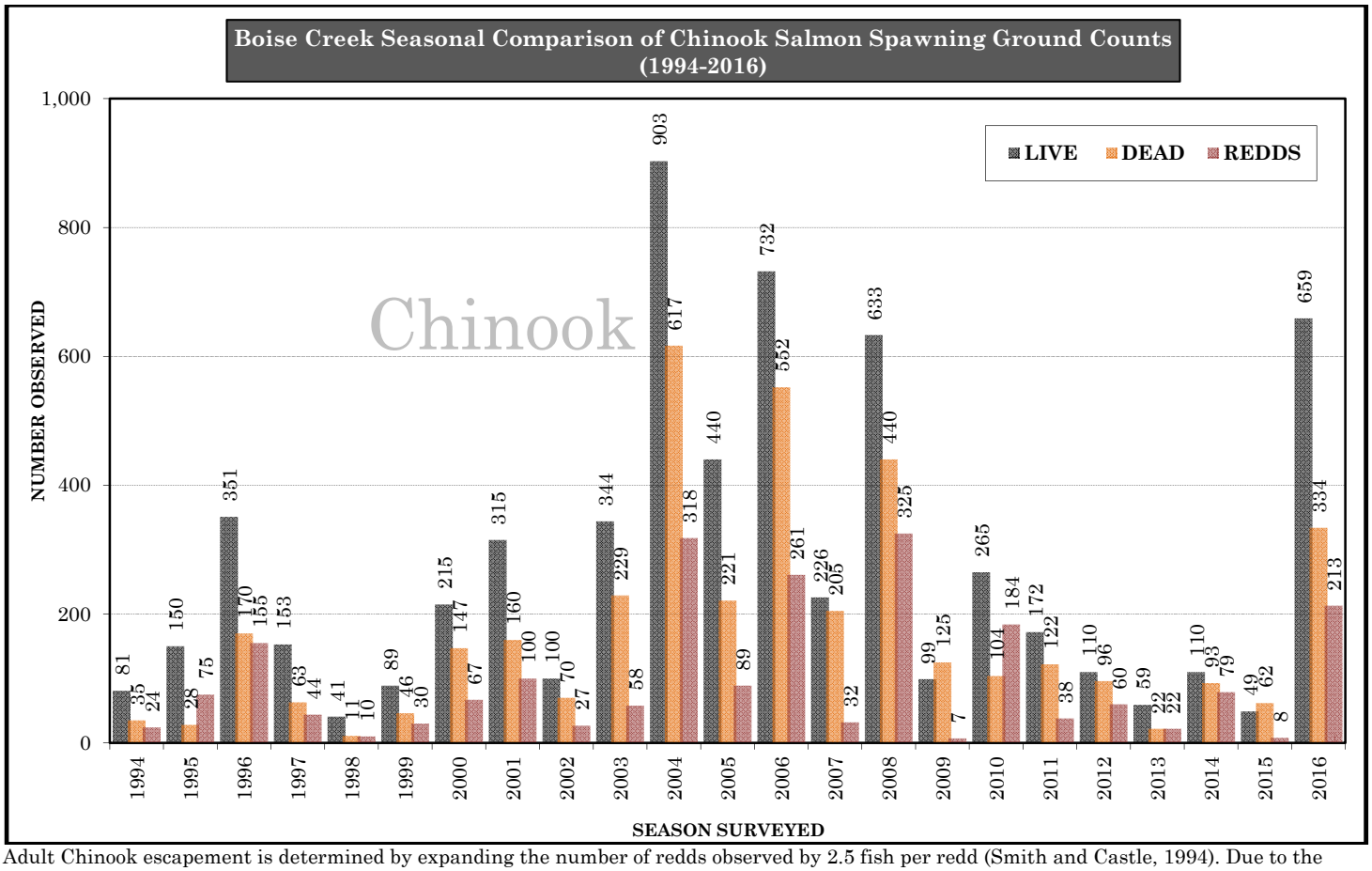
Chinook, coho, and steelhead *(right photo)* are especially vulnerable to poaching and harassment in this urban stream. In addition, surrounding agricultural land use continues to impact channel and water quality conditions *(below)*. Other limiting factors affecting Boise include the loss of historic flood plain and streamside riparian, channel confinement and realignment, temperature and other water quality issues *(surface water discharge)*; as well as, reduced LWD inputs and the removal of instream LWD and substrate material *(dredging)* by land owners. Tremendous improvements to riparian and stream channel conditions are possible but require willing land owners, technical expertise and funding.

Steelhead in Boise Creek

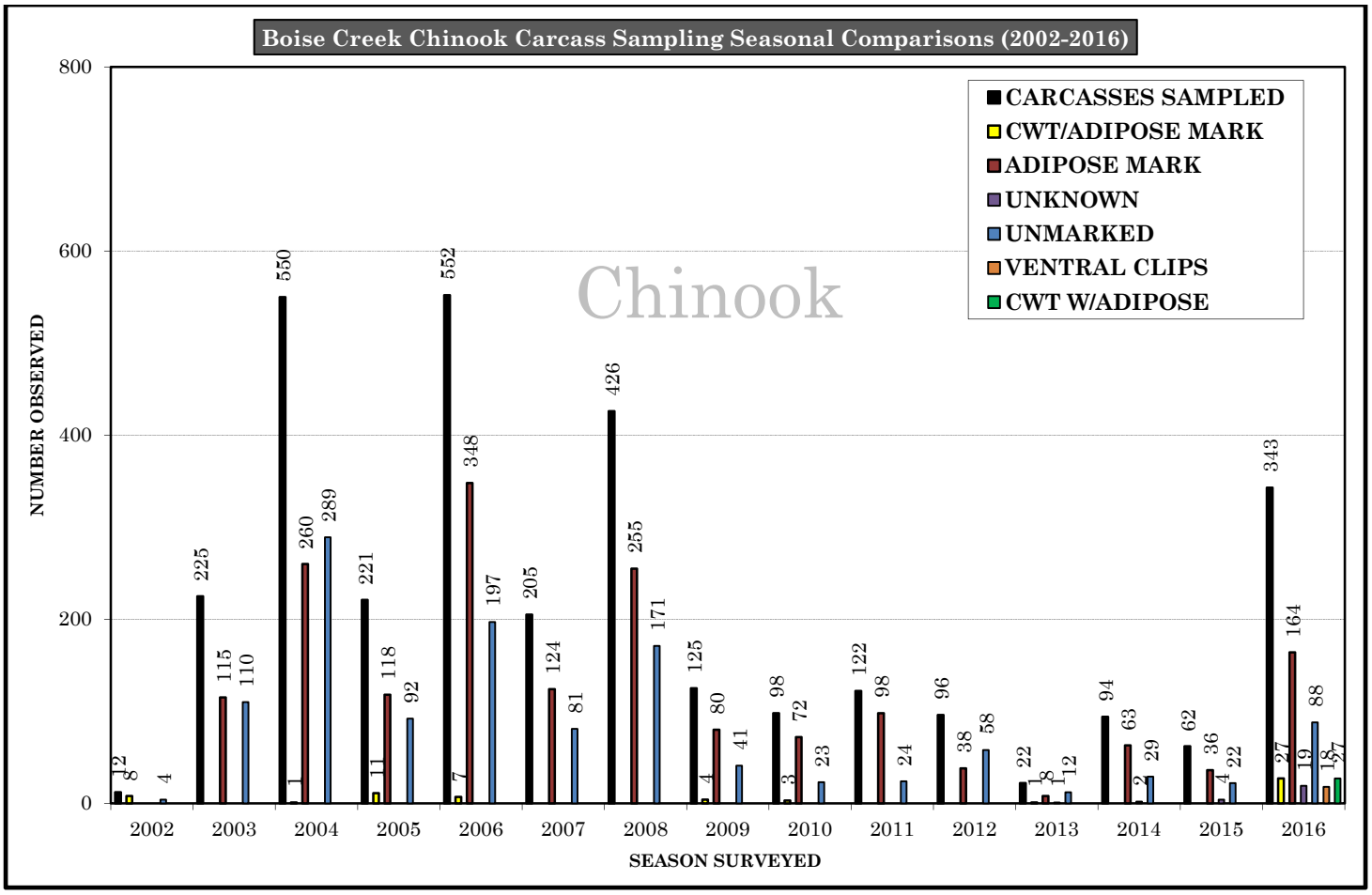
In the spring of 2013, the King County Water and Land Resources Division initiated a channel enhancement project along the mid Boise Creek channel above 268th St. *(top)*. In 2010, the establishment of a new lower channel restoration was completed; starting from Mud Mountain Dam Road, downstream to the White River confluence. The new channel provides improved rearing and spawning habitat. The project is designed to improve in-stream and surrounding wetland complexity, as well as fish and wildlife utilization. Additional restoration projects are currently under design and engineering. In August of 2003, the city of Tacoma *(TPU)* removed its 99 year old concrete pipeline crossing located at RM 23 on the White River. The concrete and rebar structure had long been suspected of injuring salmon and limiting upstream migration of weaker swimmers like chum salmon. The removal of the old concrete structure has resulted in chum salmon being able to access Boise Creek when present.

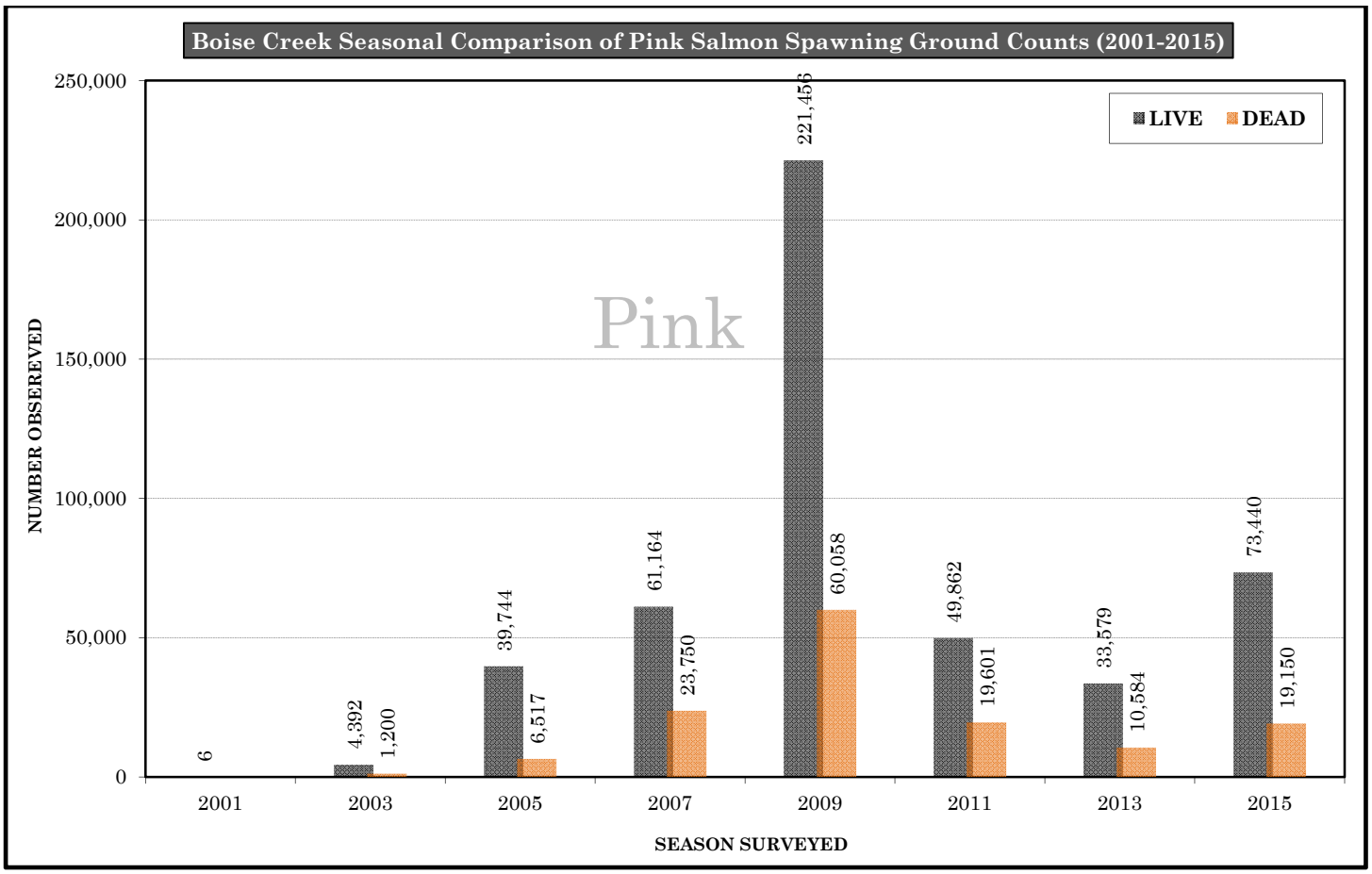
Livestock accessing Boise Creek

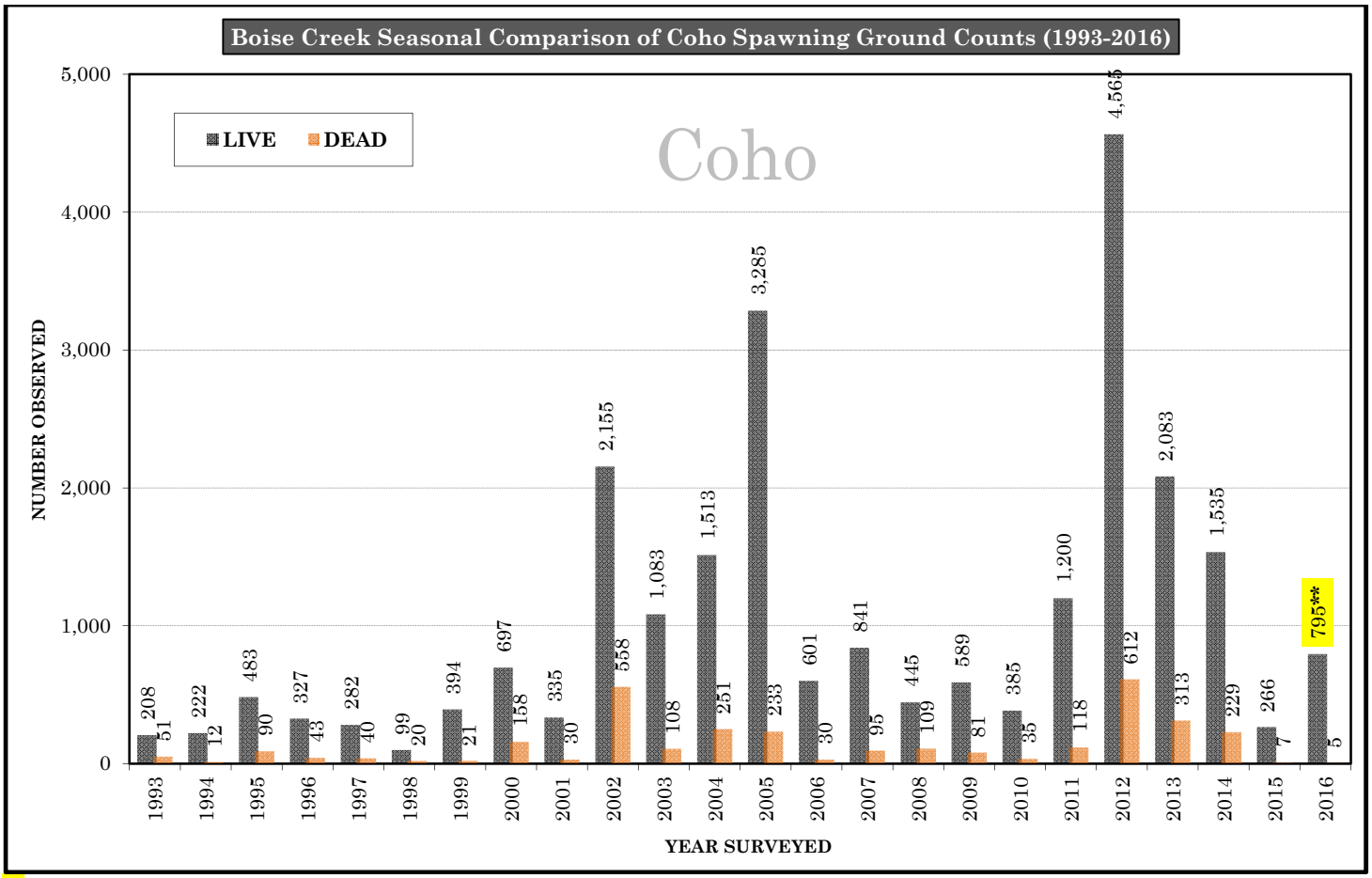




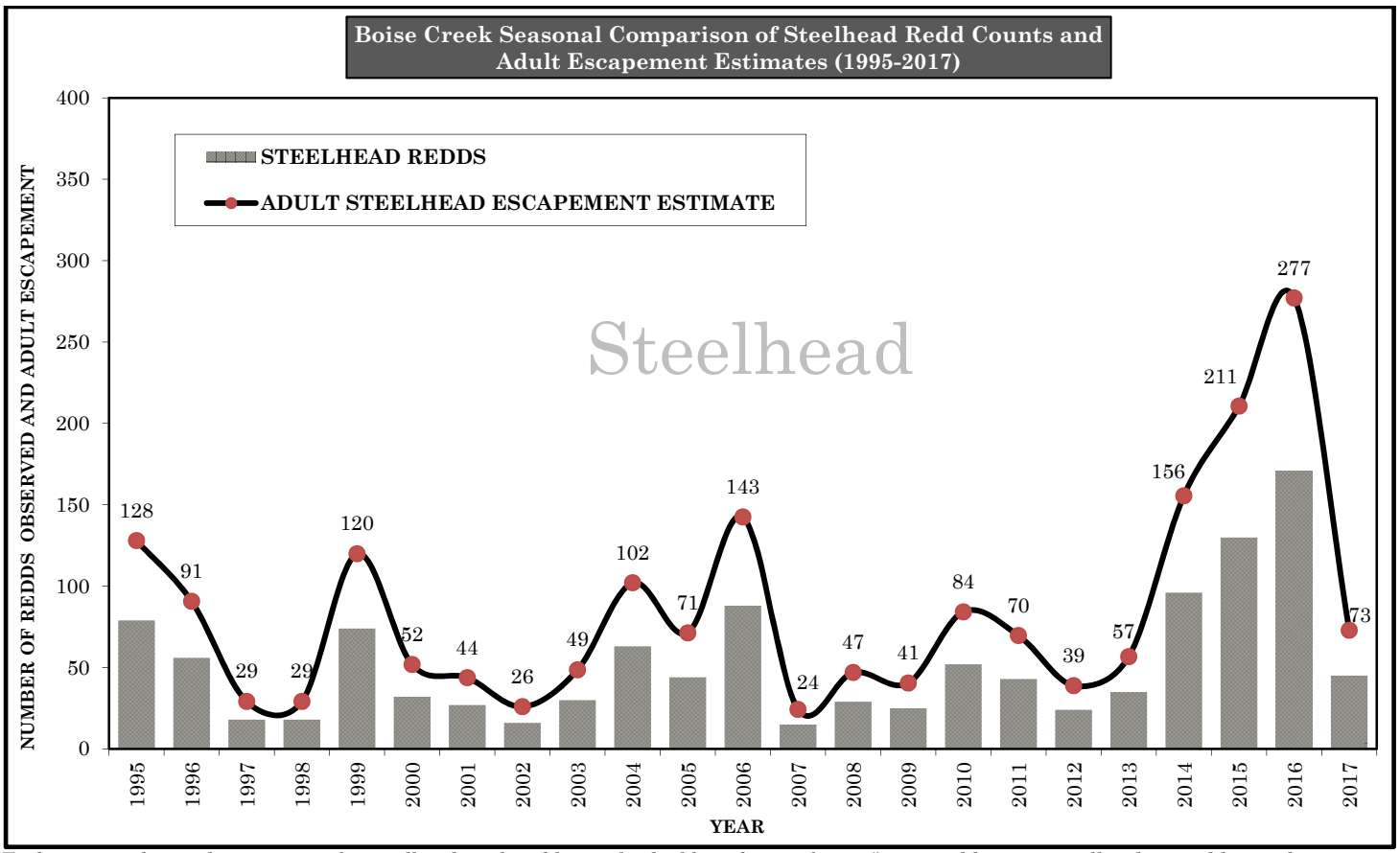
Adult Chinook escapement is determined by expanding the number of redds observed by 2.5 fish per redd (Smith and Castle, 1994). Due to the tremendous volume of pink salmon during odd years (since 2003), the success of determining Chinook redds from pinks is vastly reduced. Therefore, The AUC method is used to determine escapement during pink runs.


Boise Creek Chinook Carcass Sampling Seasonal Comparisons (2002-2016)
CARCASSES SAMPLED
CWT/ADIPOSE MARK
ADIPOSE MARK
UNKNOWN
UNMARKED
VENTRAL CLIPS
CWT W/ADIPOSE
Chinook
NUMBER OBSERVED
SEASON SURVEYED
2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016
12 8 4 225 115 110 550 1 260 289 221 11 118 92 552 7 348 197 205 124 81 426 255 171 125 4 80 41 98 3 72 23 122 98 24 96 38 58 22 1 8 12 94 63 2 29 62 36 4 22 343 27 164 19 88 18 17


Boise Creek Seasonal Comparison of Pink Salmon Spawning Ground Counts (2001-2015)
LIVE
DEAD
Pink
NUMBER OBSEREVED
SEASON SURVEYED
2001 2003 2005 2007 2009 2011 2013 2015
6 4,392 1,200 39,744 6,517 61,164 23,750 221,456 60,058 49,862 19,601 33,579 10,584 73,440 19,150



**2016 coho data consist of only a single survey. High flows prevented additional surveys from being conducted.



To determine the total escapement for steelhead, each redd is multiplied by a factor of 1.62 *(i.e. 42 redds x 1.62 steelhead per redd = total escapement of 68 steelhead)*; no additional expansion factors are applied. See steelhead redd locations map in appendix B.

BUCKLEY:
USACE FISH TRAP WHITE RIVER

The U.S. Army Corps of Engineers' *(USACE)* fish trapping facility *(circa 1948)* is located at RM 24.3 near Buckley *(top left photo).* Salmon, steelhead, bull trout and other native fishes *(mountain whitefish, rainbow & cutthroat)* migrating to the upper White River enter this trap and are transported above Mud Mountain Dam. Fish not allowed upstream during sampling include marked hatchery released Fall Chinook and summer-run steelhead strays *(ad clipped)*. Only BWT steelhead released as part of the White River recovery program are passed upstream. The Corps' trapping facility is uniquely integrated into a diversion dam and flume intake that was, up until January 2004, used to divert water from the White River to generate power. Since PSE ceased power production, some measure of water has continued to be diverted from the White River to maintain the water levels and water quality in Lake Tapps. Engineering and development is currently underway way to replace the existing structure with a new diversion dam and fish trapping facility. The USACE facility offers unparalleled access to significant numbers of salmonids, which has been invaluable tool for research, salmon recovery and escapement estimates. During the months that salmon, steelhead and bull trout return to the upper White River, the USACE empties the trap daily, the trap is hoisted to a tanker truck, and fish are released from the trap into the truck. Fish are then transported above Mud Mountain Dam and released back into the White River at RM 33.6; four miles above the dam and approximately one mile below the confluence with the Clearwater River.

Sampling steelhead for BWT

Species of salmonids captured in the trap include Spring and Fall Chinook, coho, pink, sockeye, chum, steelhead, cutthroat and bull trout. Puyallup Tribe Fisheries staff samples the contents of the trap once a week throughout the entire year. Species sampled regularly include Chinook, steelhead, sockeye, and bull trout. During the Spring Chinook/sockeye/bull trout run *(late May-to- early October)* PTF staff sample the trap 1 to 7 days per week; the frequency is dependent on the number of fish captured throughout the entire run. Steelhead are sampled regularly by PTF staff from late January through June. All fish sampled are dip-netted from the trap and placed into a 30 gallon water filled stainless steel bin and anesthetized with MS-222. All fish are examined for fin–clips; in addition, Chinook and steelhead are sampled for coded/blank wire tags with a metal detector *(center photo)*, and bull trout are scanned for PIT tags. Further sampling efforts includes measuring each of the previous species for fork length; collecting a tissue sample for DNA analysis; as well as several scales for aging and other life history information. DNA sampling

Bull trout

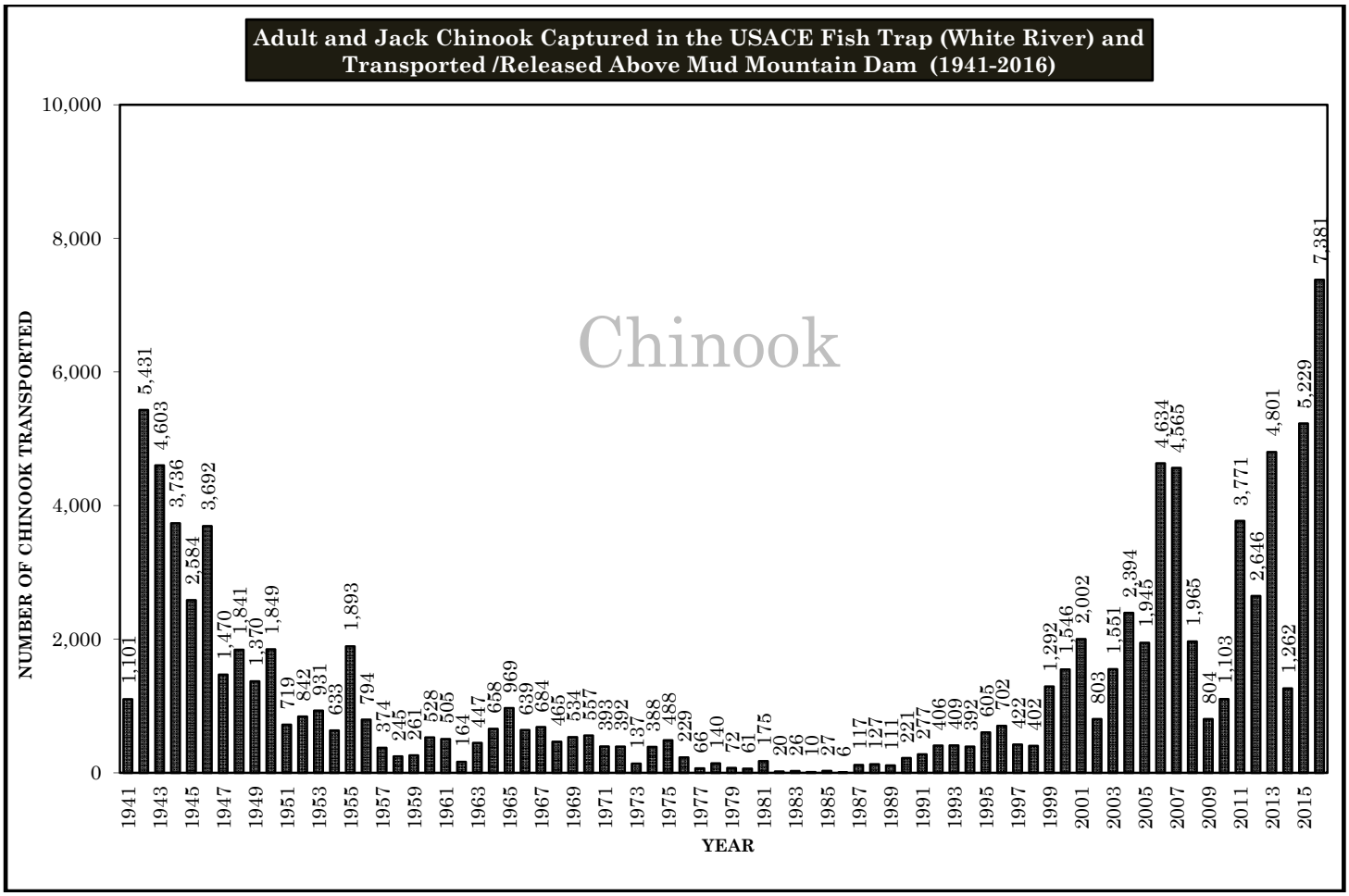
DNA blotting sheet

involves removing a small amount of the anal fin tissue and placing it on a DNA blotting sheet *(top center)* for later analysis. In addition to DNA and scale samples, bull trout are PIT tagged and transported above Mud Mountain Dam. Wild, and White River program steelhead are transported and release approximately 2 miles above Mud Mountain dam, while non White River *(adipose clipped)* steelhead are returned back to the White River below the USACE trap as per agreement with the Muckleshoot Indian Tribe and the State of Washington.

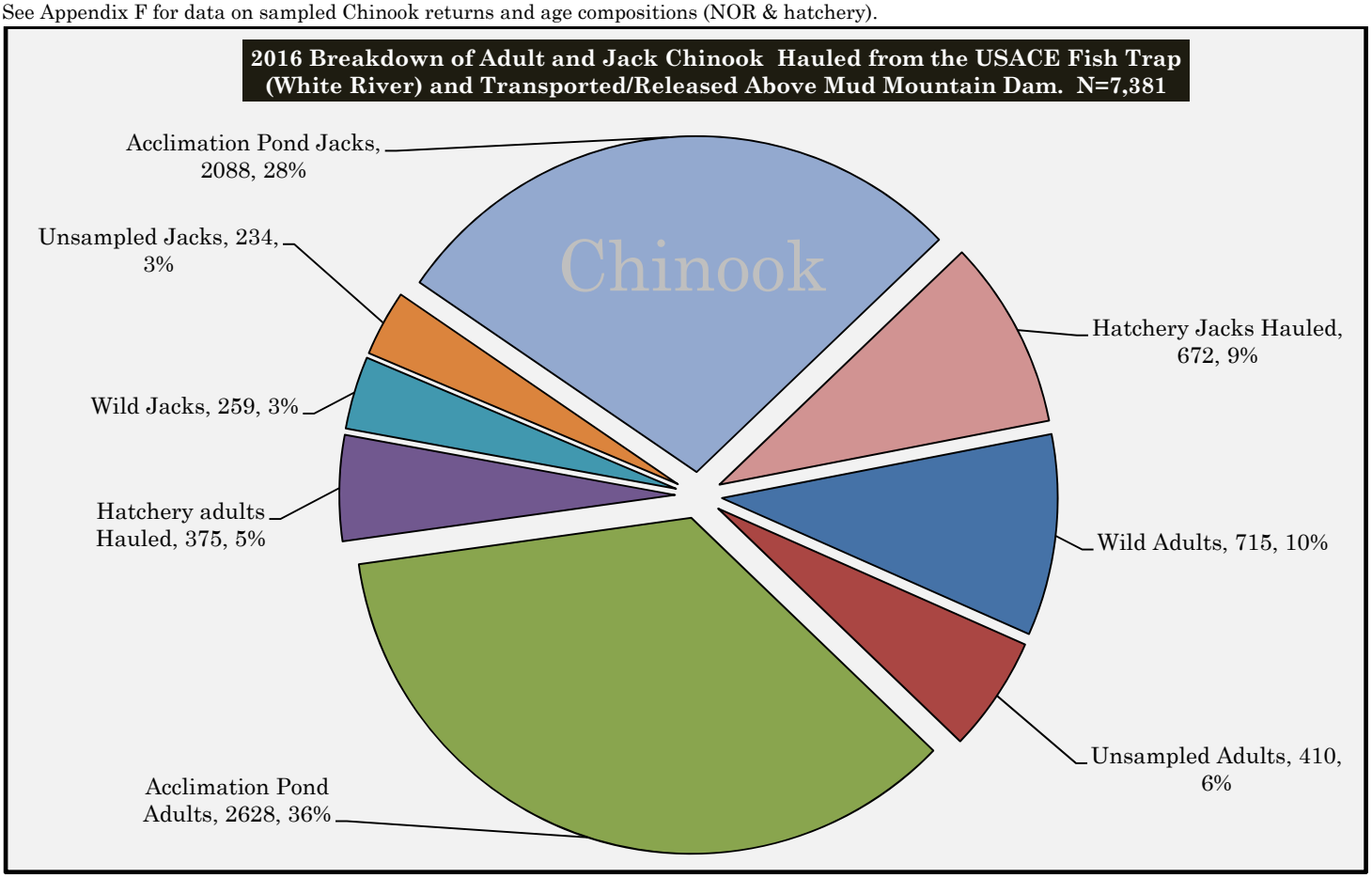
In 2006, the Puyallup Tribe, in partnership with WDFW and the Muckleshoot Tribe, began artificially propagating White River winter steelhead. Rearing young steelhead is an integral part of the White River winter steelhead project; the program is intended to increase winter steelhead escapement in the White River. Since January of 2009, the Puyallup Tribe has assumed the majority of responsibility for continuing this significant restoration/recovery effort. Steelhead brood-stock *(approximately 10 males and 10 females)* are collected from the White River USACE fish trap in Buckley and are currently held, spawned, incubated and reared at the Puyallup Tribe's Diru Creek hatchery for a year. Each fish is implanted with a blank wire tag *(same as a CWT- minus the binary code)* for later identification. After rearing for a year and fish are of size *(approximately 11-17 fish per pound)*; the pre-smolts are planted in one of the available acclimation ponds to acclimate before being released into the White River. The project goal is to release up-to 40,000+ steelhead pre-smolts annually. Currently, the project releases approximately 25K+ pre-smolts. This project has already seen some success; several marked *(blank wire tag)* steelhead have been captured and passed above Mud Mountain dam since 2009 *(see data in this section and appendix G)*. However, damage to the diversion dam structure in 2015 and 2016, allowed an undetermined number of steelhead to migrate upstream of the fish trap *(between the two dams)*. Dozens of steelhead were observed milling around the base of Mud Mountain Dam in 2015. In cooperation with the USACE, Puyallup Tribal biologist recovered 14 steelhead and released them upstream near the community of Greenwater.

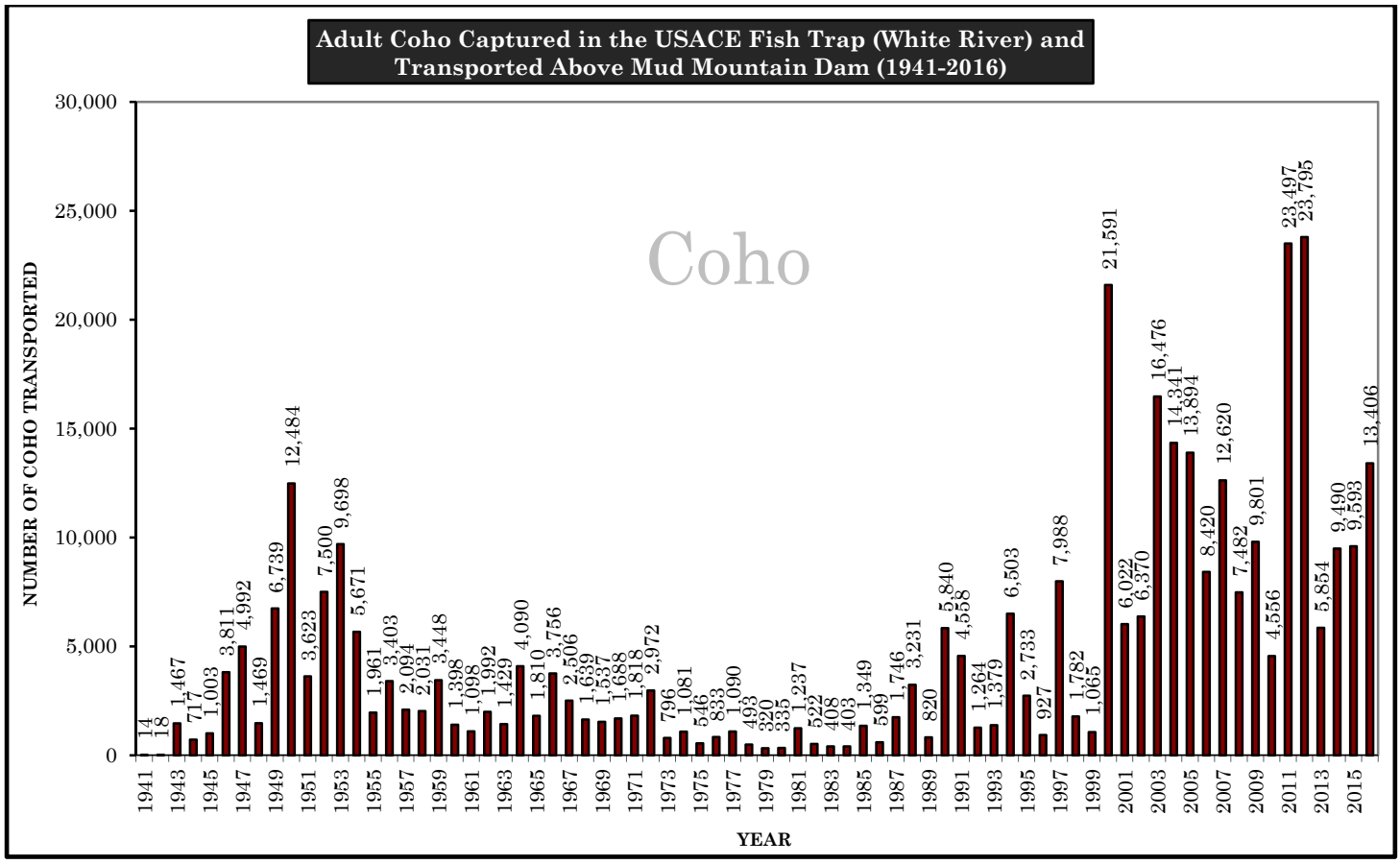
Common fish injury

Since the fall of 2003, substantial returns of pink salmon *(odd years)* have been transported above Mud Mountain Dam to spawn in the Upper White River, and the West Fork of the White. The Washington Department of Fish and Wildlife escapement data from 1959 to 2001 shows the number of adult pinks returning to the Puyallup/White River system ranged from 2,700-to-49,000. In 2009, over 540,000 pinks were transported above MMD by the USACE *(peak escapement year)*. Unfortunately, the sheer number of pink salmon attempting to reach the upper White River has at times, overtaxed the Corps' resources and capabilities. The current fish trapping and hauling operation is at times incapable of managing the magnitude of pinks returning to the White River. The current design is also responsible for causing numerous injuries to fish *(bottom center)*. Planning and engineering is 100% complete for a modern trap and haul facility. Current projections for the completion of the new facility is sometime in 2020-2021.

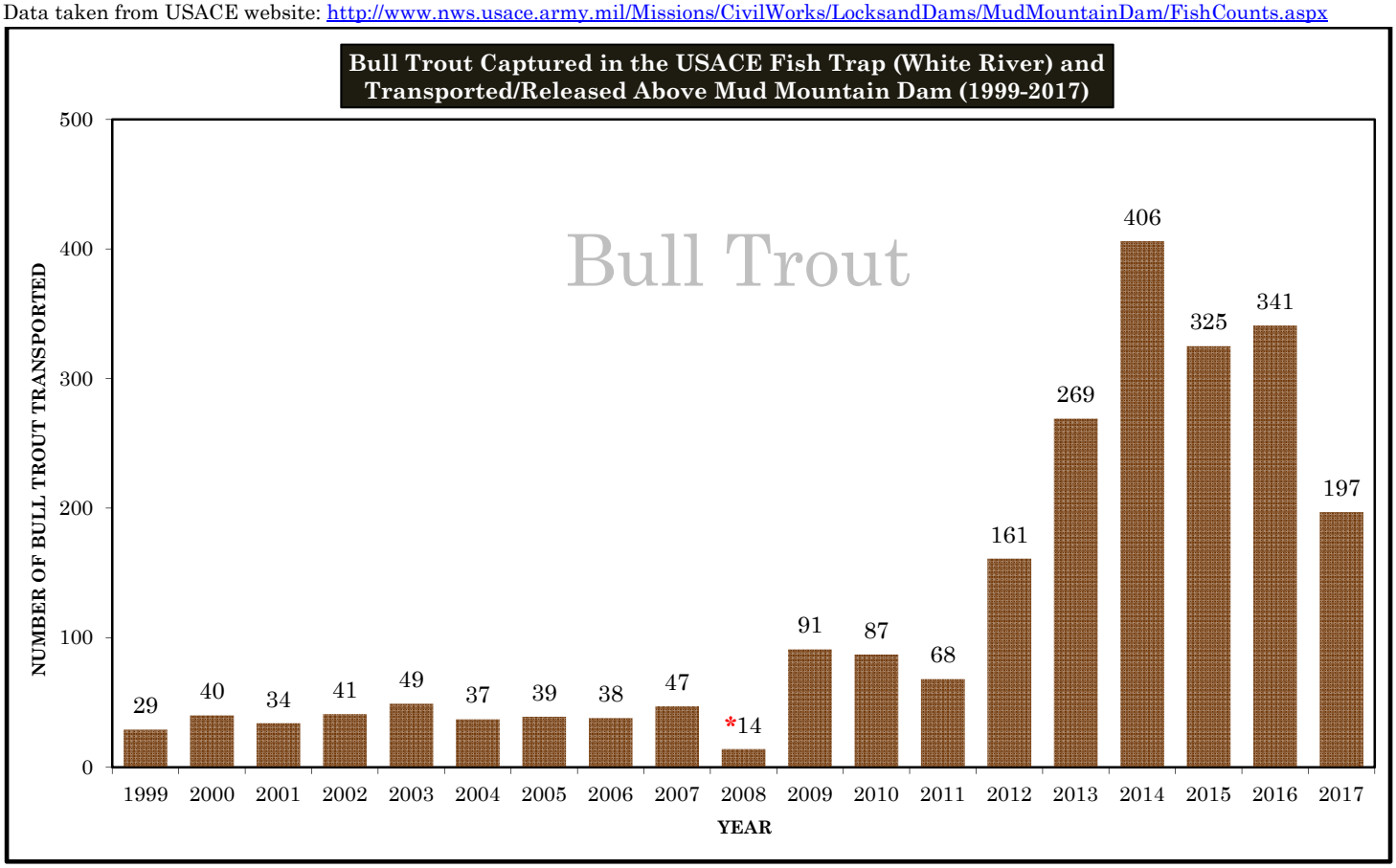


See Appendix F for data on sampled Chinook returns and age compositions (NOR & hatchery).

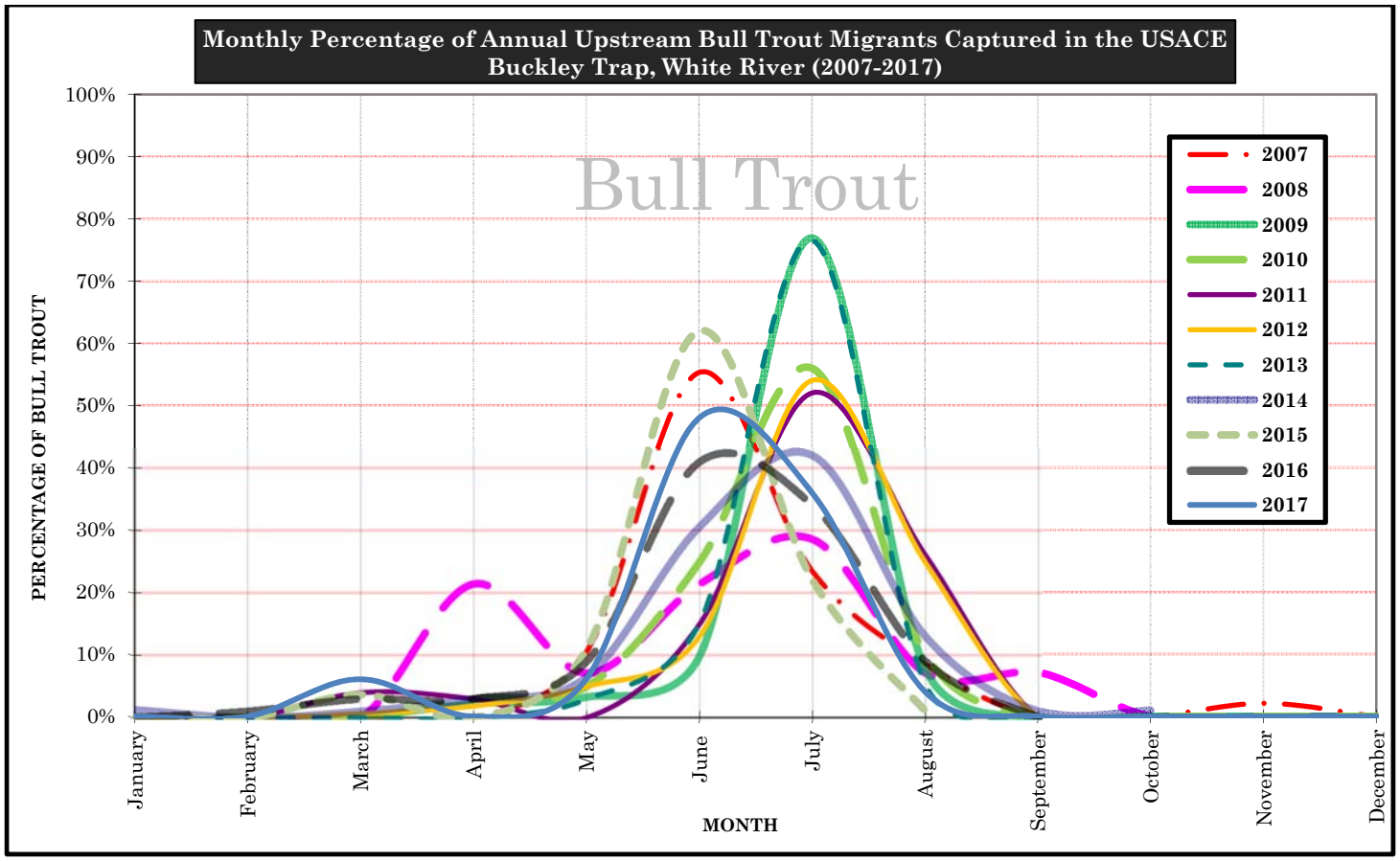


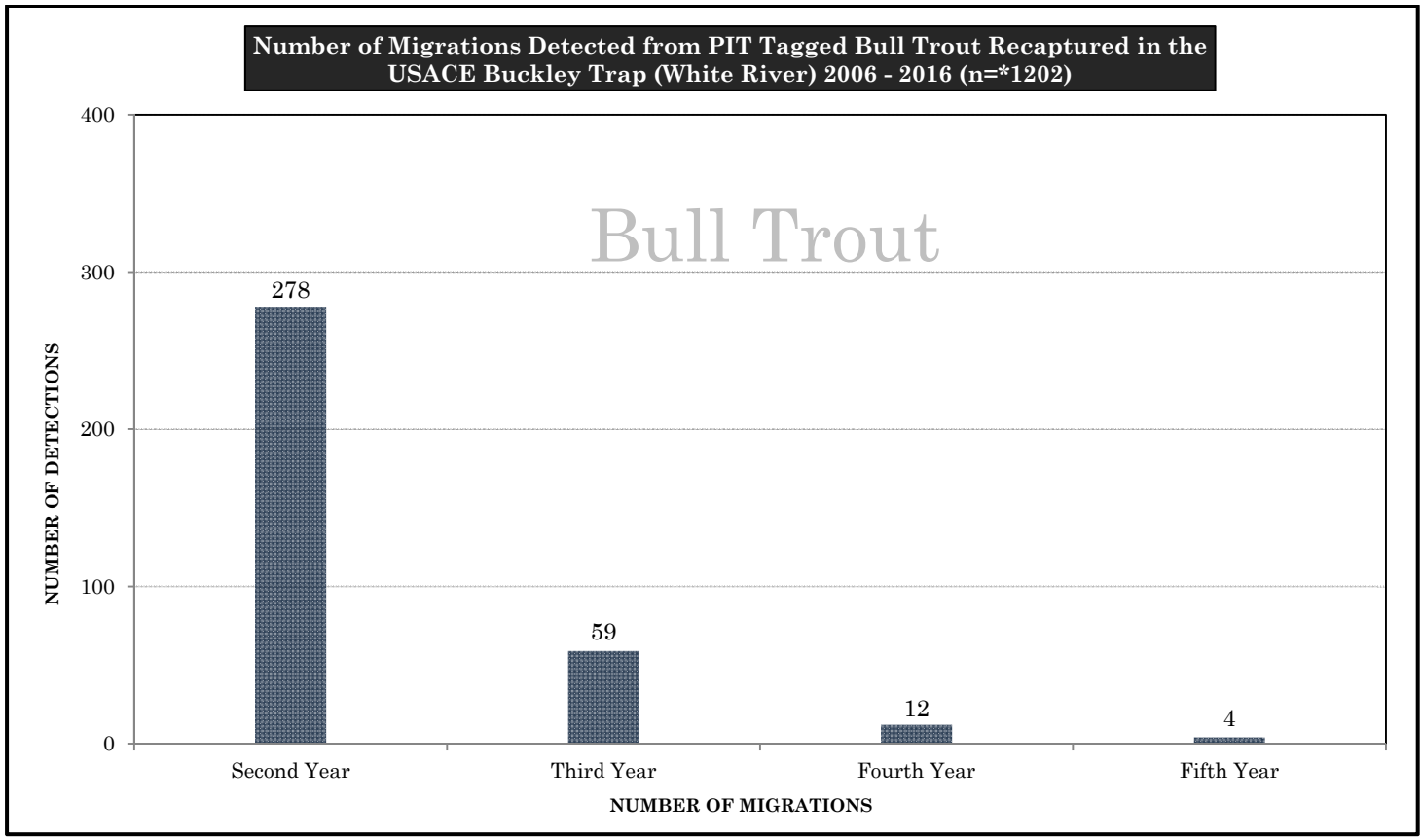


Data taken from USACE website: http://www.nws.usace.army.mil/Missions/CivilWorks/LocksandDams/MudMountainDam/FishCounts.aspx



2017 data indicates the number of bull trout transported through August 31st (See Appendix E for sampling data). *The low number of bull trout captured in 2008 is likely due to significant complications which occurred with trapping operations; thereby, preventing capture and/or generating migratory delays.

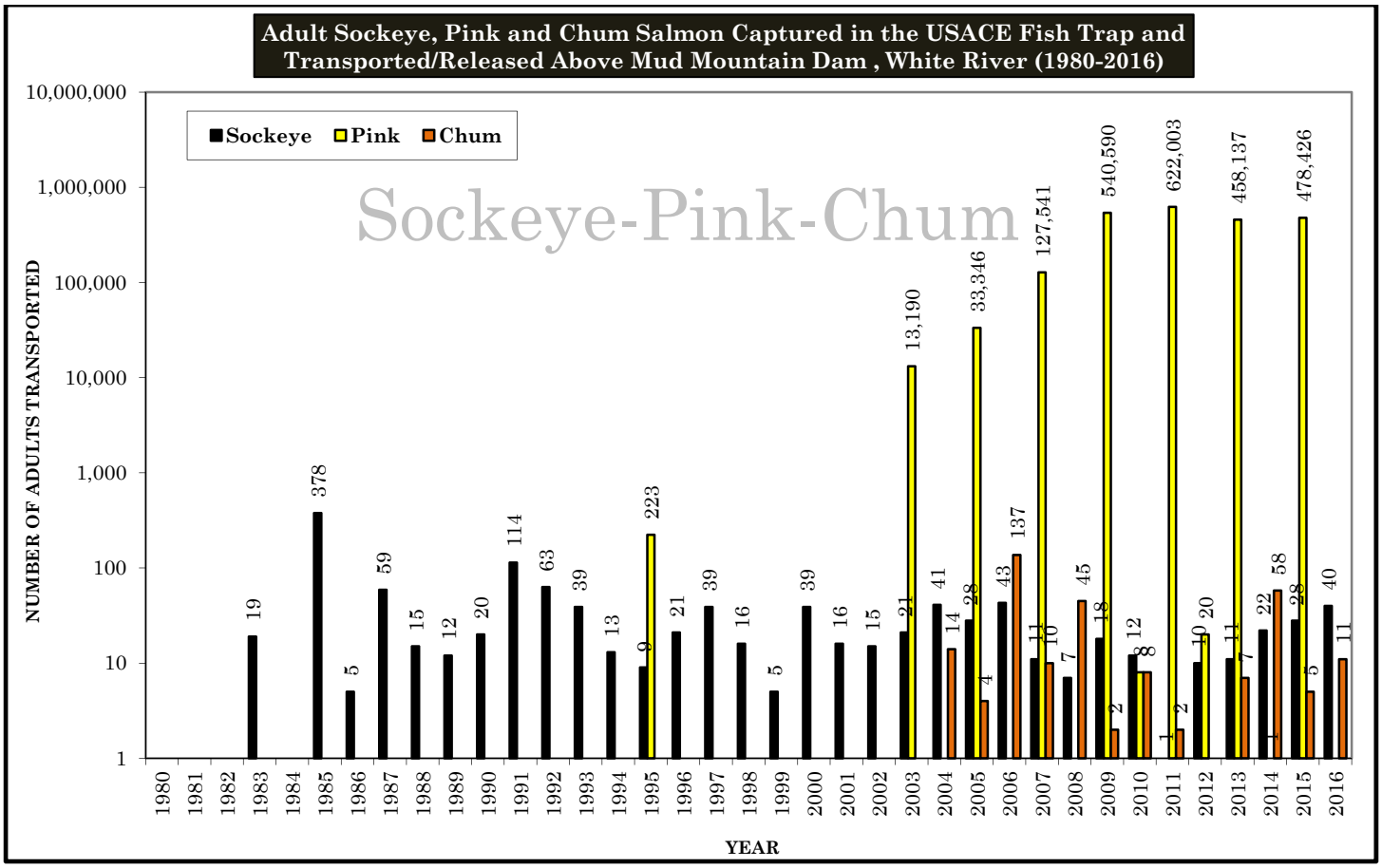




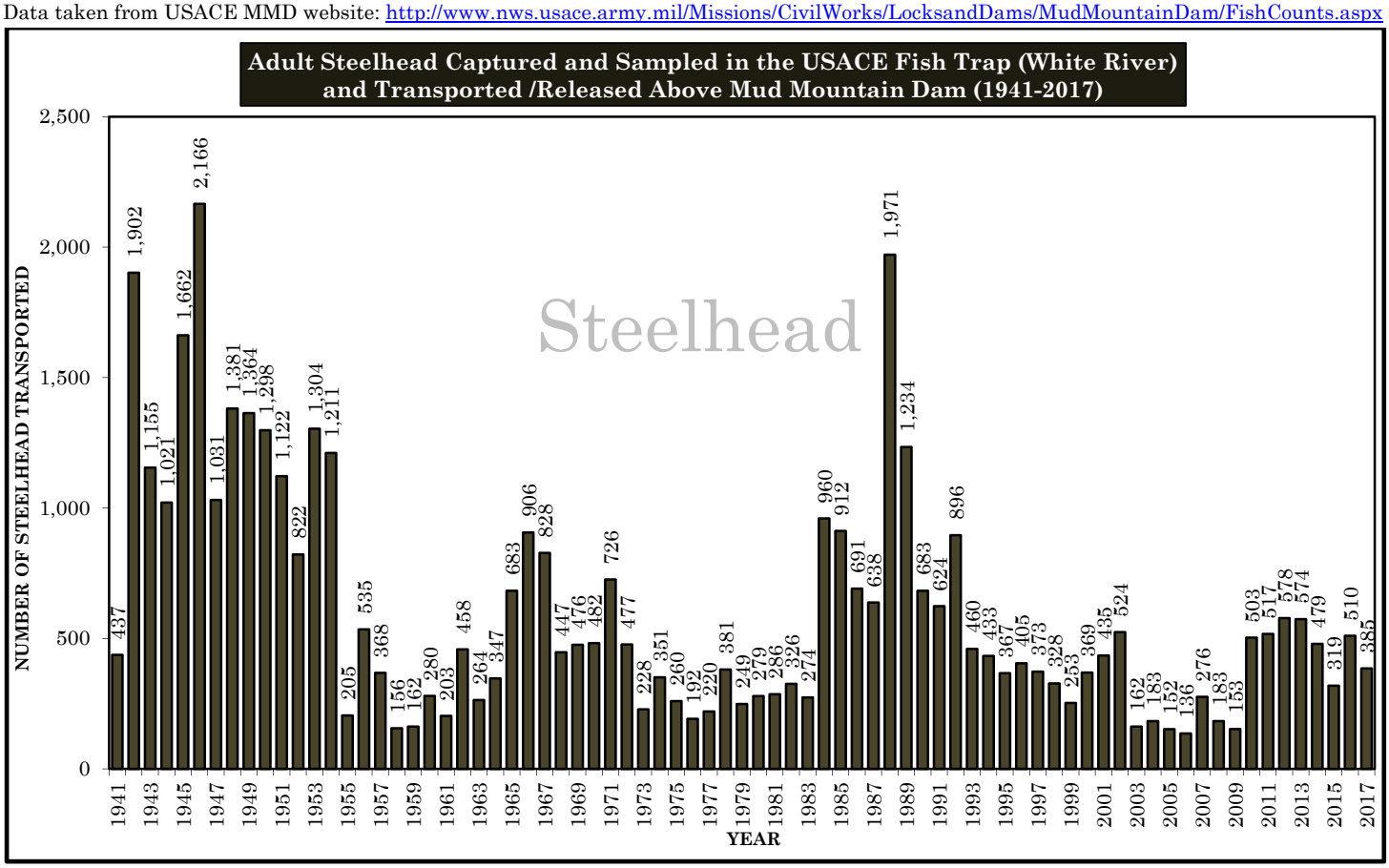
*1202 Total BT tagged from 2006-2016.

*For all Bull Trout Tagged/sampled, only 8 (0.66%) moved back to the trap and were hauled a second time in a single year

*For all Bull Trout Tagged/sampled, 36 (2.9%) were captured in numerous years with one year separation between detections



Data taken from USACE MMD website: http://www.nws.usace.army.mil/Missions/CivilWorks/LocksandDams/MudMountainDam/FishCounts.aspx



The graph above details the number of steelhead transported above Mud Mountain Dam. Additional steelhead captured in the trap since 2006 have been utilized as brood-stock for the White River steelhead supplementation project (see data in this section). See Appendix G&H for the breakdown/age of steelhead returns sampled.

Winter Steelhead Returns Sampled in USACE Fish Trap and Pre-Smolts Released, White River (2007-2017)

YEAR SAMPLED/ RELEASED	N=	WILD(NOR)	*FISH TAKEN FOR BROOD-STOCK PROGRAM	STEELHEAD WITH ‡BWT (PROGAM FISH)	PRE-SMOLTS RELEASED (BROOD YEAR) [RELEASE SITE]
2017	385	288	26	71	27,625 (2016) [Twentyeight Mile Cr. Acclimation Pond]
†**2016**	533	476	23	34	29,920 (2015) [Jensen Cr. Acclimation Pond]
†**2015**	319	273	26	20	31,219 (2014) [Jensen Cr. Acclimation Pond]
2014	479	392	23	64	49,998 (2013) [Huckleberry Cr. Acclimation Pond]
2013	574	338	28	208	27,990 (2012) [Muckleshoot Hatchery]
2012	345	345	24	209	31,129 (2011) [Muckleshoot Hatchery]
2011	539	164	22	353	27,876 (2010) [Muckleshoot Hatchery]
2010	523	204	20	299	25,650 (2009) [Muckleshoot Hatchery]
2009	165	116	19	30	31,900 (2008) [Muckleshoot Hatchery]
2008	207	177	24	6	56,378 (2007) [Muckleshoot Hatchery]
2007	303	276	27	0	25,631 (2006) [Muckleshoot Hatchery]

Steelhead sampling was conducted by Puyallup Tribal Fisheries. See Appendix H for additional steelhead sampling results.

See page #40 or Appendix D for current salmon and steelhead acclimation pond sites.

*During the spring of 2006, in response to the declining number of winter steelhead, the Puyallup and Muckleshoot Tribes; as well as the Washington Department of Fish and Wildlife, began a steelhead supplementation pilot project developed for the White River. The primary goal of this project is to restore the run to a strong self-sustaining population. The project is currently funded and managed by the Puyallup Tribe and utilizes captured wild brood stock from the USACE trap in Buckley to generate approximately 25K-35K+ yearling smolts.

†An undetermined number of adult steelhead ascended above the Buckley diversion dam due to missing panels.

‡ Blank Wire Tag (BWT): Small piece of wire implanted in the snout that is the same as a Coded Wire Tag (CWT) implant minus the binary code.

CAMP CREEK

WRIA 10.0112

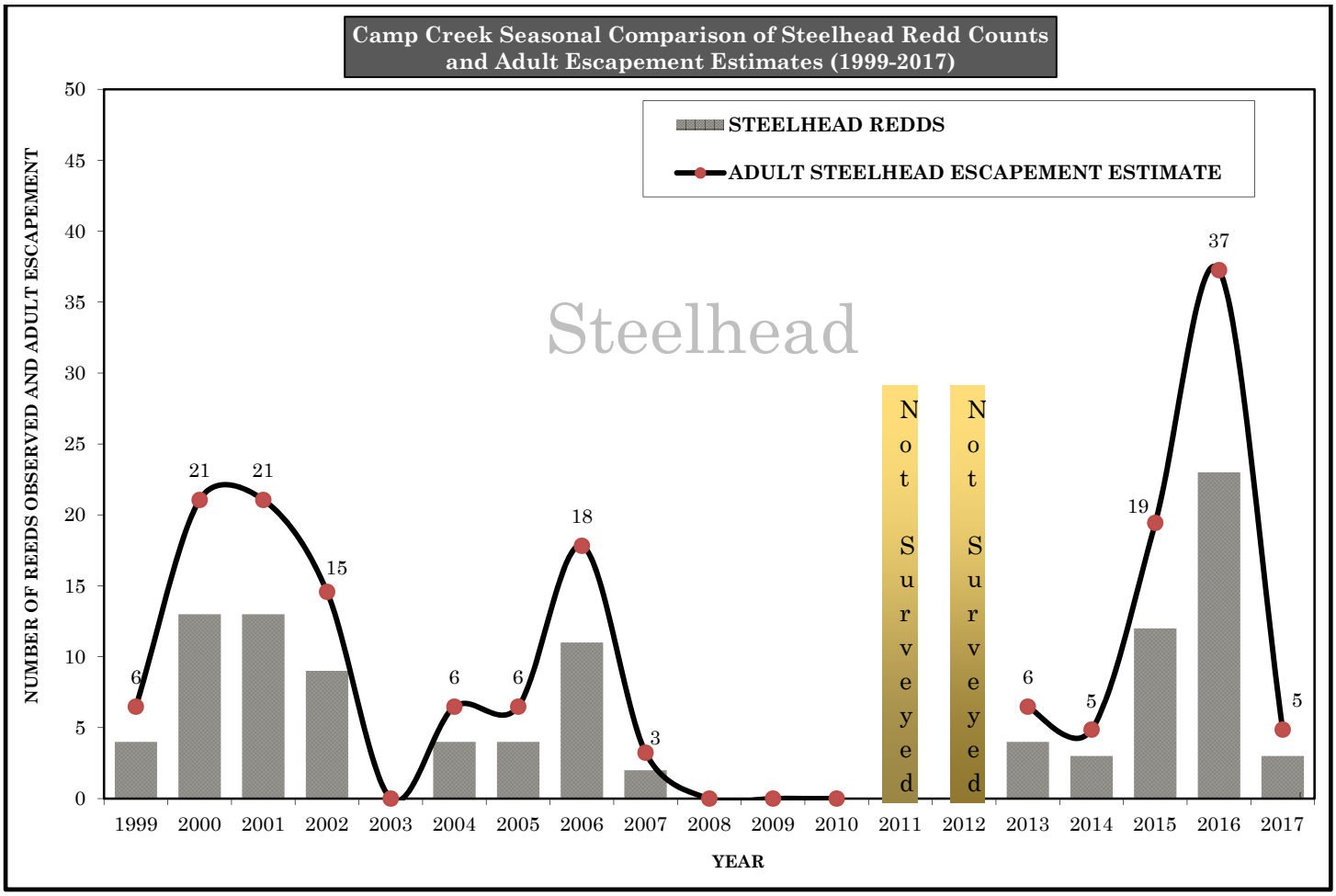
Camp Creek is a left bank tributary of the upper White River (RM 43.3), located near the community of Greenwater. Camp is approximately 3.6 miles in length; however, only the lower 0.75 miles is anadromous. The creek supports ESA listed Spring Chinook, steelhead and bull trout; as well as non-listed coho, pink and cutthroat, by providing foraging, spawning and overwintering habitat for all life stages. However, insufficient flows can prevent adult Chinook from accessing the creek in late summer and early fall. Therefore, the creek is surveyed essentially for adult steelhead spawning activity. All adult salmon and steelhead that spawn in the Upper White River and its tributaries are initially captured in the USACE fish trap in Buckley; then transported above Mud Mountain dam *(RM 29.6)*. Since precise escapement numbers for the Upper White River drainage are known, surveys are conducted to determine fish distribution and spawning success. This is especially important regarding Spring Chinook and steelhead, given that adult production monitoring is an essential part of recovery planning.

Lower Camp Creek

Typical of many upper river tributaries, the mouth of the creek frequently drifts due to its position within the open channel migration zone of the White River. As a result of mainstem river incursions, the creeks lower channel and riparian habitat are frequently altered. The habitat within this section is the least conducive to spawning due to a primarily sandy substrate. In addition, this reach of the creek is highly subjected to the possibility of redd scouring or heavy silt deposition due to the influences of the mainstem White River.

Nearly the entire anadromous reach of the creek *(approximately 0.75 miles)* is low gradient *(lower photos)*. Although spawning does occur within this anadromous reach *(depending on mainstem river influence),* it is limited due the quantity and quality spawning substrate created by the fine alluvial deposits *(sand & silt)* from the White River. In addition, adult salmon spawning has more consistent and frequent in this tributary compared to that observed in other upper river tributaries located along the White River such as Rocky Run Creek, located 1.2 miles upstream. Limited quantities of small and medium instream woody debris is present, as well as a beneficial riparian buffer zone of primarily alders and conifers along the majority of the creek. Upstream of the anadromous reach, the creek enters the more heavily forested lower slope of the valley floor as it begins to climbs up the valley wall. From this point, the creek assumes a pool-riffle-cascade configuration as it ascends the lower valley slope.

Lower Camp Creek



All adult steelhead that spawn in the Camp Creek were captured at the USACE fish trap in Buckley, and transported above Mud Mountain dam. Since precise escapement numbers for the Upper White River are known (Appendix G & H), surveys for steelhead are conducted for distribution, timing and spawning success. See steelhead redd location map in appendix B.

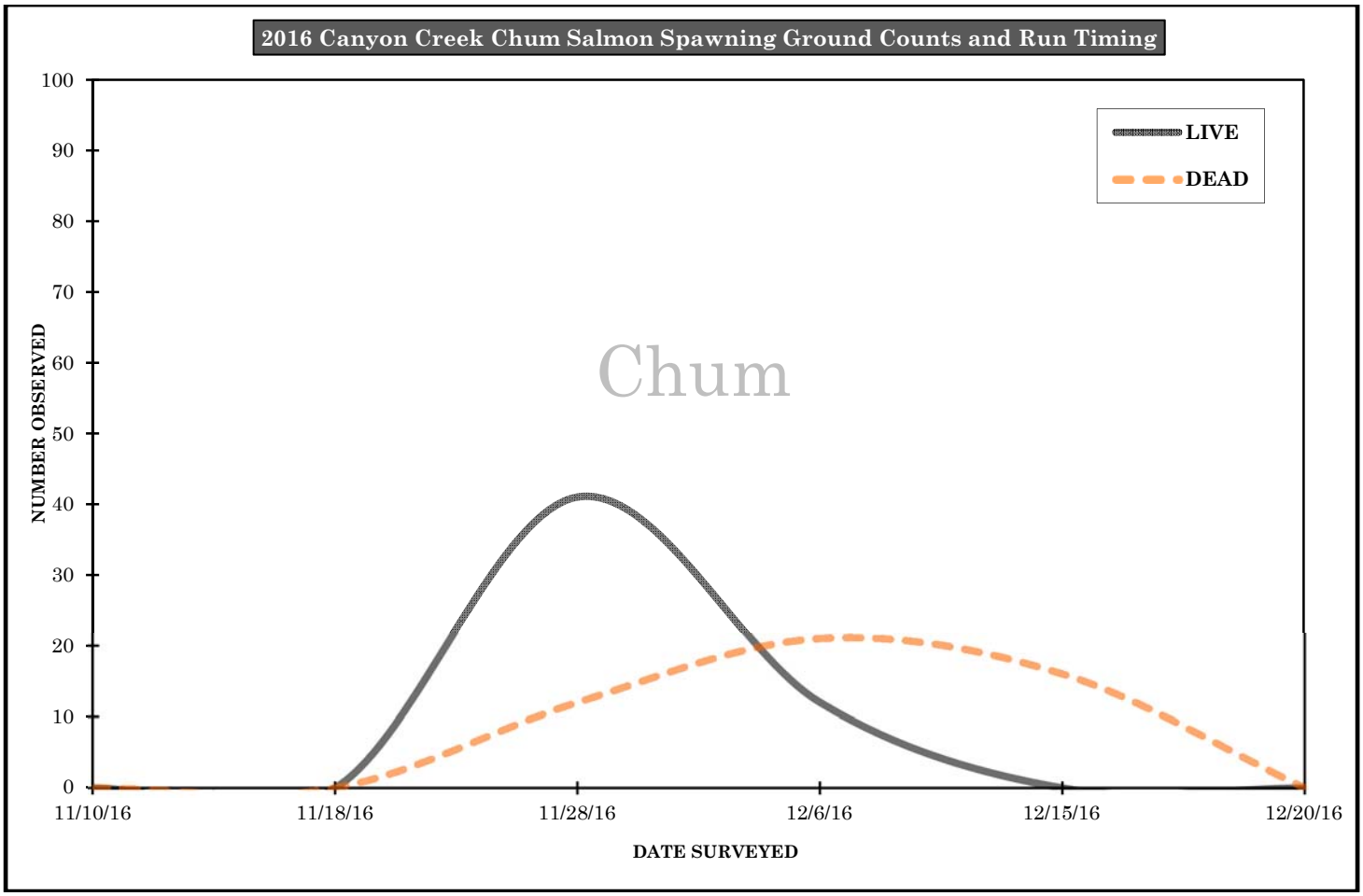
CANYON CREEK

Canyon Creek is a small tributary within the larger 12.1 mi² Clear Creek Basin *(10.0022)*. The Clear Creek Basin drains the plateaus and flatlands running along the southern valley of the lower Puyallup River, just west of the city of Puyallup. Canyon Creek doesn't appear on the hydrology of most common mapping systems. Furthermore, this stream is not listed in the WRIA catalog of streams for area 10, and has not been assigned a designated WRIA number. Canyon supports several species including: Chinook, coho, pink, chum, steelhead/rainbow, cutthroat and bull trout.

Little stream complexity exists within Canyon Creek, and seasonal flows are rarely adequate to allow access for adult Chinook or steelhead to spawn. However, adult Chinook have been observed in the creek and it's highly likely juveniles from adult spawners *(Chinook and/or coho)* in Clear and Swan creeks utilize Canyon Creek, especially for foraging and overwintering. There is often an abundance of chum fry during the spring, as well as coho fry throughout spring and summer for steelhead and cutthroat to forage on. Adult fluvial bull trout are also known to forage in the smaller tributaries of the lower Puyallup, including Canyon Creek.

Chum salmon have been the only species regularly observed spawning in Canyon, and can be seen spawning in the creek from late November through January. Unfortunately, chum escapement has dropped precipitously since 2011. Adult coho are periodically seen in the same reach as chum, but no surveys are conducted for coho by the Puyallup Tribe given their escapement numbers are extremely low. However, juvenile coho are often observed in this stream. Canyon lacks significant habitat complexity such as LWD, riparian, off channel habitat, or variation in stream channel type. The greater part of the lower reach of the creek consists of a flat low gradient channel with few hydraulic breaks. All species are able to ascend just upstream of the culvert running under Canyon Road. Cutthroat and bull trout are capable of ascending the steeper gradient beyond the culvert. Cutthroat *(bottom figure)* and sculpin are the predominant species present in the upper anadromous reach located below the culvert crossing adjacent to Miles quarry on Canyon Road.

Upstream of the culvert crossing under lower Canyon Road, the gradient increases and prevents weaker swimmers like chum from ascending further. In the past, the culvert itself did not appear to be an encumbrance to chum, since they were often observed spawning on the fine gravel within the culvert. The main channel above the culvert has been engineered with the placement of log weirs to retain gravel. They appear to be only moderately effective because the amount of fines in the entire reach is excessive. However, a problematic issue is the continuing bedload accumulations within the culvert and at the downstream opening causing the channel below to avulse when bedload builds. Downstream of Pioneer, the substrate consists of fine sand and extremely compacted small gravel. Storm and ground water runoff along the east side of Canyon Road flows down into Canyon Creek next to the downstream end of the culvert and can be excessive at times; enough so that at times fish have been drawn up the east side of the road only to get stranded when storm waters recede.


2016 Canyon Creek Chum Salmon Spawning Ground Counts and Run Timing
LIVE
DEAD
Chum
NUMBER OBSERVED
0
10
20
30
40
50
60
70
80
90
100
11/10/16
11/18/16
11/28/16
12/6/16
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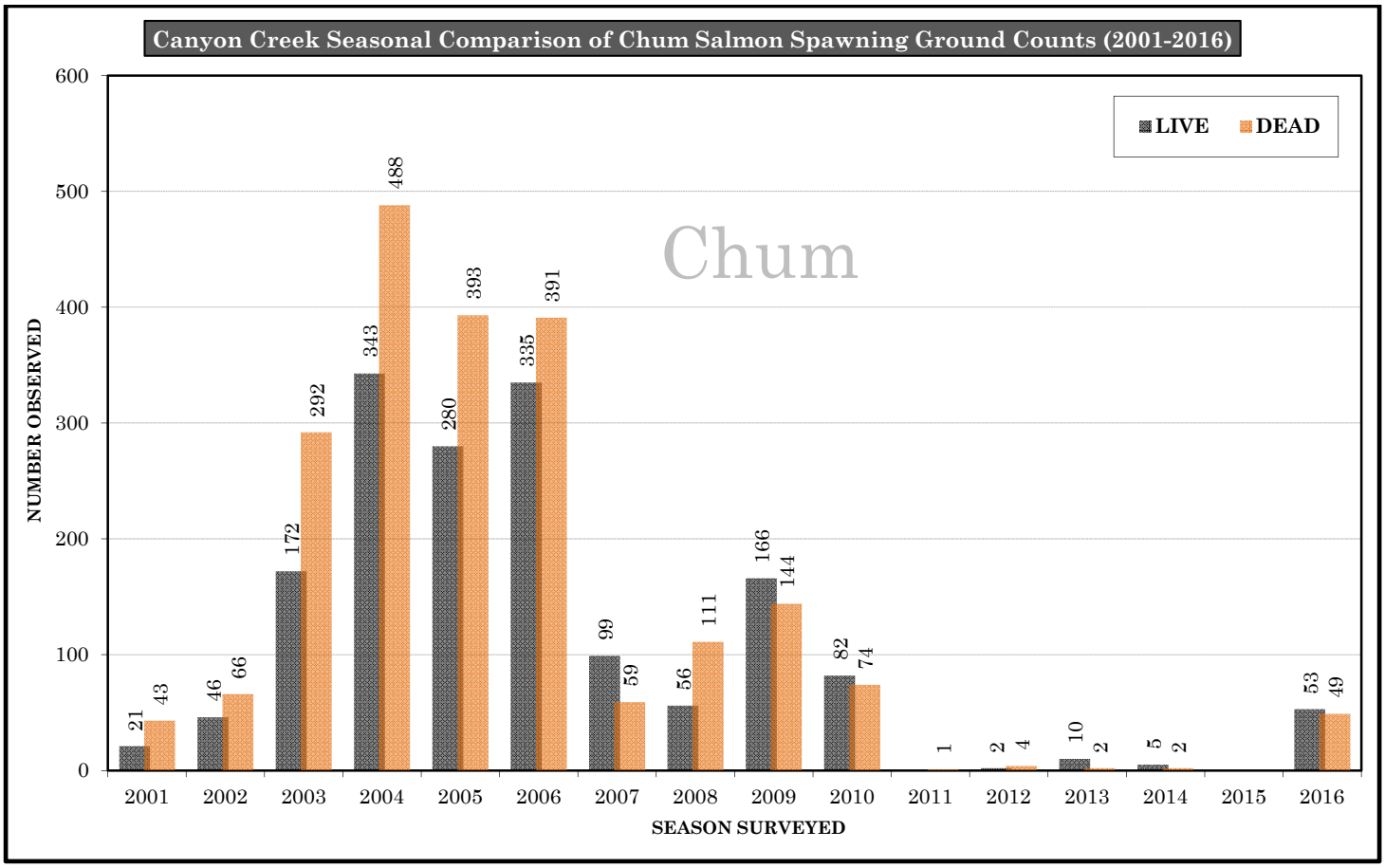
12/20/16
DATE SURVEYED


Canyon Creek Seasonal Comparison of Chum Salmon Spawning Ground Counts (2001-2016)
LIVE
DEAD
Chum
NUMBER OBSERVED
0
100
200
300
400
500
600
21
43
46
66
172
292
343
488
280
393
335
391
99
59
56
111
166
144
82
74
1
2
4
10
2
5
2
53
49
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
SEASON SURVEYED

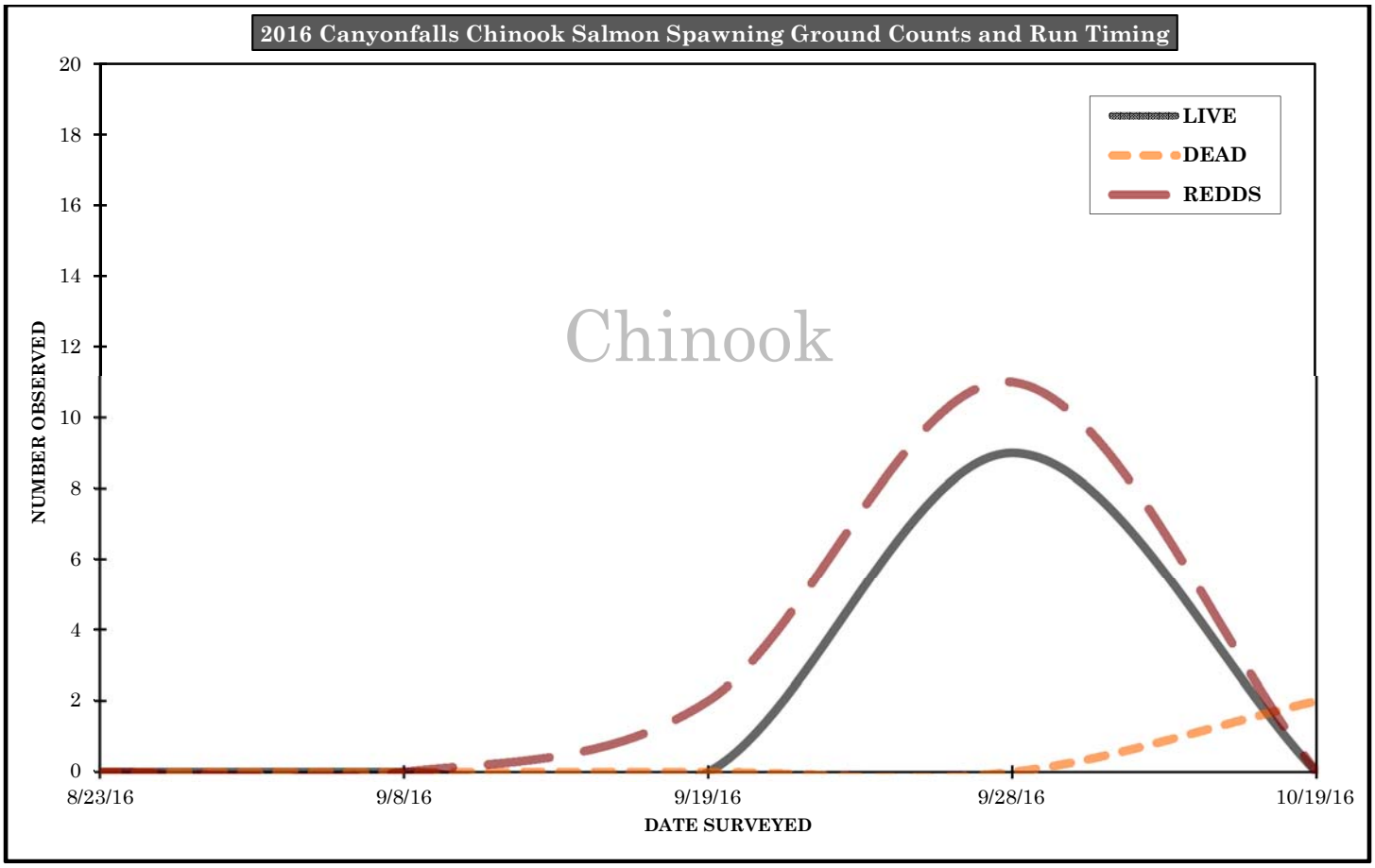
CANYONFALLS CREEK

WRIA 10.0410

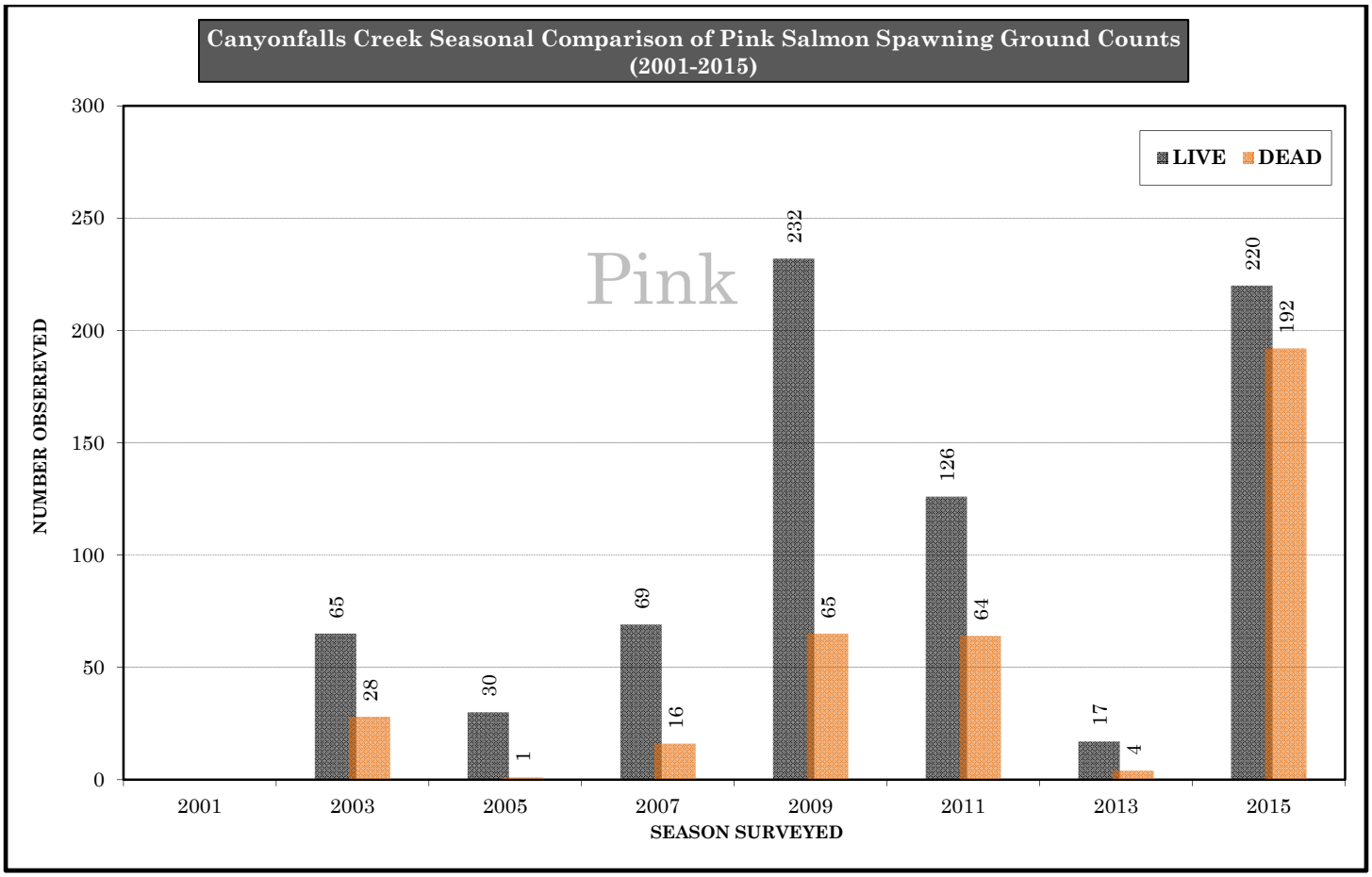
Canyonfalls Creek is a small tributary entering the Puyallup River at approximately RM 16.2, near the town of McMillin *(north of the city of Orting)*. Canyonfalls is primarily a spring fed stream that has relatively consistent instream flows, even in late summer. Although the stream length is three mile, nearly all spawning activity for species common to the creek takes place below the culvert under McCutcheon Rd. at RM 0.5. The gradient quickly increases above the culvert, but several pockets of usable spawning gravel exist just upstream of the culvert. In 2003, Pierce County replaced the culvert under McCutcheon Road with a larger cement box culvert. However, significant aggradation of bedload has created potential road flooding risks; as well as, upstream anadromous access to spawning habitat. This culvert is once again due for replacement in order to meet current hydraulic and fish passage needs.

Approximately 400 feet upstream of the culvert, the creek rapidly climbs nearly 300 feet in elevation to where it's discharged from a privately owned hatchery *(Trout Lodge)*. The creek is diverted to meet the needs of raising trout for planting in regional lakes. Above the hatchery the creek continues to climb through a forested area. As mentioned, the lower anadromous reach of the creek extends downstream of McCutcheon road; the substrate is a combination of sand and gravel within a low gradient pool-rifle channel. In the summer of 2002, 220 cubic yards of 1-to-3 inch spawning quality drain rock was deposited directly downstream of the McCutcheon road culvert, and distributed along an approximately 0.2 mile *(1,000')* stretch of the creek. The rock was deposited as a result of a settlement agreement between the Puyallup Tribe, and Fennel Resources, which has a gravel mining operation located on Fennel Creek. Nearly all spawning activity observed occurs within this short 0.2 mile stretch of the creek. Below this point the substrate consists primarily of fines, which is more typical for this stream type, but unfortunately is rarely suitable for spawning. The riparian is primarily alder and salmonberry. The width of the riparian zone along the right bank is limited due to the extremely close proximity of McCutcheon Rd. Canyonfalls creek also benefits from small amounts of woody debris inputs; as well as excellent coho habitat created by frequent beaver (*Castor canadensis*) activity. Although in 2004, a beaver dam below the survey reach prevented Chinook from accessing the spawning habitat farther upstream. Currently, beaver dams are notched in the fall to allow anadromous access.

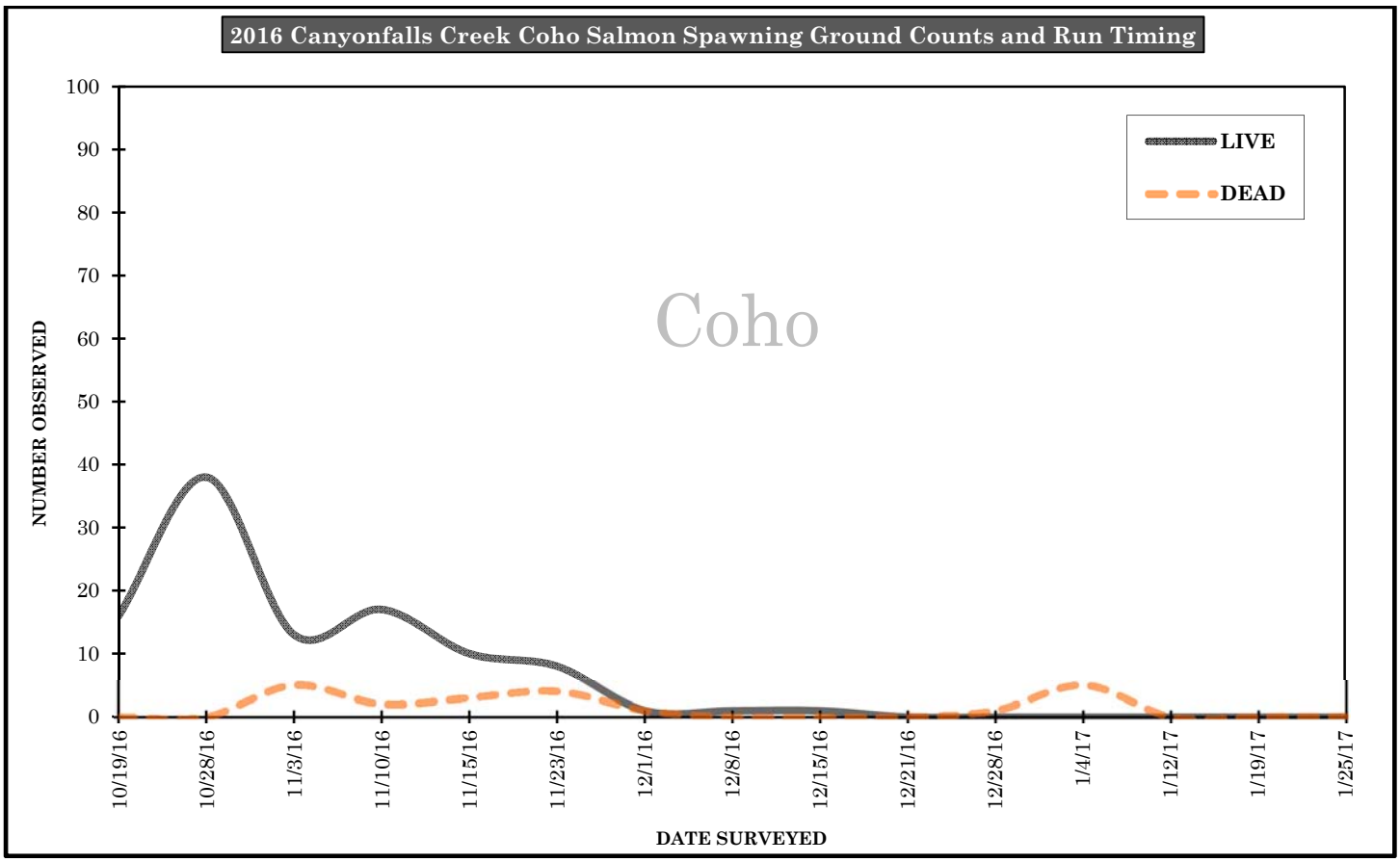
Chinook, coho and chum are the most prevalent species observed spawning in the creek. Coho juveniles and fry are present in the creek year round, and are often observed during adult spawning surveys. In addition to these key species, pink salmon have been observed consistently during odd years since 2003. Prior to 1998, steelhead were documented spawning in the creek on a regular annual basis. Unfortunately, similar to many lower watershed streams within the Puyallup and White Rivers, few live steelhead or signs of spawning activity have been observed over the past decade. Adult bull trout have been caught by sport anglers in the Puyallup River near the mouth of Canyonfalls; however, bull trout utilization within this spring fed drainage is unknown, but presumed. Canyonfalls does offer excellent foraging and overwintering opportunities for all species, including bull trout.



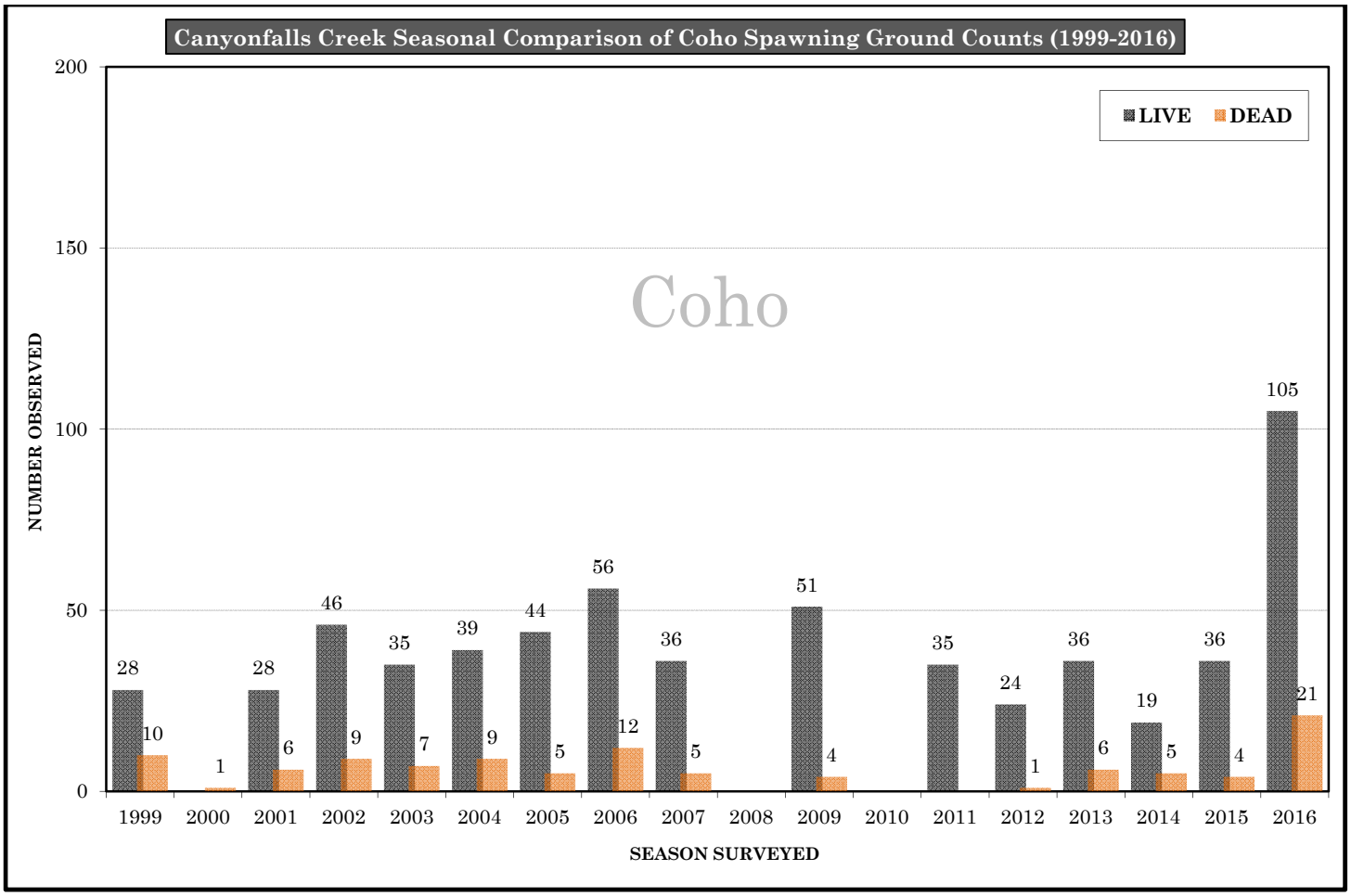
Adult Chinook escapement is determined by expanding the number of redds observed by 2.5 fish per redd (Smith and Castle, 1994). Due to the tremendous volume of pink salmon during odd years, the success of determining Chinook redds from pinks is vastly reduced. Therefore, The AUC method is used to determine escapement during pink runs (odd years).

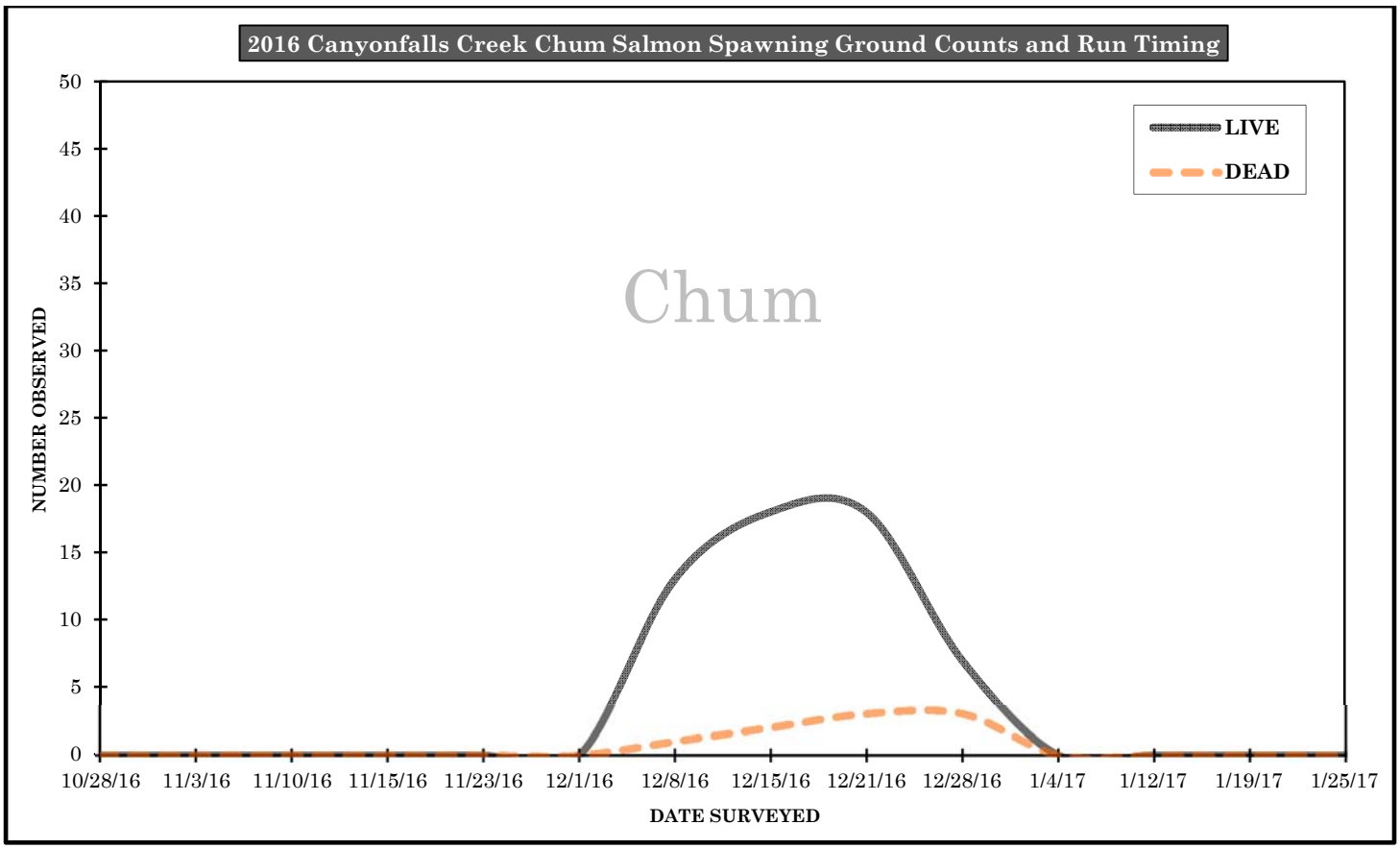


Canyonfalls Creek pink graphs generated using survey data collected by PTF and WDFW biologists.

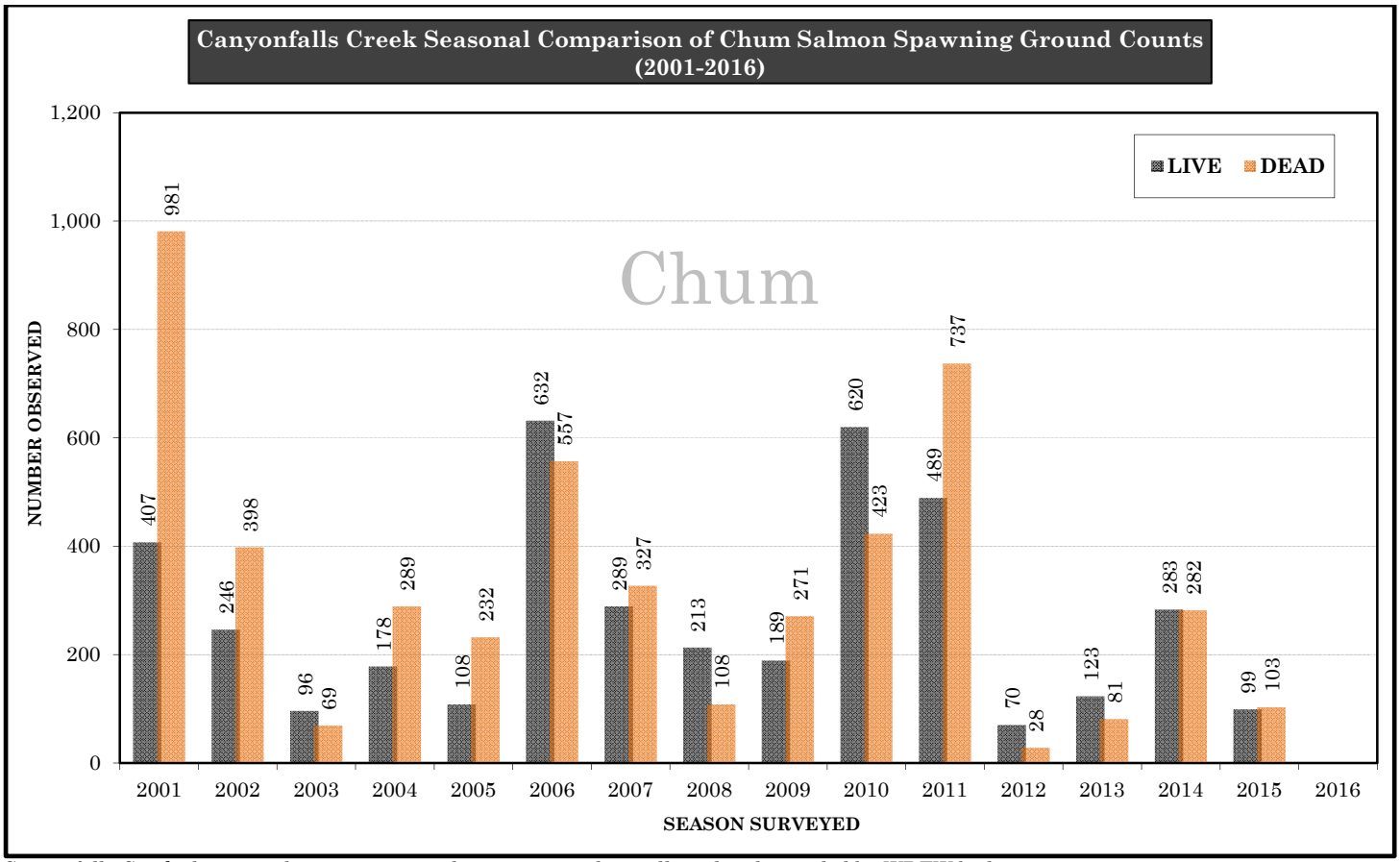


Canyonfalls Creek coho graphs were generated using survey data collected and provided by WDFW biologists.

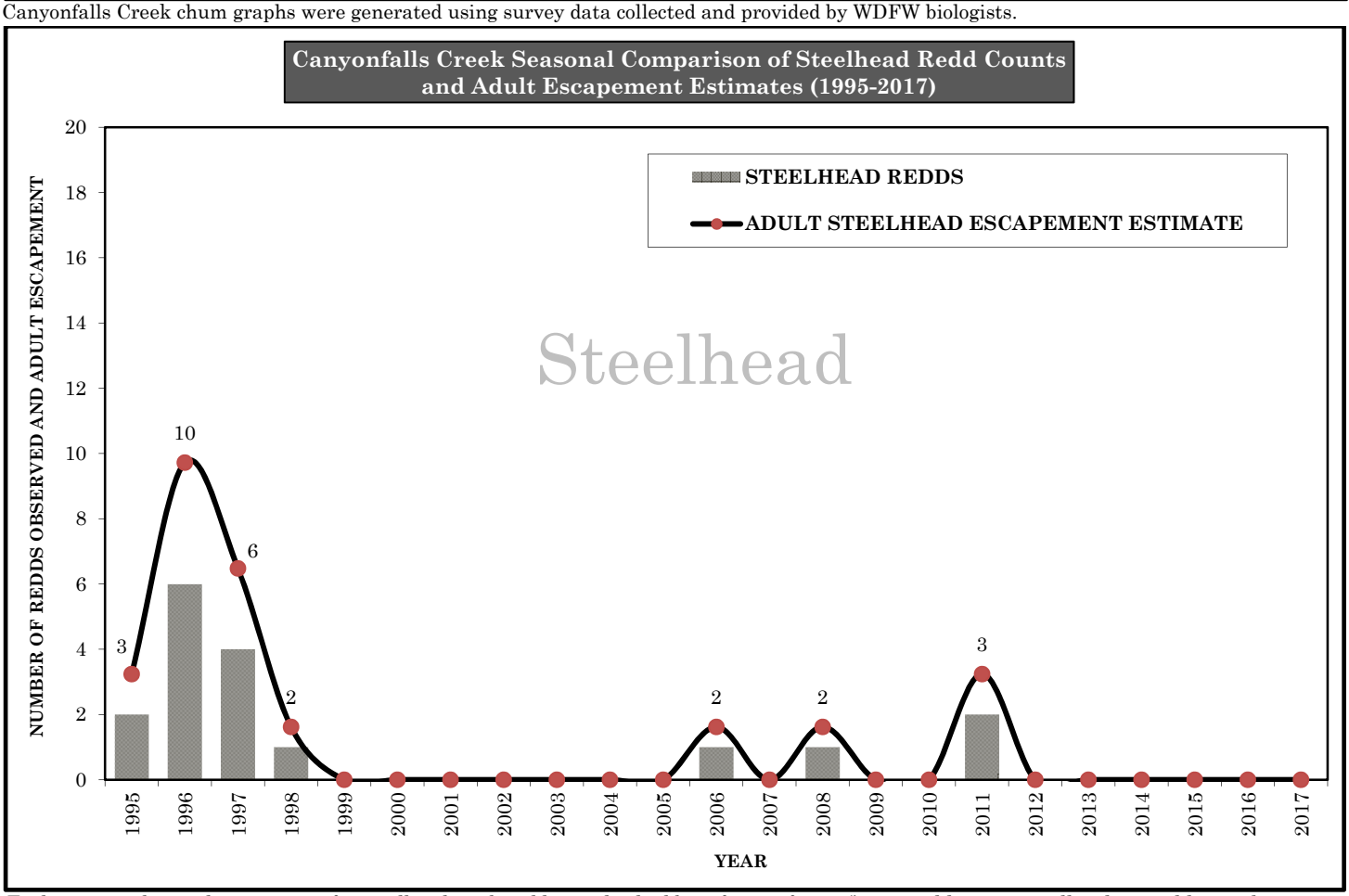




Canyonfalls Creek chum graphs were generated using survey data collected and provided by WDFW biologists.



Canyonfalls Creek chum graphs were generated using survey data collected and provided by WDFW biologists.



To determine the total escapement for steelhead, each redd is multiplied by a factor of 1.62 *(i.e. 42 redds x 1.62 steelhead per redd = total escapement of 68 steelhead).*

CARBON RIVER

WRIA 10.0413

Lower Carbon River

The Carbon River is a major tributary of the Puyallup River, entering the Puyallup at RM 17.9, just north of the city of Orting. The Carbon River and its associated tributaries provide excellent spawning and rearing opportunities for salmon, steelhead, and bull trout. In the past, steelhead have been documented as high as the Mt. Rainier National Park boundary. However, the majority of spawning for all species within this drainage, with the exception of bull trout, occurs in South Prairie Creek and the lower 11 miles of the mainstem Carbon River. *The availability and nature of fish and stream habitats are not static conditions and are frequently altered. The habitat descriptions in this report provide a general analysis of habitat conditions, and are not intended to fulfill the requirements of a rigorous biological assessment/evaluation.*

The lower 3 miles of the Carbon River are constrained by earthen levees. Failures along this levee system during the November 2006 flood event reinforces the need for levee set-backs, which would help address the need for improved fish habitat and increase flood capacity within this drainage. Currently, the lower river channel varies considerably in width *(up to 1000')*. The resulting channel is only moderately diverse with a pool riffle character. Spawning gravel exists in limited quantities and is utilized by all species of salmonids present, although not in the numbers observed in the upper reaches. From RM 3.0 to the mouth of South Prairie Creek at RM 6.0, the river is constrained by a levee along the south bank3. Large natural bluffs hold the Carbon along its northern bank allowing the river to migrate over a channel of up to 0.5 miles wide. This reach contains multiple channels and many woody debris jams throughout its length. The spawning and rearing habitat is more improved throughout this reach and the highest spawning densities of all species are observed along this stretch of the river.

The reach above South Prairie Creek, from RM 6.0 to 8.5, is again constrained by both levees and natural bluffs along the north bank *(left & bottom photos)*. This reach has a slightly higher gradient than the lower river and as a result contains less spawning habitat. There are portions that are utilized by Chinook and steelhead, but not in the densities observed in the reach above Voights Creek *(RM 4.0)*. Above RM 8.5, the Carbon River flows through a narrow canyon for several miles before becoming unconstrained downstream of the Mt. Rainier National Park boundary. This canyon reach supports Chinook and steelhead spawning, however, chum and pink salmon have not been observed above RM 8.

The Mt. Rainier National Park boundary is located at RM 23. From the park boundary, up to approximately RM 26, the gradient remains low

enough to provide some spawning opportunities along channel margins and pool tail-outs. Several small and moderate debris jams occur throughout this reach. Above this, the gradient gradually increases to the terminus of the Carbon glacier. There is less channel braiding in this section and the substrate is considerably larger providing far fewer spawning opportunities.

Several tributaries of the Carbon River providing critical habitat for fish include South Prairie Creek, Voights Creek, Ranger and Ipsut creeks.

South Prairie Creek is a major tributary of the Carbon River, entering the Carbon near RM 6, just downstream of the Highway 162 and the Foothills Trail bridge crossings. With a drainage area over 90 mi^2, South Prairie Creek is considered one of the most productive drainages in the Puyallup/White River Watershed. The headwaters originate along the northwest foothills of Mt. Rainier within the Mt. Baker-Snoqualmie National Forest. The mainstem creek flows for over 21.5 miles; coursing its way through or near the communities of Wilkeson, Burnett, and South Prairie. The creek offers critical spawning and rearing habitat for adult and juvenile salmonids including; Chinook, pink, coho, chum and steelhead. Bull trout have been documented in the creek, but distribution and utilization is unknown. Limiting factors associated with South Prairie include; low summer flows, channel confinement and narrowing, bank erosion, disconnected floodplain, water quality *(303 (d) listed for temperature)*, areas of deficient riparian cover, and invasive non-native plant species.

Upper Carbon River @ RM 23

The anadromous range extends roughly the first 15 miles of the mainstem; a series of impassable falls near RM 15.4 prevents any further upstream migration. Tributaries including Wilkeson, Spiketon, Beaver, plus several unnamed tributaries, add miles of additional spawning and rearing habitat, as well as flow contributions.

From the mouth, upstream to RM 12.6, the stream is typically a low to moderate gradient pool-riffle channel with many deep pools and a few short low gradient cascades. The lower 8 miles flows within a broad valley floor and spawning opportunities for all species is abundant throughout. Land use along this section is mainly agricultural and recreational. Chinook spawning occurs primarily within the lower 8 miles, while coho show increased usage throughout the middle and upper reaches of the 15 mile anadromous section of the creek. South Prairie experiences a unique late-run of coho, which often spawn into late February and early March. Chum regularly utilize the lower 3 miles heavily but are frequently observed well above RM 10. Steelhead utilize areas along the entire stream below the barrier falls; however, usage is reduced in the canyon reach below the falls. The valley walls narrow significantly above RM 8; at this point the creek channel becomes more confined and the gradient increases. Spawning and rearing opportunities are still prevalent here, as is the increase in LWD and LWD inputs from the surrounding forest.

From RM 12.6 to the falls at RM 15.4, the channel gradient increases substantially and the creek channel becomes moderately to extremely confined within a steep canyon. Spawning and rearing opportunities are severely reduced or non-existent. Spawning gravel is scarce in this upper reach and many heavily scoured bedrock sections exist.

Steelhead redd survey on the Carbon River

The riparian zone changes dramatically over the 15.4 miles of anadromous stream. The upper canyon reach flows through a commercial forest and streamside vegetation consists of second growth fir and alder. Buffer widths along recent harvest areas are generally wider than the state regulated minimum due to steep, potentially unstable slopes along the canyon. From RM 12.6 to RM 6.0 the riparian zone is relatively intact, consisting of mature hardwoods with some fir. Below this point, to the confluence, significant portions of the banks are armored and streamside residential development is common. Much of the lower 6 miles flows through active agricultural land where alder and cottonwood are the most common streamside tree species.

Winter steelhead stocks have experienced declines for the better part of the past twenty years. Tribal and state fisheries managers are currently working on a recovery plan to improve future steelhead returns and hope to implement this plan within the next few years. Continuing efforts are being made by the Puyallup Tribe fisheries staff to increase the survey coverage along the Carbon River through increased rafting and helicopter surveys from the NPS boundary at RM 23, to its confluence with the Puyallup River.

Voights Creek is a tributary to the lower Carbon River, entering the Carbon at RM 4.0. Voights is currently only surveyed for steelhead due to the presence of a state salmon hatchery at RM 0.5. There are just less than 4 miles of anadromous habitat available in Voights Creek, an impassable falls at RM 3.9 blocks any further upstream migration. Steelhead are often observed spawning throughout the entire creek, right up to the falls. Unfortunately, steelhead escapement in Voights Creek has fallen dramatically over the past few years. During higher autumn flows, coho, and occasionally Chinook, easily bypass the hatchery and spawn throughout the entire creek up to the falls. The stream channel varies in complexity from wide, braided channels, to confined narrow gorges. Nearly the entire 3.9 miles below the falls contains excellent, although somewhat sporadic patches of gravel within a moderate gradient stream channel. However, below the water intake for the state hatchery at RM 1.0 the gradient decreases, the substrate size is more consistent although smaller and somewhat compacted. The riparian zone is a mix of 2nd growth conifer and deciduous trees. There is a moderate amount of small and medium woody debris recruited, and minute amounts of LWD present, what little is present is generally quite old.

Ranger Creek is a left bank tributary to the upper Carbon River; entering at RM 28.3. Typical of many headwater tributaries, Ipsut Creek is non-glacial and is characterized by confined steep valley channels with a comparatively short, low-to-moderate gradient anadromous reach. This mountain stream flows for just over 2.8 miles through a steep glacial valley originating near Castle Peak along the Alki Crest. Ipsut flows entirely within Mt. Rainier National Park. Headwater sources are derived from snowpack accumulations; as well as other surrounding surface and groundwater sources including Doe Creek *(right bank- RM 1.2)* and an unnamed tributary *(right bank- RM 0.8)*. Neither tributary is accessible by fish. The creek continues to drop precipitously from through much of its length until it reaches the lower channel migration zone of the Carbon River, at which point the creek channel is reduced to a low-moderate gradient pool-riffle channel capable of supporting salmonids.

Past surveys have verified bull trout utilization within Ipsut; furthermore, the creeks 2300' elevation makes it one of the lowest elevation streams known to support bull trout spawning and is quite capable of supporting Chinook, coho, pink and steelhead as well. Other species including cutthroat, non-native brook trout and sculpins are known to inhabit the creek. However, salmonid migration upstream to reach headwater tributaries in the upper Carbon Basin, including Ipsut, is assumed to be extremely limited due to substantial cascades present throughout the roughly 5 mile long Carbon River Gorge. The Puyallup Tribe conducted salmon, steelhead and bull trout spawning surveys during 2000 and 2001; yet, no salmon or steelhead were observed. However, surveyors did observe several bull trout redds. Despite access issues, the National Park Service has been able to conducted bull trout surveys most years since 2002.

The riparian zone along Ipsut consists primarily of old growth cedar, fir and hemlock which contributes greatly to the large woody debris in the stream; as well as diversity to the channel habitat. Unfortunately, spawning opportunities are limited due to the size and makeup of the substrate material; much of which consists of flat and angular stones not conducive to movement, especially by smaller fish such as bull trout. However, small patches of suitable gravel do exist. The lower anadromous reach of the creek is also subject to, and has frequently experienced disturbances caused by Carbon River flood events. These intrusions often deposit significant amounts of fine material and woody debris. An impassable falls at approximately RM 0.7 prevents any further upstream migration.

Ipsut Creek is a left bank tributary to the upper Carbon River; entering at RM 28.3. Typical of many headwater tributaries, Ipsut Creek is non-glacial and is characterized by confined steep valley channels with a comparatively short, low-to-moderate gradient anadromous reach. This mountain stream flows for just over 2.8 miles through a steep glacial valley originating near Castle Peak along the Alki Crest. Ipsut flows entirely within Mt. Rainier National Park. Headwater sources are derived from snowpack accumulations; as well as other surrounding surface and groundwater sources including Doe Creek *(right bank- RM 1.2)* and an unnamed tributary *(right bank- RM 0.8)*. Neither tributary is accessible by fish. The creek continues to drop precipitously from through much of its length until it reaches the lower channel migration zone of the Carbon River, at which point the creek channel is reduced to a low-moderate gradient pool-riffle channel capable of supporting salmonids.

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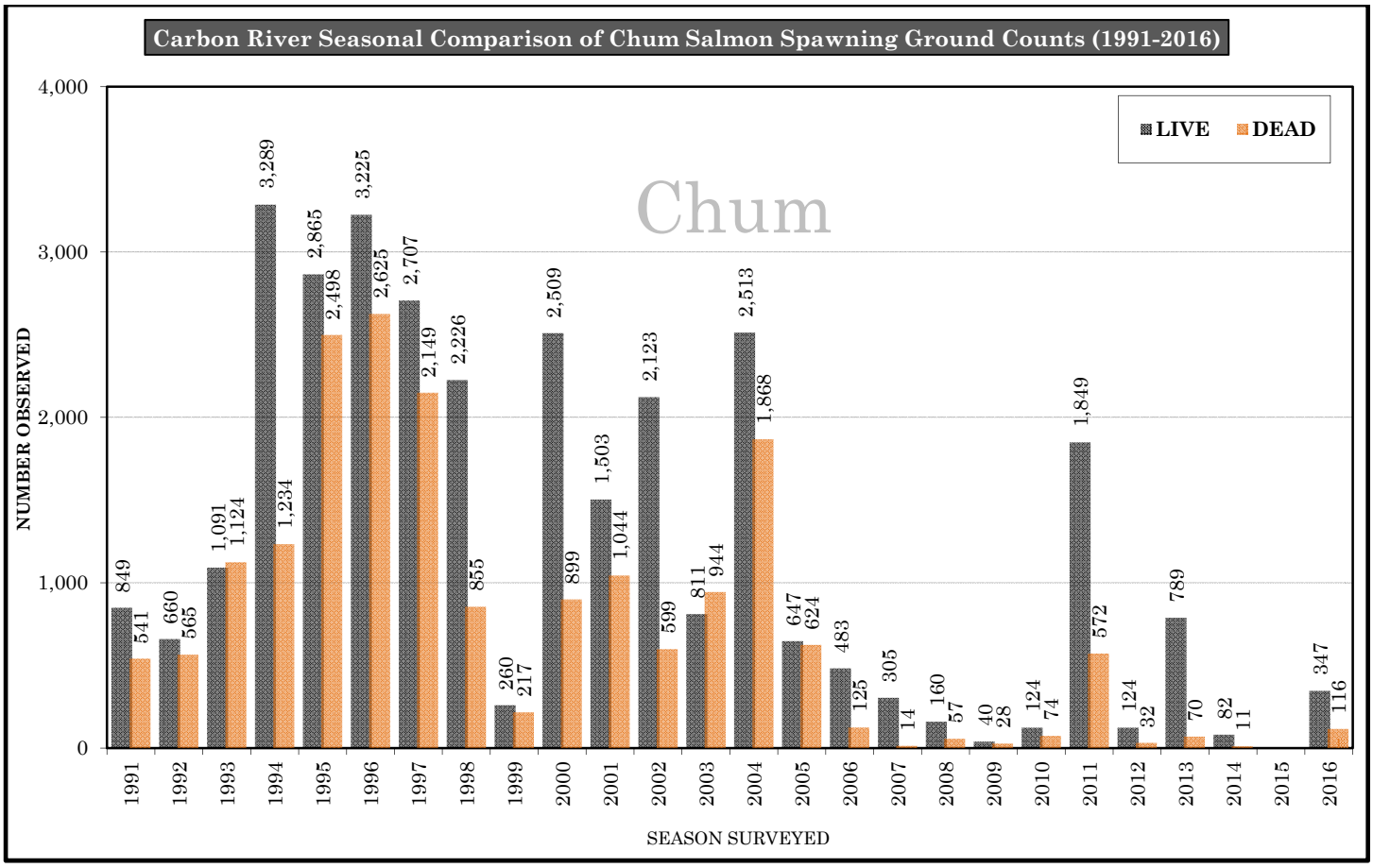
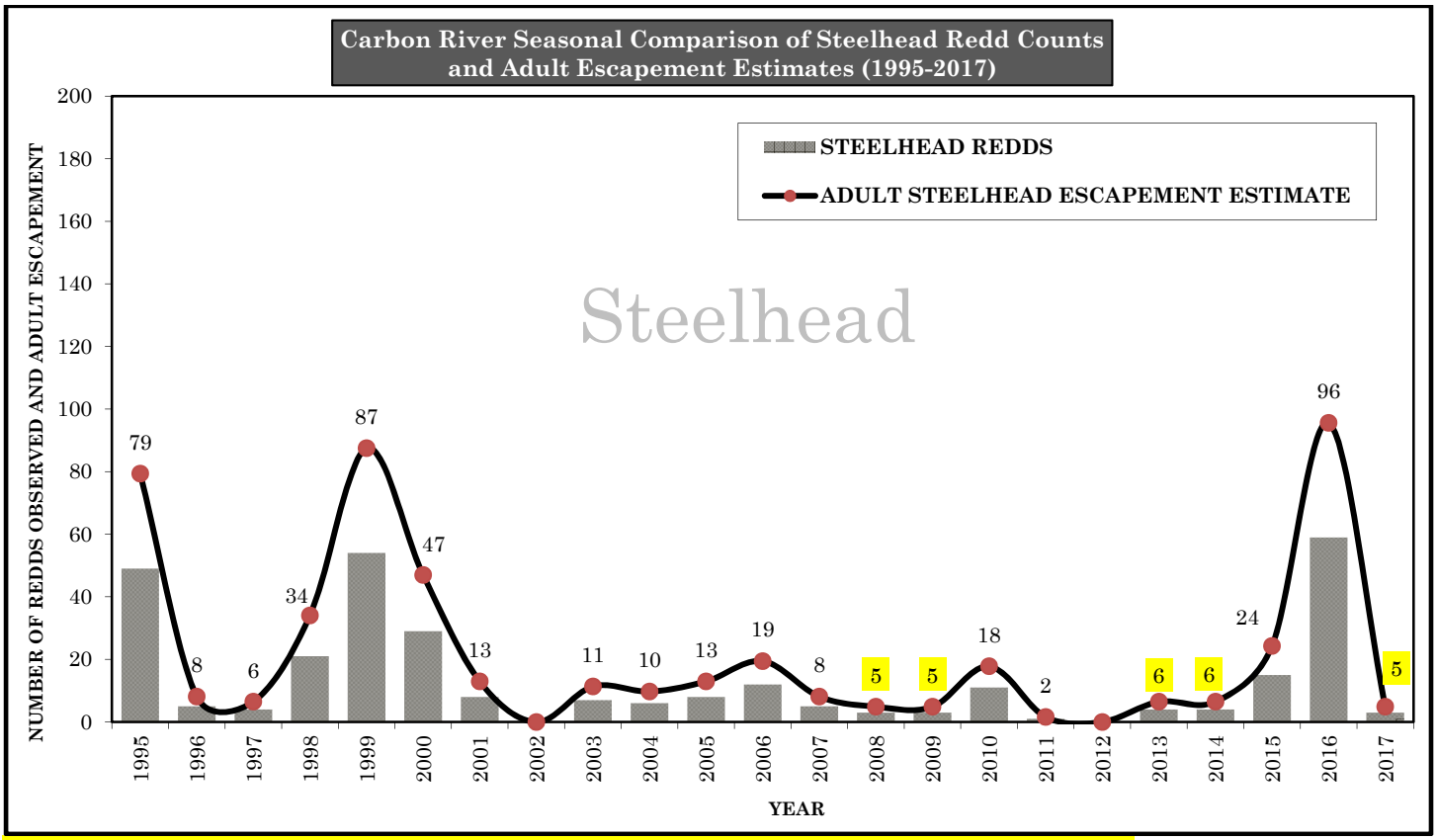
The riparian zone along Ipsut consists primarily of old growth cedar, fir and hemlock which contributes greatly to the large woody debris in the stream; as well as diversity to the channel habitat. Unfortunately, spawning opportunities are limited due to the size and makeup of the substrate material; much of which consists of flat and angular stones not conducive to movement, especially by smaller fish such as bull trout. However, small patches of suitable gravel do exist. The lower anadromous reach of the creek is also subject to, and has frequently experienced disturbances caused by Carbon River high flow/flood events. These intrusions often deposit significant amounts of fine material and woody debris. An impassable falls at approximately RM 0.7 prevents any further upstream migration.



The 2014 & 2015 data is incomplete due to extremely poor survey condition which prevented a regular full season of surveys.



The redd data is incomplete due to extremely poor survey condition which prevented a regular full season of surveys. To determine the total escapement for steelhead, each redd is multiplied by a factor of 1.62 *(i.e. 42 redds x 1.62 steelhead per redd = total escapement of 68 steelhead).* Addition biological expansion factors are applied to estimate escapement for suitable habitat areas that are often unsurveyable. See steelhead redd location map in appendix B.

CLARKS CREEK

WRIA 10.0027

Spawned-out chum salmon

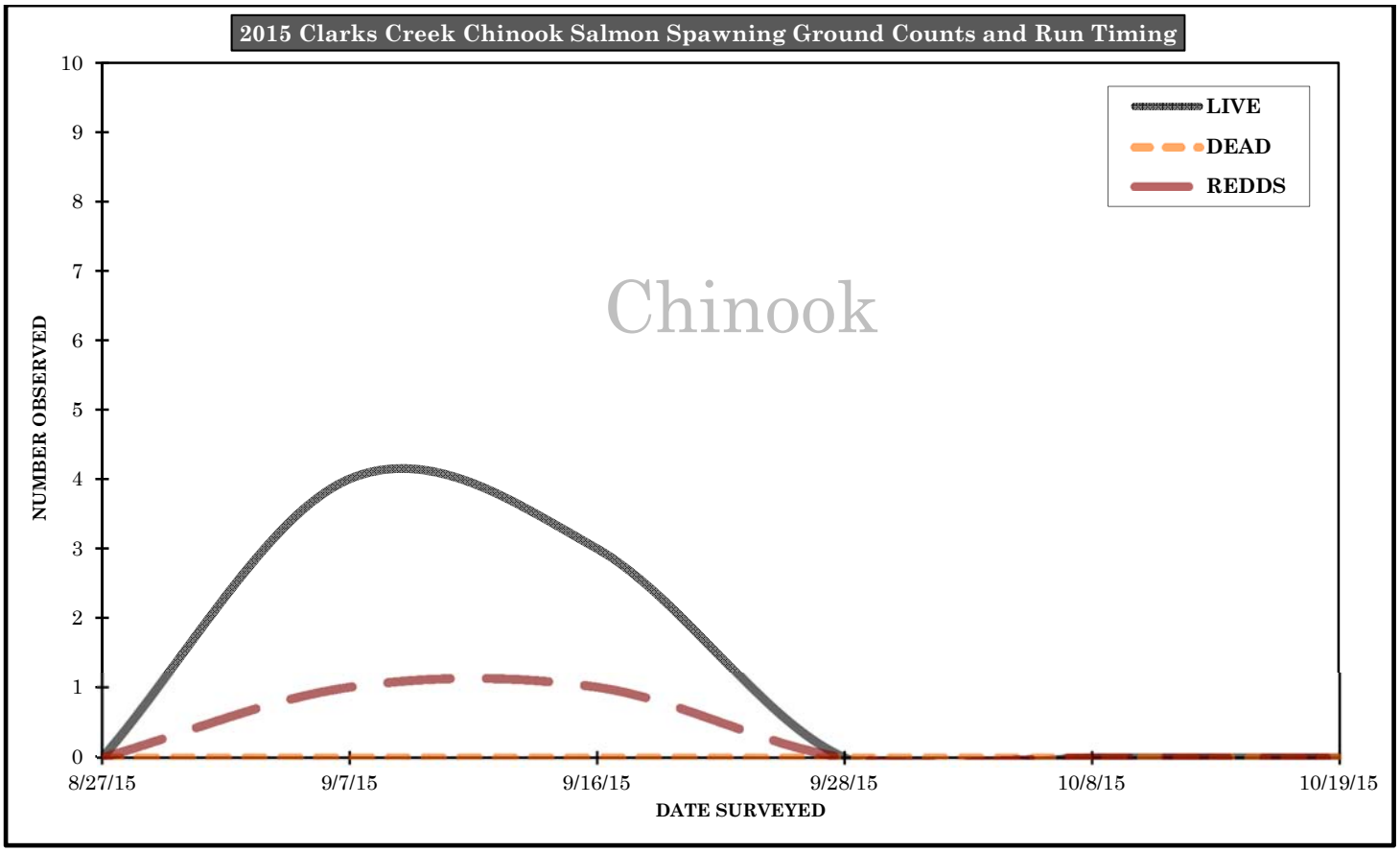
Clarks Creek is an urban tributary flowing into the lower Puyallup River, entering the Puyallup at RM 5.8. The Clarks Creek Basin drains the plateaus and flatlands running along the southern valley of the lower Puyallup River, just west of the city of Puyallup. The basin drains a 13 mi^2 area, with an average flow of nearly 60 cfs *(Basin Gauge #12102075)*. Clarks has several smaller tributaries, including Diru and Rody creeks; both of which are salmon bearing streams supporting Chinook *(above)*, coho, chum, pink, steelhead, and bull trout. Woodland Creek and Meeker Ditch contribute additional flow. Several salmonid species are known to utilize Clarks Creek for spawning, rearing and foraging. Species include ESA threatened Chinook, steelhead and bull trout; as well as non-listed coho, pink, chum and cutthroat. Brown trout, a non-native species is also present in the basin.

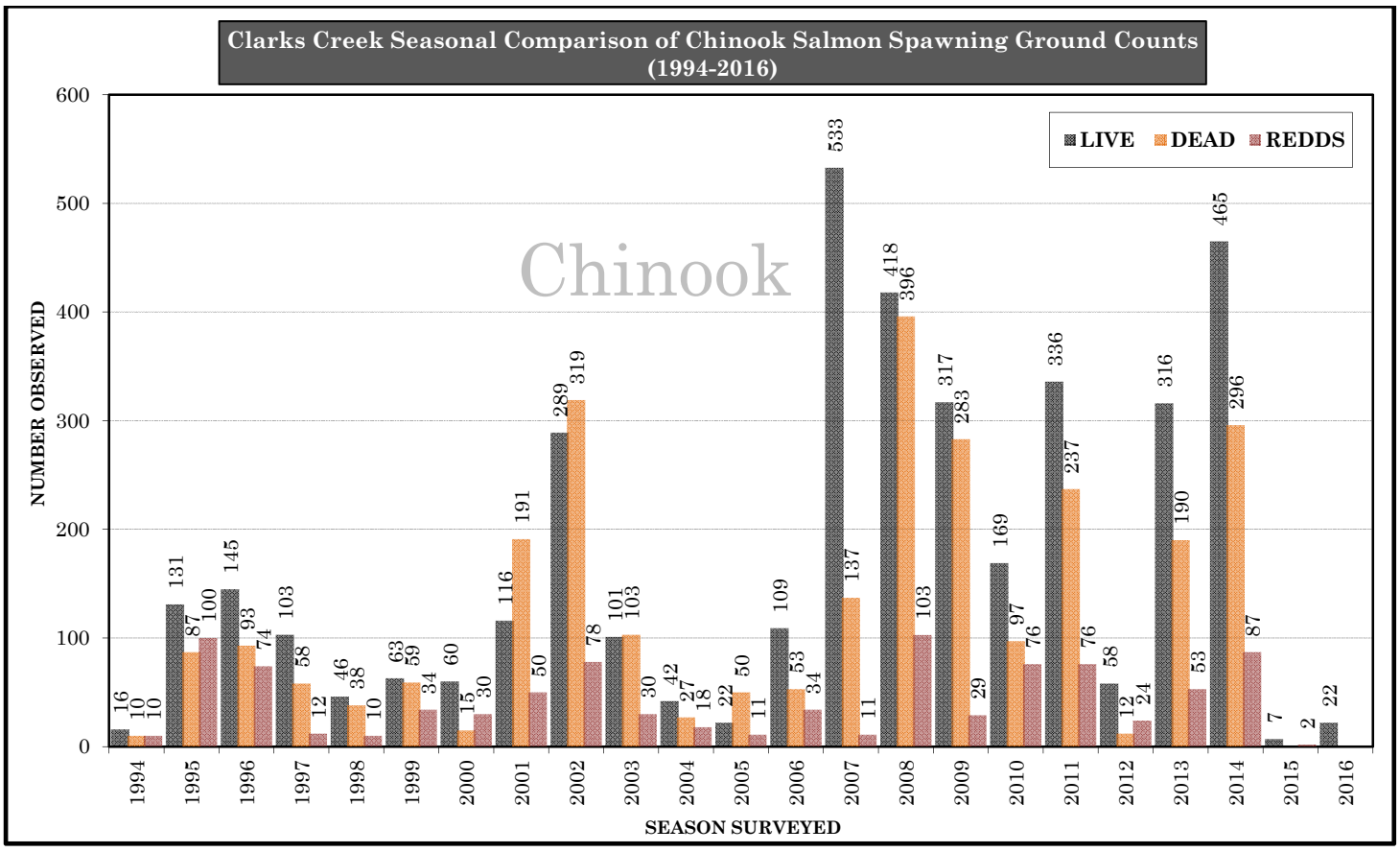
Several fish and habitat limiting factors associated with Clarks include; channel confinement, complete fish barriers, no off-channel habitat, flooding and channel erosion, absent or deficient riparian cover, water quality *(Iron, pH & bacteria)*, conveyance of storm water run-off, and the expansive growth of elodea (*Elodea canadensis*). In addition, there is considerable development along the creek, primarily rural residential.

The anadromous reach of Clarks is a low gradient spring-fed stream *(Maplewood Springs)* with a pool-riffle character. The surveyed reach of the Clarks Creek *(RM 3.4 to 3.7)* provides abundant spawning opportunities for all species; however, upstream migration is blocked by a dam at RM 3.7. Consequently, the dam also prevents the longitudinal continuity of gravel downstream to critical spawning areas.

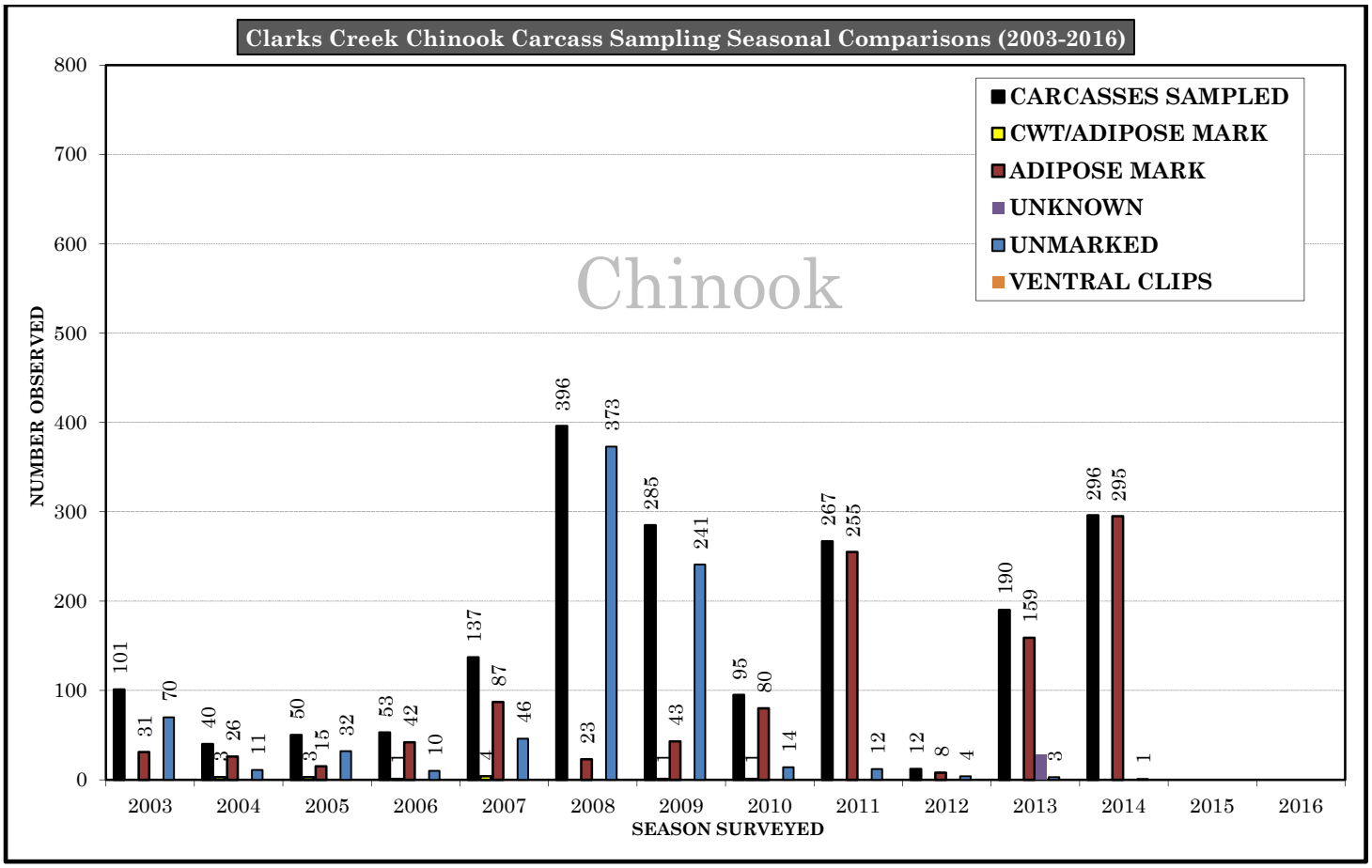
Salmonberry, maple, and alder dominate the overstory riparian zone along much of the upper surveyed reach. The remaining stream channel below the surveyed reach *(RM 3.4)* contains little gravel and the substrate consists of fine sand and mud; subsequently, little or no spawning has been observed downstream of this point. WDFW operates a fish hatchery near the barrier dam on Clarks. The state operated hatchery raises trout for stocking local lakes; as well as, rearing Spring Chinook *(since 2013)* for planting in White River acclimation ponds, and coho which are released on site. Spawning size gravel was introduced into the channel from RM 3.5 to 3.7 in the fall of 1997, and the summer of 1999. In addition to gravel inputs, several log weirs have been placed above the interpretive bridge to aid in gravel retention. This has greatly enhanced the spawning opportunities for Chinook, pink, coho and chum salmon. Unfortunately, adult steelhead spawning activity has rarely been observed in Clarks Creek since 1997. However, steelhead are occasionally captured or observed in tributaries of Clarks Creek. Due to limited availability of spawning habitat, high densities of Chinook and chum often results in considerable redd superimposition throughout this short reach. There is often an abundance of coho and chum fry during the spring *(also pink fry during late winter/spring in even years)* for cutthroat and juvenile Chinook to feed on. Adult and sub-adult bull trout are also known to forage in Clarks Creek.

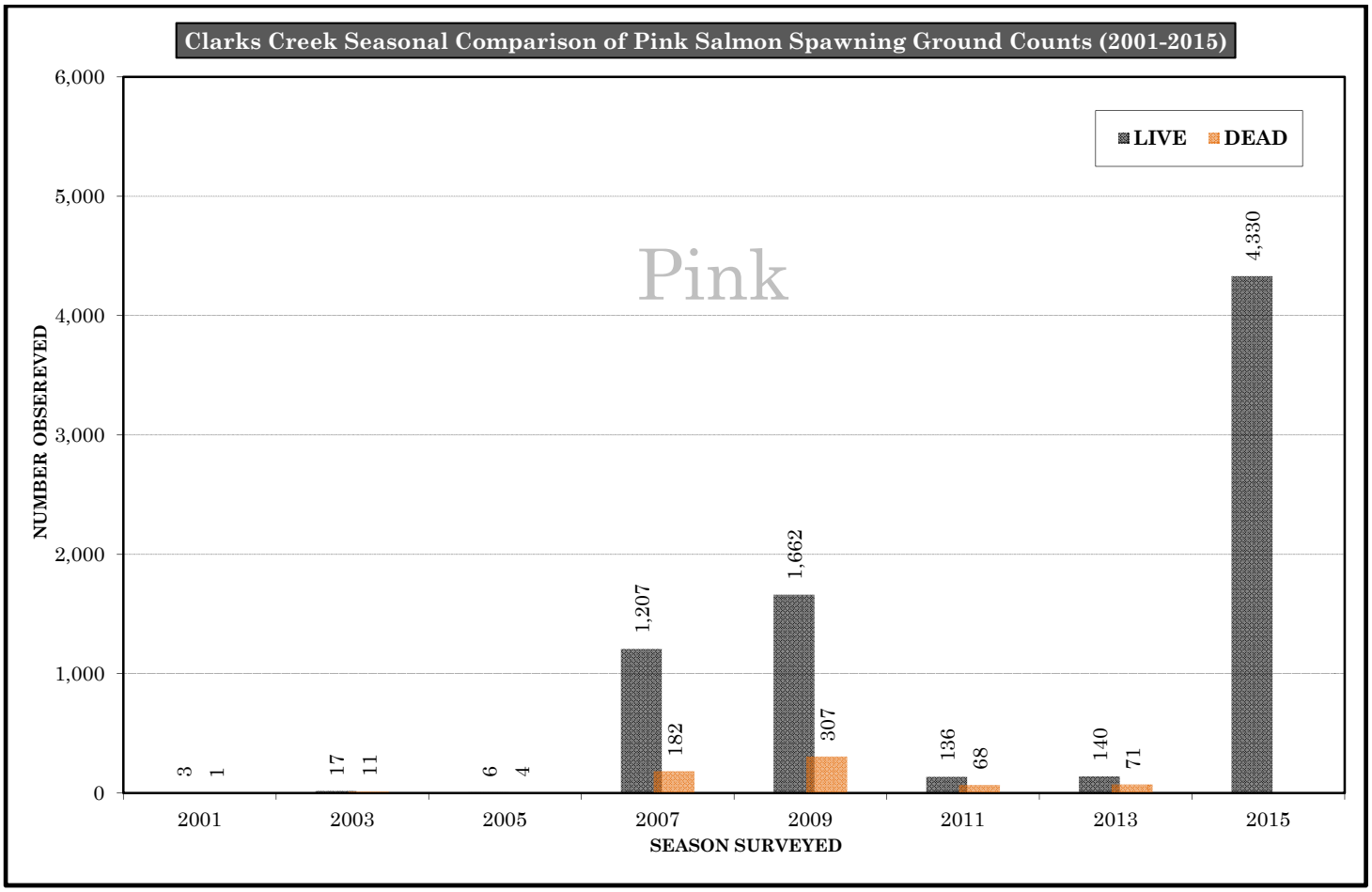
In 2004, the Puyallup Tribe completed construction of a Fall Chinook salmon hatchery on Clarks Creek *(RM 1.0)*. The hatchery was constructed in order to address several fish management issues, one of which includes minimizing the straying of adult Fall Chinook reared by the Puyallup Tribe.

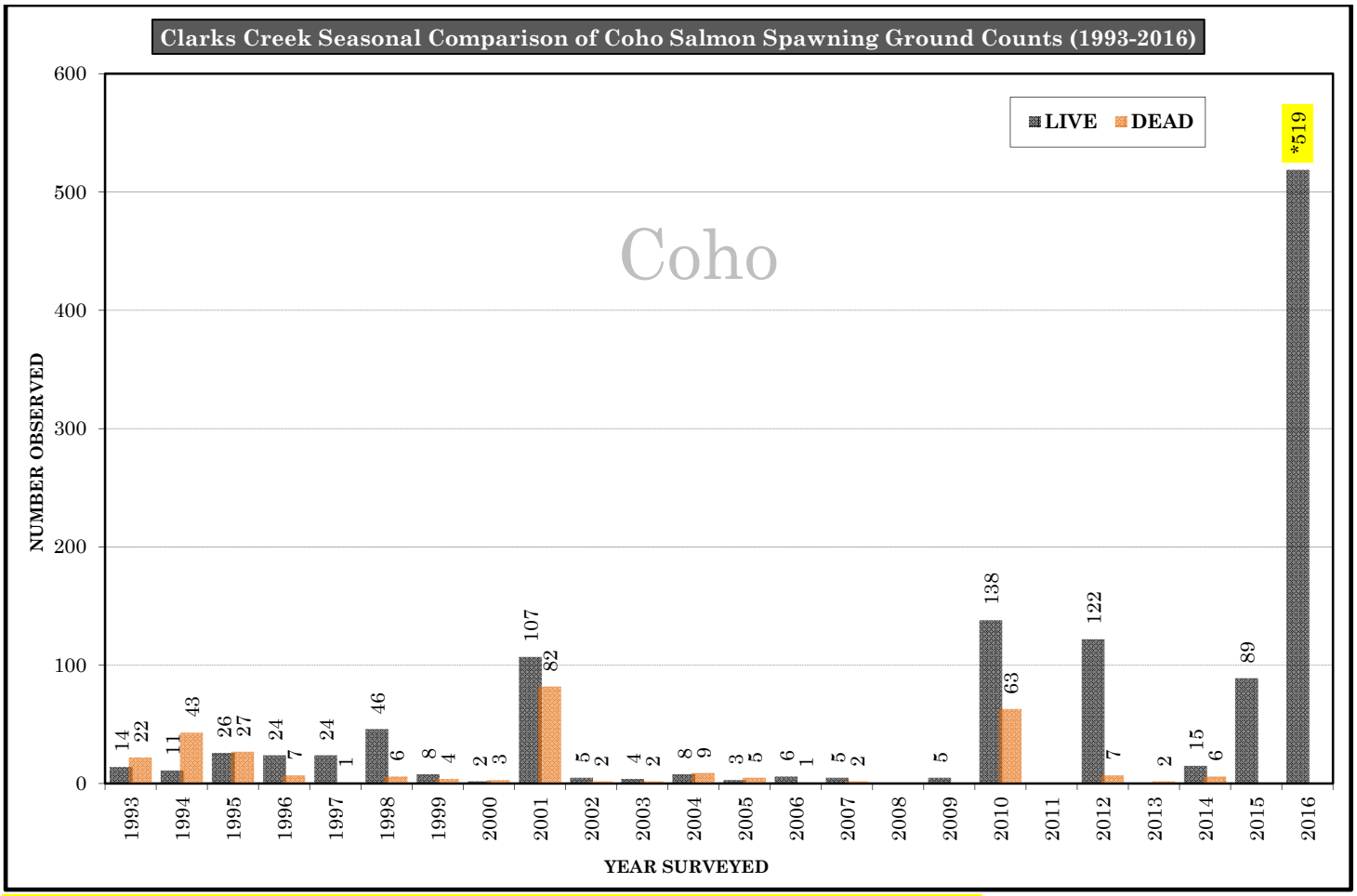




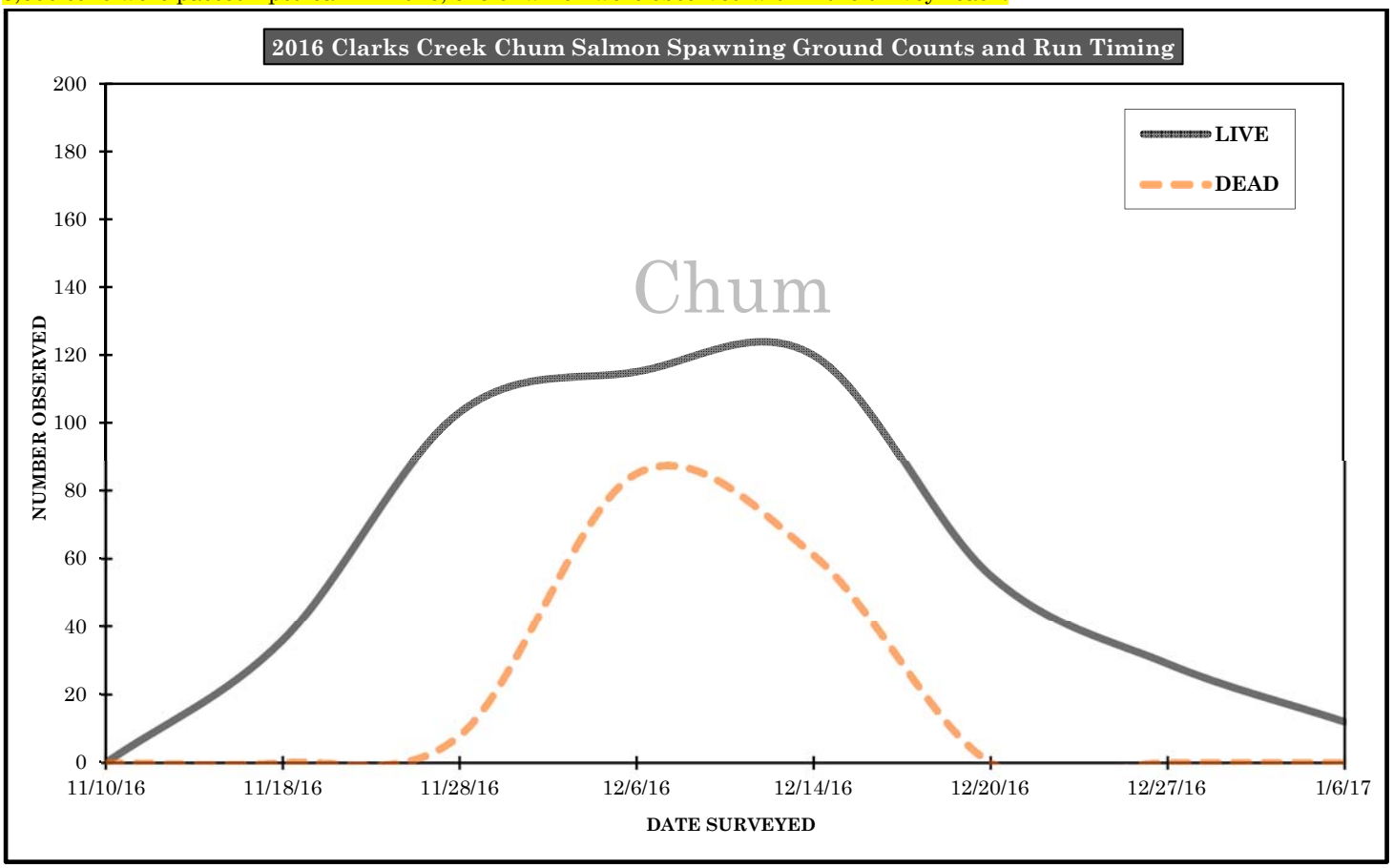
Adult Chinook escapement is determined by expanding the number of redds observed by 2.5 fish per redd (Smith and Castle, 1994). Due to the tremendous volume of pink salmon during odd years, the success of determining Chinook redds from pinks is vastly reduced. Therefore, The AUC method is used to determine escapement during pink runs (odd years).**Note:** A high proportion of the Chinook observed in 2007, were jacks *(2 year olds).*

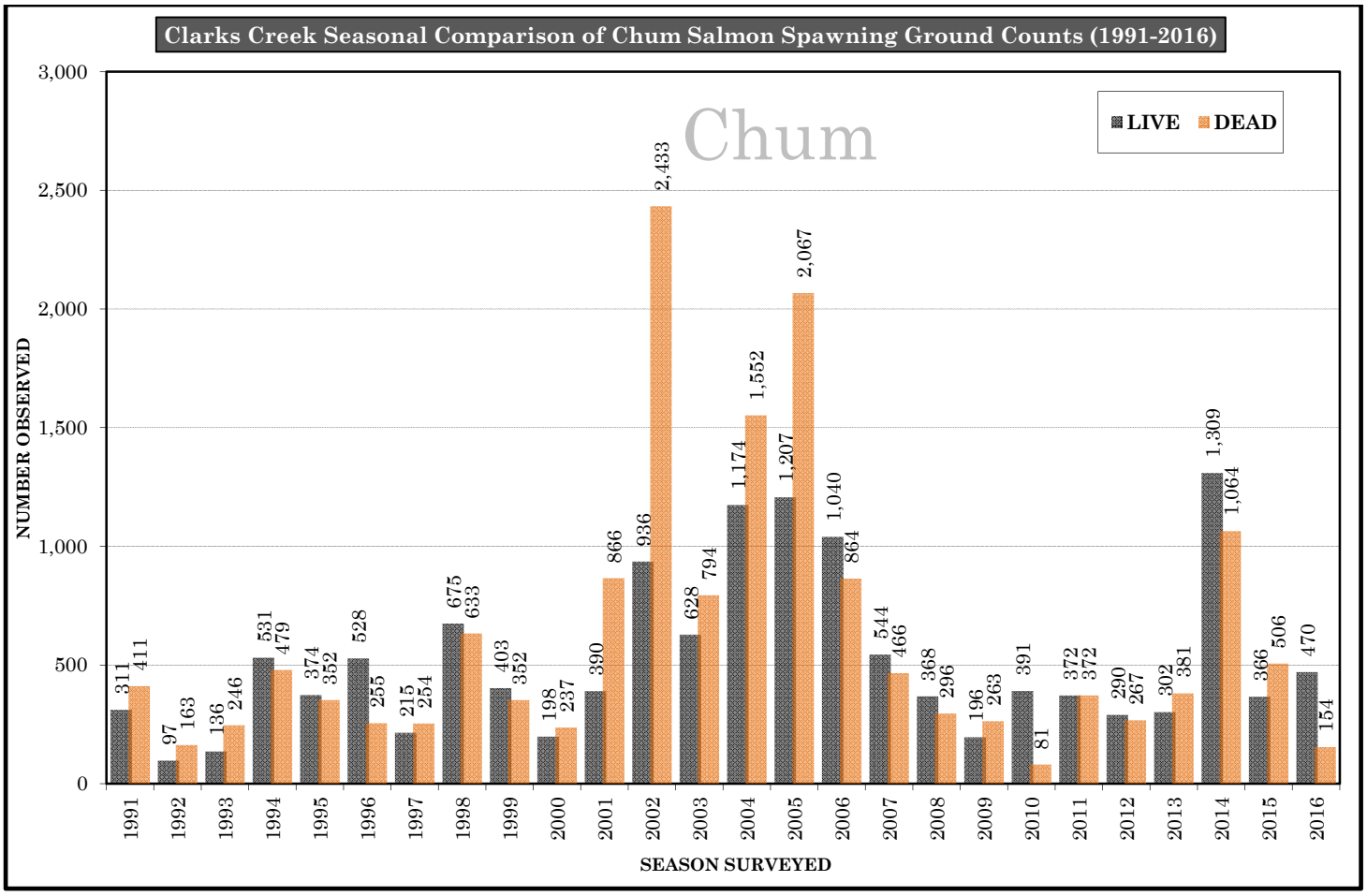

Clarks Creek Chinook Carcass Sampling Seasonal Comparisons (2003-2016)
CARCASSES SAMPLED
CWT/ADIPOSE MARK
ADIPOSE MARK
UNKNOWN
UNMARKED
VENTRAL CLIPS
Chinook
NUMBER OBSERVED
SEASON SURVEYED
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016
101 31 70
40 3 26 11
50 3 15 32
53 1 42 10
137 4 87 46
396 23 373
285 1 43 241
95 1 80 14
267 255 12
12 8 4
190 159 3
296 295 1

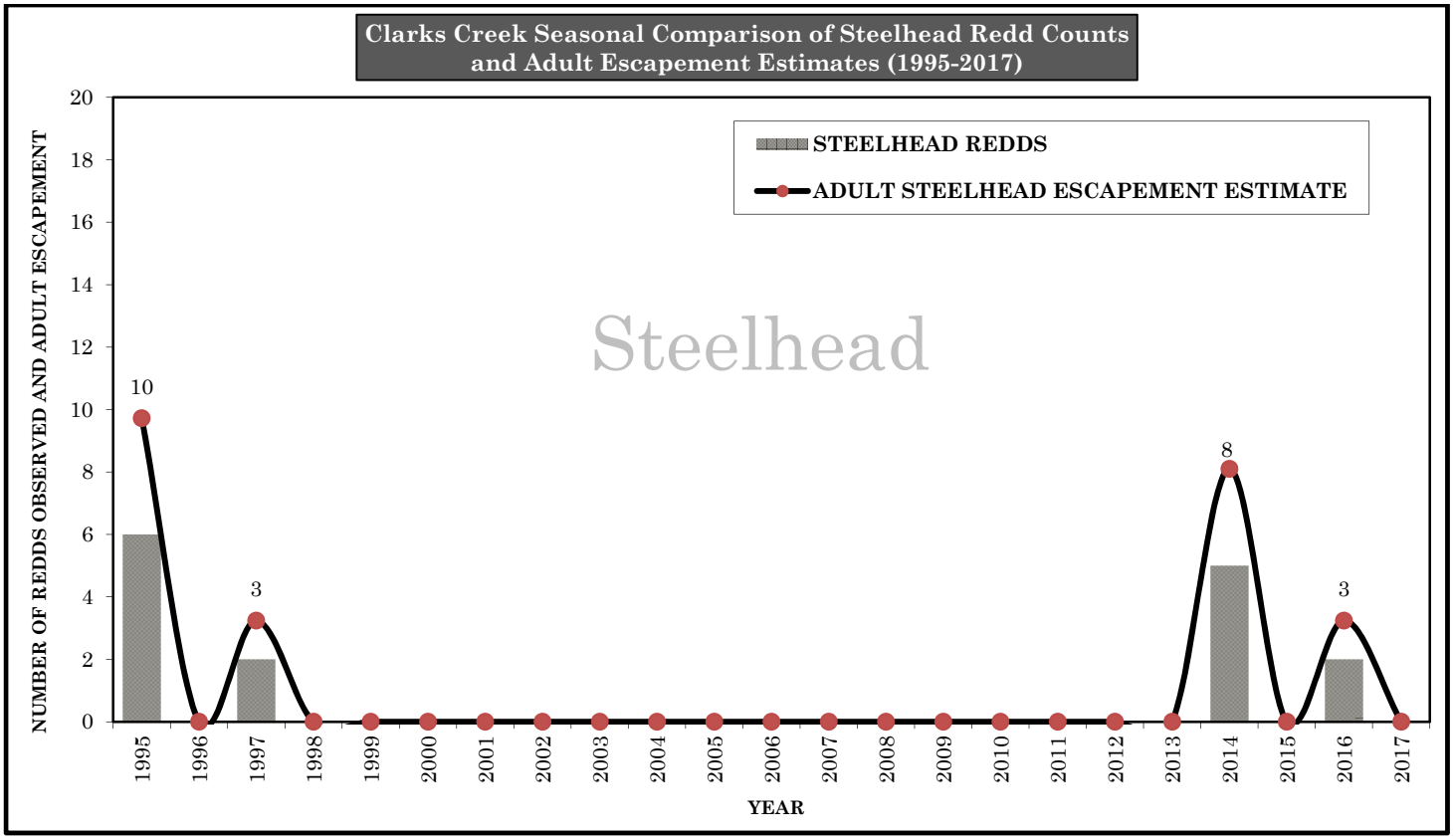

Clarks Creek Seasonal Comparison of Pink Salmon Spawning Ground Counts (2001-2015)
LIVE
DEAD
Pink
NUMBER OBSERVED
SEASON SURVEYED
2001 2003 2005 2007 2009 2011 2013 2015
3 1
17 11
6 4
1,207 182
1,662 307
136 68
140 71
4,330



3,600 coho were passed upstream in 2016, 519 of which were observed within the survey reach.





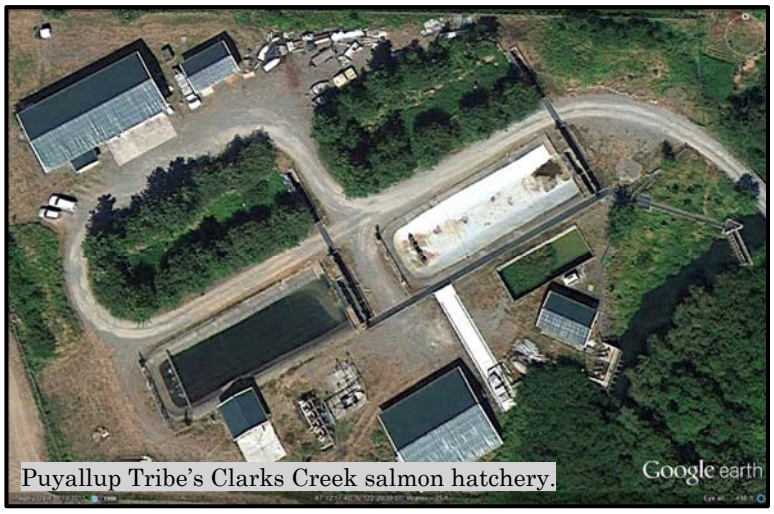


To determine the total escapement for steelhead, each redd is multiplied by a factor of 1.62 *(i.e. 42 redds x 1.62 steelhead per redd = total escapement of 68 steelhead)*; no additional expansion factors are applied. See steelhead redd location map in appendix B.

CLARKS CREEK SALMON HATCHERY

Puyallup Tribe of Indians Hatchery Facility

Clarks Creek Salmon Hatchery is a Puyallup Tribe of Indians facility located at RM 1 on Clarks Creek *(10.0027)*, a tributary to the lower Puyallup River. The Clarks Creek hatchery *(below)* was constructed in order to address several fish management, and water supply issues including; minimizing the straying of adult Fall Chinook reared by the tribe; providing space for rearing and acclimating White River Spring Chinook, chum and winter steelhead if necessary; creating an independent and self-sustaining fall and Spring Chinook program for the tribe; as well as providing a reliable water supply to rear and expand fish production.



Puyallup Tribe's Clarks Creek salmon hatchery.

Water is supplied from five vertical turbine pumps, each 20-horsepower. Each pump has a flow capacity of 1,600 gpm. Each pump is capable of supplying one of four ponds with approximately 3.6 cfs. Each of the four ponds has approximately 12,000+ cubic feet of water volume, two ponds are concrete lined and designed to hold adult and juveniles, while the other two are natural acclimation ponds.

In addition, the Puyallup Tribe operates several acclimation ponds in the Puyallup Watershed. Two of the acclimation ponds are used for reestablishing Fall Chinook and coho into a 30-mile reach in the Upper Puyallup River above Electron Dam *(Cow Skull & Rushingwater)*. A fish ladder was constructed and completed in fall of 2000; for 97 years prior to the completion of the fish ladder the Electron diversion dam had been an anadromous barrier. Several additional acclimation ponds are located in the Upper White River drainage *(Huckleberry Cr., Greenwater River (George Cr.), Twentyeight Mile Cr. (Greenwater R.)& Jensen Cr. (Clearwater R.)*. These ponds are used for reestablishing White River Spring Chinook and steelhead back into their endemic ranges. All ponds have approximately 25,000 cubic feet of rearing space and between 1 to 3 cubic feet per second flow. A 35,000 cu. ft. Spring Chinook acclimation pond was completed in the summer of 2007 near George Creek *(Greenwater River)*. Capable of holding over 500,000 Spring Chinook, the construction of the acclimation pond was funded by the City of Tacoma as a result of a mitigation settlement. The newest pond located on 28 Mile Creek *(Greenwater River)* was completed in the fall of 2015.

The Puyallup Tribe's restoration goal is to rebuild depressed Chinook and steelhead stocks and remove them from ESA listing. Using acclimation ponds, limiting harvest, and making substantial gains in habitat restoration, the tribe will be able to accomplish this task. Levee setbacks, oxbow reconnections both inter tidal and upland, Commencement Bay cleanup, and harvest cutbacks have already been initiated. Only the re-establishment of

Chinook in habitat areas devoid of fish has remained one of our biggest challenges. Acclimation ponds are a proven method in increasing fish numbers on the spawning grounds. Hatchery rearing 200,000 Fall Chinook for release on station and 200,000 for acclimation ponds in the upper Puyallup River for a combined 6,857 pounds of fish. Historically, Fall Chinook have been reared since 1980 with a variety of stocks, goals, and objectives.

Raceways constructed in 2016

Spring Chinook Hatchery Production

The Puyallup Tribe operates several acclimation ponds in the Upper White River Watershed designed to reestablish and enhance Spring Chinook stocks *(Huckleberry Cr., Greenwater River (George Cr.), Twentyeight Mile Cr. (Greenwater R.)& Jensen Cr.(Clearwater R.).* Acclimation ponds could be planted collectively with up to 900K+ White River Spring Chinook and 25K+ White River winter steelhead pre-smolts. The Jensen Creek Pond *(Clearwater River)* was completed in the fall of 2012. The newest pond located on 28 Mile Creek *(Greenwater River)* was completed in the fall of 2015. Currently, Spring Chinook designated for acclimation ponds are reared at WDFW's Clarks Creek facility *(since 2013)*, and Muckleshoot White River hatchery.

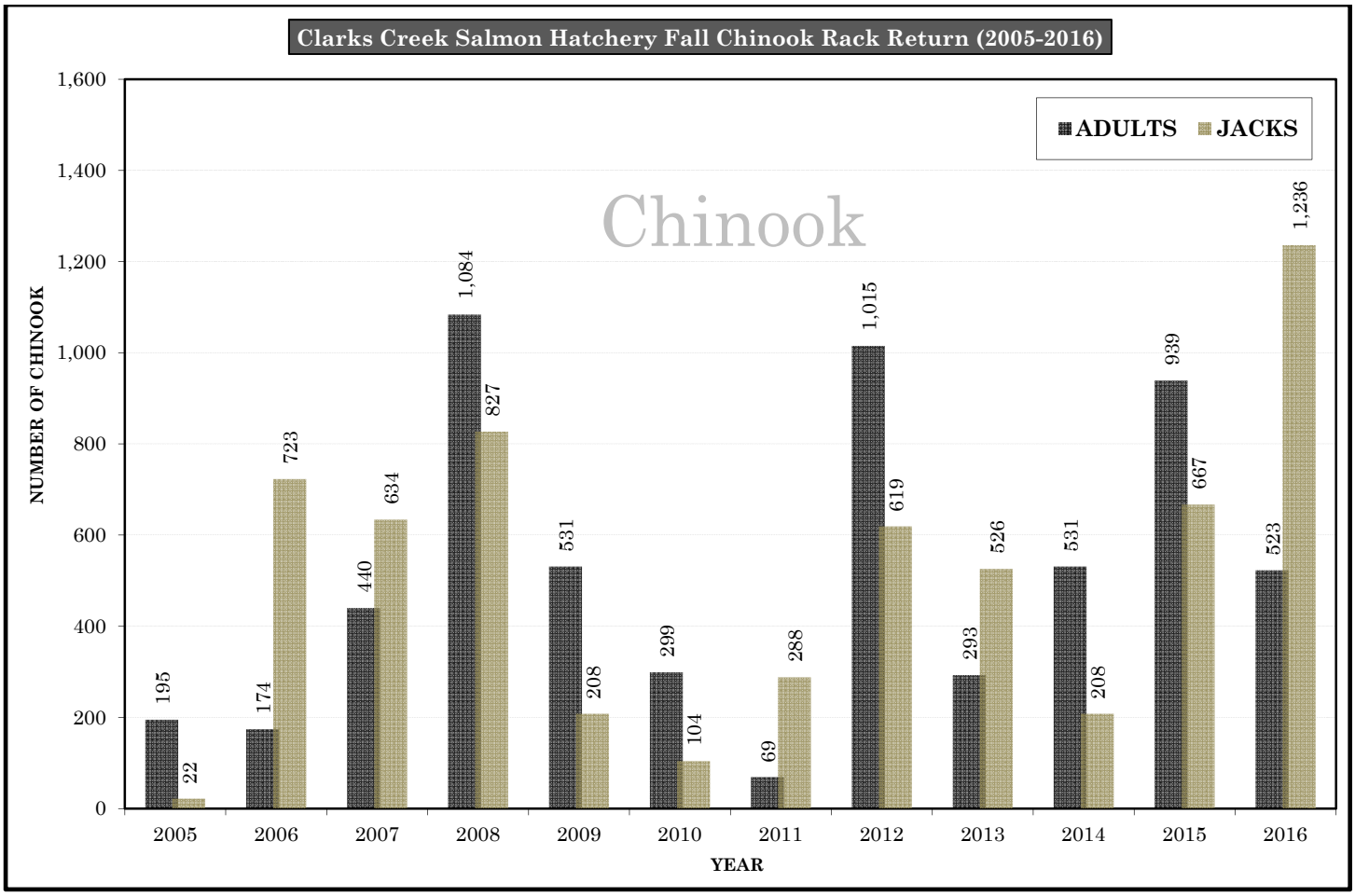
Current Fall Chinook Hatchery Production

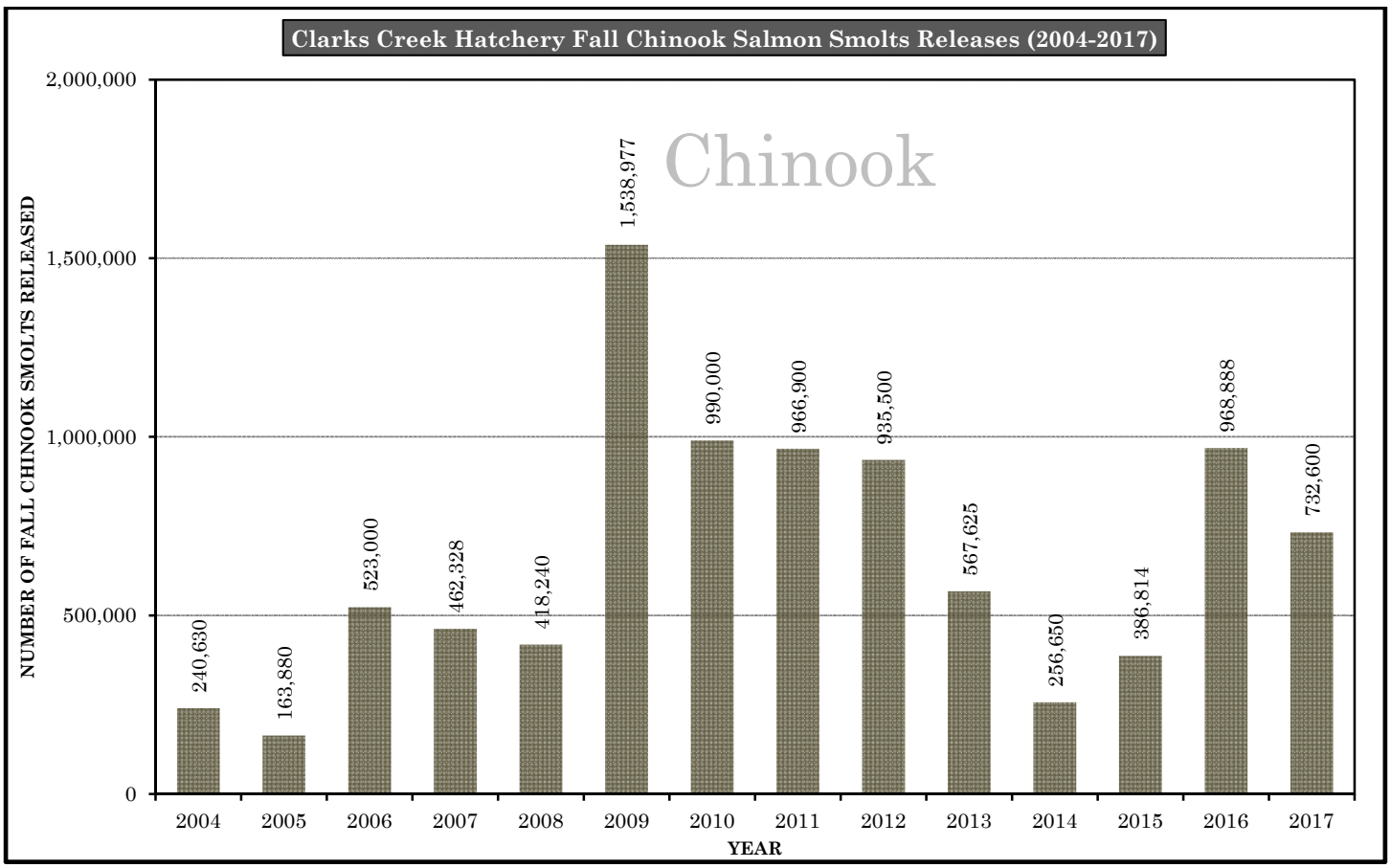
In 2004, the Puyallup Tribal Fisheries Department began acclimating and releasing Fall Chinook from the Clarks Creek facility; thus, discontinuing all Chinook releases from the Diru Creek hatchery. Adult and jack Chinook begin moving into the hatchery holding pond in September, and continue to arrive well into late October. Ripe *(ready to spawn)* adults are collected 2-3 times a week. Eggs and sperm, at a 1male-to-1 female ratio, are mixed in a small bucket to induce fertilization *(left).* Fertilized eggs are placed into an incubator tray until they hatch. In early 2005, construction of a new incubation building was completed at Clarks Creek. The incubation building houses 32 incubator stack capable of holding up to 77,000 Chinook eggs, for a total capacity of approximately 2.5 million eggs *(bottom photo).* Once fish are ready to be moved from the incubators, they are transferred to one of the concrete raceways *(top photo).*

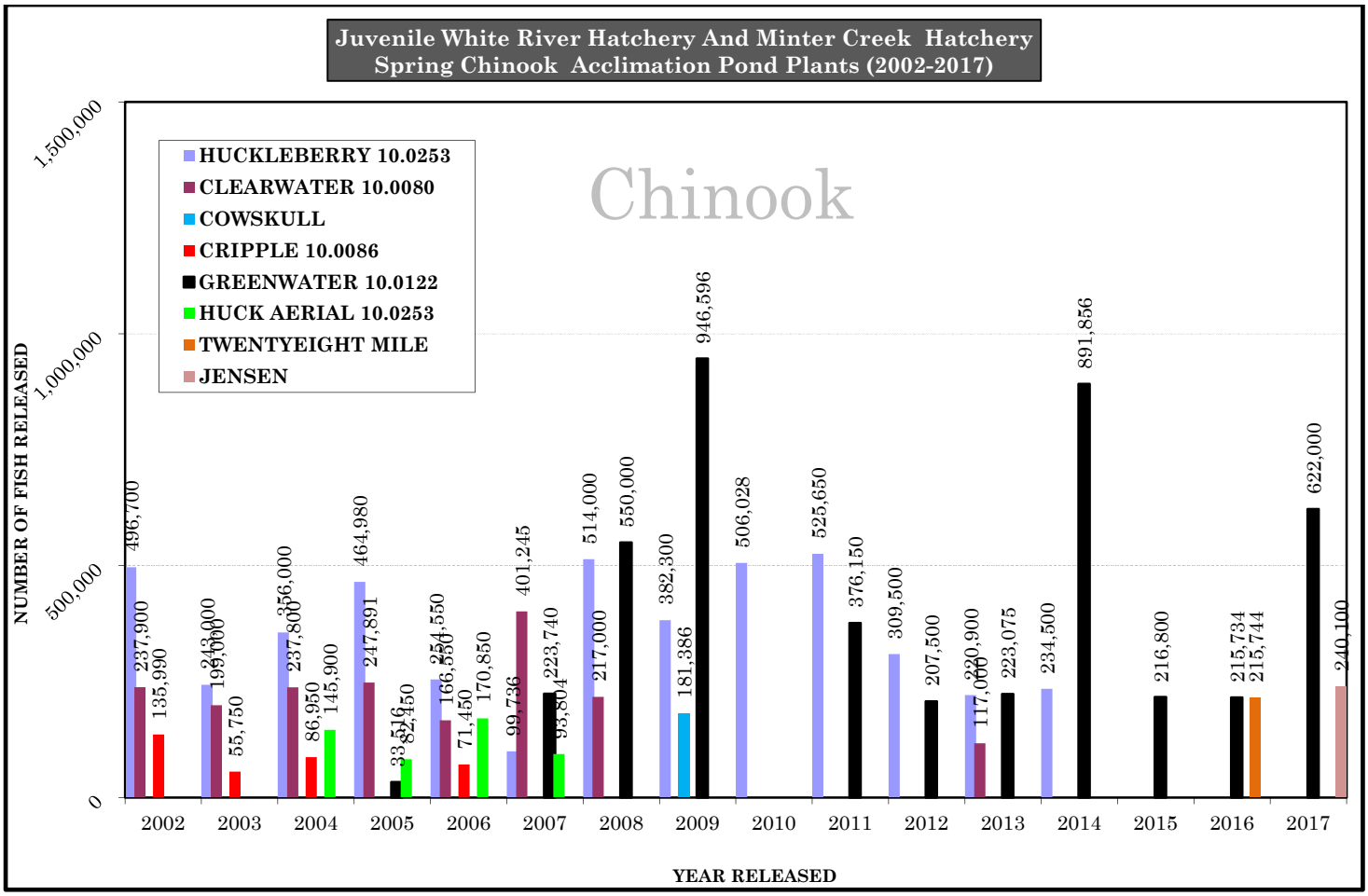
Salmon egg incubators

Holding the Chinook in the raceways is only temporary until they are up to a large enough size, usually sometime during late March to early April, to be massed marked with an automated tagger *(right)* and transferred to one of two natural ponds. The automated fish tagging trailer is operated by the Northwest Indian Fisheries Commission *(NWIFC)* out of Olympia. A proportion of the young Chinook are implanted with a coded wire tag *(CWT)* and the adipose fin is removed. The remaining fish are all massed marked by removing the adipose fin only. The markings and CWT's will be used to identify these Chinook as hatchery origin fish in the future when they return to the hatchery, are caught by fisherman, or are observed on the spawning grounds. The CWT is inscribed with a specific code that will identify the particular hatchery where the fish was tagged. Once tagged, fish are planted in one of the two natural acclimation ponds. The young Chinook are fed regularly to increase their size until they are ready to be released into the creek in late May or early June.

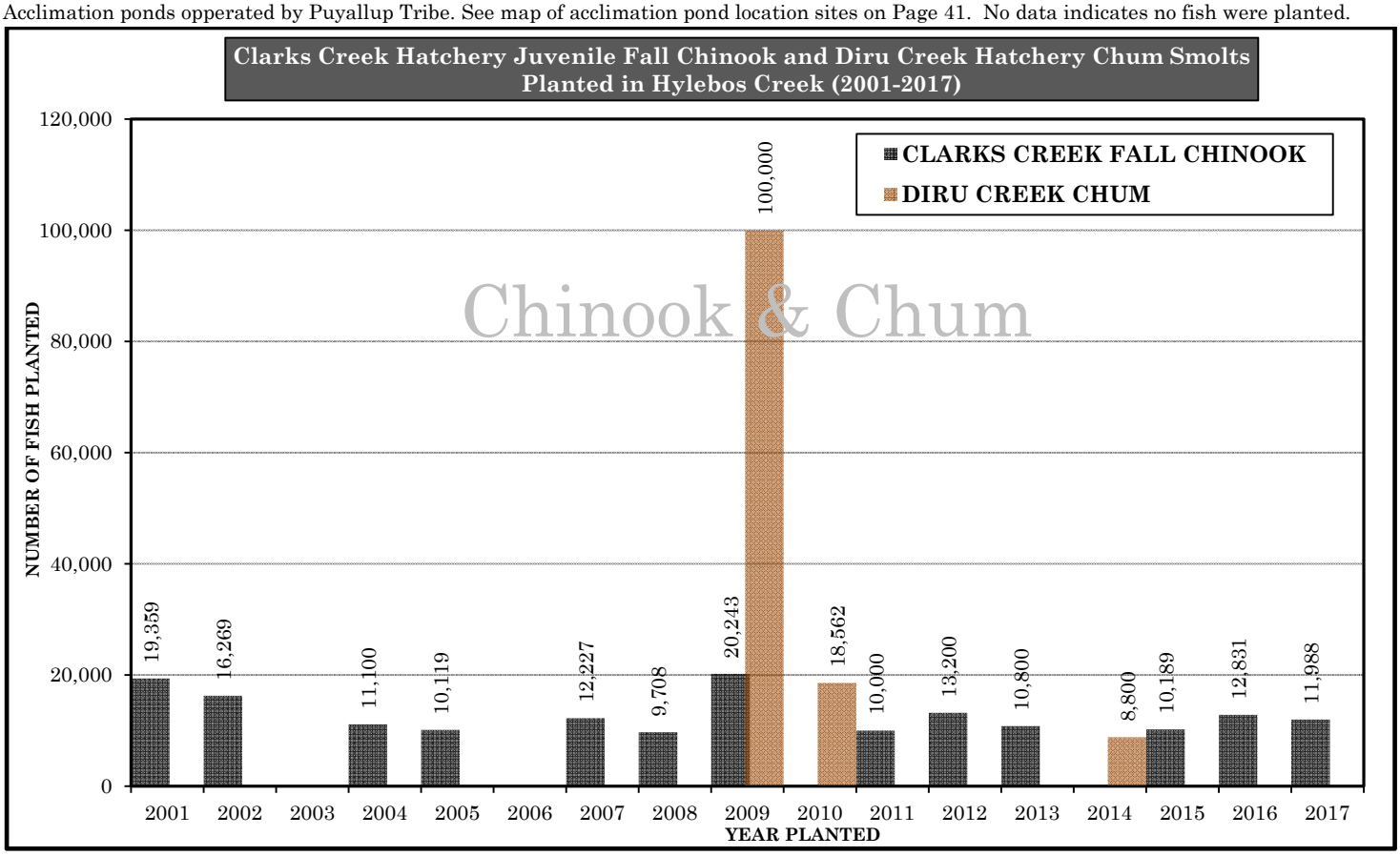
Automated fish tagger


Clarks Creek Salmon Hatchery Fall Chinook Rack Return (2005-2016)
Chinook
ADULTS
JACKS
NUMBER OF CHINOOK
YEAR
1,600
1,400
1,200
1,000
800
600
400
200
0
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016
195 22
174 723
440 634
1,084 827
531 208
299 104
69 288
1,015 619
293 526
531 208
939 667
523 1,236


Clarks Creek Hatchery Fall Chinook Salmon Smolts Releases (2004-2017)
Chinook
NUMBER OF FALL CHINOOK SMOLTS RELEASED
YEAR
2,000,000
1,500,000
1,000,000
500,000
0
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017
240,630
163,880
523,000
462,328
418,240
1,538,977
990,000
966,900
935,500
567,625
256,650
386,814
968,888
732,600



Acclimation ponds opperated by Puyallup Tribe. See map of acclimation pond location sites on Page 41. No data indicates no fish were planted.



Clarks Creek Fall Chinook and Diru Creek chum salmon are spawned and reared at Puyallup Tribal salmon hatcheries. No data indicates no fish were planted.

CLEAR CREEK

WRIA 10.0022

Chum Salmon

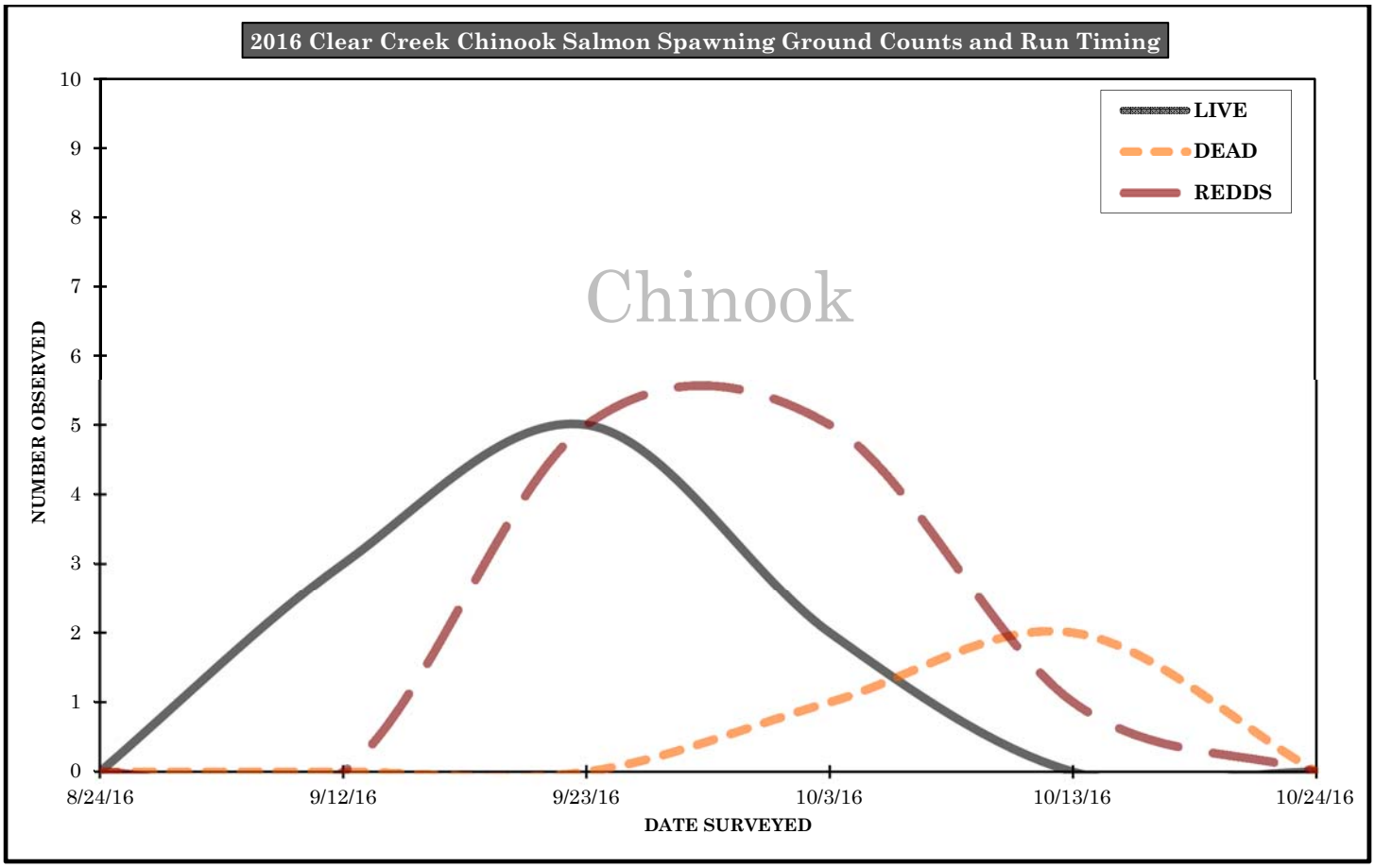
Clear Creek is a tributary to the lower Puyallup River, joining with the Puyallup at RM 2.9. The Clear Creek Basin *(12.1 mi²)* drains the plateaus and flatlands running along the southern valley of the lower Puyallup River, between the cities of Puyallup and Tacoma. Clear Creek has several tributaries which include; Swan Creek; Squally Creek; Canyon Creek and an unnamed tributary entering at RM 3.05 on the right bank. Only Swan, Squally and Canyon creeks are accessible to adult salmon.

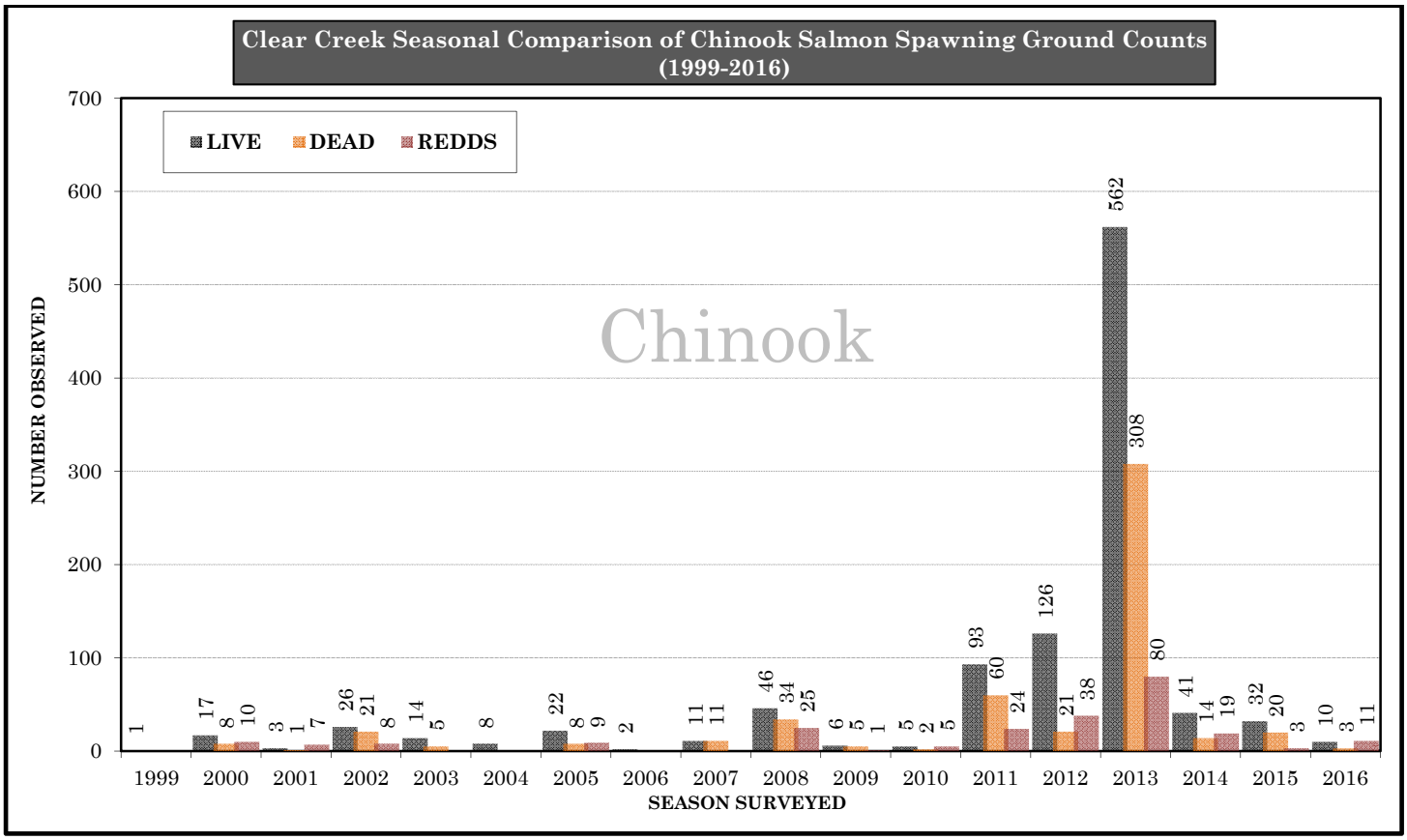
Several salmonid species are known to utilize Clear Creek for spawning, rearing and foraging. This includes ESA threatened Chinook, steelhead and bull trout; as well as, non-listed species including coho, pink, chum and cutthroat. Various limiting factors involved with Clear Creek include; low flows, channel confinement *(top)*, an anadromous barrier, lack of spawning habitat, aquatic noxious weeds, flooding and channel erosion, conveyance of storm water run-off, water quality *(D.O. & bacteria)*; as well as, absent or poor riparian cover.

Above Pioneer Way, Clear Creek flows as a low-to-moderate gradient pool-riffle stream before paralleling the road for several hundred feet. The upper anadromous reach contains good spawning gravel from RM 1.7 to 1.9. Although a significant section of the riparian area is not intact, there are undercut banks and moderate amounts of in-stream cover. A high density of reed canary grass (*Phalaris arundinacea)* and other vegetation *(watercress)* chokes approximately 300 feet of the spawning channel every summer; effectively trapping a significant amount of fine sediment which covers the available spawning gravel by several inches.

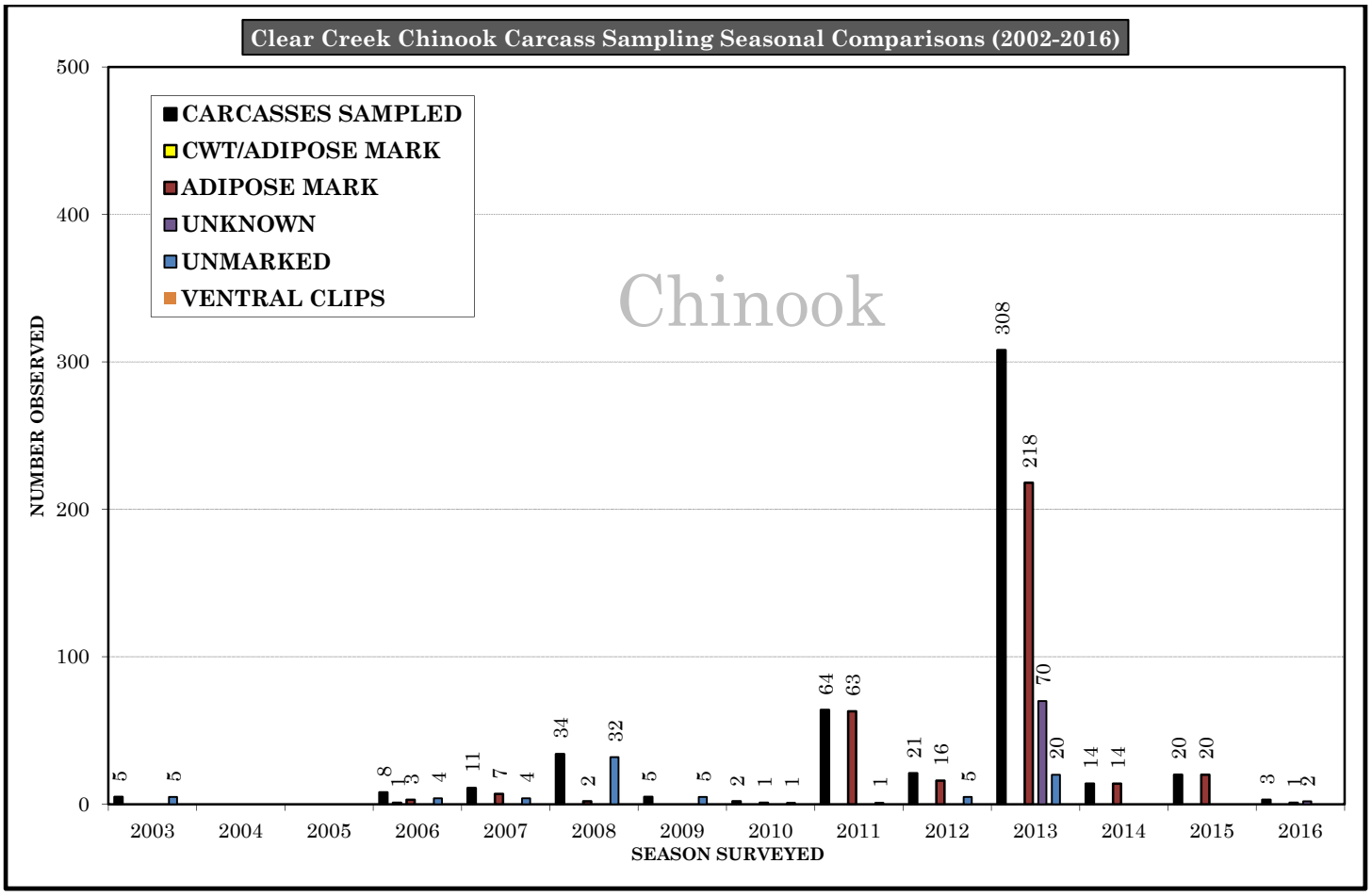
An anadromous blockage in the form of a cement diversion dam is located at RM 1.9; the dam is in place to ensure pathogen free water for hatchery raised rainbow at the Trout Lodge facility. Consequently, this also disrupts the longitudinal continuity of gravel downstream to vital spawning areas. The reach above the dam is not surveyed; however, suitable spawning habitat does exist and could be utilized if access were established. The draw off of water by the hatchery, specifically during the summer and fall seasons, significantly reduces the water throughout the bypass reach. The bypass reach is the section of stream from the water intake for the hatchery, to its discharge point downstream. Chinook are often observed holding in a large pool located at the hatchery discharge outlet. The low flows resulting from the hatchery draw regularly prevent Chinook from accessing the bypass reach where suitable spawning habitat is available. Late fall and winter flows are regularly sufficient for chum salmon to spawn in the 0.2 miles of available habitat below the dam. Adult steelhead and coho also utilize Clear Creek; however, escapement for these two species is low. The lower Puyallup tributaries often experience an abundance of chum fry during the spring, as well as coho fry throughout spring and summer for cutthroat, steelhead, and juvenile Chinook to feed on. Bull trout are also known to forage in the smaller tributaries of the lower Puyallup, including Clear Creek, which offers excellent foraging and overwintering opportunities.

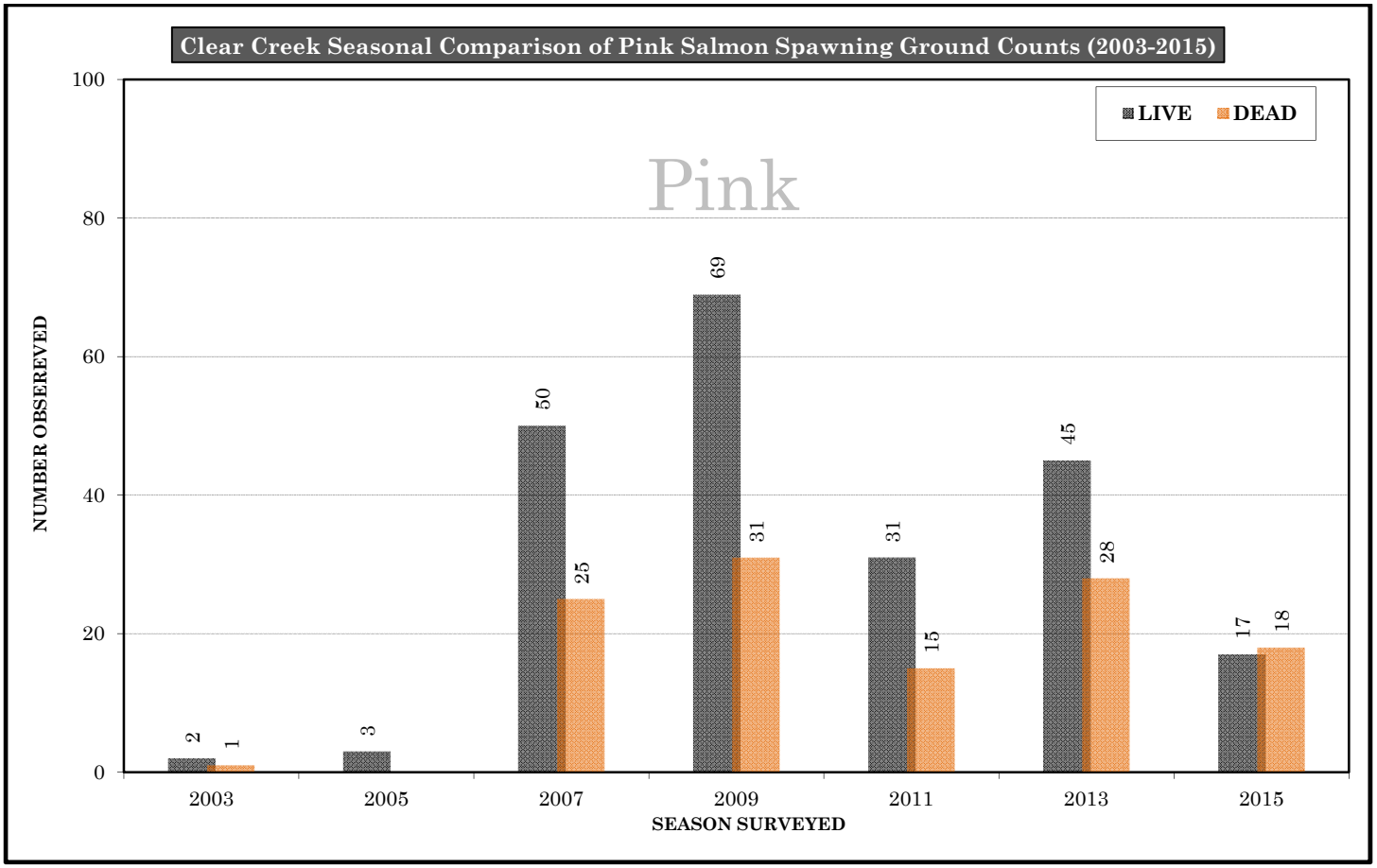
In 2016, Port of Tacoma finished constructed of a roughly 40-acre restoration project on upper Clear Creek. The project created floodplain wetland and a new, more naturalized stream channel. The project was created as a result of a mitigation settlement with EPA, at a cost of approximately $9 million dollars.

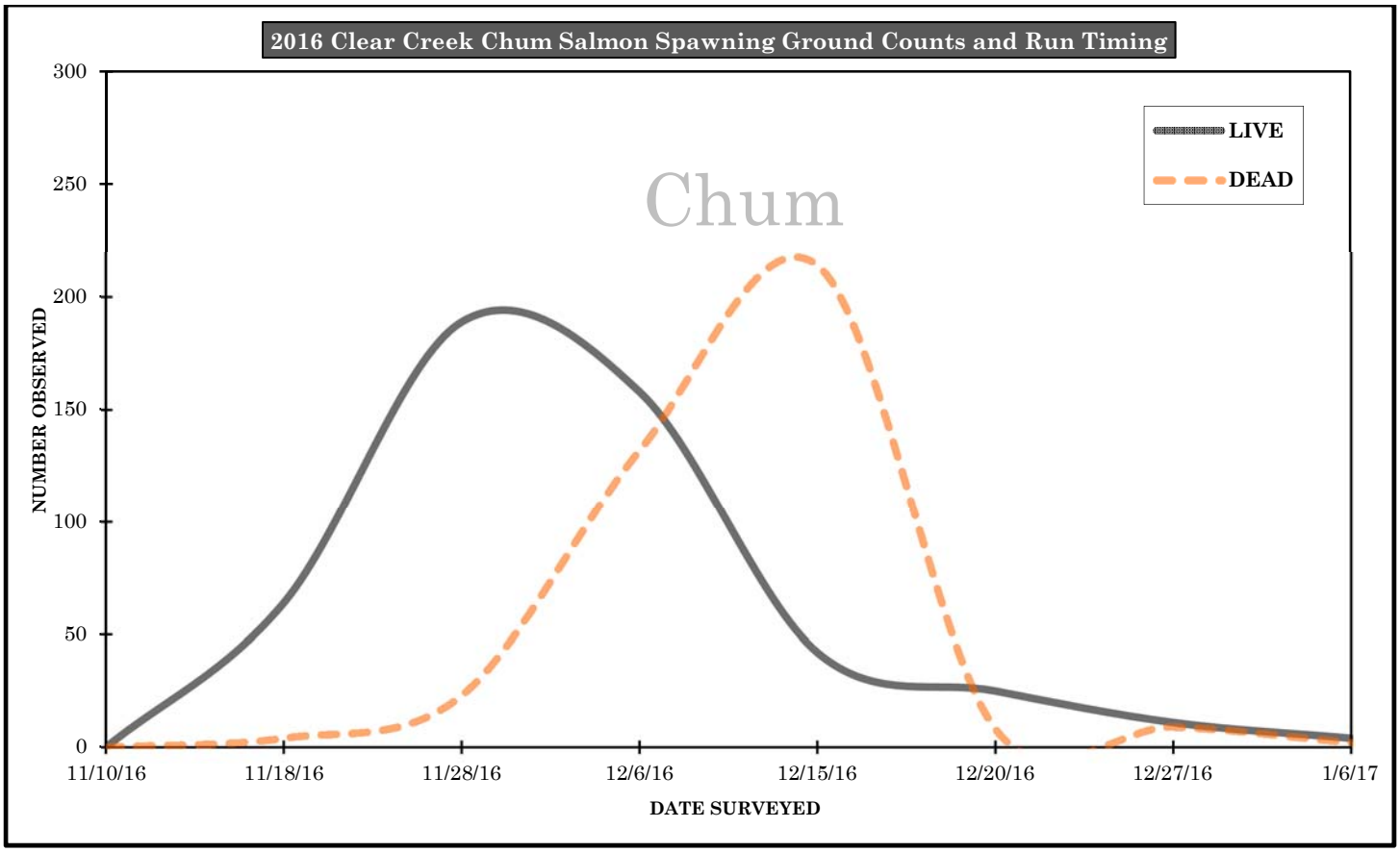


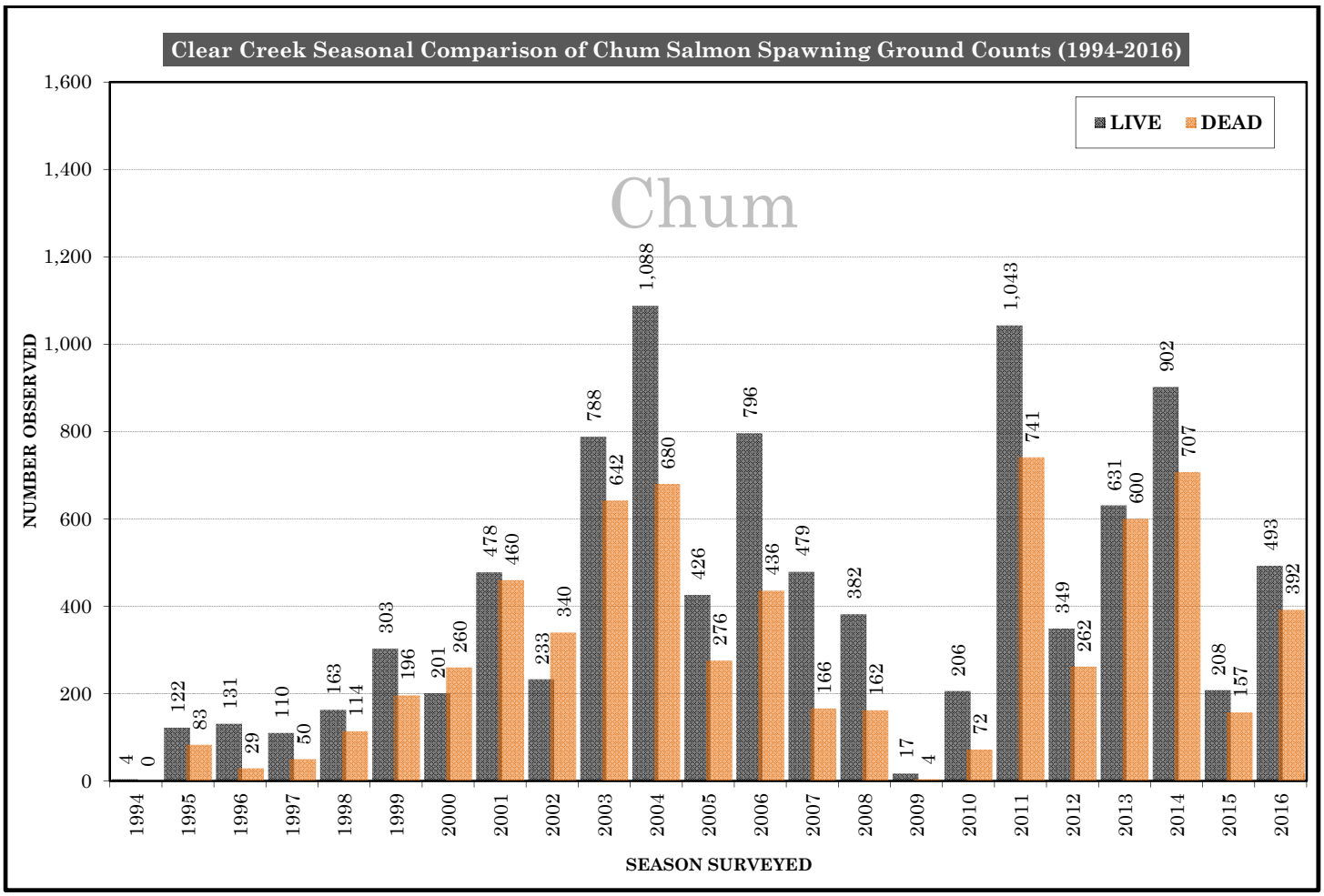


Adult Chinook escapement is determined by expanding the number of redds observed by 2.5 fish per redd (Smith and Castle, 1994). Due to the tremendous volume of pink salmon during odd years, the success of determining Chinook redds from pinks is vastly reduced. Therefore, The AUC method is used to determine escapement during pink runs (odd years).


Clear Creek Chinook Carcass Sampling Seasonal Comparisons (2002-2016)
CARCASSES SAMPLED
CWT/ADIPOSE MARK
ADIPOSE MARK
UNKNOWN
UNMARKED
VENTRAL CLIPS
Chinook
NUMBER OBSERVED
SEASON SURVEYED
0
100
200
300
400
500
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
5
5
8
1
3
4
11
7
4
34
2
32
5
5
2
1
1
64
63
1
21
16
5
308
218
70
20
14
14
20
20
3
1
2


Clear Creek Seasonal Comparison of Pink Salmon Spawning Ground Counts (2003-2015)
LIVE
DEAD
Pink
NUMBER OBSEREVED
SEASON SURVEYED
0
20
40
60
80
100
2003
2005
2007
2009
2011
2013
2015
2
1
3
50
25
69
31
31
15
45
28
17
18


2016 Clear Creek Chum Salmon Spawning Ground Counts and Run Timing
Chum
LIVE
DEAD
NUMBER OBSERVED
300
250
200
150
100
50
0
11/10/16
11/18/16
11/28/16
12/6/16
12/15/16
12/20/16
12/27/16
1/6/17
DATE SURVEYED


Clear Creek Seasonal Comparison of Chum Salmon Spawning Ground Counts (1994-2016)
Chum
LIVE
DEAD
NUMBER OBSERVED
1,600
1,400
1,200
1,000
800
600
400
200
0
4
0
122
83
131
29
110
50
163
114
303
196
201
260
478
460
233
340
788
642
1,088
680
426
276
796
436
479
166
382
162
17
4
206
72
1,043
741
349
262
631
600
902
707
208
157
493
392
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
SEASON SURVEYED

CLEARWATER RIVER

WRIA 10.0080

Steelhead Fry

The Clearwater River is a large tributary to the Upper White River, draining an area of nearly 40 mi². The Clearwater is a non-glacial river and originates on Bear Head Mountain, just west of the White River *(south of Greenwater)*. From Bear Head Mountain, the river flows just over 10.5 miles to its confluence with the White River at RM 35.3. The upper 5 miles of the river runs through a steep narrow channel within the Snoqualmie National Forest. The lower 5.5 miles of the Clearwater flows within a broader valley plain located within the privately owned White River tree farm *(owned by Muckleshoot Indians)*; currently managed by Hancock Forest Management.

Lower Clearwater River

Limited amounts of LWD are present in the lower channel, and much of what is present is undersized or hardwood in origin. There are a series of cascades just above Lyle Creek at approximately RM 4.5; these cascades are considered a block to further upstream migration. However, much of the spawning takes place in the lower 2 miles of the river, although fish and redds are often observed and documented in the upper reaches later in the season.

The substrate throughout much of the lower reach of the river consists of small cobbles and flat angular stone, with smaller spawning size gravel in the many of the lower gradient riffles and tail-outs. The riparian area is primarily second growth conifer forest; however, recent clear cutting is evident along several areas of the upper and lower survey reach. The Clearwater River hosts several tributaries; such as, Falls, Mineral, Byron, Lyle, Lilly, and Milky creeks. There is some limited coho and pink spawning in both Byron and Mineral creeks.

Some of the habitat and fish limiting factors associated with the Clearwater River include, water quality issues, timber harvesting *(heavier silt load intrusion)* and channel confinement by logging roads which continues to affected the rivers natural morphology. Channel confinement has reduced the adequacy of off channel habitat critical for adult spawning, as well as overwintering for juvenile Chinook, steelhead and coho. In addition, low in-stream flows are often encountered during the late summer and early fall, and can prevent Chinook from advancing beyond the lower 1 or 2 miles of the river to spawn. Chinook, pink and coho are often seen holding in pools in the lower river for extended periods of time before increased flows *(freshet)* allow further upstream migration. Despite these deficiencies, the Clearwater River continues to support a substantial number of Chinook, coho, pink and steelhead spawners. Bull trout utilization is unknown, but presumed. Predation and scavenging is common along the Clearwater. Observations and signs of black bear *(Ursus*

Engineered Log Jam (ELJ).

americanus-photo below) and river otter (*Lutra canadensis)* are prevalent.

Black bear tracks at the mouth of Clearwater

It's important to note that all adult salmon and steelhead that spawn in the Clearwater River were captured at the USACE fish trap in Buckley, and transported above Mud Mountain dam. Since precise escapement numbers for the upper White River drainage are known, surveys are conducted to determine fish distribution and spawning success. This is especially important regarding Spring Chinook, since adult production monitoring is part of the White River Spring Chinook Recovery Plan. Puyallup tribal fisheries biologists survey the Clearwater annually for Chinook, coho and pink *(odd years)* salmon. Coho have been observed in the Clearwater since surveys began for Chinook in 1991, but were not surveyed for until 2002. Coho survey data is often incomplete because it's often difficult to survey the river when late autumn and winter flows increase. The first pink salmon surveys were conducted beginning in 2003. Prior to 2003, few or no pinks were captured at the Buckley trap to be transported upriver to spawn. Biologists with WDFW or MIT regularly survey the Clearwater for steelhead spawning activity in the spring.

As part of the Spring Chinook recovery plan, the Puyallup Tribe has operated a Spring Chinook acclimation pond since 1995. Prior to 2009, approximately 200,000 plus Spring Chinook from the Muckleshoot White River hatchery were transported to the Clearwater pond on Mineral Cr. in early spring, and released in late May. All Spring Chinook destined for acclimation ponds fish are mass marked with left or right ventral fin clips. Odd brood years are marked with left ventral clips, and even years with right ventral clips. These acclimation pond fish are easily identified in the future when caught as adults or jacks at the USACE fish trap in Buckley, and can be passed above Mud Mountain dam to spawn naturally. Unfortunately, the road accessing the Mineral Cr. acclimation pond was washed out in January, 2009. The active river channel currently occupies the old road base; preventing future repairs and access to the pond site and the acclimation pond has since been decommissioned. Construction of a new acclimation pond, located approximately one mile downstream near Jensen Creek, began in July 2012 *(lower right)*, and was completed in late August. The new pond will be utilized to enhance both White River Spring Chinook and winter steelhead. In addition, a large woody debris enhancement project through SPSSEG slated for the lower Clearwater in 2012, was initiated during the summer of 2013 *(see following page)*. Also, the installation of a USGS flow gauge at the 6050 road bridge in 2011 will help correlate fish spawning density, and upstream access extent, with instream flows.

Jensen Creek acclimation pond

Clearwater River Floodplain Restoration Project

Written by: Kristin Williamson
Salmon Restoration Biologist
South Puget Sound Salmon Enhancement Group
(Reprinted with Permission)

Project Description

The Clearwater River Floodplain Restoration Project is planned to address major limiting habitat factors and impaired processes on the Clearwater River through strategic placement of large wood

structures and removal of nearly a mile of road from the historic floodplain. Historically, the Clearwater River meandered through a forested valley floor with large trees, a dense canopy, and a system of branching channels. The advent of timber harvest in the watershed and construction of a rail line (now road) in the Clearwater River floodplain for transport of timber in the early 1900s removed critical riparian structure from the valley floor and confined the floodplain. Loss of the riparian buffer has resulted in easily erodible banks due to root loss and associated soil cohesion, dramatic reductions in large wood debris recruitment to the stream channel, and loss of overhanging vegetation.

Channel spanning Engineered Log Jam (ELJ)

Project efforts would install up to 39 wood structures of varying types and sizes to meter natural wood through the system, trap sediment, and aggrade incised sections of the channel for the long term reconnection of a network of 19 side channels in the floodplain. The project would also decommission nearly a mile of road and remove 10 associated culverts. Removal of three of the culverts would provide immediate improved passage to wall-based wetland channels, and the removal of the other 7 would provide long term access to spring fed channels and alluvial fans currently impounded by the road.

The Puyallup and White River Salmon Recovery Strategy specifically identifies the Clearwater River as a high priority geographic area for White River Spring Chinook recovery, as determined by Mobrand EDT modeling. By extension, this project will also benefit other native stocks, including coho and pink salmon, steelhead, and bull trout. This project will specifically address strategic priorities identified within the strategy including: increasing the quantity and quality of instream habitat through input of wood structures and improving the riparian conditions in the watershed through abandonment and decompaction of a stream adjacent road prism and active plantings.

Watershed and Aquatic Benefits:

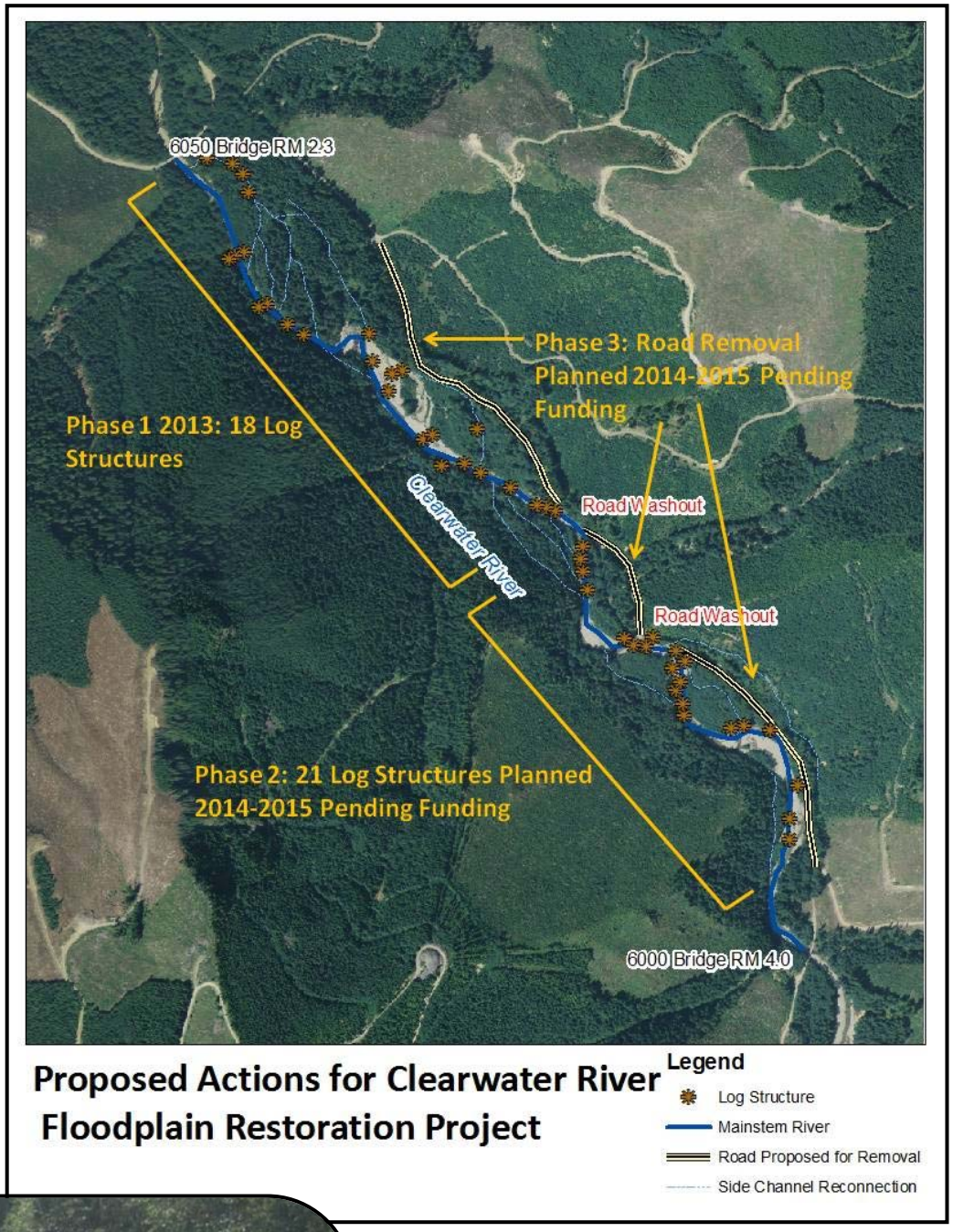
The overall goal of the project is to increase spawning and rearing capacity of the watershed for Spring Chinook, steelhead, coho, pink, and coastal and resident cutthroat species. Realized benefits from project actions will include:

- Activate 14.5 acres of historic floodplain through road decommissioning and removal of 10 culverts.
- Active 70 acres of floodplain through placement of wood structures and subsequent aggradations of the channel bed.
- Activate 19 existing side channels and promote the formation of new side channels through channel migration.
- Dissipate flood energy through placement of wood structures to partition sheer stress.
- Increase quantity and quality of instream, pool, and refuge habitat through placement of wood structures.
- Improve riparian function through abandonment/ripping of a stream adjacent road.
- Establish a riparian corridor on former road prism through planting of 2,500 native trees.

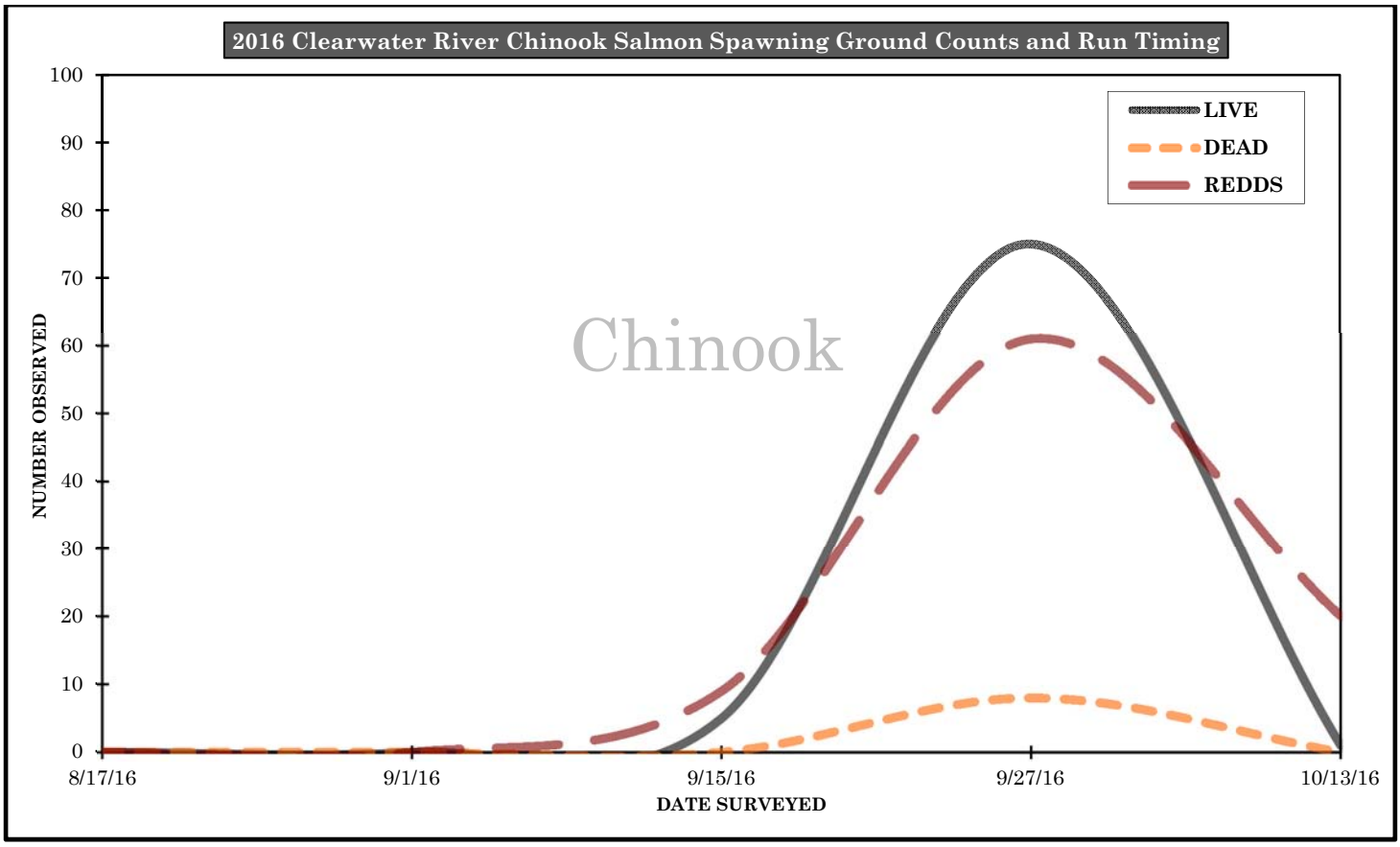
Progress to Date (Completed 2015)

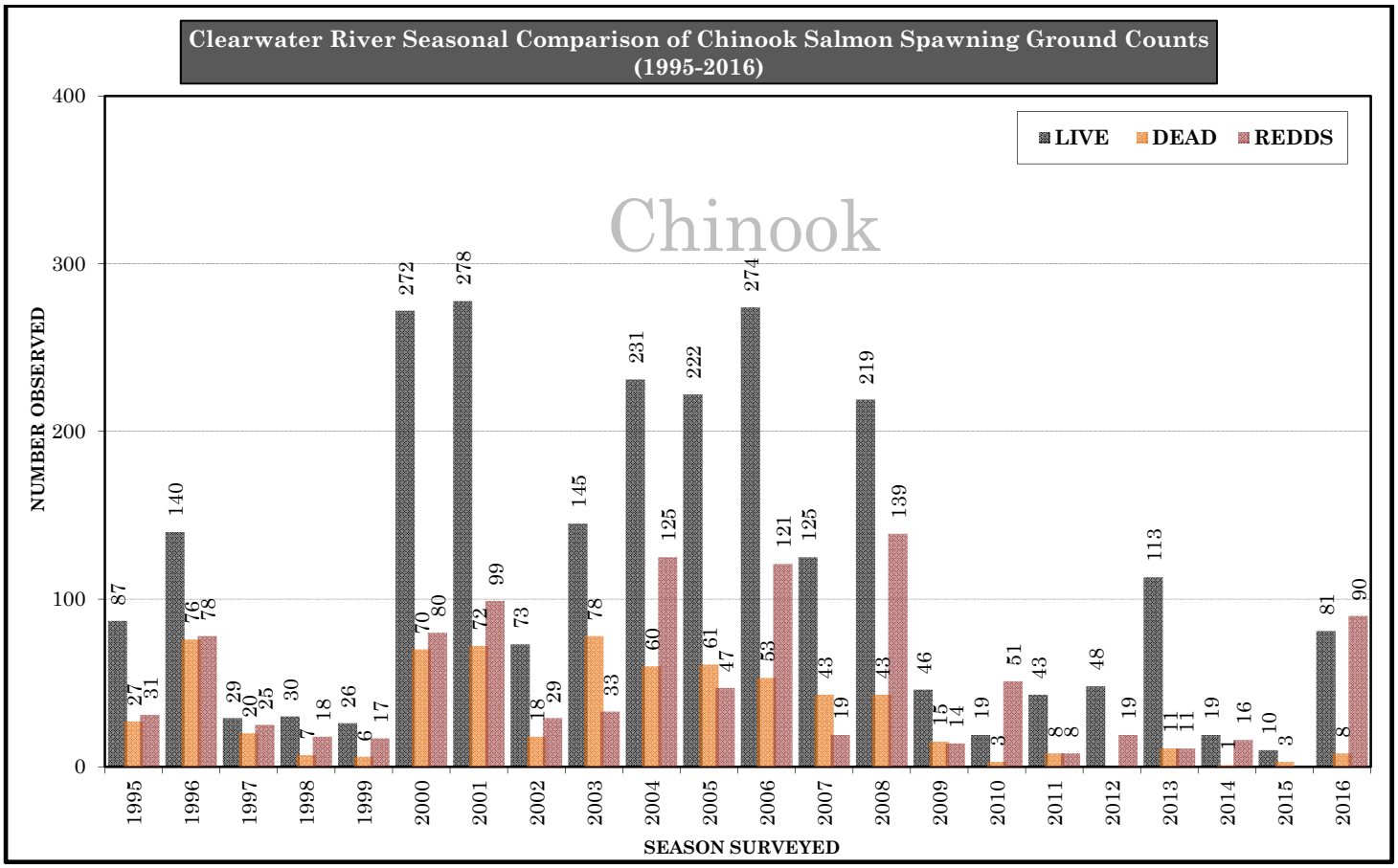
A total of 18 large and small engineered log jams were installed in the Clearwater River between river mile 2.3 and 3.1 in summer 2013. Placement of these log jams will activate flows to a network of 11 existing side channels, dissipate flood flows, and increase instream structure and cover in the river. This work completed about half of the proposed work plan. An additional 10 ELJ's *(below)* were installed during the summer of 2015; as well as the decommissioning of the old roadway from the 6000 bridge to the lower washout *(phase 2&3)*.

ELJ- Summer 2015

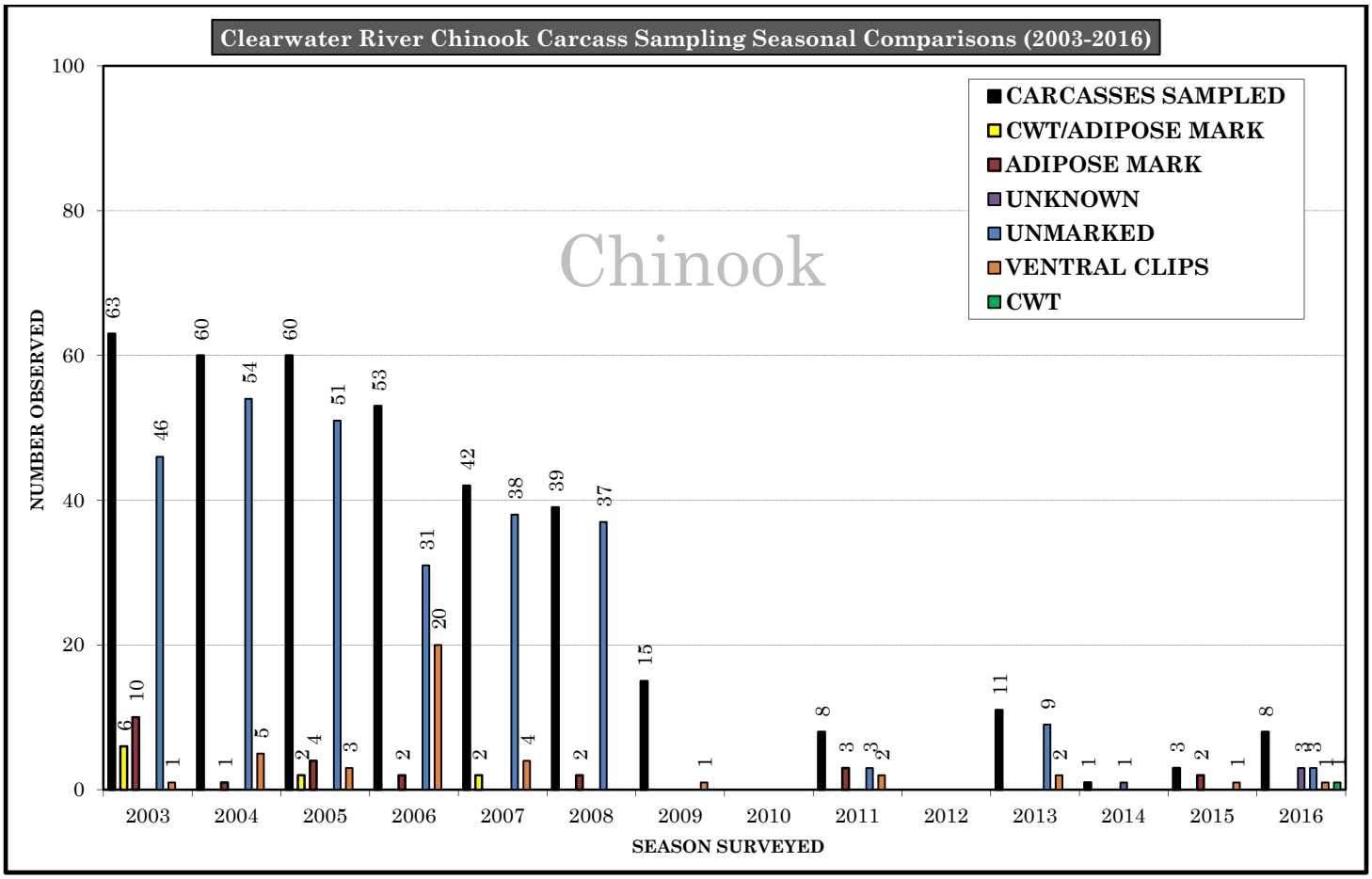


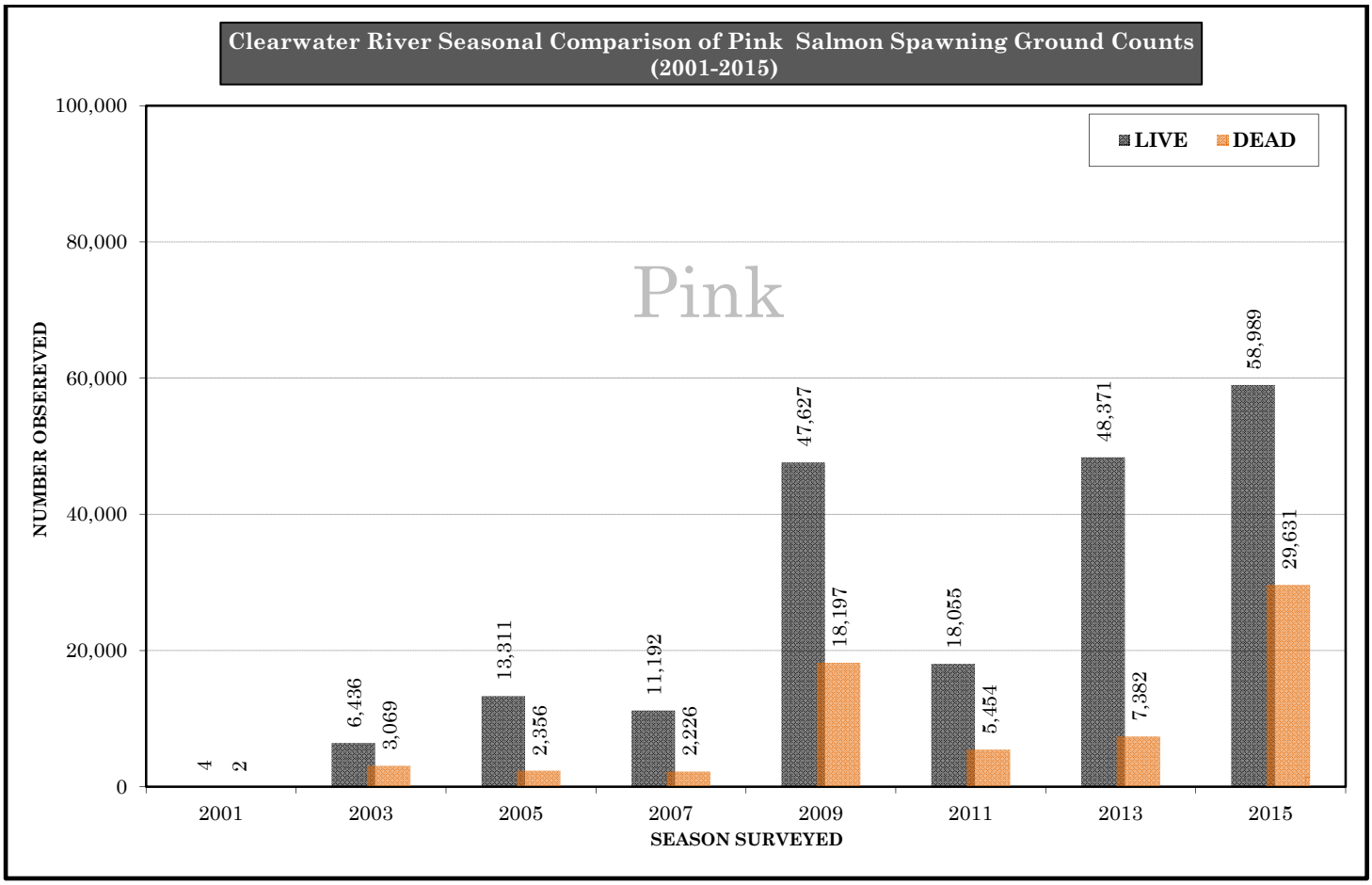
ELJ-Summer 2015

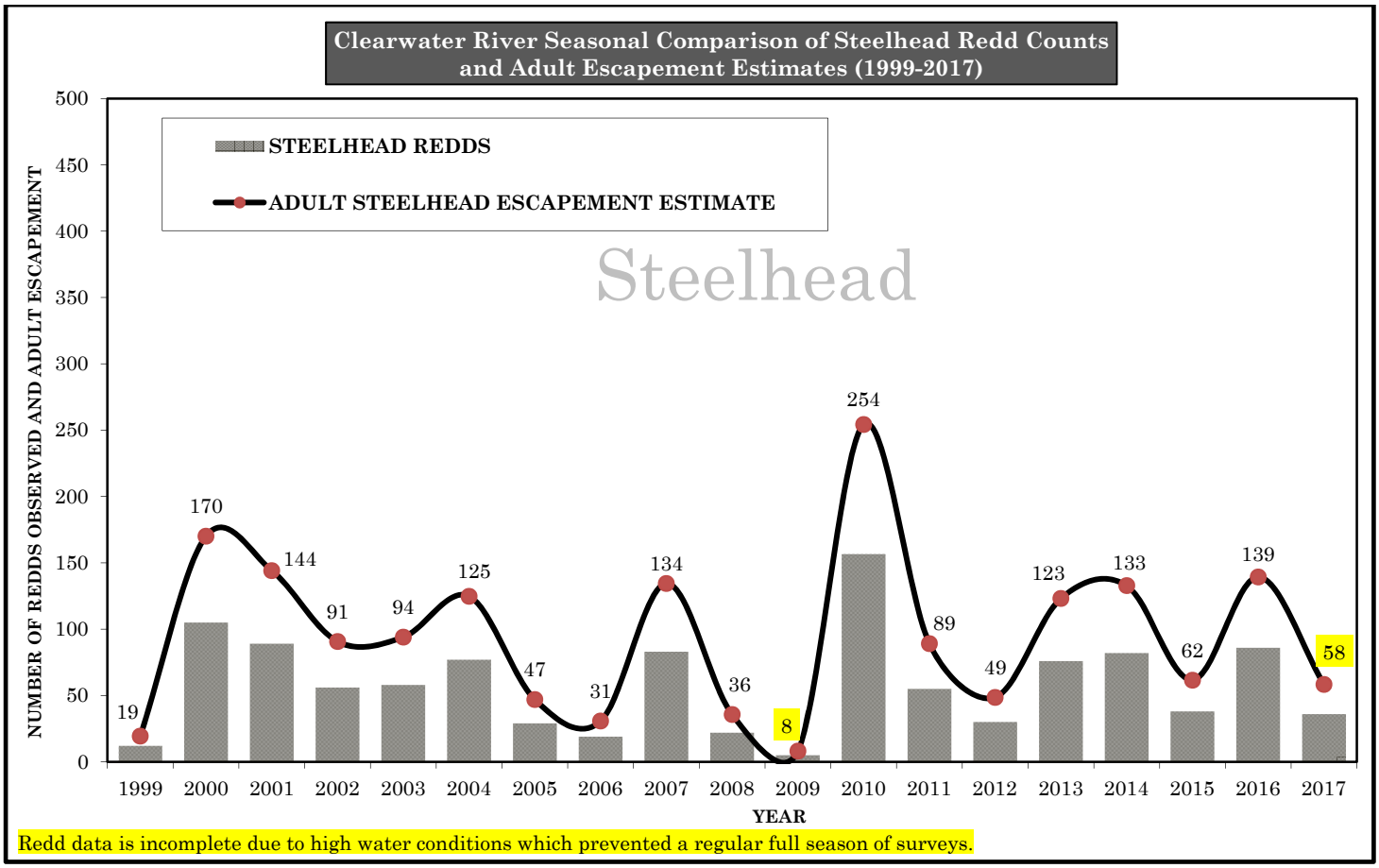




Adult Chinook escapement is determined by expanding the number of redds observed by 2.5 fish per redd (Smith and Castle, 1994). Due to the tremendous volume of pink salmon during odd years, the success of determining Chinook redds from pinks is vastly reduced. Therefore, The AUC method is used to determine escapement during pink runs (odd years).

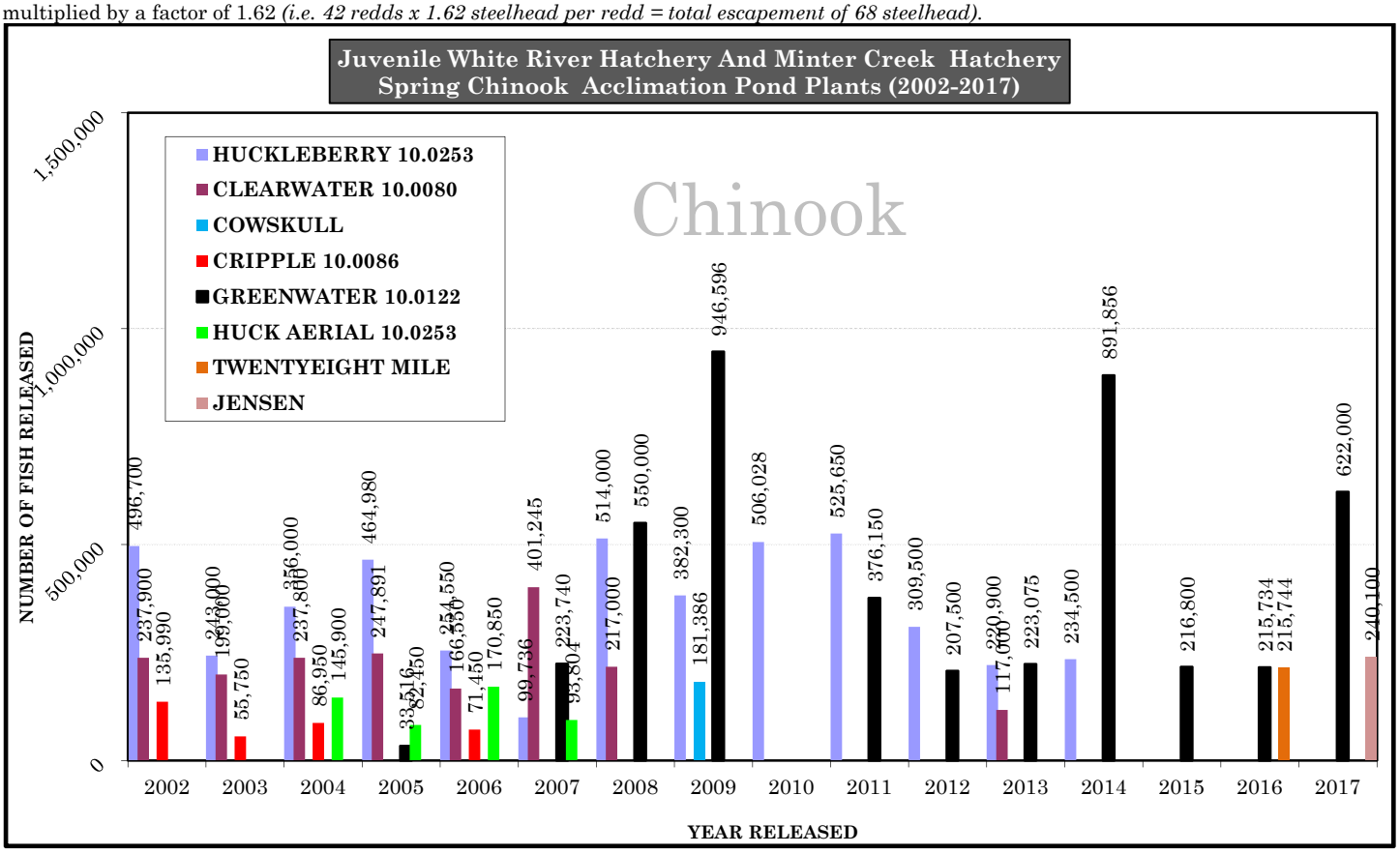

Clearwater River Chinook Carcass Sampling Seasonal Comparisons (2003-2016)
Chinook
CARCASSES SAMPLED
CWT/ADIPOSE MARK
ADIPOSE MARK
UNKNOWN
UNMARKED
VENTRAL CLIPS
CWT
NUMBER OBSERVED
SEASON SURVEYED
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016
63 6 10 46 1 60 1 54 5 60 2 4 51 3 53 2 31 20 42 2 38 4 39 2 37 15 1 8 3 3 2 11 9 2 1 1 3 2 1 8 3 3 1


Clearwater River Seasonal Comparison of Pink Salmon Spawning Ground Counts (2001-2015)
Pink
LIVE
DEAD
NUMBER OBSEREVED
SEASON SURVEYED
2001 2003 2005 2007 2009 2011 2013 2015
4 2 6,436 3,069 13,311 2,356 11,192 2,226 47,627 18,197 18,055 5,454 48,371 7,382 58,989 29,631

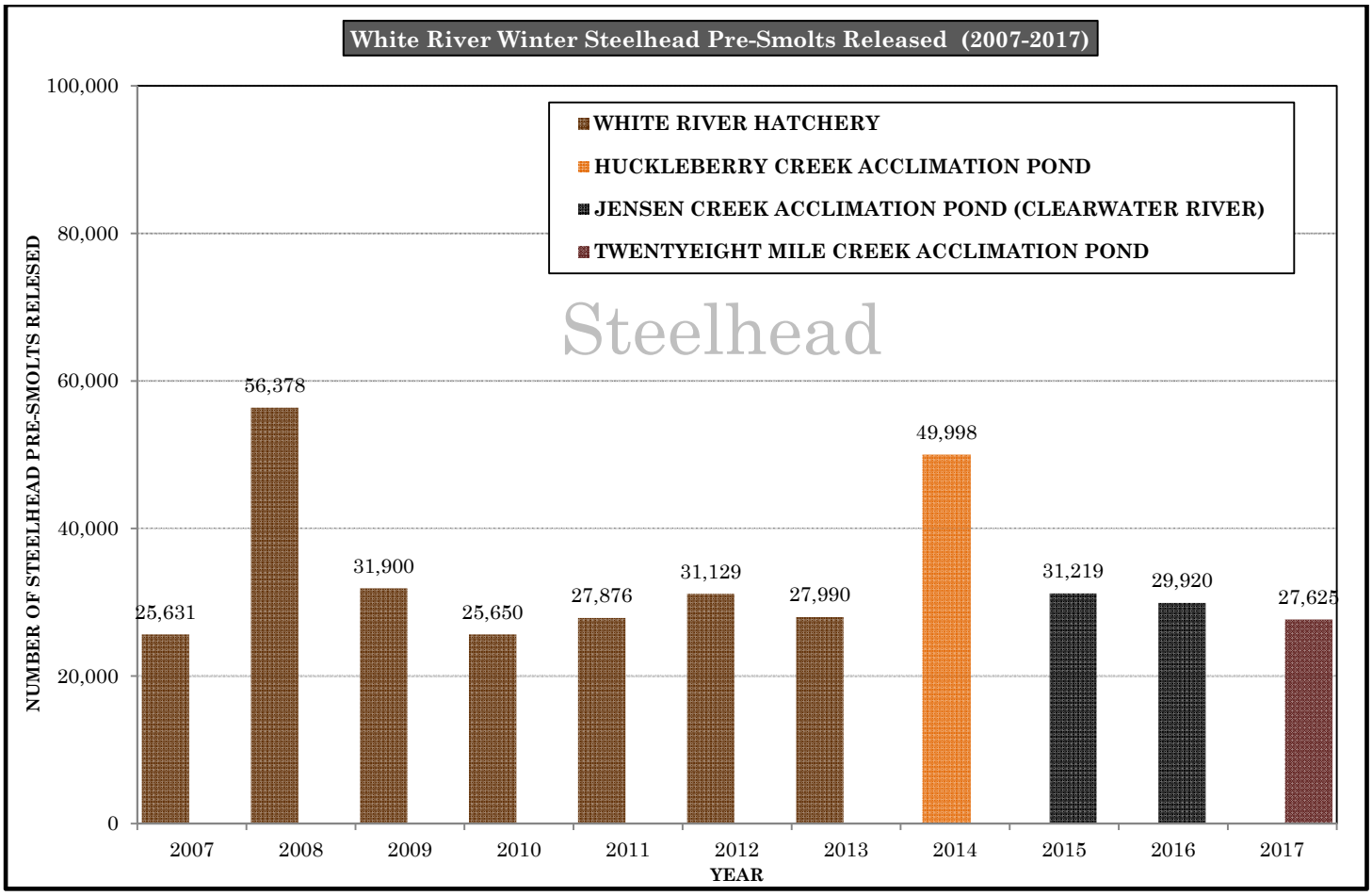


Redd data is incomplete due to high water conditions which prevented a regular full season of surveys.

All adult salmon and steelhead that spawn in the Clearwater River were captured at the USACE fish trap in Buckley, and transported above Mud Mountain dam. Since precise escapement numbers for the upper White River drainage are known, surveys are conducted to determine fish distribution and spawning success. All survey data collected by WDFW/MIT biologists. To determine the total escapement for steelhead, each redd is multiplied by a factor of 1.62 *(i.e. 42 redds x 1.62 steelhead per redd = total escapement of 68 steelhead).*



Acclimation ponds opperated by Puyallup Tribe. See map of acclimation pond location sites on Page 41. No data indicates no fish were planted.



Acclimation ponds opperated by Puyallup Tribe. See map of acclimation pond location sites on Page 41.

COAL MINE CREEK

WRIA 10.0432A

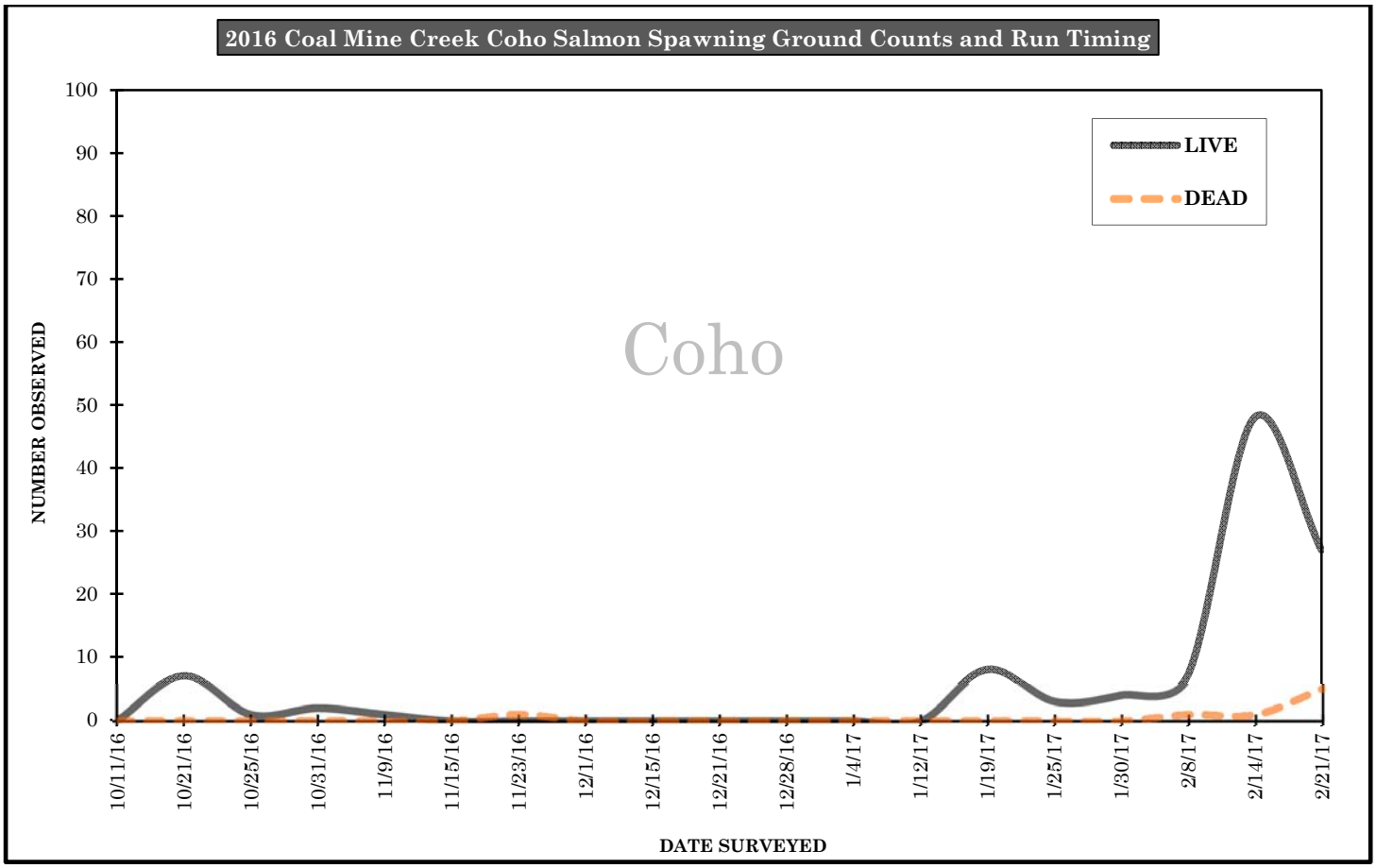
Coal Mine Creek, which derived its name from the local areas profound history in the coal mining industry, is a small tributary to Wilkeson Creek *(10.0432)*. Wilkeson Creek in turn is a major tributary to South Prairie Creek *(10.0429)*. The creek flows southwest for just over a mile before entering Wilkeson Creek near RM 5.7, just south of the community of Wilkeson.

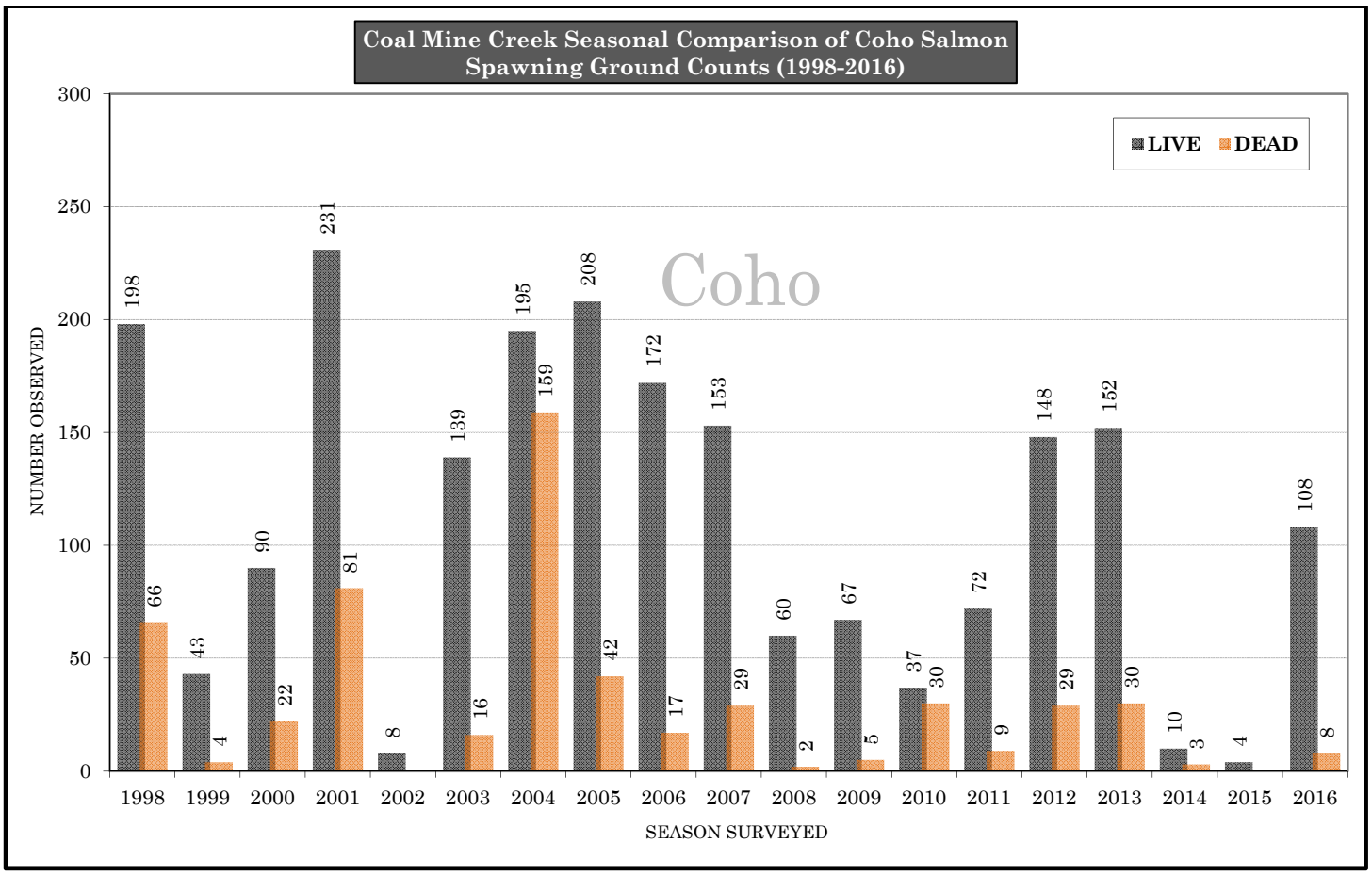
Coal Mine is one of 5 index streams in the Puyallup Watershed that is surveyed for coho by the Washington Department of Fish and Wildlife. State biologists use the coho escapement from five "Index" tributaries *(Coal Mine, Spiketon, Fiske, Fennel and Canyonfalls)* to estimate the total escapement for the Puyallup River. Surveys of the creek over the past decade have yet to document adult Chinook or steelhead spawning utilization. Low instream seasonal flows in Wilkeson, as well as Coal Mine, are likely the strongest limiting factors preventing these species from reaching the stream to spawn. Although inconsistent from season to season, small numbers of chum have been observed spawning in Coal Mine during the month of December. Bull trout utilization within this small stream is unknown.

Coal Mine is a small order short run stream with moderately low gradient; making it somewhat ideal for coho, pink and chum. Unfortunately, the majority of the steam has little complexity; several portions of the creek have minimal natural bank protection, little or no instream woody debris or quality spawning gravel. However, the creek does provide good quality rearing and overwintering conditions for juvenile salmonids. Coho juveniles are frequently observed throughout the entire surveyed reach of the creek. Cutthroat are also ever-present in this small rural stream. It is likely that juvenile steelhead, the offspring from adult spawners in Wilkeson Creek, utilize Coal Mine for rearing, foraging and overwintering as well.

Moderate rural development exists along the lower 0.5 mile section of the creek; consisting primarily of private family homes, county and private roads, as well as a rock quarry and public school. The creek flows through a fish passable cement box culvert approximately 0.15 miles up from the mouth, and a second culvert near RM 0.6. When the fish passable box culvert was installed under Railroad Avenue several years ago, some complexity had been added to the creek via a small restoration project which included the placement of small sill logs, root wads, boulders, along with native tree and vegetative plantings. The alder along the banks have since grown to provide improved coverage of the stream *(top left photo)*.

Spawning opportunities are noticeably reduced downstream of the culvert crossing at Railroad Ave. due to a narrow confined channel, in addition to the absence of suitable spawning gravel *(right photo)*. Most of the substrate through this section consists of fine silt, sand, and exceedingly small patches of undersized gravel; however, relatively abundant spawning gravel exists above the culvert. Nevertheless, several silt deposits exist throughout the entire surveyed section. The rock and gravel quarry site located near the creek is one of the suspected sources of the silt.





Coal Mine Creek coho graphs were generated using survey data collected and provided by WDFW biologists.

COW SKULL CREEK

SALMON ACCLIMATION POND

Cowskull Cr. natural acclimation pond

Cow Skull Creek is not officially named by the Washington State Board on Geographic Names; however, for easy identification the creek is referred to as "Cow Skull" by PTF staff. Cow Skull Creek is a small left bank tributary to the upper Puyallup River, entering the Puyallup at RM 45.5. Unfortunately, anadromous salmon were unable to access Cow Skull for nearly a century due to the streams location upstream of the Electron diversion dam. With the completion of the Electron fish ladder *(@ RM 41.7)* in the fall of 2000, anadromous fish passage was restored for the first time since 1904. Restoring anadromous access to the upper Puyallup River has made approximately 26+ miles of spawning, rearing, and foraging habitat above the diversion available for several species, including Chinook, coho, pink, steelhead, and bull trout. Cow Skull is the location of one of two acclimation ponds used for reestablishing coho, and occasionally Chinook *(spring & fall)*, into a 26+ mile reach of the Upper Puyallup River. Acclimation ponds are a proven method in increasing fish numbers on the spawning grounds. The pond is located just off the main channel of the Puyallup at RM 0.1. The pond holds approximately 14,000 cu. ft. of water with a flow rate of 1-3 cfs; in past years (2001-2007), 20,000 to 100,000+ coho yearlings were imprinted and released from Cow Skull annually. Coho yearlings originated from Voights Creek Hatchery, where they were adipose clipped and coded wire tagged for future identification. Fish were released at 20 fish per pound, for a total biomass of 10,000 pounds. When available, Fall Chinook are acclimated in Cowskull as well. During the summer of 2015, the pond was given its first maintenance dredging since it was originally constructed. This was necessary due to more than half of the ponds capacity being lost due to sediment build-up.

The Cow Skull drainage flows within the Kapowsin tree farm, which is private timber property managed by Hancock. This high mountain stream originates from snowpack accumulations near 3,400'; as well as, surface and groundwater from the surrounding valley. Cow Skull is non-glacial and flows northwest through a steep narrow valley for much of its 1.2 mile length. The gradient decreases substantially over the lower 0.46 miles; in so doing, provides beneficial habitat for fish rearing, foraging and spawning. Cow Skull supports juvenile Chinook *(planted)*; as well as juvenile and adult coho *(planted and NOR),* and cutthroat. Steelhead and bull trout utilization is unknown. However, bull trout utilization is presumed, to some degree, since the upper Puyallup is a documented occupied habitat area.

Watershed Fish Enhancement Program

Project Description: The Puyallup Tribe operates several acclimation ponds in the Puyallup/White River Watershed designed to reestablish and enhance Spring/Fall Chinook, winter steelhead and coho stocks. Each of two acclimation ponds *(Cowskull & Rushingwater)* on the Puyallup would receive as many as 100K+ hatchery origin Spring/Fall Chinook and/or coho. Additional acclimation ponds located in the Upper White River drainage *(Huckleberry Cr., Greenwater River (George Cr.), Twentyeight Mile Cr. (Greenwater R.)& Jensen Cr.(Clearwater R.)* would be planted collectively with up to 900K+ White River Spring Chinook and 25K+ White River winter steelhead pre-smolts. The newest pond located

on 28 Mile Creek *(Greenwater River)* was completion in the fall of 2015. The Jensen Creek pond, in the Clearwater River drainage, was completed in the fall of 2012. When obtainable, the Puyallup Tribe will collect, haul and plant surplus adult hatchery Fall Chinook and coho from WDFW's Voights Creek hatchery to spawn naturally in minor spawning or underutilized areas.

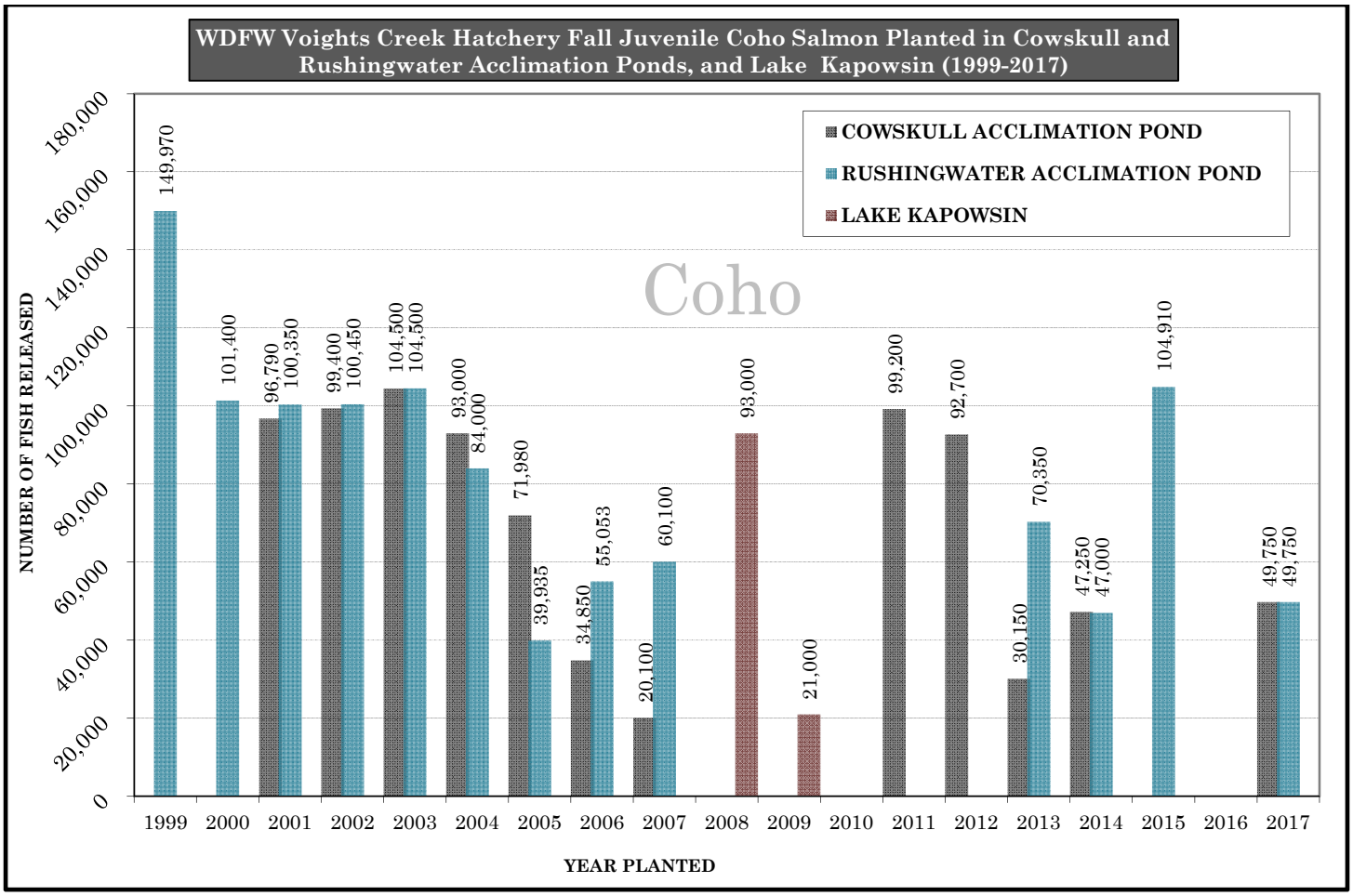
Goals, Purpose and Expected Benefits: One of the Puyallup Tribe's most significant restoration goals is to rebuild depressed Chinook and steelhead stocks and remove them from ESA listing. Acclimation ponds, juvenile in-stream plants and adult surplus fish plants are a proven method for increasing fish stocks, and are key component to restoration goals. Using acclimation ponds, limiting harvest and creating substantial gains in habitat restoration, the tribe will be able to accomplish restoration goals. Levee setbacks, oxbow reconnections both inter tidal and upland, Commencement Bay cleanup, and harvest cutbacks have already been initiated.

Purpose:

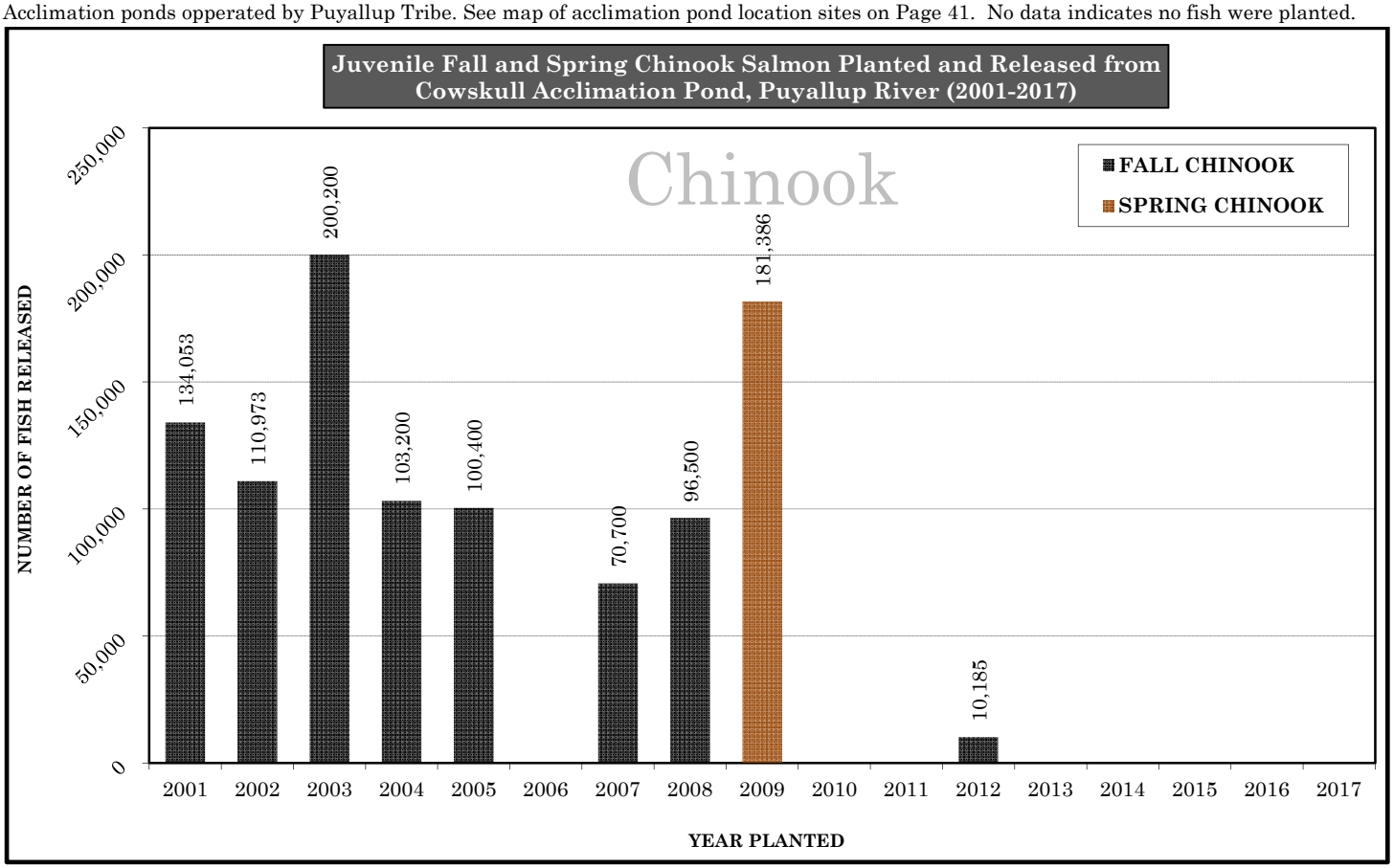
- Produce Spring/Fall Chinook, winter steelhead and coho for the Puyallup/White River salmon conservation and harvest programs.
- Establish a total annual return of Spring Chinook Natural Origin Recruits (NORs) that meets the escapement goals for White River Spring Chinook Recovery.
- Provide sustainable harvest for tribal and non-tribal fisheries on Fall Chinook and non ESA listed coho.
- Optimize hatchery and natural production consistent with the conservation of naturally produced native fish.
- Maintain genetic makeup of Chinook and steelhead populations spawned or reared in captivity.

Benefits:

- Reestablish and enhance ESA listed Spring/Fall Chinook and steelhead; as well as non-listed coho into their endemic ranges.
- Increased total abundance of the composite natural/hatchery population.
- Increased spawning ground escapement and trend of Natural Origin Recruits (NORs).
- Improve distribution *(out planting of live fish)* of salmon to minor spawning and underutilized rearing habitat areas.
- Provide future tribal and sport harvest opportunities.
- Nutrient enhancement in oligotrophic *(nutrient-poor)* streams.



Acclimation ponds opperated by Puyallup Tribe. See map of acclimation pond location sites on Page 41. No data indicates no fish were planted.



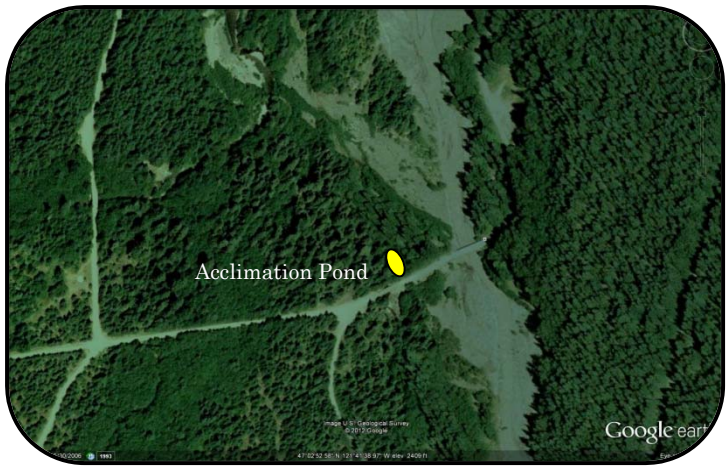
Acclimation ponds opperated by Puyallup Tribe. See map of acclimation pond location sites on Page 41. No data indicates no fish were planted.

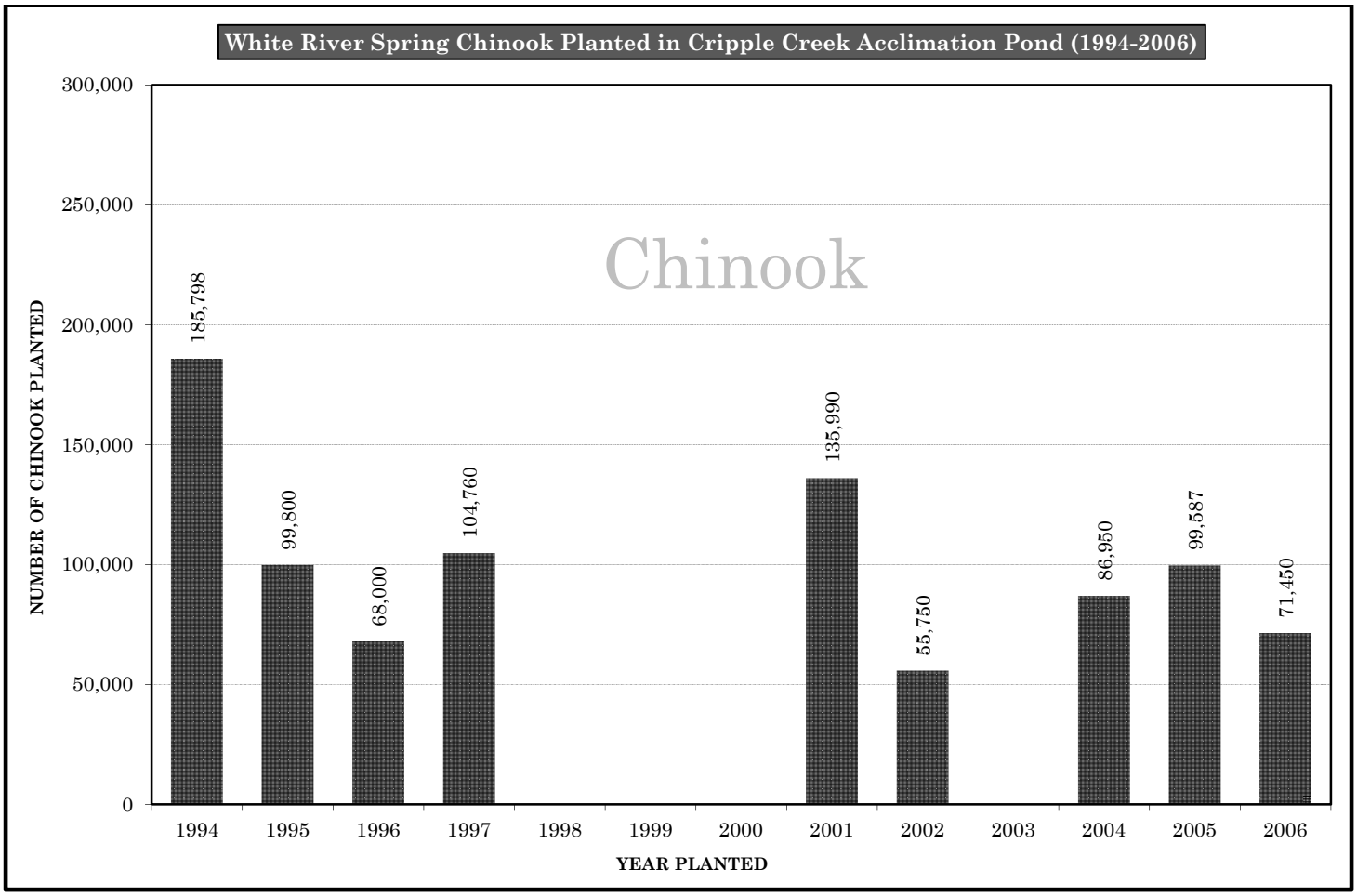
CRIPPLE CREEK

Cripple Creek is a short-run tributary that flows within the West Fork White River flood plain. The stream channel has a moderate amount of stream complexity created by a few well-placed pieces of LWD; in addition to the stream natural sinuosity. Cripple quickly joins Pinochle Creek approximately 0.5 miles above Pinochle's confluence with the West Fork White River. Cripple Creek flows through a low gradient pool riffle channel with generally thick, brushy riparian cover; as well as a mix of coniferous and deciduous trees. The substrate contains a large amount of fine materials, but several small patches of suitable spawning gravel exist throughout the entire reach. Coho frequently spawn within the lower 0.3 miles of the creek; however, low flows can prevent Chinook from accessing the creek to spawn in August and early September. Other species known to utilize the creek include pink, sockeye, cutthroat, rainbow and bull trout.

Cripple was surveyed for adult salmon escapement, and is the site for one of the Puyallup Tribe's acclimation ponds. Unfortunately, flood damage to Forest Service Road 74 has prevented access to the creek since 2006; so, no escapement surveys or fish plants have occurred since. All adult salmon that spawn in Cripple Creek were initially captured at the USACE fish trap in Buckley, and transported above Mud Mountain dam. Specific escapement numbers for the upper White River drainage are known; therefore, surveys were conducted to determine fish distribution and spawning success. This is especially important regarding Spring Chinook, since adult production monitoring is part of the White River Spring Chinook Recovery Plan. Also, as part of the recovery plan, the Puyallup tribe operated a Spring Chinook acclimation pond located at RM 0.3 *(right)*. Spring Chinook were reared and released from Cripple Creek for several years *(1994-2006)*. Approximately 50,000 plus Spring Chinook from the Muckleshoot White River hatchery were transported annually to the Cripple Creek acclimation pond in early spring, and released in late spring. Returns to this small stream, as well as Pinochle and Wrong creeks, are likely the result of these earlier plantings. The current state of the acclimation pond is unknown; however, when access is reestablished, it is anticipated that the pond can be reutilized and spawning surveys will resume. Although the ponds capacity is relatively small, its low elevation makes it ideal in terms of accessibility during seasons of high snowfall.

Acclimation pond





Acclimation ponds opperated by Puyallup Tribe. See map of acclimation pond location sites on Page 41. No data indicates no fish were planted.

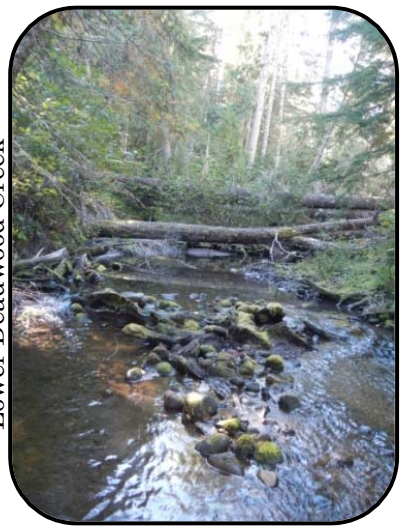
DEADWOOD CREEK

WRIA 10.0355

Deadwood Creek is a significant right bank headwater tributary to the White River. The creek is exclusively surveyed for bull trout from late August through early October, and is not surveyed for other species because, with the exception of steelhead, its elevation is likely too high for most salmon. In 2007, PTF biologists observed pink salmon in Sunrise Creek *(elev. 2800')* which is located just inside the National Park boundary, approximately 4.5 miles downstream of Deadwood. This is the highest point on the White River that adult salmon have been documented by the Puyallup Tribe since surveys began in 2000.

Deadwood Creek is a phenomenal non-glacial stream, originating from the Deadwood Lakes *(elev. 5236')* near Yakima Peak *(Chinook Pass)*. Deadwood is a north facing stream flowing entirely within Mt. Rainier National Park. Deadwood enters the White River at approximately RM 67.5, roughly 0.4 miles downstream from Klickitat Creek. The creek is surrounded by old growth and the water temperature is tempered by cold clear water year round. Deadwood flows for approximately 2.5 miles from upper Deadwood Lake to its convergence with the White River; however, only the lower 0.45 miles provides spawning and rearing opportunities. A single unnamed tributary adds flow to Deadwood; unfortunately, it does not contribute any beneficial spawning or rearing habitat given it is located above natural anadromous barriers.

Deadwood provides exceptional habitat conditions for bull trout rearing and spawning. The first 0.1 miles is low gradient, with significant fines and sparse spawning gravel; as well as significant amounts of in-channel LWD *(center)*. The next 0.44 miles flows through the perimeter of the forested area along the White River channel. The creek channel contains several pieces of LWD *(left)* and abundant spawning gravels, in addition to a heavily mixed conifer riparian overstory. Numerous pools and side channels provide excellent habitat for all life history stages of bull trout; from newly emerged fry to adults. At approximately RM 0.45, the creek curves and swiftly climbs up the valley wall. At this point the stream quickly develops into a series of impassable cascades preventing any further upstream migration. Numerous surveys have been conducted above this point; however, no fish or redds have been observed, nor have any other salmon species been observed spawning in the creek. Fluvial and residential bull trout are observed spawning in the creek during late summer and early fall. In addition, juvenile bull trout have been observed within pools and lateral habitats during annual surveys. The few dead bull trout encountered during surveys appear to be pre-spawned mortalities due to predation.



Lower Deadwood Creek

For three seasons *(2005-2007)*, PTF biologists conducted extensive bull trout migration telemetry studies in conjunction with redd surveys along the upper White River and West Fork White River. The study focused heavily on the headwater tributaries located within and adjacent to Mt. Rainier National Park. Study results showed that the cold high mountain streams locat-

ed within the park provide the majority of the critical bull trout spawning habitat within the basin.

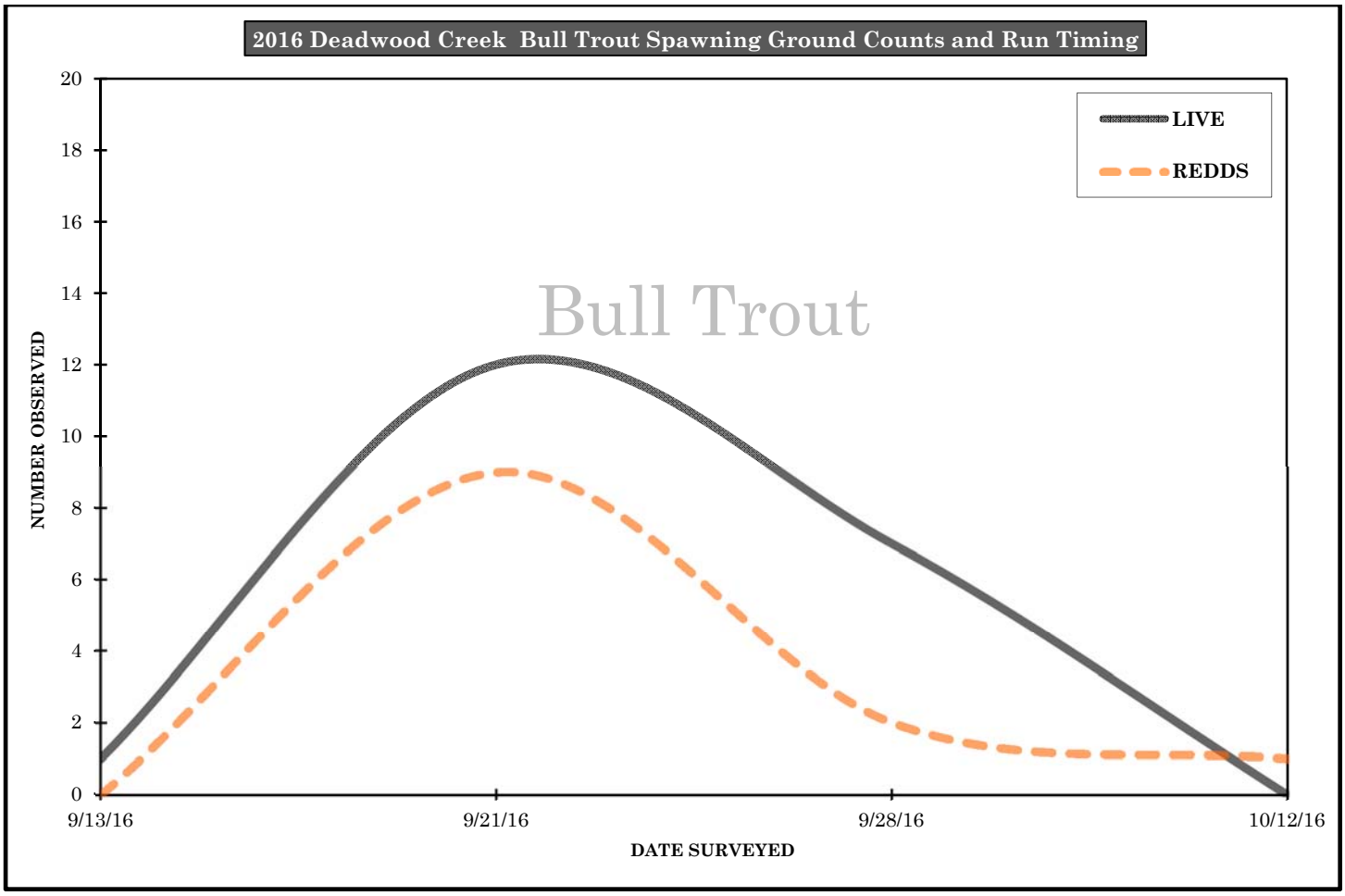
Resident bull trout reside in smaller headwater tributaries, while fluvial bull trout frequently travel long distances; utilizing the mainstem rivers and larger tributaries to forage and overwinter. During the fall, migratory forms of bull trout journey from spawning and rearing habitats in the upper watershed to foraging and overwintering habitats located lower in the river system. Beginning in spring and early summer, they begin the return journey back to spawning and foraging areas high in the watershed. In response to changing habitat and reproductive needs, migratory bull trout in the White River travel up to 75 miles or more between the lower river and headwaters located in or near Mt. Rainier N.P. To accomplish this, bull trout require unobstructed migration corridors and connectivity of streams and rivers in order to provide them with access to spawning, rearing, foraging, and overwintering habitats.

Bull trout

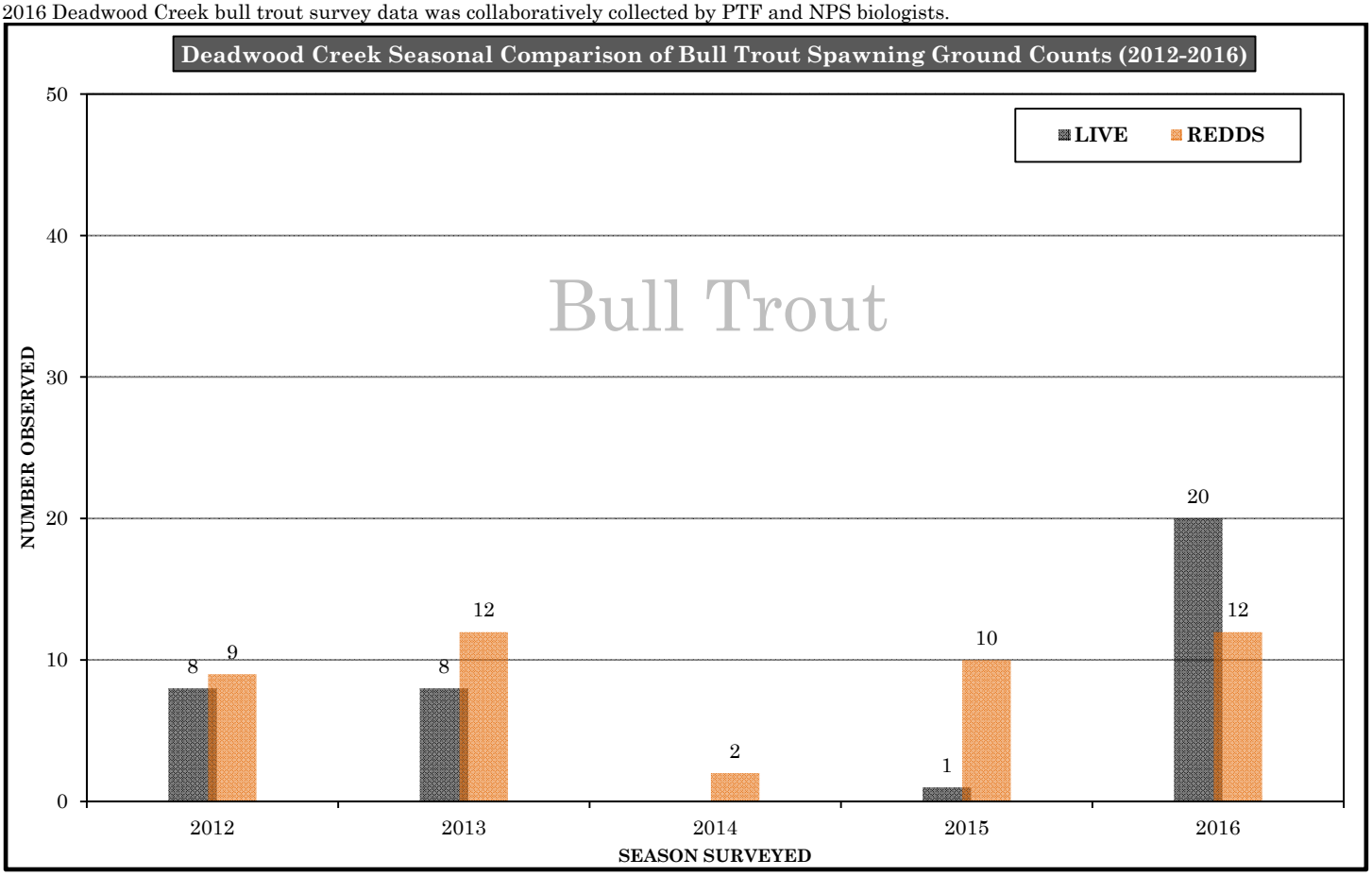
Bull trout spawning occurs primarily during the first three weeks in September, however, spawning has been observed taking place from the last week of August through the first week of October. Bull trout are iteroparous *(have the ability to spawn more than once)*; therefore, recovering pre-or-post spawn mortalities for examination is extremely rare. Spawners in the upper White River tributaries are observed utilizing various sized substrate from small gravels to small cobble. Redds are often constructed in the tail-out of pools and along channel margins. Embryonic development is slow *(depending on water temperatures)*; it may take between 165-235 days for eggs to hatch and for alevin to absorb their yolk (Pratt 1992). Bull trout fry emerge in late winter and early spring. Young fry can be seen by mid-March foraging in the lateral habitat along the upper mainstem White River and associate tributaries.

Bull trout habitat throughout the Puyallup and White rivers has been severely impacted by over a century of land and water resource exploitation; including, damming and substantial water diversions, considerable riparian alterations *(deforestation)*, dewatering and low instream flow regimes, as well as significant channel manipulation. These impacts have lead to a marked deterioration in land and hydrological behavior within these river systems by causing water flow of poorer quality, quantity and timing. Several limiting factors are involved with regards to the healthy function of stream habitat and bull trout populations in the watershed; including lost or diminished habitat connectivity and migration corridors *(human-made fish passage barriers)*, fragmentation and reduction of habitat quality *(entrainment, transportation networks, forest management practices and operations, direct water withdrawal)*; in addition to, water quality, fish entrainment and entrapment, unknown species interactions, and potential climate change impacts *(changes in flow regimes, scour effects, thermal variations, changes in water chemistry)*.

Bull trout are primarily piscivorous *(fish eaters)*; however, they are opportunistic feeders, feeding on a variety of prey items depending on their particular life history strategy and stage of development. Adults feed almost exclusively on other fish, including a range of salmon and trout species; as well as other resident fish species. Juveniles feed on aquatic invertebrates, including stoneflies *(Plecoptera)*, caddisflies *(Trichoptera)*, and mayflies *(Ephemeroptera)*. Bull trout require a healthy aquatic environment in order to survive and flourish. They need an environment that provides the necessary prey base; in addition to the rearing and reproductive habitat essential to ensure their continued survival and reproductive success. The USFWS finalized bull trout recover plan is available at: *http://www.fws.gov/pacific/bulltrout/pdf/Final_Bull_Trout_Recovery_Plan_092915.pdf*.



2016 Deadwood Creek bull trout survey data was collaboratively collected by PTF and NPS biologists.



DEER CREEK

WRIA 10.0685

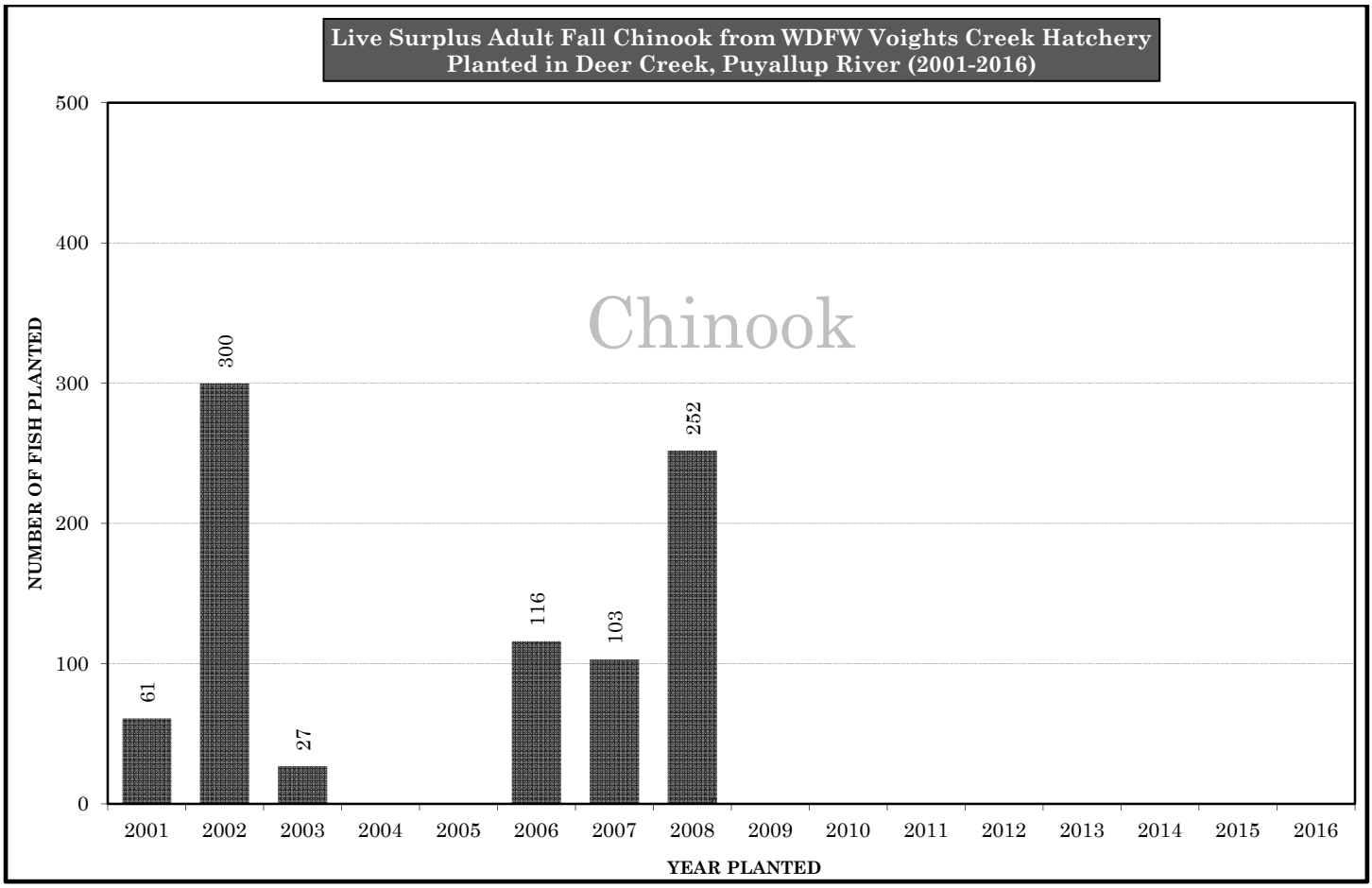
Deer Creek is a left bank headwater tributary to the Puyallup River; entering the upper Puyallup at mile 45.7, approximately 0.6 miles below Swift Creek. This high mountain stream flows northwest through a steep narrow glacial valley along the lower western slope of Mt. Rainier. Nearly the entire 6.5 miles of the Deer Creek drainage flows within the Mount Baker-Snoqualmie National Forest and is non-glacial in origin. Instead, its sources originate from snowpack accumulations; as well as other surface and groundwater sources from the surrounding valley. The additional surface water sources consist of three tributaries including Big Creek, and two unnamed tributaries. Unfortunately, these tributaries do not add any beneficial spawning or rearing habitat given their locations well above natural anadromous barriers.

Past forestry operations along the creek, primarily timber harvesting and road construction, have had negative impacted on portions of the stream. Currently, a beneficial riparian buffer zone of conifers and mixed deciduous trees exists along the majority of the creek. The creek channel is confined by moderate to steep valley walls, with an impassable falls located at approximately RM 2.7. Spawning is significantly reduced upstream of RM 1.2 due to the substantial increase in gradient, flow velocities, and the lack of suitable spawning substrate *(right)*. The gradient along the lower 1.2 miles is moderate with numerous deep pools. The substrate throughout a great deal of this spawning reach consists of small boulders, cobble, and flat angular stone; though, several pockets of good spawning medium are often located along the stream margins and pool tail-outs.

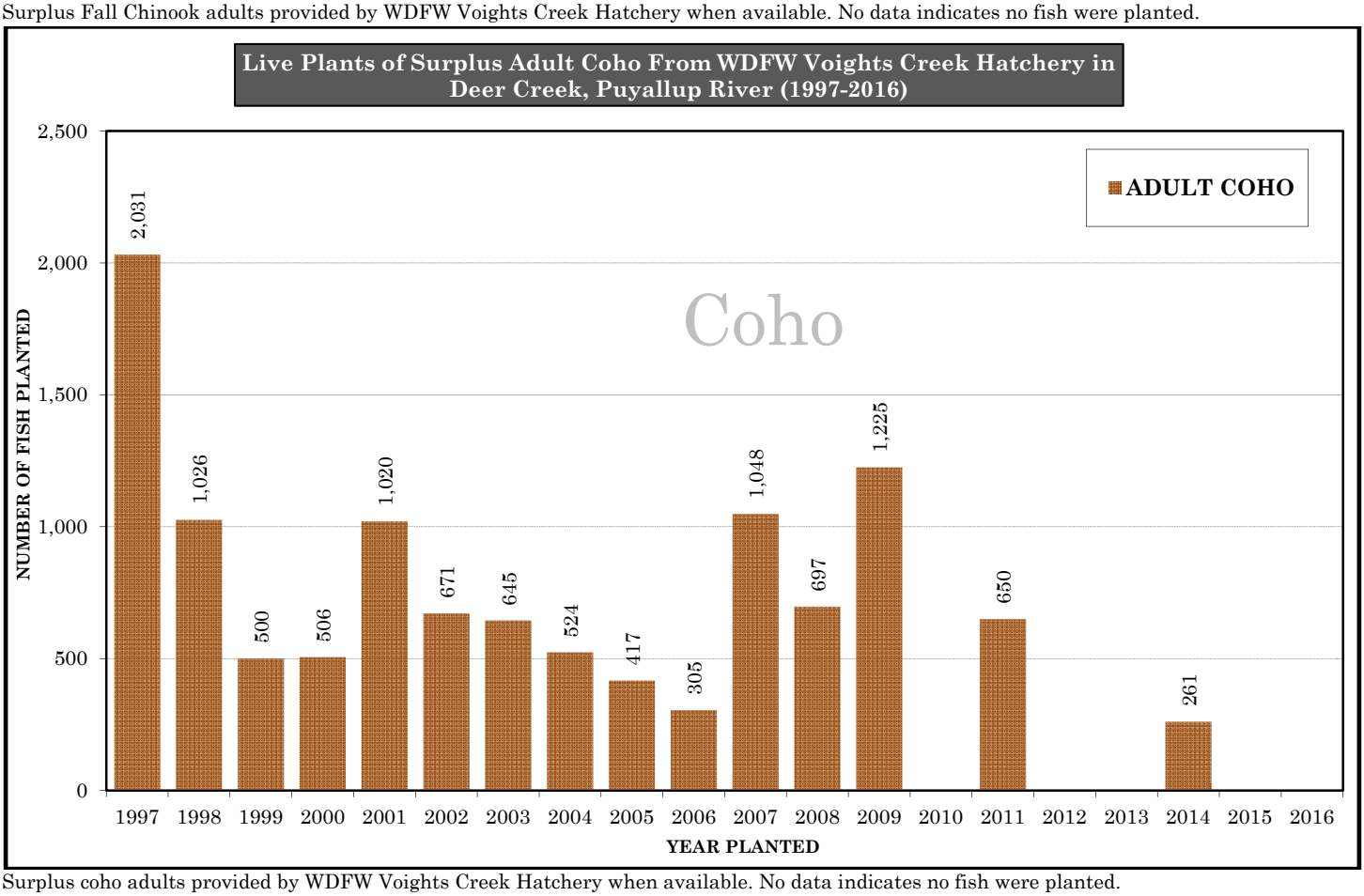
Unfortunately, anadromous salmon were unable to access Deer Creek for nearly a century due to the streams location upstream of the Electron diversion dam on the Puyallup River. With the completion of the Electron fish ladder *(@ RM 41.7)* in the fall of 2000, anadromous fish passage was restored for the first time since 1904. Restoring anadromous access to the upper Puyallup River has made approximately 26+ miles of spawning, rearing, and foraging habitat above the diversion available for several species, including Chinook, coho, pink, steelhead, and bull trout.

Deer Creek is part of the surplus adult Chinook and coho planting program. Deer Creek is one of the few streams in late summer and early fall with adequate water flow to plant adult Chinook. Surplus adult Chinook from the WDFW hatchery located on Voights Creek are planted during late summer to early fall, and coho in late fall when available. The Puyallup Tribe has been hauling surplus adults from Voights Creek and planting them in the upper Puyallup Watershed since1997; unfortunately no natural returns of Chinook or coho have been documented in Deer Creek as a result of these efforts. However, natural returns of adult coho have occurred in Rushingwater, Cow Skull, Niesson, and Kellog creeks. Deer Creek is not surveyed regularly; rather, it is spot checked to see how successful the adult plants were. The creek does; on the other hand, have a resident population of cutthroat. Bull trout are well documented in the Mowich River and upper Puyallup; however, the degree of bull trout utilization in Deer creek is unknown.

Upper Deer Creek



Surplus Fall Chinook adults provided by WDFW Voights Creek Hatchery when available. No data indicates no fish were planted.



Surplus coho adults provided by WDFW Voights Creek Hatchery when available. No data indicates no fish were planted.

DIRU CREEK SALMON HATCHERY

Puyallup Tribe of Indians Hatchery Facility

Diru Creek Hatchery is located on Diru Creek *(Rainbow Springs*), a tributary to Clarks Creek in Puyallup. Water for the hatchery is supplied from two pumped wells (*800 gpm*); as well as gravity flow from of Diru Creek (*200-500 gpm*). Incubation consists of 20 vertical stacks of 12 trays. Initial rearing uses 16 shallow troughs in the hatchery building. Additional rearing containers include four 50'x5'x5' raceways, two 6696 cubic foot ponds (*UP1 and UP2*), and one 13,000 cubic foot pond (*below, left*) that are also used for holding returning adults, as well as juveniles.

In addition, the Puyallup Tribe operates several acclimation ponds in the Puyallup Watershed. Two of the acclimation ponds *(Cowskull & Rushingwater)* are used for reestablishing Spring/Fall Chinook and coho into a 30-mile reach in the Upper Puyallup River above Electron Dam. Electron Dam has been an anadromous barrier for 97 years. A fish ladder was constructed, and completed in fall of 2000. The other acclimation ponds are located in the Upper White River drainage. These ponds are used for reestablishing White River Spring Chinook back into their endemic range. All ponds have approximately 25,000 cubic feet of rearing space and between 1 to 3 cubic feet per second flow. A 35,000 cu. ft. acclimation pond was completed in the summer of 2007 near George Creek. Capable of holding over 500,000 Spring Chinook, the construction of the acclimation pond was funded by the City of Tacoma as a result of a mitigation settlement.

The Puyallup Tribe's restoration goal is to rebuild depressed Chinook and steelhead stocks and remove them from ESA listing. Using acclimation ponds, limiting harvest, and making substantial gains in habitat restoration, the tribe will be able to accomplish this task. Levee setbacks, oxbow reconnections both inter tidal and upland, Commencement Bay cleanup, and harvest cutbacks have already been initiated. Only the jump-starting of Chinook in habitat areas lacking, or devoid of fish, remains the largest challenge. Acclimation ponds are a proven method in increasing fish numbers on the spawning grounds. Hatchery rearing 200,000 Fall Chinook for release on station and 200,000 for acclimation ponds in the upper Puyallup River for a combined 6,857 pounds of fish. Historically, Fall Chinook have been reared since 1980 with a variety of stocks, goals, and objectives.

Spring Chinook Hatchery Production

The Puyallup Tribe operates several acclimation ponds in the Puyallup/White River Watershed designed to reestablish and enhance Spring/Fall Chinook, winter steelhead and coho stocks. Each of two acclimation ponds on the Puyallup would receive as many as 100K+ hatchery origin Spring/Fall Chinook and/or coho. Three additional acclimation ponds located in the Upper White River drainage *(Huckleberry Cr., Greenwater River (George Cr.), Twentyeight Mile cr. (Greenwater R.)& Jensen Cr.(Clearwater R.)* would be planted collectively with up to 900K+ White River Spring Chinook and 25K+ White River winter steelhead pre-smolts. The Jensen Creek in the Clearwater River drainage was completed in the fall of 2012.

Fall Coho Hatchery Production

Currently, up to 200,000 coho yearlings are Acclimated *(imprinted)* and released in the Upper Puyallup Watershed *(acclimation ponds)*. Coho originate from Voights Creek Hatchery where

100,000 are adipose clipped and coded wire tagged. Fish are released at 20 fish per pound, for a total biomass of approximately 10,000 pounds.

Winter Chum Hatchery Production

The Puyallup Tribe currently raises 1.5 to 2.3 million chum smolts for release into the lower Puyallup River. This program significantly augments a Tribal river fishery and All Citizen purse seine fishery in East and West Pass in Puget Sound. This stock originated initially from Chambers Creek. Puyallup Tribal Fisheries releases 1,000 to 3,000 pounds annually based on available brood- stock returns to Diru Creek Hatchery. The program was started in 1991 and has become self-sustaining.

Fertilizing chum salmon eggs.

Fall Chinook Hatchery Production

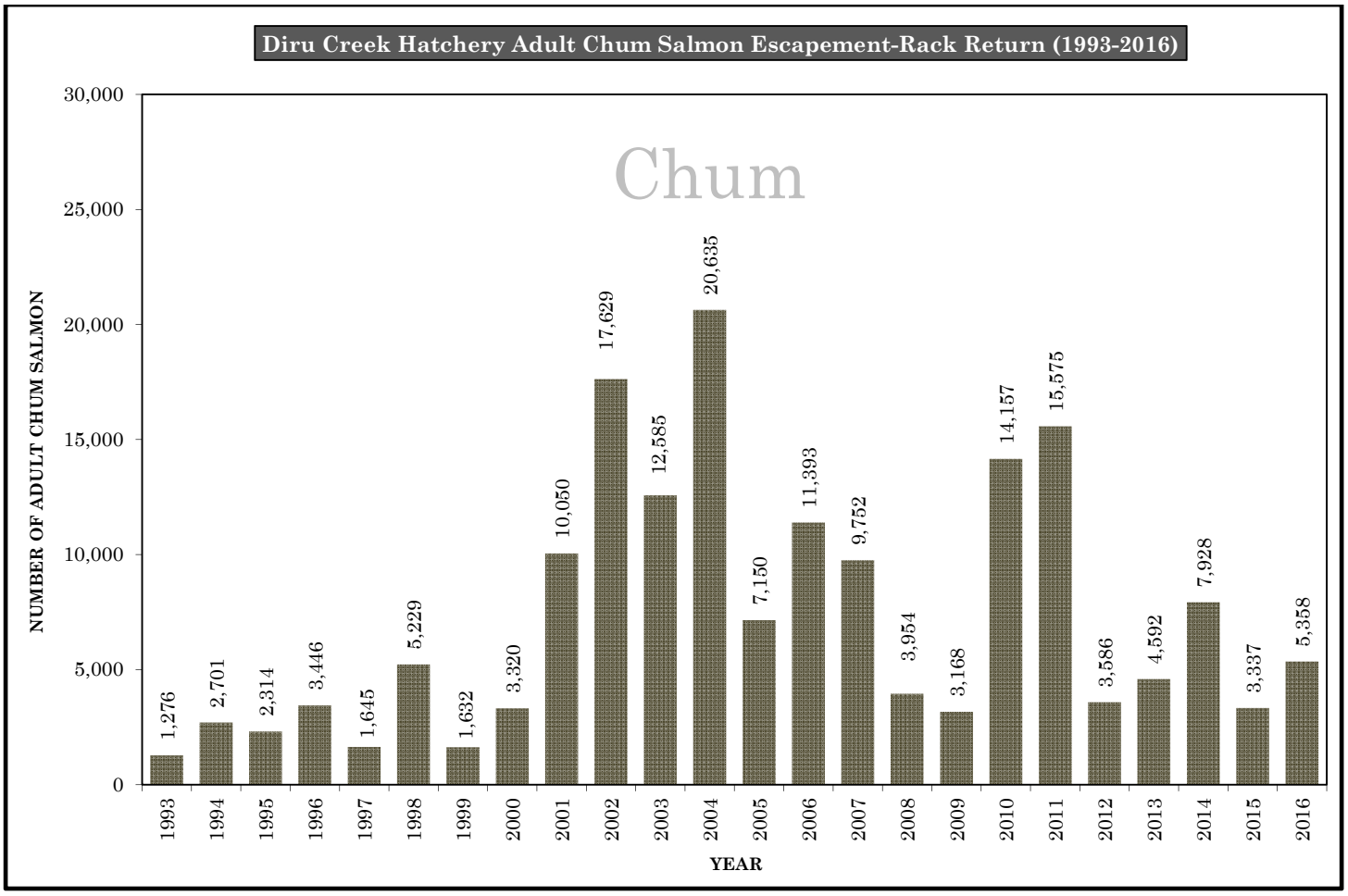
In 2004, the Puyallup Tribal Fisheries Department began acclimating and releasing Fall Chinook from its Clarks Creek facility, thereby discontinuing all Chinook releases from the Diru Creek Hatchery. In early 2005, construction of a new incubation building was completed at Clarks Creek. The incubation building houses 32 incubator stack; each stack is capable of holding up to 77,000 Chinook eggs. This provides for a total capacity of approximately 2.5 million eggs. Once fish are ready to be moved from the incubators, they can be place in one of the 16 aluminum raceway-troughs and hand feeding can begin. The troughs are 16 feet in length with a flow rate of up to 25 gpm. When the fish are approximately 500 to the pound, they are transferred to one of two cement lined rearing ponds. Holding the Chinook in the cement pond is only temporary until they are up to a large enough size, usually in late April, to be massed marked via an automated tagger. Once tagged, the fish are planted in one of the two natural acclimation ponds until they are released in late May or early June.

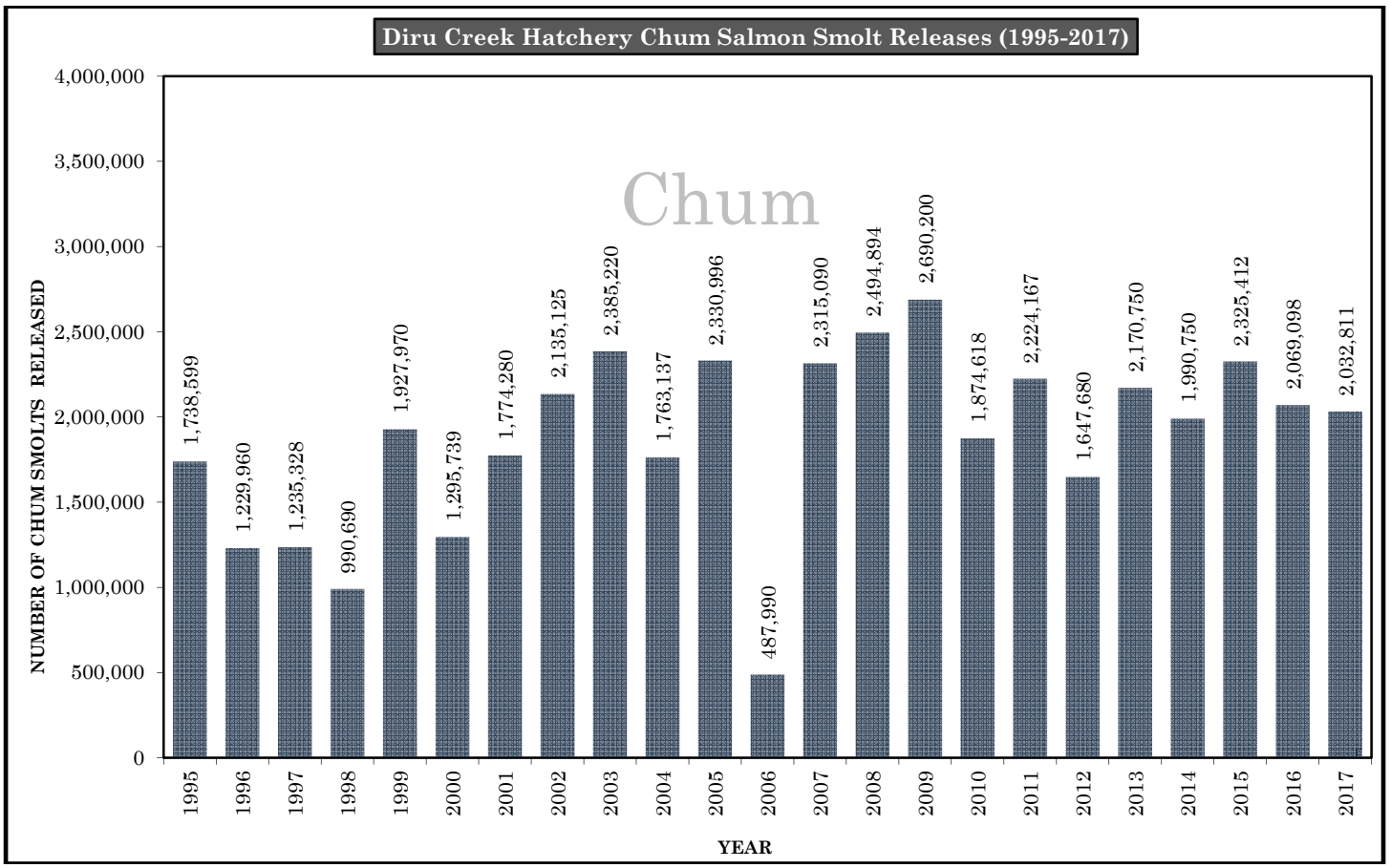
White River Winter Steelhead Production

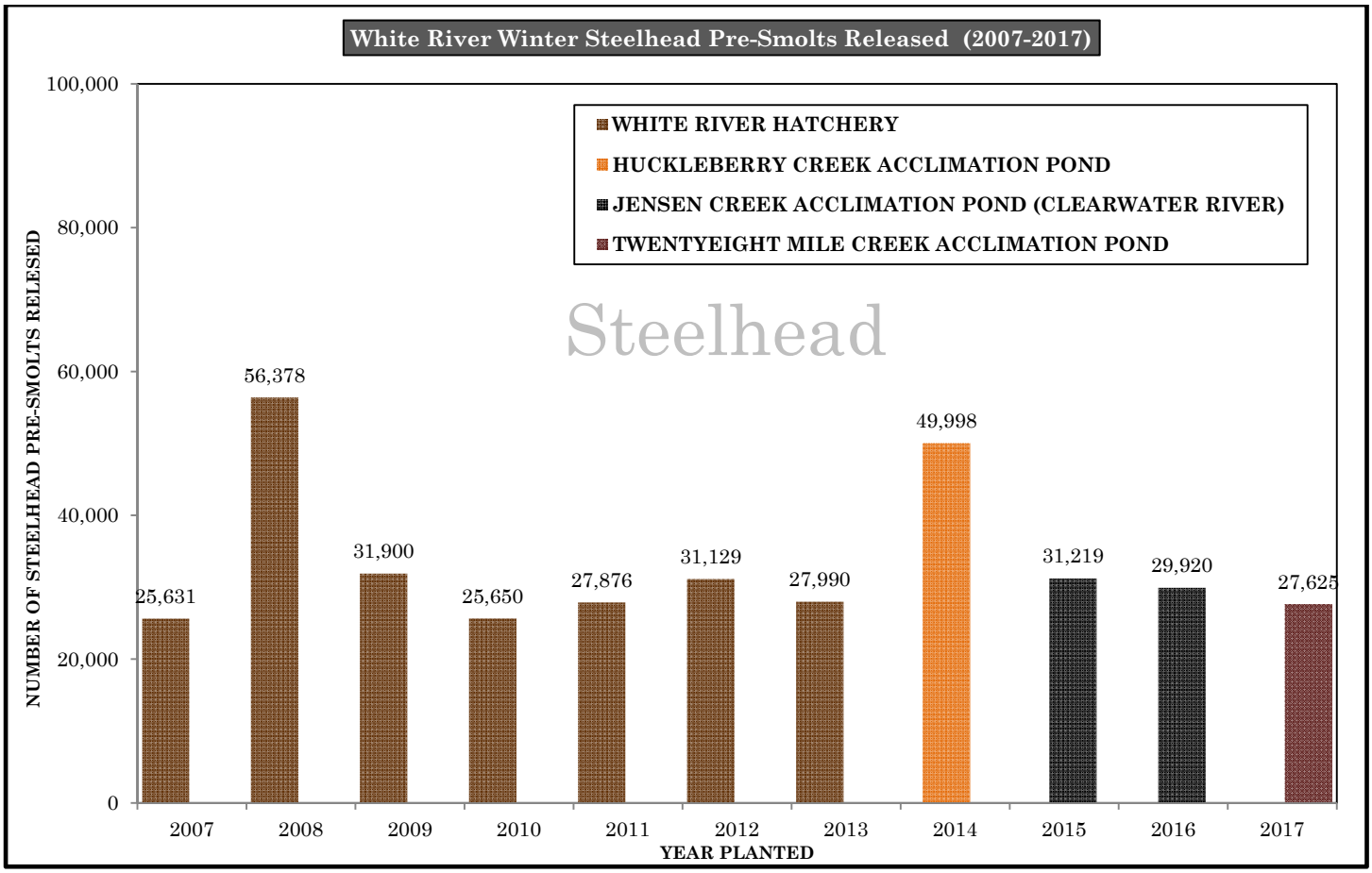
In 2006, the Puyallup Tribe, in partnership with WDFW and the Muckleshoot Tribe, began artificially propagating White River winter steelhead. Rearing young steelhead is an integral part of the White River winter steelhead pilot project, a program designed to increase winter steelhead escapement in the White River. Beginning in 2009, the Puyallup Tribe assumed the majority of responsibility for continuing this important restoration effort. Steelhead brood-stock *(approximately 10 males and 10 females)* are collected from the White River USACE fish trap in Buckley and are held, spawned *(right)*, incubated, and reared at the Puyallup Tribe's Diru Creek hatchery for a year. Each fish is implanted with a coded wire tag for later identification. After rearing for a year and fish are of size *(approximately 17 fish per pound)*, the pre-smolts are transported to the Muckleshoot hatchery on the White River to acclimate before being released into the White River *(fish were acclimated and released from the Huckleberry pond in 2014)*. The project goal is to release between 35,000-40,000 steelhead pre-smolts annually. This project has already seen some success; several hundred marked *(coded wire tag)* steelhead have been captured and passed above Mud Mountain dam since 2009 *(see the Buckley section in this report for more information, and appendix G for data)*.

Live spawning steelhead.

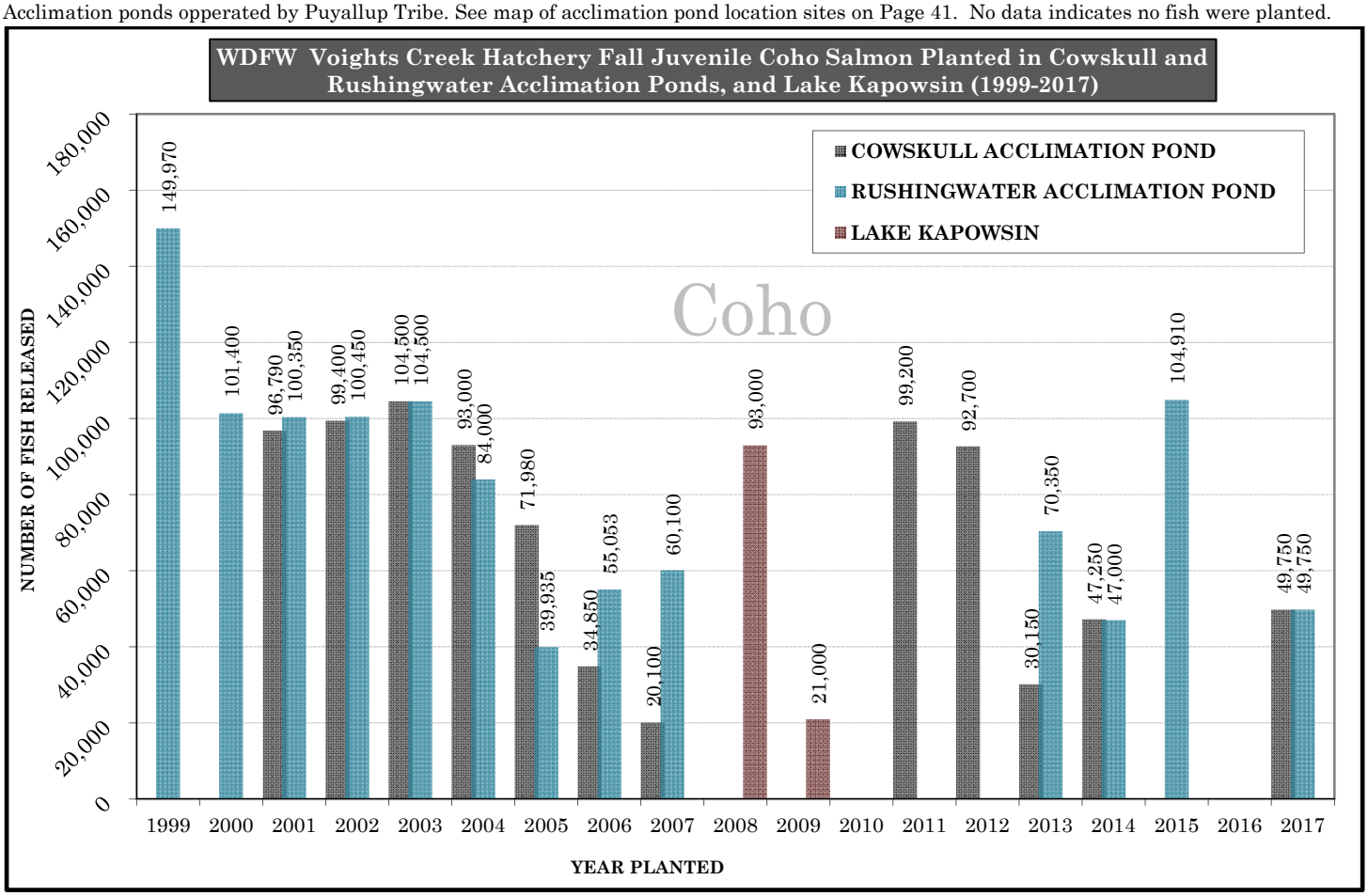
Steelhead fry


Diru Creek Hatchery Adult Chum Salmon Escapement-Rack Return (1993-2016)
Chum
NUMBER OF ADULT CHUM SALMON
YEAR
30,000
25,000
20,000
15,000
10,000
5,000
0
1993 1,276
1994 2,701
1995 2,314
1996 3,446
1997 1,645
1998 5,229
1999 1,632
2000 3,320
2001 10,050
2002 17,629
2003 12,585
2004 20,635
2005 7,150
2006 11,393
2007 9,752
2008 3,954
2009 3,168
2010 14,157
2011 15,575
2012 3,586
2013 4,592
2014 7,928
2015 3,337
2016 5,358

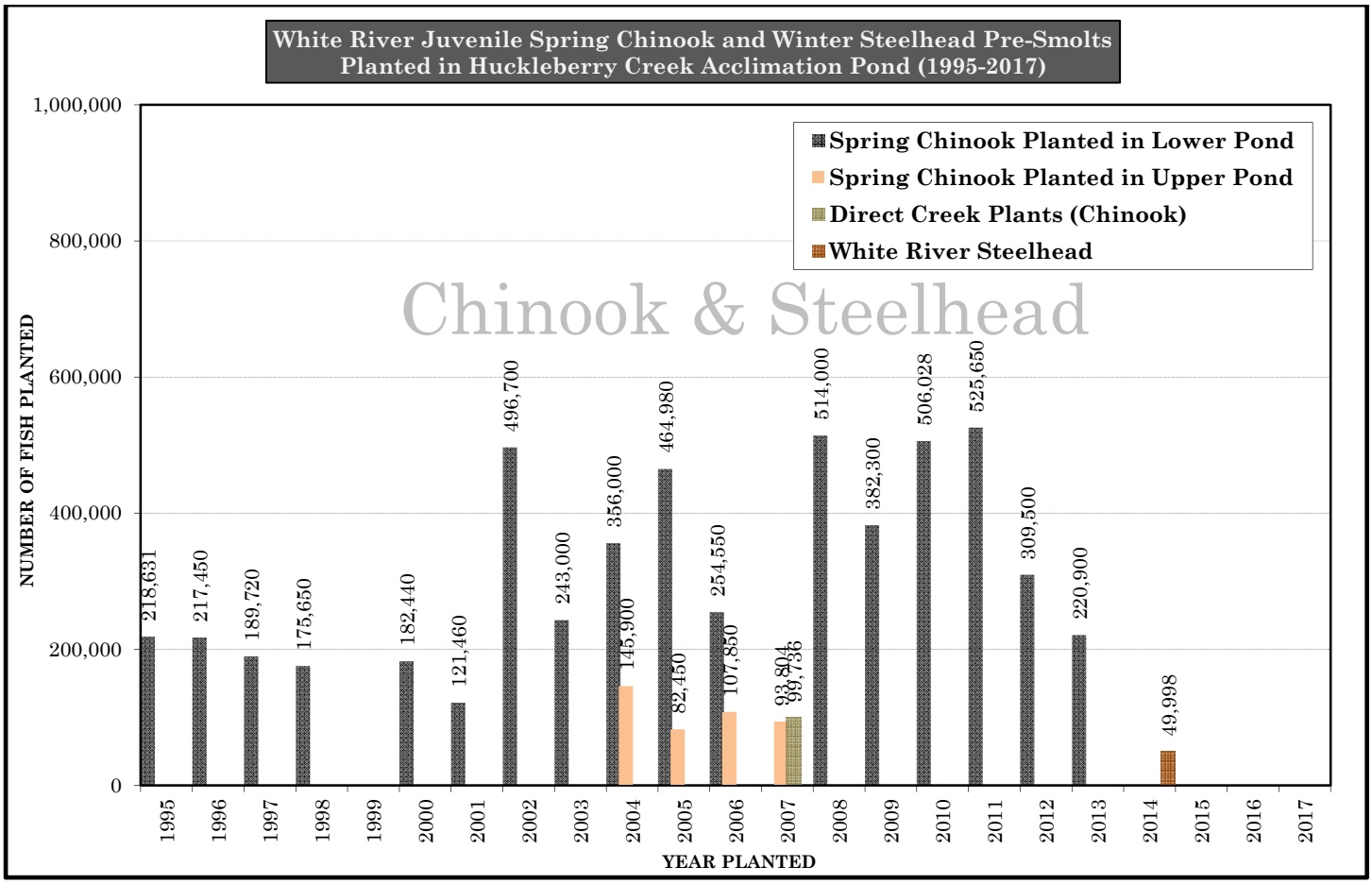

Diru Creek Hatchery Chum Salmon Smolt Releases (1995-2017)
Chum
NUMBER OF CHUM SMOLTS RELEASED
YEAR
4,000,000
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
1995 1,738,599
1996 1,229,960
1997 1,235,328
1998 990,690
1999 1,927,970
2000 1,295,739
2001 1,774,280
2002 2,135,125
2003 2,385,220
2004 1,763,137
2005 2,330,996
2006 487,990
2007 2,315,090
2008 2,494,894
2009 2,690,200
2010 1,874,618
2011 2,224,167
2012 1,647,680
2013 2,170,750
2014 1,990,750
2015 2,325,412
2016 2,069,098
2017 2,032,811



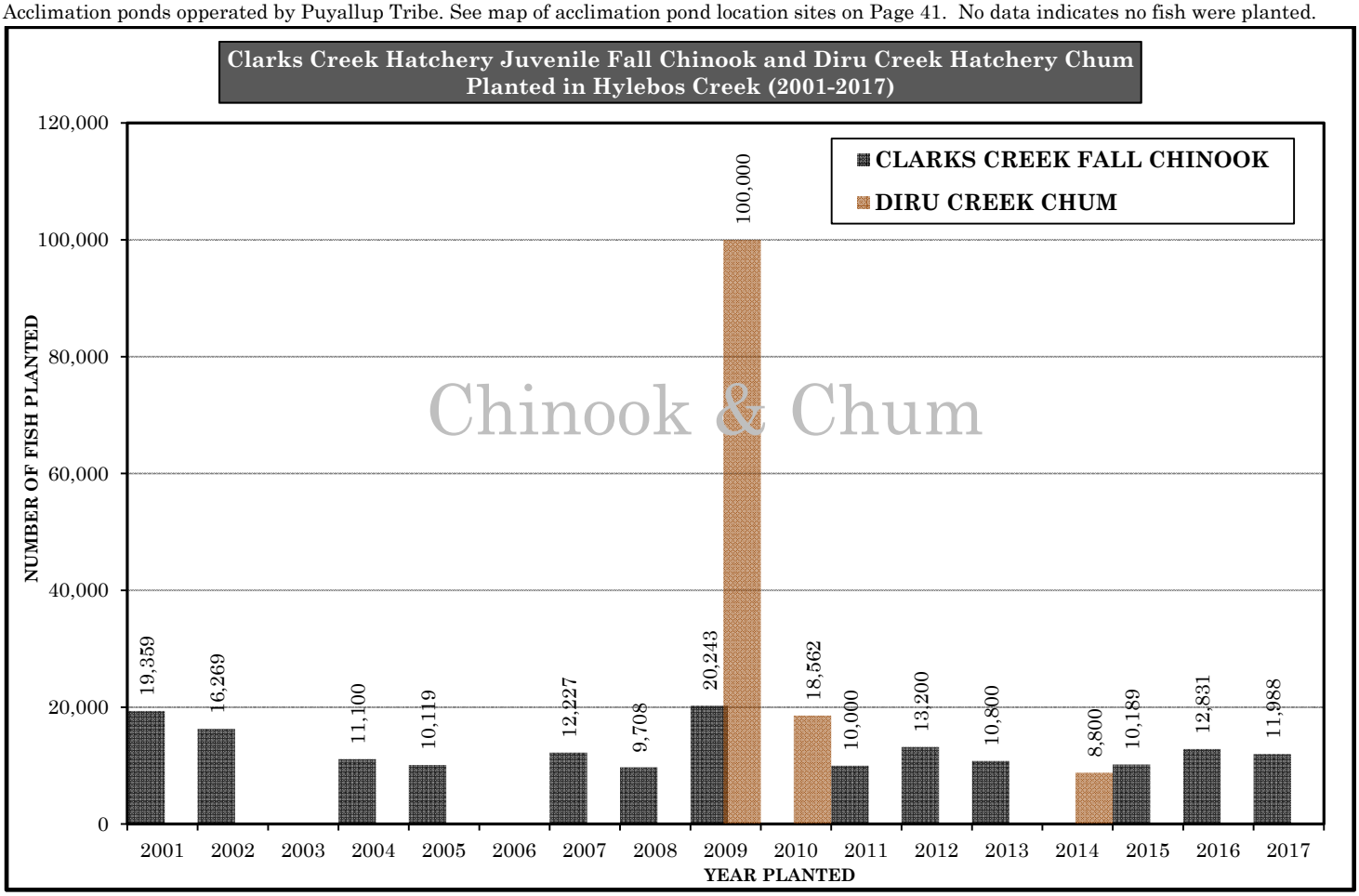
Acclimation ponds opperated by Puyallup Tribe. See map of acclimation pond location sites on Page 41. No data indicates no fish were planted.

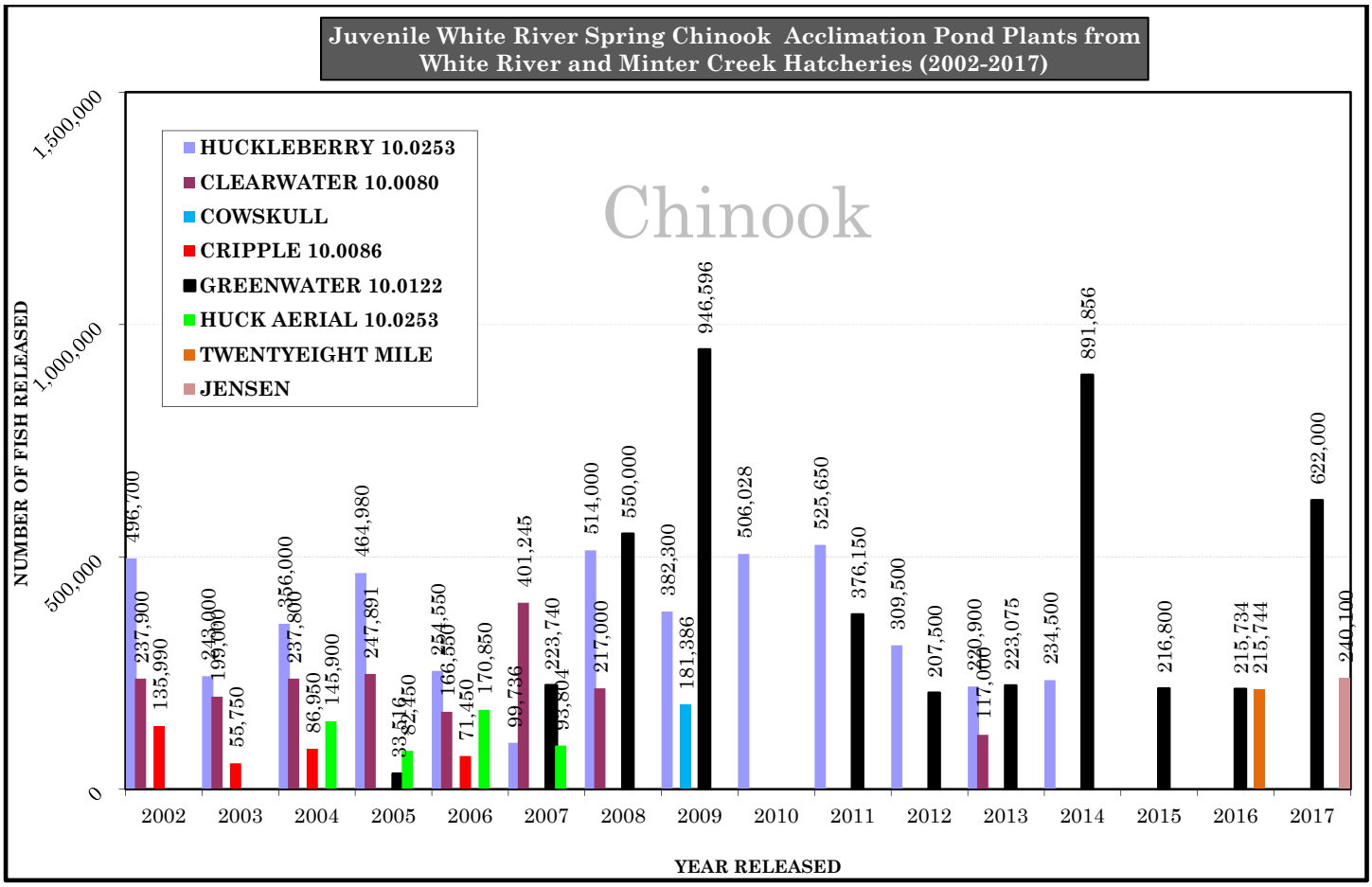


Acclimation ponds opperated by Puyallup Tribe. See map of acclimation pond location sites on Page 41. No data indicates no fish were planted.



Acclimation ponds opperated by Puyallup Tribe. See map of acclimation pond location sites on Page 41. No data indicates no fish were planted.



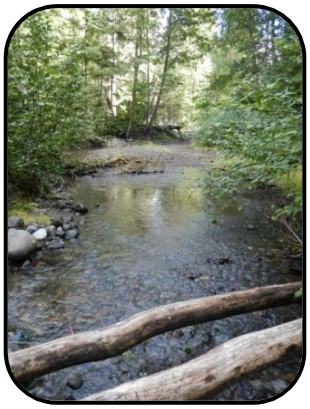


Acclimation ponds opperated by Puyallup Tribe. See map of acclimation pond location sites on Page 41. No data indicates no fish were planted..

DISCOVERY CREEK

Discovery Creek is not officially named by the Washington State Board on Geographic Names, nor is it identified on most topological or hydrological maps; however, for easy identification the creek is referred to as "Discovery Creek" by PTF staff. Discovery Creek is a small right bank tributary to the upper White River; this small creek was discovered in 2007 while conducting telemetry and spawning ground surveys for bull trout, hence the name. As with most of the headwater tributaries of the White, the elevation of this creek is likely too high for Chinook, coho and pink salmon. Discovery Creek originates from a spring at the base of a small ridge running parallel to the White River access road. Discovery Creek enters the White River just upstream of Shaw Creek at approximately RM 69.5, and provides 0.5+ miles of exceptional habitat conditions for bull trout rearing and spawning.

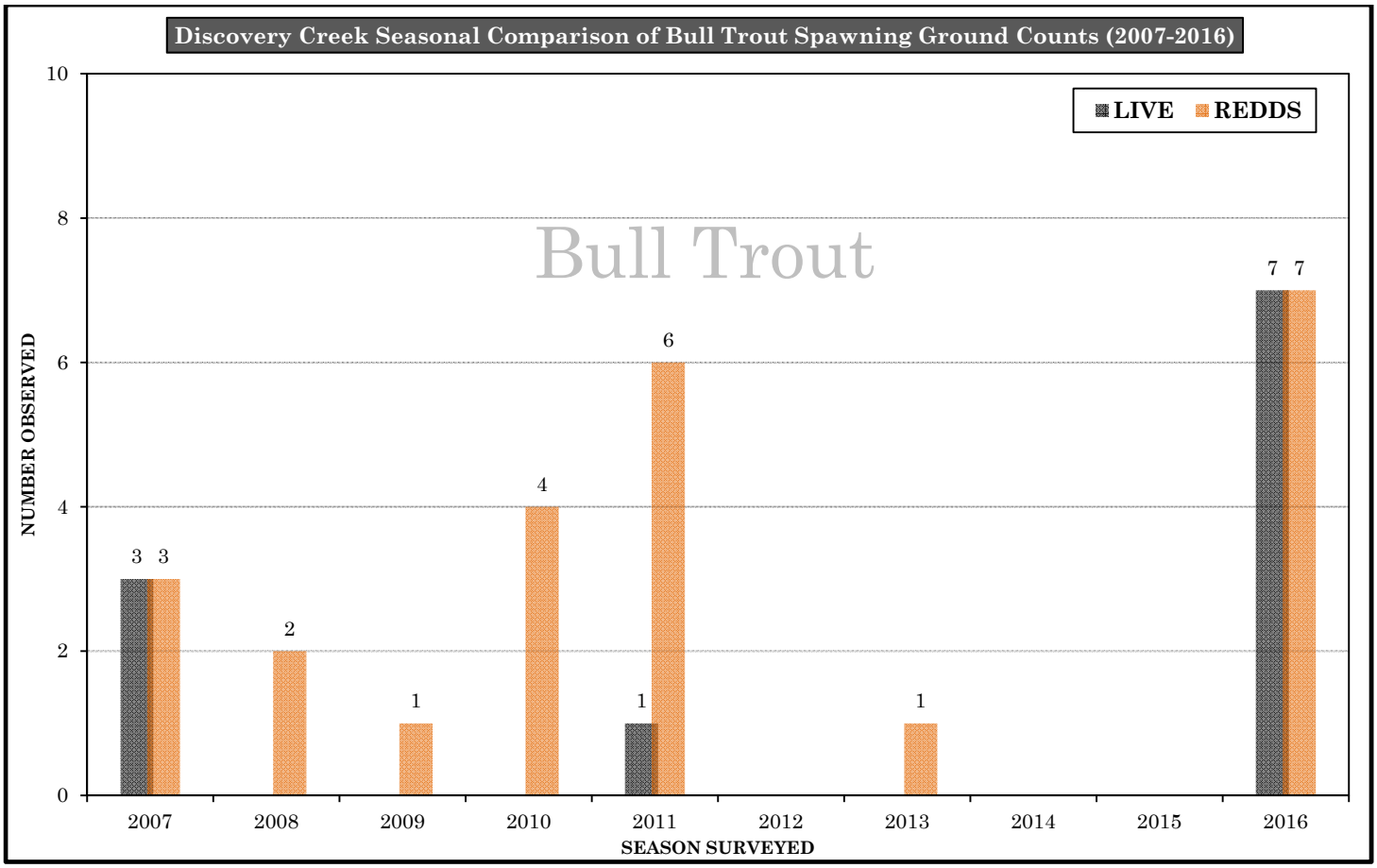
Bull trout spawning in glacial mix water.



The creek is low gradient and flows within the channel migration zone *(CMZ)* of the White River. The habitat within this section offers suitable spawning conditions for bull trout. However, a 2-3 foot jump in the creek channel, combined with the low summer flow *(approx. 2-3 cfs.)* prevented bull trout from accessing the upper 0.2 miles. Conversely, higher flows would undoubtedly provide access to the upper reach above this bench. The remaining 0.5 miles of the creek meanders through the edge of the forested area along the White River floodplain. The creek channel gradient increases slightly, as well as the stream complexity due to some small debris jams and LWD input. The surrounding riparian consists of primarily mature conifers with a limited number of mixed deciduous trees. Near RM 0.5 the creek turns sharply into the base of a small valley ridge.

From 2005-2007, PTF biologists conducted extensive bull trout migration telemetry studies and redd surveys along the upper White River and West Fork White River, focusing heavily on the headwaters located within Mt. Rainier National Park. The study results determined that the cold high mountain streams located within the National Park, including Discovery, provide the majority of the critical bull trout spawning habitat in the basin. In addition, bull trout spawning was less frequent in this tributary compared to that observed in several significant headwater tributaries located along the White River, such as Klickitat and No Name.

Spawning activity was first observed during the 2007 season. During 2007, two of the bull trout observed spawning were part of the migration telemetry study. Both bull trout were surgically implanted with LOTEK® Wireless Inc.'s Nano Tag Series transmitters *(NTC-4-2L)* and released near the Greenwater River (*RM 45*) in late June. The fish were then tracked to the creek where they were observed spawning together beneath a channel spanning piece of LWD in the lower 75 feet of the creek. The USFWS finalized bull trout recover plan is available at: *https://www.fws.gov/pacific/bulltrout/pdf/Final_Bull_Trout_Recovery_Plan_092915.pdf*



See Appendix B for bull trout redd locations.

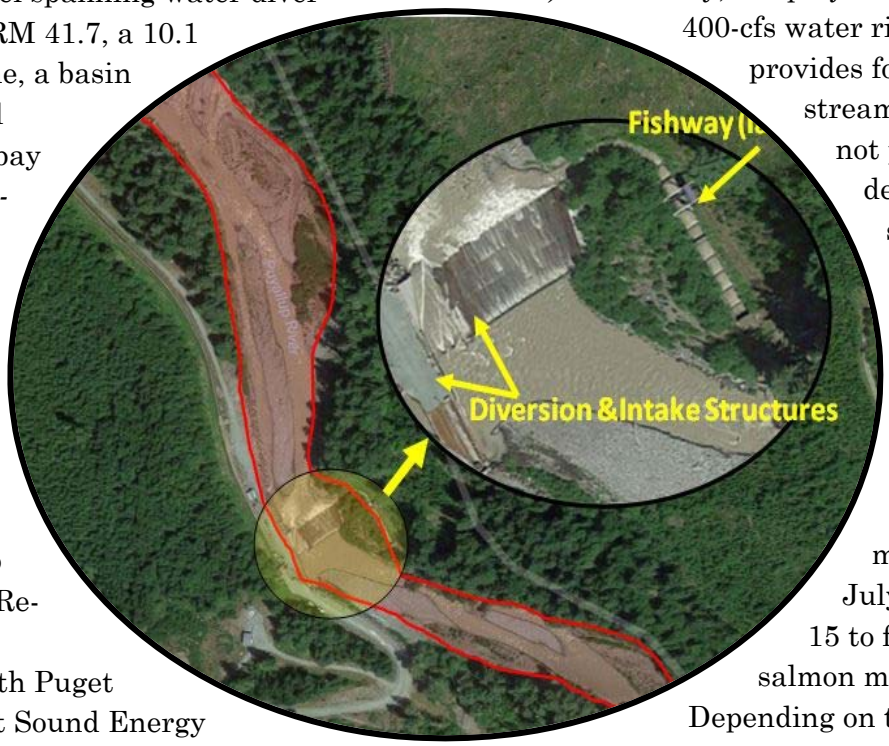
ELECTRON HYDRO LLC

FISH COLLECTION FACILITY

Electron Hydro LLC
PUYALLUP RIVER
DIVERSION & HYDRO PROJECT

Electron Hydro fish collection facility (trap), and water-to-water fish tranfer into hauling trailer.

Electron Hydro LLC's hydroelectric facility *(formally owned/operated by Puget Sound Energy1904-2014)* utilizes water diverted from the Puyallup River at RM 41.7 *(bottom photo).* Approximately 26 miles of stream habitat located in the Upper Puyallup Basin *(upstream of RM 41.7)* was void of anadromous fish from1904-2000 due to the construction of the Electron Diversion Dam in 1904. Connectivity was reestablished in the fall of 2000 with the completion of a 1.1 million dollar 215 foot fish ladder. The Electron Hydroelectric Project is the only human-made obstacle impacting survival and through-migration of salmon, steelhead and bull trout on the Puyallup River. The Electron project involves a channel spanning water diversion dam located at RM 41.7, a 10.1 mile of flume/flow line, a basin for sediment removal *(Lizard Lake)*, a forebay for water storage *(approximately 124 ac-ft.)*, fish collocation facility *(fish trap top right)* and a power generation station *(power house)* and transmission equipment. In 1997 the Puyallup Tribe entered into a Resource Enhancement Agreement *(REA)* with Puget Sound Energy (Puget Sound Energy and Puyallup Tribe of Indians 1997). The REA initiated fisheries restoration efforts within the project affected area. http://wdfw.wa.gov/conservation/habitat/planning/energy/rea.pdf



The current REA agreement is scheduled to expire in 2026. The Electron project was sold and ownership transferred to Electron Hydro LLC in the fall of 2014. The REA includes provisions for the maintenance of minimum instream flows within the project bypass, or middle reach *(a 10.5-mile section of the Puyallup River from the diversion to the power house formerly subjected to extreme water withdrawal).* Currently, the project operates under a 400-cfs water right. The REA also provides for minimum instream flows which were not previously required despite established state law. Under the REA, Electron Hydro will provide 60-cfs year-round in the bypass reach. This increases to 80-cfs during the four-month period from July 15 and November 15 to facilitate adult salmon migrating upstream. Depending on timing, manipula-

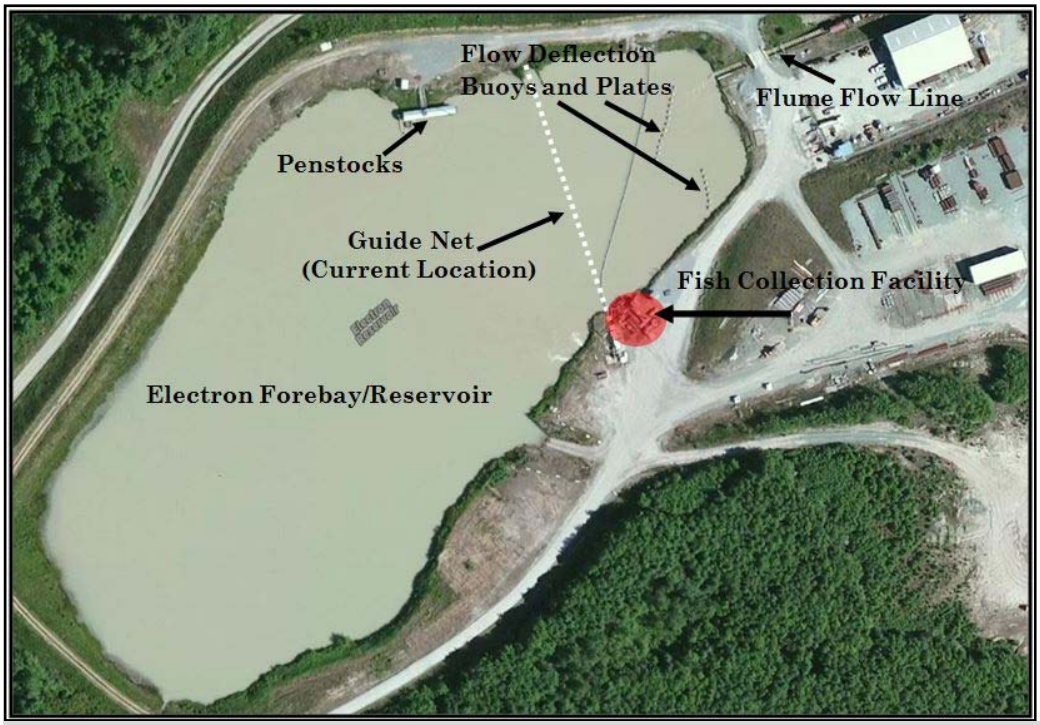
tions in flow regimes through the bypass reach, created by the Electron project, can have negative effects on adult mainstem spawner by altering habitat availability or dewatering redds *(lower figures)*. Water spilled at the dam in conjunction with tributary and spring flow accretion will provide sufficient flow for upstream passage. Completion of the 215 foot roughened channel with chevron weirs fish ladder was the centerpiece of the REA *(bottom of previous page)*. Viable fish habitat must be accessible to realize full production potential. The fishway is designed to operate with at least 40-cfs and incorporates a modified weir and rock design. Electron Hydro has effectively maintained fish passage through the fishway since procuring the project in 2014.

Flow change within a 24 hour period over a steelhead redd *(location indicated by red arrow)* in the bypass reach before *(top)* and after *(bottom)* Electron flow manipulation.

The absence of anadromous fish above Electron Dam prior to 2000 has in all likelihood biased the scrutiny and regulatory oversight of past land use, forest practice and road construction/maintenance actions. Hancock Forest Resource Group *(formally Camble Group LLC)* is the primary private landowner in this WAU but the federal government has considerable holdings as well. The bulk of the Forest Service ownership is contiguous with the Mount Rainier National Park and located on the east headwaters. Primary fish bearing tributaries to the upper Puyallup include: Niesson Creek, Kellogg Creek, LeDout Creek, Swift Creek, Deer Creek, Mowich River, Rushingwater Creek and the North/South Forks of the Puyallup River. In addition, numerous small-unnamed wall base channels parallel the Puyallup River and provide prime rearing habitat.

Electron Hydro's project directly diverts up to 400 cfs. of water *(unscreened)* from the Puyallup River at RM 41.7. This structure/operation contributes, in whole or in part, too many of the impact issues previously stated. For 96 years *(1904-2000)* the diversion dam completely severed anadromous access and isolated the population(s) of bull trout *(and other salmonids)* established throughout the 26+ miles of habitat upstream of the structure; thereby, stemming the genetic flow from bull trout *(populations)* located elsewhere in the basin, or watershed, for multiple generations. There are no known barriers above the water diversion that prevent fish from migrating throughout the upper basin. Prior to 1998, there were no means of removing fish entrained in the project, and fish losses were tremendous. However, in 1998, PSE began operating a fish collection facility *(fish trap / previous page)* to help address the fish losses associated with the project. The Puyallup Tribe has advocated for over twenty years that the project needs to be properly screened to prevent fish inclusion. Electron Hydro is currently planning and engineering the construction of fish screens to exclude fish from the flow line just downstream of the headworks/project intake. However, the fish screening project is not slated to begin for at least two or more years from the summer of 2017.

Forebay and Fish Collection Facility



Electron forebay, and location of the fish collection facility.

Fish entrained in the Electron project travel 10.1 miles through the flume *(flow line)* and a settling pond *(Lizard Lake)* before collecting into a reservoir, or forebay. The water held in the forebay is used to generate power via four turbines located in the power house approximately 873 feet below the Forebay. Upon entering the forebay, water flow is directed towards the fish collection facility by large steel plates suspended underwater by surface buoys. An exclusionary guide net is also in place across the forebay, and is maintained and kept in place year-round. The steel plates and guide net are designed to direct fish toward the fish collection facility. All age classes of salmonids are regularly entrained in the project, from alevins-to-adults. Juveniles, alevins and fry diverted into the forebay are regularly able to migrate beyond the exclusionary guide net and are likely drawn to the intake flow of the penstocks where they are subsequently destroyed in the powerhouse generators below. Larger predatory fish and adults are too large to pass through the penstock screens. The larger predatory fish including steelhead/rainbow, cutthroat and bull trout have a high propensity of residing in the forebay foraging on smaller fish; however, the level of predation by these larger fish is unknown. Bull trout are known to be proficient at exiting the fish collection facility trap; making them even more difficult to capture and remove. As a result, several reproductive bull trout are removed from the spawning population due to long term entrainment in the project.

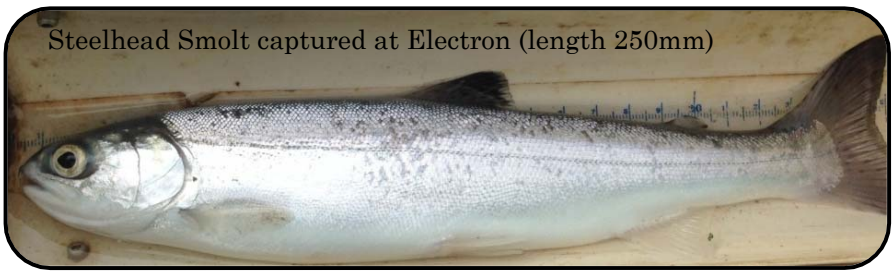
Throughout the projects history, maintenance activities have required periodic shutdowns, or "outages". These outages typically require eliminating all flow to the forebay. The duration of these outages can vary from hours to months. During extended outage operations when water is retained in the forebay, but flow is shut-off, water quality becomes an issue of concern for fish occupying the forebay. Depending on forebay levels, the fish collection facility may, or may not be operational. It is possible for fish to be impounded in the forebay for the duration of an outage with no method of removal. Fortunately, during these operations, Electron Hydro allows the Puyallup Tribe to monitor the water quality in the forebay. However, if the fish collection facility is non-operational and water quality becomes deleterious, there are no methods in place to successfully remove fish. Some maintenance outages call for a complete drawdown *(drainage)* of the forebay, which necessitates a fish salvage operation to remove fish that are trapped and would otherwise perish if not removed. Unfortunately, it is not possible to successfully remove 100% of the fish during salvage operations. Fish salvage operations often result in the removal of larger predatory fish including bull trout; steelhead/rainbow and cutthroat, which frequently avoid entering the fish collection facility. Case in point, the most recent fish salvage conducted on August 30th, 2015, resulted in the capture of 15 bull trout. Fish salvages have also resulted in the capture of pre-spawned adult steelhead and kelts; as well as mature cutthroat and

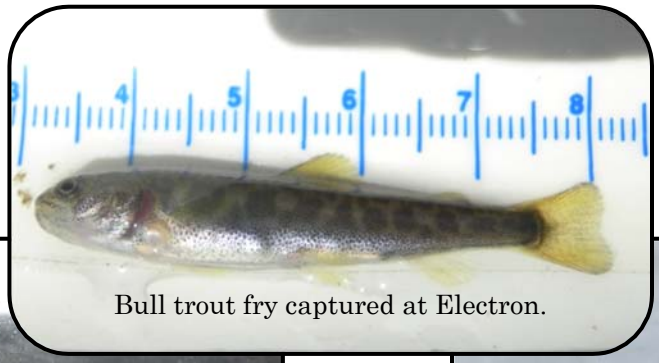
rainbow trout. The majority of fish captured include smaller juvenile coho, Chinook and cutthroat.

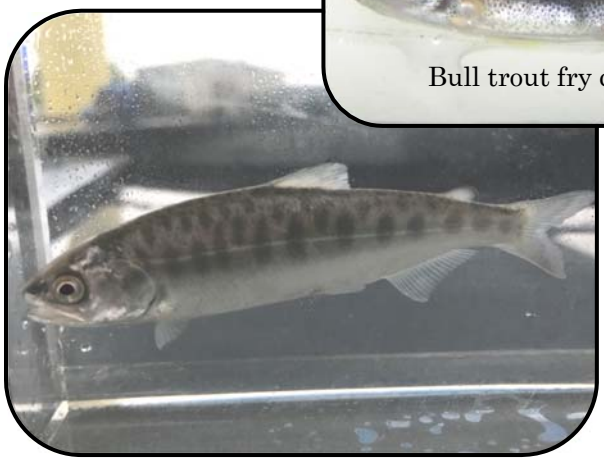
Adult bull trout mortality encountered at the Electron fish collection facility.

Fish Sampling

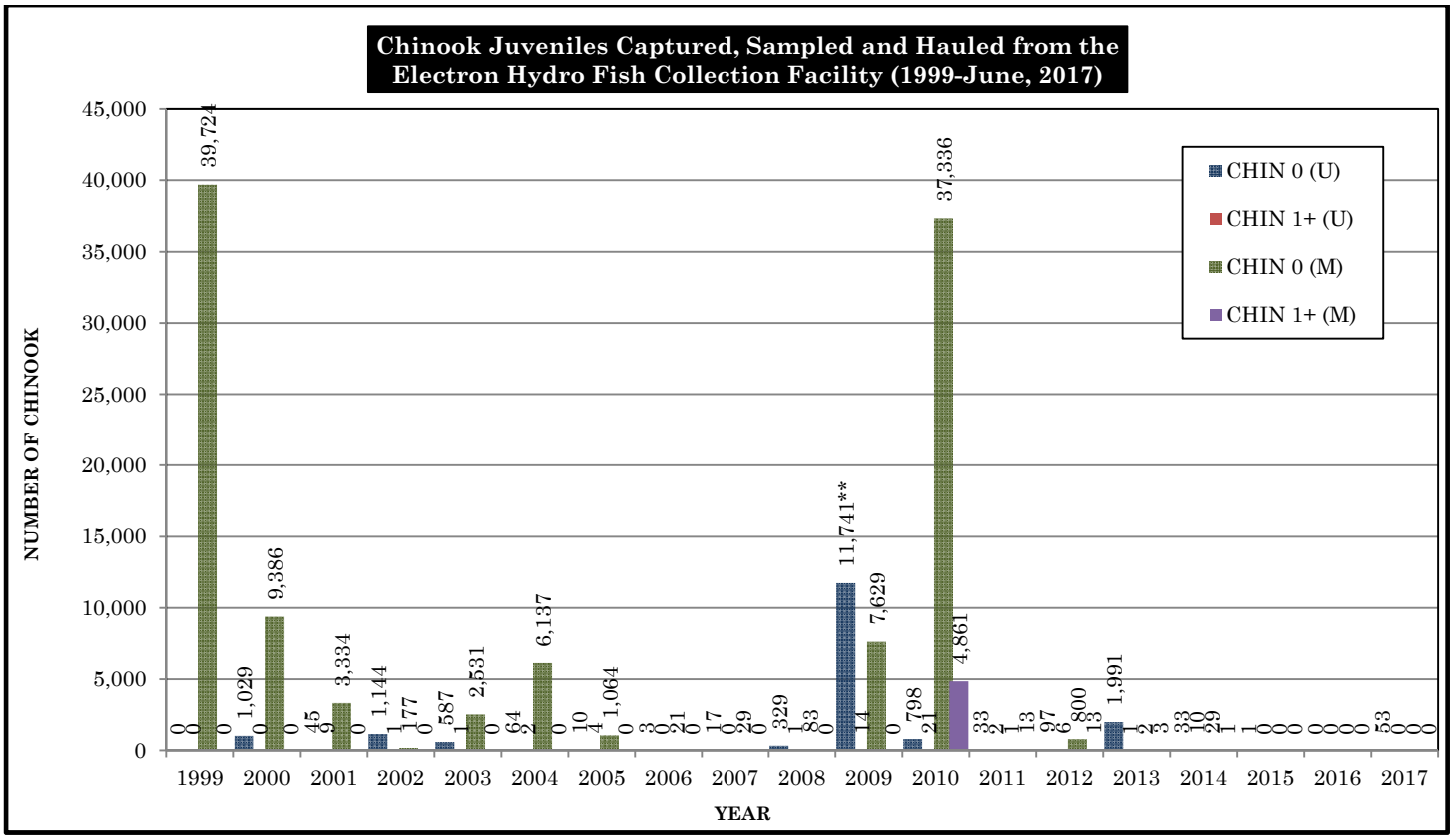
The fish collection facility is operated continuously, with the exception of maintenance outages/shutdowns. The trap is checked 1-4 days a week depending on the volume/density of fish entering the trap. Electron Hydro and PTF staff biologists coordinate trap checks and sampling efforts. PTF staff is generally available once a week to assist with fish sampling. Electron Hydro has had a full-time on site biologist since the fall of 2014. Prior to 2014, much of the fish sampling conducted by PSE was not performed by a qualified fish biologist or fisheries technician. Fish captured in the fish collection facility are mechanically crowded into a lift hopper, and subsequently deposited into a large holding tank to be sampled. Fish are dip-netted from the holding tank and placed into a smaller sampling container *(below)* and anesthetized with MS222 *(tricaine methanesulfonate)*. Fish are identified by species and age class. All fish are examined for fin–clips to distinguish wild from acclimation pond/hatchery origin and measured for fork length. In addition, DNA and scale samples are collected from bull trout, steelhead adults and steelhead smolts. DNA collection involved removing a small amount of the anal or pelvic fin and placing it on a DNA blotting sheet for later analysis. After sampling, fish are placed into a water trailer *(with Oxygen)* for transport down to the powerhouse *(downstream)* where they are released back into the Puyallup River at RM 31.2. Salmonids captured and sampled include: Chinook *(hatchery & wild)*, coho *(hatchery & wild),* steelhead/rainbow, cutthroat and bull trout. When fish densities are high in the trap, a water-to-water transfer is conducted from the trap to the water trailer to reduce stress/mortality on fish. Well after the fish collection facility went on-line in the late 1990's, Chinook and coho losses continued; with coho rates slightly higher than Chinook. Future improvements are essential to prevent these losses.


Steelhead Smolt captured at Electron (length 250mm)

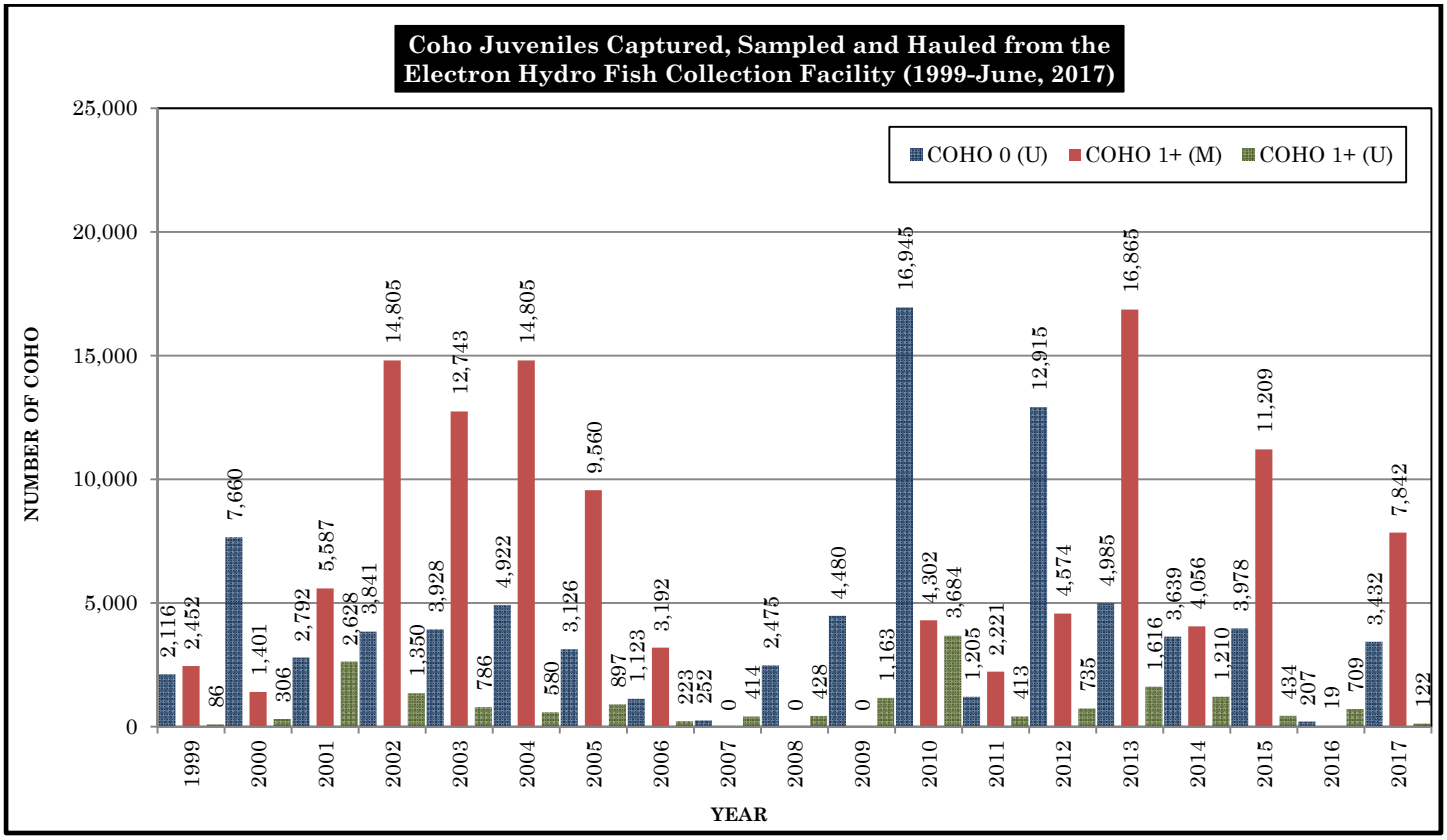

Bull trout fry captured at Electron.


Chinook pre-smolt (85mm) sampled at Electron.

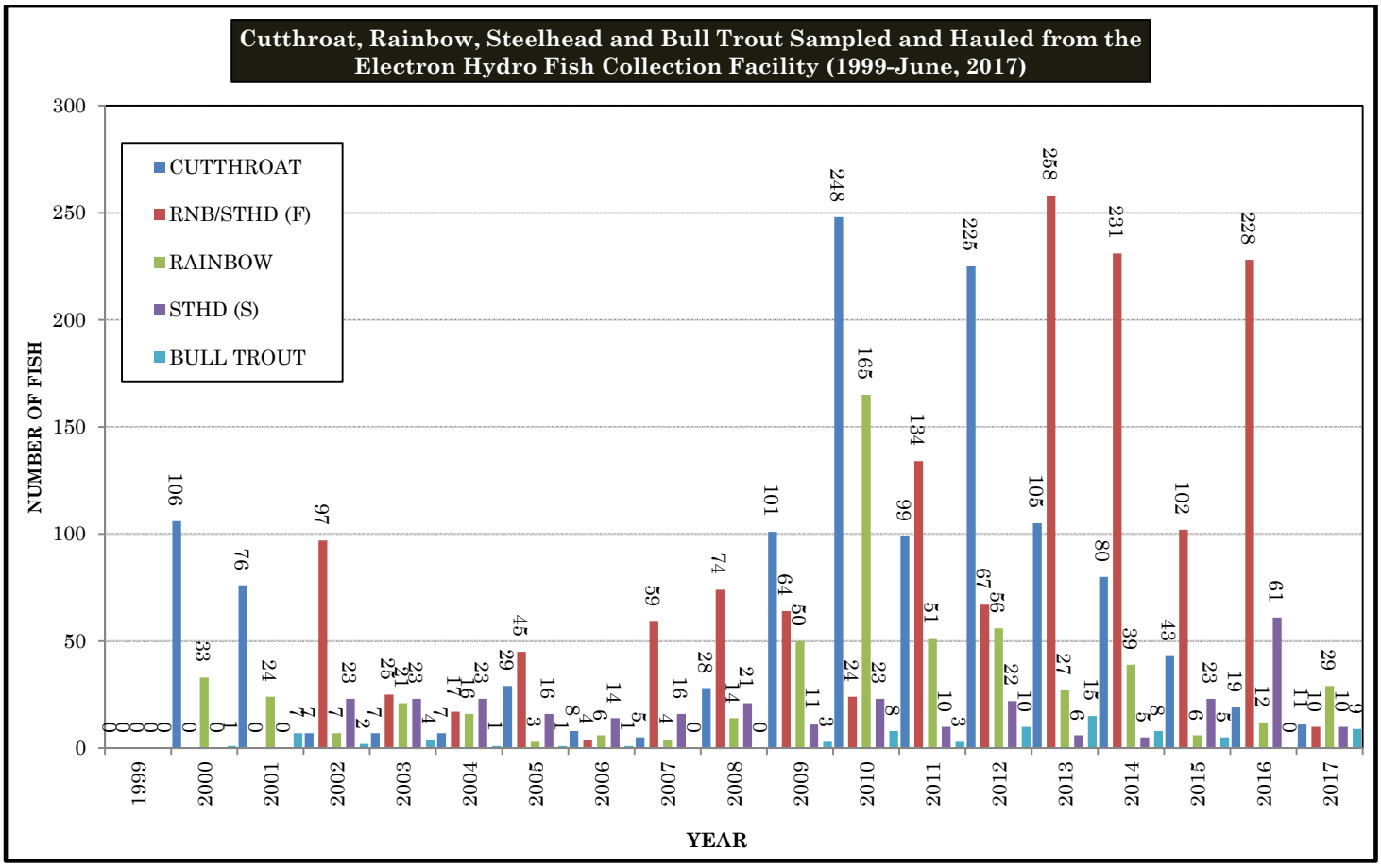
Chinook fry captured at Electron.



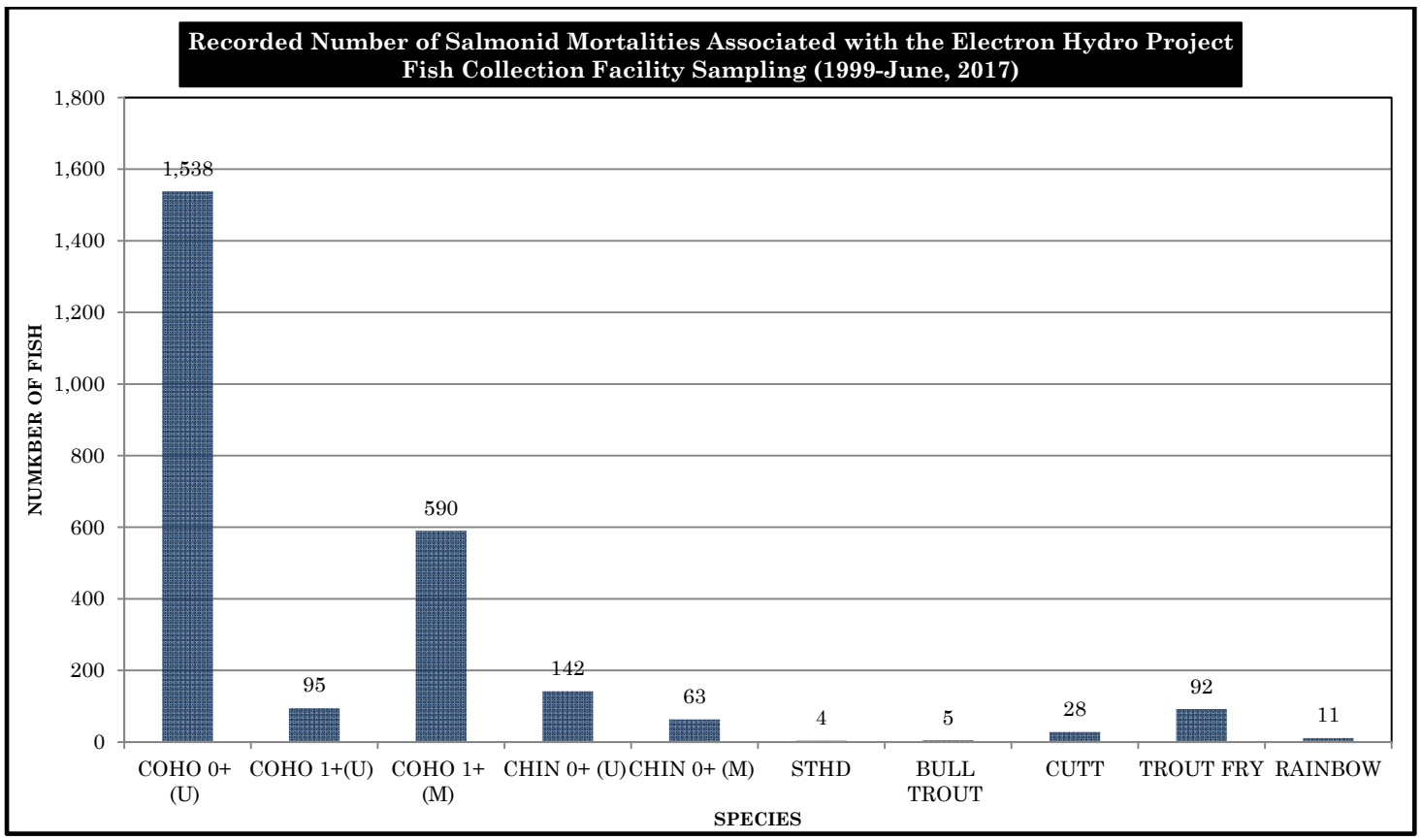
Chinook juveniles captured, sampled and hauled from the Electron fish collection facility (1999- June, 2016) **[M:** Marked fish *(fin clip)*, hatchery origin, **U:** Unmarked fish, wild origin, **0:**Young of the year, **1+:** 1 year+ age fish]. Results do not include mortalities or fish removed during forebay outage recoveries. ******Unmarked Chinook captured and sampled in 2009 were unmarked Spring Chinook sub-yearlings (0's) released from the Rushingwater acclimation pond.



Coho juveniles captured, sampled and hauled from the Electron fish collection facility (1999- June, 2015) **[M:** Marked fish *(fin clip)*, hatchery origin, **U:** Unmarked fish, wild origin, **0:**Young of the year, **1+:** 1 year+ age fish]. Results do not include mortalities or fish removed during forebay outage recoveries.



Steelhead, rainbow and bull trout captured, sampled and hauled from the Electron fish collection facility (1999- June, 2016) **[S**: Smolt, **A**: Adult fish, **F**: Fry]. Results do not include mortalities or fish removed during forebay outage recoveries.



Recorded salmonid mortalities encountered during Electron Hydro project fish sampling (2000-June, 2017).

FENNEL CREEK

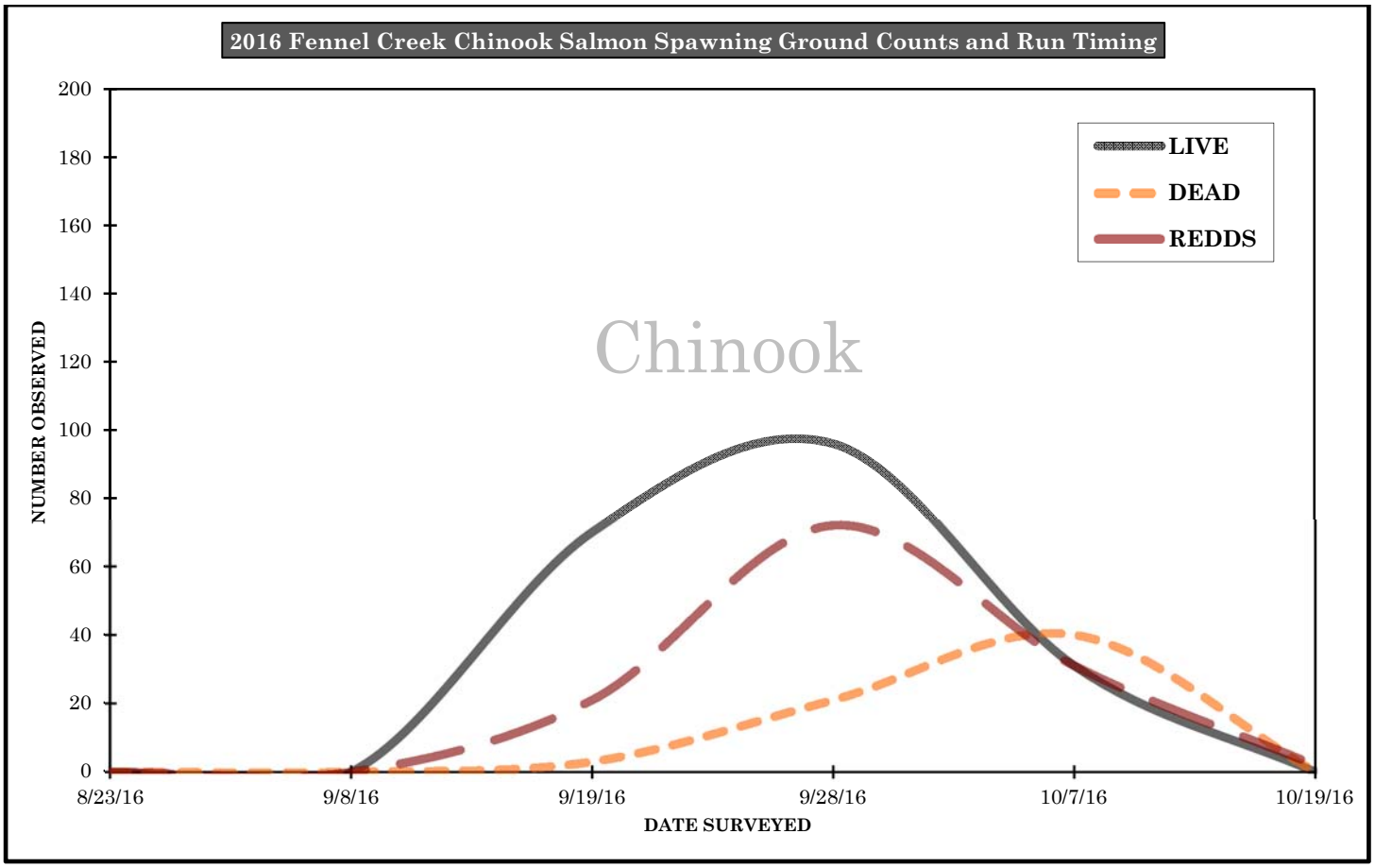
WRIA 10.0406

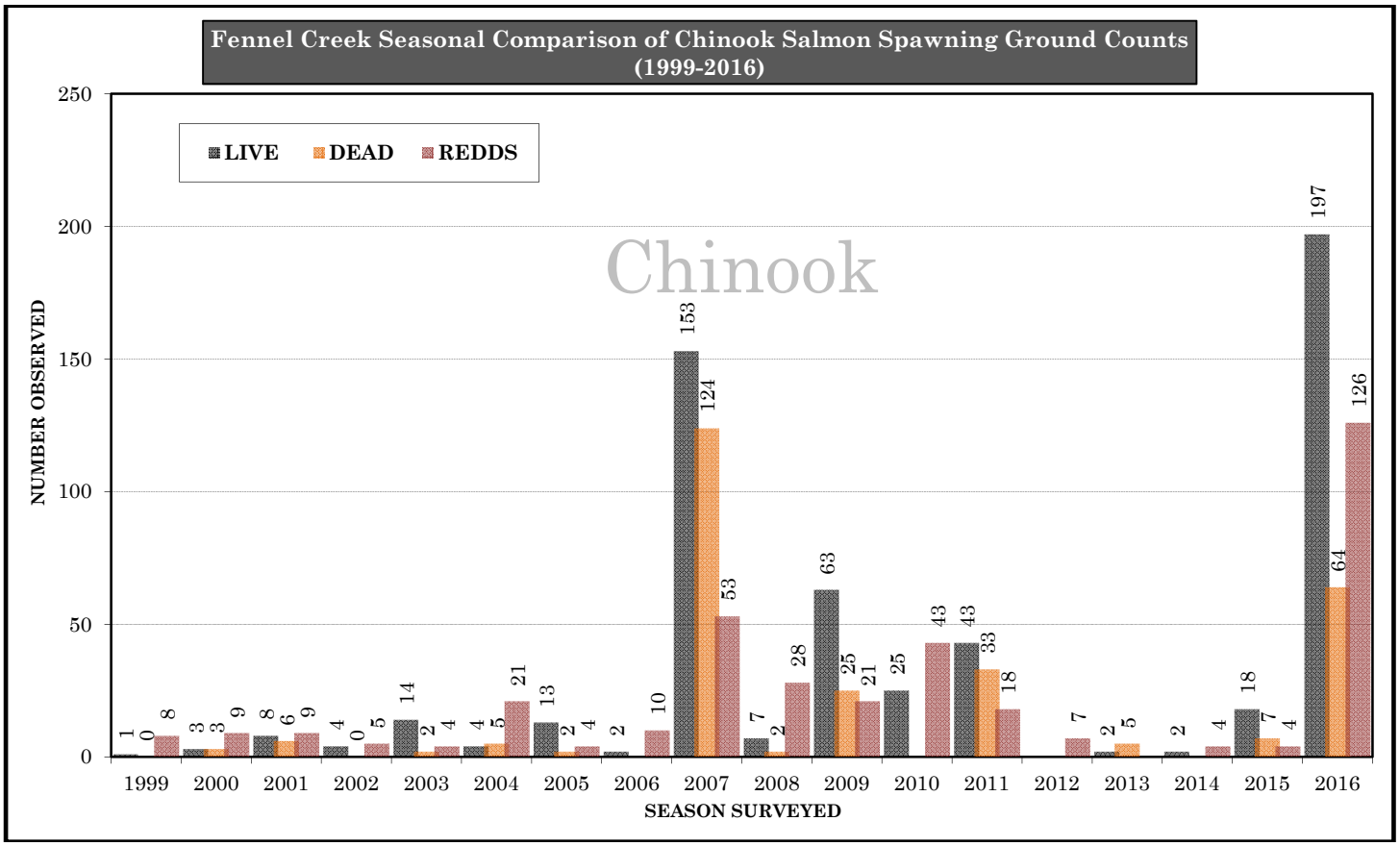
Lower Fennel Creek restoration site

Fennel Creek (*Kelly Cr.*) flows nearly 8 miles from its source of wetlands and lowland lakes located on the plateau near Bonney Lake and HWY 410; to its eventual convergence with the Puyallup River near Alderton at RM 15.5. With a drainage area of over 6.5 square miles, Fennel Creek provides approximately 2 miles of anadromous usage. A natural 100 foot barrier falls (*Victor Falls*) is located at river mile 1.9. The anadromous reach provides abundant suitable habitat for Chinook, coho, pink, chum, and steelhead. Pink and chum salmon are undoubtedly the most prolific species to spawn in the creek; unfortunately, steelhead escapement has dropped precipitously over the past decade. Bull trout utilization in Fennel Creek is unknown; however, it is assumed that adult/sub adult fluvial bull trout likely exploit prey species in Fennel Creek. Other species present throughout Fennel include cutthroat, sculpins, sticklebacks, and lamprey.

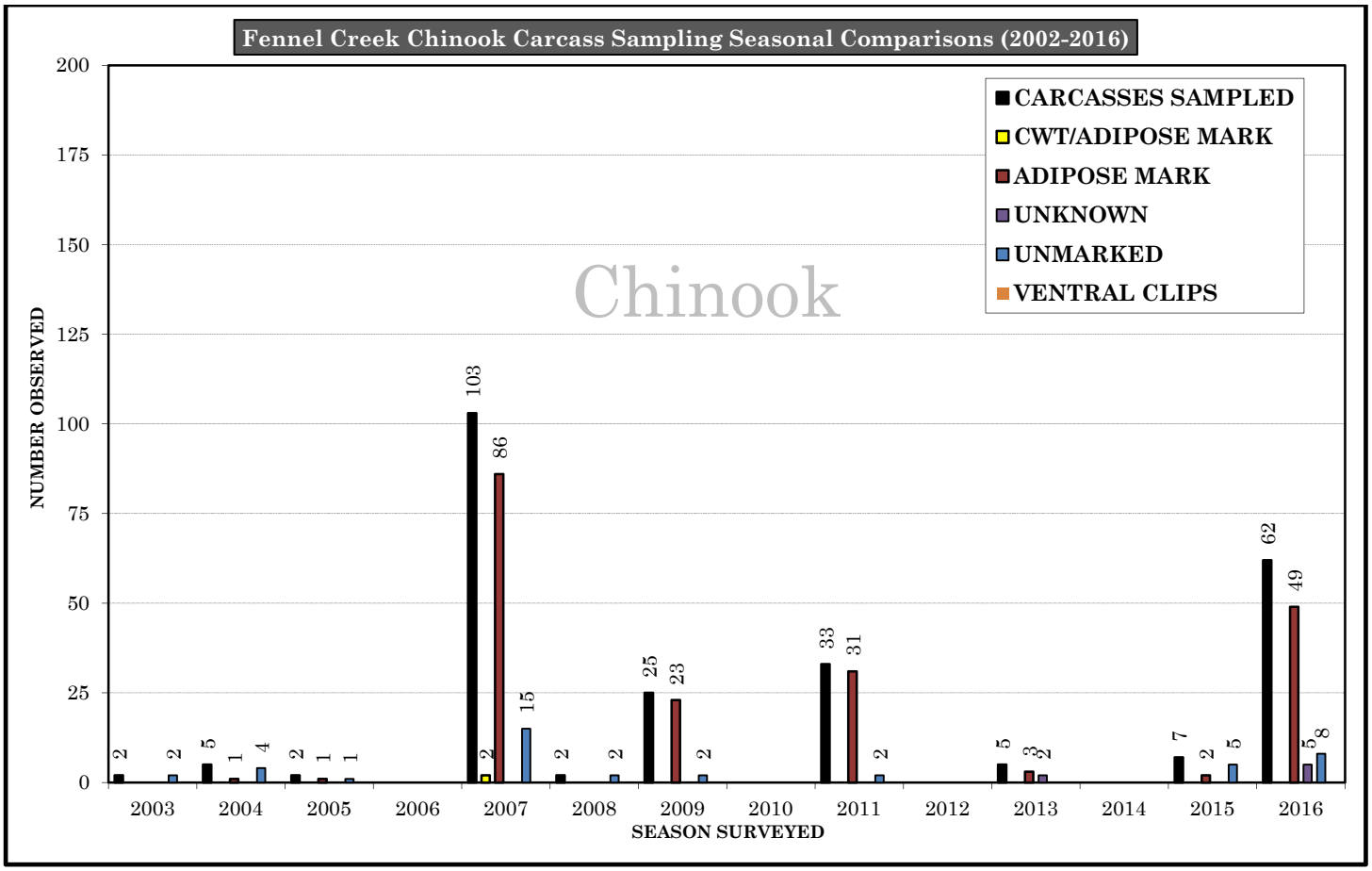
In 2015, Pierce County completed the construction of a new lower channel restoration on Fennel creek. The new channel; in addition to the bordering 40 acres is designed to improve instream and surrounding wetland complexity, as well as fish and wildlife utilization. The new stream channel restoration meanders downstream over 1,800 feet from McCutchen Road *(top photo)*.

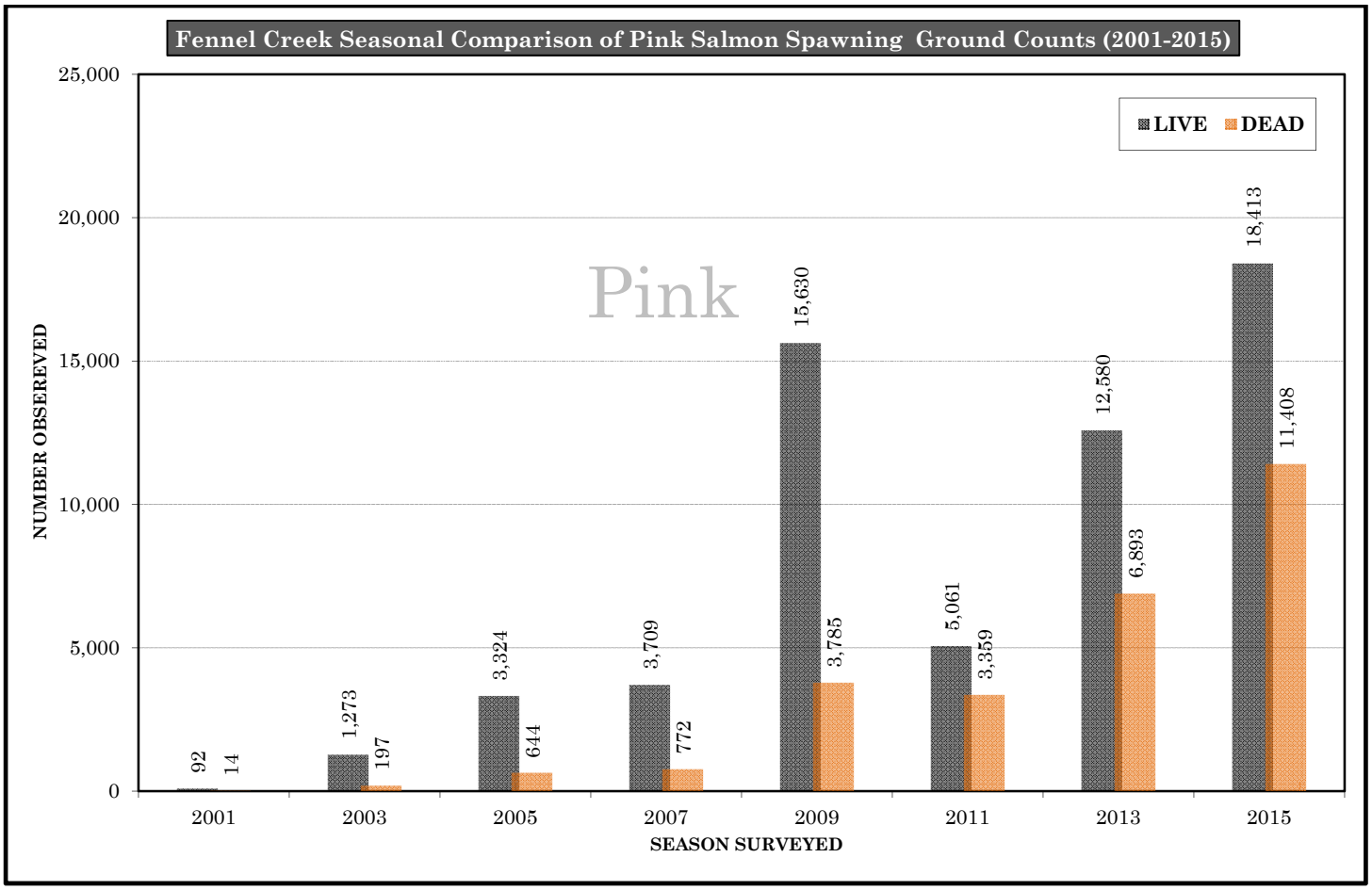
Approximately 0.2 miles upstream of the McCutcheon Bridge is a short run spring fed tributary, Fennel Tributary, which contains excellent spawning gravel and has supported high densities of adult chum spawners in the past. The upper anadromous reach of Fennel Creek is a complex, moderate gradient, pool-riffle/step-pool stream flowing through a broad valley. Victor falls, at RM 1.9, blocks any further upstream migration. The riparian zone is well intact due to little or no agricultural or residential land use development along most of the creek channel; the overstory riparian consists of a mature hardwood and conifer forest with a dense understory of salmonberry and vine maple. Throughout the upper 1.5 mile anadromous stretch, abundant LWD lies in and adjacent to the channel; as well as several small in-stream logjams. Spawning gravel is abundant and excellent throughout this reach, as are numerous deep resting pools for juveniles and adult migrants. Uniquely, Fennel Creek experiences an early run of chum salmon each year; with fish often entering the creek in late October, nearly three weeks earlier than most lower Puyallup tributaries. In May of 2009, a 9.75-acre land conservation area along Fennel Creek in Bonney Lake was created through a cooperative partnership between Pierce County, the City of Bonney Lake, and the Cascade Land Conservancy. The land conservancy will protect habitat along Fennel Creek and will eventually be the location of the Fennel Creek Trailhead.

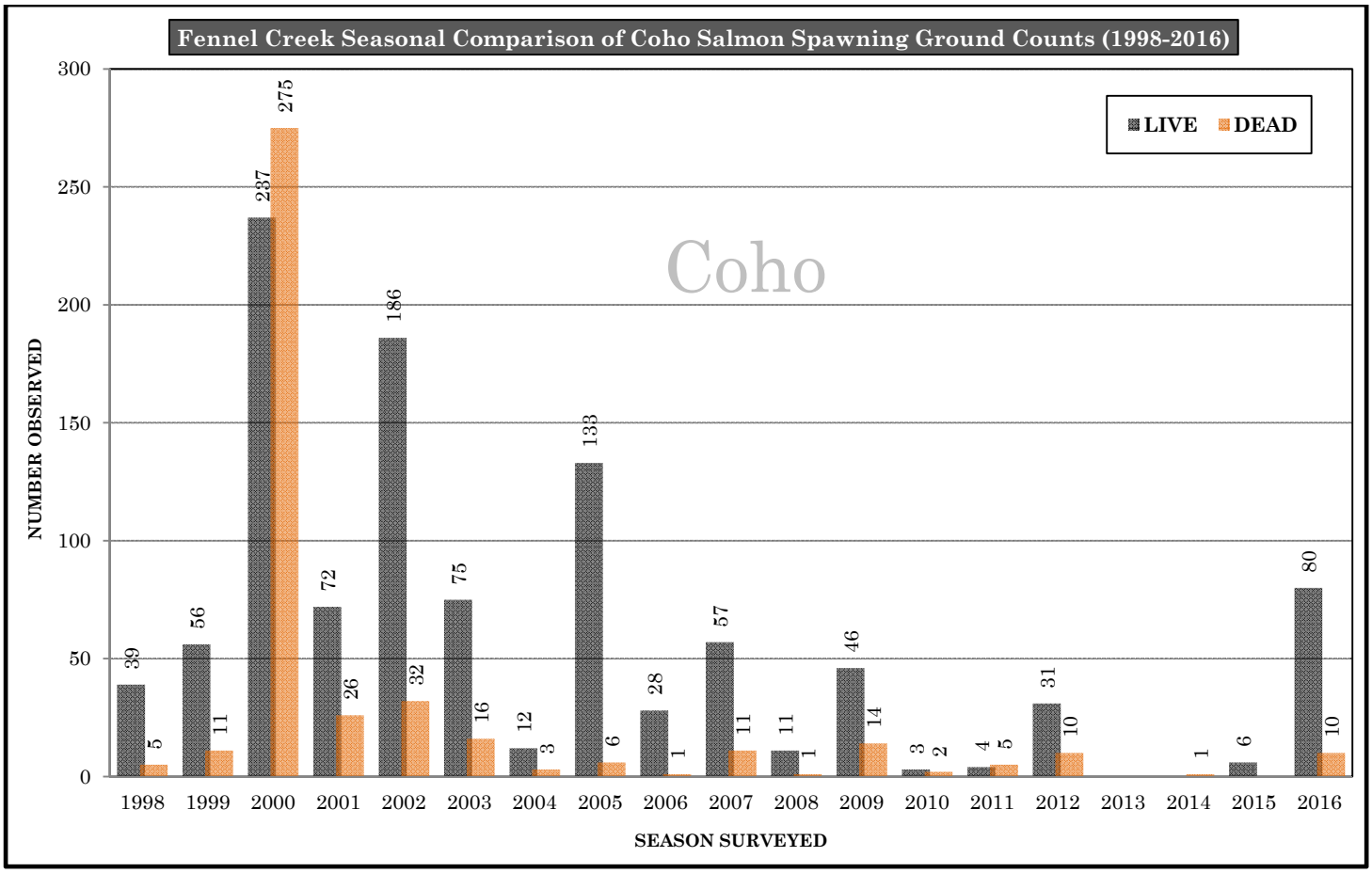




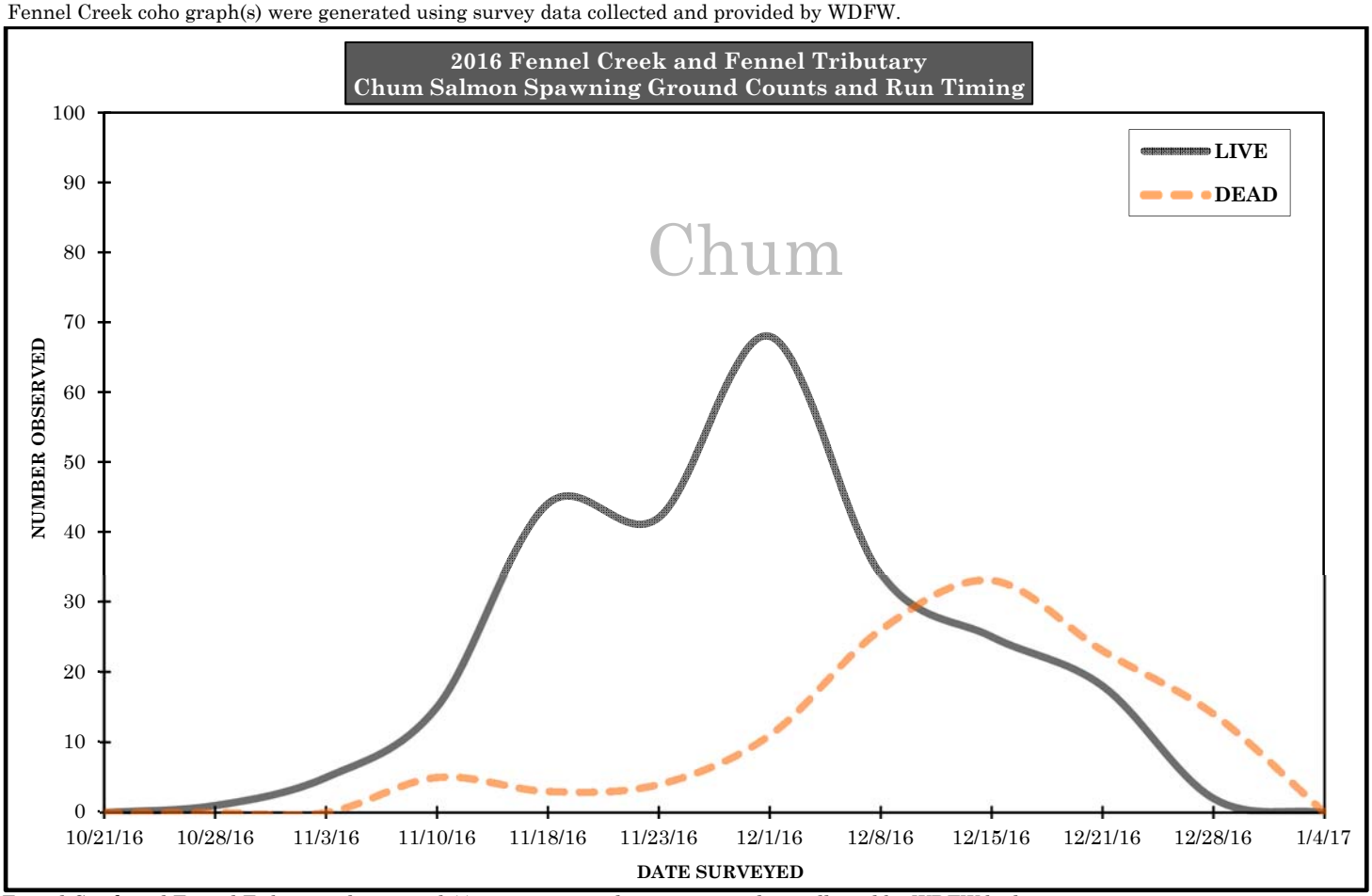
Adult Chinook escapement is determined by expanding the number of redds observed by 2.5 fish per redd (Smith and Castle, 1994). Due to the tremendous volume of pink salmon during odd years, the success of determining Chinook redds from pinks is vastly reduced. Therefore, The AUC method is used to determine escapement during pink runs (odd years).


Fennel Creek Chinook Carcass Sampling Seasonal Comparisons (2002-2016)
CARCASSES SAMPLED
CWT/ADIPOSE MARK
ADIPOSE MARK
UNKNOWN
UNMARKED
VENTRAL CLIPS
Chinook
NUMBER OBSERVED
SEASON SURVEYED
0
25
50
75
100
125
150
175
200
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2 2 5 1 4 2 1 1
103 2 86 15
2 2
25 23 2
33 31 2
5 3 2
7 2 5
62 49 5 8

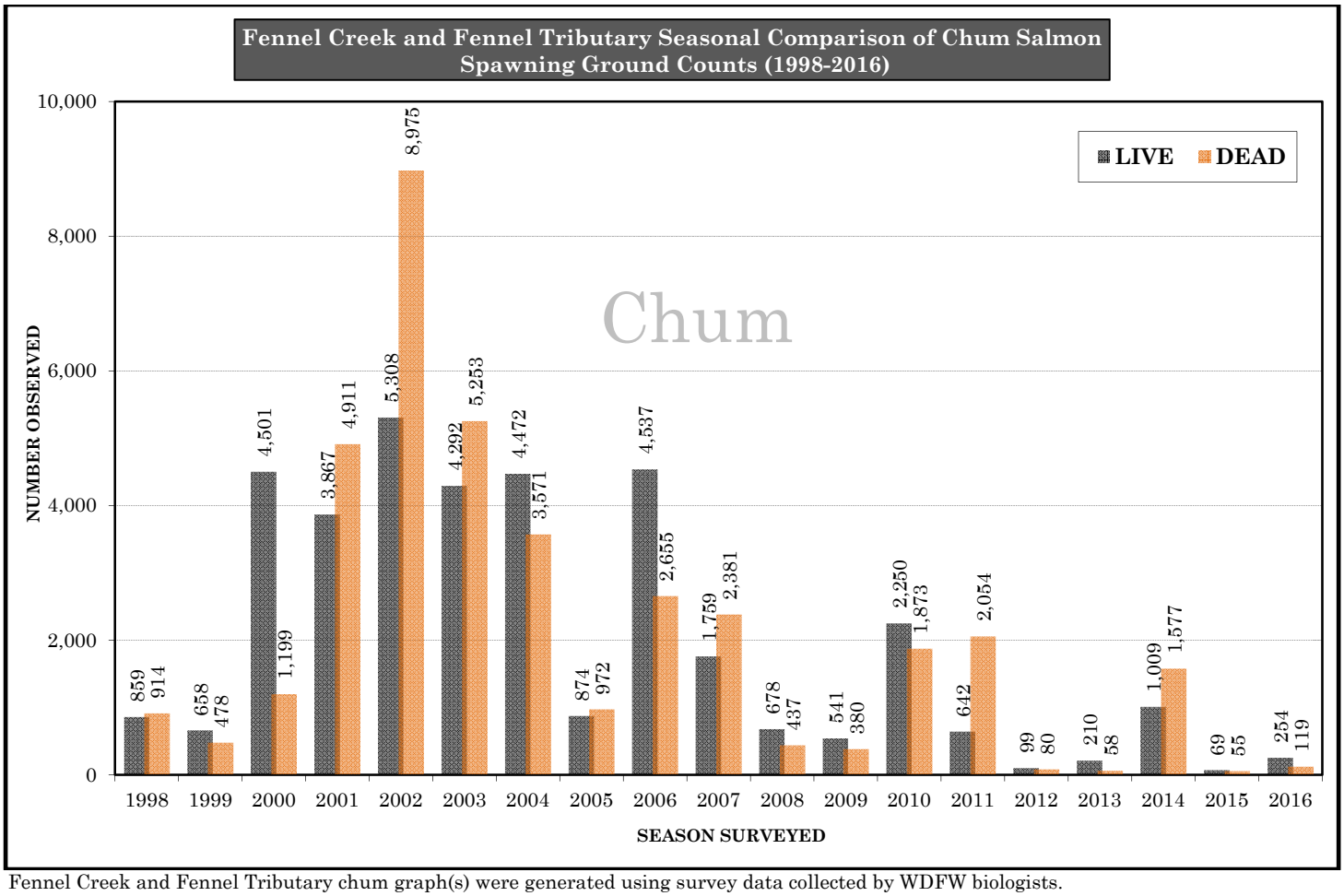

Fennel Creek Seasonal Comparison of Pink Salmon Spawning Ground Counts (2001-2015)
LIVE
DEAD
Pink
NUMBER OBSERVED
SEASON SURVEYED
0
5,000
10,000
15,000
20,000
25,000
2001
2003
2005
2007
2009
2011
2013
2015
92 14
1,273 197
3,324 644
3,709 772
15,630 3,785
5,061 3,359
12,580 6,893
18,413 11,408



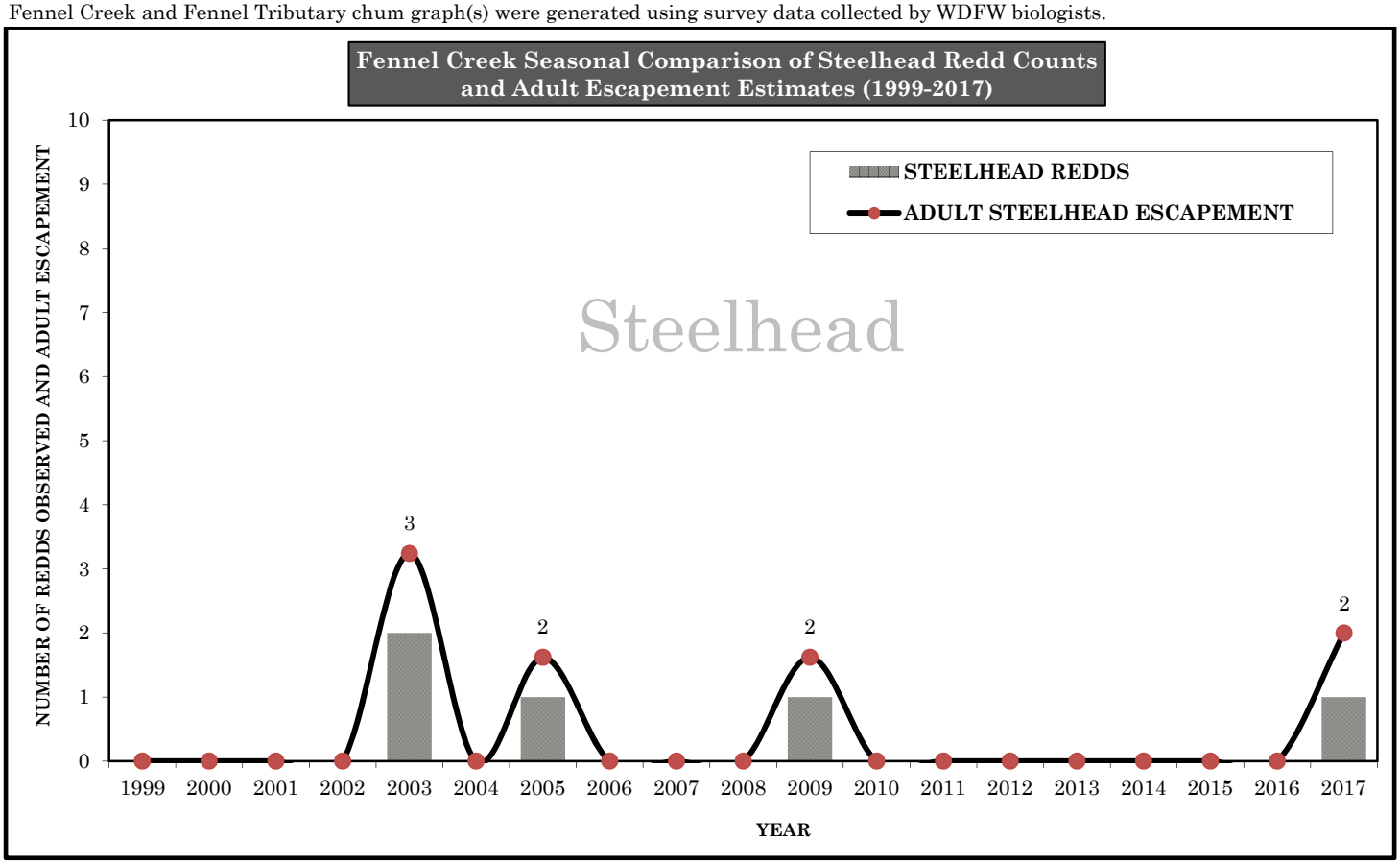
Fennel Creek coho graph(s) were generated using survey data collected and provided by WDFW.



Fennel Creek and Fennel Tributary chum graph(s) were generated using survey data collected by WDFW biologists.



Fennel Creek and Fennel Tributary chum graph(s) were generated using survey data collected by WDFW biologists.



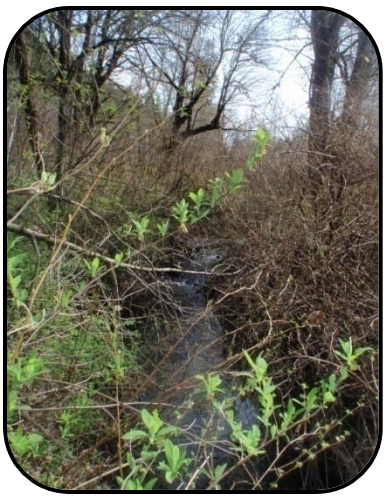
To determine the total escapement for steelhead, each redd is multiplied by a factor of 1.62 *(i.e. 42 redds x 1.62 steelhead per redd = total escapement of 68 steelhead).*

FISKE CREEK

WRIA 10.0596

Fiske Creek is a small tributary to the Puyallup River, entering the Puyallup at approximately RM 26.6. Fiske Creek, (*fiske is a Swedish word meaning "fish"*) is one of 5 index streams in the Puyallup Watershed surveyed for coho by the Washington Department of Fish and Wildlife. State biologists use the coho escapement from five "index" tributaries (*Coal Mine, Spiketon, Fiske, Fennel and Canyonfalls creeks*) to estimate the total escapement for the Puyallup River.

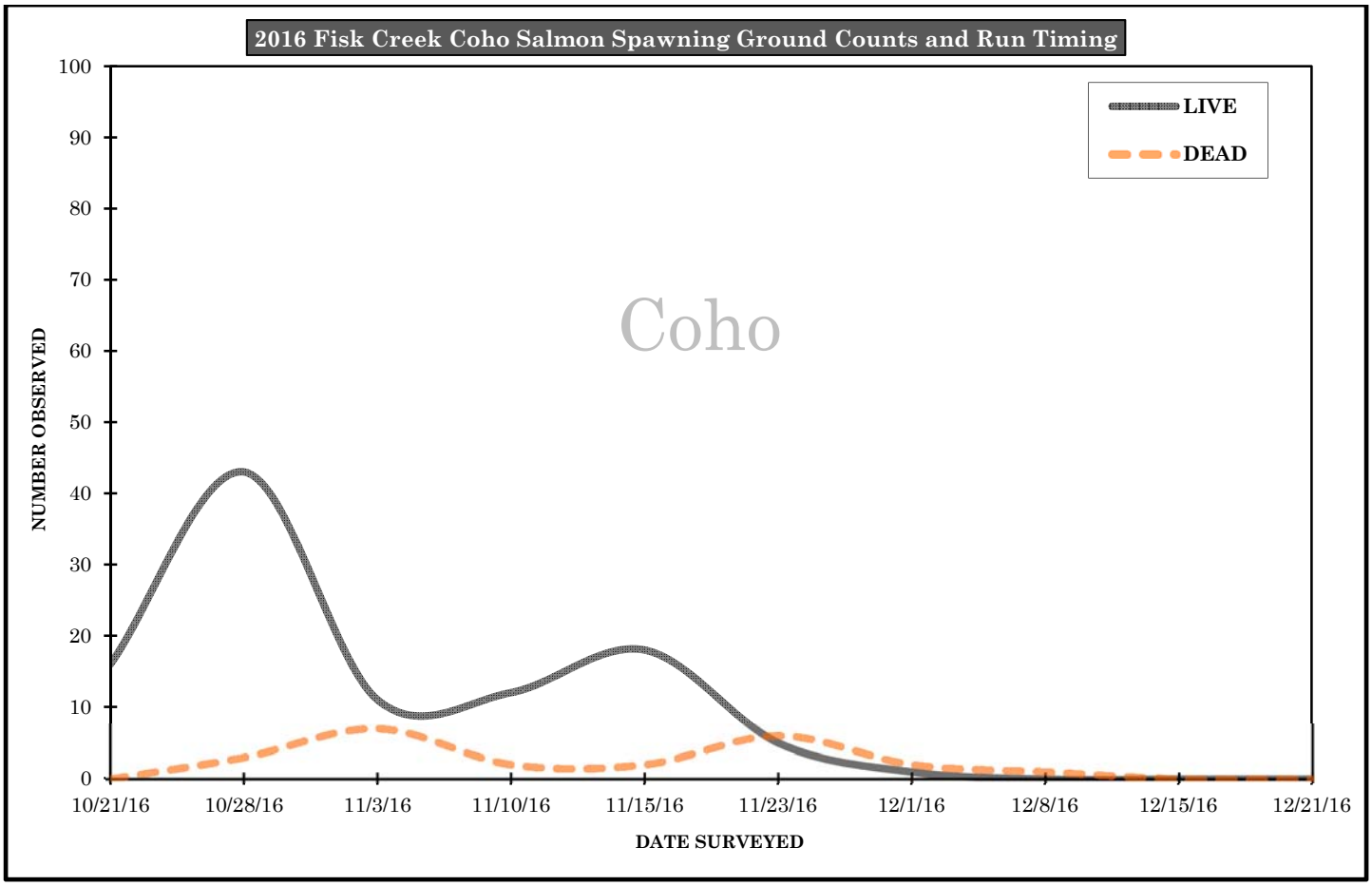
Coho are the only species observed spawning within Fiske Creek in significant numbers, although those numbers are relatively low *(average 39, range 0-141).* In the past, steelhead and chum have been documented spawning in the creek as well. Unfortunately, seasonal flows within Fiske Creek can be inadequate to allow access for Chinook or steelhead to spawn. Furthermore, the streams location in the watershed, nearly 27 miles from Commencement Bay, make is less than ideal for chum. Bull trout are known to utilize the mainstem river; however, it's currently unknown what bull trout utilization is, if any, within Fiske.



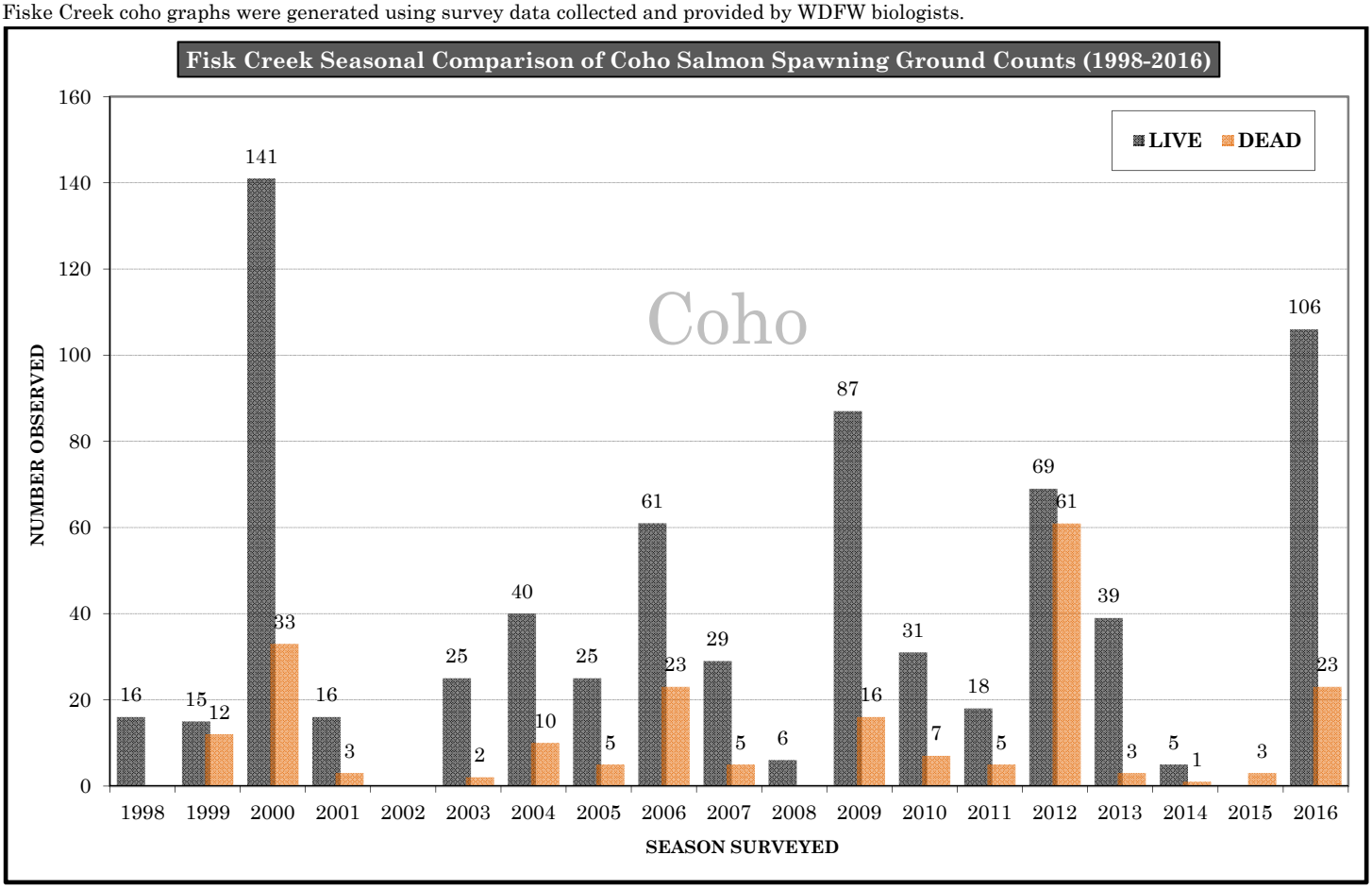
Fiske Creek is a small stream flowing just over 2 miles, with a small unnamed tributary entering its right bank at RM 1.0. The upper headwaters reach is primarily cascades/step pool, with a substrate consisting primarily of large cobble and boulders. The lower reach of the creek consists of a low to moderate gradient pool-riffle channel with moderate riparian cover from the surrounding conifer and deciduous forest. Relatively abundant spawning gravel exists throughout most of the stream, but is somewhat compacted in the lower portion of the channel

There are several limiting factors affecting fish and habitat within Fiske. The creek channel is confined due to natural channel cutting, steep banks and rip-raped banks. Along the road and within the boundaries of private property, the channel is slightly incised and lacks any real complexity or off-channel habitat such as wetlands, side channels, or large woody debris. Moderate amounts of residential and other land use development exist along the creek, including private forest management. Land use along the lower reach consists mostly of private family residences and a county road (*Brooks Road*) which often traverses the creek. In addition, water is regularly diverted from the creek into a private pond on the lower reach. The creek passes through a couple of small, yet fish passable culverts *(right)*, as well as a low narrow bridge located approximately 0.3 miles up from its mouth. Several years ago, some complexity was added to the creek via a small restoration project which included the placement of small sill logs and boulders. However, tremendous improvements are possible to stream channel habitat and instream flows.

Fiske Creek & Brooks Road



Fiske Creek coho graphs were generated using survey data collected and provided by WDFW biologists.



Fiske Creek coho graphs were generated using survey data collected and provided by WDFW biologists.

FOX CREEK

WRIA 10.0608

Coho

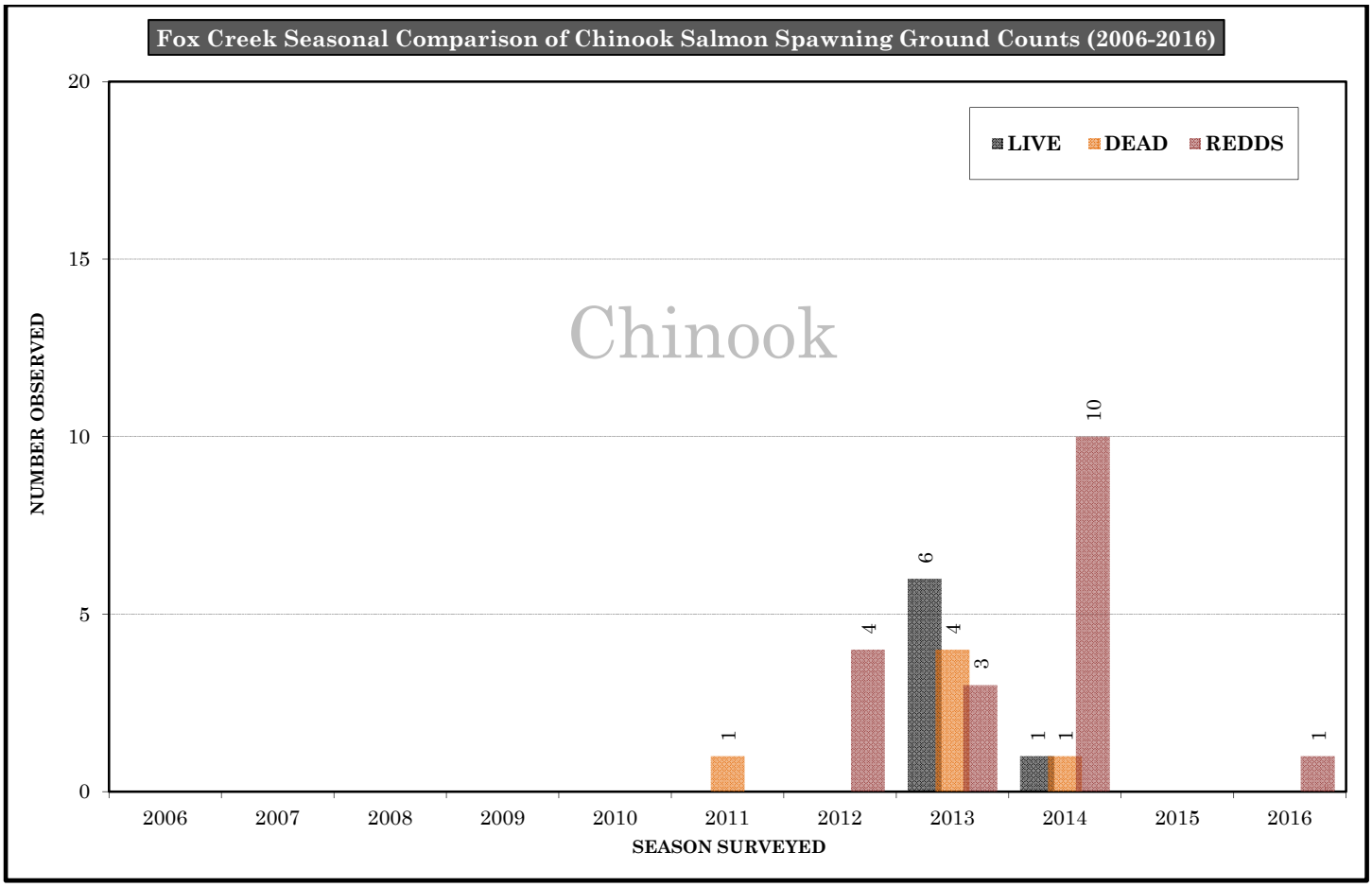
Fox Creek joins the Puyallup River at RM 29.5. Fox Creek is primarily a coho stream *(above)*, with fish likely ascending as far up as the 6 Road; however, the majority of spawning occurs within the first mile of the creek. Fox Creek flows within the Kapowsin tree farm (*Hancock Forest Resource Group*); where roads and timber harvesting have impacted several portions of the stream in the past. The most suitable spawning habitat exists from the mouth, up to the Road 1 Bridge. The first significant pink salmon escapement was observed during the 2009 season. Although sporadic, chum and steelhead spawning activity has been observed in the past; as well as a Chinook *(below)*.

Extensive sampling of coho carcasses for coded wire tags and fin clips has revealed that many of the spawners in Fox are Voights Creek hatchery origin fish. As juveniles, these fish were relocated from Voights Creek hatchery to acclimation ponds in the upper Puyallup River (*Cowskull and Rushingwater*) or Lake Kapowsin. Each spring, as many as 200,000+ coho yearlings are imprinted and released from the acclimation ponds, or are planted directly into the lake. All fish are marked with an adipose fin clip and approximately half are implanted with a coded wire tag, in addition to an adipose fin clip.

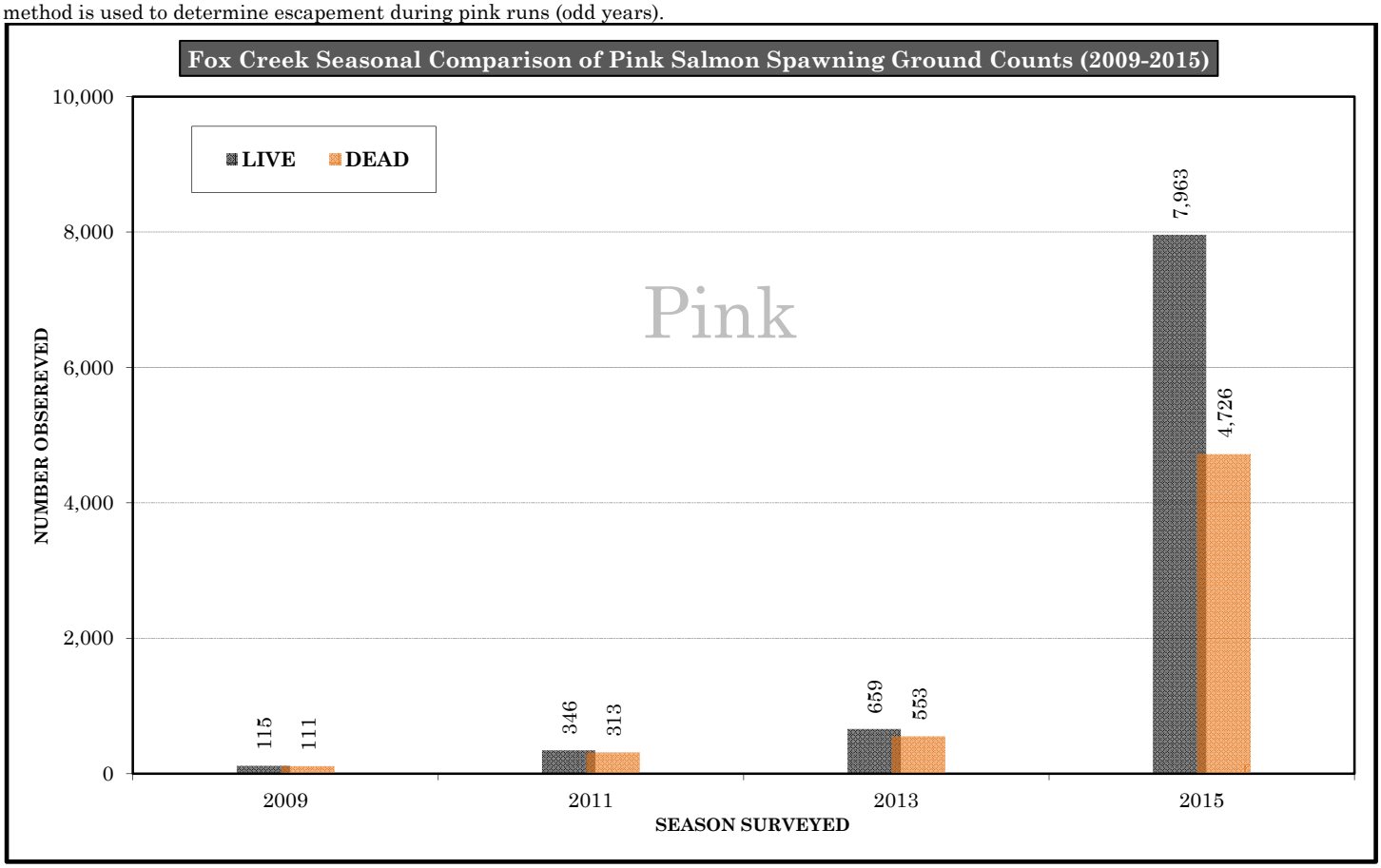
Chinook

From its confluence with the Puyallup River, to approximately RM 0.3, Fox is a low gradient pool-riffle stream flowing through a moderately dense forested area consisting mostly of alders. There's abundant spawning habitat available throughout the lower 1 mile reach. Spawning activity by pink, coho, chum and steelhead have been observed within this lower reach. An adipose clipped Chinook jack was observed in 2011. Beyond this, from RM 0.3 to 0.5 the creek meanders through a grassy area with little riparian cover and moderate amounts of fine materials obscuring the gravelly substrate. The channel is relatively narrow and incised, yet coho spawning is prolific throughout the entire segment. This "middle reach" often has the highest spawning densities. Beyond RM 0.5, Fox becomes a moderate gradient step-pool/riffle stream with good pool frequency, along with adequate small conifer and hardwood riparian cover. There are few mature conifers in this reach, although many young Grand firs were planted as a part of a past restoration project.

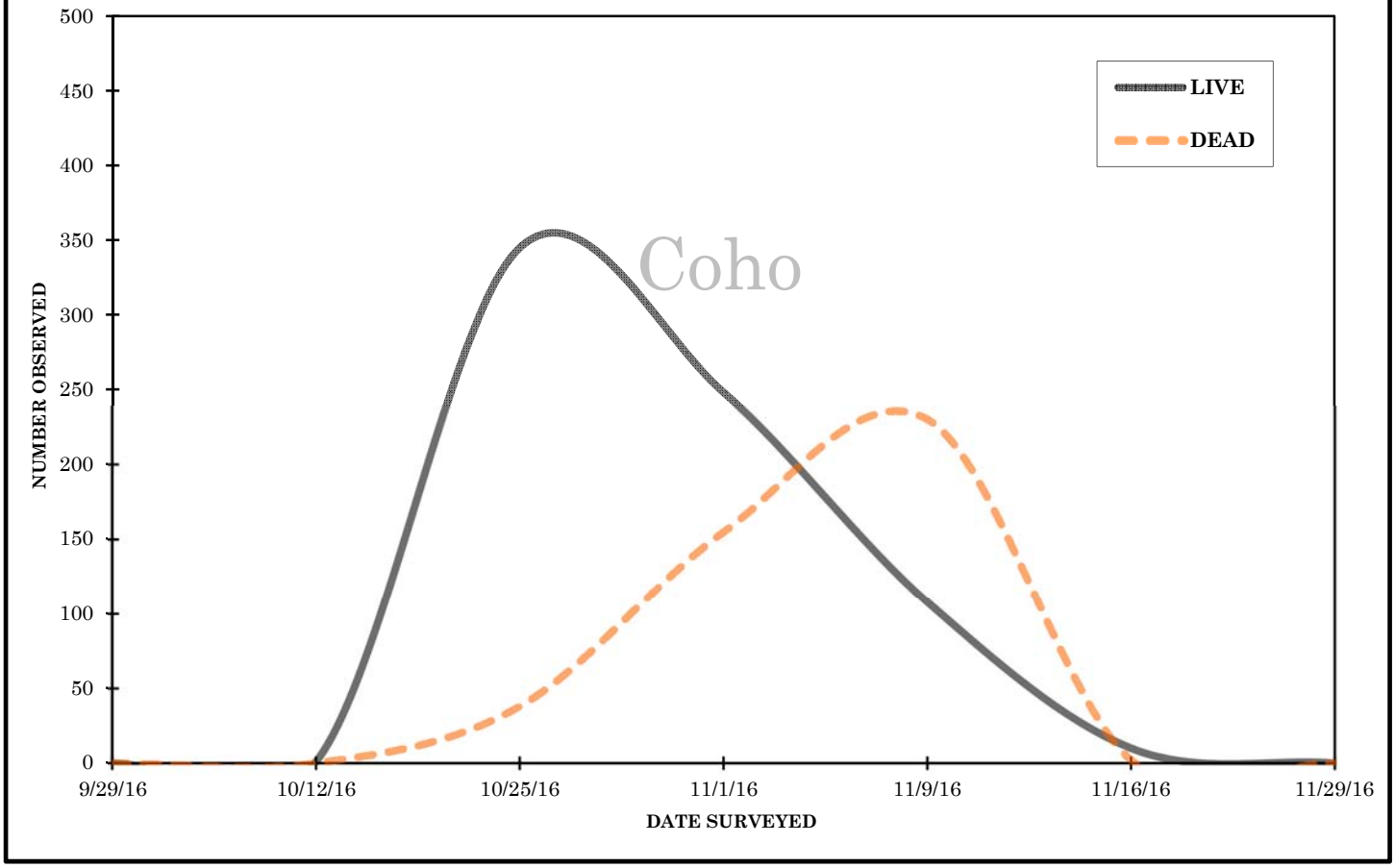
A substantial amount of beaver (*Castor canadensis*) activity exists throughout Fox Creek. Beaver dams, some up to six feet in height, often completely block and prevent fish from migrating upstream. Dams located along the lower mile of the creek are often breached during the beginning of the coho season to allow fish access to the spawning habitat above. Currently, the lower reach of the creek *(RM 0-0.15)* is a low gradient channel flowing within the open channel migration zone of the Puyallup River; a section repeatedly manipulated by mainstem river incursions.



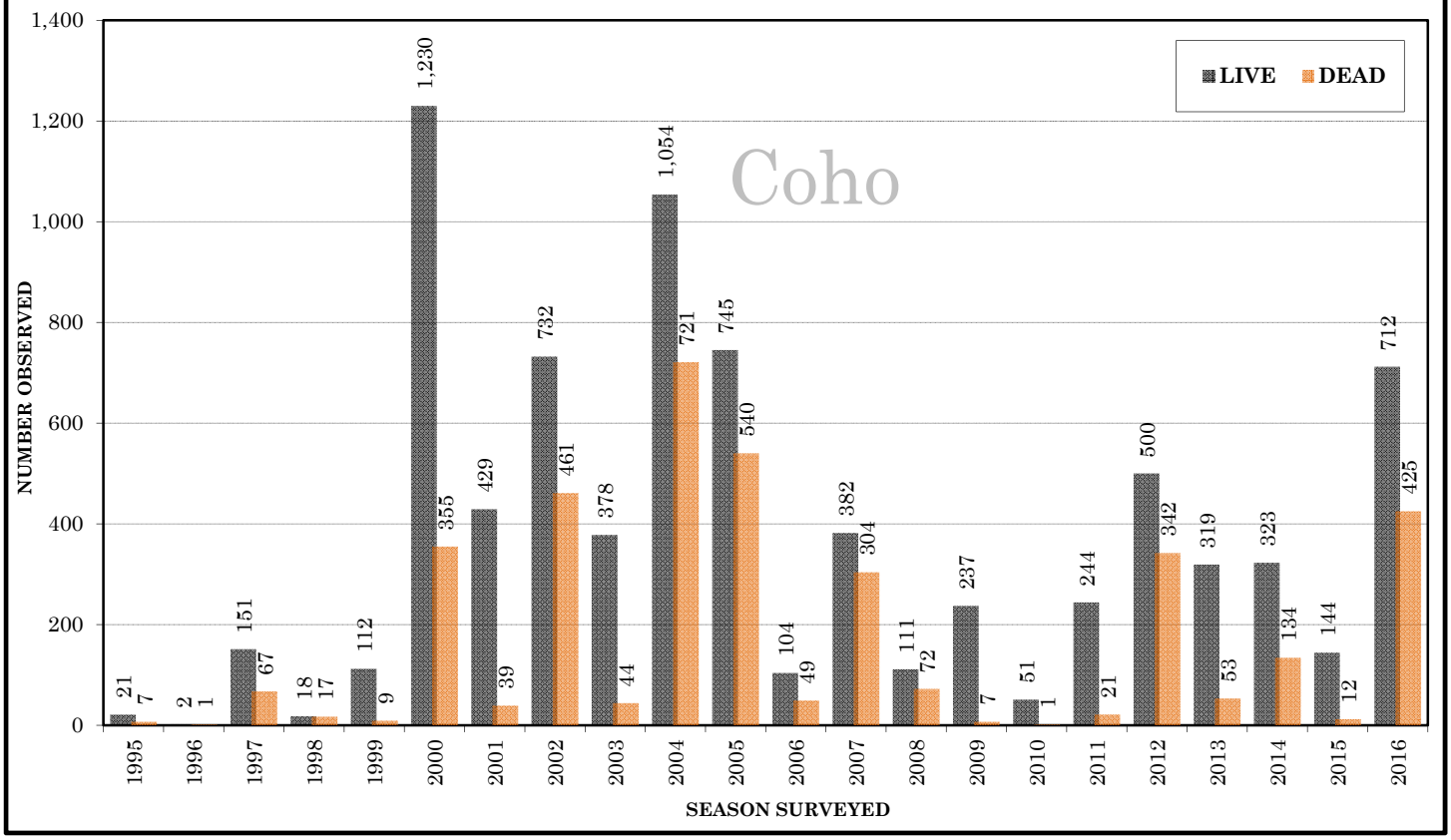
Adult Chinook escapement is determined by expanding the number of redds observed by 2.5 fish per redd (Smith and Castle, 1994). Due to the tremendous volume of pink salmon during odd years, the success of determining Chinook redds from pinks is vastly reduced. Therefore, The AUC method is used to determine escapement during pink runs (odd years).

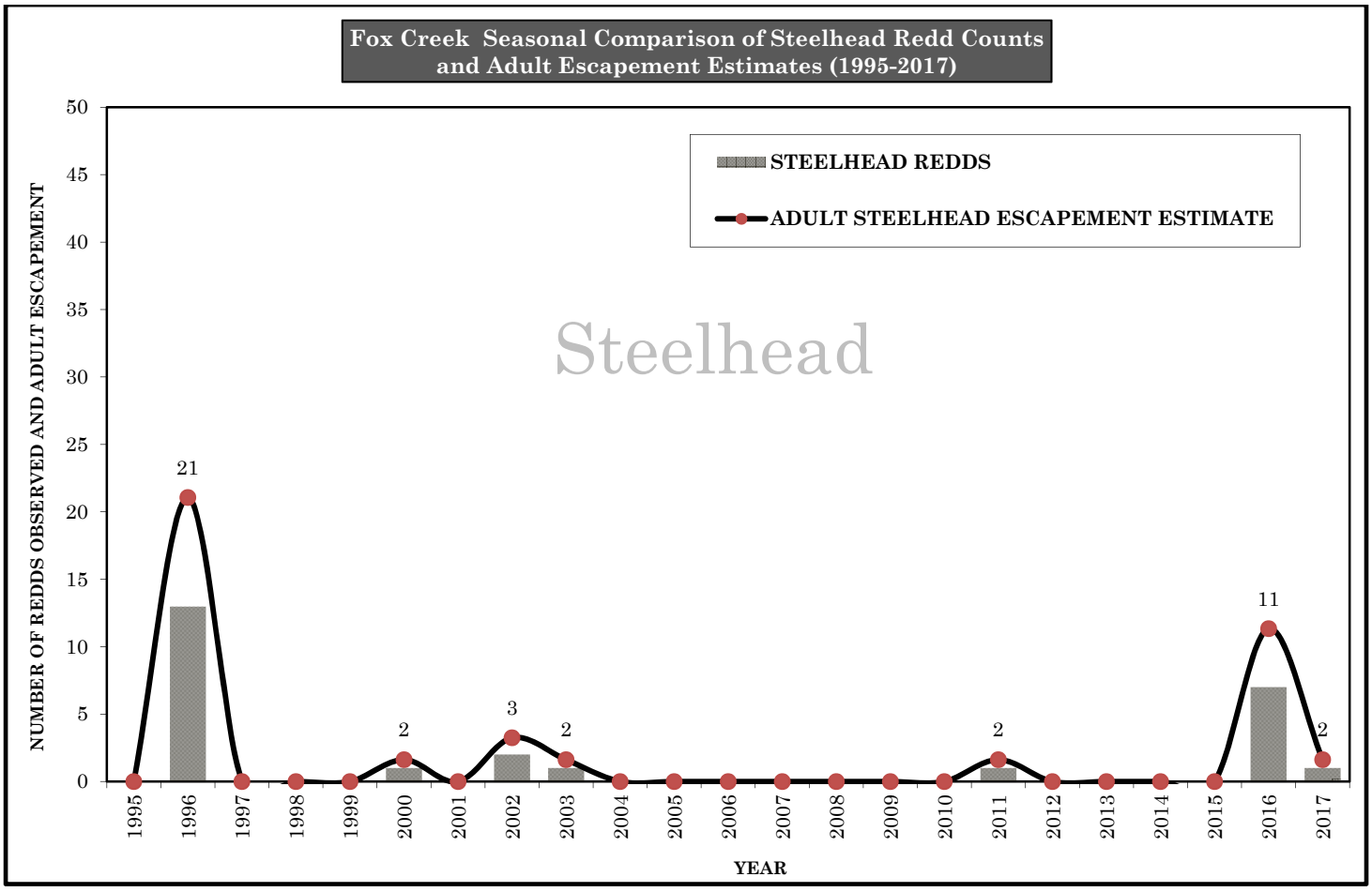


2016 Fox Creek Coho Salmon Spawning Ground Counts and Run Timing



Fox Creek Seasonal Comparison of Coho Salmon Spawning Ground Counts (1995-2016)





To determine the total escapement for steelhead, each redd is multiplied by a factor of 1.62 *(i.e. 42 redds x 1.62 steelhead per redd = total escapement of 68 steelhead).* See steelhead redd location map in appendix B.

FRYINGPAN CREEK

WRIA 10.0369

Bull trout in Fryingpan Creek

Fryingpan Creek is a moderate sized right bank tributary to the Upper White River. This headwaters creek is surveyed for bull trout from late August through September. Unfortunately, the 3700'+ elevation is likely too high for most salmonids; however, steelhead are quite capable of ascending to this headwater tributary to spawn; therefore, this should not preclude the possibility of steelhead utilization within this stream. Fryingpan does host a population of resident cutthroat and bull trout *(above)*; providing excellent rearing and spawning habitat for these two species.

Fryingpan enters the White River north of Sunrise Park Road at approximately RM 70.5. Fryingpan provides approximately 1.7 miles of anadromous usage. A falls *(below)* located at approximately RM 1.7 blocks any further upstream migration. The creek is almost entirely bordered by an old growth coniferous forest, and the water is cooled year round by glacial melt water from Fryingpan Glacier. In addition to the glacial influenced mainstem flow, there are several smaller non-glacial tributaries contributing flow along Fryingpan's nearly 4.7 mile length.

Fryingpan Creek falls

Typical of headwater streams, substrate bedding consists mainly of Tertiary sedimentary rock and other products created by ancient volcanic activity. Substrate size within active river channels is typically large; consisting primarily of large gravels, cobble and boulders. Significant quantities of LWD are present within the channel migration zone; however, a considerable amount of the larger wood which is deposited during high flow events and settles on the higher bars is detached from, or perched well above active channels during average flow regimes, thereby reducing any habitat creating interactions. The first 1.4 miles of Fryingpan consists of a large active braided channel that is low-to-moderate gradient. Several patches of excellent spawning gravel are available throughout this lower reach of the creek. Considerable amounts of LWD are present in the channel, although a great deal of it doesn't interact with the stream during average seasonal flows. Nevertheless, ample amounts of LWD are embedded in the creek channel creating beneficial fish habitat. In addition to spawning habitat, numerous pools and side channels are located throughout this lower reach; providing excellent rearing habitat for juvenile fish. Wright Creek and an unnamed tributary *(see Winzig Cr. in this report)*, both right bank tributaries located at RM 1.5 and 1.3, provide additional spawning habitat for bull trout.

From approximately RM 1.4 to the falls, the channel begins to narrow considerably due to the confinement created by steep upper valley walls. The channel assumes a step-pool configuration from this point on. Throughout this final reach of fish utilization, spawning opportunities are reduced due to the increased gradient, predominately larger substrate and rapid flows encountered. Bull trout have been documented ascending as far as the base of the falls. In 2006 and 2007, Puyallup Tribal Fisheries staff radio tagged bull trout (*9 fish in 2006 & 19 fish in 2007*) captured in the USACE fish trap near Buckley. Subsequently, a few of these bull trout were tracked from their release site at RM 45 on the

White River (*near the town of Greenwater*) to Fryingpan Creek and its tributary Wright Creek. Spawning was observed in both creeks during the month of September.

Resident bull trout reside in smaller headwater tributaries, while fluvial bull trout frequently travel long distances; utilizing the mainstem rivers and larger tributaries to forage and overwinter.

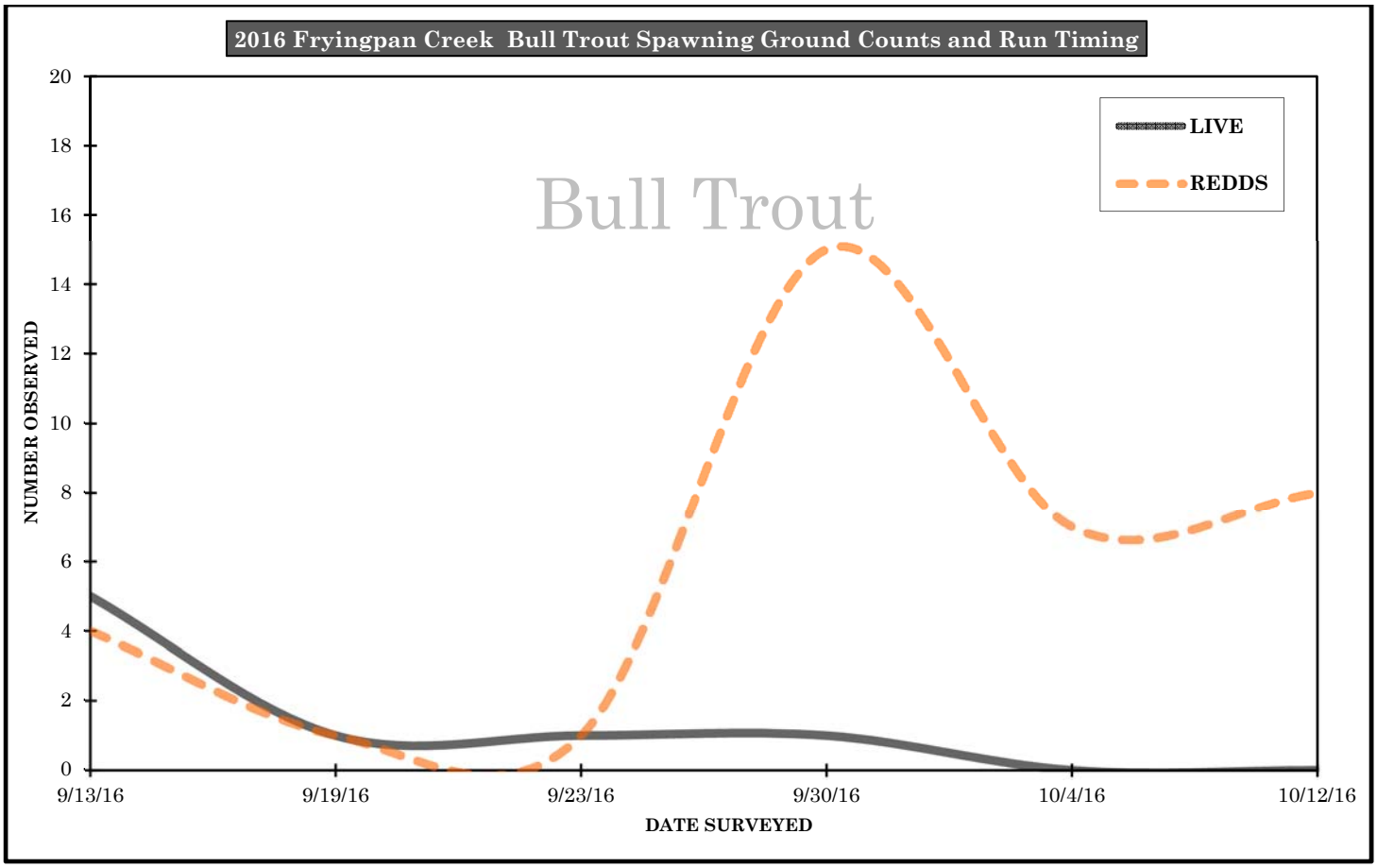
Lower Fryingpan Creek

During the fall, migratory forms of bull trout journey from spawning and foraging habitats in the upper watershed to foraging and overwintering habitats located lower in the river system. Beginning in spring and early summer, they begin the return journey back to spawning and rearing areas high in the watershed. In response to changing habitat and reproductive needs, migratory bull trout in the White River travel up to 75 miles or more between the lower river and headwaters located in or near Mt. Rainier N.P. To accomplish this, bull trout require unobstructed migration corridors and connectivity of streams and rivers in order to provide them with access to spawning, rearing, foraging, and overwintering habitats.

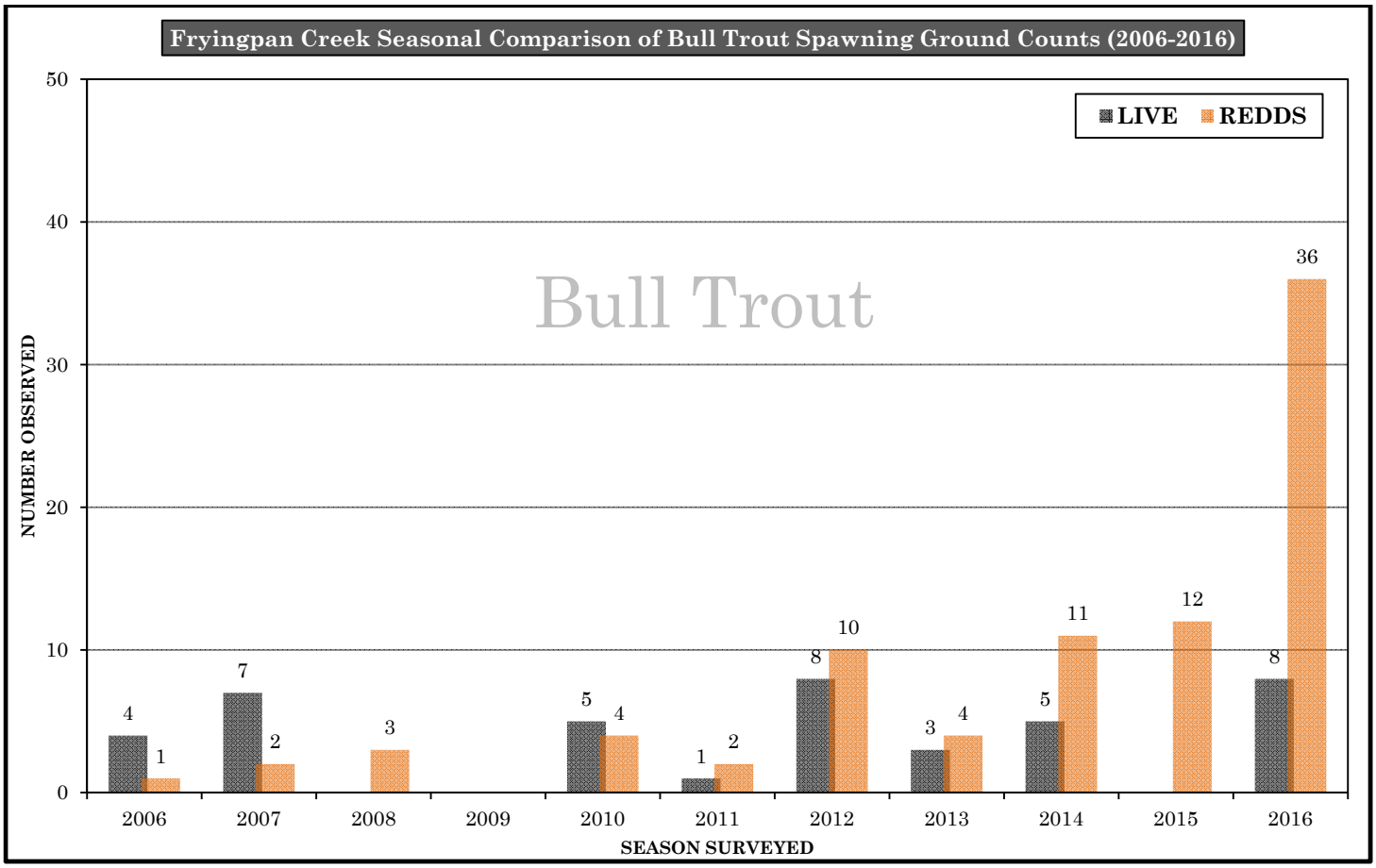
Bull trout spawning occurs primarily during the first three weeks in September, however, spawning has been observed taking place from the last week of August through the first week of October. Bull trout are iteroparous *(ability to spawn more than once)*; therefore, recovering pre-or-post spawn mortalities for examination is extremely rare. Spawners in the upper White River tributaries are observed utilizing various sized substrate from small gravels to small cobble. Redds are often constructed in the tail-out of pools and along the channel margins. Embryonic development is slow *(depending on water temperatures)*; it may take between 165-235 days for eggs to hatch and for alevin to absorb their yolk (Pratt 1992). Bull trout fry emerge in late winter and early spring. Young fry can often be seen by mid-March foraging in the lateral habitat along the upper mainstem White River and associate tributaries.

Bull trout habitat throughout the Puyallup and White rivers has been severely impacted by over a century of land and water resource exploitation; including, damming and substantial water diversions, considerable riparian alterations *(deforestation)*, dewatering and low instream flow regimes, as well as significant channel manipulation. These impacts have lead to a marked deterioration in land and hydrological behavior within these river systems by causing water flow of poorer quality, quantity and timing. Several limiting factors are involved with regards to the healthy function of stream habitat and bull trout populations in the watershed; including lost or diminished habitat connectivity and migration corridors, fragmentation and reduction of habitat quality *(entrainment, transportation networks, forest management practices and operations, direct water withdrawal)*; in addition to, water quality, fish entrainment and entrapment, unknown species interactions, and potential climate change impacts *(changes in flow regimes, scour effects, thermal variations and water chemistry)*.

Bull trout are primarily piscivorous *(fish eaters)*. However, they are extremely opportunistic feeders, feeding on a variety of prey items depending on their particular life history strategy and stage of development. Adults feed almost exclusively on other fish, including a range of salmon and trout species; as well as other resident fish species. Juveniles feed on aquatic invertebrates, including stoneflies *(Plecoptera)*, caddisflies *(Trichoptera)*, and mayflies *(Ephemeroptera)*. Bull trout require a healthy aquatic environment in order to survive and flourish. Furthermore, they need an environment that provides the necessary prey base; in addition to the rearing and reproductive habitat essential to ensure their continued survival and reproductive success. The USFWS finalized bull trout recover plan is available at: *https://www.fws.gov/pacific/bulltrout/pdf/Final_Bull_Trout_Recovery_Plan_092915.pdf*



2016 Fryingpan Creek bull trout survey data was collaboratively collected by PTF, NPS and USFWS biologists. See Appendix B for bull trout redd locations, and Appendix C for spawning data.



GREENWATER RIVER

WRIA 10.0122

The Greenwater River is a right bank tributary to the upper mainstem White River. The Greenwater originates in the Norse Peaks Wilderness area on Castle Mountain and flows westerly until it converges with the White River (*RM 46*) near the small town of Greenwater. The Greenwater basin drains an area over 73 square miles with an average water discharge of 210 cfs (*USGS gauge #12097500*). Several significant tributaries contribute flow along the Greenwater River's 21 mile course, including Pyramid; Lost; Maggie; Slide and Twentyeight Mile creeks. Historically, the Greenwater River has supported ESA listed Spring Chinook *(1999 listing)* and steelhead (*2007 listing*). In addition to Chinook and steelhead, the Greenwater supports large runs of pink and coho salmon. Other species present include bull trout *(1999 ESA listing)*, rainbow and cutthroat. Traditionally, the Greenwater Basin has also supported a substantial amount of recreational use, which has had its impacts on fish and wildlife.

Acclimation pond

The Greenwater is a modest sized, low gradient pool-riffle stream with abundant high quality spawning gravel. Much of the river flows through U.S. Forest Service land and the riparian zone consists primarily of second growth conifers, and hardwoods. Forestry operations along the river, primarily timber harvesting and road construction, have negatively impacted portions of the stream. Only limited amounts of LWD exist in the channel, and the average size reflects the surrounding young forest and is therefore generally small in nature. Unfortunately, large key pieces of timber are located too far from the river channel; thus, the need for additional ELJ projects.

The Greenwater has been surveyed in the past for both Chinook and steelhead by the Washington Department of Fish and Wildlife; however, surveys are not conducted for coho. As with all upper White River surveys; adult salmon and steelhead that spawn in the Greenwater River were captured at the USACE fish trap in Buckley, and transported above Mud Mountain dam. Since precise escapement numbers for the upper White River drainage are known, surveys are conducted to determine fish distribution and spawning success. The Upper White River coho escapement is derived from counts made at the Army Corps of Engineers' Buckley trap.

In the spring of 2007, the Puyallup tribe transported 223,740 juvenile Spring Chinook from WDFW's Minter Creek facility, to the Greenwater River. These fish were planted directly into the creek since there was no acclimation pond available on the Greenwater prior to 2007. To address this issue, a Spring Chinook acclimation pond was completed in the summer of 2007, near George Creek (*center photo*). Capable of holding over 500,000 Spring Chinook; the construction of the acclimation pond was funded by the City of Tacoma as a result of a mitigation settlement. Design engineering was funded by the Pacific Coast Salmon Recovery Fund (*PCSRF*). The Twentyeight Mile Creek acclimation pond was completed in

2015 *(next page).* The bulk of the funding for Twentyeight Mile *($385,685)* was provided from two sources including the NRDA trustees as partial mitigation to the PSE Crystal Mountain/ Silver Creek oil spill of November, 2006 and an EPA Puget Sound Restoration and Protection grant for $112,450. Project coordination, permitting and planning time by tribal staff was paid for using Cascade Water Alliance funding.

Watershed Fish Enhancement Project: The Puyallup Tribe operates up to several acclimation ponds in the Puyallup/White River Watershed designed to reestablish and enhance Spring/Fall Chinook, winter steelhead and coho stocks. Each of two acclimation ponds *(Cowskull & Rushingwater)* on the Puyallup would receive as many as

Twentyeight Mile Creek acclimation pond

100K+ hatchery origin spring/Fall Chinook and/or coho *(depending on availability).* The additional acclimation ponds located in the Upper White River drainage *(Huckleberry Cr., Greenwater River (George Cr.), Twentyeight Mile Cr. (Greenwater R.)& Jensen Cr.(Clearwater R.)* can be planted collectively with up to 900K+ White River Spring Chinook and 25K+ White River winter steelhead pre-smolts. When obtainable, the Puyallup Tribe will collect, haul and plant surplus adult hatchery Fall Chinook and coho from WDFW's Voights Creek hatchery to spawn naturally in minor spawning or underutilized areas. When available, the Puyallup Tribe will in-stream plant juvenile hatchery Fall Chinook and chum smolts from the Tribe's Clarks and Diru Creek hatchery facilities to underutilized habitat areas.

Goals, Purpose and Expected Benefits: One of the Puyallup Tribe's most significant restoration goals is to rebuild depressed Chinook and steelhead stocks and remove them from ESA listing. Acclimation ponds, juvenile in-stream plants and adult surplus fish plants are a proven method for increasing fish stocks, and are key components to restoration goals.

Purpose:

- Produce Spring/Fall Chinook, winter steelhead and coho for the Puyallup/White River salmon conservation and harvest programs.
- Establish a total annual return of Spring Chinook Natural Origin Recruits (NORs) that meets the escapement goals for White River Spring Chinook Recovery.
- Provide sustainable harvest for tribal and non-tribal fisheries on Fall Chinook and non ESA listed coho.
- Optimize hatchery and natural production consistent with the conservation of naturally produced native fish.
- Maintain genetic makeup of Chinook and steelhead populations spawned or reared in captivity.

Benefits:

- Reestablish and enhance ESA listed Spring/Fall Chinook and steelhead; as well as non-listed coho into their endemic ranges.
- Increased total abundance of the composite natural/hatchery population.
- Increased spawning ground escapement and trend of Natural Origin Recruits (NORs).
- Improve distribution *(out planting of live fish)* of salmon to minor spawning and underutilized rearing habitat areas.
- Provide future tribal and sport harvest opportunities.
- Nutrient enhancement in oligotrophic *(nutrient-poor)* streams.

In 2011, an extensive floodplain restoration project was completed on the Greenwater River.

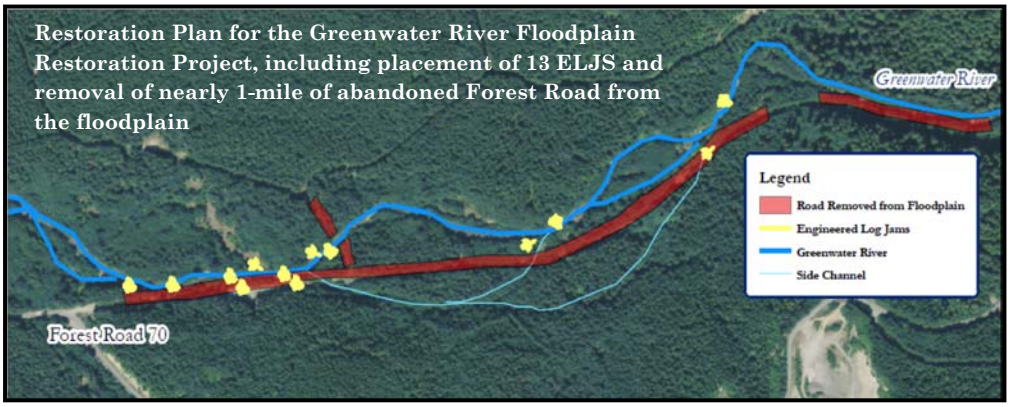
The following aptly describes the project that restored a two mile reach along the lower river.

Greenwater River Floodplain Restoration Project

Written by: Kristin Williamson
-South Puget Sound Salmon Enhancement Group
(Reprinted with Permission)

Project Description

The objective of the Greenwater River Floodplain Restoration Project is to restore aquatic and riparian habitat within a 2 mile reach of the Greenwater River. The project reach is River Mile 5.0 to 7.0 within the Mount Baker-Snoqualmie National Forest, adjacent to Forest Service Road 70. Restoration is focused on the re-introduction of functional wood and the removal of .8miles/4,500 linear feet of the abandoned Forest Service Road 7000 located within the Greenwater River Floodplain.



Restoration Plan for the Greenwater River Floodplain Restoration Project, including placement of 13 ELJS and removal of nearly 1-mile of abandoned Forest Road from the floodplain

Historically, the Greenwater River was one of the principle spawning and rearing areas in the White River watershed for Spring Chinook, bull trout, steelhead and coho. Based upon the old-growth forest in the Greenwater Valley floor, evident in the 1956 aerial photographs, recruitment of large trees to the floodplain was likely the primary factor maintaining salmon habitat in the River. Early photos show the River to be in pristine condition, characterized by sinuous channels with many large, deep pools associated with log jams. Pool habitat is critical for rearing salmon, bull trout, and other resident fishes to provide cool places for forage and refuge from predators.

A legacy of timber harvest altered the Greenwater River between the late 1950s and late 1960s. During this period, the majority of the trees in the Greenwater River were removed from the valley all the way to the banks of the River. These practices effectively stripped the Greenwater River of all instream wood, removed the forest structure from the floodplain, and subsequently increased channel incision, stream velocities, and river bed scour. The current channel is incised with very few pools, little holding and rearing habitat available to salmonids, and almost no functional stream side cover to provide shade, structure, input of nutrients, and recruitment of woody debris.

Given these impacts and the current lack of large woody debris, the young age of the existing stream-side forest, and large volumes of sediment available in the Greenwater River, it could take centuries for the system to return to a river sustained by natural processes. To help reestablish the natural conditions needed to sustain salmon and other species utilizing the system, a restoration plan was developed to rehabilitate the lost processes of wood recruitment, forest canopy, and floodplain connection through strategic placement of Engineered Log Jams (ELJs) and removal of road fill and armor from the floodplain.

Watershed and Aquatic Benefits

Overall, project efforts will increase flood storage within the project reach and reduce downstream peak flows, thereby providing greater stability and balance to the watershed. The proposed log jam struc-

tures will accelerate and maintain system-wide natural processes while reducing sediment loading, stabilizing banks for establishment of streamside forest, and providing habitat for salmon and other fish. The species benefiting from this project include: White River Spring Chinook, Puget Sound steelhead, pink salmon, coho salmon, bull trout, and coastal and resident cutthroat.

Specifically, project efforts will:

- Create large, persistent structures that will trap mobile wood and sediment
- Reduce erosion and sedimentation sources within the project reach by dampening peak flow velocities
- Aggrade the existing river bed elevation to reconnect stream flows to the floodplain to increase flood storage, and provide backwater, flood refuge for rearing juvenile fish
- Increase side channel rearing capacity and spawning opportunity for juvenile and adult salmon
- Encourage trapping and sorting of spawning gravels within the main stream channel to increase spawning opportunity
- Improve salmon egg retention and survival by reducing scour stress of the river
- Increase the quantity and quality of pools with lots of overhead, woody cover for predator avoidance for juvenile salmon, and for staging of upstream-migrating adult salmon.
- Provide interim, instream structure and stability to allow the Greenwater valley forest to regenerate to a size that will naturally stabilize the River.

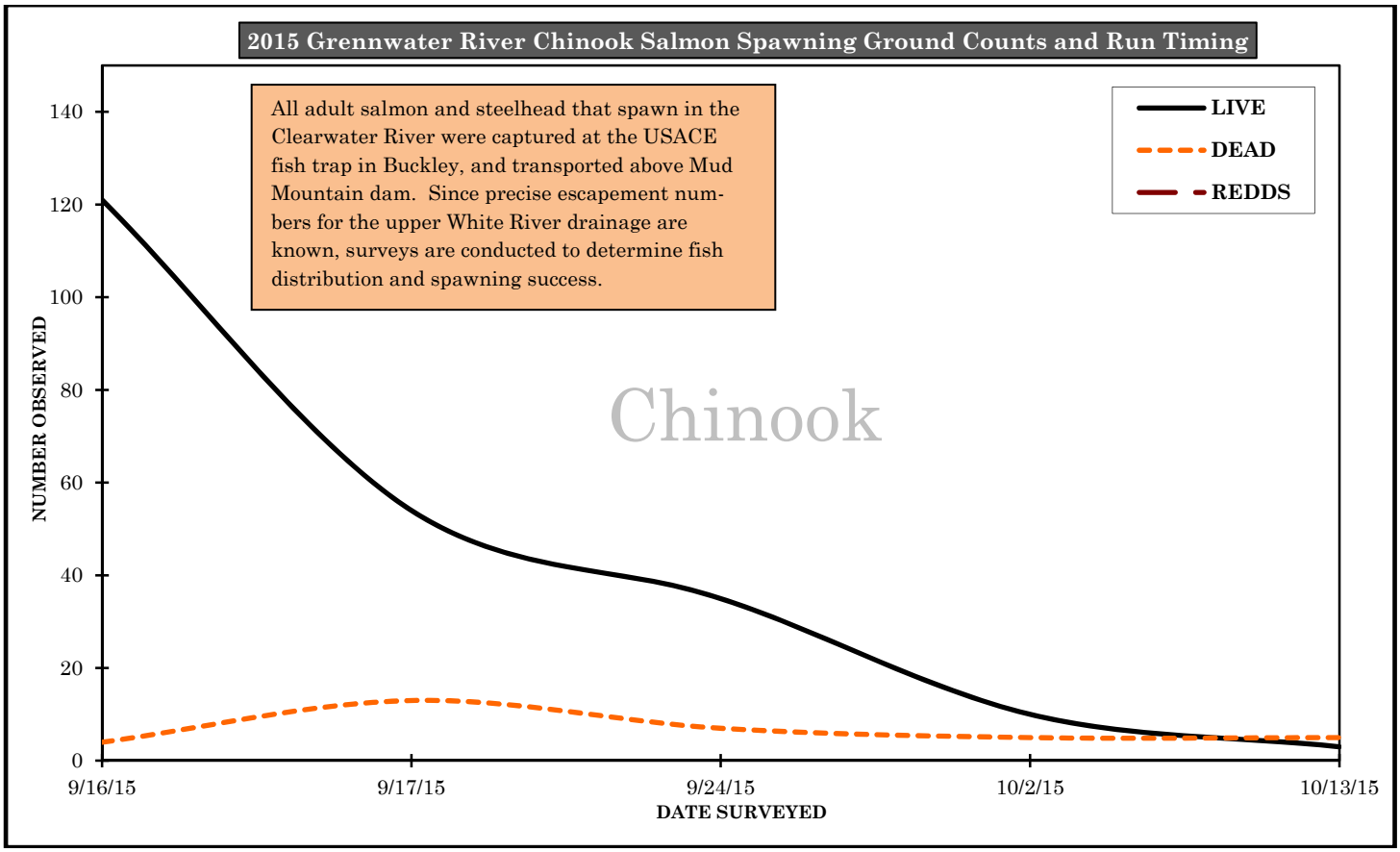
Project Partners

- **Project Managers:** South Puget Sound Salmon Enhancement Group
- **Engineers**: Herrera Environmental Consultants, Cardno ENTRIX, Olympic Region Engineering Cluster
- **Contractors**: RV Associates, McClung Construction, Southworth and Sons
- **Stakeholders**: US Forest Service, Muckleshoot Tribe, Puyallup Tribe, Community of Greenwater
- **Funding Partners**: Salmon Recovery Funding Board, Forest Service, Puyallup Tribe and Puget Sound Partnership, Natural Resource Damage Assessment Trustees, Washington State Department of Transportation.

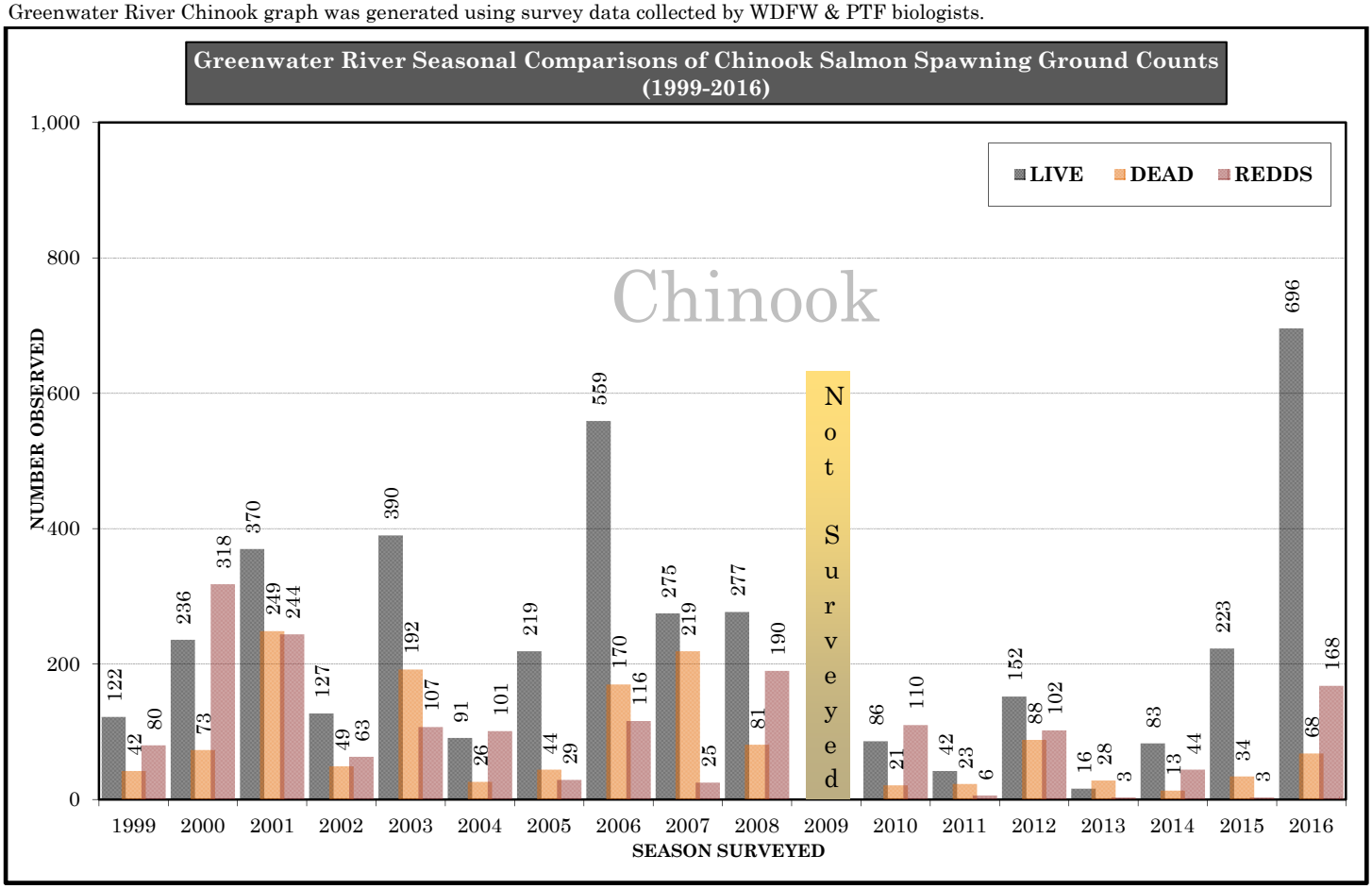
Funding: Collective funding for the project totaled $1.9million in salmon recovery and mitigation dollars.

Looking downstream at restoration site

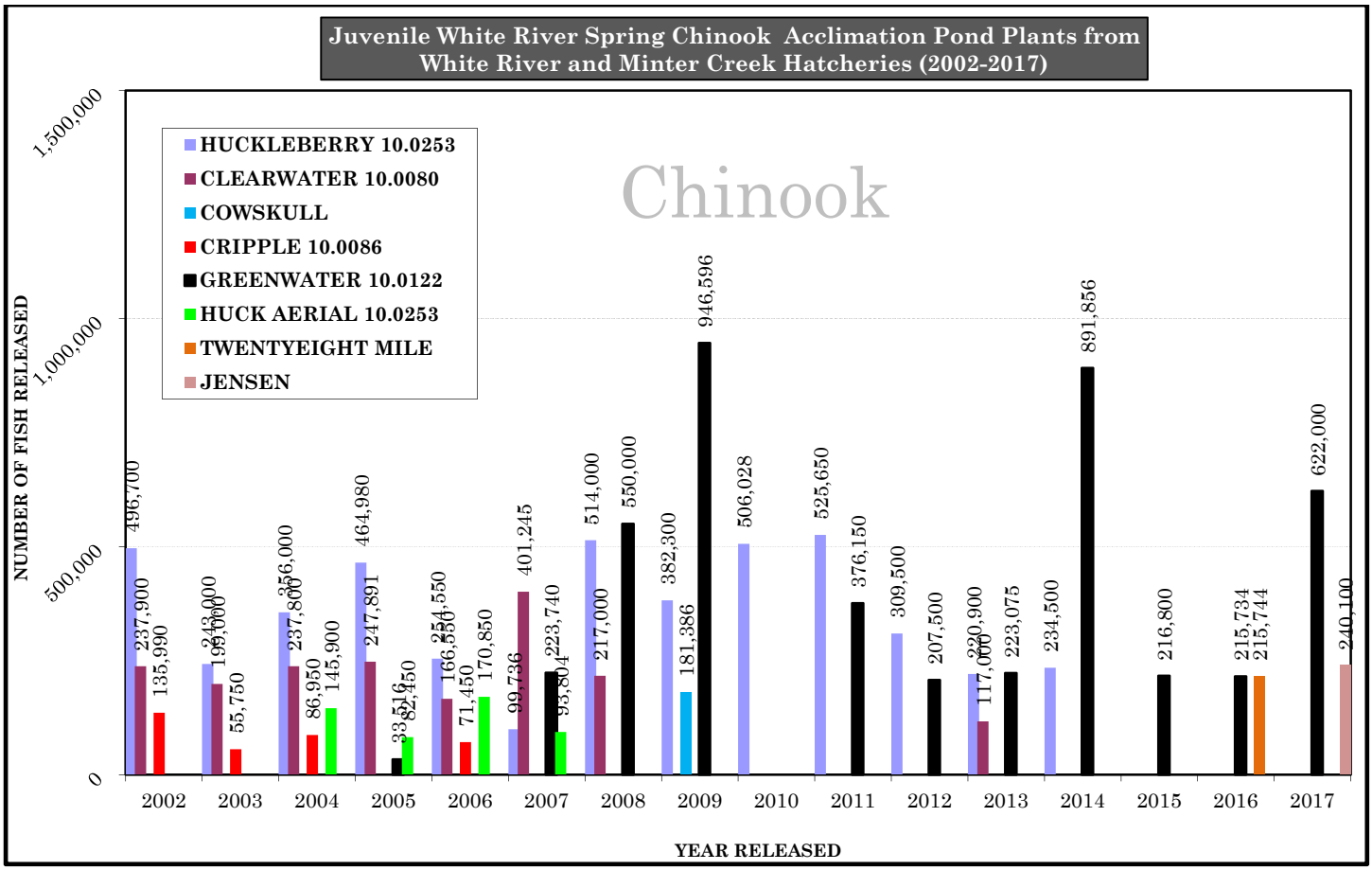
Source	Amount
SRFB/RCO 06-2223	485,000
SRFB/RCO 07-1867	590,000
Forest Service RAC Grant	10,300
EPA/PSP-Puyallup Tribe	101,300
Donated Wood, Forest Service and USACE	145,100
WSDOT Mitigation	287,000
NRDA Funds-PSE Spill	313,000
Total Funding	**$1,931,700**



Greenwater River Chinook graph was generated using survey data collected by WDFW & PTF biologists.



Adult Chinook escapement is determined by expanding the number of redds observed by 2.5 fish per redd (Smith and Castle, 1994). Due to the tremendous volume of pink salmon during odd years, the success of determining Chinook redds from pinks is vastly reduced. Therefore, The AUC method is used to determine escapement during pink runs (odd years).



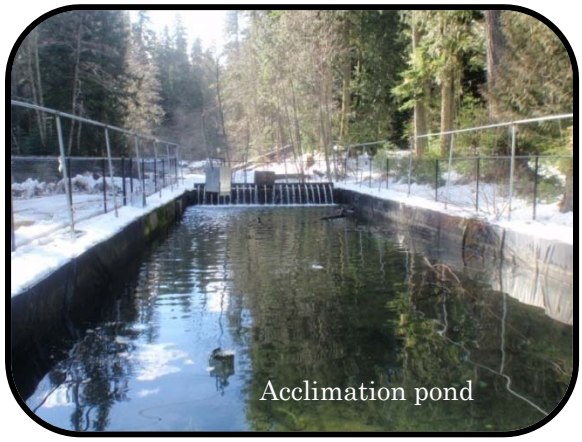
Acclimation ponds opperated by Puyallup Tribe. See map of acclimation pond location sites on Page 41. No data indicates no fish were planted.

HUCKLEBERRY CREEK

WRIA 10.0253

Spring Chinook

Huckleberry Creek is a tributary to the Upper White River. The creek originates from the Huckleberry basin along the North Slope of Mt. Rainier and is non-glacial. The creek flows through the National Park and Snoqualmie National Forest lands before meeting the West Fork of the White at RM 53.1. The lower 0.5 miles consists of a low gradient, occasionally braided channel with a large side channel complex breaking off around RM 0.3. The surrounding riparian is a mixture of conifers and deciduous trees. The spawning gravel is excellent in the first half mile reach, which consistently supports the highest densities of Spring Chinook and coho spawners each season; as well as, a significant escapement of pinks on odd years. Steelhead usage has also been documented in Huckleberry; however, steelhead surveys have not been conducted for several years. Bull trout presence has been documented; however, the extent of utilization is unknown. The gradient increases slightly From RM 0.5 to 1.5, but the gravel quality remains excellent, although slightly larger and patchy in nature. The riparian corridor consists of old growth conifers upstream of the acclimation pond at RM 0.5, offering excellent LWD recruitment. In-stream LWD is moderate throughout the entire creek, creating several logjams, as well as free and fixed channel spanning structures.


Acclimation pond

As with all upper White River tributaries, adult salmon and steelhead that spawn in Huckleberry Creek were captured at the USACE fish trap in Buckley, then transported and released approximately 4 miles above Mud Mountain Dam. Since precise adult fish escapement for the upper White River drainage is known, spawning surveys are conducted to determine fish distribution and spawning success. This is important regarding Spring Chinook, since adult production monitoring is part of the recovery plan process.

The Puyallup Tribe currently operates a single acclimation pond used for acclimating Spring Chinook *(center)*. Juveniles are planted in March, and released in late May or early June. The Spring Chinook plants are an integral part of the White River Spring Chinook Recovery Plan. The juvenile Spring Chinook originated from the Muckleshoot White River Hatchery and WDFW's hatchery on Minter Creek. Unfortunately, WDFW terminated fish contribution to the Spring Chinook restoration project in 2012. Production levels have been around 400,000 smolts; although, it fluctuates based on available brood-stock. They have a production capacity of 837,000 zero age smolts. Between 100,000 to 500,000+ Spring Chinook are transported to the Huckleberry Creek acclimation ponds in early spring, and released in late spring. All fish are mass marked with left or right ventral fin clips. Odd brood years are marked with left ventral clips, and even years with right ventral clips. These fish can later be identified when caught at the USACE fish trap in Buckley and passed above the Mud Mountain dam to spawn.

Pink salmon in Huckleberry Creek

Watershed Fish Enhancement Project: The Puyallup Tribe operates several acclimation ponds in the Puyallup/White River Watershed designed to reestablish and enhance Spring/Fall Chinook, winter steelhead and coho stocks. Each of two acclimation ponds *(Cowskull & Rushingwater)* on the Puyallup would receive as many as 100K+ hatchery origin Spring/Fall Chinook and/or coho. The additional acclimation ponds located in the Upper

White River drainage *(Huckleberry Cr., Greenwater River (George Cr.), Twentyeight Mile Cr. (Greenwater R.)& Jensen Cr.(Clearwater R.)* can be planted collectively with up to 900K+ White River Spring Chinook and 25K+ White River winter steelhead pre-smolts. When available, the Puyallup Tribe will collect, haul and plant surplus adult hatchery Fall Chinook and coho from WDFW's Voights Creek hatchery to spawn naturally in minor spawning or underutilized areas. When available, the Puyallup Tribe will in-stream plant juvenile hatchery Fall Chinook and chum from the Tribe's Clarks and Diru Creek hatchery facilities to underutilized habitat areas.

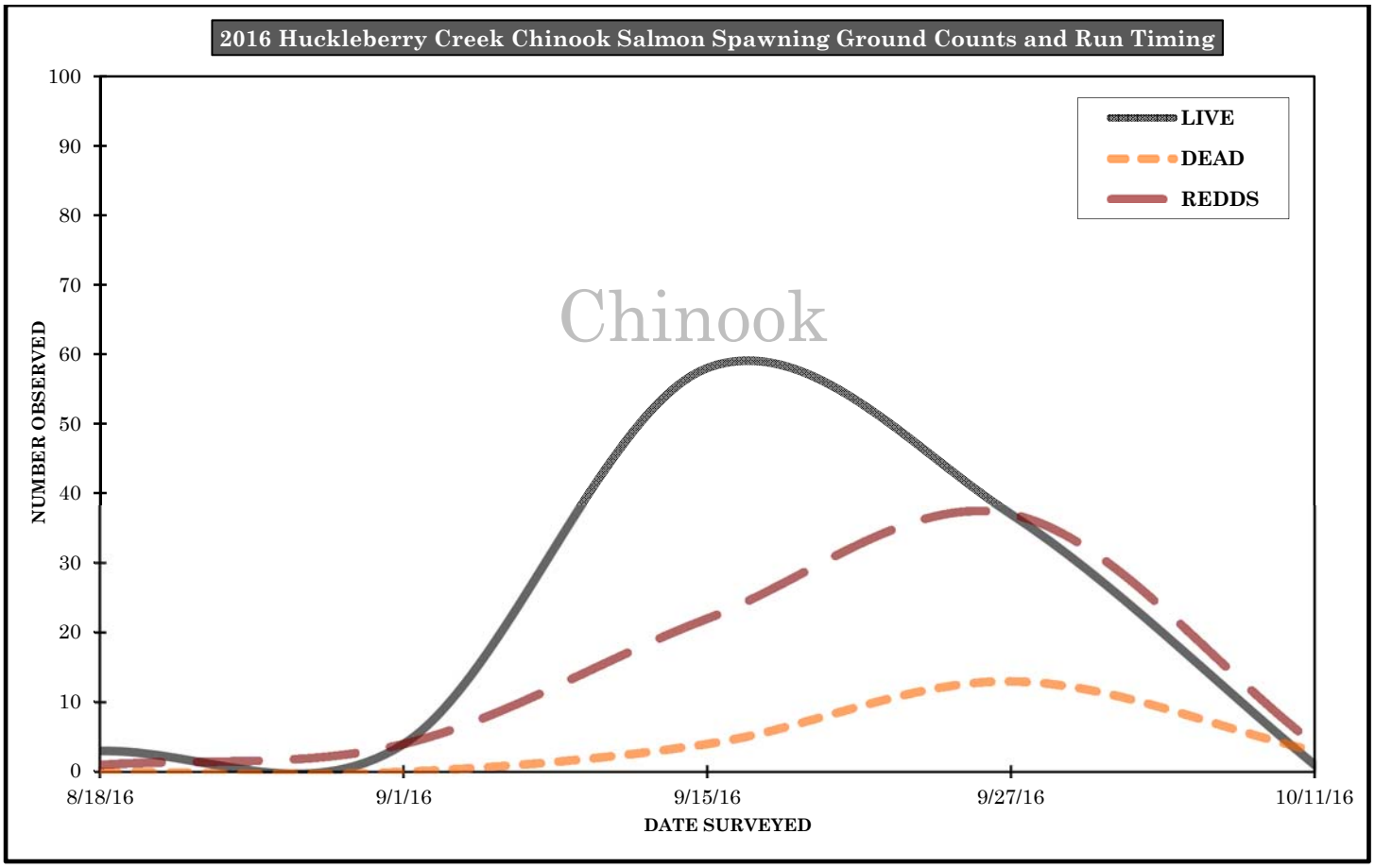
Goals, Purpose and Expected Benefits: One of the Puyallup Tribe's most significant restoration goals is to rebuild depressed Chinook and steelhead stocks and remove them from ESA listing. Acclimation ponds, juvenile in-stream plants and adult surplus fish plants are a proven method for increasing fish stocks, and are key component to restoration goals.

Purpose:

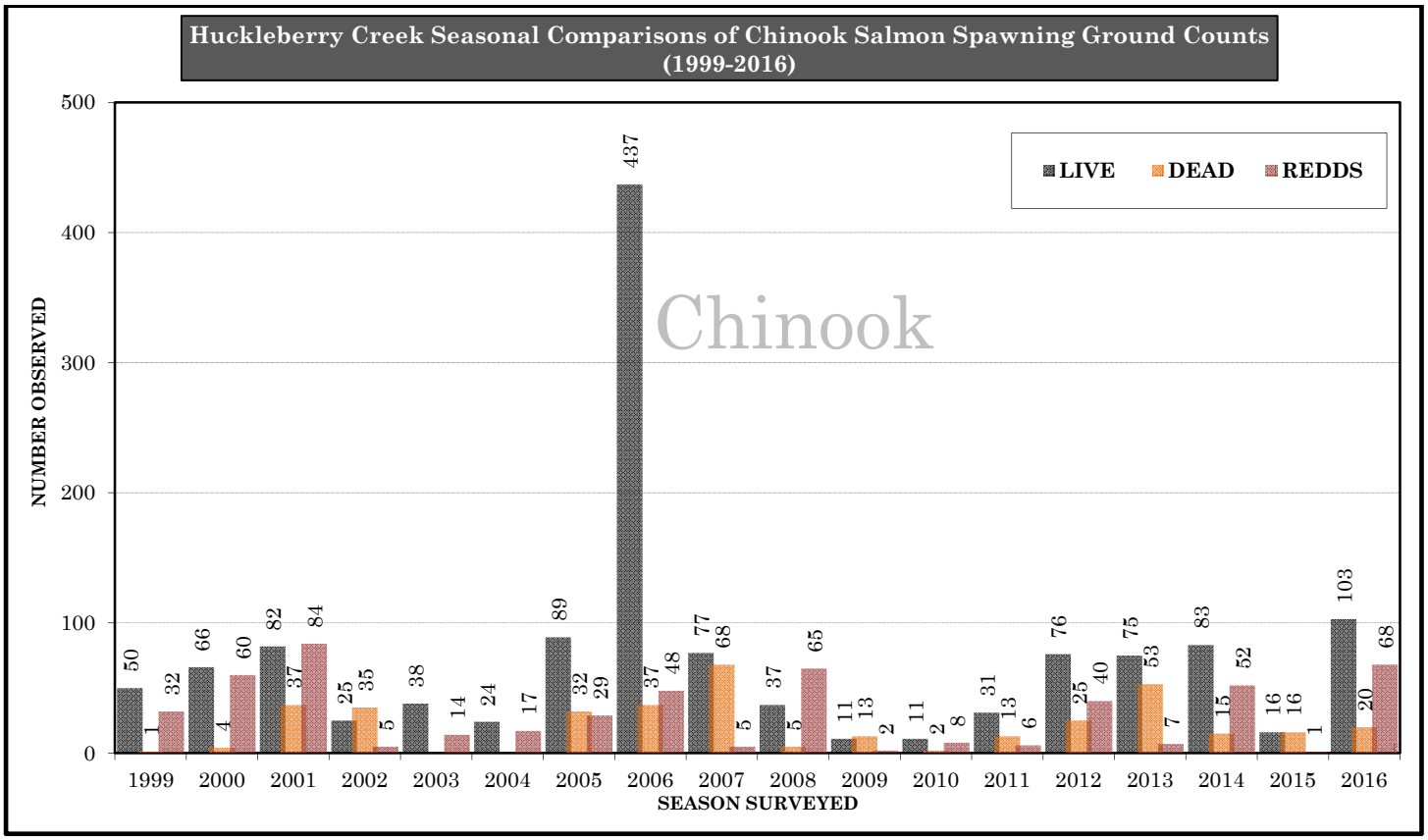
- Produce Spring/Fall Chinook, winter steelhead and coho for the Puyallup/White River salmon conservation and harvest programs.
- Establish a total annual return of Spring Chinook Natural Origin Recruits (NORs) that meets the escapement goals for White River Spring Chinook Recovery.
- Provide sustainable harvest for tribal and non-tribal fisheries on Fall Chinook and non ESA listed coho.
- Optimize hatchery and natural production consistent with the conservation of naturally produced native fish.
- Maintain genetic makeup of Chinook and steelhead populations spawned or reared in captivity.

Benefits:

- Reestablish and enhance ESA listed Spring/Fall Chinook and steelhead; as well as non-listed coho into their endemic ranges.
- Increased total abundance of the composite natural/hatchery population.
- Increased spawning ground escapement and trend of Natural Origin Recruits (NORs).
- Improve distribution *(out planting of live fish)* of salmon to minor spawning and underutilized rearing habitat areas.
- Provide future tribal and sport harvest opportunities.
- Nutrient enhancement in oligotrophic *(nutrient-poor)* streams.



Upper White River surveys show distribution and timing. Actual escapement totals are known from the USACE trap counts.



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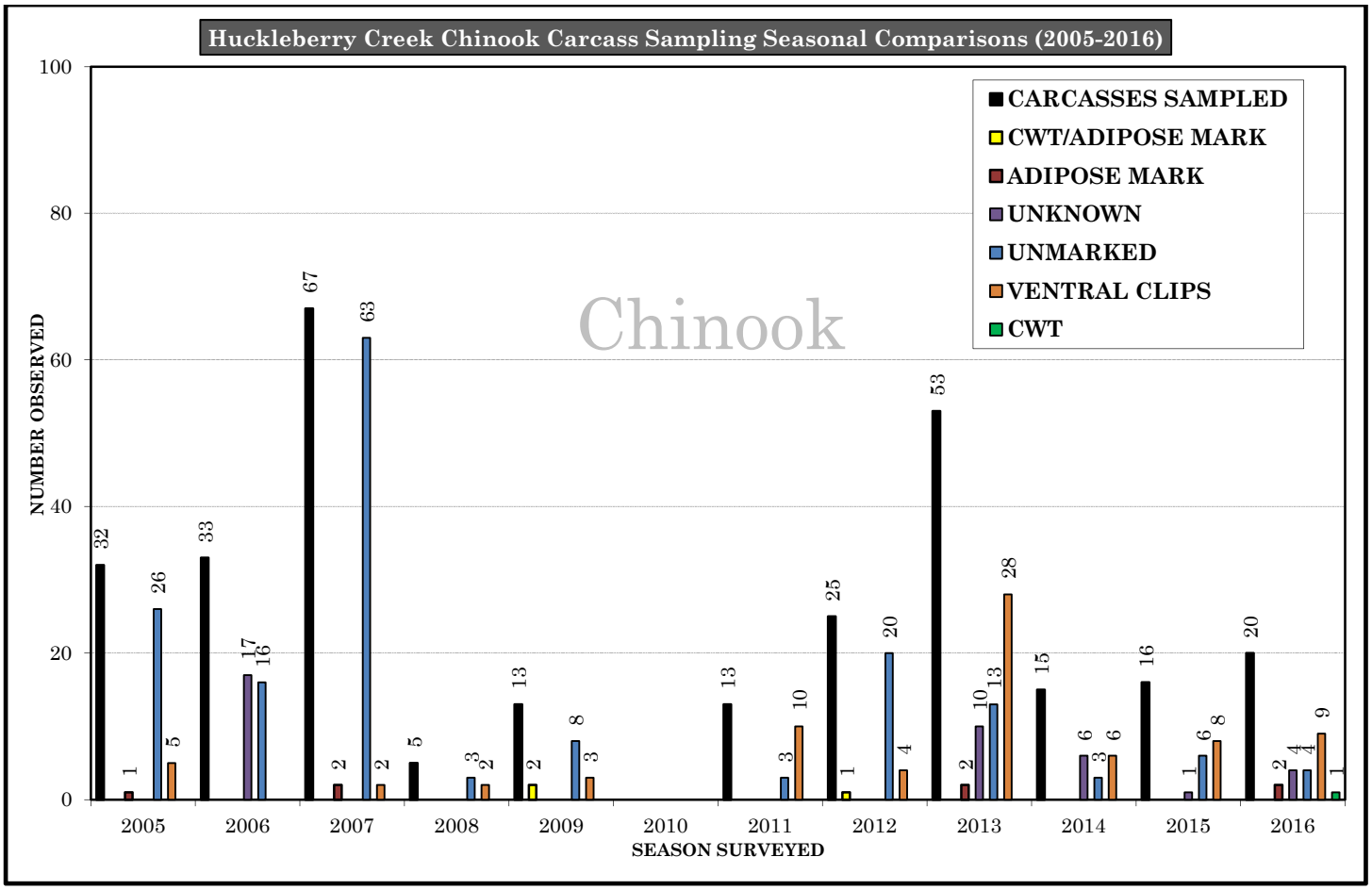
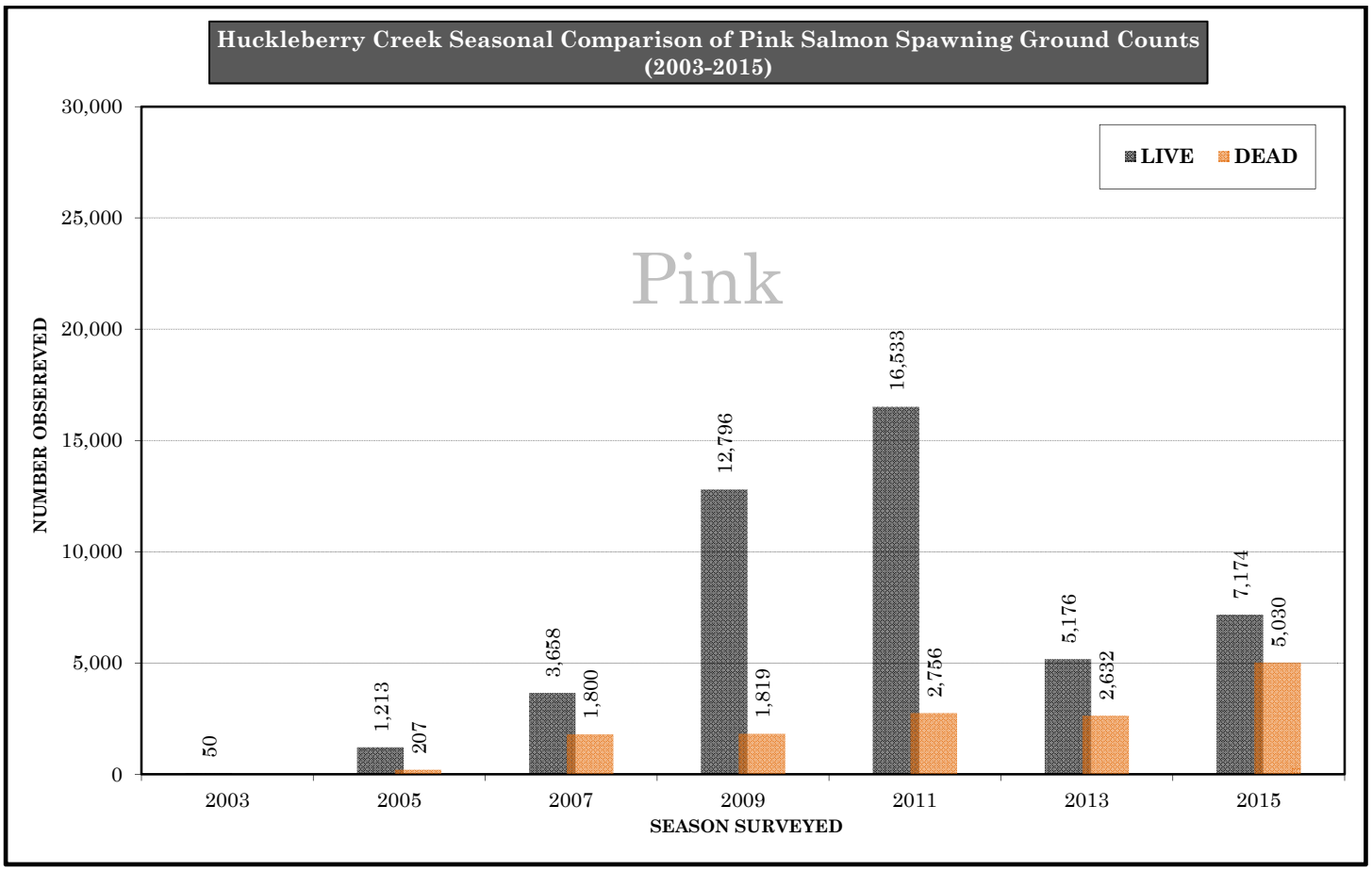
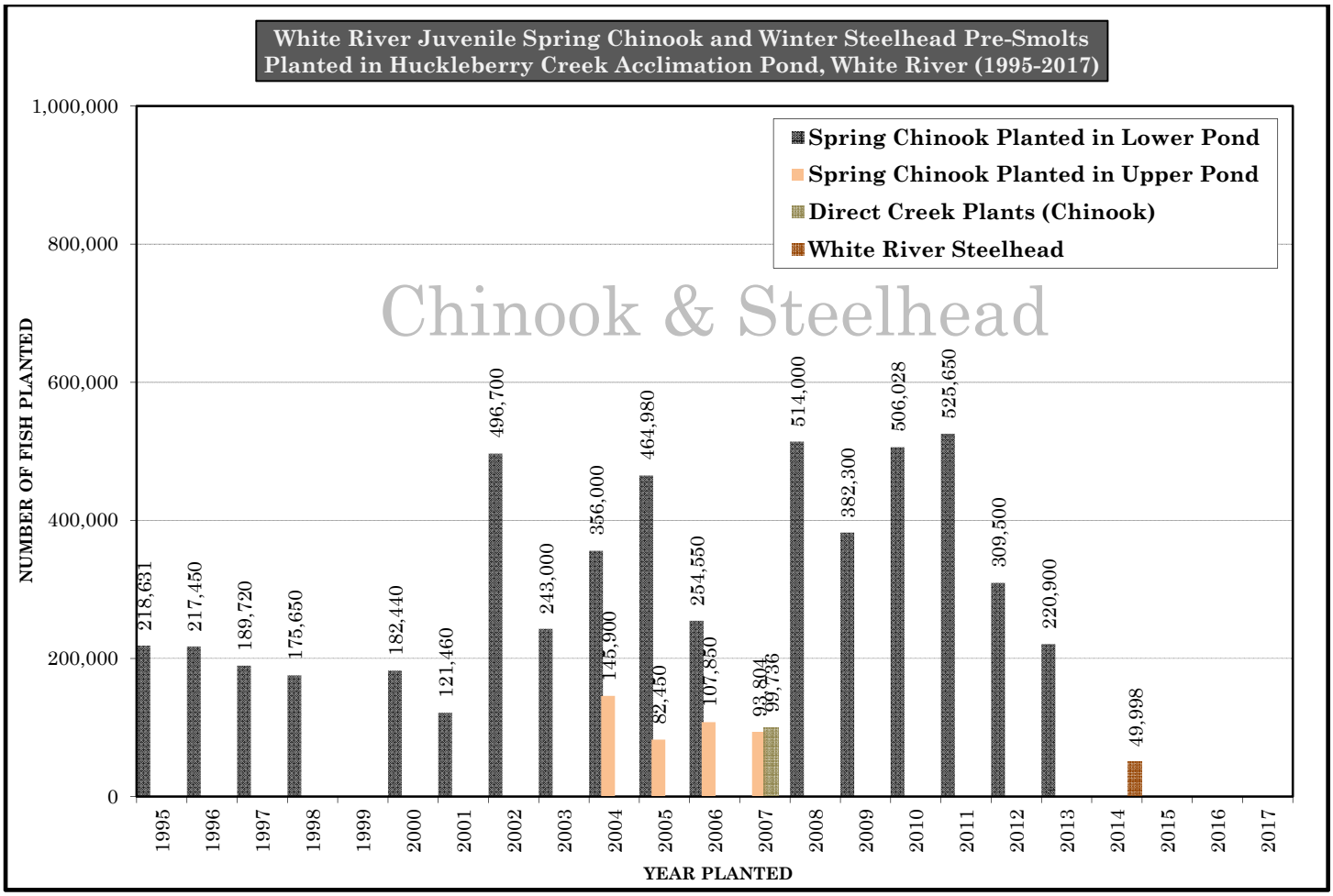

Huckleberry Creek Chinook Carcass Sampling Seasonal Comparisons (2005-2016)
CARCASSES SAMPLED
CWT/ADIPOSE MARK
ADIPOSE MARK
UNKNOWN
UNMARKED
VENTRAL CLIPS
CWT
Chinook
NUMBER OBSERVED
SEASON SURVEYED
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016


Huckleberry Creek Seasonal Comparison of Pink Salmon Spawning Ground Counts (2003-2015)
LIVE
DEAD
Pink
NUMBER OBSERVED
SEASON SURVEYED
2003
2005
2007
2009
2011
2013
2015



Acclimation ponds opperated by Puyallup Tribe. See map of acclimation pond location sites on Page 41. No data indicates no fish were planted.

HYLEBOS CREEK

WRIA 10.0006

The West Fork of Hylebos Creek just downstream of the Spring Valley Ranch restoration site.

Hylebos Creek *(Named after Peter Francis Hylebos (1848-1918),original native name haxtl', also called "Koch" by early natives)*[1] is an large, independent drainage from that of the Puyallup/White River system. Draining an area of over 18 square miles, the headwaters of the Hylebos system originate in the city of Federal Way and flow southwest until it empties into the Hylebos Waterway; one of several waterways located in Commencement Bay within the city of Tacoma. The East and West Forks of the Hylebos comprise two of the three basins within this system, and make up the upper part of the watershed. The East and West Forks converge just east of I-5 to form the Lower Hylebos.

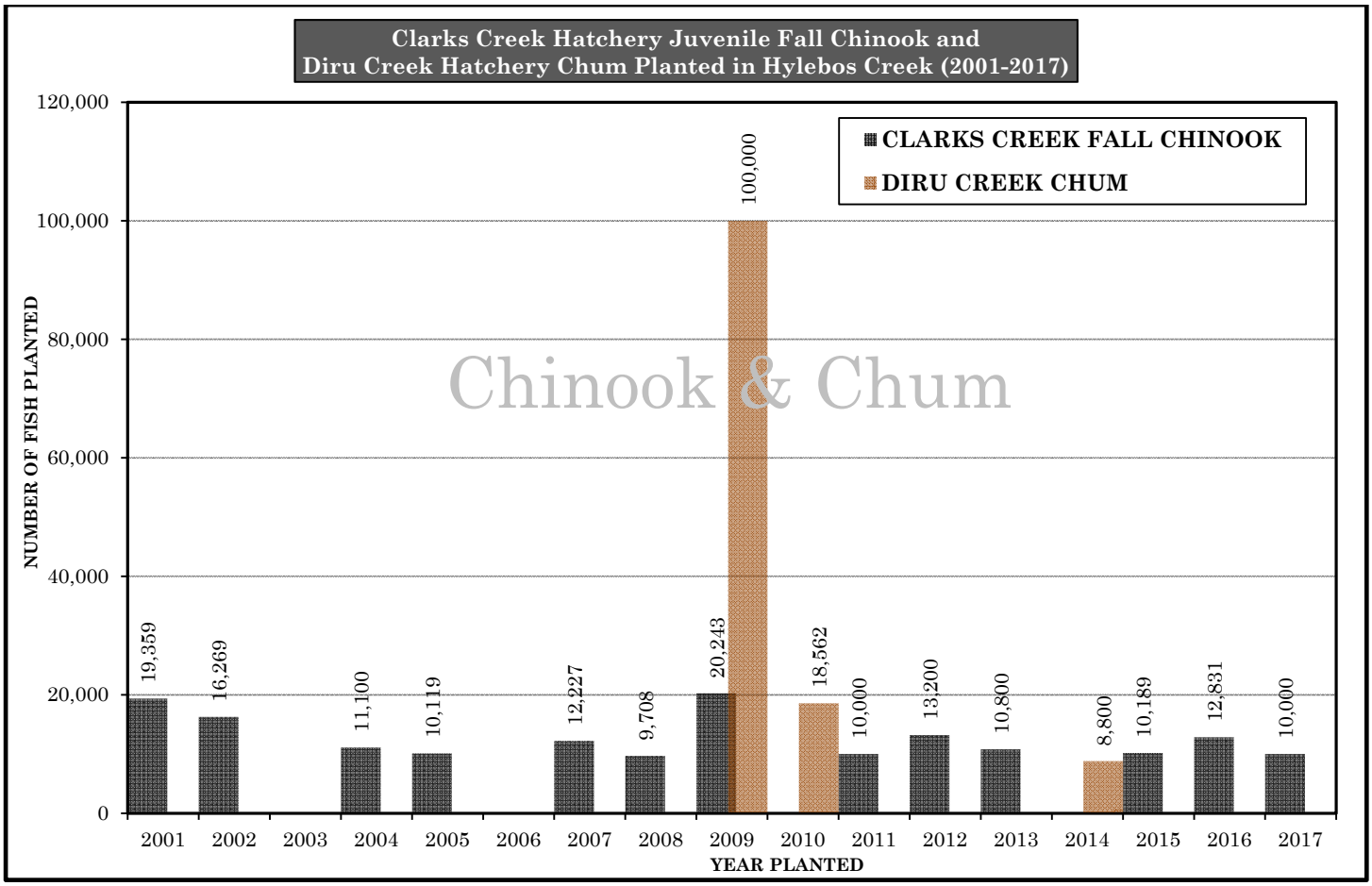
The Hylebos Watershed has been severely impacted by urban development. Land uses over the past several decades has resulted in an extensive loss of estuarine and wetland habitats, reduction of water quality (*303(d) listed*) and fish production, as well as diminished instream flows and stream channel continuity. Nevertheless, the watershed does have protected areas, and substantial parcels of the creek and surrounding land have been acquired in recent years for protection and restoration.

Although spawning frequency is low for all species and inconsistent for some; Chinook, chum, pink, coho, and steelhead have all been observed spawning within the surveyed area of Hylebos Creek. In addition, Hylebos Creek also host a large population of cutthroat, as well as other native and nonnative species including sticklebacks, sculpins, lamprey and bass. The stream section most often surveyed by the Puyallup Tribe is the Lower West Fork Hylebos extending from 373rd St., upstream to the Montessori school at Hwy. 99 and downstream from 373rd to the East Fork. The upper extent of Chinook spawning is generally a half mile past the convergence of the East and West Forks. Passage beyond this is often difficult due low instream flows that can prevent Chinook from migrating far up either fork. Higher instream flows experienced during the fall and winter often allow coho and chum to access the upper reaches of the Hylebos.

As part of the continuing fish and habitat restoration efforts, the Puyallup Tribe regularly released between 10-to-20 thousand juvenile Fall Chinook into the West Fork of Hylebos Creek during the spring. Spawning surveys over time have identified these fish on the spawning grounds due to fin clips administered at the hatchery prior release. In addition, the 27 acres above 373rd St., known as the Spring Valley Ranch, was purchased by the Washington State Department of Transportation (*WSDOT*) in 2004. Restoration efforts for this site were completed in 2007. The restoration project restored nearly a quarter mile of creek channel and wetland habitat. The project will also establish a riparian buffer zone comprised of native trees and plants. In 2008, the City of Federal Way acquired the 22 acre Goldmax property. This acquisition will preserve 1,200 feet of creek channel and surrounding land located on the West Fork of the Hylebos. For additional information about the Hylebos Creek watershed, go to:

- *https://www.earthcorps.org/ftp/ECScience/Hylebos/HylebosWatershedPlan_2016.pdf*
- *http://www.earthcorps.org/hylebos.php*

[1] Caster, D. 2003. Father Hylebos, St. George's Indian School and Cemetery, and St. Claire's Mission Church. Prepared for the Historical Society of Federal Way. 18pp.



Clarks Creek Fall Chinook and Diru Creek chum salmon are spawned and reared at Puyallup Tribal salmon hatcheries. No data indicates no fish were planted.

IPSUT CREEK

WRIA 10.0550

Bull trout

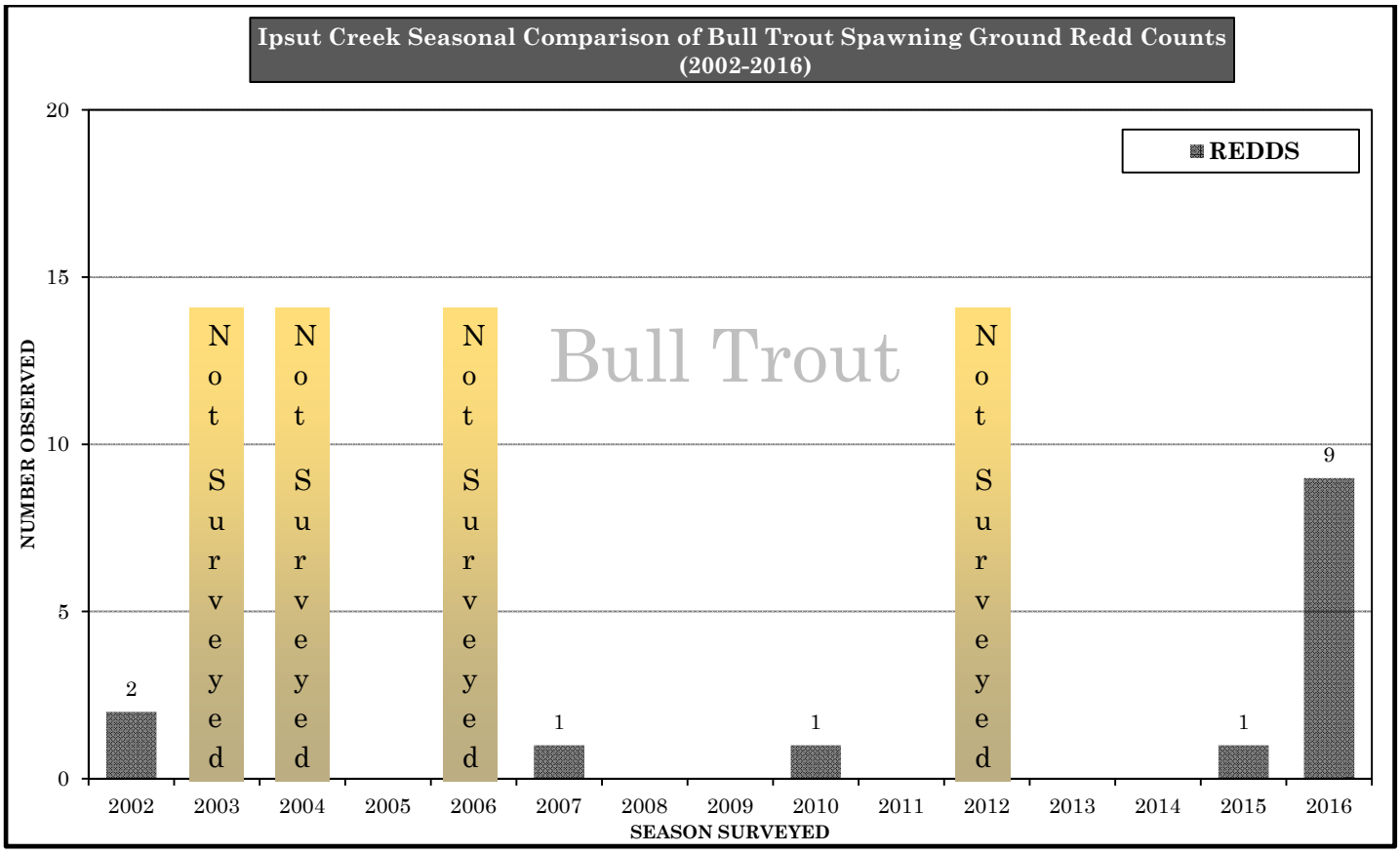
Ipsut Creek is a left bank tributary to the upper Carbon River; entering at RM 28.3. Typical of many headwater tributaries, Ipsut Creek is non-glacial and is characterized by confined steep valley channels with a comparatively short, low-to-moderate gradient anadromous reach. This mountain stream flows for just over 2.8 miles through a steep glacial valley originating near Castle Peak along the Alki Crest. Ipsut flows entirely within Mt. Rainier National Park. Headwater sources are derived from snowpack accumulations; as well as other surrounding surface and groundwater sources including Doe Creek *(right bank- RM 1.2)* and an unnamed tributary *(right bank- RM 0.8)*. Neither tributary is accessible to fish. The creek continues to drop precipitously throughout much of its length until reaching the lower channel migration zone of the Carbon River, at which point the creek channel is reduced to a low-moderate gradient pool-riffle channel capable of supporting salmonids.

Ipsut Falls

Past surveys have verified bull trout utilization within Ipsut; furthermore, the creeks 2300' elevation makes it one of the lowest elevation streams known to support bull trout spawning and is quite capable of supporting Chinook, coho, pink and steelhead as well. Other species including cutthroat, non-native brook trout and sculpins are known to inhabit the creek. However, salmonid migration upstream to reach headwater tributaries in the upper Carbon Basin, including Ipsut, is assumed to be extremely limited due to substantial cascades present throughout the roughly 5 mile long Carbon River Gorge. The Puyallup Tribe conducted salmon, steelhead and bull trout spawning surveys during 2000 and 2001; yet, no salmon or steelhead were observed. However, surveyors did observe several redds early in the spawning season *(September)*, but their timing matched the bull trout spawning documented in other headwater tributaries in the watershed including Ranger Creek and several Upper White River tributaries.

The riparian zone along Ipsut consists primarily of old growth cedar, fir and hemlock which contributes greatly to the large woody debris in the stream; as well as diversity to the channel habitat. Unfortunately, spawning opportunities are limited due to the size and makeup of the substrate material; much of which consists of flat and angular stones not conducive to movement, especially by smaller fish such as bull trout. However, small patches of suitable gravel do exist. The lower anadromous reach of the creek is also subject to, and has frequently experienced disturbances caused by Carbon River flood events. These intrusions often deposit significant amounts of fine material and woody debris. An impassable falls at approximately RM 0.7 prevents any further upstream migration.

Unfortunately, no substantial data is available on bull trout spawning escapement or population size within the upper Carbon River. The USFWS finalized bull trout recover plan is available at: *https://www.fws.gov/pacific/bulltrout/pdf/Final_Bull_Trout_Recovery_Plan_092915.pdf*



Ranger Creek bull trout survey data was collected and provided by Mt. Rainier National Park Service (MORA) biologists.

KAPOWSIN CREEK

WRIA 10.0600

Fall Chinook

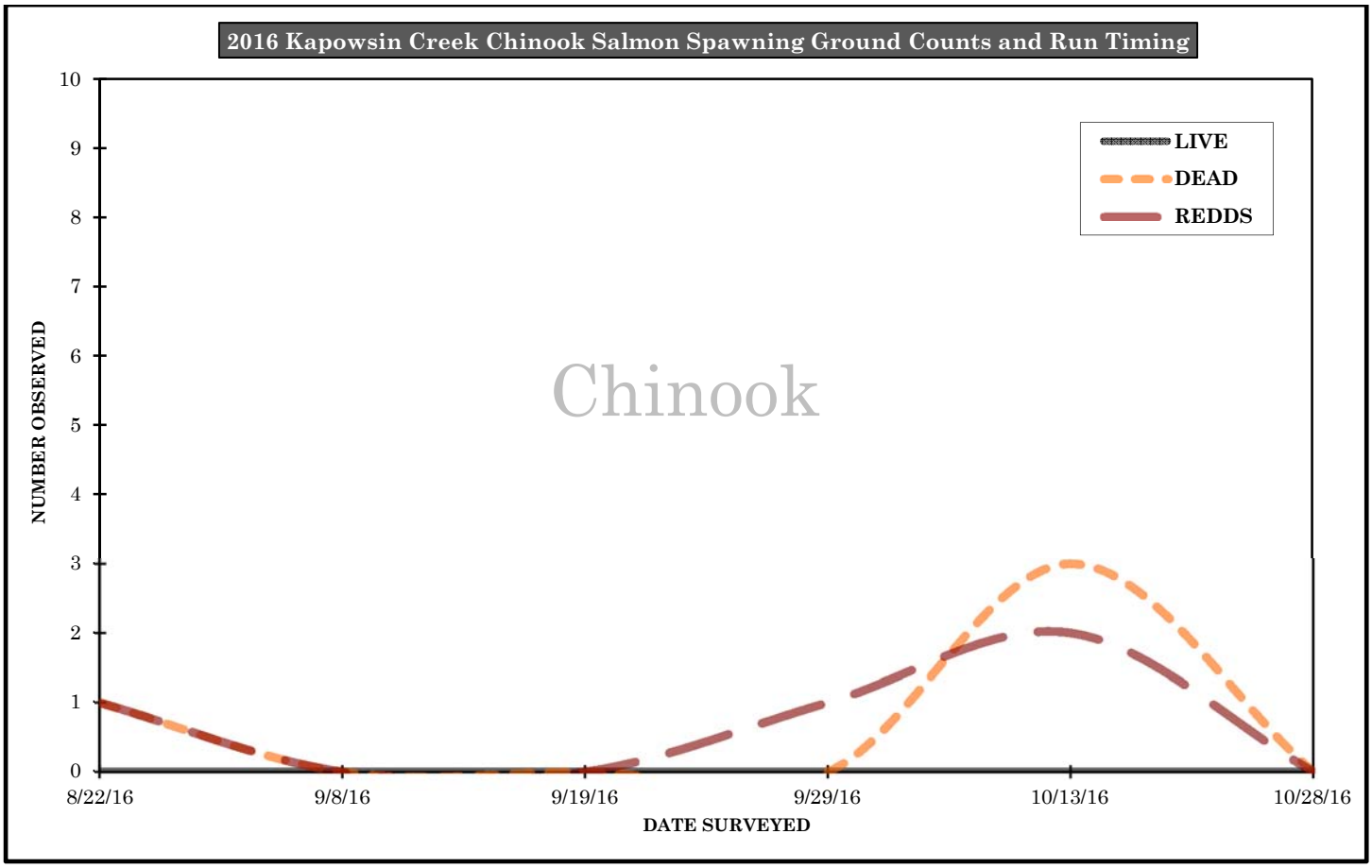
Kapowsin Creek is a tannic stream originating at the north shore of Lake Kapowsin, which sits approximately 3.6 miles upstream from the creeks confluence with the Puyallup River. Kapowsin Creek supports a host of adult salmon species including; Chinook *(above)*, pink, coho, steelhead, bull trout and occasionally a few chum. Chinook have not been observed beyond the top of Kapowsin Creek where it enters the lake. On the other hand, coho, and occasionally a few steelhead move through Kapowsin Lake into Ohop Creek to spawn. Ohop Creek, which enters the south end of the lake, is technically considered the continuation of Kapowsin creek. Lake Kapowsin supports a large population of game fish including: bluegill, largemouth bass, black crappie, yellow perch and pumpkinseed. WDFW also stocks the lake annually with rainbow.

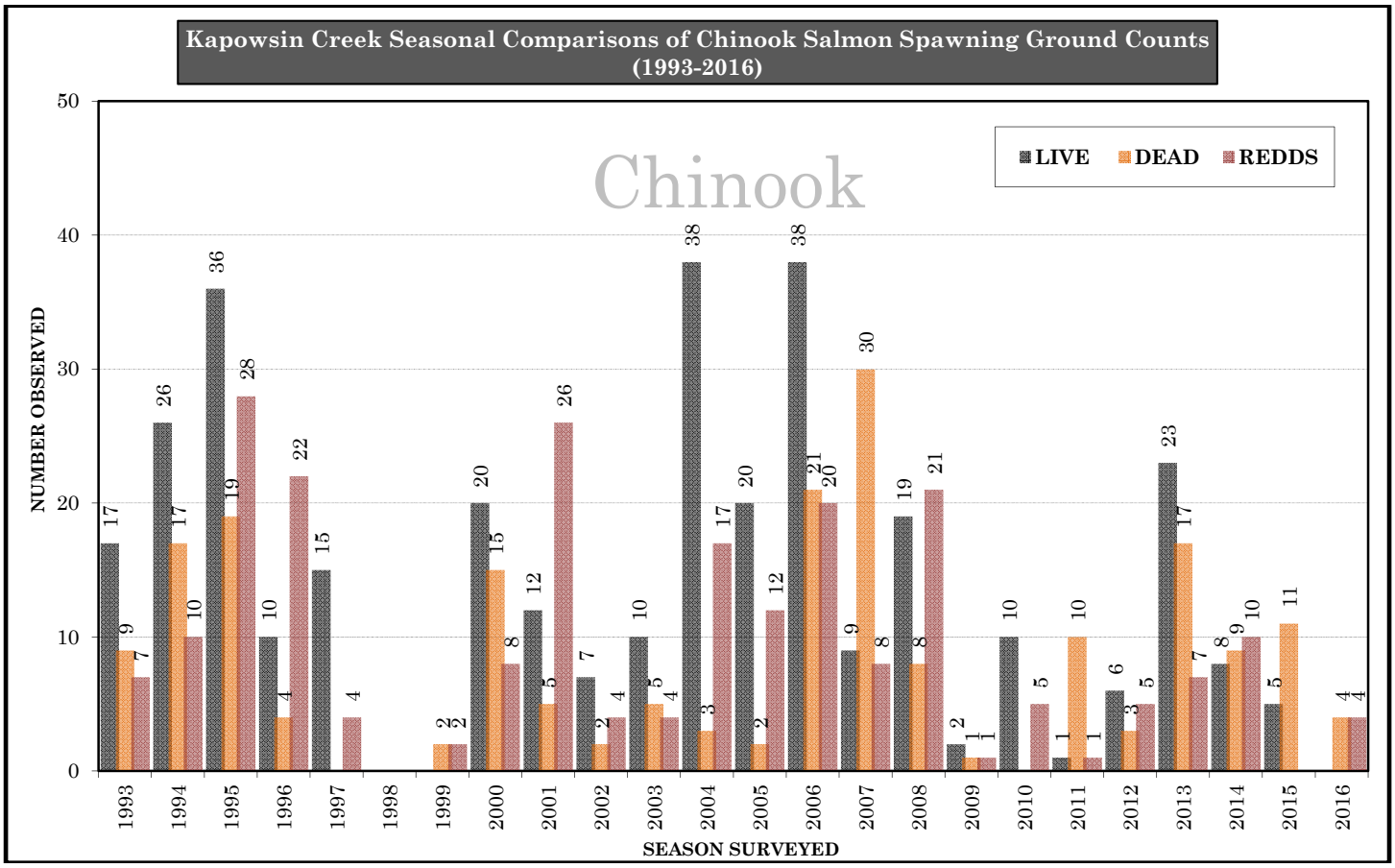
Unfortunately, steelhead escapement in Kapowsin is low, however, this drop in escapement is not uncommon; winter steelhead stocks in the Puyallup basin have been declining since 1990. The precipitous decline within just the past few years has created serious concern among fisheries managers. Factor(s) responsible for the decline in steelhead escapement are unknown, especially when other salmon species are experiencing relatively good success.

Coho are the predominate species in the creek. Recovered CWT data has shown that many of the coho spawning in Kapowsin are fish that were released a couple of years earlier as juveniles from the upper Puyallup acclimation ponds (*Cowskull and Rushingwater*), or are descendants of the net-pen acclimation project in Kapowsin Lake. From 1993 to 1997, the Puyallup Tribe fisheries staff transported juvenile coho from WDFW's Voights Creek hatchery to four net-pens in Kapowsin Lake to acclimate. Prior to this fish restoration project, few or no coho were observed in Kapowsin or Ohop.

Suitable spawning gravel is available throughout the 3.6 mile survey reach of Kapowsin, although much of it is sporadic. A number of downed trees within the channel along with several sizable logjams create complexity throughout the stream. Cattle and other livestock have been allowed access to the stream channel at approximately RM 1.7. Homes and outbuilding are frequently present along the creek between RM 0.5 and RM 2.0. Human-made rock dam structures; as well as sill logs, span the creek and alter the channel hydrology along this stretch. During the summer and fall when water levels are low, these formations that can cause upstream migration issues for adult salmon. In addition to human-made obstacles, the creek experiences frequent beaver (*Castor canadensis*) activity. Beaver dams, often constructed during the low summer flow, regularly occlude the entire creek channel preventing upstream migration. Most of the stream has a dense riparian zone consisting of fir, cedar, alder, cottonwood, and salmonberry.

Pierce County completed construction of the new Orville road bridge over the head of Kapowsin Creek in early 2006. In addition, the 2006 flood event destroyed extended portions of the levee along Orville Rd. near Kapowsin Creek. Currently, the lower segment of the creek *(RM 0-0.2)* is a low gradient channel flowing within the open channel migration zone of the Puyallup River, and is repeatedly occupied by mainstem river incursions.





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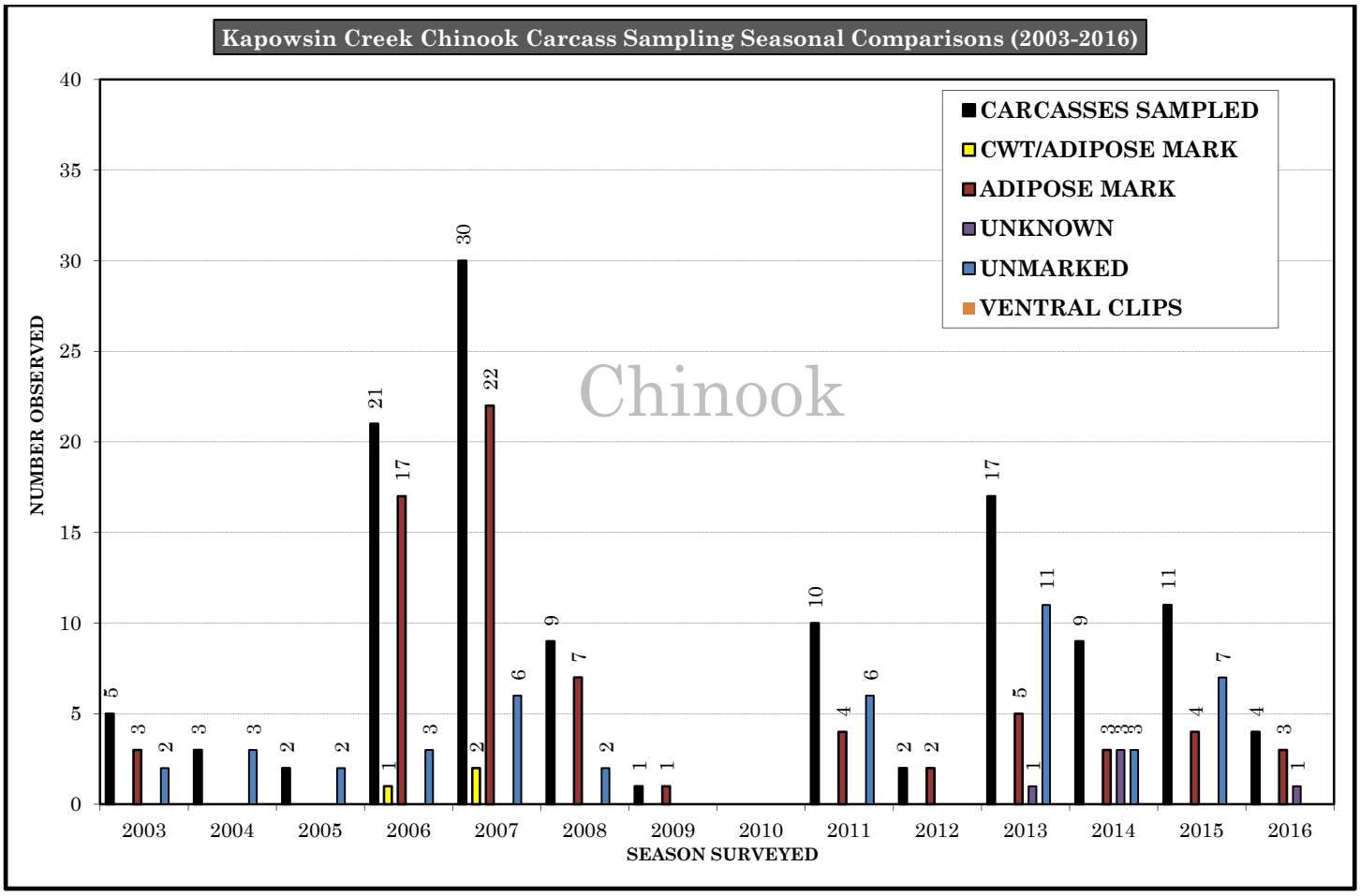
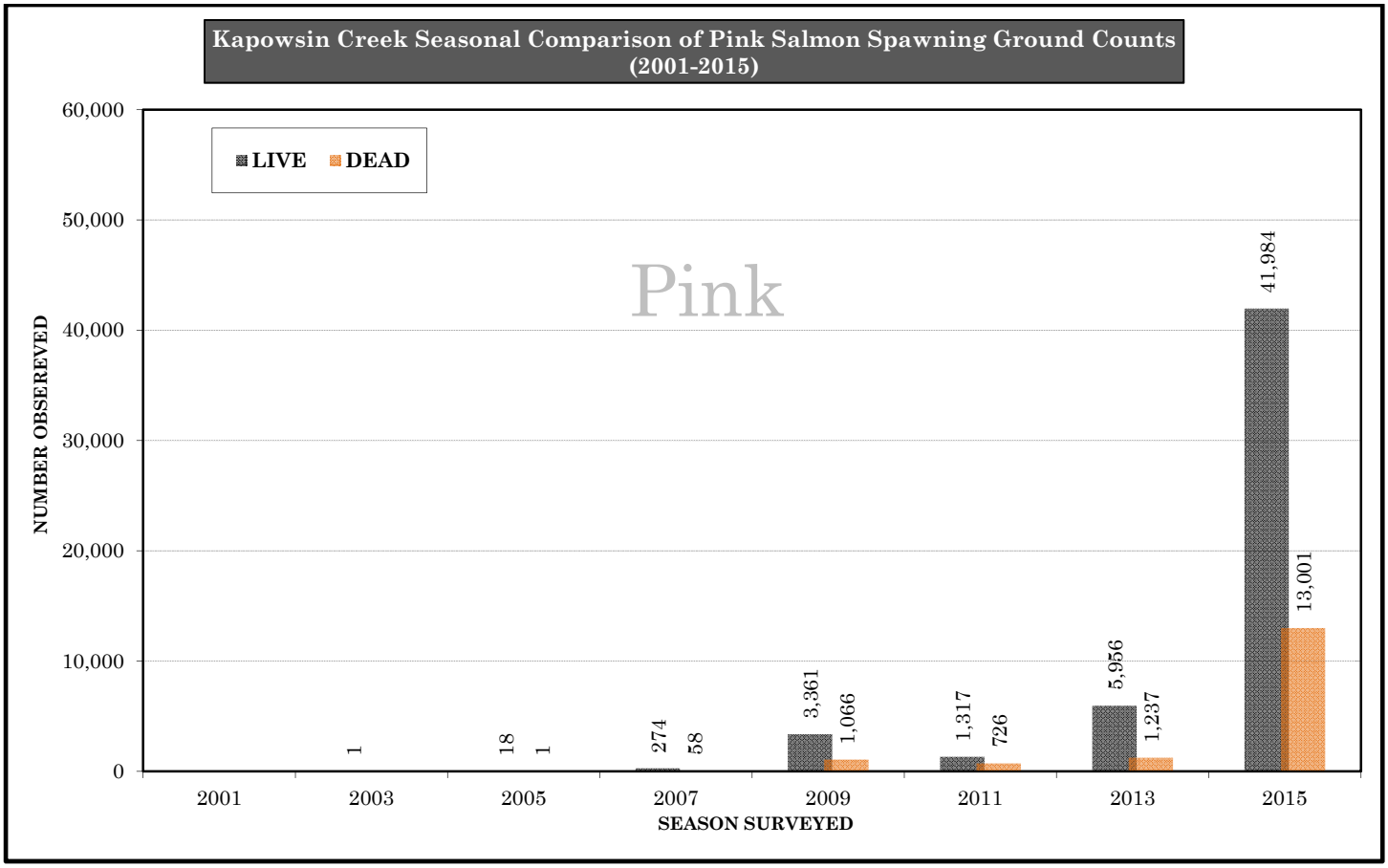
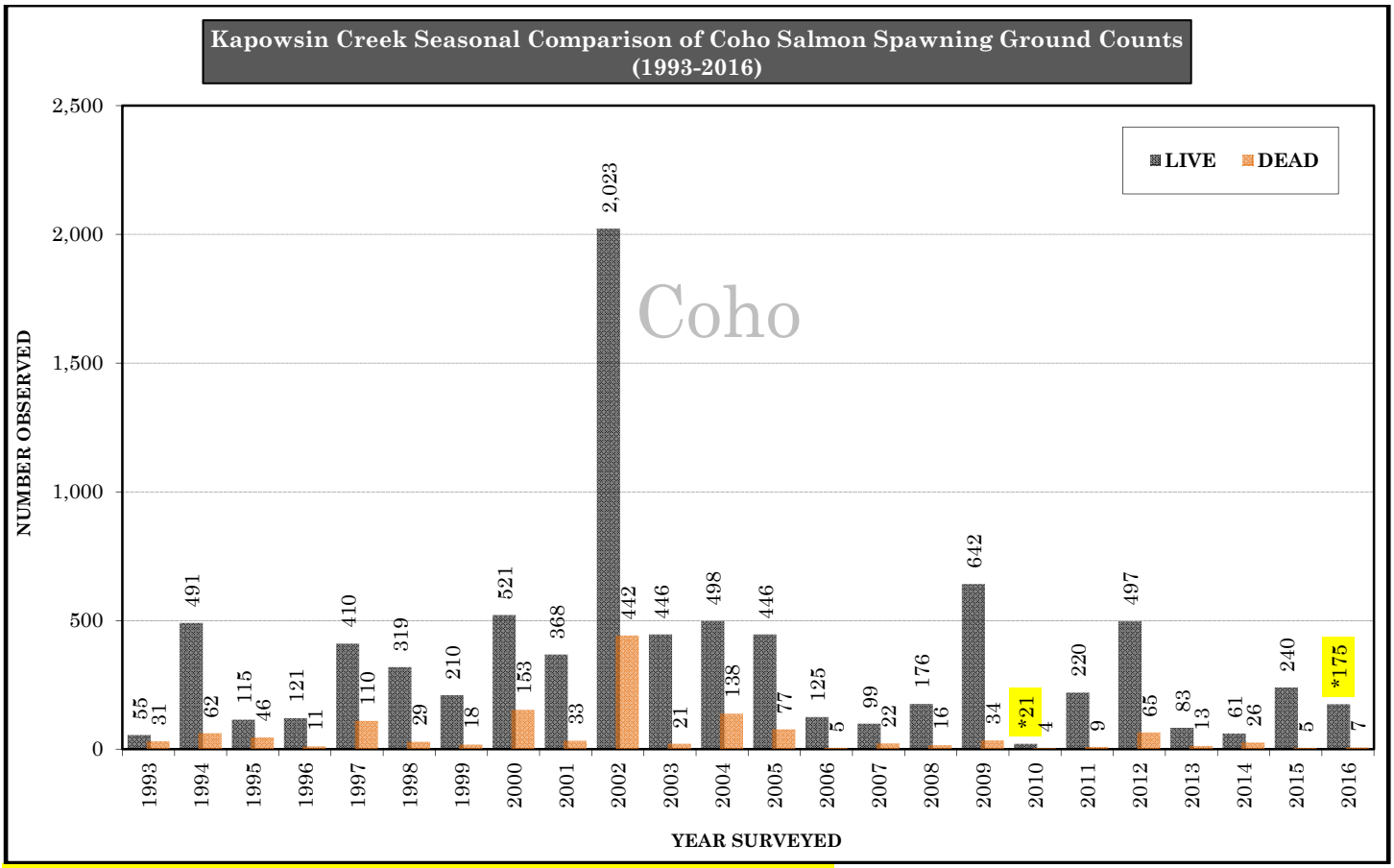
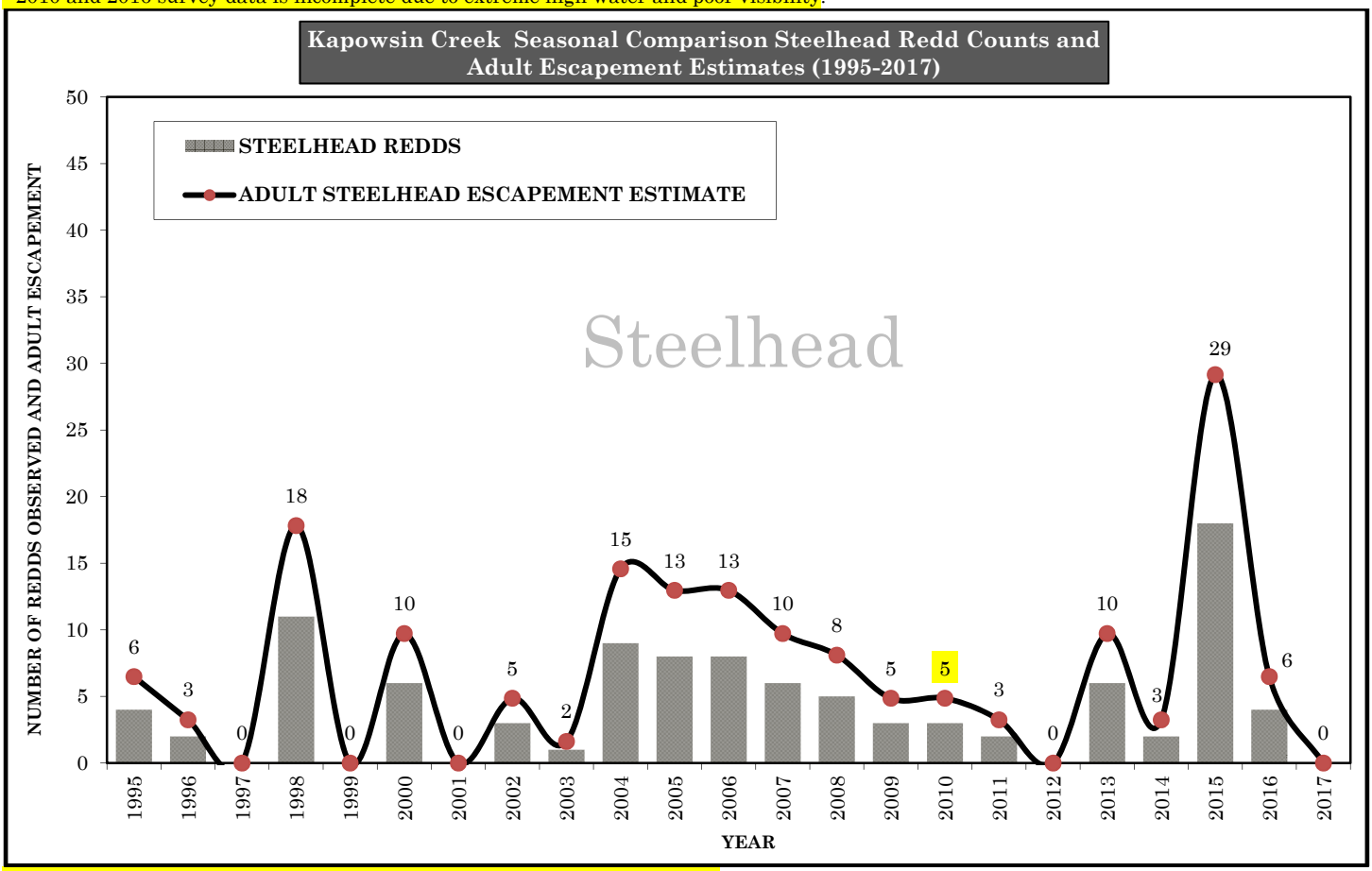

Kapowsin Creek Chinook Carcass Sampling Seasonal Comparisons (2003-2016)
CARCASSES SAMPLED
CWT/ADIPOSE MARK
ADIPOSE MARK
UNKNOWN
UNMARKED
VENTRAL CLIPS
Chinook
NUMBER OBSERVED
SEASON SURVEYED
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016


Kapowsin Creek Seasonal Comparison of Pink Salmon Spawning Ground Counts (2001-2015)
LIVE
DEAD
Pink
NUMBER OBSEREVED
SEASON SURVEYED
2001 2003 2005 2007 2009 2011 2013 2015
1
18
1
274
58
3,361
1,066
1,317
726
5,956
1,237
41,984
13,001



*2010 and 2016 survey data is incomplete due to extreme high water and poor visibility.



2010 Survey data is incomplete due to extreme high water and poor visibility. To determine the total escapement for steelhead, each redd is multiplied by a factor of 1.62 *(i.e. 42 redds x 1.62 steelhead per redd = total esc. of 68 steelhead).* See steelhead redd location map in appendix B.

KELLOG CREEK

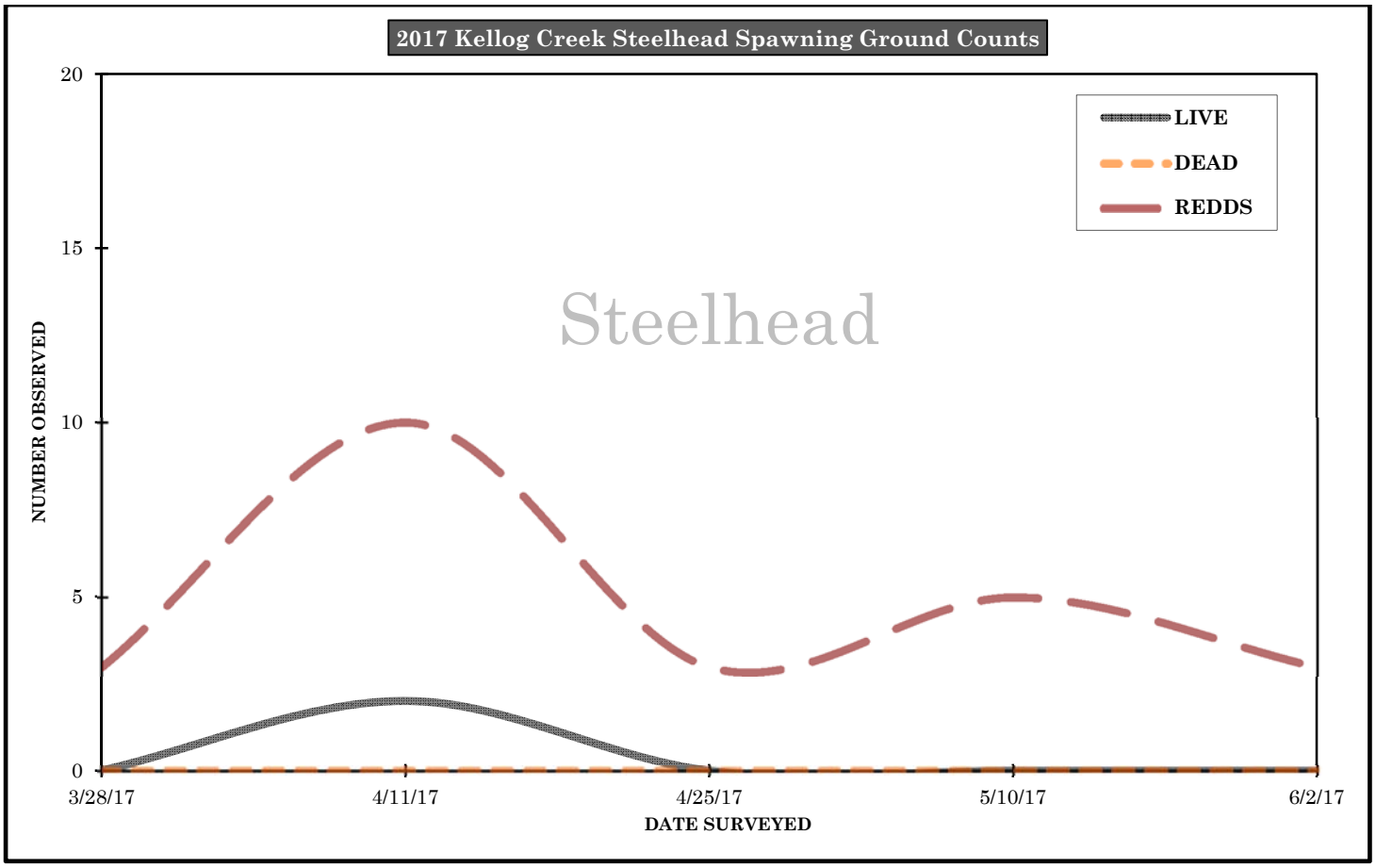
WRIA 10.0621

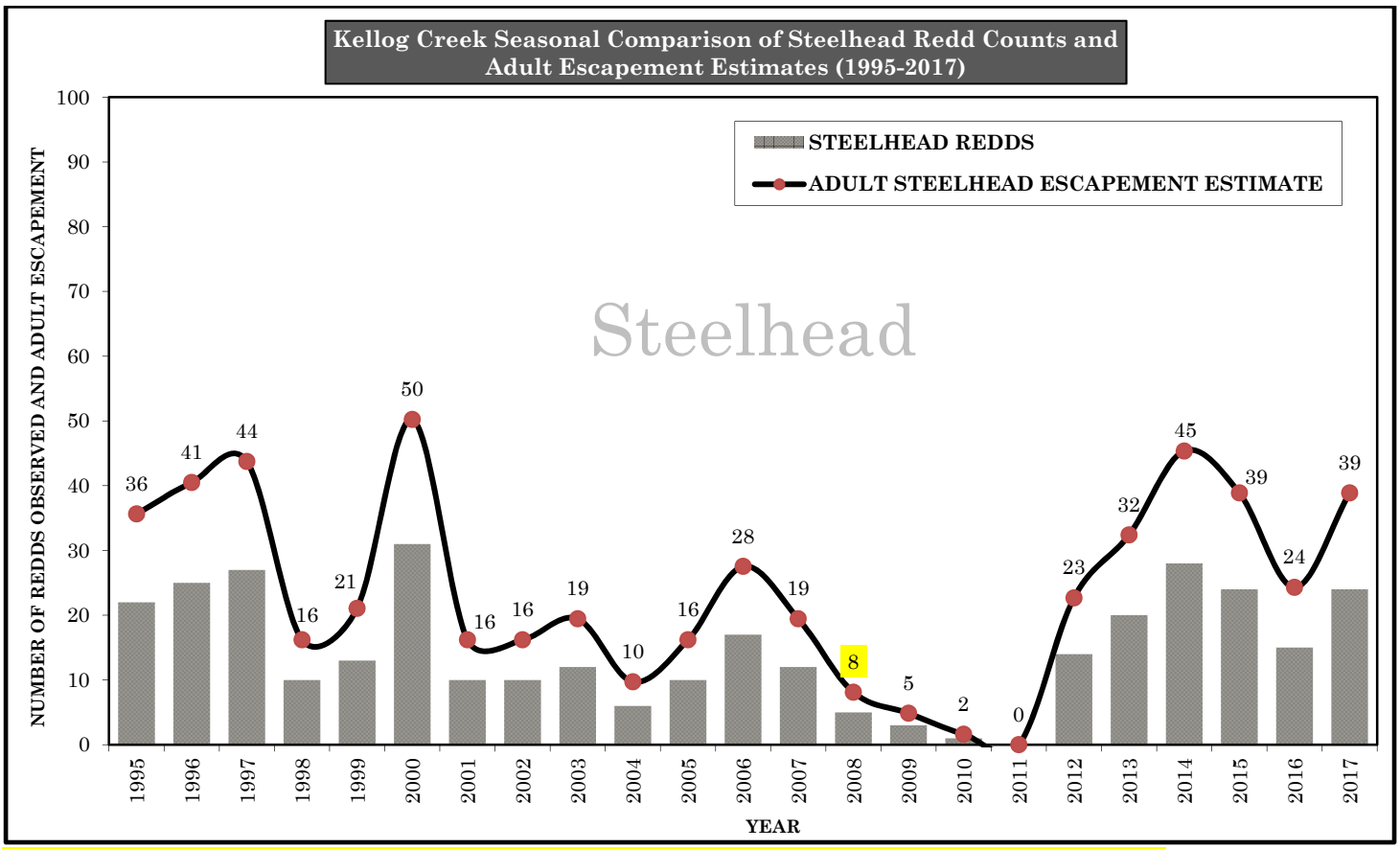
Kellog Creek is a headwater tributary to the Puyallup River, entering the Puyallup at approximately RM 39.7. Kellog is a short run stream with nearly three miles of accessible habitat; however, the anadromous spawning usage extends approximately the first 2 miles of the creek. At RM 2.5, Kellog passes through a large fish passage culvert *(installed 2008)* running under the Mainline 2 Road within the Kapowsin tree farm currently managed by Hancock (*Hancock Timber Resource Group).* Kellog Creek flows entirely within the privately owned Kapowsin tree farm where roads and past timber harvests have negatively impacted several portions of the stream.

Kellog provides spawning and rearing habitat for adult; as well as juvenile steelhead, cutthroat, coho and Chinook. Wild steelhead maintained a small foothold in Kellog Creek prior to 2000 due to the fact that the mouth of the creek is located downstream of the Electron diversion dam. Flows over the past century have frequently been sufficient during late winter and spring; thereby allowing steelhead access to tributaries located downstream of the diversion dam at RM 41.7. Naturally returning coho were observed in Kellog Creek in 2004. These were the first natural spawners seen since adult and juvenile coho plants began in the upper Puyallup basin in 1997. Coho activity has been observed as high as RM 1.4, whereas steelhead activity is often observed as high as RM 2.1. Bull trout have been observed; however, spawning utilization is unknown. It is suspected bull trout utilize the creek for overwintering and foraging. The first adult Chinook spawner was observed in 2013.

Upstream of the culvert, the creek assumes a moderate to high gradient step-pool composition unsuitable for larger adult spawners such as coho or steelhead. Steelhead surveys are conducted from the culvert, downstream to the mouth. From the culvert at RM 2.5, downstream to RM 1.6, the creek flows through a moderate gradient step-pool/cascade channel containing patchy gravel. Several sections of the surrounding banks are comprised of exposed compacted glacial debris; contributing both fine and small course materials to the stream. Due to timber harvesting, the riparian zone throughout this reach consists of a thin mature 2nd growth conifer buffer on both sides. However, there is a significant amount of wind-throw in the channel associated with this insufficient riparian buffer. Steelhead spawning activity is occasionally observed in this segment; however, steelhead spawning commonly begins below RM 1.6. At this point, substantial flow from a left bank tributary, and the reduction in gradient, create a more conducive spawning environment.

Below RM 1.5, the gradient relaxes for the next mile and excellent spawning gravel is consistently available. The majority of steelhead spawning activity is observed within this lower 1.5 miles. The RMZ is more intact along this lower reach as well. In addition to a few substantial debris jams, there are several interactive pieces of LWD present in the stream channel. The gradient increases near RM 0.5 as the creek drops down into the Puyallup River flood plain. A large, structurally complex section of the channel exists just below the Electron flume line. This complex was created by historic amounts of course materials moved during the 1996 flood event. Near the mouth of Kellog, the creek initially drops into the Puyallup River channel migration zone and may flow for an additional 0.1-0.5 miles before dumping into the active main river channel.





The 2008 redd data is incomplete due to extremely poor survey conditions which prevented a regular full season of surveys. To determine the total escapement for steelhead, each redd is multiplied by a factor of 1.62 *(i.e. 42 redds x 1.62 steelhead per redd = total escapement of 68 steelhead).* See steelhead redd location map in appendix B.

KLICKITAT CREEK

WRIA 10.0357

Bull Trout (Male)

Klickitat Creek is a significant right bank headwater tributary to the White River. The word Klickitat is a native word meaning "beyond" or "prairie people". The creek is exclusively surveyed for bull trout from late August through early October. The creek is not surveyed for other species because, with the exception of steelhead, the creeks 3300' elevation at its mouth is likely too high for most salmon. In 2007, PTF biologist observed pink salmon in Sunrise Creek *(elev. 2800')* which is located just inside the National Park boundary, approximately 5 miles downstream of Klickitat. This is the highest point on the White River that adult salmon have been documented by the Puyallup Tribe since surveys have been conducted.

Klickitat Creek is a phenomenal non-glacial stream, originating from Ghost Lake *(elev. 4396')* near Cayuse Pass. Klickitat is a north facing stream flowing entirely within Mt. Rainier National Park, and is the source of drinking water for the NPS White River compound. Klickitat enters the White River north of Sunrise Park Road at approximately RM 67.9. The creek is surrounded by old growth and the water temperature is tempered by cold clear water year round *(three year average summer temperature from 2006-2008 was 6.56 ^{o}C [range 3.8-8.5 ^{o}C]).* The only drawback being, there is only about 0.3 miles of anadromous usage. Three significant unnamed tributaries add flow to Klickitat; unfortunately, they do not contribute any beneficial spawning or rearing habitat given they are located well above natural anadromous barriers.

Lower Klickitat provides exceptional habitat conditions for bull trout (*char*) and cutthroat rearing and spawning. The first 0.3 miles is low gradient, with excellent spawning gravel and significant amounts of in-channel LWD *(lower right).* Numerous pools and side channels provide excellent habitat for all life history stages of bull trout; from newly emerged fry to adults. A series of bedrock falls and cascades at RM 0.3 blocks any further upstream migration. Numerous surveys have been conducted above the falls; however, no fish or redds have been observed. The Puyallup Tribe has surveyed Klickitat for bull trout escapement since 1999; thus far, no other salmon species have been observed spawning in the creek. Bull trout from the mainstem White River are observed spawning in the creek early in the fall, and juvenile bull trout have been observed in the pools and lateral habitat during these surveys. The few dead bull trout encountered during surveys appear to be pre-spawned mortalities due to predation.

Klickitat Creek has been recognized as a key index stream for bull trout spawning. During the 2002 through 2007 survey seasons, bull trout floy tagged at the USACE trap in Buckley were observed spawning in the creek. For three seasons, from 2005-2007, PTF biologists conducted extensive bull trout migration telemetry studies; as well as redd surveys along the upper White River and West Fork White River. The study focused heavily on the headwater tributaries located within Mt. Rainier National Park. Study results showed that the cold high

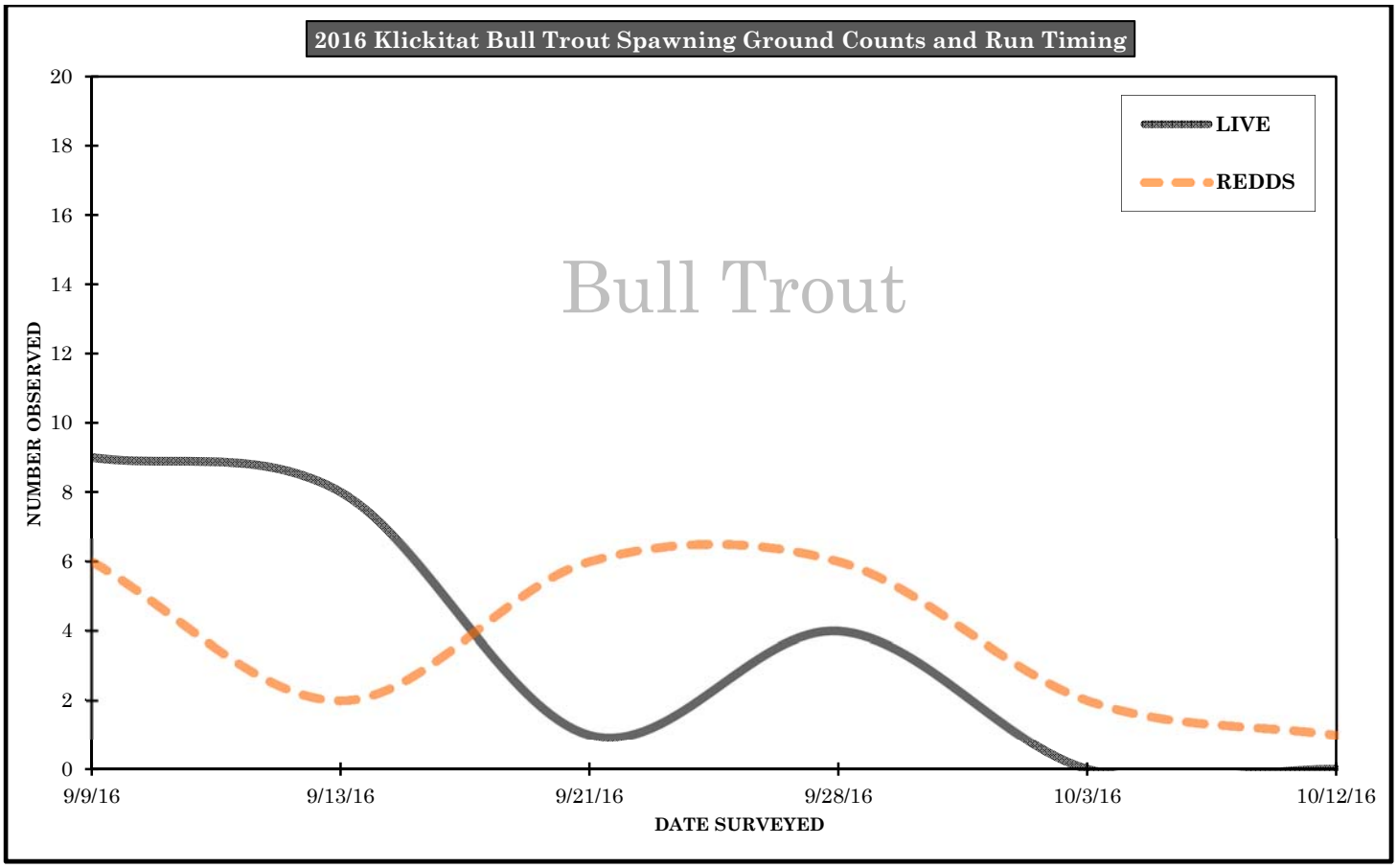
mountain streams located within the park provide the majority of the critical bull trout spawning habitat within the basin. Two of the bull trout observed spawning in 2007were part of the migration telemetry study. Both fish had been implanted with radio tags and released near Greenwater *(RM 45)* in late June, and were observed spawning together in Klickitat during September just below the falls.

Resident bull trout reside in smaller headwater tributaries, while fluvial bull trout frequently travel long distances; utilizing the mainstem rivers and larger tributaries to forage and overwinter. During the fall, migratory forms of bull trout journey from spawning and rearing habitats in the upper watershed to foraging and overwintering habitats located lower in the river system. Beginning in spring and early summer, they begin the return journey back to spawning and foraging areas high in the watershed. In response to changing habitat and reproductive needs, migratory bull trout in the White River travel up to 75 miles or more between the lower river and headwaters located in or near Mt. Rainier N.P. To accomplish this, bull trout require unobstructed migration corridors and connectivity of streams and rivers in order to provide them with access to spawning, rearing, foraging, and overwintering habitats.

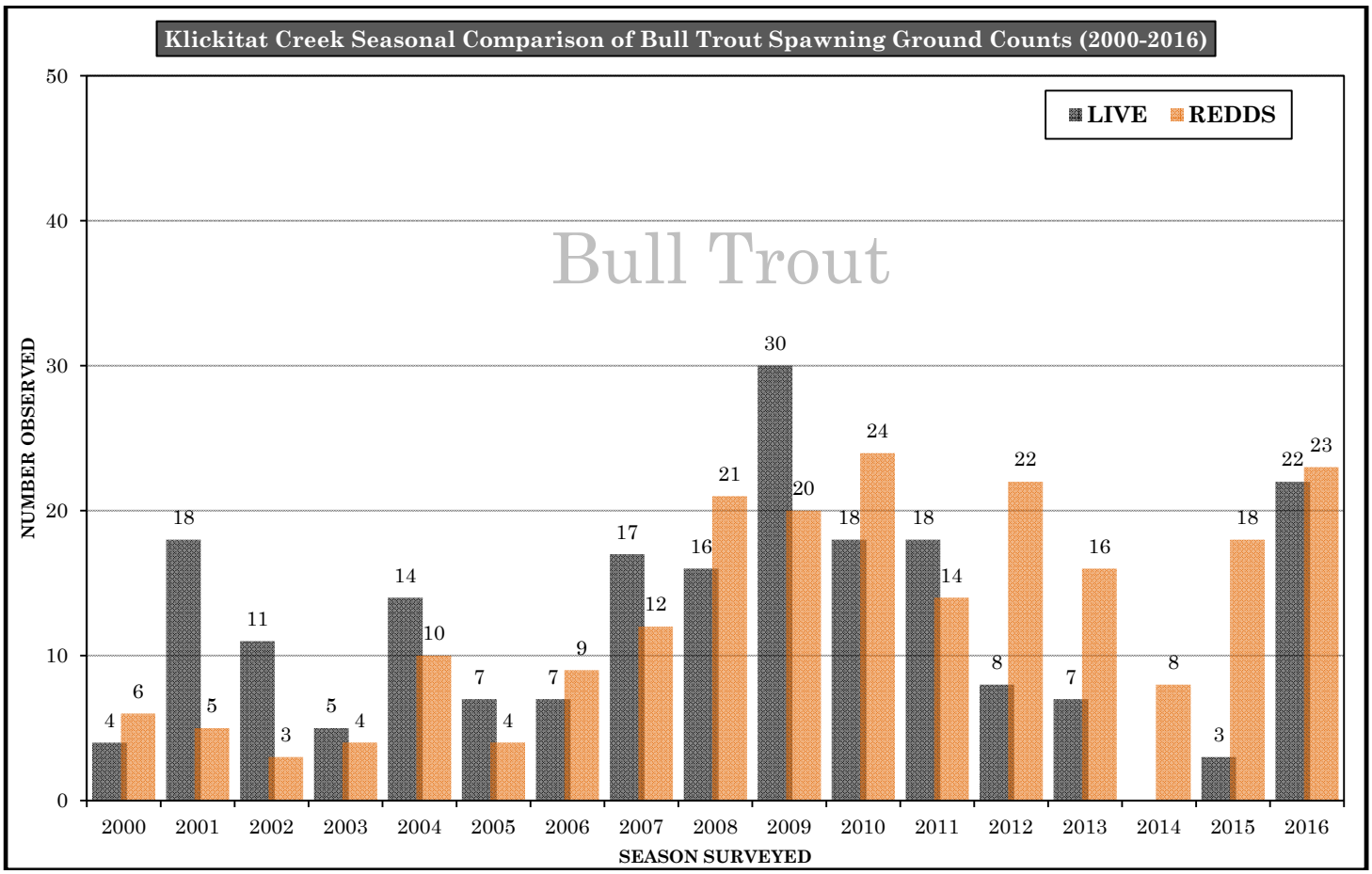
Bull trout spawning occurs primarily during the first three weeks in September, however, spawning has been observed taking place from the last week of August through the first week of October. Bull trout are iteroparous *(ability to spawn more than once)*; therefore, recovering pre-or-post spawn mortalities for examination is extremely rare. Spawners in the upper White River tributaries are observed utilizing various sized substrate from small gravels to small cobble. Redds are often constructed in the tail-out of pools and along channel margins. Embryonic development is slow *(depending on water temperatures)*; it may take between 165-235 days for eggs to hatch and for alevin to absorb their yolk (Pratt 1992). Bull trout fry emerge in late winter and early spring. Young fry can often be seen by mid-March foraging in the lateral habitat along the upper mainstem White River and associate tributaries.

Bull trout habitat throughout the Puyallup and White rivers has been severely impacted by over a century of land and water resource exploitation; including, damming and substantial water diversions, considerable riparian alterations *(deforestation)*, dewatering and low instream flow regimes, as well as significant channel manipulation. These impacts have lead to a marked deterioration in land and hydrological behavior within these river systems by causing water flow of poorer quality, quantity and timing. Several limiting factors are involved with regards to the healthy function of stream habitat and bull trout populations in the watershed; including lost or diminished habitat connectivity and migration corridors *(human-made fish passage barriers)*, fragmentation and reduction of habitat quality *(entrainment, transportation networks, forest management practices and operations, direct water withdrawal)*; in addition to, water quality, fish entrainment and entrapment, unknown species interactions, and potential climate change impacts *(changes in flow regimes, scour effects, thermal variations, changes in water chemistry)*.

Bull trout are primarily piscivorous *(fish eaters)*; however, they are opportunistic feeders, feeding on a variety of prey items depending on their particular life history strategy and stage of development. Adults feed almost exclusively on other fish, including a range of salmon and trout species; as well as other resident fish species. Juveniles feed on aquatic invertebrates, including stoneflies *(Plecoptera)*, caddisflies *(Trichoptera)*, and mayflies *(Ephemeroptera)*. Bull trout require a healthy aquatic environment in order to survive and flourish. They need an environment that provides the necessary prey base; in addition to the rearing and reproductive habitat essential to ensure their continued survival and reproductive success. The USFWS finalized bull trout recover plan is available at:*https://www.fws.gov/pacific/bulltrout/pdf/Final_Bull_Trout_Recovery_Plan_092915.pdf*



2016 Klickitat Creek bull trout survey data was collected collaboratively by PTF and NPS biologists. See Appendix B for bull trout redd locations, and Appendix C for spawning data.

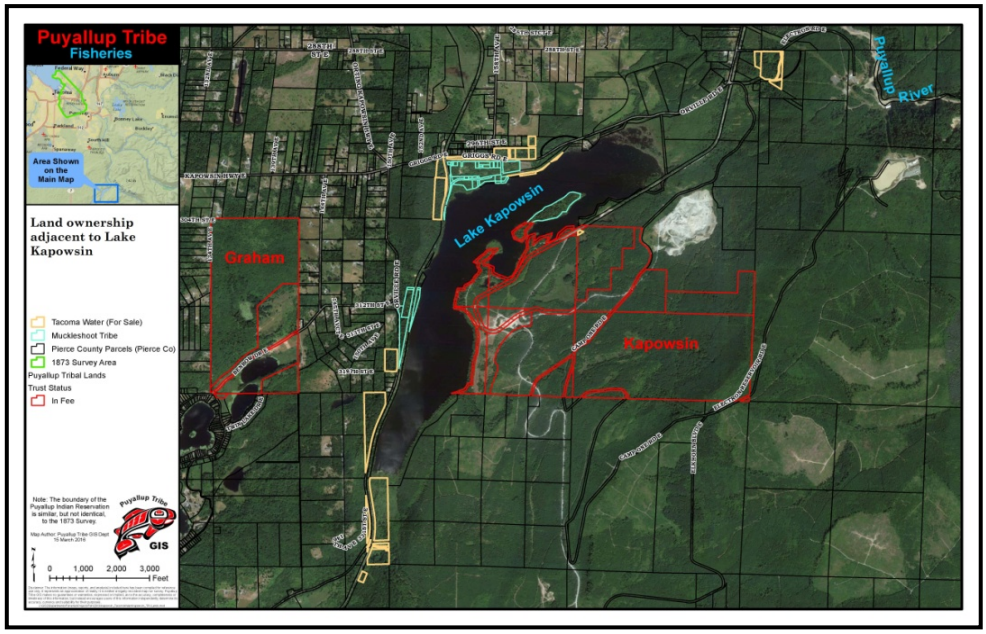


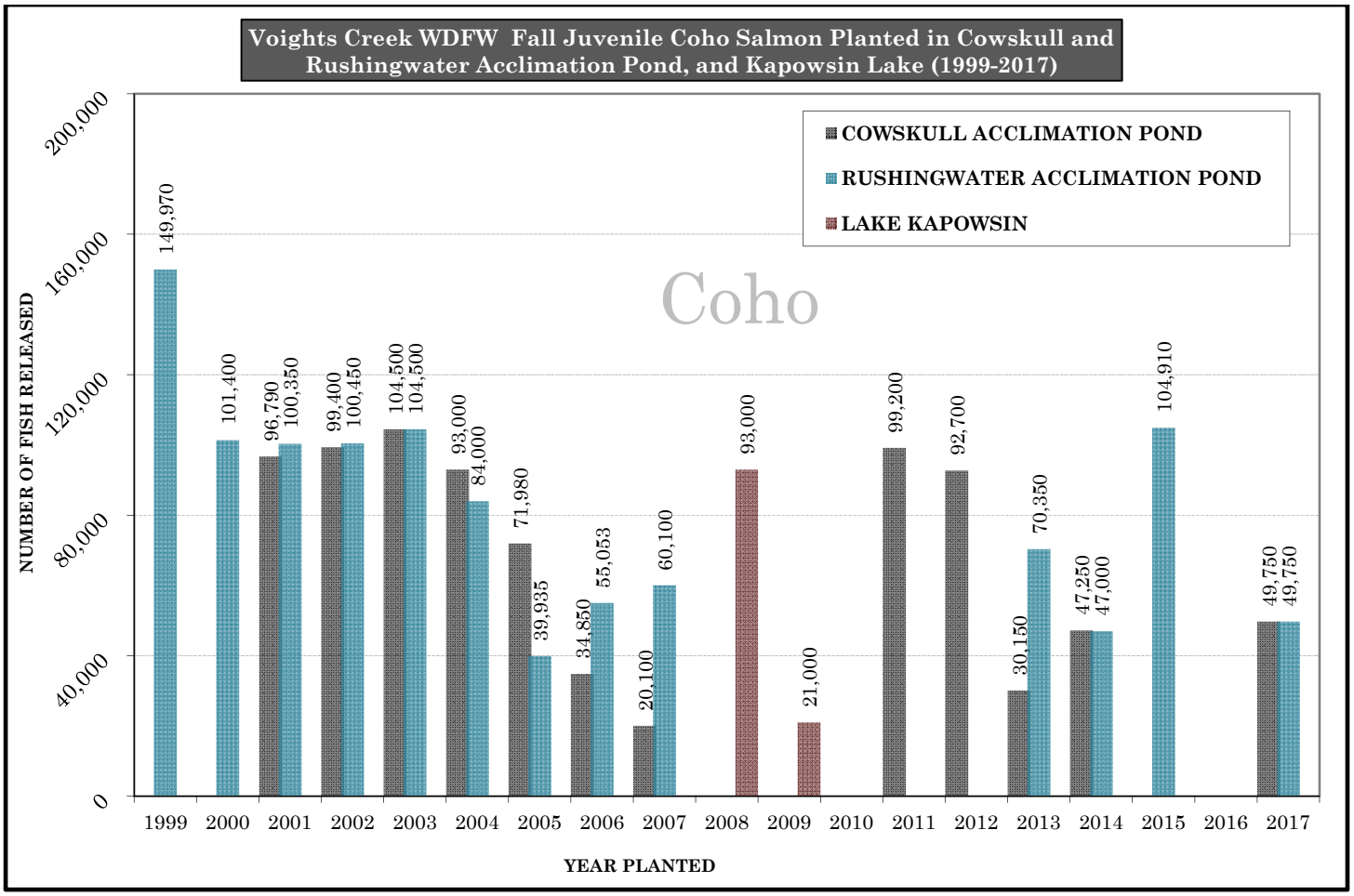
LAKE KAPOWSIN

Lake Kapowsin is a 512-acre naturally formed lowland lake located near the town of Graham. Uses of the lake and surrounding lands include recreation, conservation and enhancement. The lake was designated as a State Aquatic Reserve in September of 2016 http://file.dnr.wa.gov/publications/aqr_resv_lake_kapowsin_draft_mgmtplan_0716.pdf. There are several oranizations that own land adjacent to this largly undeveloped lake, including the Puyallup and Muckleshoot Tribes *(see map)*.

Kapowsin Lake was formed approximately 500 years ago by a significant geological event. The Electron lahar/mud flow *(hydrothermally altered rock - highly fluidic slurry of soil materials, rocky debris and water)* originated along the west slope of Mt. Rainier and coursed its way down the mountain into the lower valley, inflicting tremendous destruction on the lowland forest habitat. In its wake, the resulting lahar deposits created a dam which formed Lake Kapowsin. The remnants of the forest that once occupied the area the lake currently rests, is still visible today. The woody materials *(stumps, trees)* which have persisted in the lake provide vital and sustaining habitat for many forms of wildlife including fish, amphibians and mammals. The lake also provides critical wetland habitats for wildlife. Lake Kapowsin is a relatively shallow *(20'-30')* connecting Ohop Creek *(inlet)* and Kapowsin Creek *(outlet)*. The lake supports a significant array of native salmonids and warm water species including; coho, pink, steelhead, cutthroat and rainbow, largemouth bass, yellow perch, rock bass, black crappie, bluegill, pumpkin seed sunfish, walleye, and bullhead catfish. Kapowsin Creek also supports Chinook, chum and bull trout.

Lake Kapowsin is also an essential fisheries enhancement resource. From 1995-1997, the Puyallup Tribe operated an extremely successful coho net-pen enhancement program in the lake, with the purpose of establishing a self-sustaining coho run in Kapowsin and Ohop creeks. Approximately 200,000 specially tagged coho *(coded wire tags)* from WDFW's Voights Creek Hatchery were reared in the lake annually. Although coho escapements in Kapowsin and Ohop creeks have decreased, decedents of the original net-pen program continue to return to the creeks to spawn. Additional enhancement efforts are made seasonally to supplement the coho run by planting surplus adult coho, when available, from WDFW's Voights Creek Hatchery into Ohop Creek, where they are able to spawn naturally.





Acclimation ponds opperated by Puyallup Tribe. See map of acclimation pond location sites on Page 41. No data indicates no fish were planted.

LE DOUT CREEK

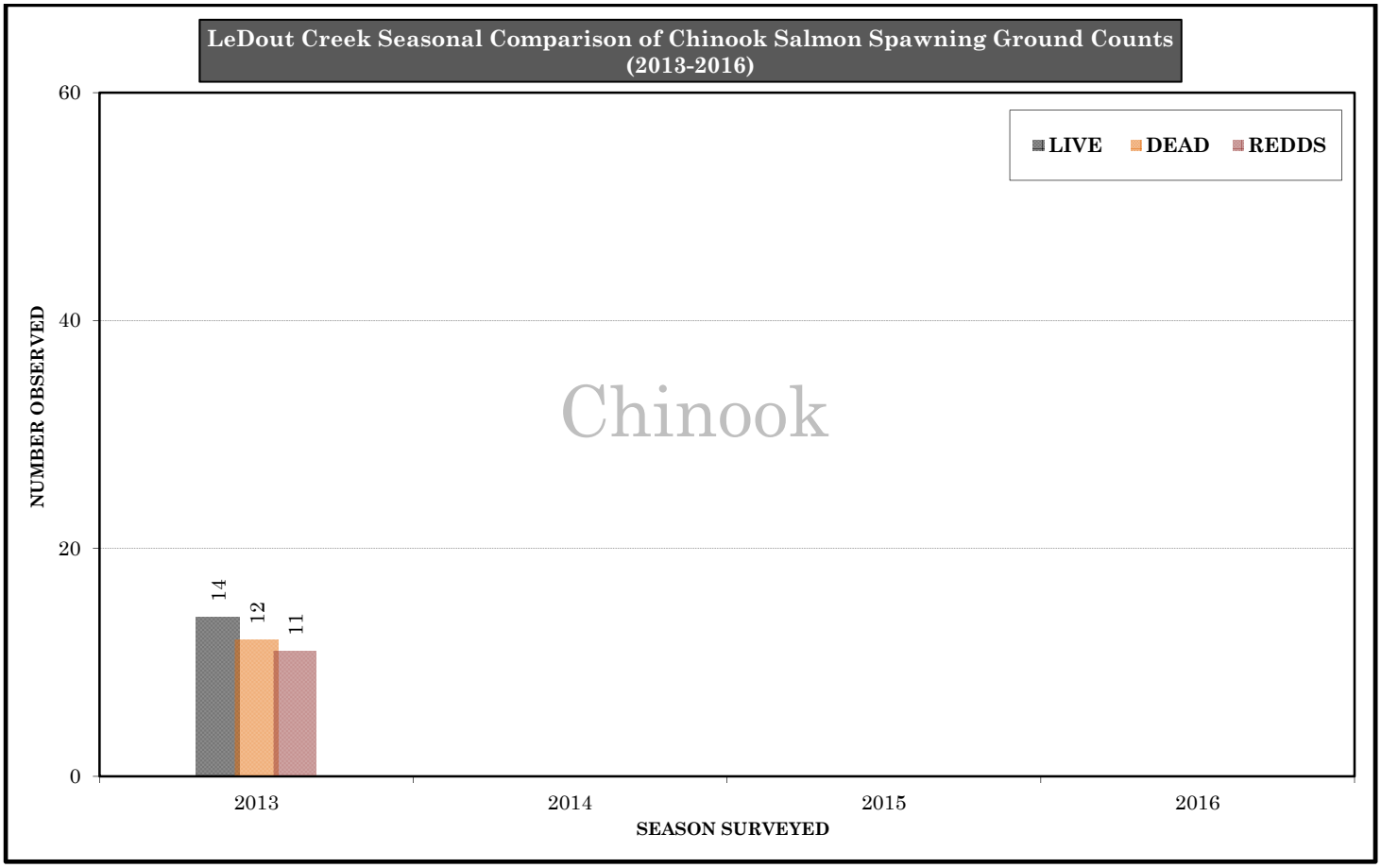
WRIA 10.0620

Le Dout Creek is a small tributary to the Upper Puyallup River, entering the mainstem river channel at RM 39.2. This small order stream drains a wetland area at just over 1,800 feet, and flows northwest for approximately 2.5 miles before meeting the Puyallup. Unfortunately, low flows *(major factor)* can prevent adult salmon from ascending past the first 0.45 miles. Le Dout is located within the Kapowsin tree farm currently managed by Hancock (*Hancock Timber Resource Group).* Several areas along the upper reach have undergone several timber harvests in the past. Le Dout Creek supports an exceptionally limited number of coho and steelhead spawners. Creek flow can be insufficient during late summer to allow Chinook *(left)* access to spawn; however, higher than average flow allowed the first significant number of adult Chinook to enter the creek in 2013. Bull trout utilization is unknown. However, bull trout utilization is well documented in the Mowich and Puyallup; as well as nearby tributaries Rushingwater and Kellog Creeks.

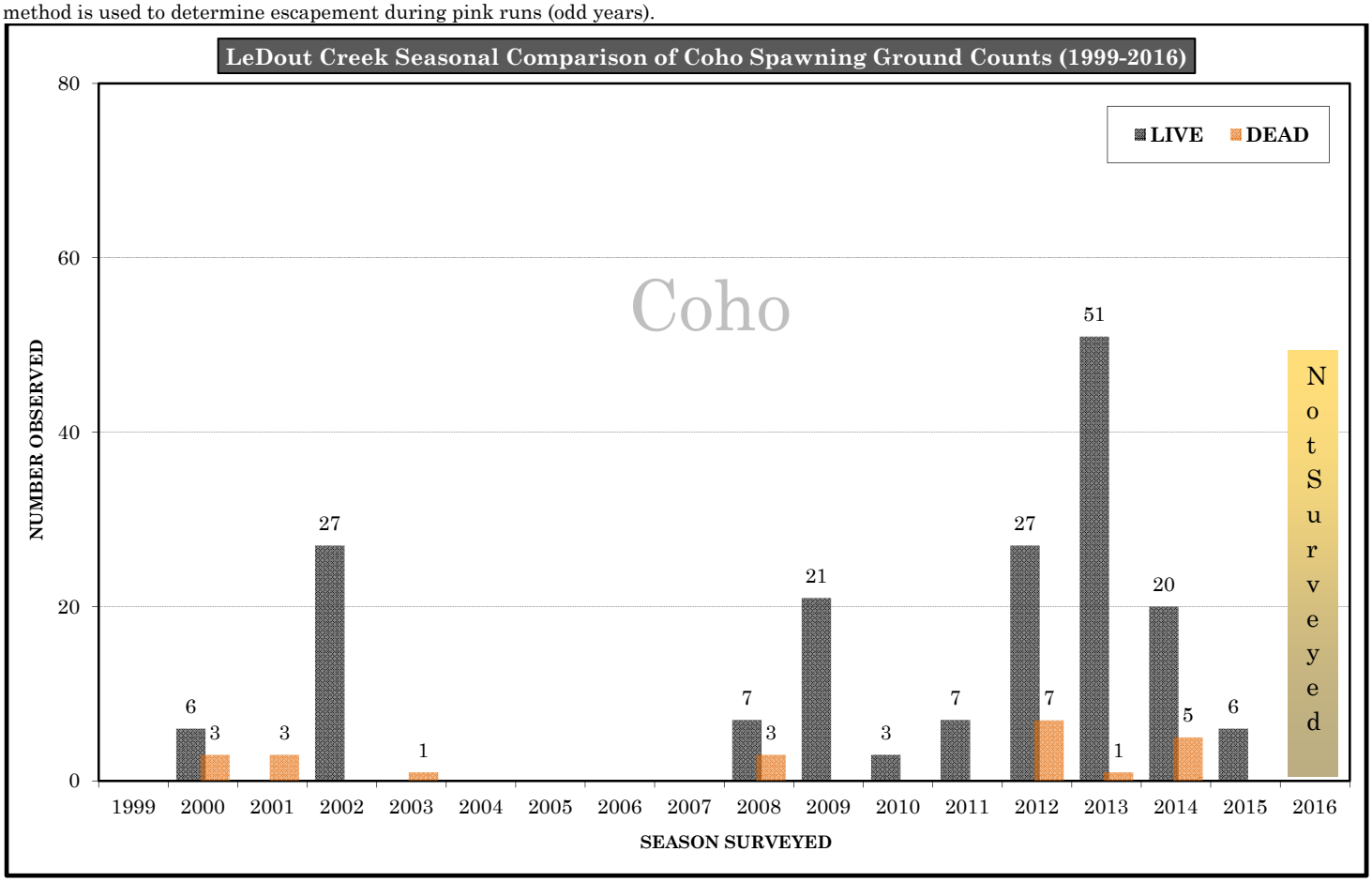
Chinook spawning

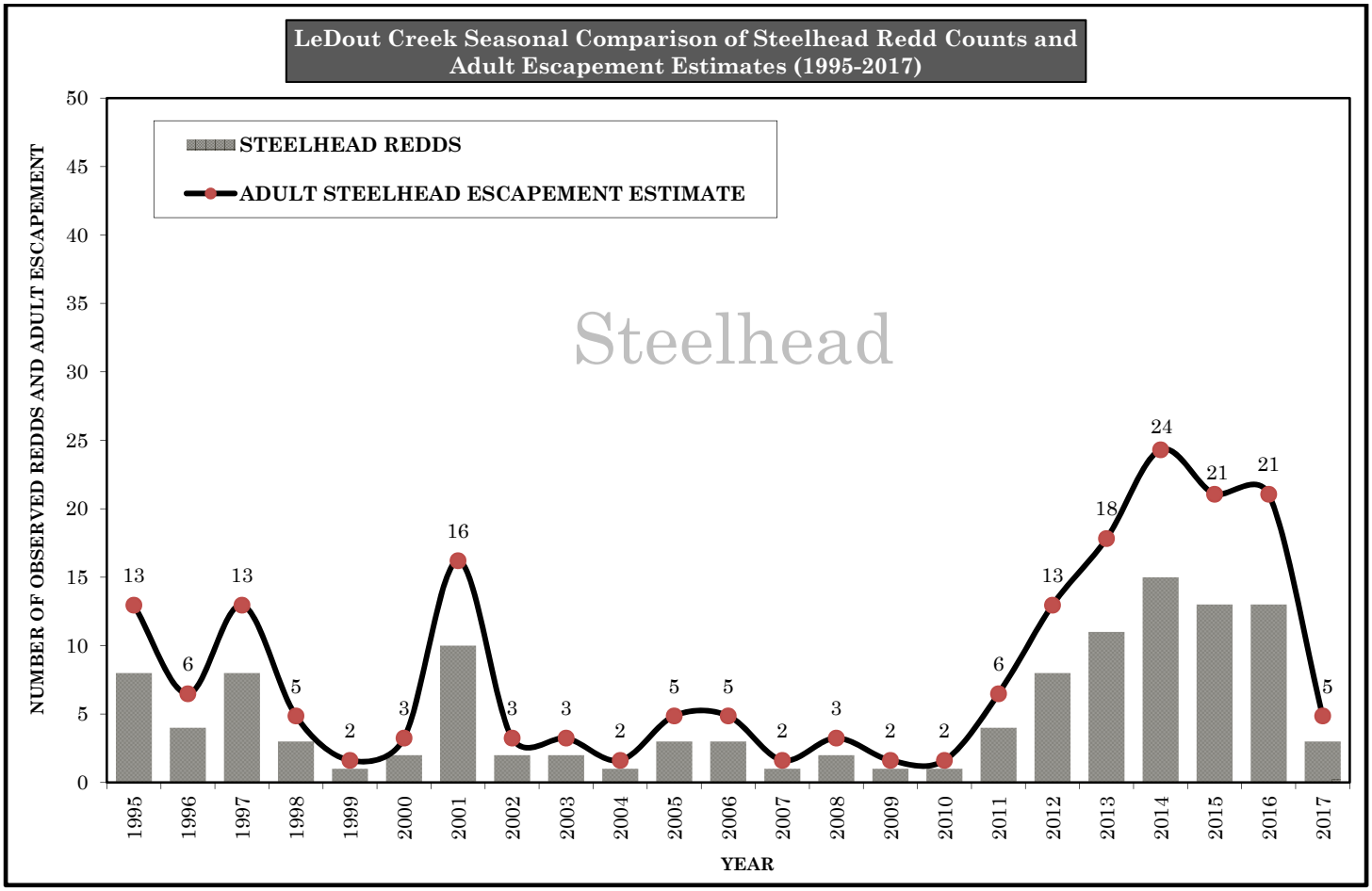
Le Dout is a stream with moderate complexity, and habitat that is well suited for coho and steelhead adult spawners, as well as juveniles. To a large extent the substrate present throughout Le Dout consists of small and large cobble; yet, good quality patches of spawning gravels are available *(lower left).* The channel habitat consists mostly of low gradient pools and riffles. The creek contains a substantial proportion of small and medium size woody debris, and the surrounding riparian zone consists mostly of alder and Douglas fir. Logging activities occurred along the lower reach of LeDout in the past; however, there is currently a good RMZ along the majority of the lower spawning reach of the creek. A split in the channel at RM 0.45 can prevent adult fish from migrating further upstream due an increase in the gradient along with a reduction in flow. The upper reach of the creek is steep with impassable cascades. The 62 Rd. crosses Le Dout Creek approximately 0.45 miles from its confluence with the Puyallup River.

The mouth of Le Dout is located about 2.6 miles below the Electron diversion dam. Given that the creek is downstream of the diversion dam, and river flows over the past century have often been high enough during late winter and spring to prevent the mainstem channel of the Puyallup River from being drawn dry, wild steelhead have managed to maintain a minute foothold in Le Dout Creek. Despite generally low escapement numbers, steelhead surveys in Le Dout are conducted annually by the Puyallup Tribe. Winter steelhead stocks in the Puyallup basin have experienced a dramatic decline since 1990 *(ESA listed in 2007).* The precipitous decline within just the past few years has created serious concern among fisheries managers. Factor(s) responsible for the decline in steelhead survival are unknown, especially when other salmon species are experiencing relatively good success.



Adult Chinook escapement is determined by expanding the number of redds observed by 2.5 fish per redd (Smith and Castle, 1994). Due to the tremendous volume of pink salmon during odd years, the success of determining Chinook redds from pinks is vastly reduced. Therefore, The AUC method is used to determine escapement during pink runs (odd years).

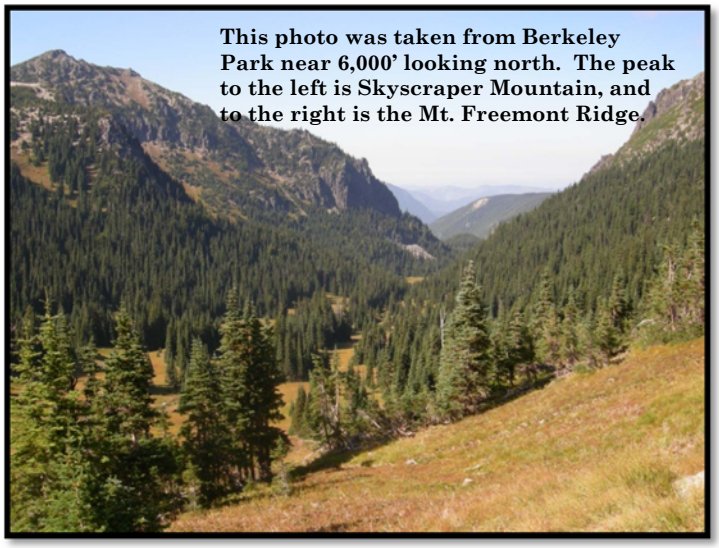




To determine the total escapement for steelhead, each redd is multiplied by a factor of 1.62 *(i.e. 42 redds x 1.62 steelhead per redd = total escapement of 68 steelhead).* See steelhead redd location map in appendix B.

LODI CREEK

WRIA 10.0227



This photo was taken from Berkeley Park near 6,000' looking north. The peak to the left is Skyscraper Mountain, and to the right is the Mt. Freemont Ridge.

Lodi Creek is a significant right bank headwater tributary to the West Fork White River. The name Lodi apparently originated from early mineral prospectors in the region. This high mountain stream flows northwest through a steep glacial valley, bordered by Skyscraper Mountain to the west and the Mount Fremont ridgeline running along the east *(top left)*. Lodi flows entirely within Mt. Rainier National Park *(NPS stream designation #f09-00a)*, the creek is non-glacial in origin; rather, its sources are derived from snowpack accumulations within Berkeley Park, located at 6,400+ feet of elevation *(top left)*; as well as other surrounding surface and groundwater sources. Berkeley Park is nestled into the northern slopes of the Burroughs Mountain Range. Lodi Creek flows for just over 4 miles from its headwaters before entering the White River at approximately RM 13.7; situating it about a mile upstream of Van Horn Creek *(RM 12.65)*.

The lower reach of Lodi provides excellent habitat conditions for bull trout rearing and spawning. Various surveys have verified both resident and fluvial bull trout utilization within this stream. However, the creeks 3400' elevation is likely too high for Chinook, coho and pink salmon. PTF surveys the creek for bull trout spawning during the month of September. From 2005-2007, PTF biologists conducted extensive bull trout migration telemetry studies and redd surveys along the upper White River and West Fork White River; focusing heavily on the headwaters located within Mt. Rainier National Park. The study results showed that the cold high mountain streams located within the National Park, including Lodi, provide the majority of the critical bull trout spawning habitat in the basin. In addition, bull trout spawning was less consistent and frequent in this tributary compared to that observed in several significant headwater tributaries located along the White River.

During the 2007 season, several bull trout redds were documented in Lodi from mid-to-late September. During the 2008 season, no bull trout spawning activity was observed. The only bull trout observed spawning during 2006 was part of the migration telemetry study. This bull trout had been implanted with radio a tag and released near Greenwater *(RM 45)* in early June, and was observed spawning in the creek on September 8th.

Characteristic of many headwater tributaries, the lower reach of the creek is a low gradient channel flowing within the open channel migration zone of the West Fork White River floodplain, and is repeatedly manipulated by mainstem river incursions. There is little significant LWD present in this portion of the channel and the high solar exposure results in significant algae mats accumulating over the substrate *(right)*. Although spawning does occur within this small stretch, it can be limited due the lack of quality spawning substrate created by the alluvial deposits *(fine sand and silt)* from the West Fork White River. Beyond the open floodplain, the creek enters the forested lower slope of the valley floor as it parallels the West Fork White River channel. From this point, the creek assumes a pool-riffle configuration for approximately the next 0.8 miles before climbing its way up the steep valley wall; an impassable falls prevent any further upstream migration. The forested reach provides quality spawning and rearing opportunities.

MEADOW CREEK

WRIA 10.0630

Meadow Creek is a tributary to the Mowich River, entering the Mowich at RM 3.9. The creek was named by Bailey Willis *(1857-1949)* in 1883. Willis was a geological engineer who played an essential role in establishing Mt. Rainier as a national park. Meadow originates from Eunice Lake *(elev. 5353')*, deep within Mt. Rainier National Park. With exception of the Mountain Meadows habitat area below Eunice Lake, the creek flows through a high gradient, frequently confined channel for most of its 4.6 mile length. Meadow Creek has one significant tributary, Hayden Creek, at RM 2.5. Pristine spawning and rearing habitat exists within the lower one-mile reach of the creek. This anadromous reach consists of a low to moderate gradient channel, with a pool-riffle character, abundant spawning gravel, LWD; as well as an intact mature riparian zone along the entire creek. Several pieces of LWD along with stable log jams have created remarkable stream complexity throughout the lower reach of the creek.

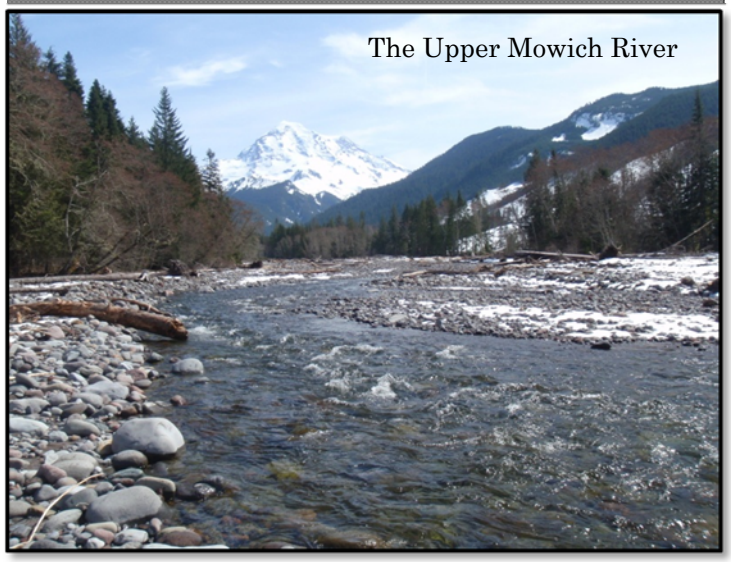
Meadow Creek is unspoiled in many ways and has incredible potential to be a highly productive salmon and steelhead stream. Unfortunately, anadromous salmon were unable to access the creek for nearly a century due to the streams location above the Electron diversion dam on the Puyallup River. With the completion of the Electron fish ladder *(@ RM 41.7)* in the fall of 2000, anadromous fish passage was restored for the first time since 1904. Restoring anadromous access to the upper Puyallup River has made approximately 26+ miles of spawning, rearing and foraging habitat above the diversion available for several species including Chinook, coho, pink, steelhead, and bull trout. The creek does; however, have a resident population of cutthroat. Bull trout presence and spawning utilization was documented in 2016 *(Appendix C)*.

Due to the lengthy absence of anadromous fish usage and the poor rate of natural fish reestablishment, Meadow Creek is only occasionally surveyed to determine if salmon or steelhead are utilizing the stream. Disappointingly, many of the fish enhancement techniques employed by the Puyallup Tribe such as adult, juvenile, or fry plants; as well as the use of acclimation ponds, are not possible due to the creeks remote location and lack of vehicle access. Therefore, one of the Puyallup Tribe's short term goals continues to be the reintroduction of Chinook, and possibly coho via remote site incubators *(RSI)*. The obvious need for RSI's is due to the limited accessibility to the creek. Upwards of 40,000 Chinook and coho could be incubated and released into the creek annually; however, this has not been accomplished as of the printing of this report. Currently, no proposals exist for reestablishing steelhead into Meadow Creek or the Upper Puyallup system. Yet, the need for action is paramount due to the steeply declining stock of wild steelhead in the Puyallup Watershed. The first/only documented steelhead redd occurred in May 2014.

Bull trout fry in Meadow Creek (Length approx.40mm)

MOWICH RIVER

WRIA 10.0624



The Upper Mowich River

The Mowich River converges with the Puyallup River at RM 42.3, this is approximately 0.6 miles above the Electron diversion dam. *The availability and nature of fish and stream habitats are not static conditions and are frequently altered. The habitat descriptions in this report provide a general analysis of habitat conditions, and are not intended to fulfill the requirements of a rigorous biological assessment/evaluation.*

The glacial headwaters of the Mowich River originate from the Edmunds, and the North and South Mowich glaciers on the west slope of Mt. Rainier. The Mowich and its associated tributaries provide excellent spawning and rearing opportunities for salmon, steelhead and bull trout. Significant tributaries to the Mowich include; Crater, Spray, Meadow, and Rushingwater creeks. Meadow originates from Eunice Lake, deep within Mt. Rainier National Park and enters the Mowich at RM 3.9. The creek flows through a high gradient, frequently confined channel for most of its 4.6 mile length. Meadow Creek has one significant tributary, Hayden Creek, at RM 2.5. However, the lower mile of the creek has a low to moderate gradient, with a pool-riffle character, abundant spawning gravel, LWD, and riparian cover along the entire channel. Several pieces of LWD along with stable log jams have created remarkable stream complexity throughout the lower reach of the creek. Steelhead and bull trout have been documented spawning in Meadow Creek.

Upper Mowich River (RM 4.1)

Rushingwater Creek originates from the Golden Lakes in Mt. Rainier National Park. Rushingwater flows over 5 miles to its confluence with the Mowich River at RM 0.6. Most of Rushingwater flows within the Kapowsin tree farm *(Hancock Forest Management)* where roads and timber harvesting have impacted several portions of the stream. The upper survey reach of the creek is mostly comprised of pools and glides, with fine and medium sized substrate. Abundant in-stream woody debris and a moderate to dense canopy cover extend throughout most of this reach.

The North and South Mowich forks flow though Mt. Rainier National Park and reach their convergence at RM 7.5 to form the main stem Mowich River. The upper 4-5 miles of the Mowich River consist of steep and moderate gradients, with a largely cobble and boulder substrate. There is little spawning habitat available, yet some suitable spawning conditions exists in the outlying side channels below RM 7.5. The channels of the North and South Mowich are bordered by mature dense conifer and mixed deciduous forests.

From RM 6.5 to 3.1, the Mowich River is comprised of more complex habitat. The gradient decreases along this reach, resulting in a more pool-riffle character where smaller spawning substrate is deposited and resting pools

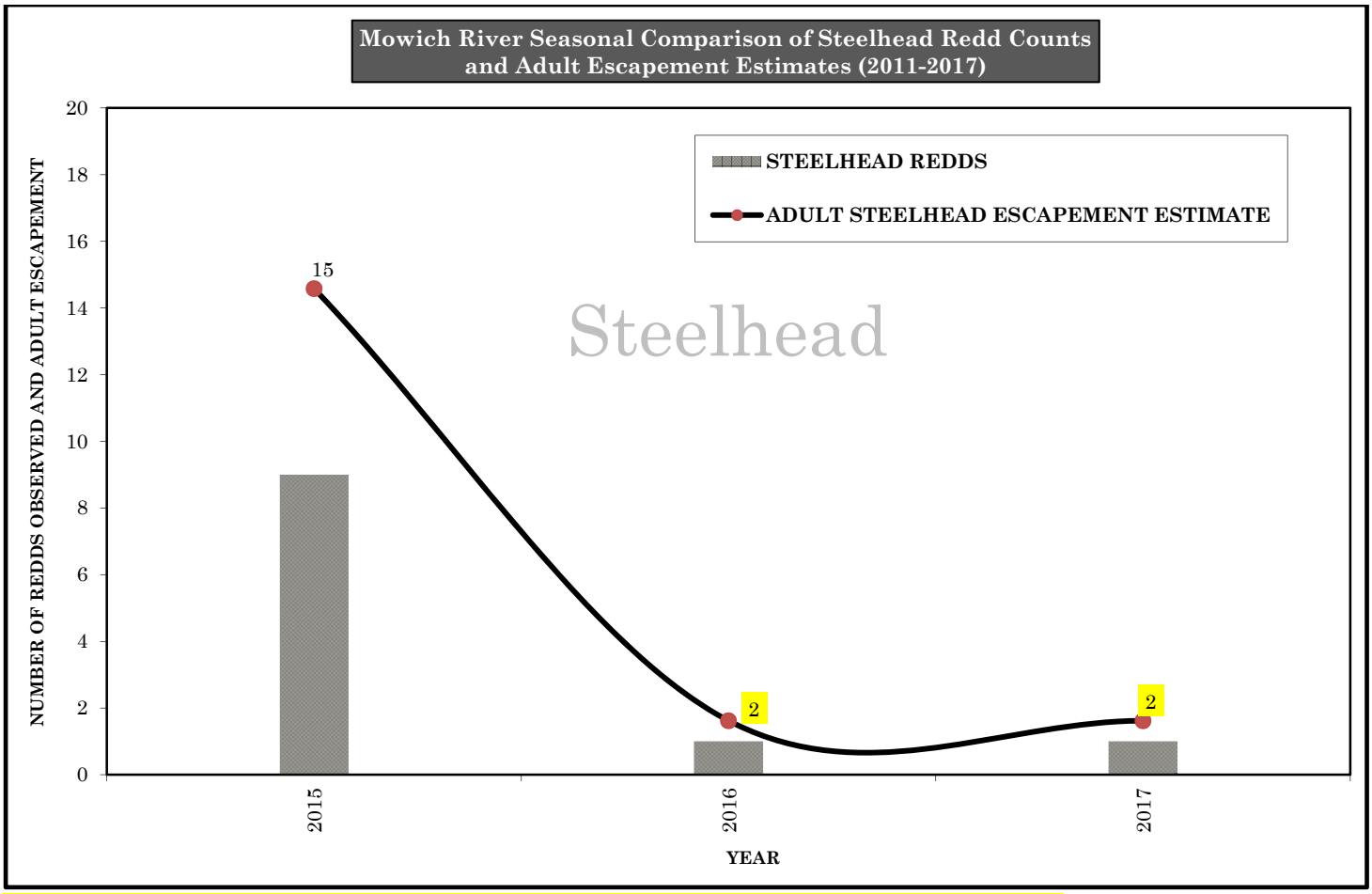
Lower Mowich River (RM 1.2)

are available for fish rearing, foraging and migration. The lower three mile of the river flows within the Kapowsin tree farm managed by Hancock. Most of the lower three miles of the channel becomes confined and narrowed by the steepening valley walls. Fortunately, much of the channel retains its complexity and spawning opportunities are abundant for both salmon and steelhead. Juvenile coho have been observed as high as RM 5.0, whereas adult and juvenile bull trout have been documented as high as RM 7.5. Of special note is the first documented spawning of naturally returning Chinook in the Mowich River in 97 years. Two females on separate redds were observed spawning in the lower reach *(RM 1.0)* on September 7, 2001.

With the completion of the Electron fish ladder *(RM 41.7)* in the fall of 2000, anadromous fish passage was restored for the first time since 1904. Surplus Chinook and coho salmon from Voights Creek Hatchery were planted in the Mowich River, and Rushingwater Creek for several years in efforts to jump start the Upper Puyallup. One of two acclimation ponds used for reestablishing coho *(prior to 2008)* into a 26+ mile reach of the Upper Puyallup River is located just off the main channel of Rushingwater Creek at RM 0.6. The pond holds 14,000 cu. ft. of water with a flow rate of 1-3 cfs, in past years, 40,000 to 100,000+ coho yearlings were imprinted and released from Rushingwater annually. Coho yearlings originated from Voights Creek Hatchery where they were adipose clipped and coded wire tagged. Fish were released at 20 fish per pound, for a total biomass of 10,000 pounds. There was also a natural acclimation pond on the Mowich used for rearing Fall Chinook, located at RM 0.1. Unfortunately, the water intake was destroyed during a flood event; rendering this pond nonoperational.

The Puyallup Tribe's restoration goal is to rebuild depressed Chinook and steelhead stocks and remove them from ESA listing. Historically, Fall Chinook have been reared since 1980 with a variety of stocks, goals, and objectives. Using acclimation ponds, limiting harvest, and making substantial gains in habitat restoration, the tribe will be able to accomplish this task. Levee setbacks, oxbow reconnections both inter tidal and upland, Commencement Bay cleanup, and harvest cutbacks have already been initiated. Only the jump-starting of Chinook in habitat areas devoid of fish is left. Acclimation ponds are a proven method in increasing fish numbers on the spawning grounds. Hatchery rearing Fall Chinook for acclimation ponds in the upper Puyallup River is a key component to restoration goals.

Lower Mowich River (RM 0.5)



Redd data is incomplete due to extremely poor survey conditions which prevented a regular full season of surveys. To determine the total escapement for steelhead, each redd is multiplied by a factor of 1.62 *(i.e. 42 redds x 1.62 steelhead per redd = total escapement of 68 steelhead).* See steelhead redd location map in appendix B.

NIESSON CREEK

WRIA 10.0622

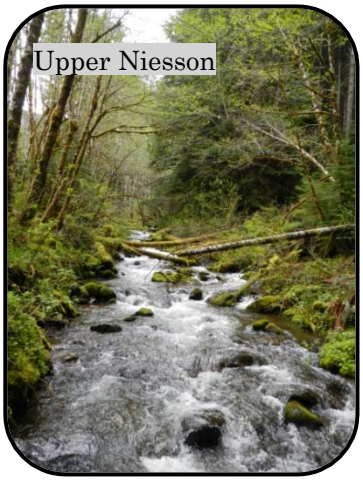
Niesson Creek is a tributary to the Upper Puyallup River. Originating from snowpack run-off and ground water, the creek runs northerly for approximately 5.3 miles before meeting the Puyallup at RM 41.1. Anadromous usage extents throughout the first 2.2 miles of the creek; supporting Chinook *(planted)*, coho *(NOR & hatchery plants)*, steelhead and bull trout.

Beyond RM 2.2, the creek climbs steeply along the remaining 3.1 miles to its origin at just over 4,000 feet. Niesson Creek is located within the Kapowsin tree farm currently managed by Hancock. The overstory riparian zone consists of mixed conifers and deciduous trees. Continuing timber harvesting activities have reduced the riparian zone to the state required minimum along several extended segments of the lower creek.

Lower Niesson

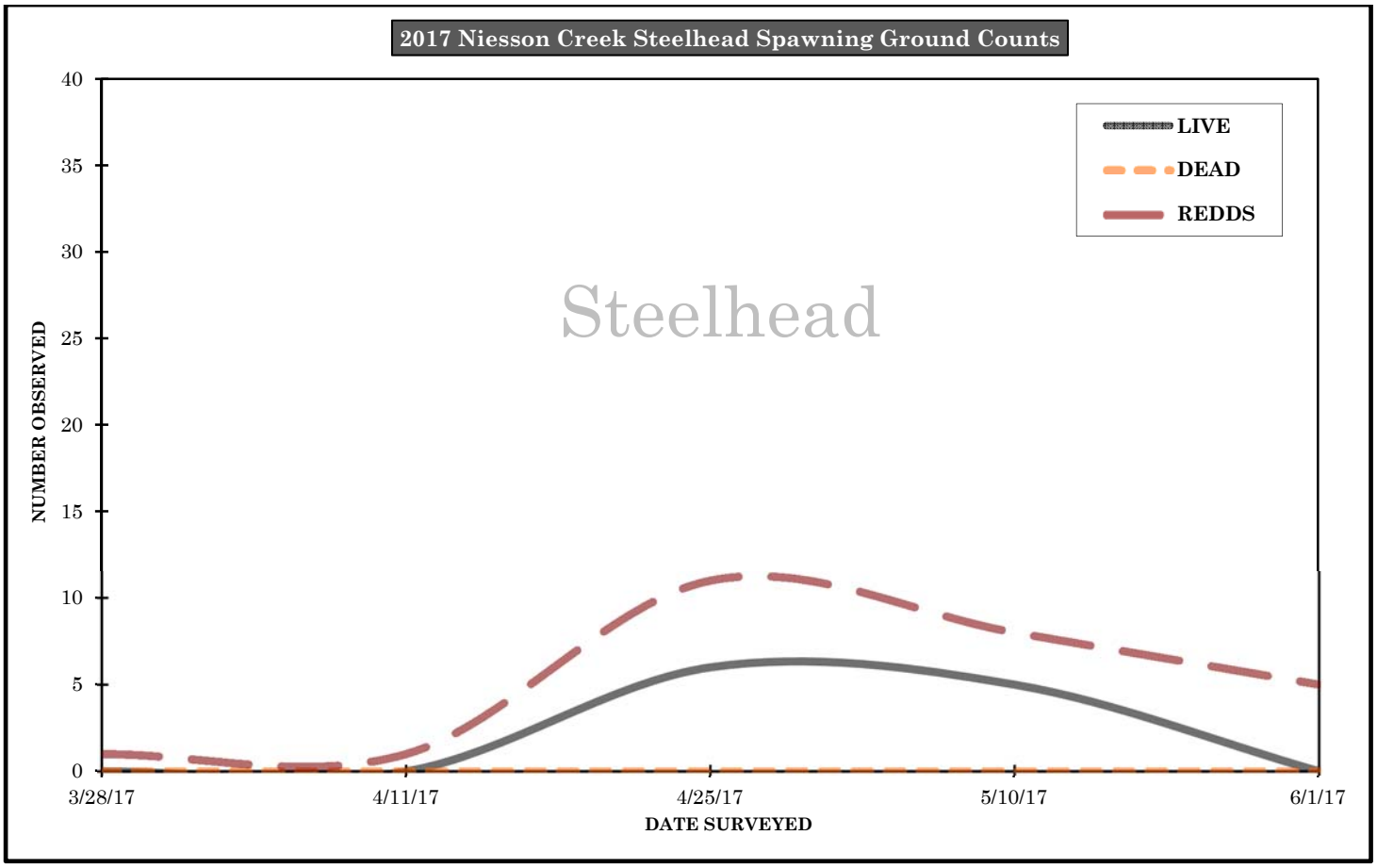
Niesson is a complex, moderate sized stream, which varies between a pool-riffle and forced pool-riffle character. The creek contains excellent and frequent spawning gravel, as well as significant LWD and debris jams throughout the 2.2 mile anadromous reach.

Niesson Creek is surveyed consistently for wild steelhead and spot checked for coho. Steelhead have been observed spawning as high as RM 2.2 near the abandoned 22 Rd. Naturally returning coho were observed for the first time in 2002. The natural returns are a result of live adult plantings and juvenile acclimation projects conducted by the Puyallup Tribal Fisheries Department. Since 1998, the Puyallup Tribe has been transporting live surplus adult coho from the WDFW's Voights Creek Hatchery in Orting; however, no fish were planted in 2004 or 2007. Instead, naturally retuning adult coho were allowed to spawn without intrusion from hatchery planted coho. Adult surplus Fall Chinook have been planted in the past when fish were available and creek flows allowed; unfortunately, the creek flow can be too low to allow naturally returning Chinook access to the creek in late summer and early fall.

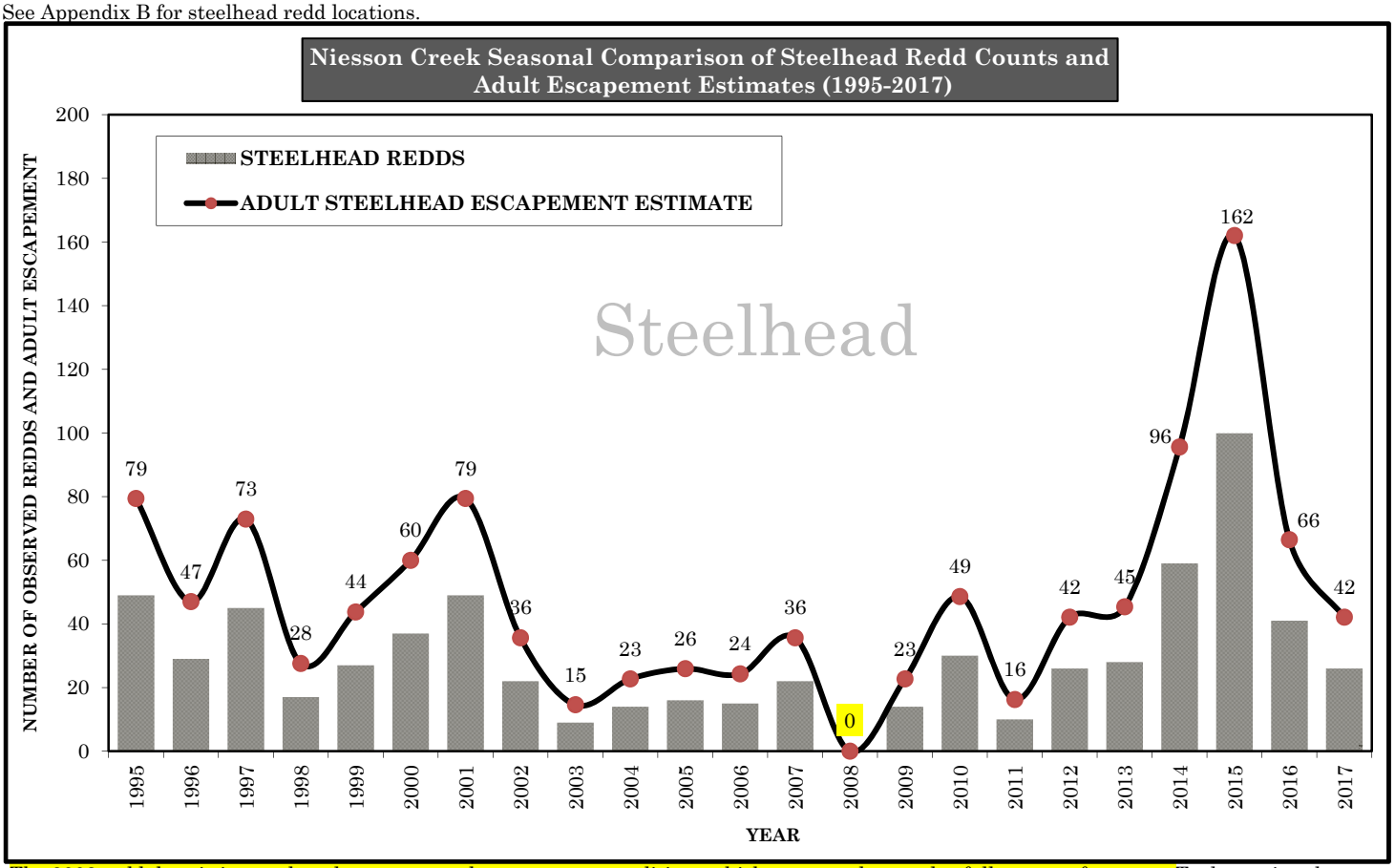


Upper Niesson

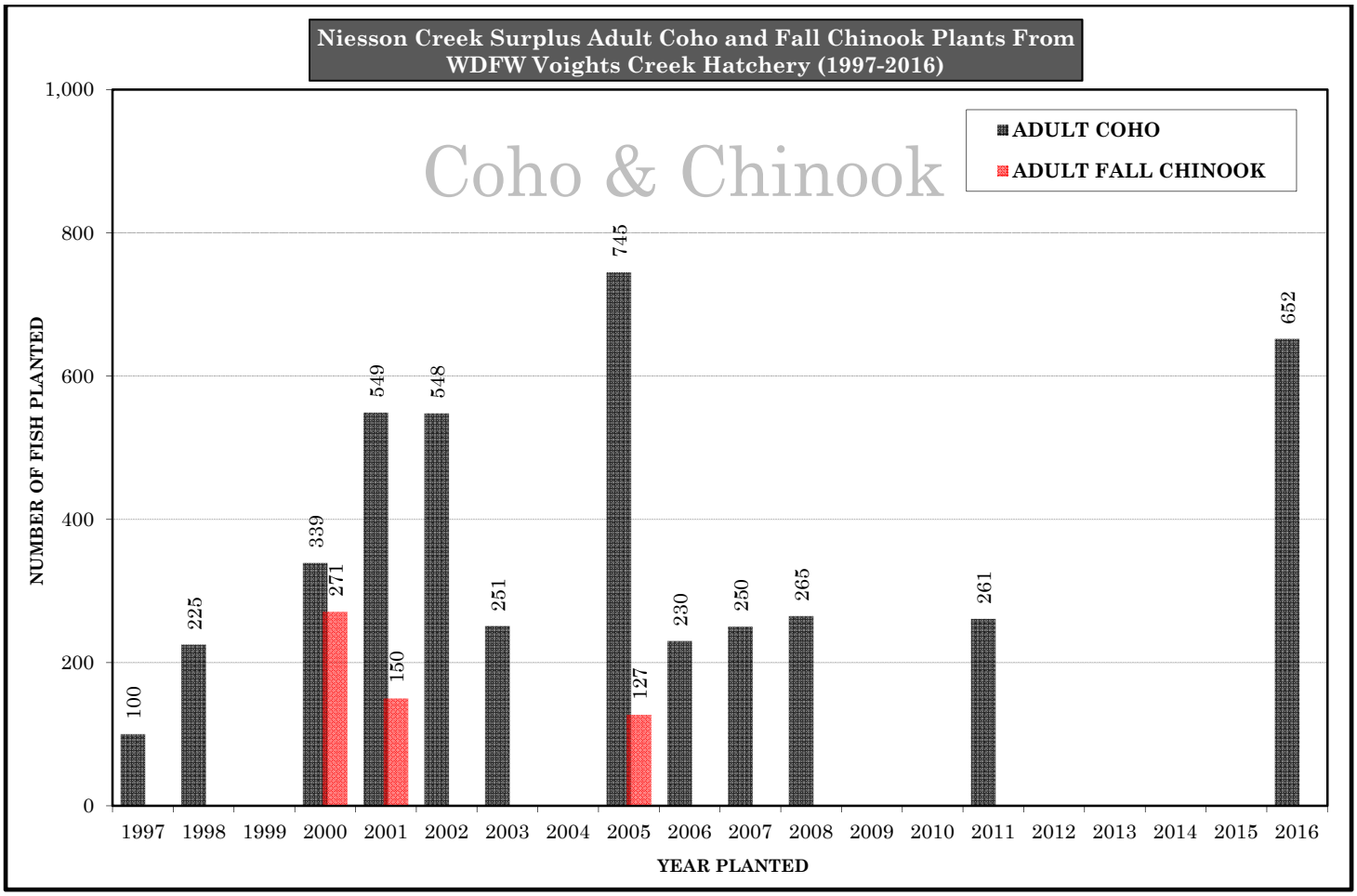
Like Kellog and Le Dout creeks, the mouth of Niesson Creek is located downstream of the Electron diversion dam. Flows over the past century have often been high enough during late winter and spring to prevent the mainstem channel of the Puyallup River from being drawn dry; the higher winter/spring flows have thereby allowed wild steelhead to maintain a foothold in Niesson Creek. Unfortunately, escapement in Niesson has decreased significantly over the past several years. The winter steelhead stocks in the Puyallup basin have been declining since 1990. The precipitous decline within the past several years has created serious concern among fisheries managers. Factor(s) responsible for the decline in steelhead escapement are unknown, especially when other salmon species are experiencing relatively good success. Unlike the White River, there are currently no enhancement or supplementation programs for steelhead on the Puyallup River.



See Appendix B for steelhead redd locations.



The 2008 redd data is incomplete due to extremely poor survey conditions which prevented a regular full season of surveys. To determine the total escapement for steelhead, each redd is multiplied by a factor of 1.62 *(i.e. 42 redds x 1.62 steelhead per redd = total escapement of 68 steelhead).* See steelhead redd location map in appendix B.



Surplus coho adults provided by WDFW Voights Creek Hatchery when available. No data indicates no fish were planted.

NO NAME CREEK

WRIA 10.0364

Bull trout in No Name Creek

NO Name is not the officially designated name for this stream as established by the Washington State Board on Geographic Names; however, it's regularly referred to as "No Name Creek" by PTF staff *(NPS designation w14-00a)*. No Name is a small south facing left bank headwater tributary of the White River; at nearly 3.5 miles in length, only the first 0.7 miles offers exceptional habitat conditions for rearing and spawning. The creek supports all bull trout life history stages, as well as residential and fluvial life history types. No Name is surveyed for bull trout from late August through early October; unfortunately, the creeks 3300' elevation is likely too high for Chinook, coho and pink salmon. No Name Creek, like Klickitat Creek, is pristine in many ways. Originating along the slopes of the Sourdough Mountains near Sunrise Park, the creek flows entirely within Mt. Rainier National Park. No Name Creek enters the White River north of Sunrise Park Road at approximately RM 68.1.

The first 0.34 miles of the creek is low gradient and flows within the channel migration zone of the White River *(photo on following page)*. The habitat within this section is the least conducive to spawning due to a primarily sandy substrate; however, pools and side channels provide excellent habitat for juvenile bull trout which are often observed in the pools and lateral habitat during adult spawning surveys. In addition, this reach of the creek is highly subjected to the possibility of redd scouring or heavy silt deposition due to the influence of the mainstem White River.

The next 0.12 miles flows through the edge of the forested area along the White River channel. At this point the channel gradient increases slightly, as do the spawning opportunities. Although the substrate throughout this section is somewhat sandy, several pockets of suitable spawning gravel exist. Stream complexity increases due to some small debris jams and limited LWD. The surrounding riparian consists of primarily alder with some small to moderate sized Douglas fir and cedar; even so, solar exposure is still high through this portion of the creek.

The final quarter mile of anadromous usage contains the best habitat. The channel contains several pieces of LWD and spawning gravels, in addition to a heavy riparian zone consisting of fir and cedar. At approximately RM 0.71 the creek turns sharply and rapidly climbs up the valley wall. At this point the stream quickly develops into a series of impassable cascades preventing any further upstream migration. Bull trout have been observed spawning in the creek from late August through September.

Juvenile bull trout

In 2006 and 2007, PTF biologist conducted extensive bull trout radio telemetry and redd surveys along the upper White River; focusing heavily on the headwaters located within Mt. Rainier National Park. During the 2007 season, several bull trout were observed

spawning in No Name Creek from early to late September. One of the bull trout observed spawning in the creek was part of the migration telemetry study. This bull trout was surgically implanted with LOTEK® Wireless Inc.'s Nano Tag Series transmitters *(NTC-4-2L)* and released near the Greenwater River (*RM 45*) in late June, and was observed spawning in late September.

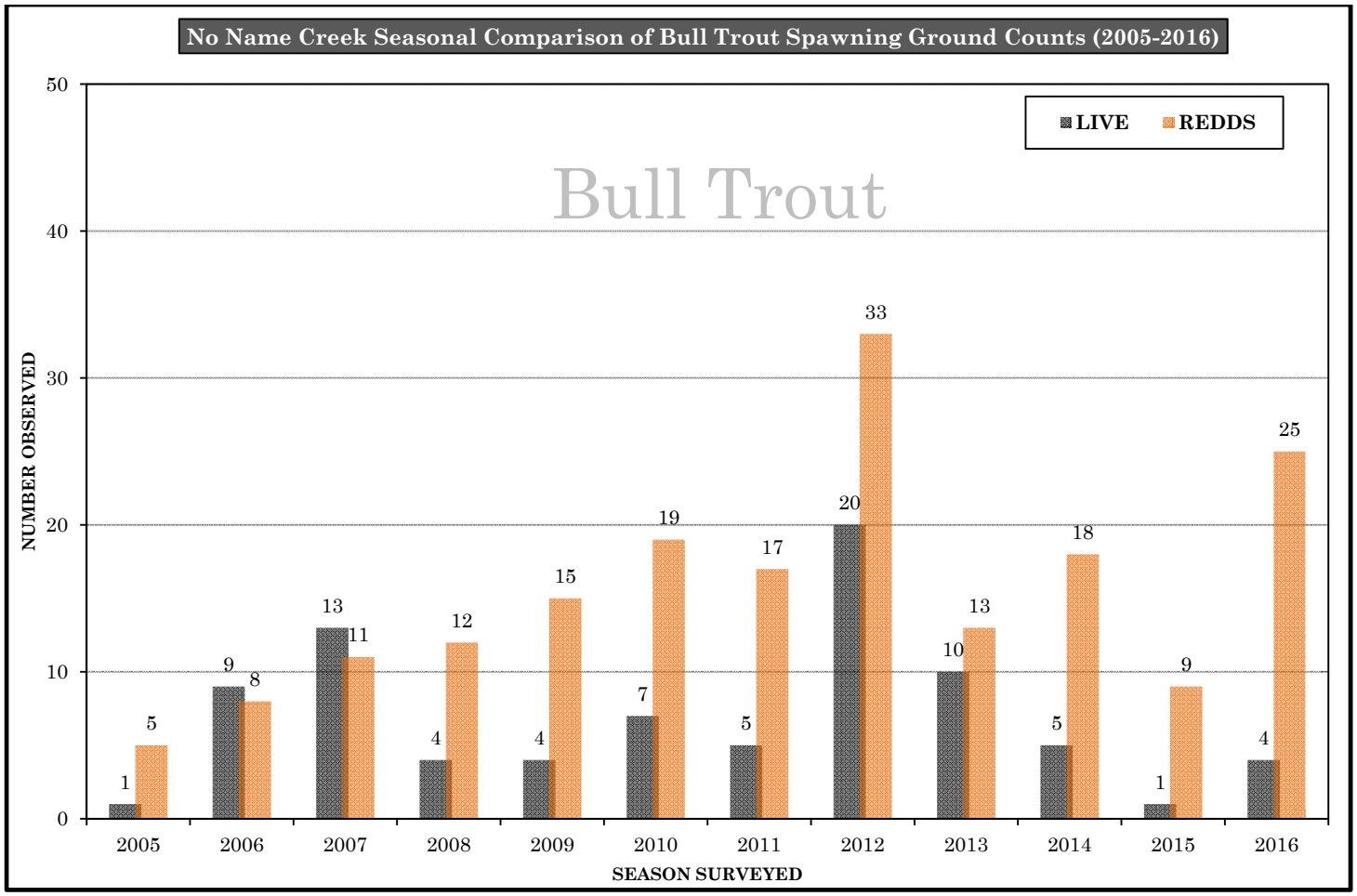
Resident bull trout reside in smaller headwater tributaries, while fluvial bull trout frequently travel long distances; utilizing the mainstem rivers and larger tributaries to forage and overwinter. During the fall, migratory forms of bull trout journey from spawning and rearing habitats in the upper watershed to foraging and overwintering habitats located lower in the river system. Beginning in spring and early summer, they begin the return journey back to spawning and foraging areas high in the watershed. In response to changing habitat and reproductive needs, migratory bull trout in the White River travel up to 75 miles or more between the lower river and headwaters located in or near Mt. Rainier N.P. To accomplish this, bull trout require unobstructed migration corridors and connectivity of streams and rivers in order to provide them with access to spawning, rearing, foraging, and overwintering habitats.

Lower No Name Creek

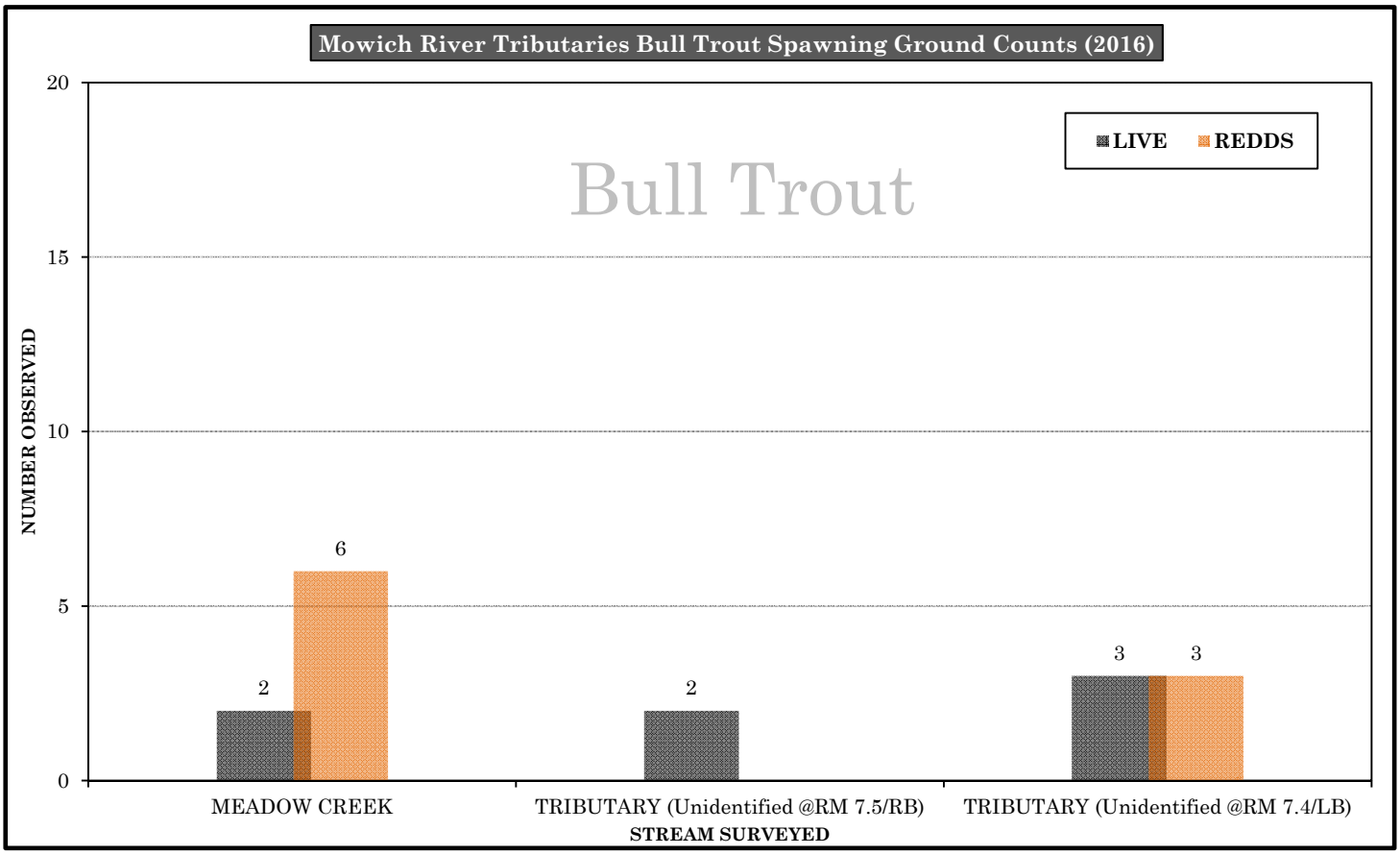
Bull trout spawning occurs primarily during the first three weeks in September, however, spawning has been observed taking place from the last week of August through the first week of October. Bull trout are iteroparous *(ability to spawn more than once)*; therefore, recovering pre-or-post spawn mortalities for examination is extremely rare. Spawners in the upper White River tributaries are observed utilizing various sized substrate from small gravels to small cobble. Redds are often constructed in the tail-out of pools and along channel margins. Embryonic development is slow *(depending on water temperatures)*; it may take between 165-235 days for eggs to hatch and for alevin to absorb their yolk (Pratt 1992). Bull trout fry emerge in late winter and early spring. Young fry can often be seen by mid-March foraging in the lateral habitat along the upper mainstem White River and associate tributaries.

Bull trout habitat throughout the Puyallup and White rivers has been severely impacted by over a century of land and water resource exploitation; including, damming and substantial water diversions, considerable riparian alterations *(deforestation)*, dewatering and low instream flow regimes, as well as significant channel manipulation. These impacts have lead to a marked deterioration in land and hydrological behavior within these river systems by causing water flow of poorer quality, quantity and timing. Several limiting factors are involved with regards to the healthy function of stream habitat and bull trout populations in the watershed; including lost or diminished habitat connectivity and migration corridors *(human-made fish passage barriers)*, fragmentation and reduction of habitat quality *(entrainment, transportation networks, forest management practices and operations, direct water withdrawal)*; in addition to, water quality, fish entrainment and entrapment, unknown species interactions, and potential climate change impacts *(changes in flow regimes, scour effects, thermal variations, changes in water chemistry)*.

Bull trout are primarily piscivorous *(fish eaters)*; however, they are opportunistic feeders, feeding on a variety of prey items depending on their particular life history strategy and stage of development. Adults feed almost exclusively on other fish, including a range of salmon and trout species; as well as other resident fish species. Juveniles feed on aquatic invertebrates, including stoneflies *(Plecoptera)*, caddisflies *(Trichoptera)*, and mayflies *(Ephemeroptera)*. Bull trout require a healthy aquatic environment in order to survive and flourish. They need an environment that provides the necessary prey base; in addition to the rearing and reproductive habitat essential to ensure their continued survival and reproductive success. The USFWS finalized bull trout recover plan is available at:https://www.fws.gov/pacific/bulltrout/pdf/Final_Bull_Trout_Recovery_Plan_092915.pdf



Raw spawning data for No Name Creek can be found in Appendix C. See Appendix B for bull trout redd locations.



OHOP CREEK

WRIA 10.0600

Coho

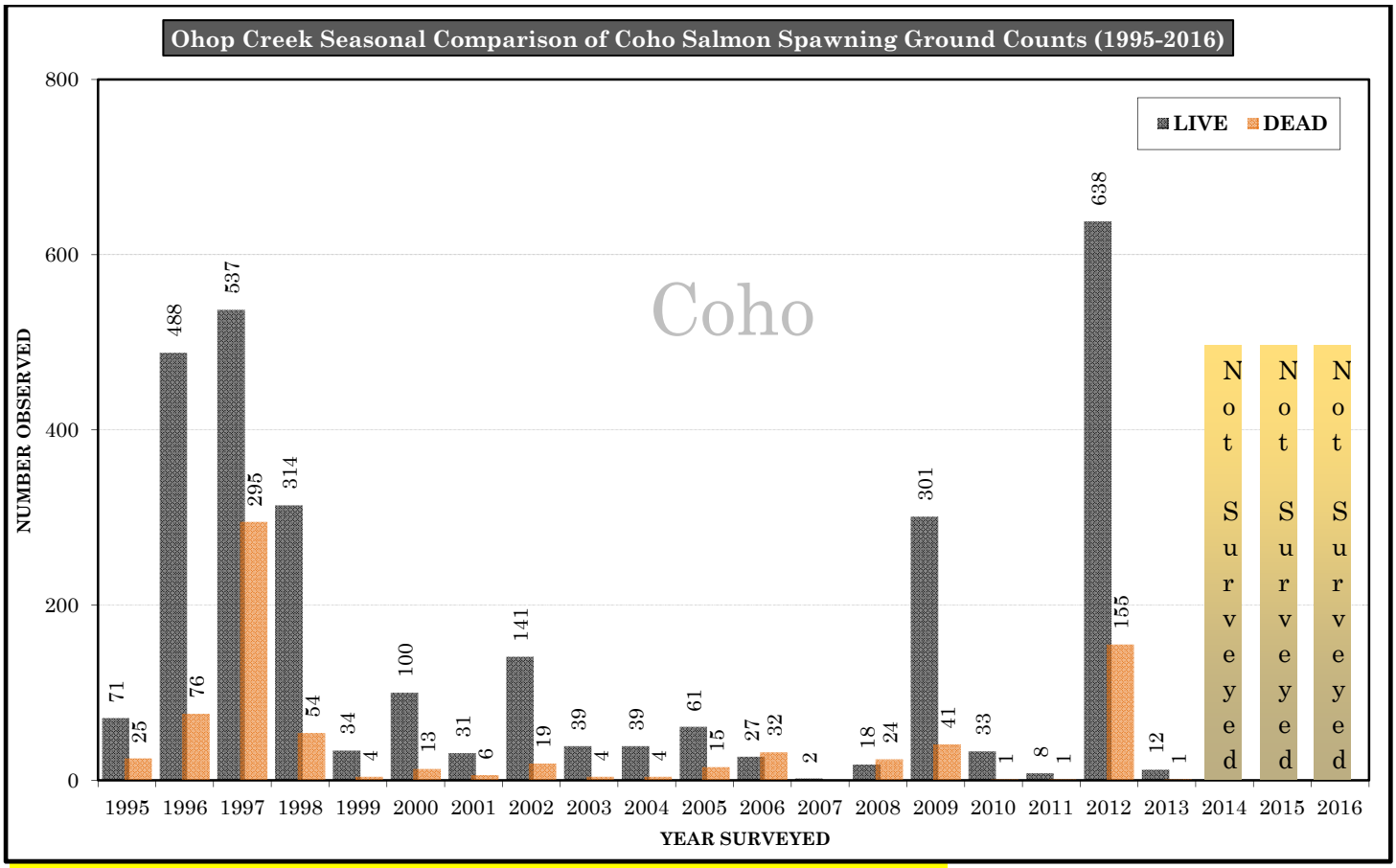
Ohop Creek is the primary feeder stream (*inlet)* to Lake Kapowsin; not to be mistaken for the Ohop Creek which is a tributary to the Nisqually. Ohop Creek and Kapowsin Creek share the same WRIA designation *(10.0600)*. Continuing for nearly 8.5 miles beyond Lake Kapowsin, the creek currently supports primarily coho *(top photo)*. In addition to coho, the creek likely continues to support a limited number of steelhead as well.

The lower 0.2 miles of Ohop Creek flows through a narrow and incised channel within the wetland boundary along the south end of Lake Kapowsin. This initial stretch is nonconductive to spawning and is heavily vegetated *(largely reed canary grass [Phalaris arundinacea])*, and is commonly the site of recurrent beaver (*Castor canadensis*) activity. From RM 6.5 to RM 7.0, the creek assumes a low gradient pool-riffle structure; containing excellent spawning gravel, as well as several deep pools and moderate amounts of in-stream woody debris. The channel meanders through a forest of cedar, fir, alder and maple that is fairly dense along much of the lower reach *(RM 6.5 to 8)*. Several side channels branch off along this reach, offering additional spawning and rearing habitat. High water events often reestablish some significantly long complex side channels located above RM 0.4. These side channels are often utilized by coho. Cattle occasionally have access to the creek, but they have had minor impact.

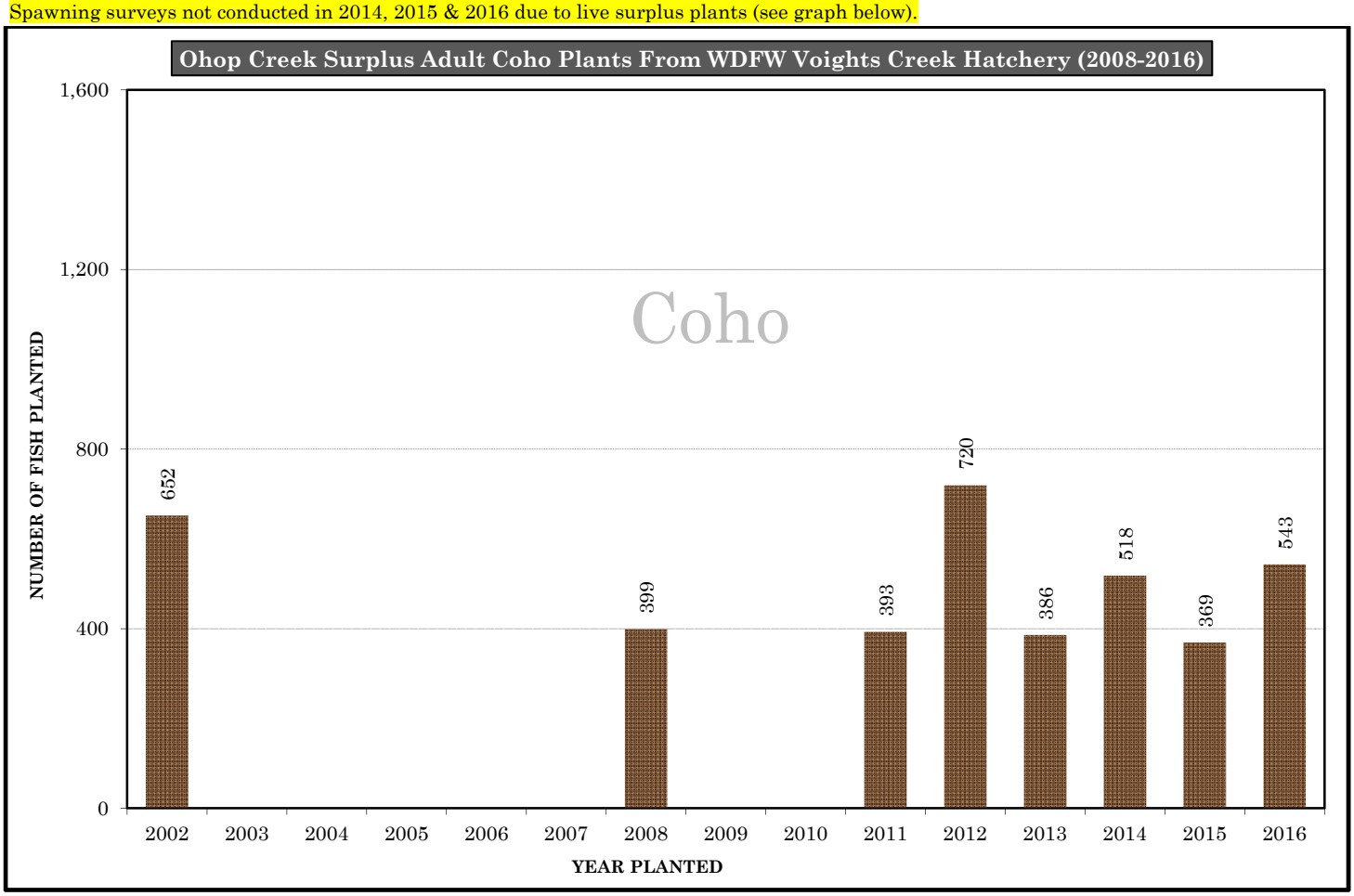
The upper reaches of Ohop Creek extend well into the Kapowsin tree farm currently managed by Hancock (*Hancock Timber Resource Group)*. Logging roads and timber harvesting have impacted several portions of the stream by way of; increased sedimentary inputs, windthrow, increased solar exposure, as well as confinement and constriction of the stream channel.

Coho are the only species surveyed for on a consistent basis. Despite the 3 year coho net-pen project employed in Lake Kapowsin by the Puyallup Tribe from 1995-1997, adult coho escapement has dropped in Ohop and Kapowsin creeks over the last two decade. Additional enhancement efforts are made seasonally to supplement the coho run by planting surplus adult coho, when available, from WDFW's Voights Creek Hatchery into Ohop Creek, where they are able to spawn naturally. Steelhead surveys have been reduced to periodic spot checks during the spring since none have been observed for several years. However, it's likely that a small number of steelhead may continue to spawn in the creek above the survey area since they are observed consistently in Kapowsin Creek.

The winter steelhead stocks in the Puyallup basin have declined since 1990. The decline has been a cause of concern among fisheries managers. The factor(s) responsible for the decline in steelhead escapement are unknown, especially when other salmon species are experiencing relatively good success. Although documented in Kapowsin Creek; Chinook, chum and pink salmon have not been observed in Ohop.



Spawning surveys not conducted in 2014, 2015 & 2016 due to live surplus plants (see graph below).



Surplus adults provided by WDFW Voights Creek Hatchery when available. No data indicates no fish were planted.

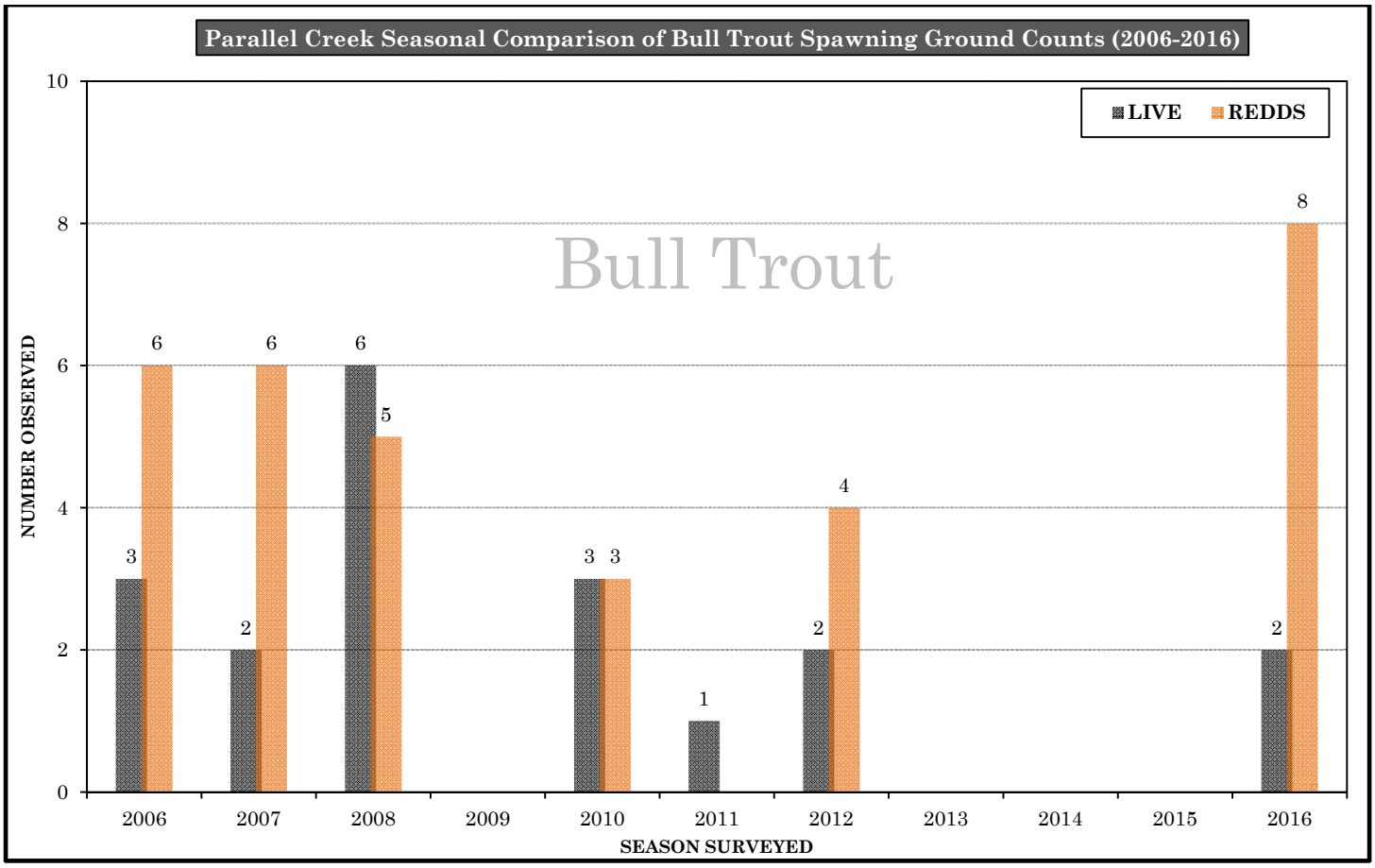
PARALLEL CREEK

Parallel Creek is not officially named by the Washington State Board on Geographic Names, nor is it identified on most topological or hydrological maps; however, for easy identification the creek is referred to as "Parallel" by PTF staff. Parallel is a small south facing left bank headwater tributary to the White River; with the lower 0.6 miles flowing parallel *(hence the name)* to the White River channel. Parallel Creek, like other bull trout streams such as Klickitat Creek and No Name, is pristine in many ways. The creek provides exceptional habitat conditions for bull trout *(bottom center)* rearing and spawning. Since 2006, the Puyallup Tribe has surveyed the creek for bull trout spawning activity from late August through early October, with peak spawning occurring around the third week in September. Unfortunately, the creeks elevation *(mouth @ 3290')* is likely too high for Chinook, coho and pink salmon. Originating along the slopes of Sunrise Ridge, the creek flows entirely within Mt. Rainier National Park, entering the White River approximately at approximately RM 67.9; which is directly across the river channel from Klickitat Creek.

Characteristic of many headwater tributaries, the mouth of the creek is frequently translocated due to its position within the open channel migration zone of the White River floodplain. As a result of the mainstem river incursions, the creeks lower channel and riparian habitat is frequently altered. The habitat within this section is the least conducive to spawning due to a primarily sandy substrate. In addition, this reach of the creek is highly subjected to the possibility of redd scouring or heavy silt deposition due to the influence of the mainstem White River.

Nearly the entire anadromous reach of the creek is low gradient, and the channel is somewhat narrow and incised. The surrounding riparian near the mouth consists primarily of alder *(pioneer species)* with some small to moderate sized Douglas fir and cedar; even so, solar exposure is still low through this portion of the creek during the summer. The approximately 0.5 miles of stream channel upstream of the mainstem area of influence flows through a heavily forested area along the White River channel. Stream complexity within this section increases due to small debris jams and moderate amounts of LWD. Throughout the majority of the anadromous reach, the channel gradient remains low as the stream meander significantly through the forest. Due to the low gradient and tranquil flow throughout this reach, the substrate consists mainly of fine material; however, several pockets of suitable spawning gravel exist, providing adult spawning opportunities *(center)*. At approximately RM 0.6 the creek rapidly climbs up the valley wall. At this point the stream quickly develops into a series of impassable cascades preventing any further upstream migration.

Spawning bull trout



2016 Parallel Creek bull trout survey data was collected collaboratively by PTF and NPS biologists. See Appendix B for bull trout redd locations, and Appendix C for spawning data.

PINOCHLE CREEK

WRIA 10.0198

Pinochle Creek is a moderate sized tributary to the West Fork White River, located on the left bank at RM 6.8, and flows within USFS Snoqualmie National Forest management area. Coho are the most abundant and common species observed in Pinochle Creek. Other species known to utilize the creek include Chinook, coho, pink, sockeye, cutthroat and steelhead/rainbow. Bull trout utilization is unknown but presence is presumed since the species is present in the West Fork White River and other West Fork tributaries. Low flows can make it problematic for Chinook to access the creek in August and September to spawn; as a result, Chinook escapement in Pinochle is often low or absent. A bedrock falls about 0.3 miles upstream of the bridge over Pinochle blocks further upstream migration. From the falls, to the confluence with the West Fork, there exists excellent spawning and rearing habitat for all species. The channel is low gradient, unconfined, and pool-riffle in character with. In addition, there is abundant woody debris from the surrounding old-growth forest. Wrong Creek and Pinochle Creek are two small tributaries to Pinochle, entering near RM 0.2.

In the past, Pinochle was surveyed for adult salmon escapement; unfortunately, flood damage to Forest Service Road 74 has prevented access to the creek since 2006; so, no escapement surveys or fish plants in the nearby acclimation pond located on Cripple Creek have occurred since. When escapement surveys were conducted, coho were often observed each season holding in two large pools just below the confluence with Pinochle and Wrong Creeks. Many of these coho would ascend Cripple and Wrong a couple of weeks after entering Pinochle. Spawning activity for all species occurs predominately within in the lower 0.2 miles. Prior to 2006, the creek was a popular recreational site; unfortunately, this often had a negative impact on the creek including human biological waste, trash and toxic materials; as well as human made anadromous blockages and fish harassment.

All adult salmon that spawn in Pinochle Creek were originally captured at the USACE fish trap in Buckley, and transported above Mud Mountain dam. Specific escapement numbers for the upper White River drainage are known; therefore, surveys were conducted to determine fish distribution and spawning success. This is especially important regarding Spring Chinook, since adult production monitoring is part of the White River Spring Chinook Recovery Plan. Also, as part of the recovery plan, the Puyallup tribe operated a Spring Chinook acclimation pond located at RM 0.3 on Cripple Creek. Spring Chinook were reared and released from Cripple Creek for several years *(1994-2006)*. Approximately 50,000 plus Spring Chinook from the Muckleshoot White River hatchery were transported annually to the Cripple Creek acclimation pond in early spring, and released in late spring. Returns to Pinochle; as well as Cripple and Wrong creeks, are likely associated with these earlier plantings. The current state of the acclimation pond is unknown; however, when access is reestablished, it is anticipated the pond can be reutilized and spawning escapement surveys will resume.

PUYALLUP RIVER

WRIA 10.0021

The Puyallup Watershed is identified as Water Resource Inventory Area 10 *(WRIA 10)* by the Washington State Department of Ecology. The Puyallup River Watershed provides over 1,300 linear river miles *(RM)* of drainage over an area greater than 1,000 square miles. The three major river drainages include the Puyallup, White, and Carbon rivers which flow almost entirely within Pierce County and part of South King County. All three river systems originate from glaciers along the north and west slopes of Mt. Rainier, located entirely within Mt. Rainier National Park. The Carbon and White rivers converge with the Puyallup River at RM 17.8 and RM 10.4 respectively. *The availability and nature of fish and stream habitats are not static conditions and are frequently altered. The habitat descriptions in this report provide a general analysis of habitat conditions, and are not intended to fulfill the requirements of a rigorous biological assessment/evaluation.* The White River is a significant tributary, with a drainage area larger than the Puyallup River. However, the White and Puyallup drainages are often viewed and managed as two distinct and separate entities. This management approach is due in part because prior to 1906, the White River did not flow into the Puyallup. Salo and Jagielo (1983) described that prior to 1906; the majority of the White River flowed north towards Elliot Bay. Yet, some of the water from the White often flowed south to the Puyallup through the Stuck River channel. In November of 1906, a flood event mobilized a tremendous amount of wood debris that blocked the north flowing channel in what is now downtown Auburn. The blockage forced the river to avulse and find a new channel. This newly created diversion sent nearly the entire White River flow down through the Stuck River channel into the Puyallup; more than doubling the size of the Puyallup River drainage. In 1915, a concrete structure was constructed, thereby permanently diverting the White River into the Puyallup.

The Puyallup River continues to flow west from its confluence with the White until it reaches Commencement Bay in Tacoma. An extensive system of levees, approximately 90 miles, was constructed along the Puyallup, White and Carbon rivers beginning in the early through mid-20th century. There are a significant number of large tributaries that feed these mainstem rivers including the Clearwater River, Greenwater River, Mowich River, Huckleberry Creek and South Prairie Creek.

In addition to the White River, the Carbon River is also key tributary of the Puyallup River, entering the Puyallup at RM 17.9; just north of the city of Orting. The Carbon River and its associated tributaries provide excellent spawning and rearing opportunities for salmon, steelhead, and bull trout. In the past, steelhead have been documented as high as the Mt. Rainier National Park boundary. However, the majority of spawning for all species within this drainage, with the exception of bull trout, occurs in South Prairie Creek and the lower 11 miles of the mainstem Carbon.

The mean annual flow of the Puyallup River over the first 86 year gauged history was 2,922 cfs. The largest flood of record was 57,000 cfs and occurred in December 1933. The majority of the large flood events have occurred in the months of November and December in response to heavy rains on a substantial snow pack. The minimum low flow defined as the 90%-exceedance level for the Puyallup was 1,156 cfs. Over the past two decades there has been a trend of decreasing low flows (Sumioka 2004). The Puyallup River at Puyallup flow gage

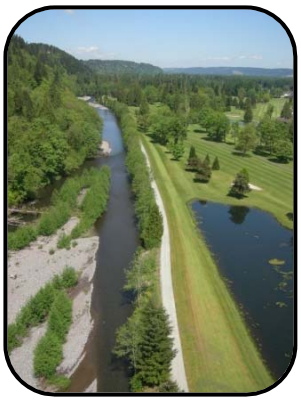
(#12101500) was activated in 1915 and is located at RM 6.6.

The systems glacial origin is responsible for the turbid conditions that are most noticeable during warmer weather in late spring and summer. The White, Carbon, and Puyallup rivers carry a tremendous volume of bed load material which contributes to the dynamic nature of the system. The high sediment loads are responsible for the anastomized channel morphology characteristic of broad valley segments. This condition is most prevalent in the upper reaches within and immediately outside the National Park boundaries.

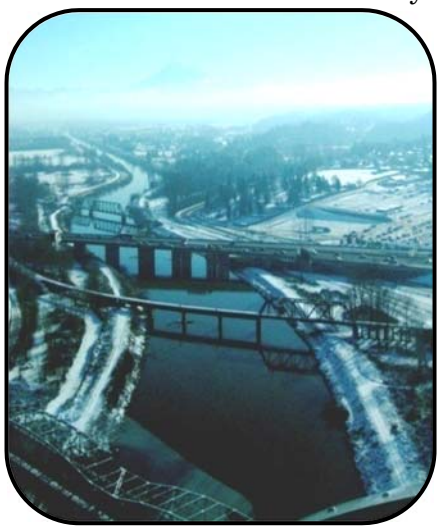
The Sha Dadx wetland restoration site *(Frank Albert Road)*.

Outside the Park boundaries, the rivers course through industrial forestlands including national forest but primarily private timber company ownership. Much of these forestlands have been harvested at least once and in many cases twice. Lands in timber production are densely roaded with some sections approaching six lineal miles per square mile. Roads have contributed to many of their trademark problems such as landslides, slope failures, altered hydrology, culvert and bridge projects that can effect upstream migration, and of course high levels if sedimentation within effected drainages.

The lowest section of the Puyallup River, from the confluence with the White River at RM 10.4 to Commencement Bay is confined by levees and the habitat lacks complexity *(lower left)*. The small amount of suitable gravel present is often compacted and offers little spawning opportunity. Steelhead have been observed spawning just upstream from the White River confluence; the lowest documented spawning of any species in the river. In the fall of 2008, the Puyallup Tribe completed construction of one of its most prevalent watershed restoration projects to date. The Sha Dadx *(Frank Albert Road-top left)* wetland restoration project, located on the lower Puyallup River, created an accessible 12-acre off-channel wetland habitat for salmonids and other freshwater resident fish. The project was instrumental in reestablishing an old disconnected oxbow and low lying wetland. The reclaimed habitat was lost during the construction of the lower river levee system in the early 1900's. In response to the loss of nearly an entire estuarine ecosystem that once existed, the creation of this critical and necessary lower river environment will provide overwintering, as well as foraging opportunities for young juvenile salmon. In addition, this habitat will offer the benefits that the estuaries once provided to out migrating *(smolting)* salmon during the transition from fresh water to salt water. An extensive side channel restoration project conducted by Pierce County near the community of Alderton, added over 4,000 linear feet of off channel fish habitat and flood protection. For more information about this restoration project, go to: **www.co.pierce.wa.us/southfork**.



Puyallup River near RM 20



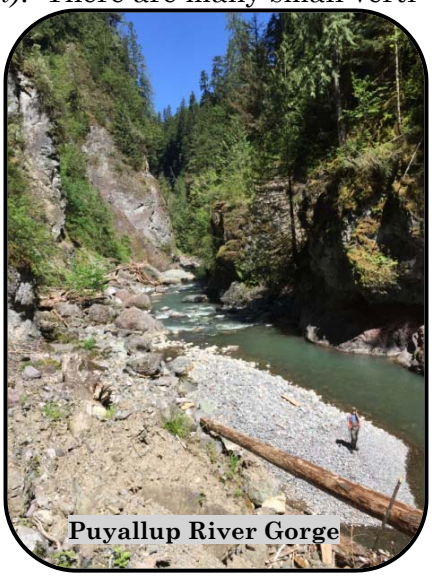
Lower Puyallup River @ I-5

The Puyallup continues to be tightly confined by levees on both sides with the expected lack of channel complexity *(center right)*. These levee constraints continue from the White River confluence to approximately RM 25, just south of the town of Orting. This reach is similar to the lower Puyallup, but does support sporadic spawning by chum, Chinook and steelhead during their respective seasons. Along Orville Rd., upstream of Orting, a levee setback project was completed in the summer of 1999. Approximately 2 miles of new levee was built back from the original levee, adding over a hundred acres

to the floodplain in this reach. In 2013, Pierce County completed the installment of a unique Engineered Log Jam *(ELJ)* revetment project in the Puyallup River along Orville Road *(RM 27)*. The ELJs utilize large concrete dolosse *(top left)* to tether large timbers and other woody material. Dolosse were used for the first time in 2009, to reinforce the North Levee on the lower Puyallup River in the city of Fife.

Lower Puyallup River dolosse

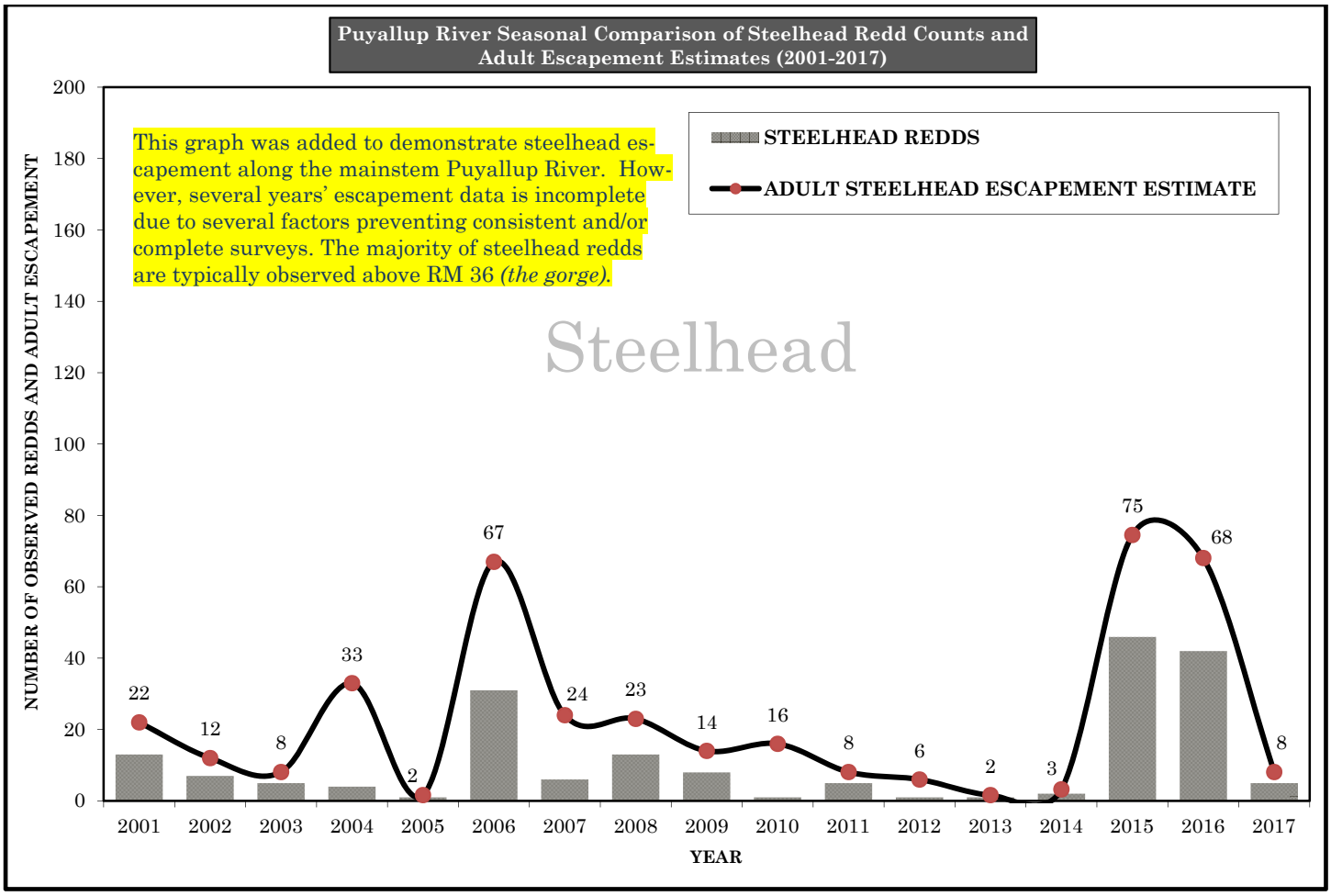
The Puyallup continues to be tightly confined by levees on both sides with the expected lack of channel complexity. These levee constraints continue from the White River confluence to approximately RM 25, just south of the city of Orting. This reach is similar to the lower Puyallup, but does support sporadic spawning by chum, Chinook and steelhead during their respective seasons. Along Orville Rd., upstream of Orting, a levee setback project was completed in the summer of 1999. Approximately 2 miles of new levee was built back from the original levee adding over one hundred acres to the floodplain in this reach. Several high water events later, many side channels have formed and spawning gravel has been retained. In late 2006, a 6,000 foot levee set-back was completed upstream of the Calistoga Bridge in the town of Orting. This set-back added over 55 acres to the floodplain within this reach. From RM 25.5 to 30.8 the channel is only partially contained by levees and there are several accessible side channels. There is little spawning activity within this reach due to the higher gradient and resulting increase in average substrate size. Upstream from Electron *Hydro's (formally owned and operated by Puget Sound Energy)* Electron powerhouse at RM 30.8 the river flows through a deep, narrow canyon *(right)*. There are many small vertical drops and bedrock cascades within this 6 mile canyon, all of which are passable to salmon and steelhead. There are frequent spawning opportunities in the tailouts of the many deep pools located within this upper river reach.


Puyallup River Gorge

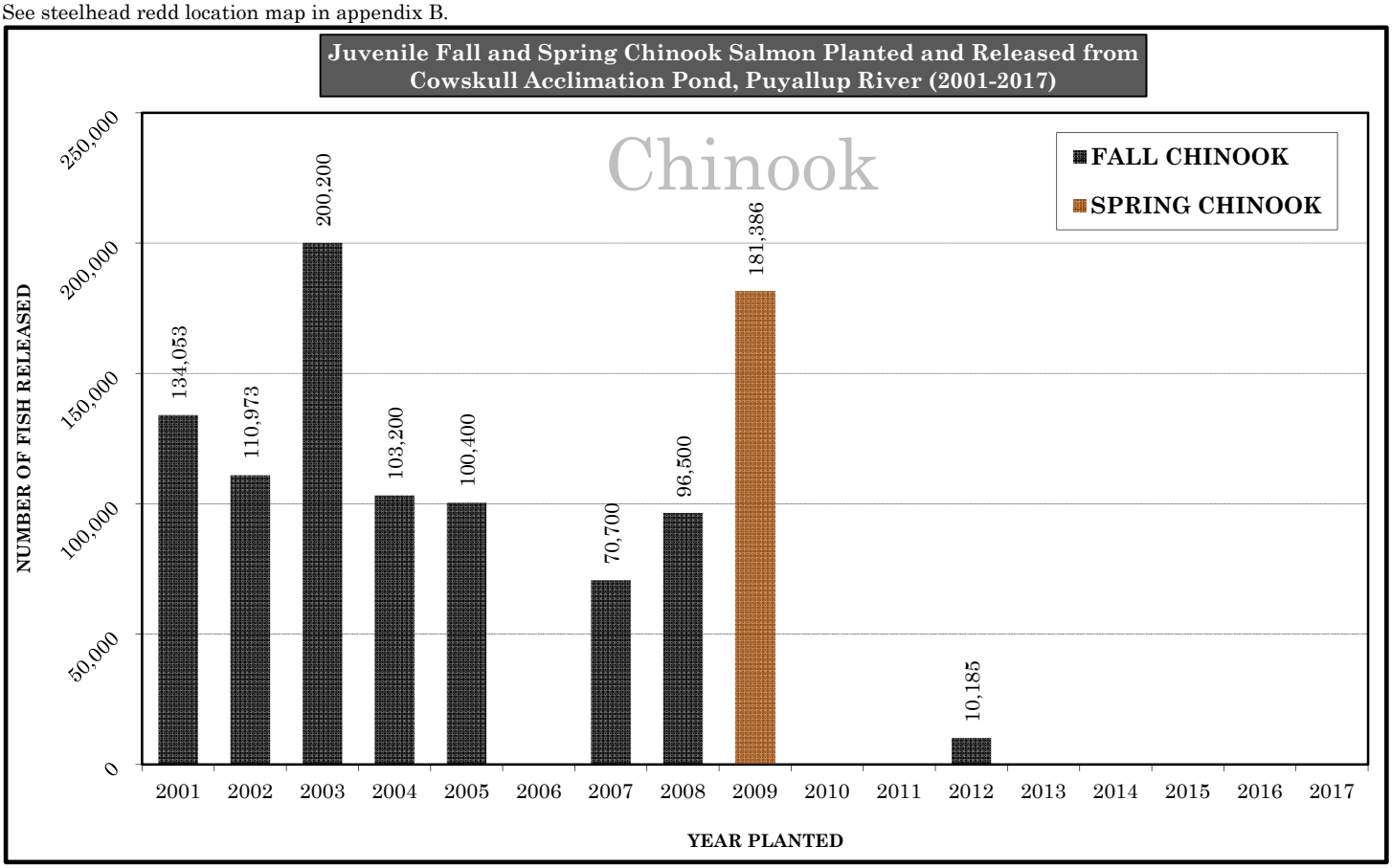
From the top of the canyon, to the diversion dam at RM 41.7, the river is moderately confined and provides several high quality spawning opportunities *(center left)*. The highest densities of steelhead spawning in the Puyallup River occur within this reach. With the completion of the Electron fish ladder *(RM 41.7 bottom)* in the fall of 2000, anadromous fish passage was restored for the first time since 1904. There are approximately 26+ miles of exploitable habitat above the diversion and surveys are conducted occasionally in response to the Puyallup Tribes live surplus Chinook and coho plants.

The Mowich River converges with the Puyallup River at RM 42.3; this is approximately 0.5 miles above the Electron diversion dam. The glacial headwaters of the Mowich River originate from the Edmunds, and the North and South Mowich glaciers on the west slope of Mt. Rainier. Significant tributaries to the Mowich include; Crater, Spray, Meadow and Rushingwater creeks. Species documented utilizing this basin include Chinook, coho, steelhead/rainbow, cutthroat and bull trout.

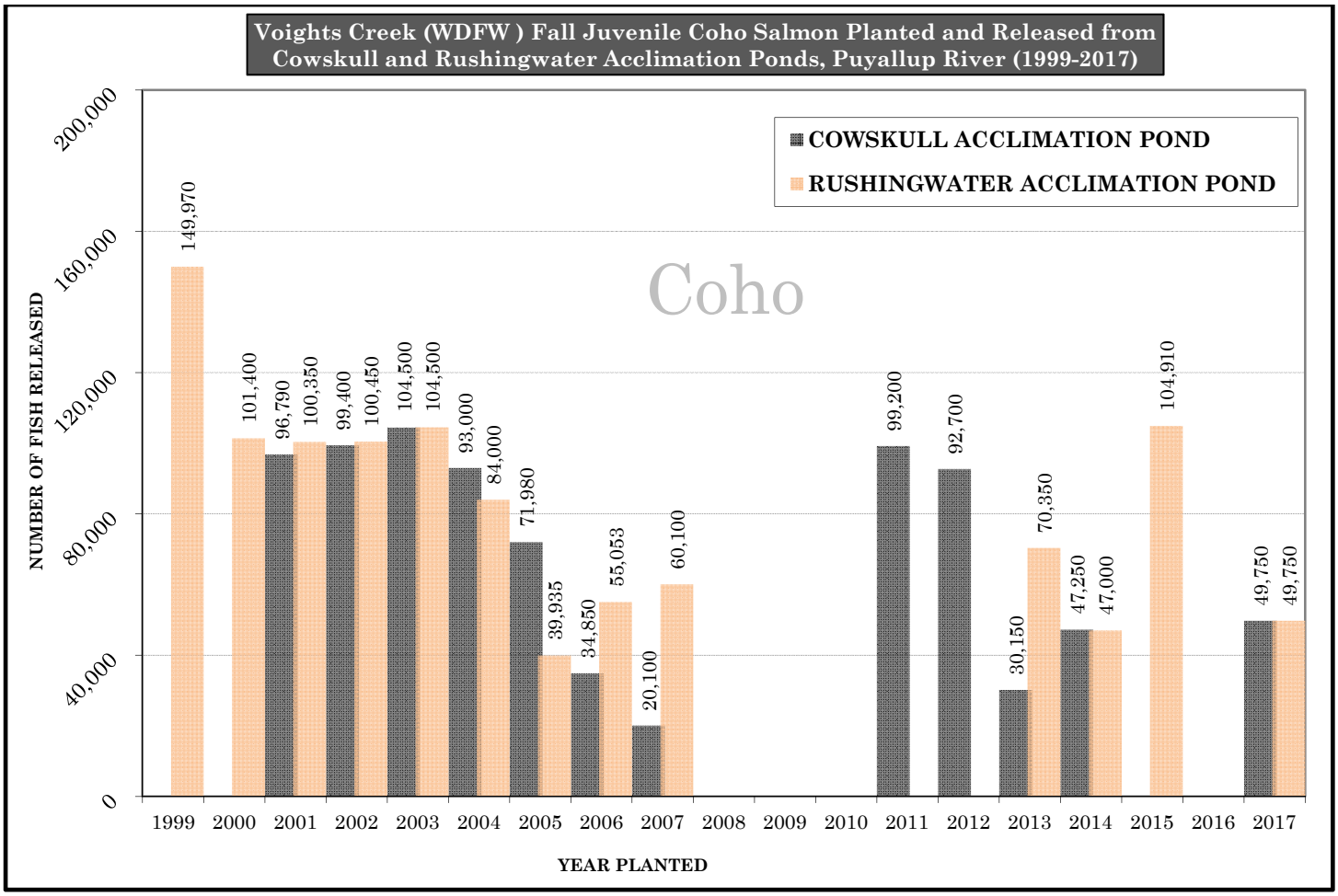
Electron fish ladder and division dam



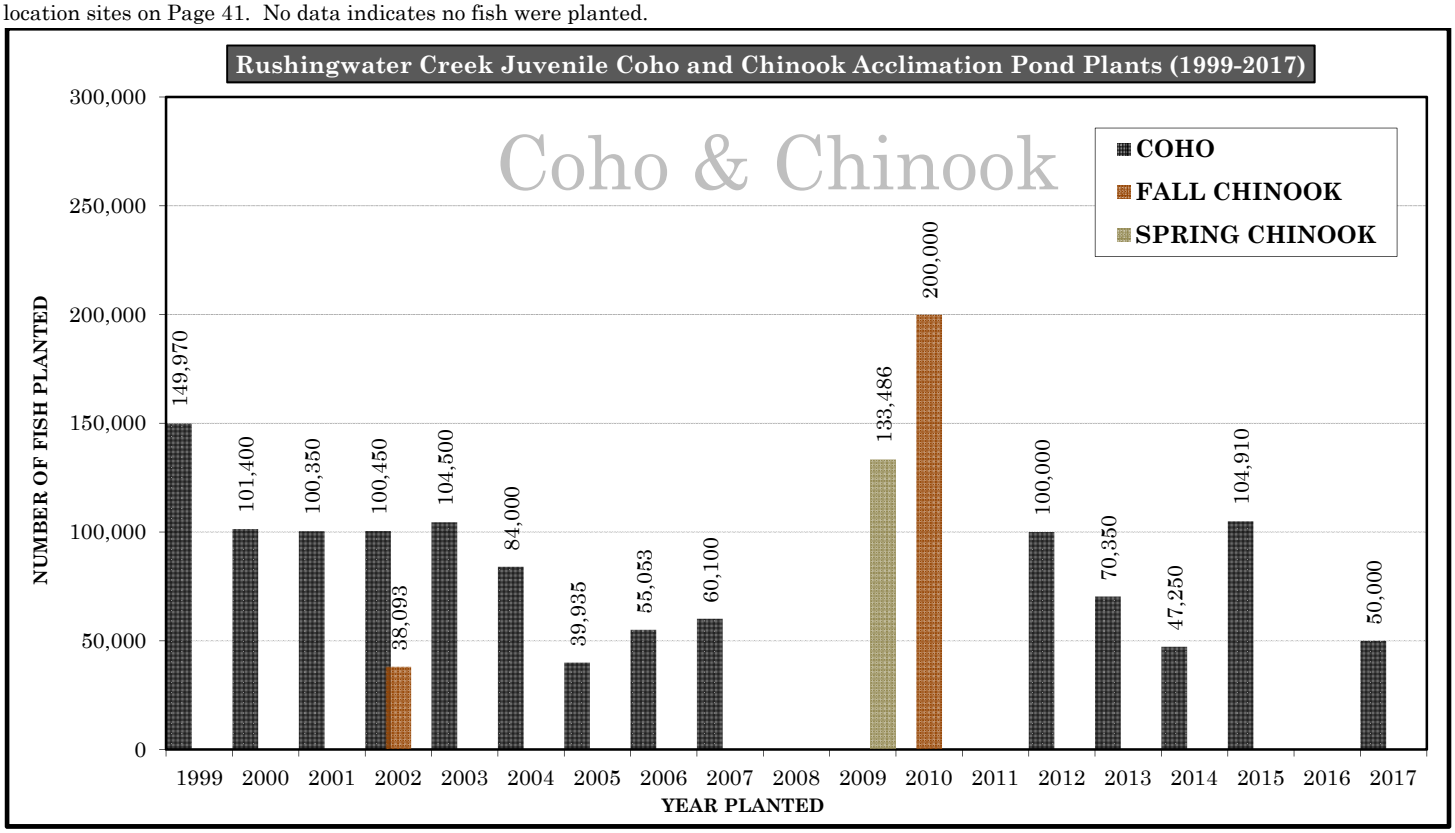
See steelhead redd location map in appendix B.



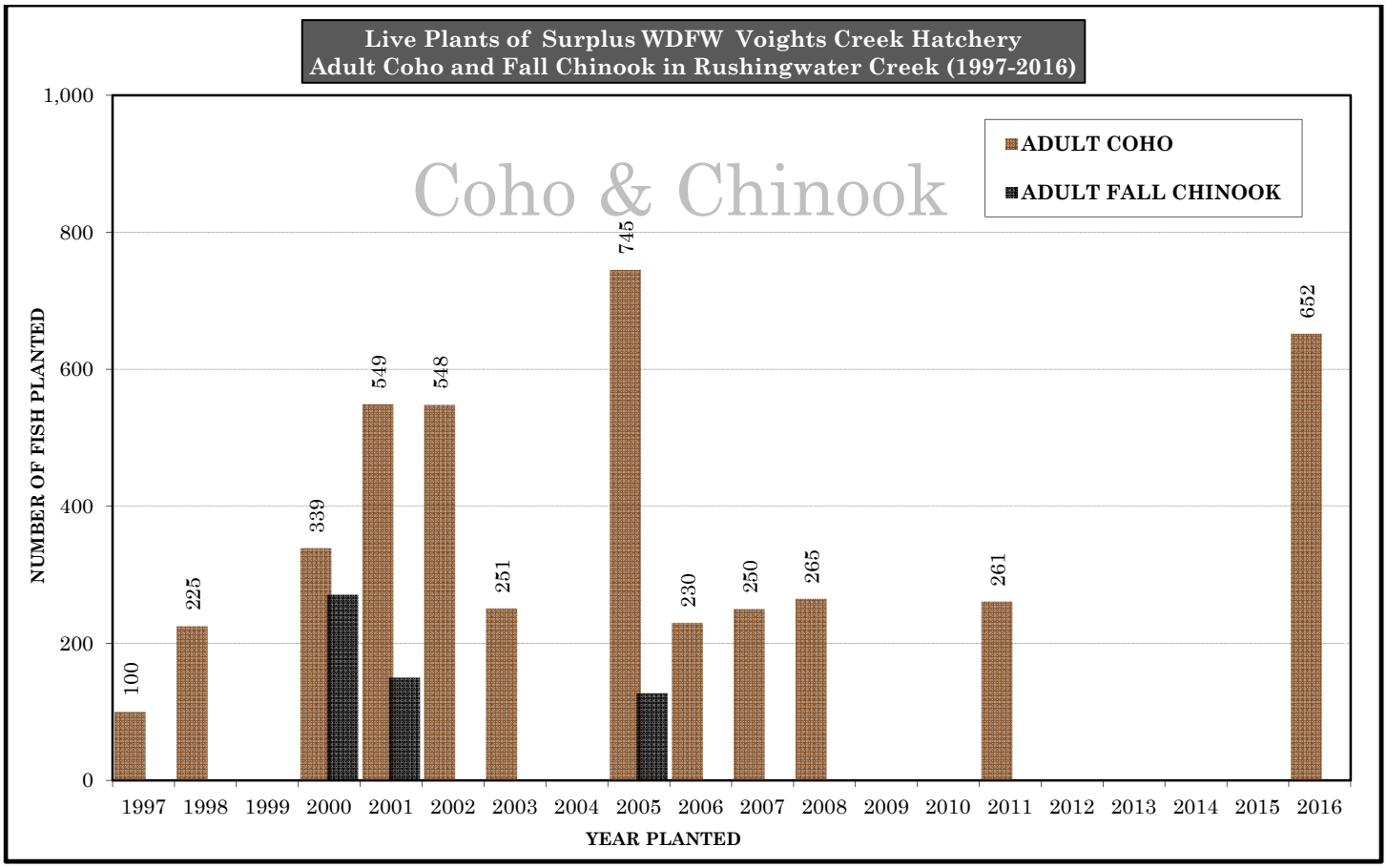
Acclimation ponds opperated by Puyallup Tribe. See map of acclimation pond location sites on Page 41. No data indicates no fish were planted.



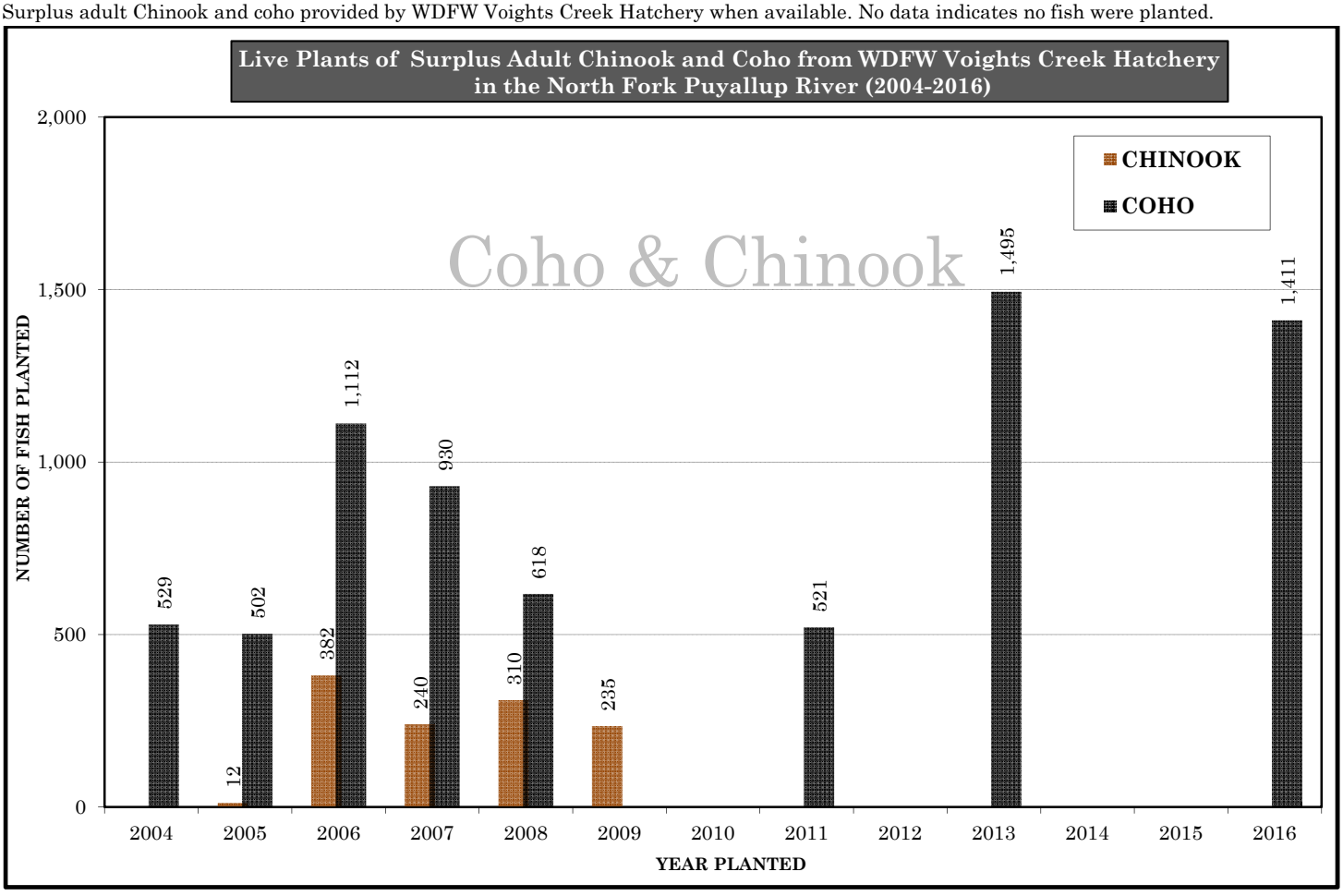
Coho provided by WDFW Voights Creek Hatchery when available. Acclimation ponds opperated by Puyallup Tribe. See map of acclimation pond location sites on Page 41. No data indicates no fish were planted.



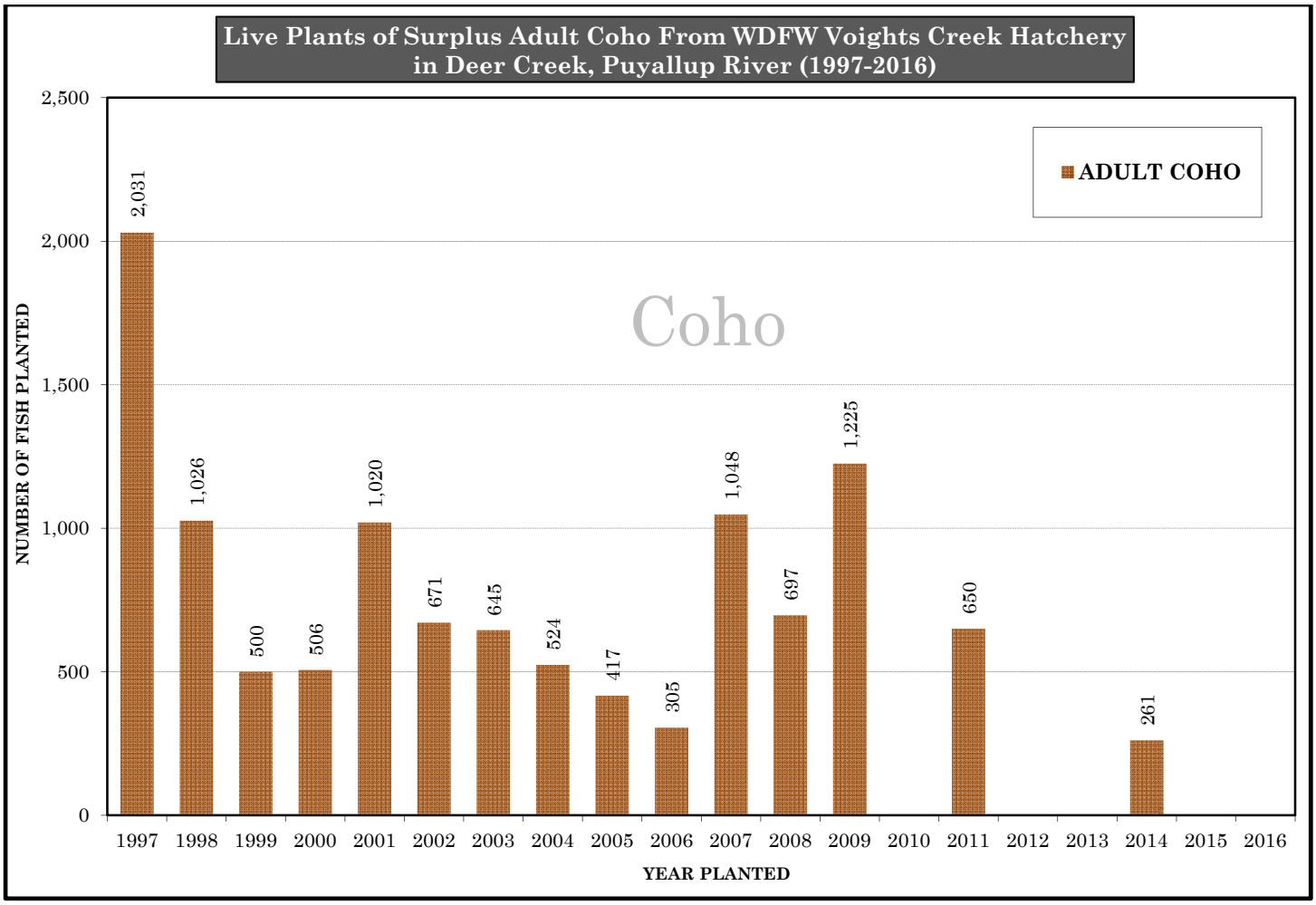
Coho provided by WDFW Voights Creek Hatchery when available. Acclimation ponds opperated by Puyallup Tribe. See map of acclimation pond location sites on Page 41. No data indicates no fish were planted.



Surplus adult Chinook and coho provided by WDFW Voights Creek Hatchery when available. No data indicates no fish were planted.



Surplus adult Chinook and coho provided by WDFW Voights Creek Hatchery when available. No data indicates no fish were planted.



Surplus adult Chinook and coho provided by WDFW Voights Creek Hatchery when available. No data indicates no fish were planted.

PUYALLUP RIVER
PRJSPA PROJECT

PUYALLUP RIVER JUVENILE SALMONID PRODUCTION ASSESSMENT PROJECT

Prepared by:Andrew Berger , Justin Paul & Julian Close

The Puyallup River Juvenile Salmonid Production Assessment Project began in 2000. The Puyallup Tribal Fisheries Department started the project to estimate juvenile production of native salmonids, with an emphasis on natural Fall Chinook salmon production and survival of hatchery and acclimation pond Chinook. In 2011, a newly constructed trapping platform employing an E. G. Solutions 8-ft diameter rotary screw *(formally 5')* was put into place on the lower Puyallup at RM 10.6, just upstream of the confluence with the White River.

As more data becomes available, juvenile production estimates may provide baseline information allowing managers to meet escapement objectives in the watershed create a production potential-based management strategy and accurately forecast future returns of hatchery and naturally produced adults. In addition, a basin spawner/recruit analysis will indicate stock productivity, helping to determine the overall health of the watershed and evaluate the contribution of enhancement projects.

Trapping Gear and Operations

The rotary screw-trap used in this study consists of a rotary cone suspended within a steel structure on top of twin, 40-foot pontoons. The opening of the rotary cone is 8 feet in diameter, allowing for a sampling depth of 4 feet. The cone and live box assembly are attached to a steel frame and may be raised or lowered by hand winches located at the front and rear of the assembly.

Three five-ton bow-mounted anchor winches with 3/8" steel cables were used to secure and adjust the direction of the trap and keep it in the thalweg. The cables were secured to trees on opposite banks.

The 8-ft diameter rotary screw trap was installed in the lower Puyallup River (RM 10.6) just above the confluence with the White River. Trap operation continue, when feasible, 24 hours a day, seven days a week throughout the trapping season. The trap was checked for fish twice a day at dawn and dusk. In some instances, the trap was checked plus or minus two hours of dusk or dawn due to the availability of personnel. During hatchery releases and high flow events, personnel remained onsite through the night to clear the trap of debris and to keep fish from overcrowding.

Revolutions per minute (rpm), water temperature, secchi depth (cm), turbidity (NTU), weather conditions, and stream flow (cfs) were described for each completed trap check. A cross sectional area of the river at the smolt trap was taken to monitor channel morphology at the site.

Goals and Objectives

The goal of this project is to report production estimates, characterize juvenile migration timing, describe length distribution for all wild salmonid, out-migrants and fulfill the objectives of the Puyallup River Fall Chinook Recovery Plan.
To reach these goals, this study will produce population estimates of out-migrating smolts, estimate species specific migration timing, compare natural versus hatchery production and run timing, analyze mean fork length of wild smolts and detail species composition of the sample population. The objectives of this project are to:

1. Estimate juvenile production for salmonids in the Puyallup River and determine freshwater survival for unmarked juvenile Chinook.

2. Estimate in-river mortality of hatchery and acclimation pond Chinook.

3. Investigate physical factors such as, light (day vs. night), flow and turbidity and their importance to trap efficiency.

Sampling Procedures

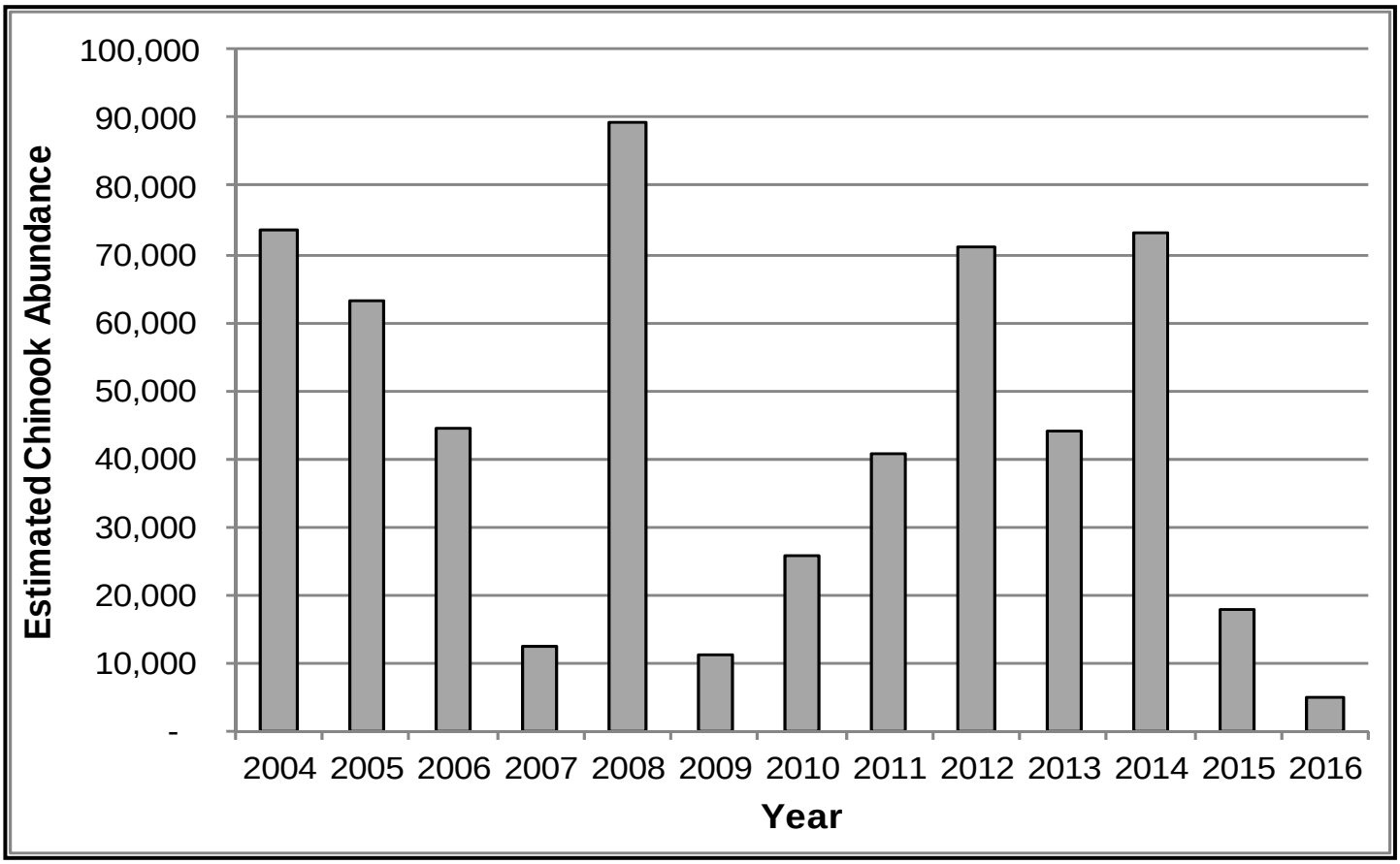
Smolts were anesthetized with MS-222 (tricaine methanesulfonate) for handling purposes and subsequently placed in a recovery bin of river water before release back to the river. Juveniles were identified as natural or hatchery origin as unmarked or marked respectively. Fork length (mm) was measured and recorded for unmarked fish. When possible, 50 chum, 50 pinks, 50 age1+ coho, 25 age 0+ coho, 25 age 0+ Chinook, and 25 steelhead were measured per day. Scale samples were additionally taken on all wild steelhead smolts.

Species were separated by size/age class. Coho were identified as fry, age 0+ (<70mm) or smolts, age 1+ (>70mm). Chinook smolts were separated by age 0+ (<150mm) or age 1+ (>150mm). All chum and pinks were identified as age 0+. Trout fry age 0+ (<60mm) were not differentiated to species.

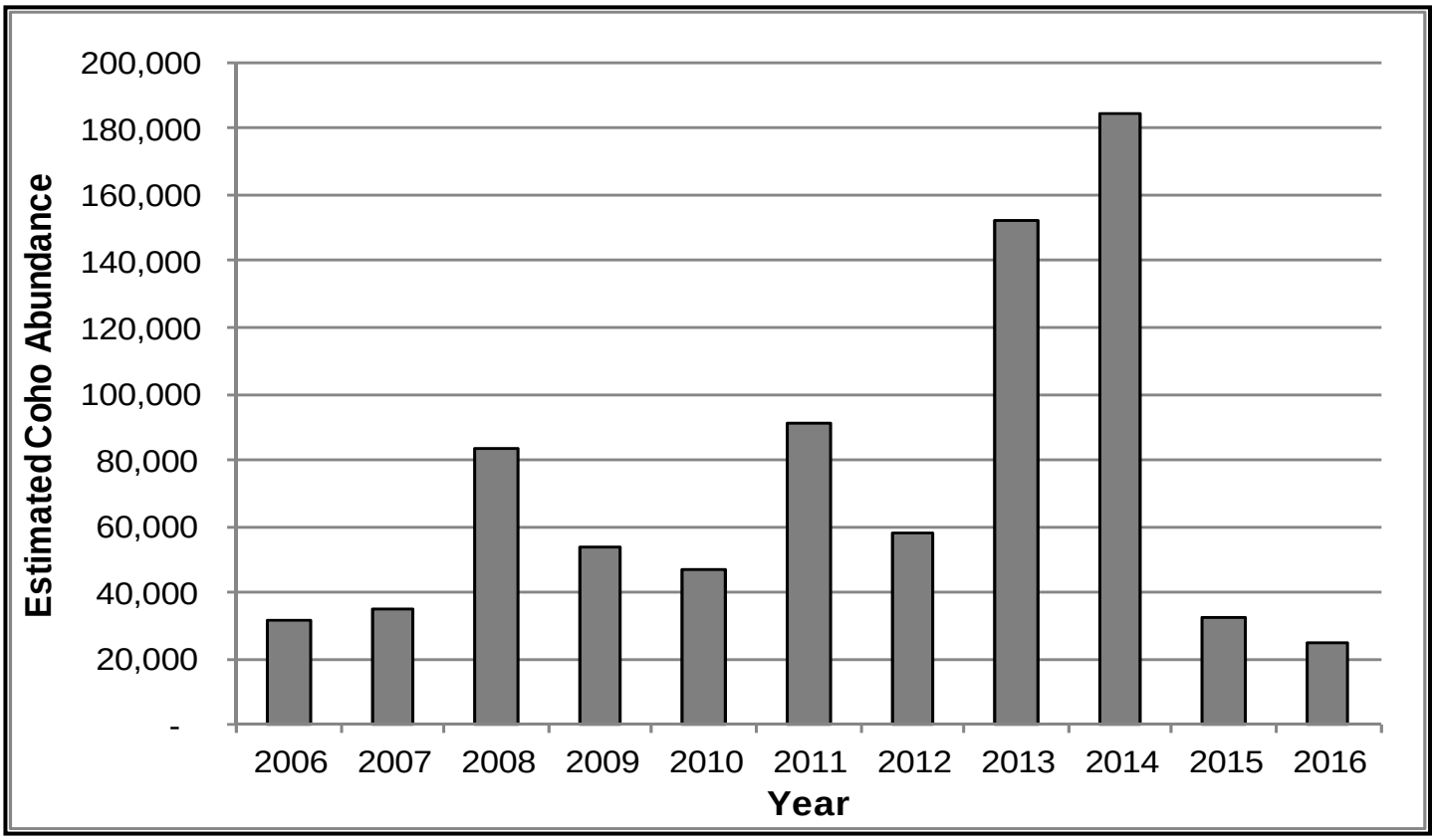
Hatchery origin fish were identified in three ways: 1) by visual inspection for adipose fin clips, 2) with a Northwest Marine Technology "wand" detector used for coded wire tag detection, and 3) with a Destron Fearing Portable Transceiver system for Passive Integrated Transponder (PIT) tagged fish.

To request a full copy of current or previous reports, contact:

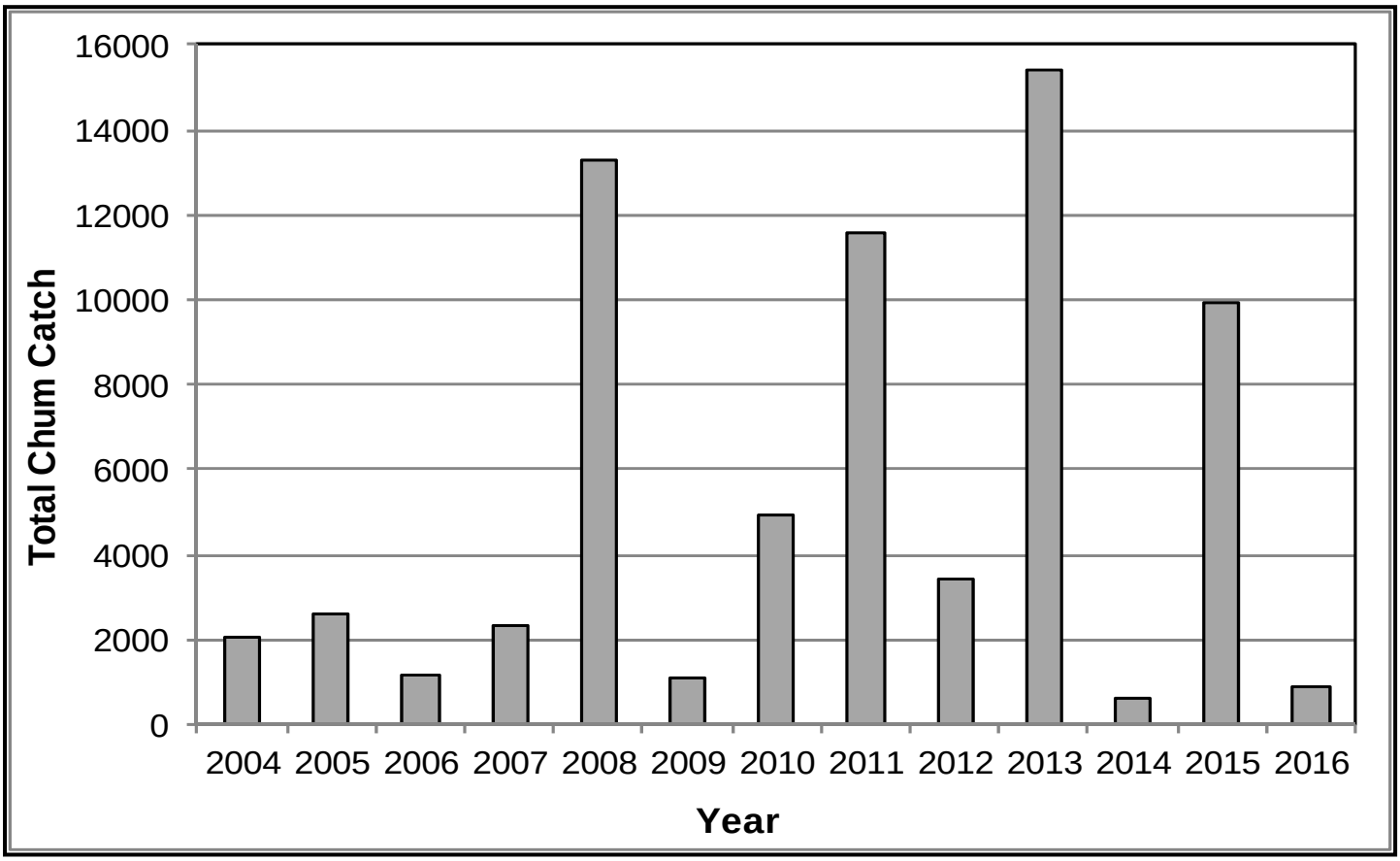
-Puyallup Tribal Fisheries Department
253-680-5560
-Andrew Berger: andrew.berger@puyalluptribe.com
253-680-5569.



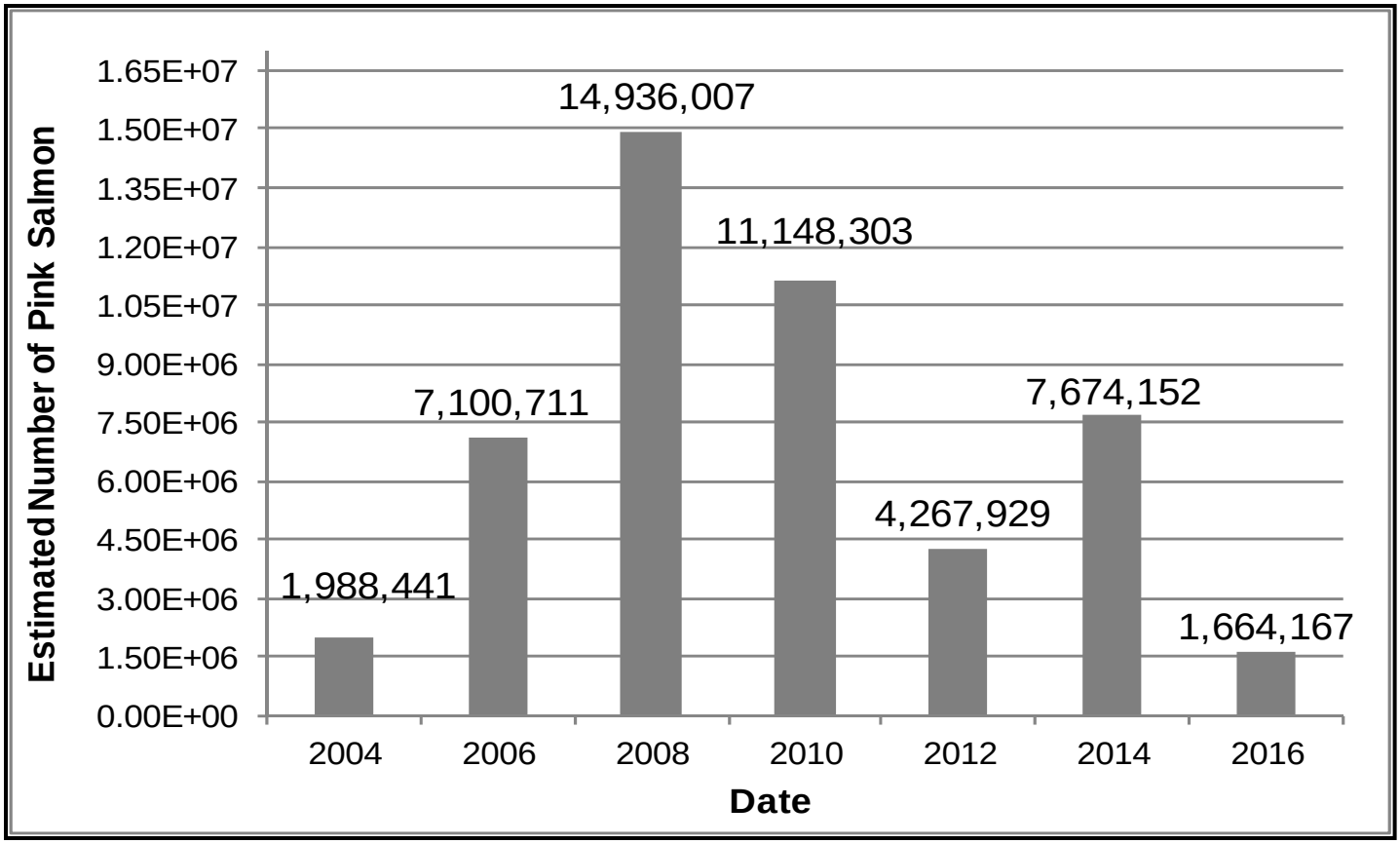
Annual production estimates of unmarked age 0+ Chinook smolts (2004–2016).
Source: (Berger et al. 2016) Puyallup River Juvenile Salmon Production Assessment Project 2016



Annual production estimates of unmarked age 1+ coho (2006–2016).
Source: (Berger et al. 2016) Puyallup River Juvenile Salmon Production Assessment Project 2016



Total number of Chum captured in the Puyallup River screw trap (2004-2016).
Source: (Berger et al. 2016) Puyallup River Juvenile Salmon Production Assessment Project 2016



Annual production estimates of pink smolts (2004–2016).
Source: (Berger et al. 2016) Puyallup River Juvenile Salmon Production Assessment Project 2016

RANGER CREEK

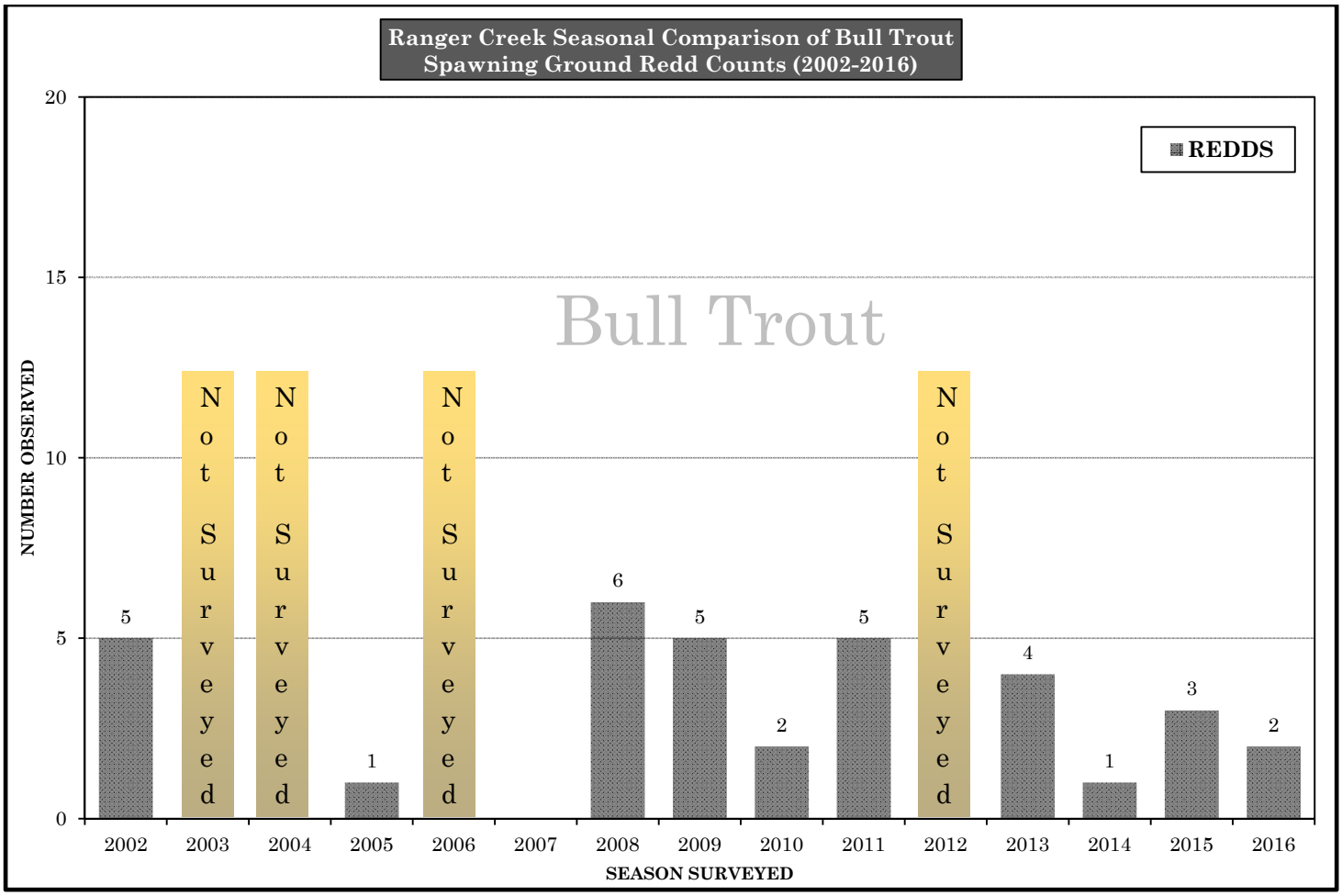
WRIA 10.0530

Ranger Creek is a left bank tributary to the upper Carbon River; entering at RM 26.8. Typical of many headwater tributaries, Ranger Creek is non-glacial and is characterized by confined steep valley channels with a comparatively short, low-to-moderate gradient anadromous reach. This mountain stream flows for just over 3 miles through a steep glacial valley originating between Howard and Tolmie Peaks along the Alki Crest. Ranger flows entirely within Mt. Rainier National Park. Headwater sources are derived from snowpack accumulations and outflow from Lake Tom *(elev. 4400')*; as well as other minor surrounding surface and groundwater sources. These headwater sources all feed the creek until it reaches Green Lake *(elev. 3185')* at approximately RM 1.3. The creek continues to drop precipitously from Green Lake until it reaches the channel migration zone of the Carbon River, at which point the creek channel is reduced to a low gradient pool-riffle channel capable of supporting salmonids.

Various survey methods have verified both resident and fluvial bull trout utilization within Ranger; furthermore, the creeks 2,080' elevation makes it one of the lowest elevation streams known to support bull trout spawning and is quite capable of supporting Chinook, coho, pink and steelhead as well. However, salmonid migration upstream to reach headwater tributaries in the upper Carbon Basin, including Ranger, is assumed to be extremely limited due to substantial cascades present throughout the roughly 5 mile long Carbon River Gorge. The Puyallup Tribe conducted salmon, steelhead and bull trout spawning surveys during 2000 and 2001; yet, no salmon or steelhead were observed. However, surveyors did observe several redds early in the spawning season *(September)*, but their small size and timing matched the bull trout spawning documented in other headwater tributaries in the watershed. Other species including cutthroat, non-native brook trout and sculpins are known to inhabit the creek.

The anadromous reach of Ranger Creek provides excellent habitat conditions for bull trout rearing and spawning. With approximately 0.5 miles of anadromous habit, Ranger is an excellent salmonid stream in several ways. The riparian zone consists of old growth cedar, fir and hemlock which contribute essential woody debris and diversity to the channel. The lower 0.4 miles is low gradient with several deep pools; as well as numerous pockets of spawning gravel. The Carbon River Road crosses the creek at approximately RM 0.35. Due to recurrent flood damage, the road is been closed to vehicular traffic beyond the park entrance. Above 0.4 miles the gradient of the creek increases significantly, and beyond RM 0.5, steep cascades preventing any further upstream migration. However, NPS data specified the presence of cutthroat and sculpins at the outlet to Green Lake *(Samora, personal communication, February 16, 2012)*.

Unfortunately, no substantial data is available on bull trout spawning escapement or population size within the upper Carbon River. Currently, the Carbon River bull trout population is considered one-of-five local populations identified and managed within the Puyallup River Watershed.



Ranger Creek bull trout survey data was collected and provided by Mt. Rainier National Park Service biologists (MORA).

ROCKY RUN CREEK

WRIA 10.0117

Rocky Run Creek is a left bank tributary of the upper White River (RM 44.5), located near the community of Greenwater. Rocky Run is approximately 3.1 miles in length; however, only the lower 0.6 miles is anadromous. The creek supports ESA listed Spring Chinook, steelhead and bull trout; as well as non-listed coho, pink and cutthroat, by providing foraging, spawning and overwintering habitat for all life stages. However, insufficient flows can prevent adult Chinook from accessing the creek in late summer and early fall. Therefore, the creek is surveyed essentially for adult steelhead spawning activity. All adult salmon and steelhead that spawn in the Upper White River and its tributaries are initially captured in the USACE fish trap in Buckley; then transported above Mud Mountain dam *(RM 29.6)*. Since precise escapement numbers for the Upper White River drainage are known, surveys are conducted to determine fish distribution and spawning success. This is especially important regarding Spring Chinook and steelhead, given that adult production monitoring is an essential part of recovery planning.

Typical of many upper river tributaries, the mouth of the creek frequently drifts due to its position within the open channel migration zone of the White River. As a result of mainstem river incursions, the creeks lower channel *(0.15 miles)* and riparian habitat are frequently altered. The habitat within this section is the least conducive to spawning due to a primarily sandy substrate. In addition, this reach of the creek is highly subjected to the possibility of redd scouring or heavy silt deposition due to the influences of the mainstem White River.

Nearly the entire anadromous reach of the creek *(approximately 0.6 miles)* is low gradient *(top left & bottom photos)*. Although spawning does occur within this small stretch *(depending on mainstem influence),* it is often limited due the lack of quality spawning substrate created by the fine alluvial deposits *(sand & silt)* from the White River. In addition, adult salmon spawning has been less consistent and frequent in this tributary compared to that observed in more significant upper river tributaries located along the White River such as Camp Creek, located 1.2 miles downstream. Small quantities of undersized instream woody debris is present, as well as a beneficial riparian buffer zone of primarily conifers and alder along the majority of the creek. Upstream of the anadromous reach, the creek enters the heavily forested lower slope of the valley floor as it begins to climbs up the valley wall. From this point, the creek assumes a pool-riffle-cascade configuration as it ascends the lower valley slope.

RODY CREEK

WRIA 10.0028

Rody Creek, a tributary to Clarks Creek, is part of the lower Puyallup River drainage system. Rody is approximately 1.6 miles in length; however, only the lower 0.6 miles is accessible to adult spawners. Rody Creek is located just northeast of downtown Puyallup. The creek passes under Pioneer Way E. through an undersized, yet generally fish passable culvert at RM 0.5. Rody has numerous deficits including, but not limited to; a confined and straightened channel, intermittent or complete fish barriers, no off-channel habitat, flooding and channel erosion, absent or deficient riparian cover, and the infestation of reed canary grass *(Phalaris arundinacea)*.

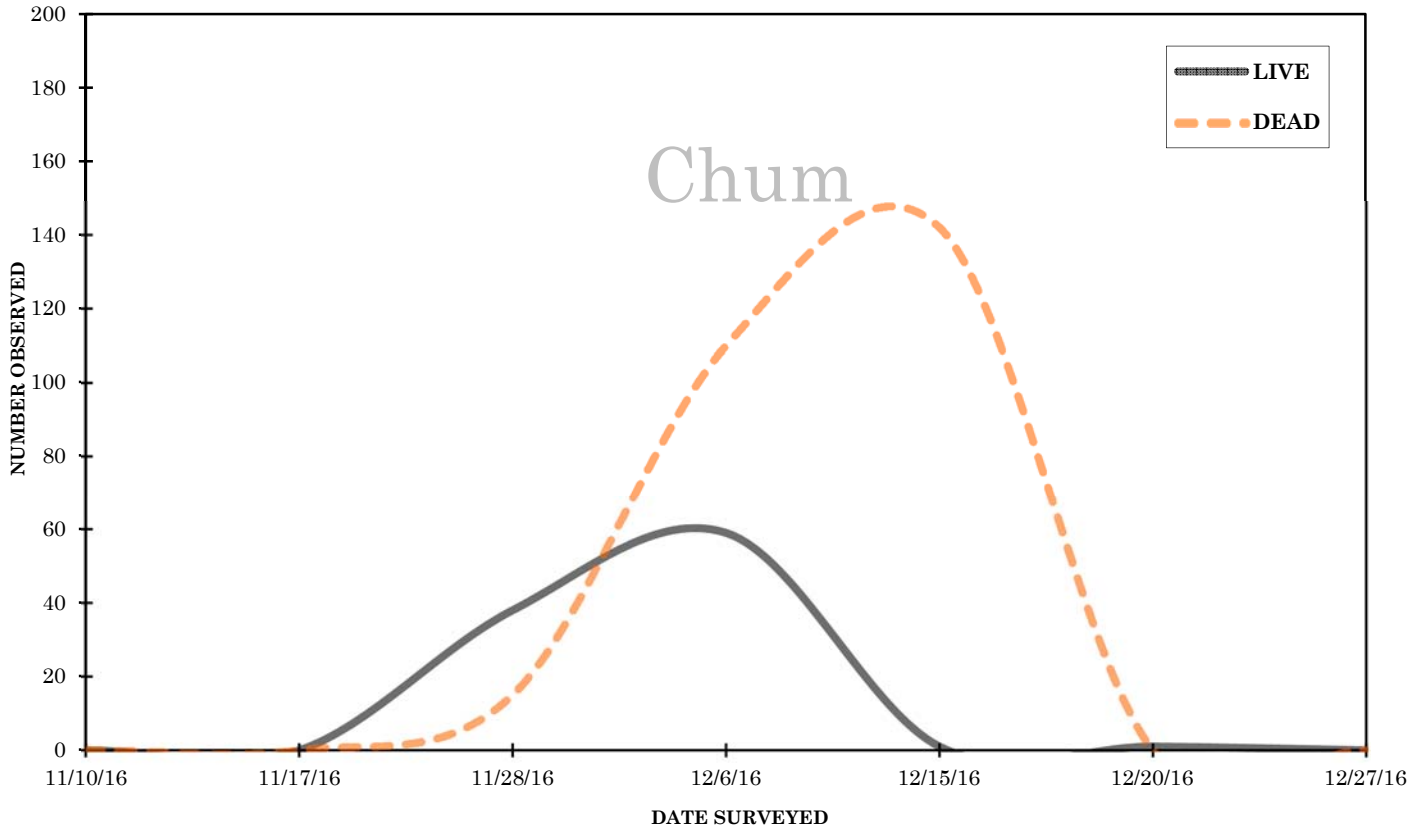
Rody Creek primarily supports adult chum spawners *(center)*; however, adult coho are occasionally observed as well. Insufficient flows prevent adult Chinook from accessing the creek in late summer and early fall. Although present in the drainage, adult steelhead have not been observed spawning in Rody. Juvenile coho; as well as Chinook and steelhead forage and rear in the creek. Bull trout are known to forage in the smaller tributaries of the lower Puyallup. Cutthroat are also present in Rody Creek.

Chum Salmon

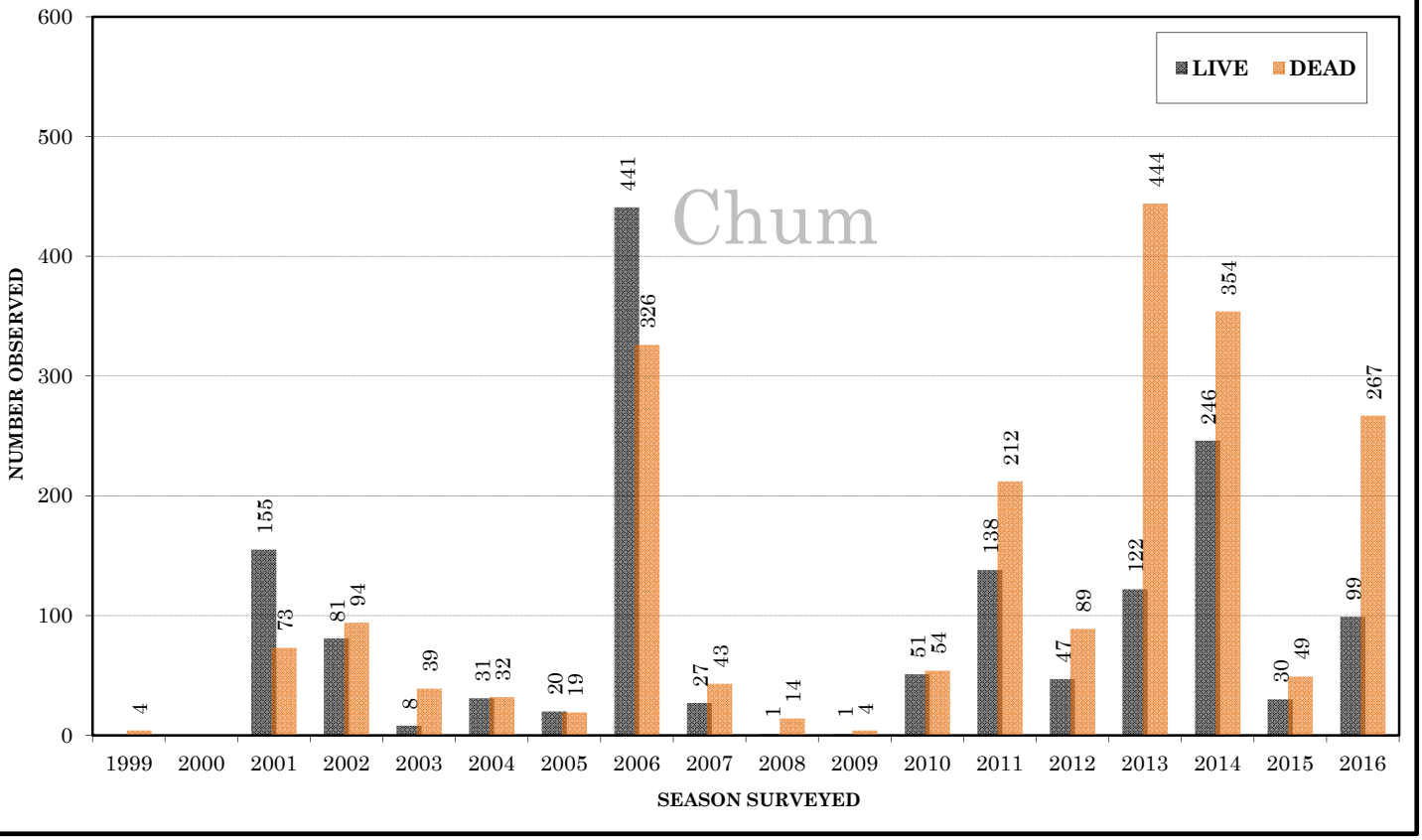
Approximately 300-400 feet of anadromous usage is available above the culvert under Pioneer Way *(left)*; however, a 3 foot high stone barrier prevents fish passage above this point. Above the stone barrier, additional habitat is available and could be utilized if the blockage were removed. In sharp contrast to the reach below Pioneer Way E., the upper reach of the creek has the only intact riparian zone which consists largely of alder.

Downstream, from Pioneer Way E. to the mouth, Rody flows through a channel that is best described as an incised and straightened drainage ditch *(left)*. The habitat throughout most of the lower half mile reach of Rody Creek is remarkably poor; much of the accessible channel has no suitable spawning gravel, and the riparian consist more or less entirely of blackberry, turf grass, and reed canary grass. The reed canary grass, as well as watercress, can be overwhelming during some seasons; often choking extended lengths of the channel and trapping or preventing fish from migrating through. In addition, the grass traps and holds large amounts of fine materials, consequently covering the spawning substrate. The channel generally becomes surveyable after the first freshet of the season. However, chum salmon are regularly observed spawning in the stream when the channel clears. Chum spawn each season in a section of available habitat just below Pioneer. An extremely high water event in the January of 2006 redistributed a large quantity of gravel throughout the channel for approximately 300 feet below Pioneer Way; however, a hydraulics violation was committed when this section of stream was illegally excavated by a land owner in fall of 2010. A half mile downstream of the culvert passage under Pioneer, Rody Creek passes under 66th and dumps into Clarks Creek, a tributary of the Puyallup River. A future restoration project is currently being engineered *(Pierce County)* for the section of creek running from just above, to just below Pioneer.

2016 Rody Creek Chum Salmon Spawning Ground Counts and Run Timing



Rody Creek Seasonal Comparison of Chum Salmon Spawning Ground Counts (1999-2016)



RUSHINGWATER CREEK

WRIA 10.0625

Rushingwater Creek originates from the Upper and Lower Golden Lakes located in Mt. Rainier National Park. Rushingwater flows over 5 miles from the lower lake to its confluence with the Mowich River at RM 0.6. Approximately the first 2 miles of the creek are anadromous. Downstream of the NPS boundary the creek flows through the Mt. Baker-Snoqualmie National Forest before reaching private timber property. The lower reach of Rushingwater flows within the Kapowsin tree farm currently managed by Hancock (*Hancock Forest Management).* Logging roads and timber harvesting have impacted sections of the stream, specifically windthrow located along the lower reach. Rushingwater supports adult and juvenile Chinook *(planted& NOR)*, coho *(planted and NOR),* steelhead and bull trout. Bull trout have been observed in Rushingwater; however, spawning utilization is unknown. However, bull trout utilization is well documented in the Mowich and Puyallup.

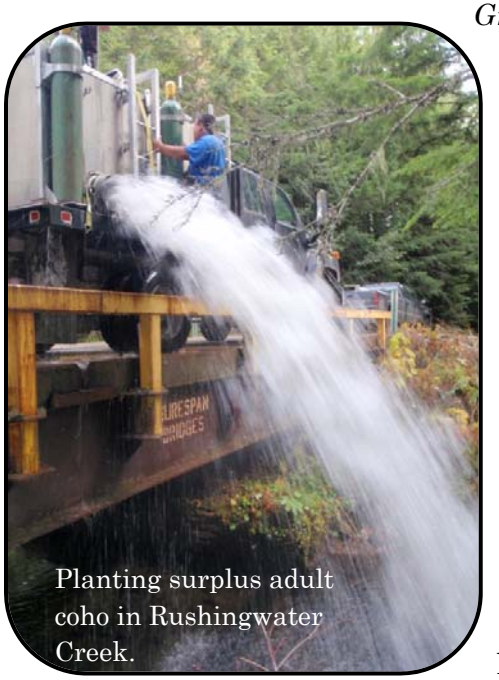
One of two acclimation ponds used for reestablishing coho, and occasionally Chinook *(spring & fall)*, into a 30-mile reach of the Upper Puyallup River is located just off the main channel of Rushingwater at RM 0.6. The pond *(next page)* holds 14,000 cu. ft. of water with a flow rate of 1-3 cfs; in past years (1999-2007), 40,000 to 100,000+ coho yearlings were imprinted and released from Rushingwater annually. Coho yearlings originated from Voights Creek Hatchery where coho were adipose clipped and coded wire tagged. Fish were released at 20 fish per pound, for a total biomass of 10,000 pounds. In addition to the acclimation of juvenile coho and Chinook, adult surplus coho and Chinook from Voights Creek Hatchery have been planted in Rushingwater when available. However, no adult fish were planted in 2004. Instead, the first naturally retuning adult coho were allowed to spawn without intrusion from hatchery planted coho. Future live plants may be reduced or eliminated based on the number of NORs.

Dividing this stream into four reaches, the lowest reach covers the first mile of the creek. This initial reach consists of a complex riffle-pool system *(top left)* with considerably large substrate; consisting of large gravel, cobble and boulders. Several windblown trees, the result of poor RMZ management, span the channel the length of this stretch. Abundant in-stream woody debris and a moderate to dense canopy cover extend through most of this reach. Beaver (*Castor canadensis*) activity is frequent throughout the upper portion. Beyond this, in reach 2, the creek climbs nearly 1,000 feet over the next 2 miles. An impassable cascade is located within this reach preventing any further upstream migration.

The 3rd reach harbors significantly different habitat *(center)*. For roughly the next mile the creek assumes a placid flow and contains excellent spawning habitat, as well as considerable amounts of beaver activity and LWD structures. This reach is one of the sites where adult surplus coho are planted. The final reach of Rushingwater once again

climbs swiftly *(2,000 feet)* over the next 1.6 miles to the outlet of Golden Lake at 4,500 feet.

Fish Enhancement Project Description: Operate several acclimation ponds in the Puyallup/White River Watershed designed to reestablishing and enhance Chinook, coho and steelhead stocks. Each of the two acclimation ponds *(Cowskull & Rushingwater)* on the Puyallup would receive as many as 100K+ hatchery origin spring/Fall Chinook and/or coho. Three additional acclimation ponds located in the Upper White River drainage *(Huckleberry Cr., Greenwater River (George Cr.), Twentyeight Mile Cr. (Greenwater R.)& Jensen Cr.(Clearwater R.)* would be planted collectively with as many as 900K+ White River Spring Chinook and 25K+ White River winter steelhead pre-smolts. When available, the Puyallup Tribe will collect, haul and plant surplus adult hatchery Fall Chinook and coho from WDFW Voights Creek hatchery. During the summer of 2015, the pond was given its first maintenance dredging since it was originally constructed. This was necessary due to more than half of the ponds capacity being lost due to sediment build-up.


Planting surplus adult coho in Rushingwater Creek.

Goals, Purpose and Expected Benefits: One of the Puyallup Tribe's most significant restoration goals is to rebuild depressed Chinook and steelhead stocks and remove them from ESA listing. Acclimation ponds are a proven method for increasing fish stocks, and are a key component to restoration goals. All six acclimation ponds in the basin were funded and are operated by the Puyallup Tribe.

Purpose of Project:

1. Supplementing ESA listed salmonid spawning.
2. Increasing weak or depressed wild salmonids *(non-ESA listed).*
3. Sustaining/enhancing a fishery population.

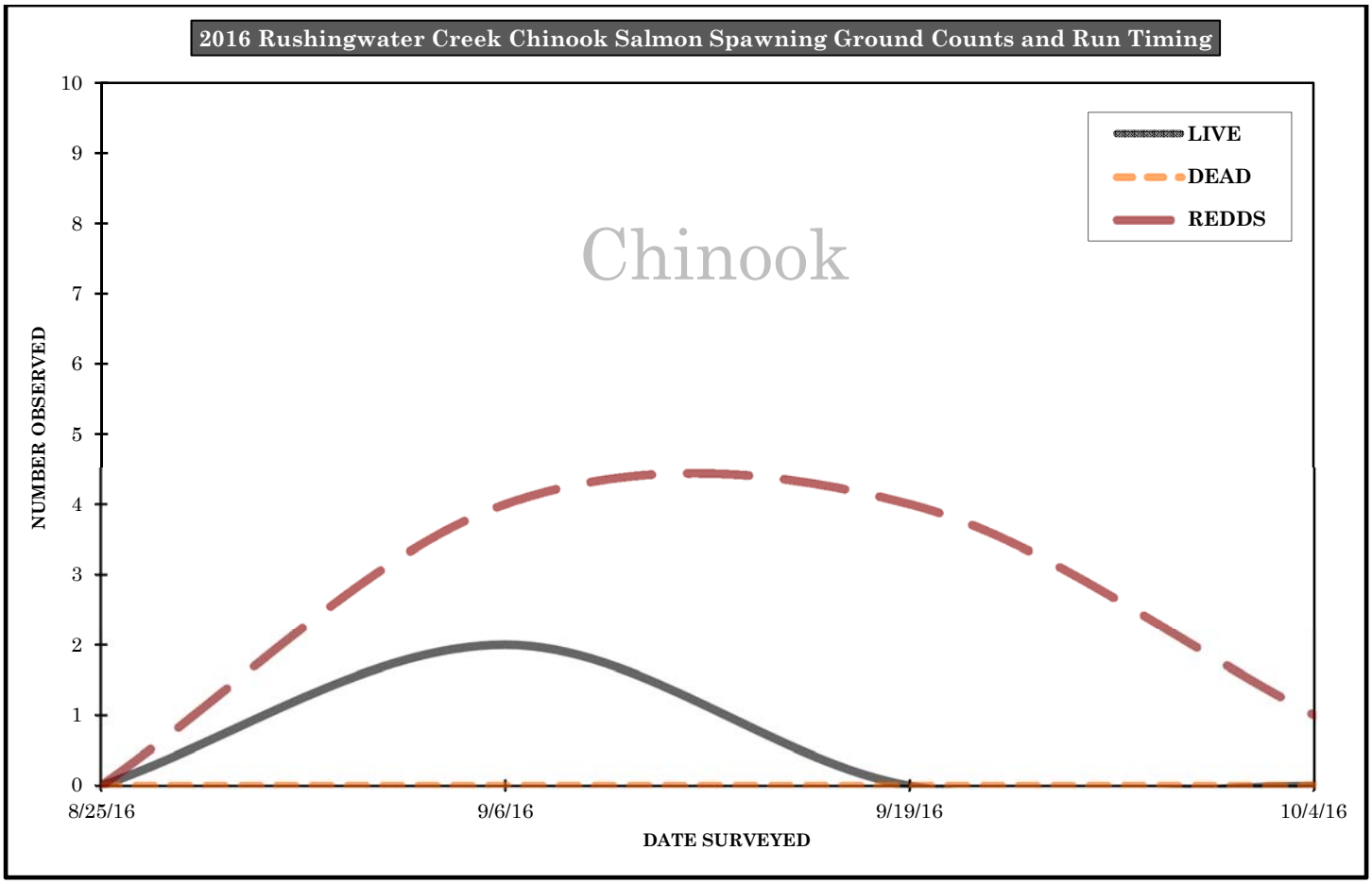
Expected Benefits Include:

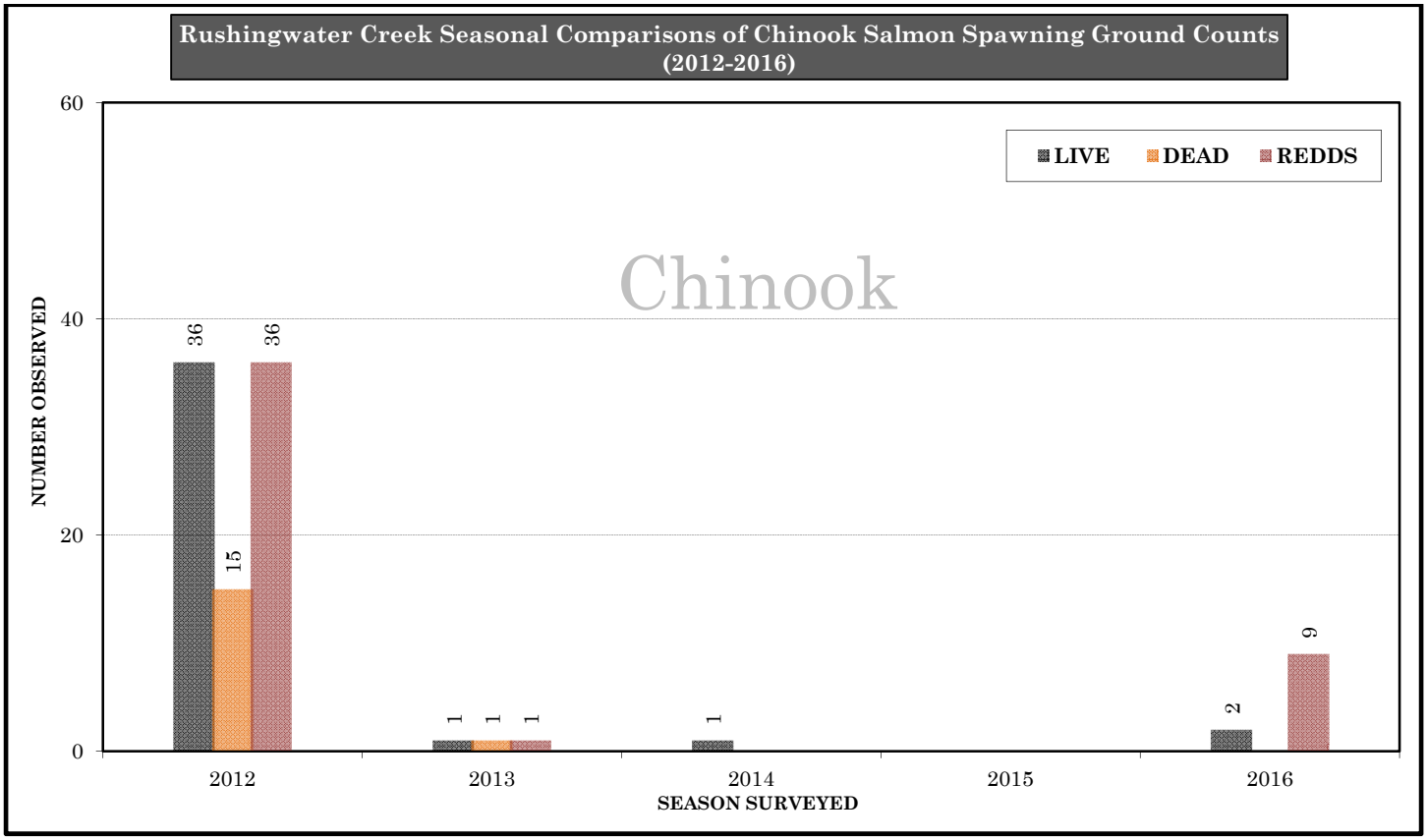
- Reestablishing Chinook and coho into their endemic ranges.
- Increased total abundance of the composite natural/hatchery population.
- Increased spawning ground escapement and trend of Natural Origin Recruits (NORs).
- Improve distribution (out planting of live fish) to minor spawning and underutilized rearing habitat areas.
- Nutrient enhancement in oligotrophic *(nutrient-poor)* streams.

Acclimation pond.

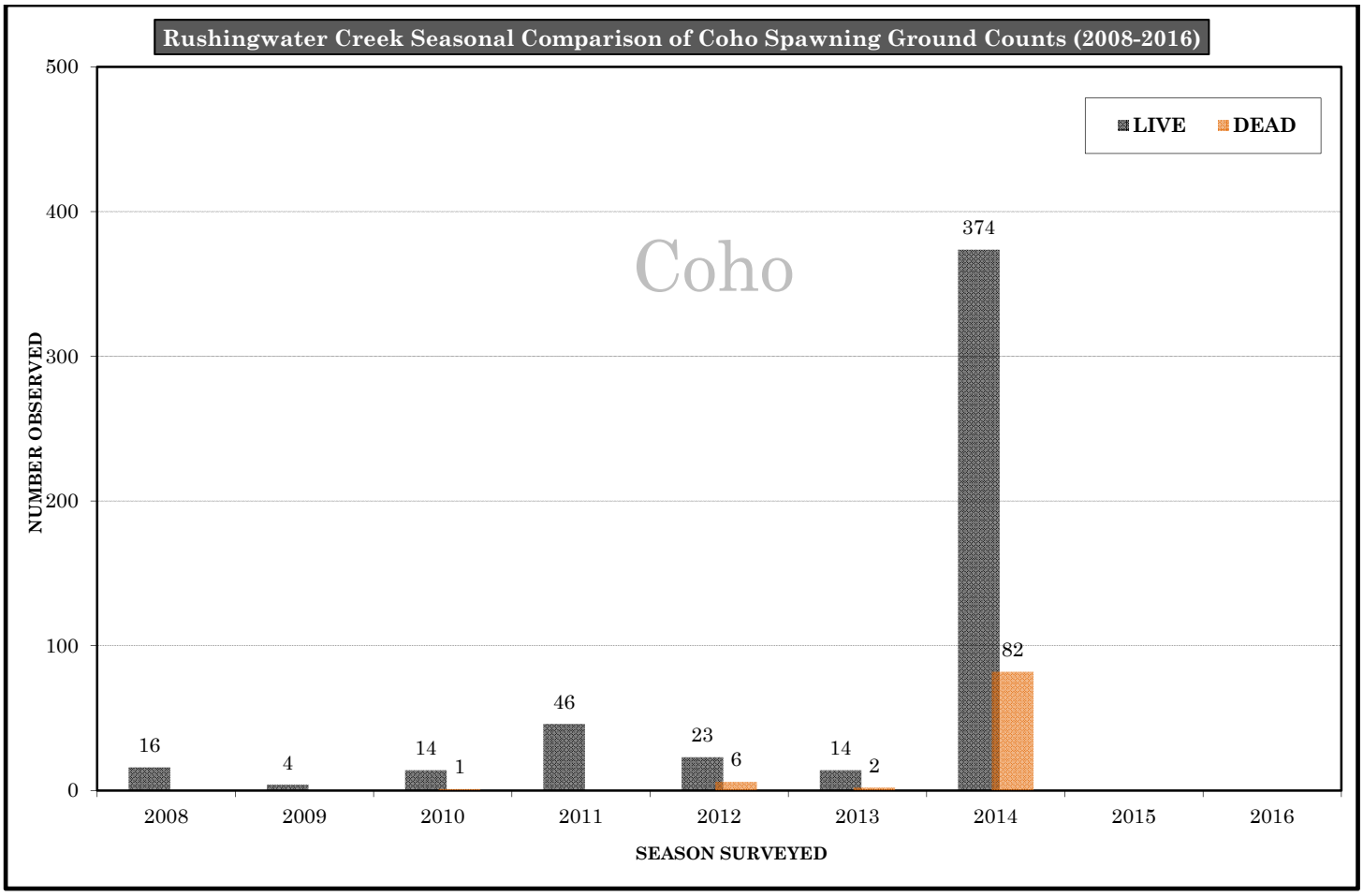
The 2012 season was the first year a significant escapement of Chinook was observed spawning in Rushingwater Creek *(right).* Sampling data *(ventral fin clips)* showed many of the Chinook were survivors from juvenile Spring Chinook released from the Rushingwater *(n=133,486)*, or Cowskull *(n=181,386)* acclimation ponds in 2009 *(2008 brood year).*

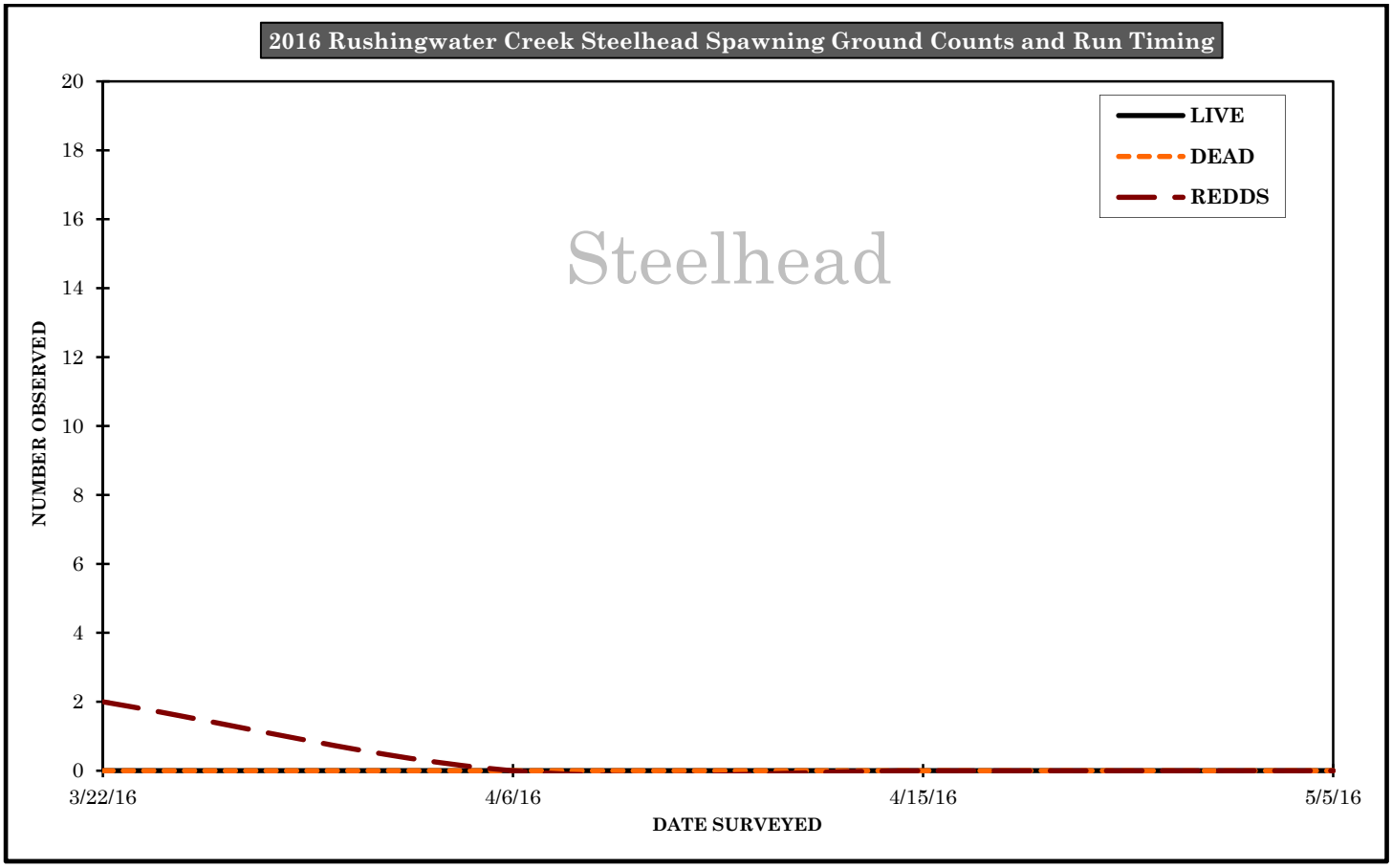
Chinook salmon in Rushingwater Creek.

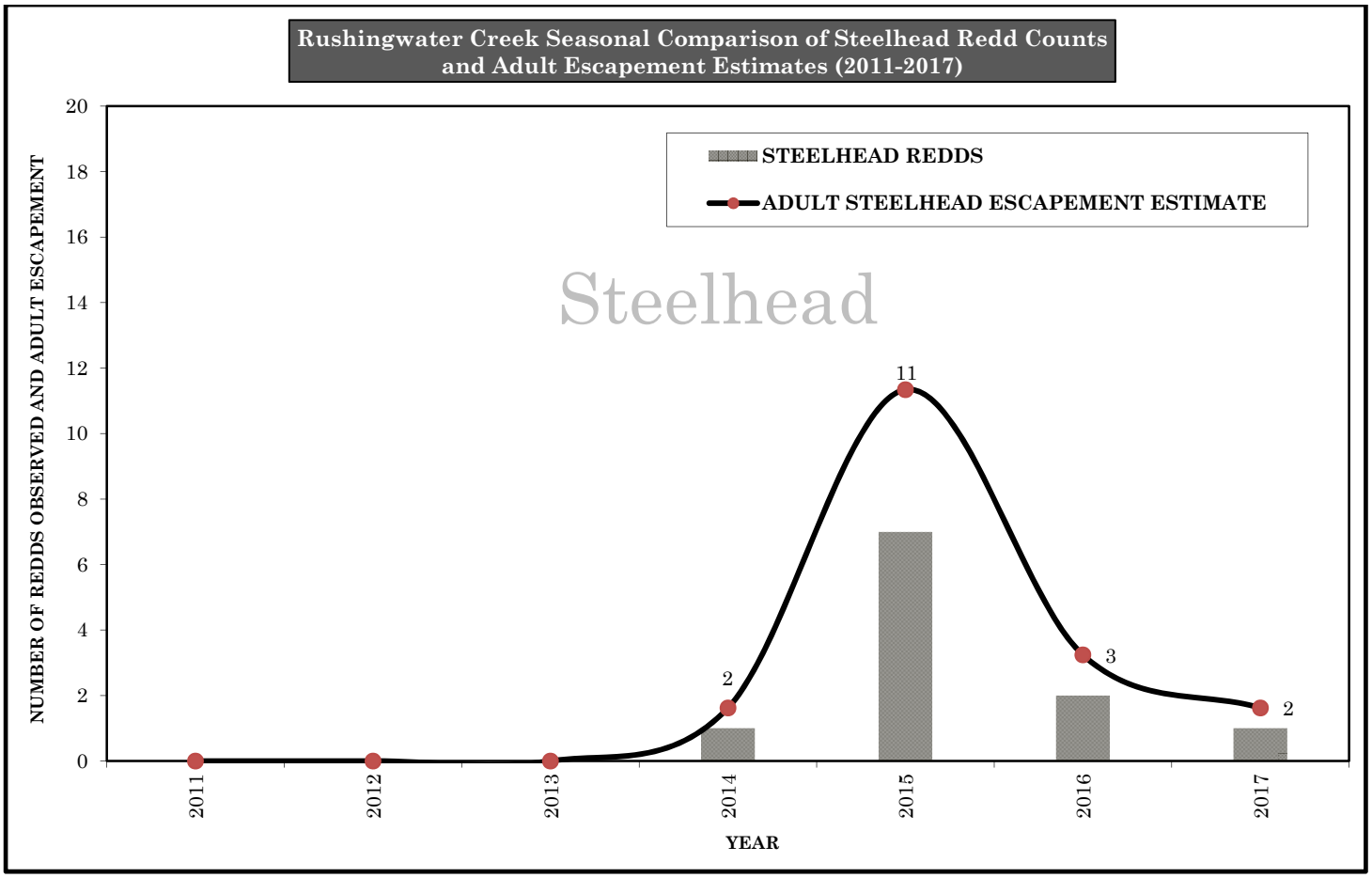




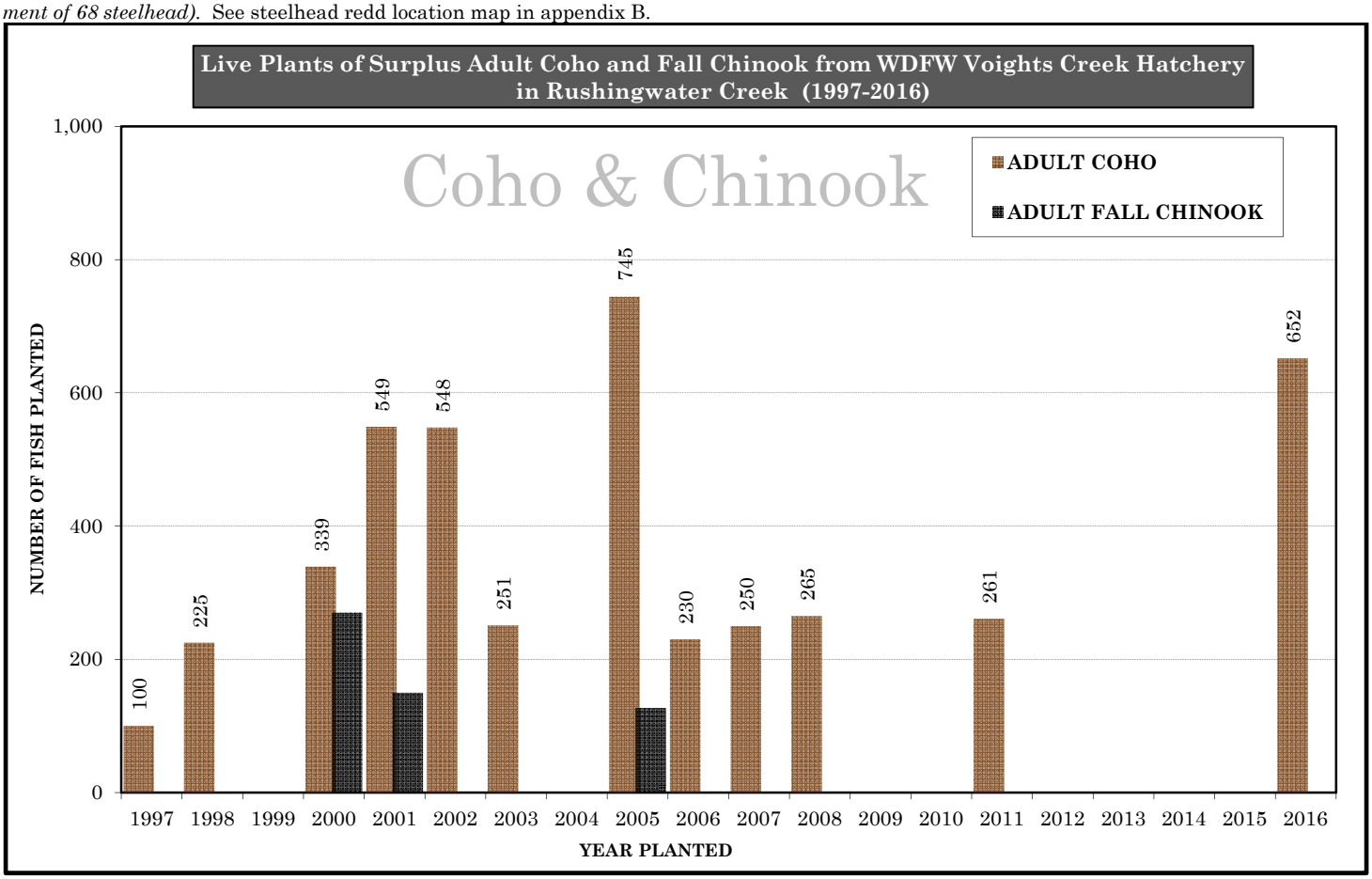
Adult Chinook escapement is determined by expanding the number of redds observed by 2.5 fish per redd (Smith and Castle, 1994). Due to the tremendous volume of pink salmon during odd years, the success of determining Chinook redds from pinks is vastly reduced. Therefore, The AUC method is used to determine escapement during pink runs (odd years).


Rushingwater Creek Seasonal Comparison of Coho Spawning Ground Counts (2008-2016)
LIVE
DEAD
Coho
NUMBER OBSERVED
SEASON SURVEYED
500
400
300
200
100
0
16
4
14
1
46
23
6
14
2
374
82
2008
2009
2010
2011
2012
2013
2014
2015
2016

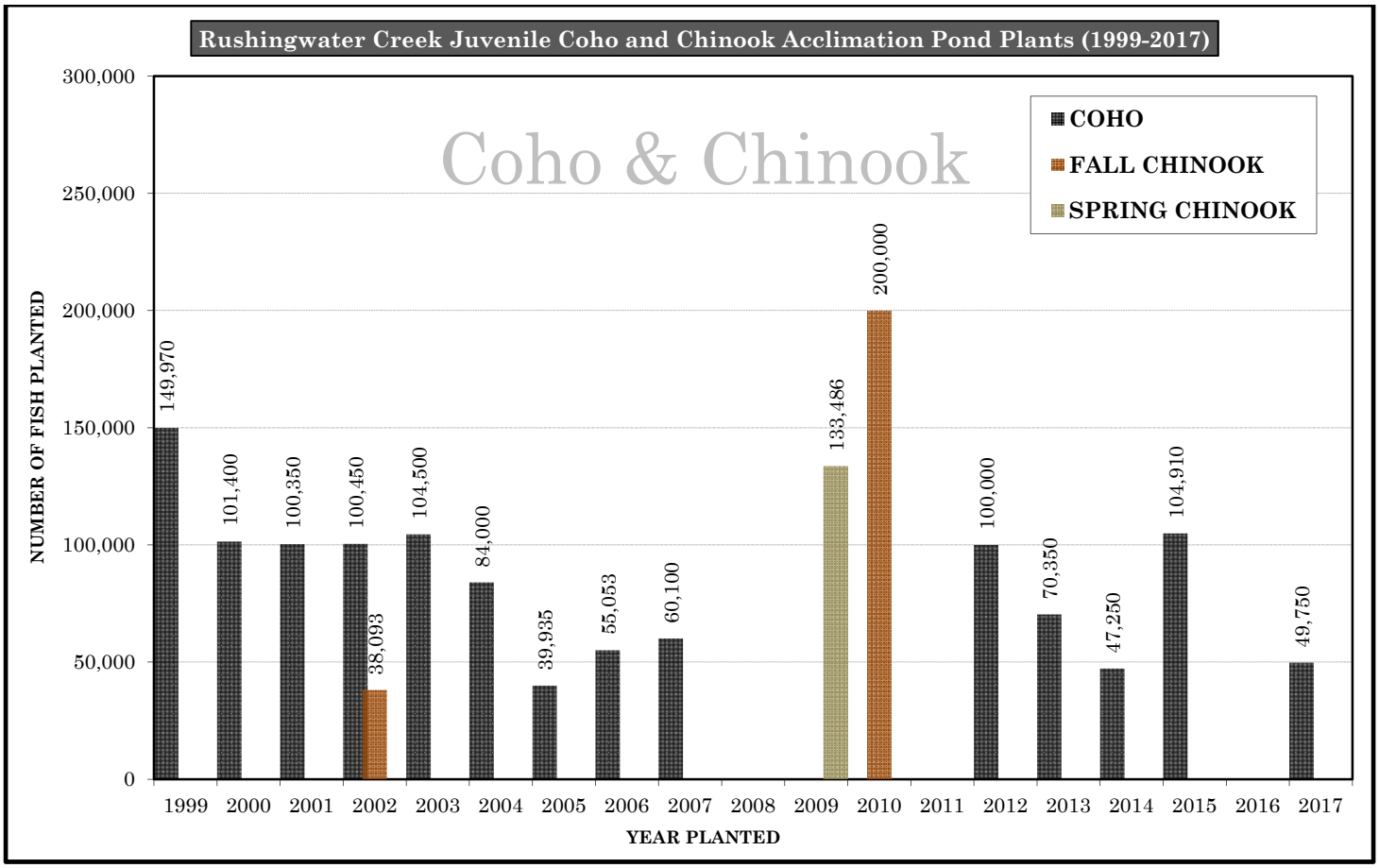

2016 Rushingwater Creek Steelhead Spawning Ground Counts and Run Timing
LIVE
DEAD
REDDS
Steelhead
NUMBER OBSERVED
DATE SURVEYED
20
18
16
14
12
10
8
6
4
2
0
3/22/16
4/6/16
4/15/16
5/5/16



To determine the total escapement for steelhead, each redd is multiplied by a factor of 1.62 *(i.e. 42 redds x 1.62 steelhead per redd = total escapement of 68 steelhead).* See steelhead redd location map in appendix B.



Surplus adults provided by WDFW Voights Creek Hatchery when available. Acclimation ponds opperated by Puyallup Tribe. See map of acclimation pond location sites on Page 41. No data indicates no fish were planted.



Acclimation ponds opperated by Puyallup Tribe. Coho provided by WDFW Voights Creek Hatchery when available. See map of acclimation pond location sites on Page 41. No data indicates no fish were planted.

SALMON CREEK

WRIA 10.0035

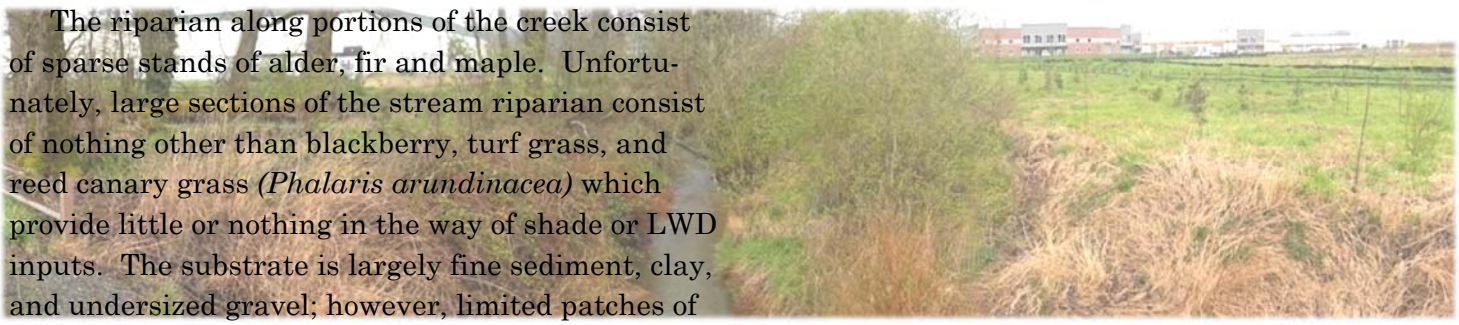
Chum Salmon

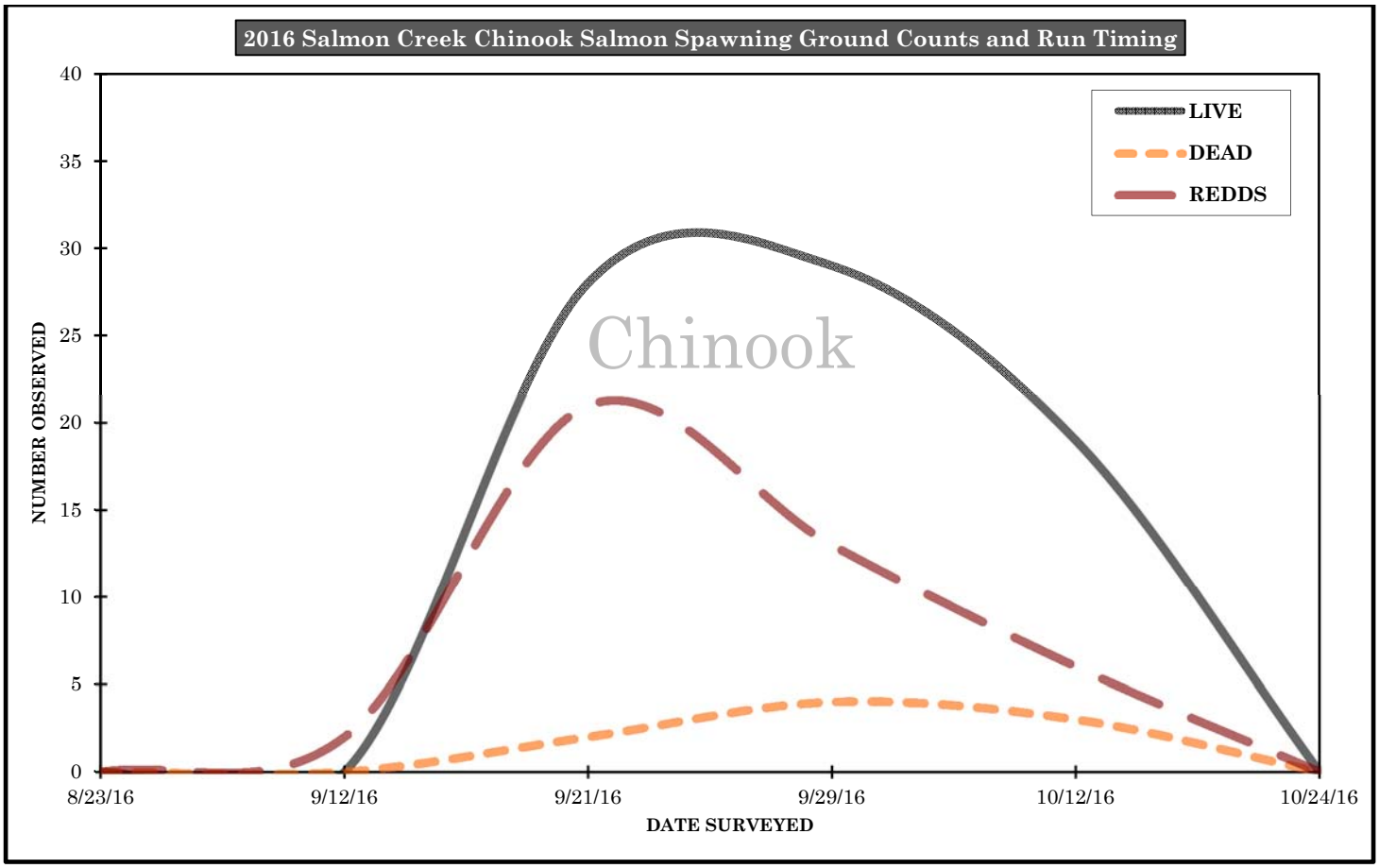
Salmon Creek, also known as Strawberry Creek, flows just north of downtown Sumner. The creek channel is narrow and incised, especially along the lower 0.5 miles *(below)*. Most of the creek flows through moderately developed private and commercial properties before entering the White River at RM 2.1. In 2004, the City of Sumner completed a large wetland restoration project adjacent to the lower reach of Salmon Creek *(RM 0.4)*. The 11 acre site was the result of a mitigation settlement with Davis Properties and Fred Myers.

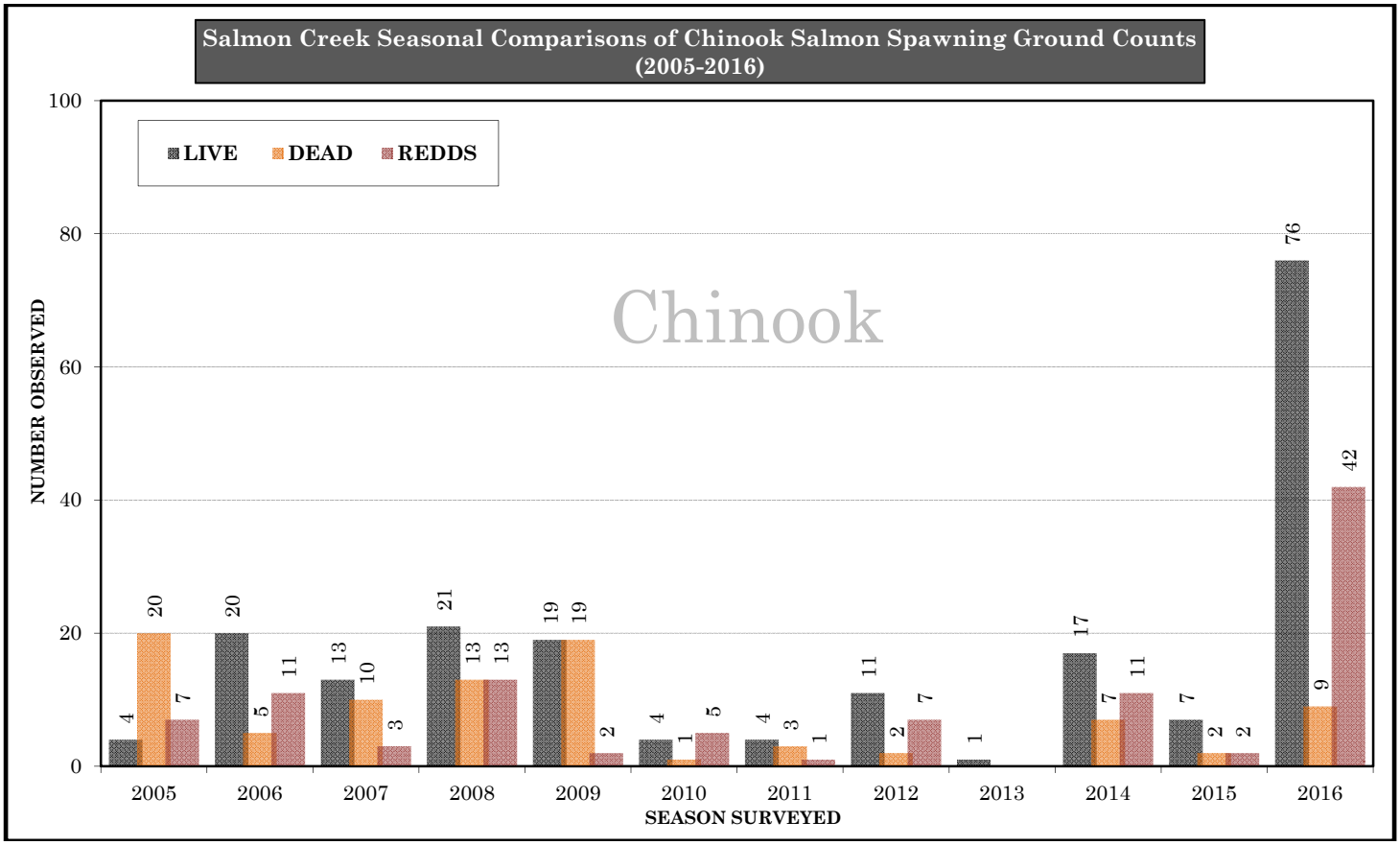
Several of the limiting factors impacting fish production in Salmon Creek include; a confined and straightened stream channel, disconnected floodplain, channel erosion, absent or deficient riparian cover, as well as low summer and fall seasonal flows. High sediment inputs, industrial discharge, and lack of channel habitat are additional limiting factors.

The riparian along portions of the creek consist of sparse stands of alder, fir and maple. Unfortunately, large sections of the stream riparian consist of nothing other than blackberry, turf grass, and reed canary grass *(Phalaris arundinacea)* which provide little or nothing in the way of shade or LWD inputs. The substrate is largely fine sediment, clay, and undersized gravel; however, limited patches of adequate sized spawning gravel, principally throughout the lower section of the creek, are available. Most of the spawning habitat within the creek, although quite limited, exists in the lower 0.5 miles of the creek. It's likely that a great deal of the gravel present throughout the lower reach is recruited from Salmon Tributary. Fish do ascend above the first half mile despite the fact that spawning opportunities are few and the habitat is considerably poorer in quality. In response to the limited spawning habitat available, several of the chum salmon observed in Salmon Creek are likely to be ascending to the spring fed tributary, Salmon Tributary, which enters Salmon Creek at RM 0.5 on the right bank. The consistent flow into Salmon Creek from this perennial tributary contributes greatly to the accessibility of Chinook during the late summer and early fall when instream flows in many streams are too low for Chinook to enter.

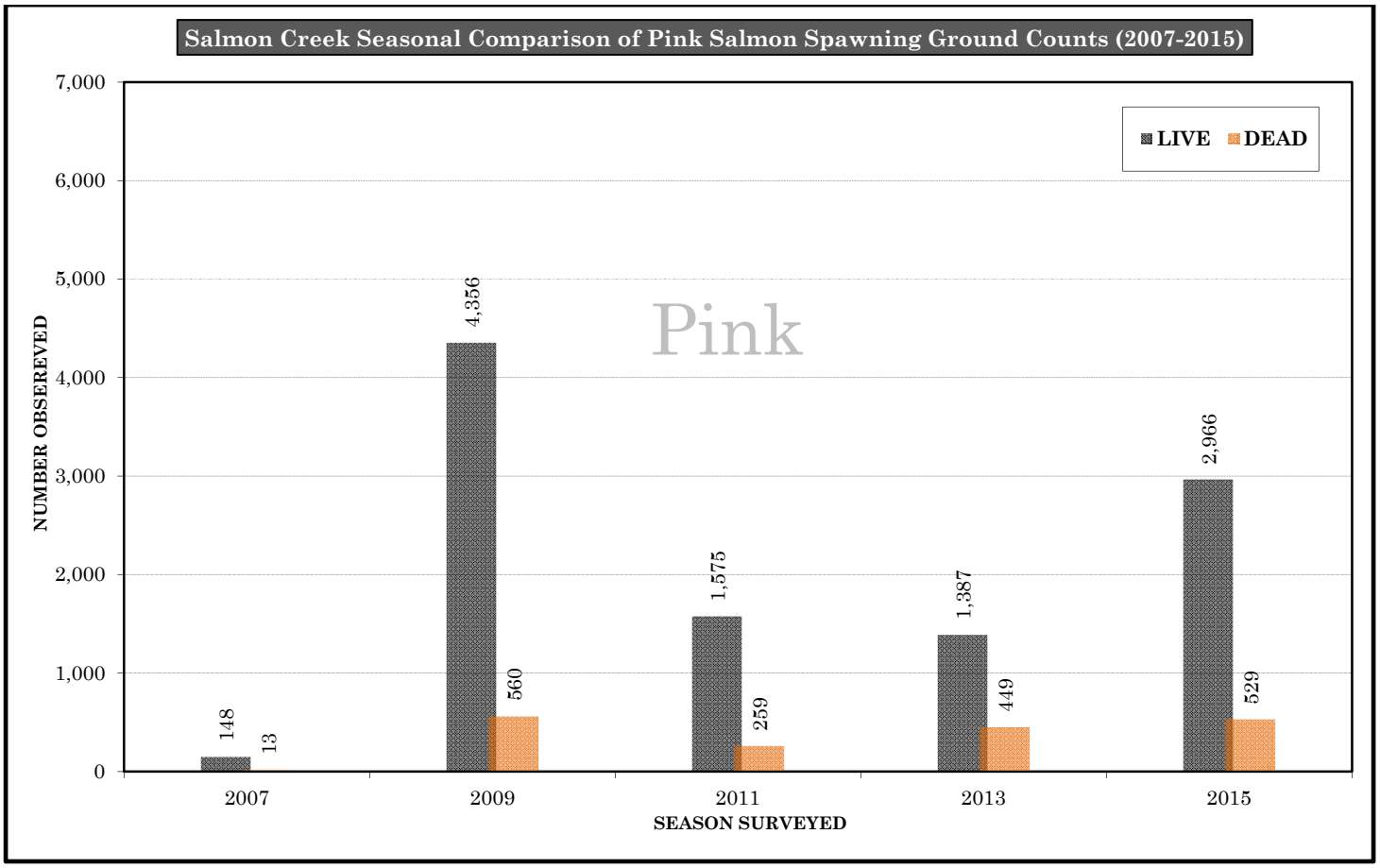
Salmon Creek supports adult Chinook, pink, coho, and chum spawners; with chum being the most abundant species present. Coho are observed spawning; however, their numbers continue to be low. Steelhead and bull trout utilization is unknown. Prior to 2005, Salmon Creek was not regularly surveyed for Chinook since they were seldom observed. However, a few Chinook carcasses were observed within the lower 300 feet of the creek while conducting coho surveys. Annual Chinook surveys conducted since 2005 have documented spawning as high as to the old Weber plant *(Elm St. E & 160th Ave E)*; however, the majority of spawning occurs in the lower 0.5 miles of the creek. Adult coho have been observed as high as 60th St. E. A new oversized culvert was installed near the mouth in 2007, and another culvert and road crossing was installed upstream in 2009.

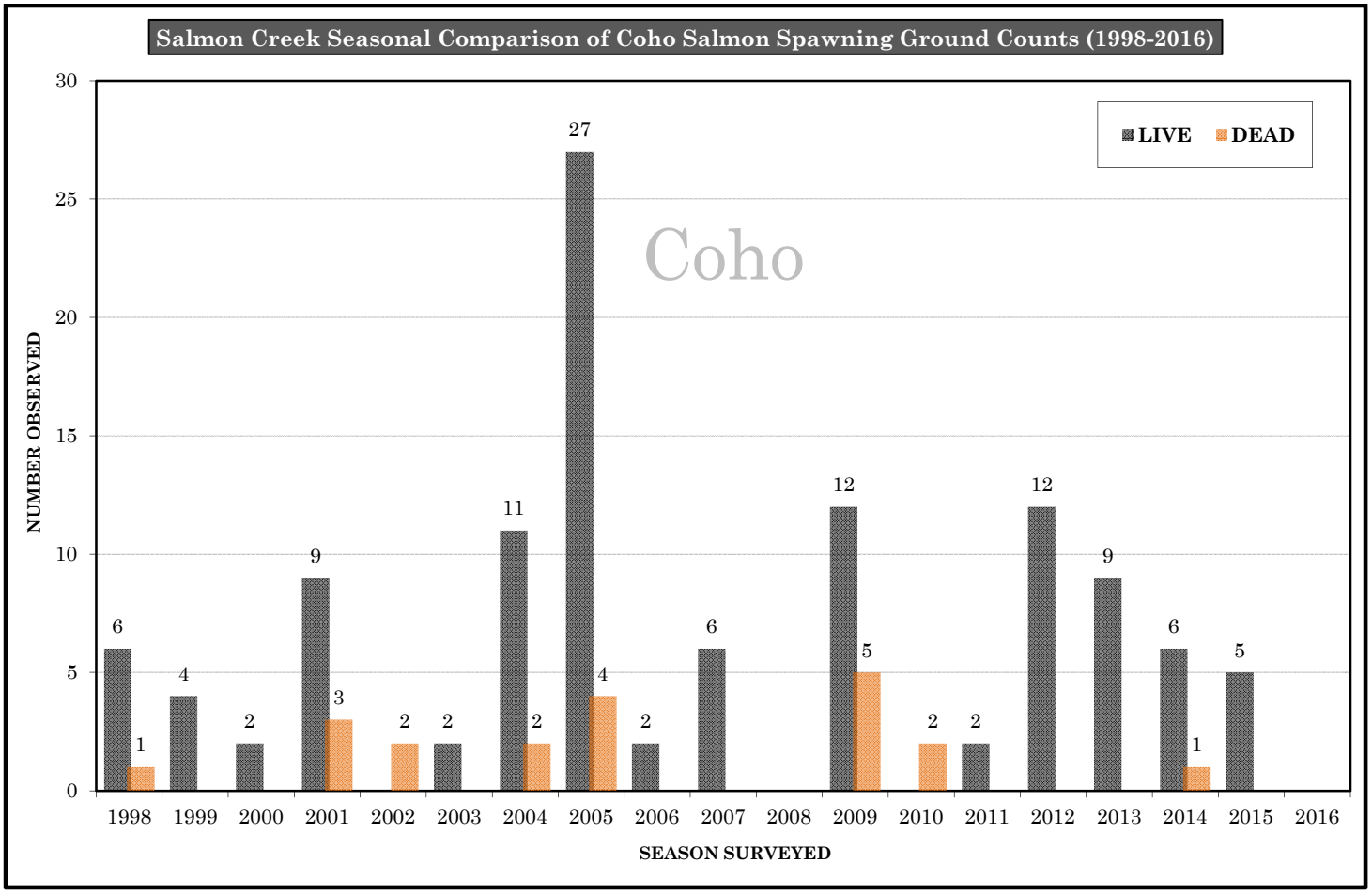


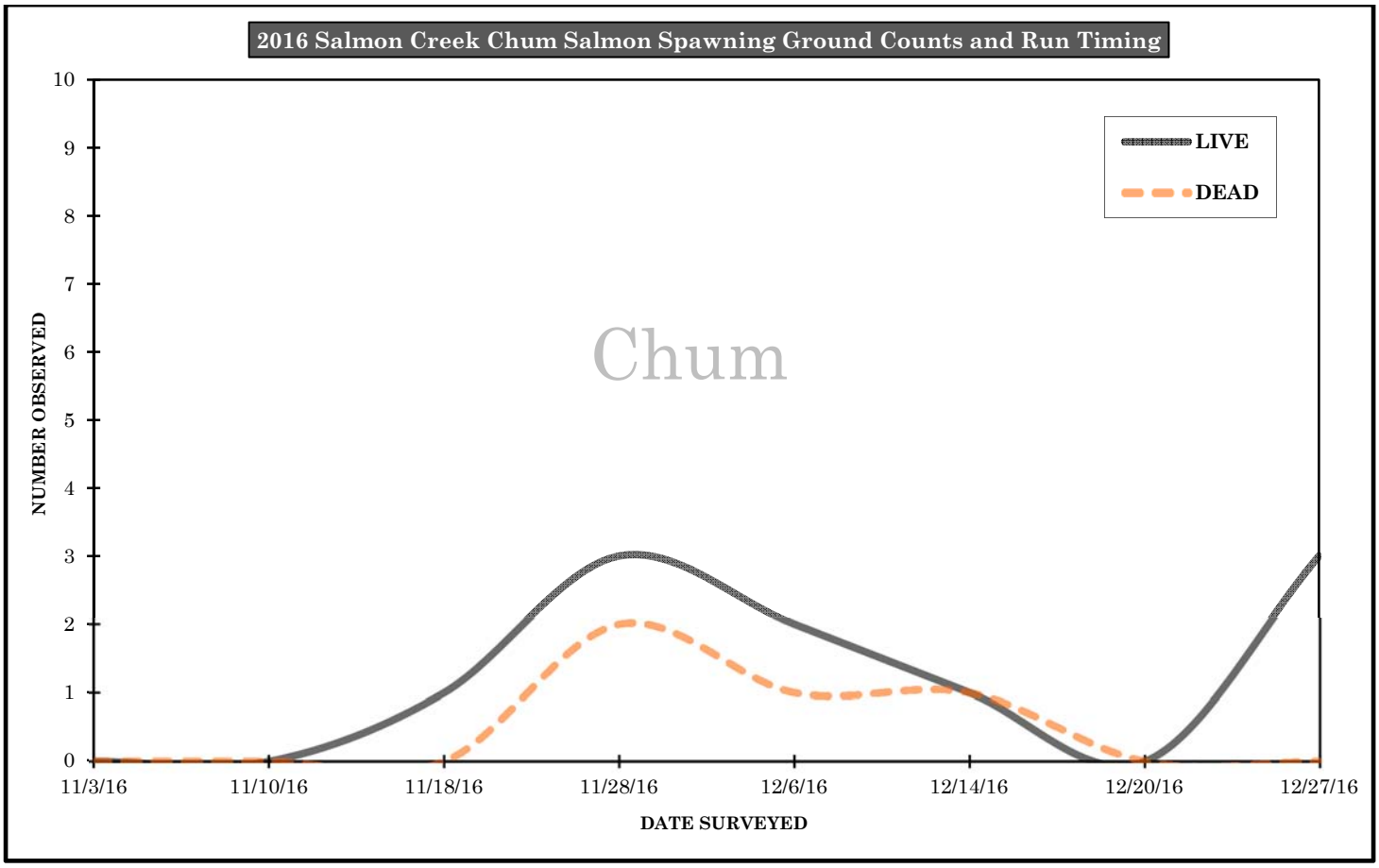


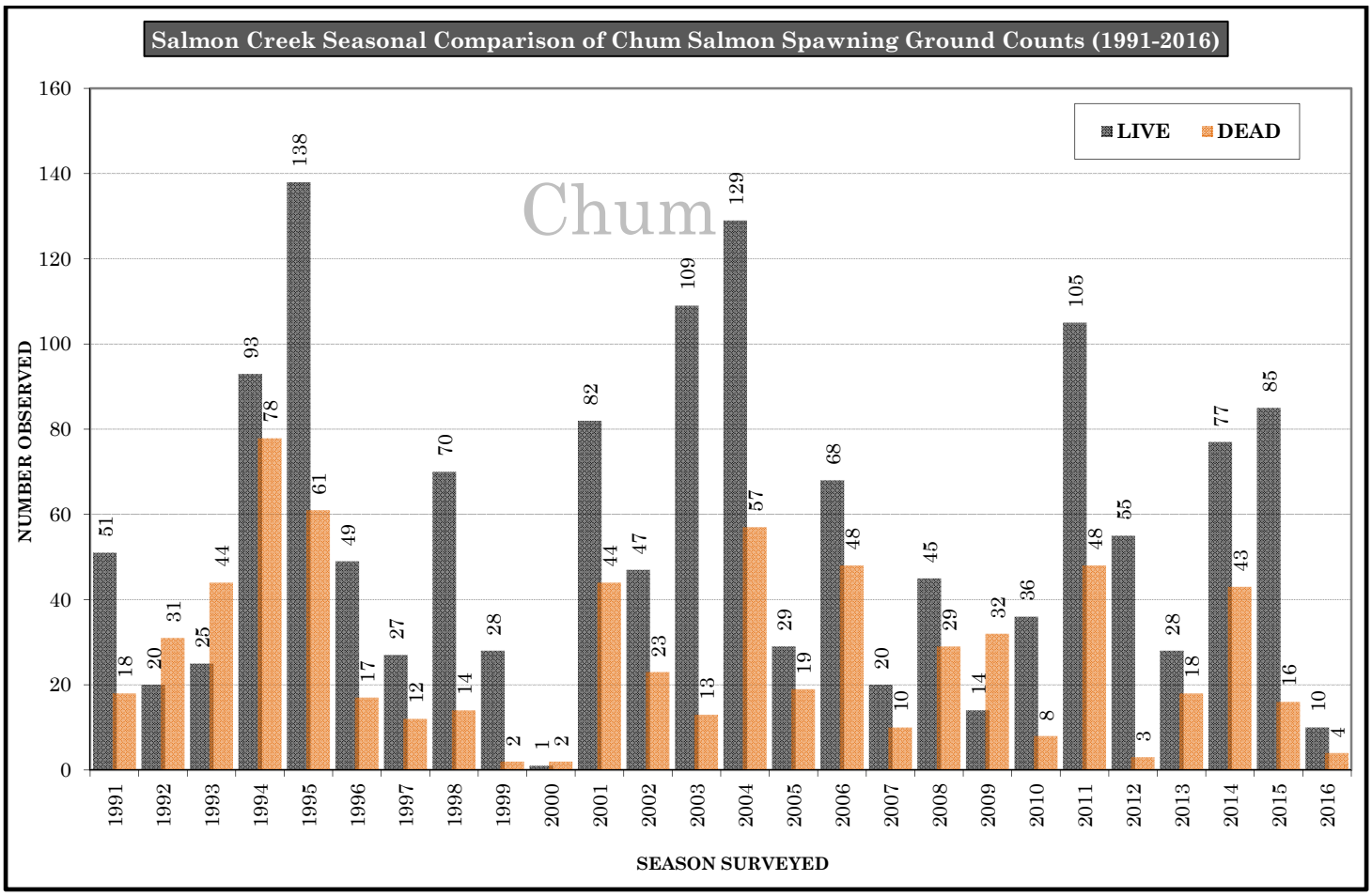


Adult Chinook escapement is determined by expanding the number of redds observed by 2.5 fish per redd (Smith and Castle, 1994). Due to the tremendous volume of pink salmon during odd years, the success of determining Chinook redds from pinks is vastly reduced. Therefore, The AUC method is used to determine escapement during pink runs (odd years).


Salmon Creek Seasonal Comparison of Pink Salmon Spawning Ground Counts (2007-2015)
LIVE
DEAD
Pink
NUMBER OBSERVED
SEASON SURVEYED
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
148
13
4,356
560
1,575
259
1,387
449
2,966
529
2007
2009
2011
2013
2015


Salmon Creek Seasonal Comparison of Coho Salmon Spawning Ground Counts (1998-2016)
LIVE
DEAD
Coho
NUMBER OBSERVED
SEASON SURVEYED
30
25
20
15
10
5
0
6
1
4
2
9
3
2
2
11
2
27
4
2
6
12
5
2
2
12
9
6
1
5
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016


2016 Salmon Creek Chum Salmon Spawning Ground Counts and Run Timing
LIVE
DEAD
Chum
NUMBER OBSERVED
0
1
2
3
4
5
6
7
8
9
10
11/3/16
11/10/16
11/18/16
11/28/16
12/6/16
12/14/16
12/20/16
12/27/16
DATE SURVEYED


Salmon Creek Seasonal Comparison of Chum Salmon Spawning Ground Counts (1991-2016)
LIVE
DEAD
Chum
NUMBER OBSERVED
0
20
40
60
80
100
120
140
160
1991 51 18
1992 20 31
1993 25 44
1994 93 78
1995 138 61
1996 49 17
1997 27 12
1998 70 14
1999 28 2
2000 1 2
2001 82 44
2002 47 23
2003 109 13
2004 129 57
2005 29 19
2006 68 48
2007 20 10
2008 45 29
2009 14 32
2010 36 8
2011 105 48
2012 55 3
2013 28 18
2014 77 43
2015 85 16
2016 10 4
SEASON SURVEYED

SALMON TRIBUTARY

WRIA 10.0036

Chum Salmon

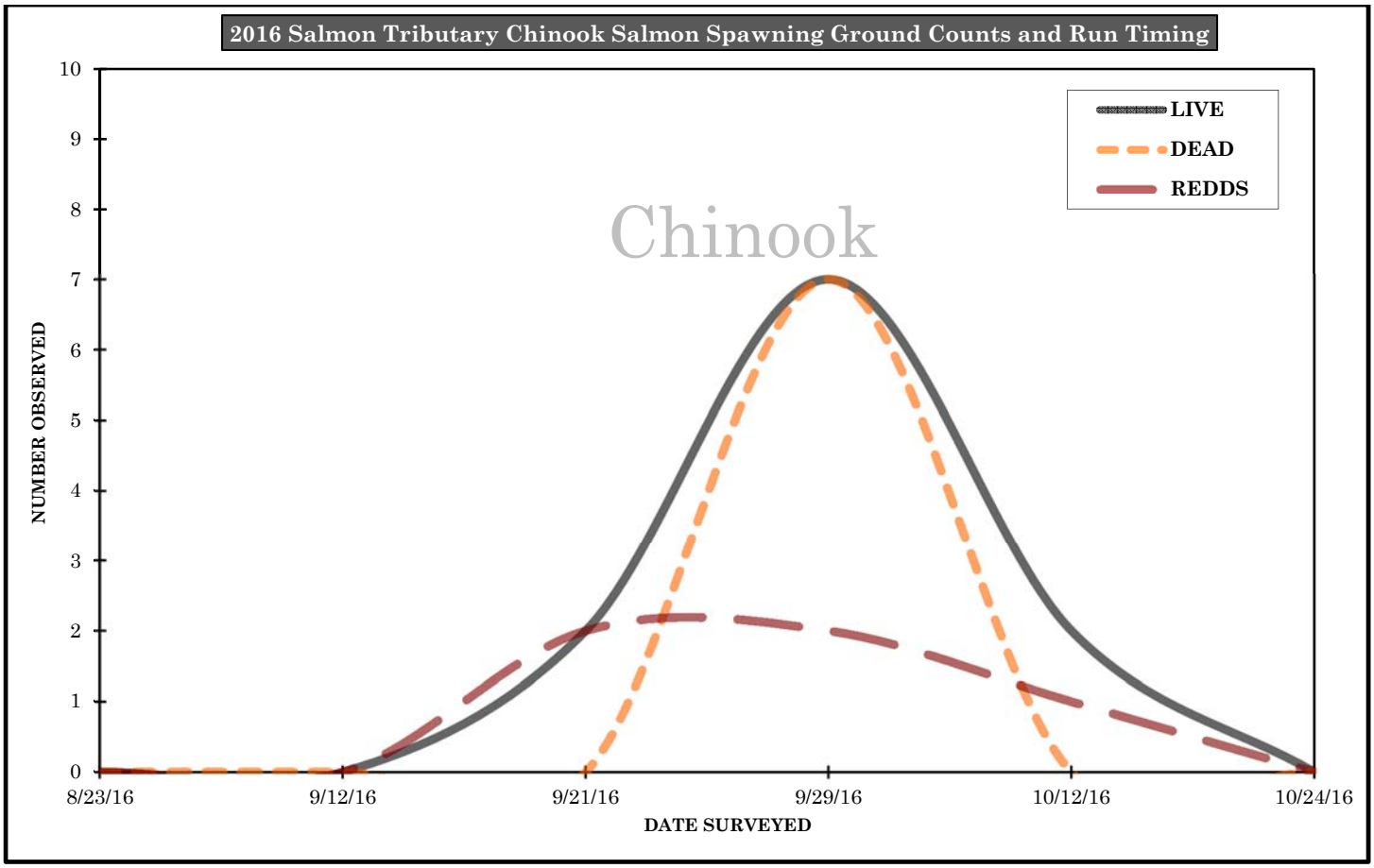
Salmon Tributary is a short run, spring-fed stream entering Salmon Creek *(Strawberry Creek)* at RM 0.5. Salmon Tributary has approximately 0.13 miles *(700 feet)* of highly productive spawning habitat. The lower anadromous reach consists of a low to moderate gradient channel with excellent spawning gavel available throughout its length *(lower left & center right)*. Although the creek lacks significant structure, it manages quit well in supporting adult spawners including chum, pink, coho, and the occasional Chinook; as well as providing limited overwintering opportunities for juvenile coho and Chinook.

Beyond the anadromous reach the creek climbs quickly to a point where impassable cascades prevent any further upstream migration. The riparian along the lower reach of the creek consists largely of alder, as well as a few conifers and holly. A few pieces of small in-stream woody debris are present; however, LWD recruitment is limited and undersized. The riparian zone along the upper non-anadromous reach is well intact.

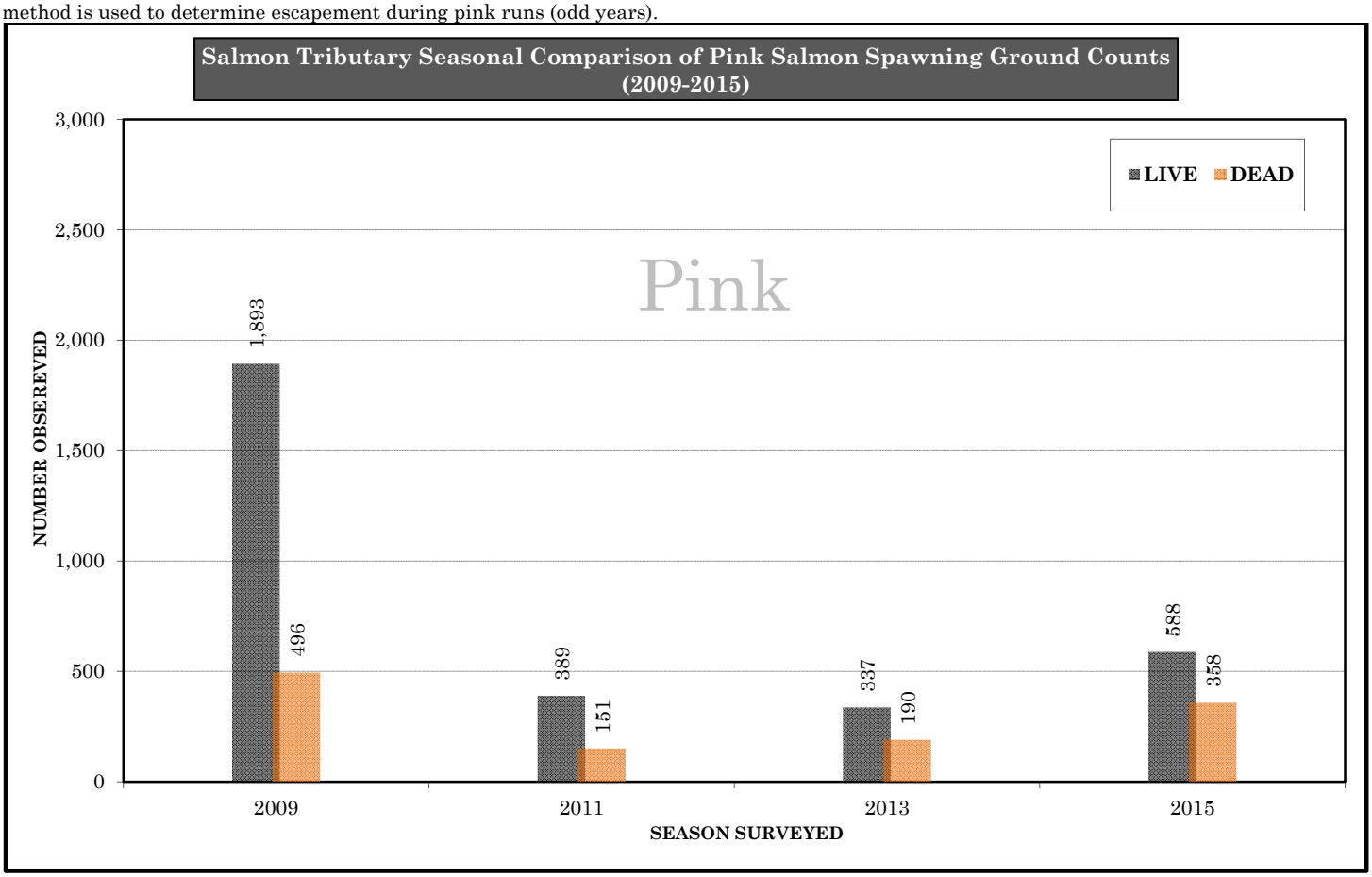
In the past, two perched culverts located on Salmon Creek have been responsible for periodically preventing adult salmon, primarily chum, from accessing Salmon Tributary. The upper culvert on Salmon Creek often created a significant fish passage problem until late 2007, when bank erosion permitted the creek to breech the culvert. During the fall of 2008, the two lower undersized cement culverts that had long been responsible for fish passage issues were removed.

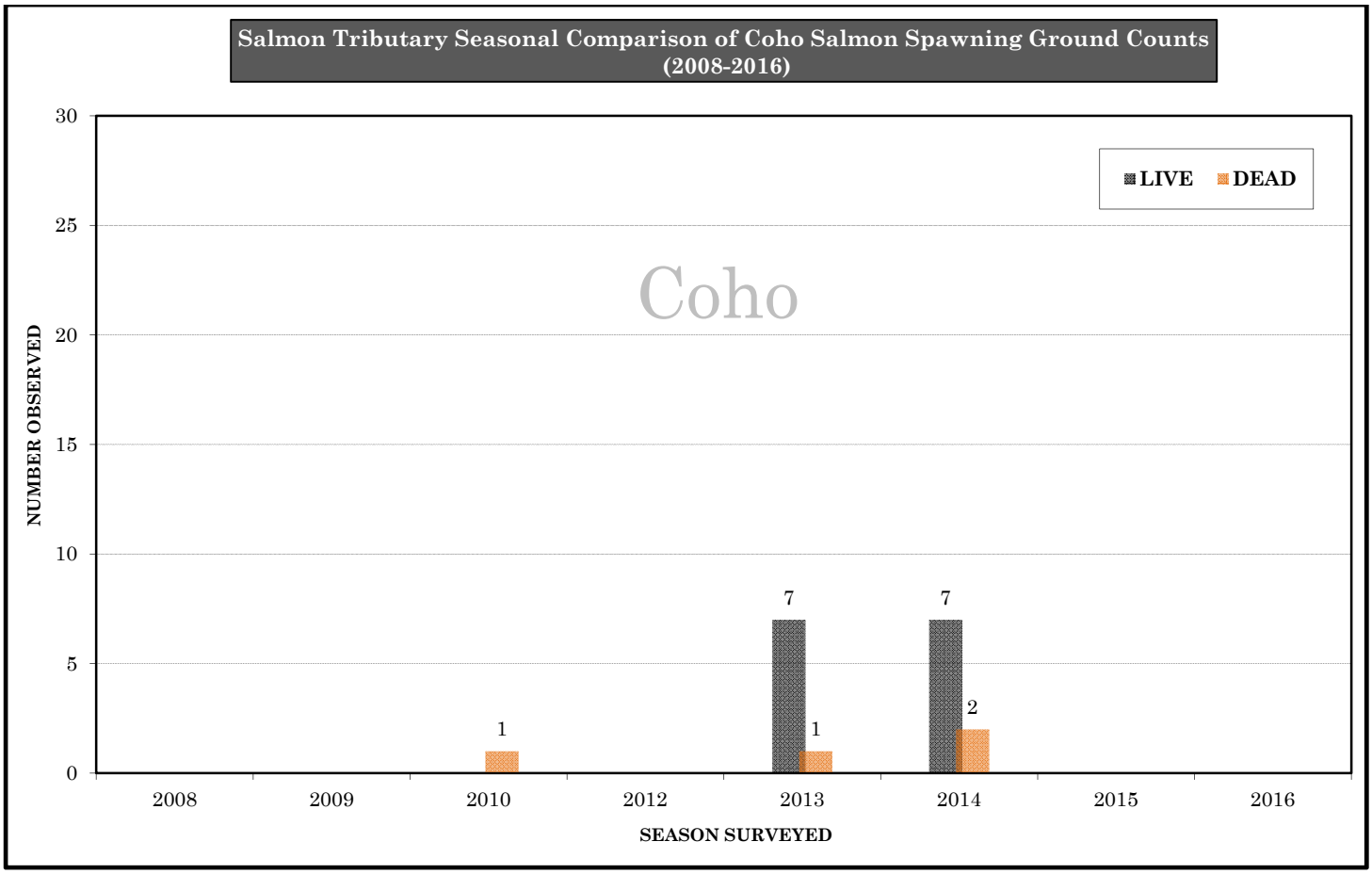
Beyond RM 0.13, the gradient increases substantially and the channel narrows. The increase in gradient and flow is by and large an obstacle to chum, which are the most abundant species to spawn in the creek. Salmon Tributary regularly supports a large run of chum salmon for a stream of its size. Chum fry will spend a brief time rearing in the creek. The process of smoltification occurs quickly and the chum will migrate towards marine waters shortly after emerging from the gravel. Prior belief that significant pre-spawning mortalities were caused by predators has proven to be incorrect. Observations over the past couple of seasons have concluded that many of the pre-spawn mortalities are associated with local dogs accessing the creek and harassing the fish by chasing them *(stranding and exhausting)* and pulling them out of the creek. Many of these fish are then preyed upon by wild animals.

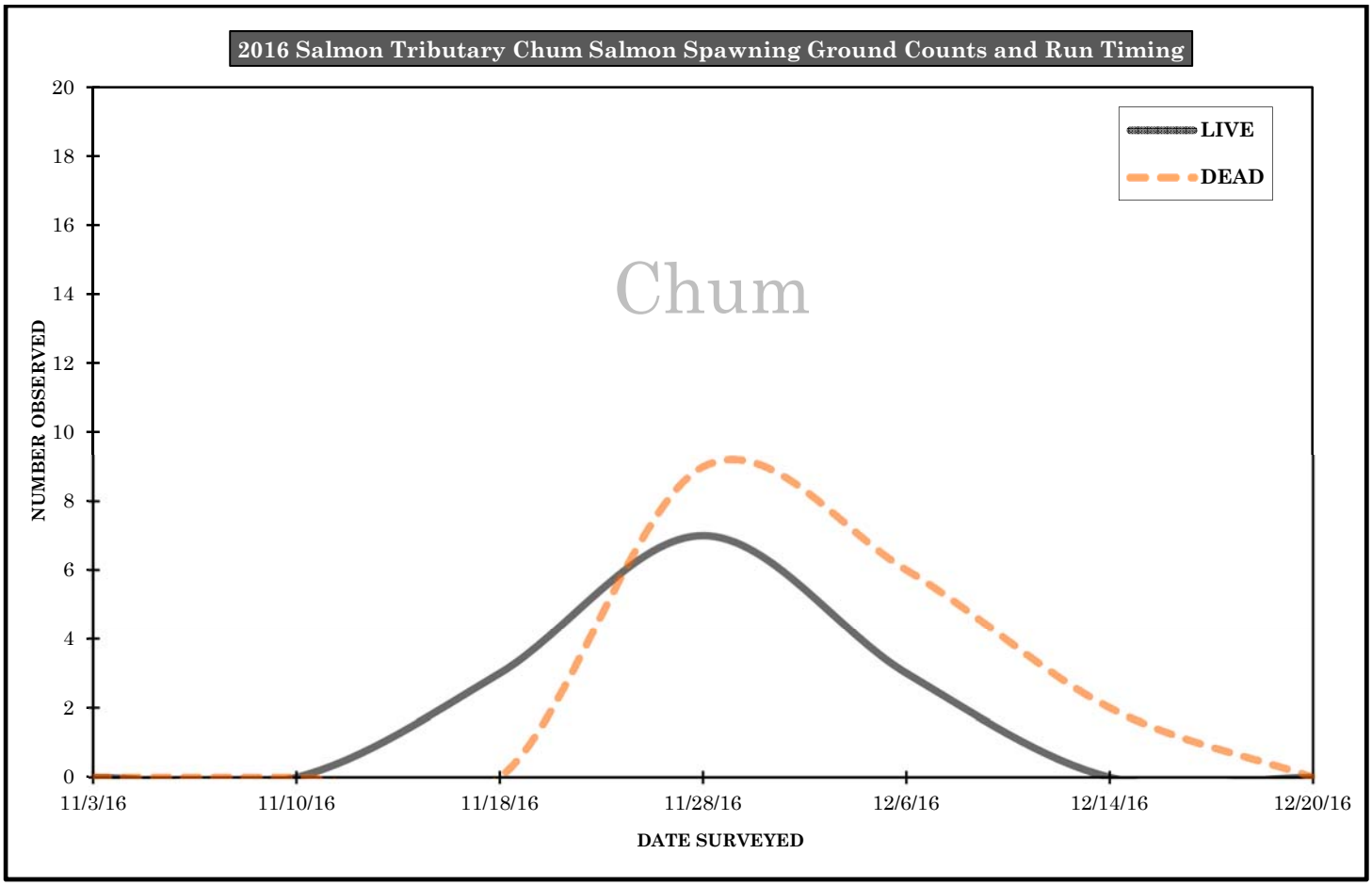
Coho are often observed in the fall spawning in the lower 250 feet of the creek. Flow in Salmon Tributary is generally too low to provide Chinook or steelhead access to spawn, yet Chinook have been observed spawning in Salmon Creek at the mouth of Salmon Tributary; as well as lower Salmon Tributary. Small, low gradient pools at the mouth provide excellent habitat for young Chinook and coho; newly emerged coho fry are regularly observed in late January and early February during the latter part of chum surveys.

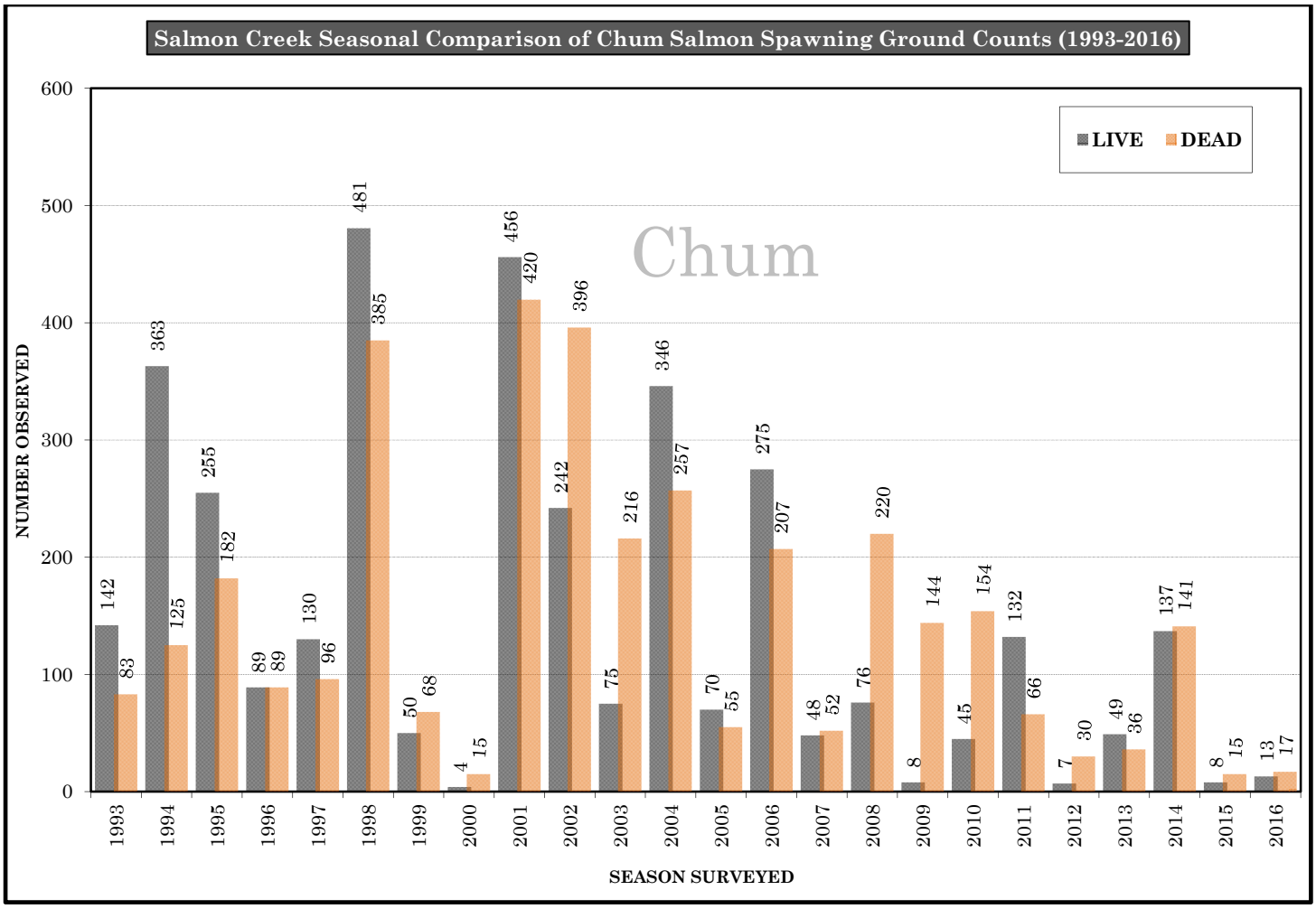


Adult Chinook escapement is determined by expanding the number of redds observed by 2.5 fish per redd (Smith and Castle, 1994). Due to the tremendous volume of pink salmon during odd years, the success of determining Chinook redds from pinks is vastly reduced. Therefore, The AUC method is used to determine escapement during pink runs (odd years).




Salmon Tributary Seasonal Comparison of Coho Salmon Spawning Ground Counts (2008-2016)
LIVE
DEAD
Coho
NUMBER OBSERVED
SEASON SURVEYED
30
25
20
15
10
5
0
2008
2009
2010
2012
2013
2014
2015
2016
1
7
1
7
2


2016 Salmon Tributary Chum Salmon Spawning Ground Counts and Run Timing
LIVE
DEAD
Chum
NUMBER OBSERVED
DATE SURVEYED
20
18
16
14
12
10
8
6
4
2
0
11/3/16
11/10/16
11/18/16
11/28/16
12/6/16
12/14/16
12/20/16


Salmon Creek Seasonal Comparison of Chum Salmon Spawning Ground Counts (1993-2016)
Chum
LIVE
DEAD
NUMBER OBSERVED
SEASON SURVEYED
0
100
200
300
400
500
600
1993 142 83
1994 363 125
1995 255 182
1996 89 89
1997 130 96
1998 481 385
1999 50 68
2000 4 15
2001 456 420
2002 242 396
2003 75 216
2004 346 257
2005 70 55
2006 275 207
2007 48 52
2008 76 220
2009 8 144
2010 45 154
2011 132 66
2012 7 30
2013 49 36
2014 137 141
2015 8 15
2016 13 17

SHAW CREEK

WRIA 10.0365

Bull Trout

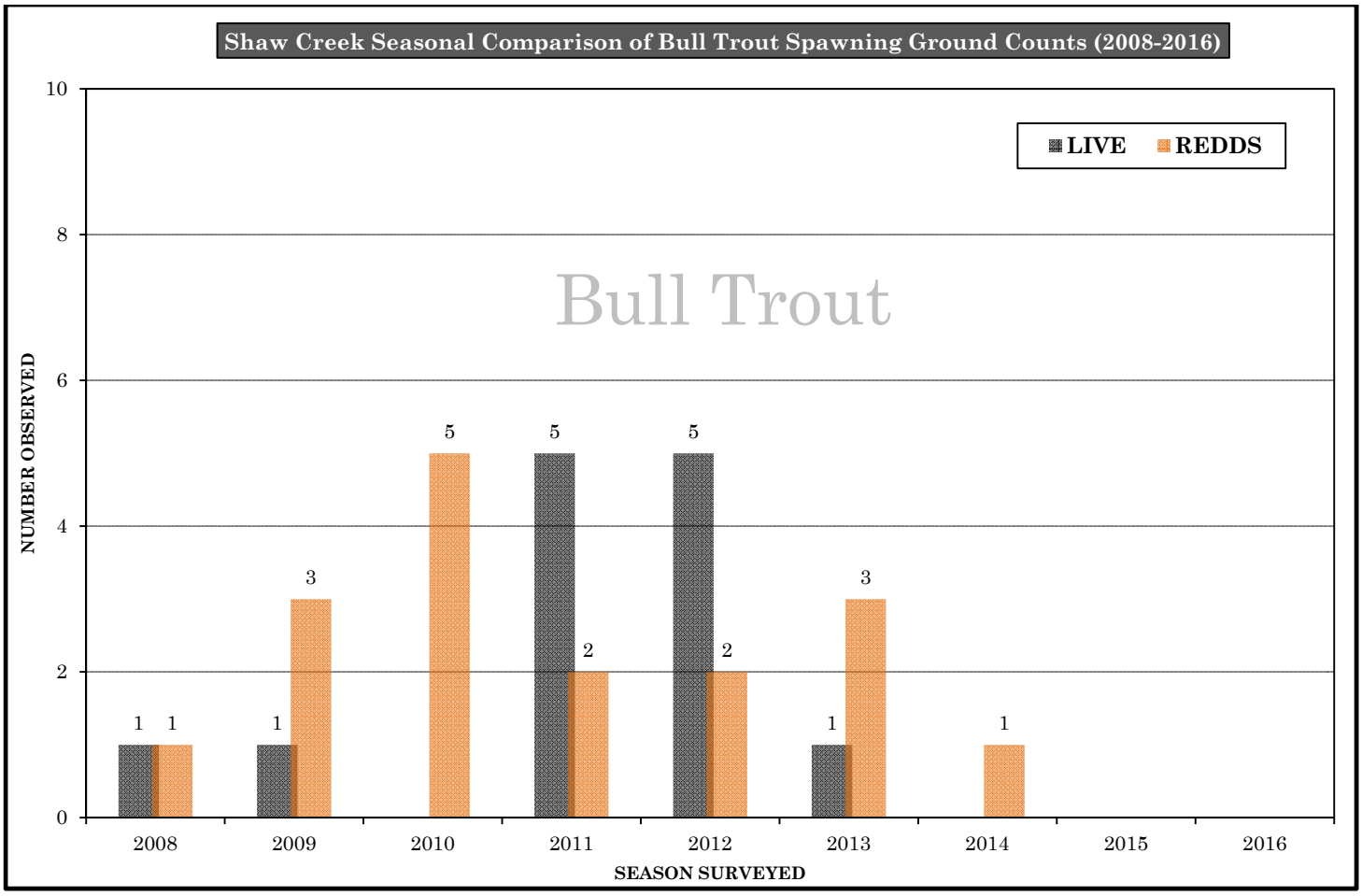
Shaw Creek is a small right bank headwater tributary of the White River. This high mountain drainage is a north facing stream flowing through the Shaw Creek Valley, between Tamanos Mountain to the west, and Governors Ridge to the east. Located entirely within Mt. Rainier National Park, the creek is non-glacial in origin; rather, its source comes from the Owyhigh Lakes located at nearly 5,200'. Shaw Creek flows for approximately 3.5 miles from Owyhigh Lakes plateau before entering the White River at approximately RM 68.8, just upstream of Klickitat Creek.

Shaw provides vital habitat conditions for bull trout *(center)* rearing and spawning. PTF surveys the creek for bull trout from late August through early October. Although bull trout spawning is consistent in this tributary, it does not experience the spawning frequency comparable to that observed in Klickitat or No Name creeks. Analogous to many headwater tributaries within the park, the lower 300-400 feet of the creek is comprised of a narrow, low gradient channel flowing within the open channel migration zone of the White River floodplain. There is no significant LWD present in this portion of the channel. Although spawning does occur within this small stretch, it is acutely limited due the lack of quality spawning substrate created by the fine alluvial deposits from the White River, and is repeatedly manipulated and affected by mainstem river incursions.

Lower Shaw Creek

Beyond the open floodplain, Shaw Creek enters the heavily forested lower slope of the valley floor as it parallels the White River. From this point, the creek channel assumes a pool-riffle configuration for approximately the next 0.65 miles. Unfortunately, only about 0.5 miles of this reach provides quality spawning and rearing opportunities. Frequently, during periods of lower flows, the creek water becomes hyporheic approximately 0.5 miles after entering the forested area; creating a provisional yet significant barrier. Furthermore, if flows are low enough, additional barriers are created throughout the wetted channel by small jumps in channel height due to bedload built-up behind LWD embedded in the channel. Fortunately, this wetted channel section provides excellent habitat for rearing; as well as spawning when flows are sufficient. Spawning gravel is abundant, as are significant logjams and in-channel LWD. In addition, numerous deep pools and side channels provide excellent habitat for juvenile and adult fish utilizing this creek.

The seasonally dry channel reach section continues beyond the Sunrise Park Road Bridge, located at approximately RM 0.62. Beyond the bridge crossing, the gradient begins to increase significantly as the stream channel begins to climb up the valley wall toward the high lakes. At this point, a series of impassable cascades marks the permanent upper extent of anadromy. The stream continues to course its way through the steep Shaw Creek Valley until reaching the Owyhigh Lakes plateau. Several small unnamed tributaries contribute additional flow to Shaw along this upper reach; unfortunately, they do not add any beneficial spawning or rearing habitat given that they are located well above the anadromous barriers.



Raw spawning data for Shaw Creek can be found in Appendix C. See Appendix B for bull trout redd locations.

SILVER CREEK

WRIA 10.0313

Silver Creek is a right bank headwaters tributary of the White River located at RM 60.5, just outside of the northern boundary of Mt. Rainier National Park. Silver Creek originates along the Crystal Mountain Ridge within the Wenatchee National Forest, and flows for over 7 miles through steep mountainous terrain, dropping nearly 3,000 feet from its source until reaching its confluence with the White River immediately West of Highway 410. Silver Creek has one major tributary; 4.4 mile Goat Creek *(10.0314)*, which enters on the right bank of Silver Creek 0.2 miles up from its mouth. Upstream of Goat Creek there are numerous smaller named and unnamed tributaries contributing flow to Silver Creek as well.

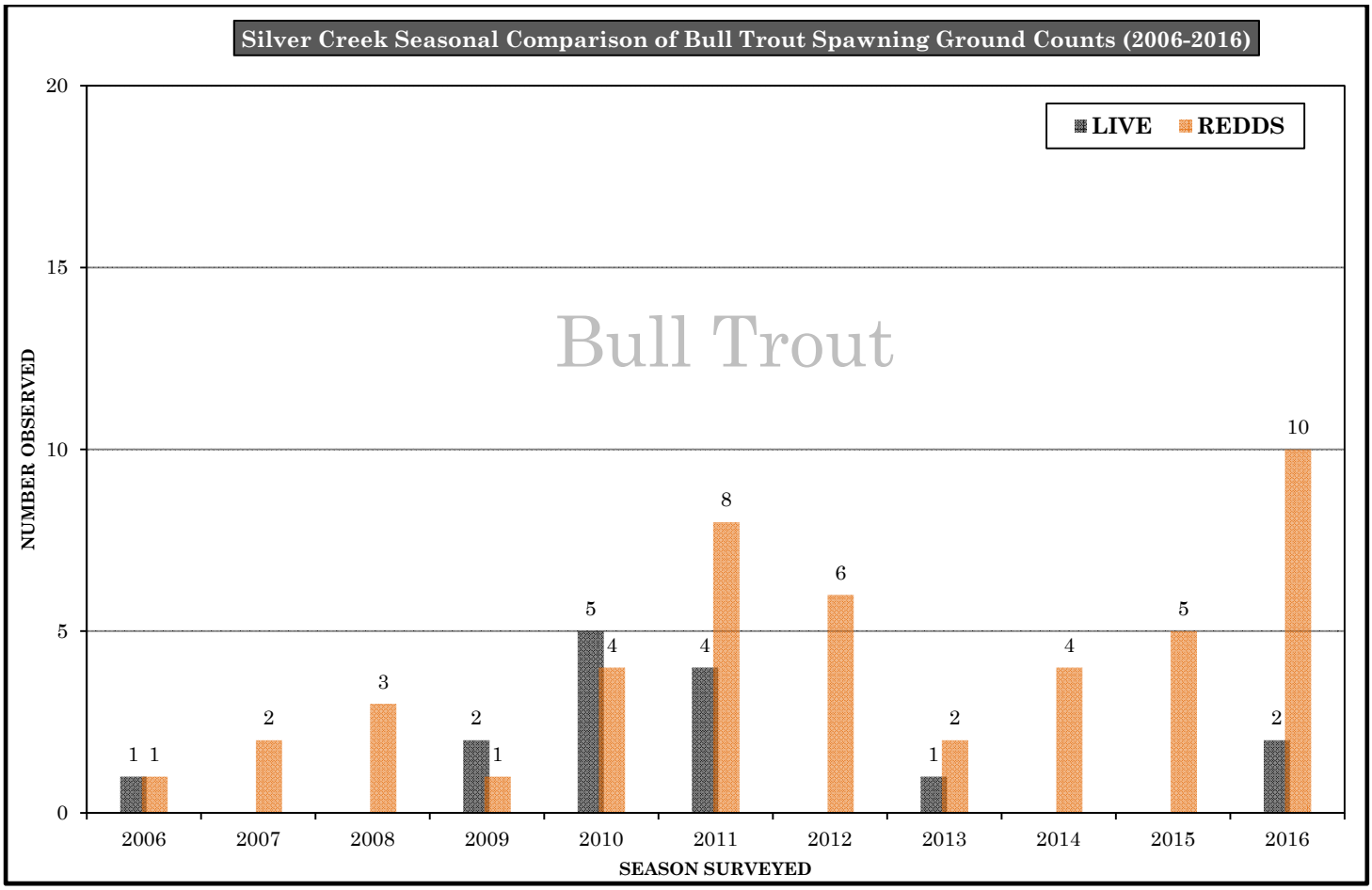
The surrounding riparian zone consists of some old growth conifers, and a mixture of younger coniferous and deciduous trees. The in-stream habitat throughout the lower 0.5 miles of Silver Creek consists of mostly moderate to high gradient cascades with shallow and moderately deep scour pools. The scour pools and some low energy pocket areas provide what little spawning habitat is available along the lower creek. Incredibly, the few spawning habitat areas available are utilized each season by bull trout. In 2007, the South Puget Sound Salmon Enhancement Group *(SPSSEG)*, with funding from the USFWS and the USFS, completed the removal of an old diversion dam suspected of causing a barrier to migrating salmon and bull trout. The removal of this aged structure has enhanced access to available spawning habitat upstream.

Bull trout, which are often observed spawning in Silver Springs, were not surveyed for in Silver Creek prior to 2006. However, in 2006 and 2007, a bull trout migration and spawning ground telemetry study was conducted by PTF on the White River. In support of the project, several bull trout captured in the USACE Buckley trap were implanted with radio transmitters. The radio tagged fish were then tracked over the next 6 months from their release site near the community of Greenwater, to several spawning sites located in the upper White River including Silver Creek. A bull trout tagged during the 2006 study was observed holding in Silver Creek prior to spawning at a site approximately 200 feet upstream from the mouth. Bull trout spawning utilization has been consist ant since surveys were initiated in 2006. Additional telemetry studies have been conducted by USFWS since 2007 *(2014-2017)*.

Although entirely feasible, steelhead utilization is currently unknown since no surveys have been conducted to determine usage. However, coho, Chinook, pink and sockeye are frequently observed in nearby Silver Springs; yet, with the exception of coho and pink salmon, PTF biologist have not observed any other salmon species spawning in Silver Creek.

In November of 2006, over 18,000 gallons of diesel fuel from a facility owned and operated by Puget Sound Energy was inadvertently released from back-up generator storage tanks. Approximately 7,900 gallons of the diesel released infiltrated Silver Creek. PSE; as well as state and federal regulatory agencies responded to the spill by conducting an emergency clean-up of contaminated soil and preventing additional fuel from entering Silver Creek.

Also of interest, Silver Creek is the final resting place of Henry C. Allen *(1848-1898)*; a civil war veteran and Purple Heart recipient who fought with the 16th Wisconsin Infantry, then relocated to the region after the war. He was found frozen near his trap lines in the winter of 1898, and was subsequently buried on site.



Raw spawning data for Silver Creek can be found in Appendix C.

SILVER SPRINGS CREEK

WRIA 10.0332A

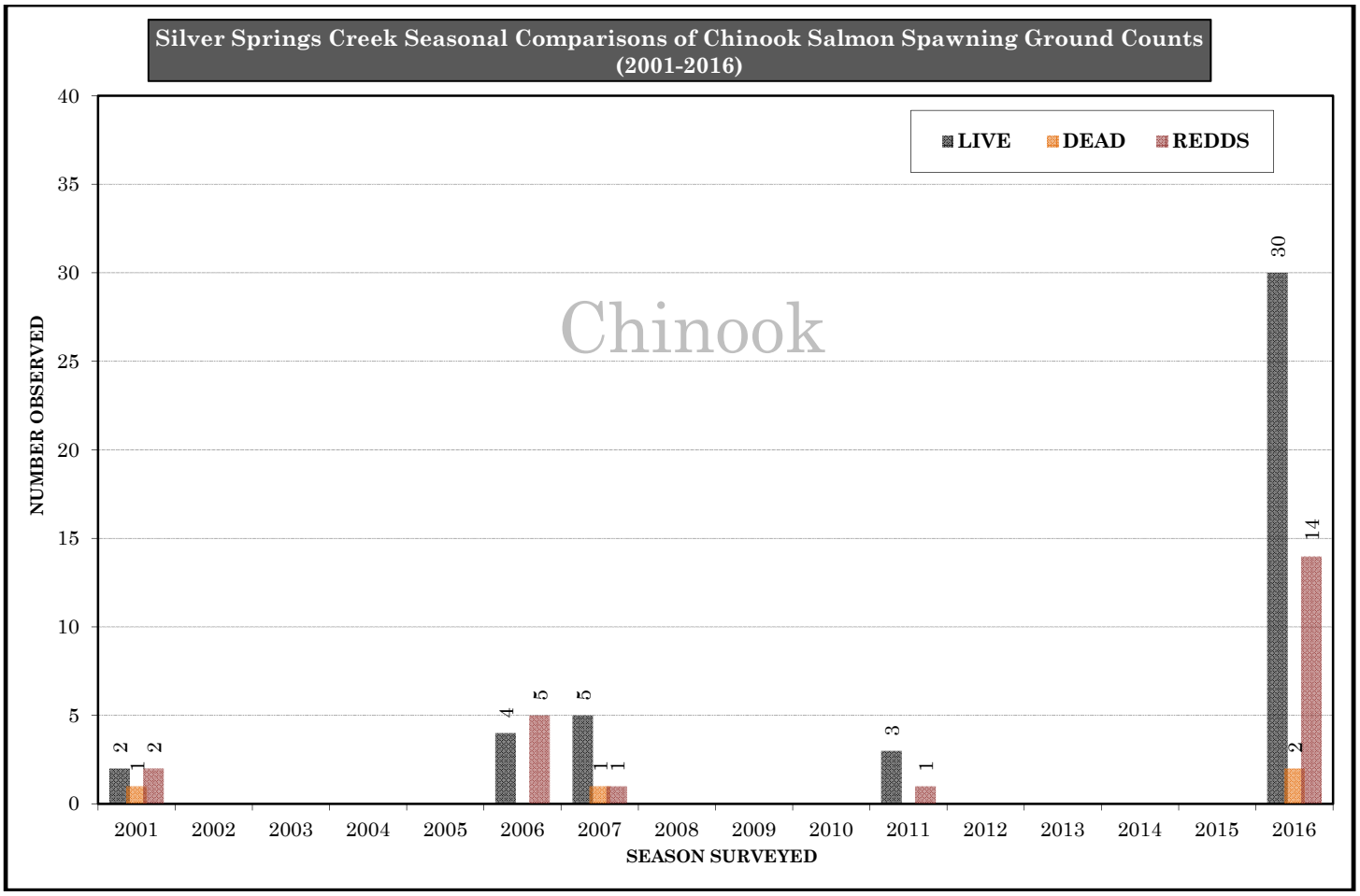
Silver Springs is a short, spring-fed headwater tributary to the White River *(RM 60.5)*. With its clear and consistent flow, this cool spring offers excellent spawning and rearing habitat for several species of salmonids. Erupting from a small bench along the forest floor within the Silver Springs Campground; this spring creek runs adjacent to Hwy. 410, approximately 0.5 mile north of the Mt. Rainier National Park boarder. Silver Springs flows for approximately 0.3 miles within a low gradient pool riffle channel. At a point along the lower creek, the channel passes through an undersized, yet fish passable culvert.

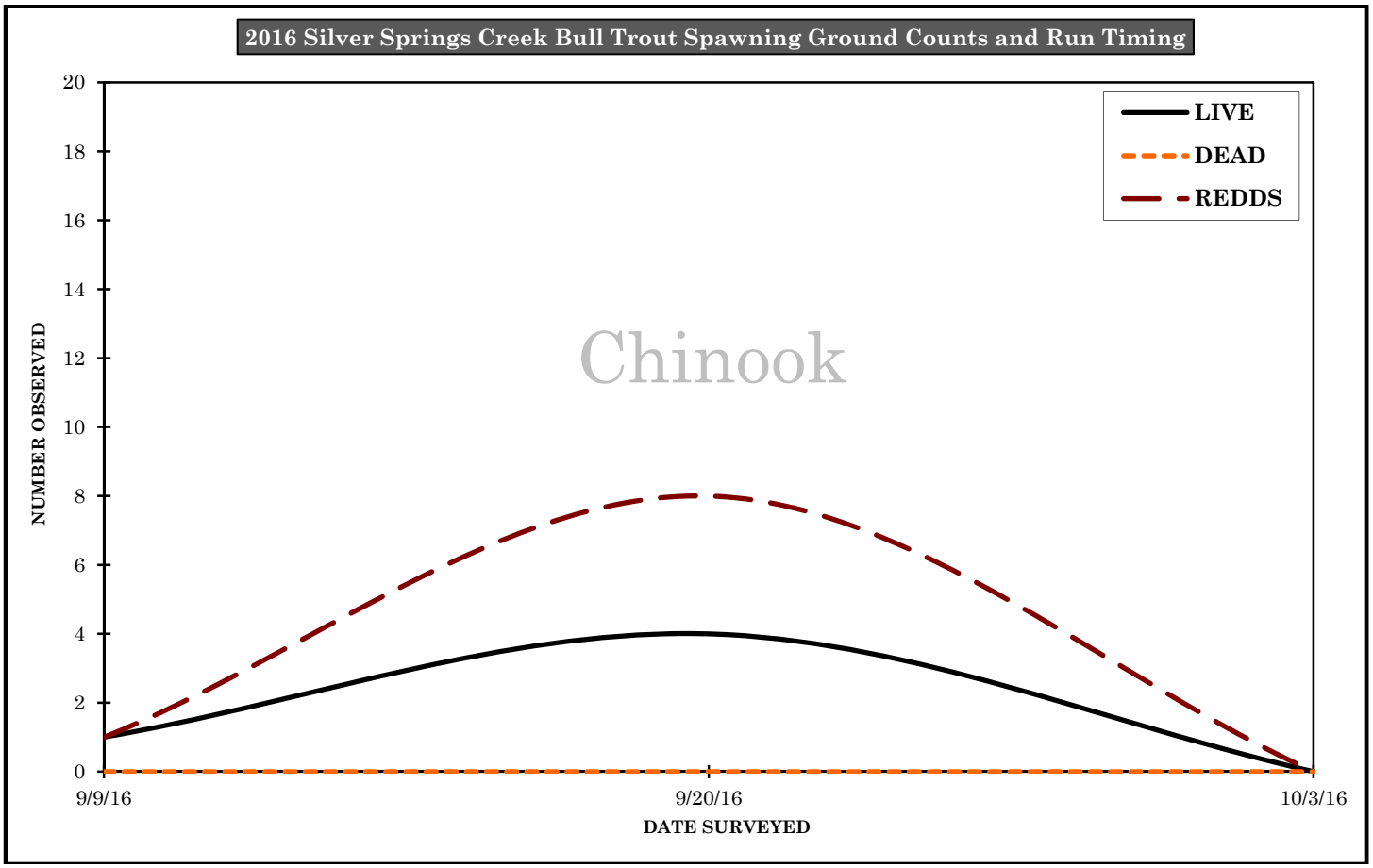
The creek contains a moderate amount of interactive in-stream LWD, in addition to one significant long-term woody debris jam located in the lower channel. The overstory riparian consists largely of mature conifers, in addition to several hardwoods located near the confluence with the White River and Silver Creek. Typical of this type of stream, the substrate is made up primarily of sand and small gravel. However, several pockets of excellent spawning gravel are present throughout the reach, although it is frequently obscured by fine sand. The entire channel of Silver Springs runs within the channel migration zone of the White River, and has on occasion been inundated by silt and woody debris from the White during high-water and flood events. In addition, the mouth of Silver Creek has frequently been relocated a couple of hundred feet due to mainstem river incursions.

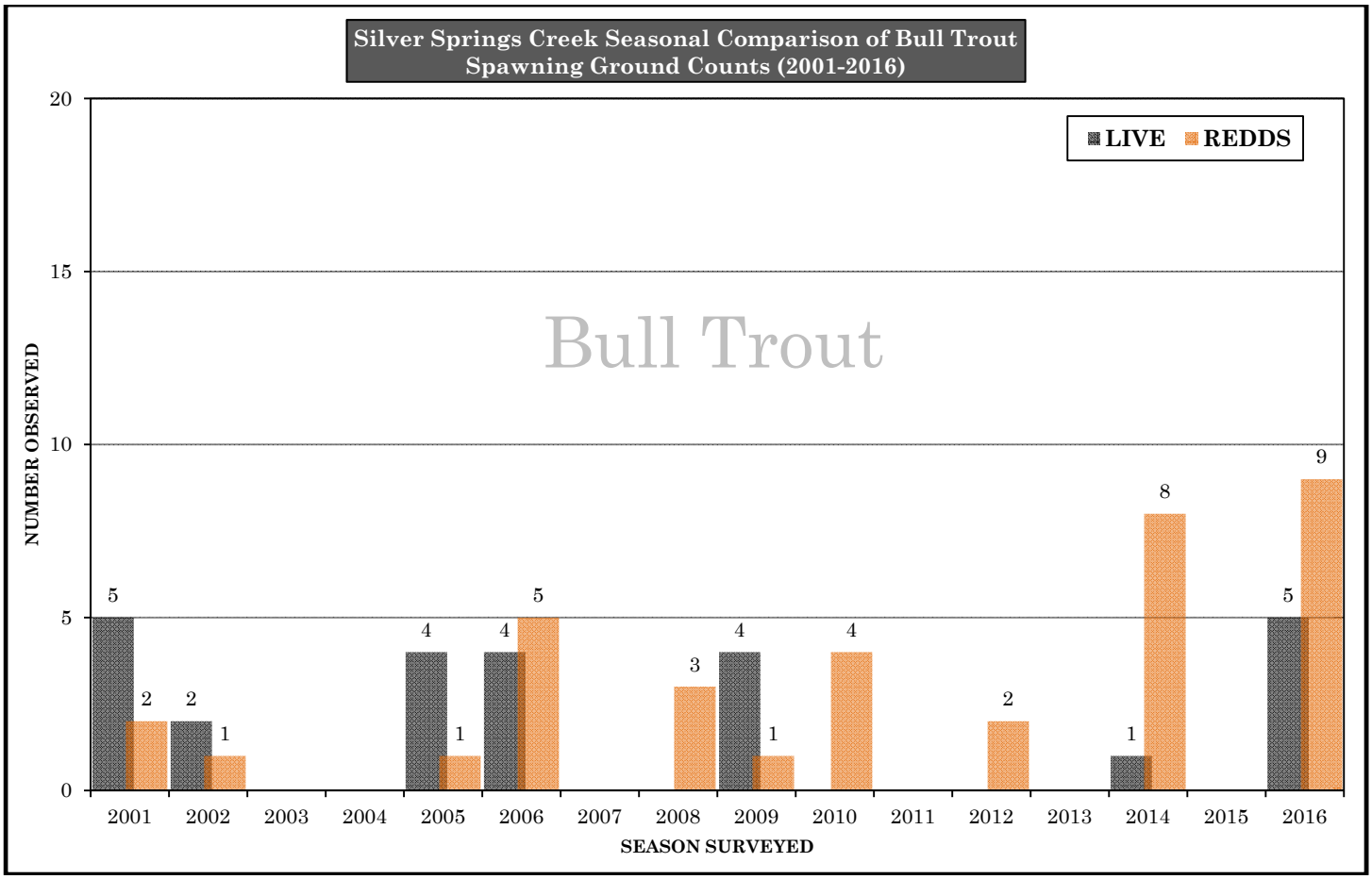
Silver Springs is principally a coho stream; however, several species including Spring Chinook, sockeye, pink salmon, and bull trout have been documented spawning in the creek. Although steelhead are present in the upper watershed, their utilization of Silver Springs is unknown. With the exception of coho, other species documented in the creek have not been observed spawning on consistent annual basis. A small number of Chinook have been observed spawning over the past decade *(`01, `06, `07, `11, and 2016)*. Pink salmon have been observed spawning in the creek on odd years since 2003; as well as a couple of sockeye *(`03, `04, `05, `07 & `09)*.

Adult salmon spawning in Silver Springs Creek were previously captured at the USACE fish trap in Buckley, and transported above Mud Mountain dam. Since precise escapement numbers are known, surveys are conducted to determine fish distribution and spawning success. Silver Springs is the second highest point at which adult salmon are observed; several hundred pink salmon were observed in Sunrise Creek in 2015 *(first pinks observed in 2007)*. Sunrise is located 2.5 miles upstream, inside Mt. Rainier National Park, making it the highest salmon migration point documented by PTF staff.

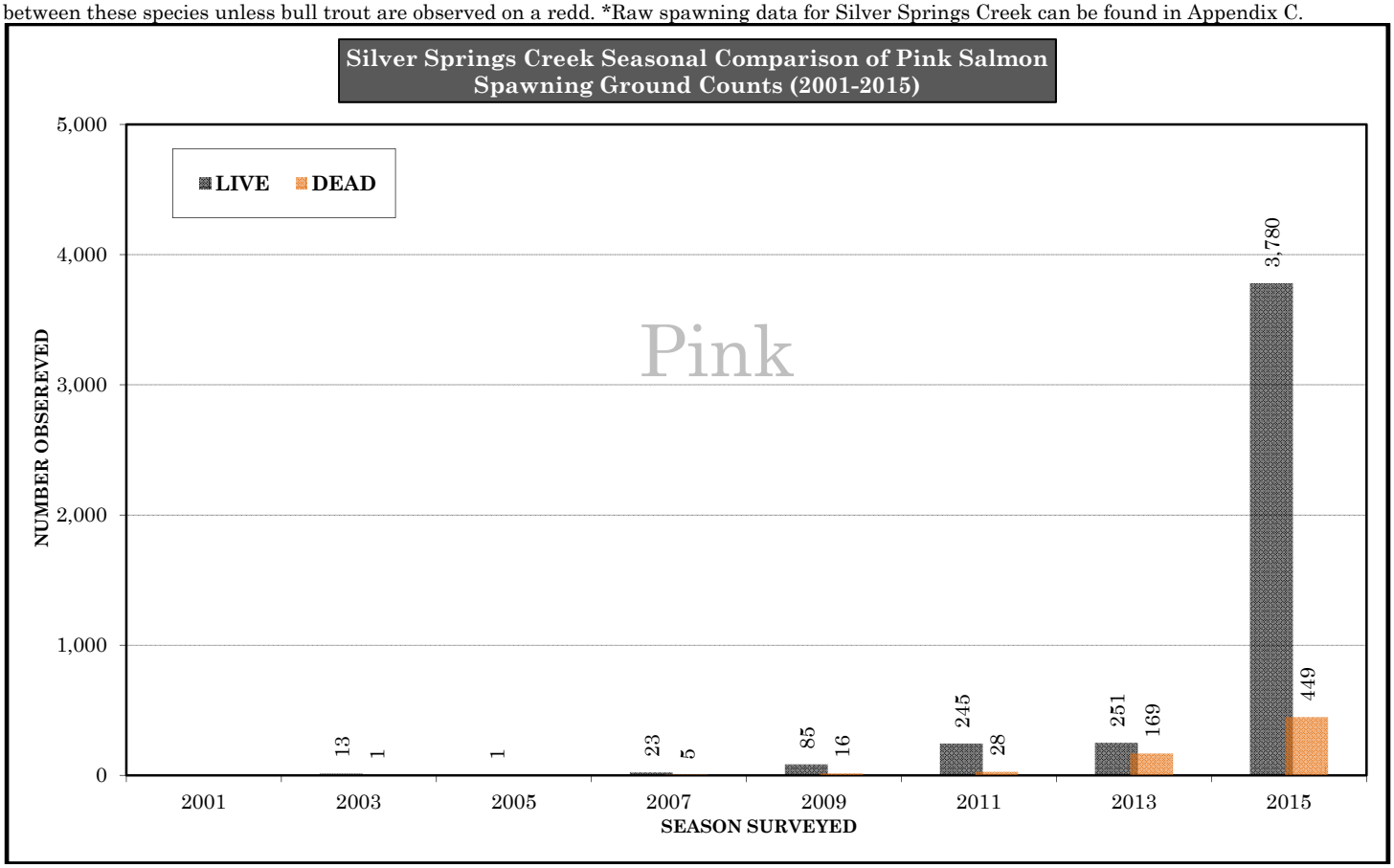
Bull trout spawning in Silver Springs generally commences in early September. However, bull trout spawning in Silver Springs is somewhat inconsistent. It's conceivable the creeks proximity to campsites, as well as two foot bridges plus a road crossing, and the presence of campers may disrupt bull trout spawning. The campground is open and active through the first week of October; then closes for the season just as coho are arriving. Determining bull trout escapement in Silver Springs Creek on odd years is extremely difficult due the presence of pink salmon spawning in the creek as well. Bull trout spawning is based on the observations of redds; when other species utilize the same habitat, redds are indistinguishable between these species unless bull trout are observed on a redd.


Silver Springs Creek Seasonal Comparisons of Chinook Salmon Spawning Ground Counts (2001-2016)
LIVE
DEAD
REDDS
Chinook
NUMBER OBSERVED
SEASON SURVEYED
0
5
10
15
20
25
30
35
40
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2
1
2
4
5
5
1
1
3
1
30
2
14


2016 Silver Springs Creek Bull Trout Spawning Ground Counts and Run Timing
LIVE
DEAD
REDDS
Chinook
NUMBER OBSERVED
DATE SURVEYED
0
2
4
6
8
10
12
14
16
18
20
9/9/16
9/20/16
10/3/16



Determining bull trout escapement in Silver Springs Creek on odd years is extremely difficult due the presence of pink salmon spawning in the creek as well. Bull trout spawning is based on the observations of redds; when other species utilize the same habitat, redds are indistinguishable between these species unless bull trout are observed on a redd. *Raw spawning data for Silver Springs Creek can be found in Appendix C.



SPRING CREEK

WRIA 10.0430

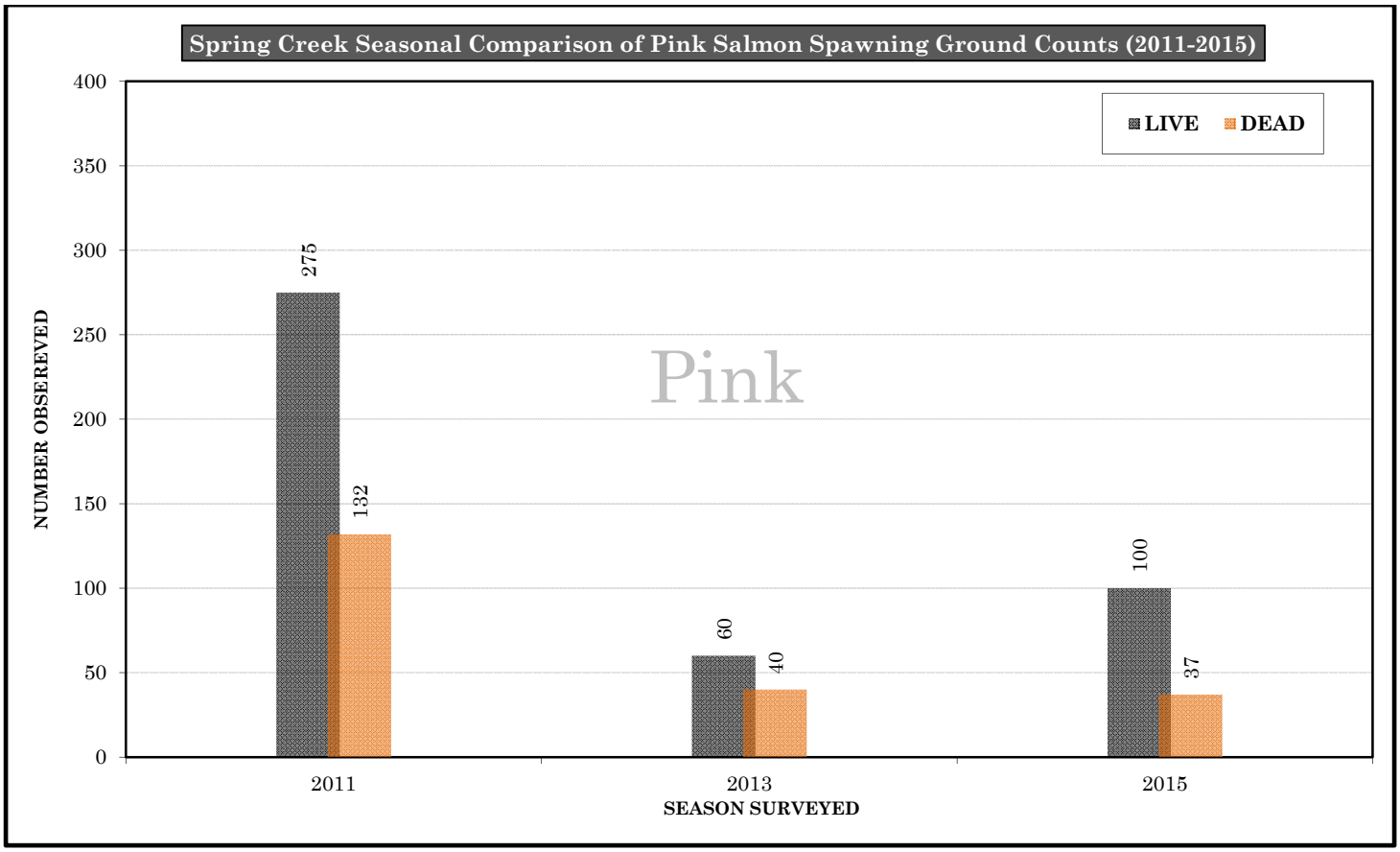
Spring Creek, also known as, South Silver Springs Creek, is a short spring-fed tributary to South Prairie Creek *(RM 4)*. Prior to the fall of 2010, the majority of the creek was inaccessible to adult and juvenile salmon. In addition to the lack of fish access, the lower reach of the creek was void of any suitable spawning habitat for salmon due to decades of agricultural and commercial land use *(U-fish trout farm)*.

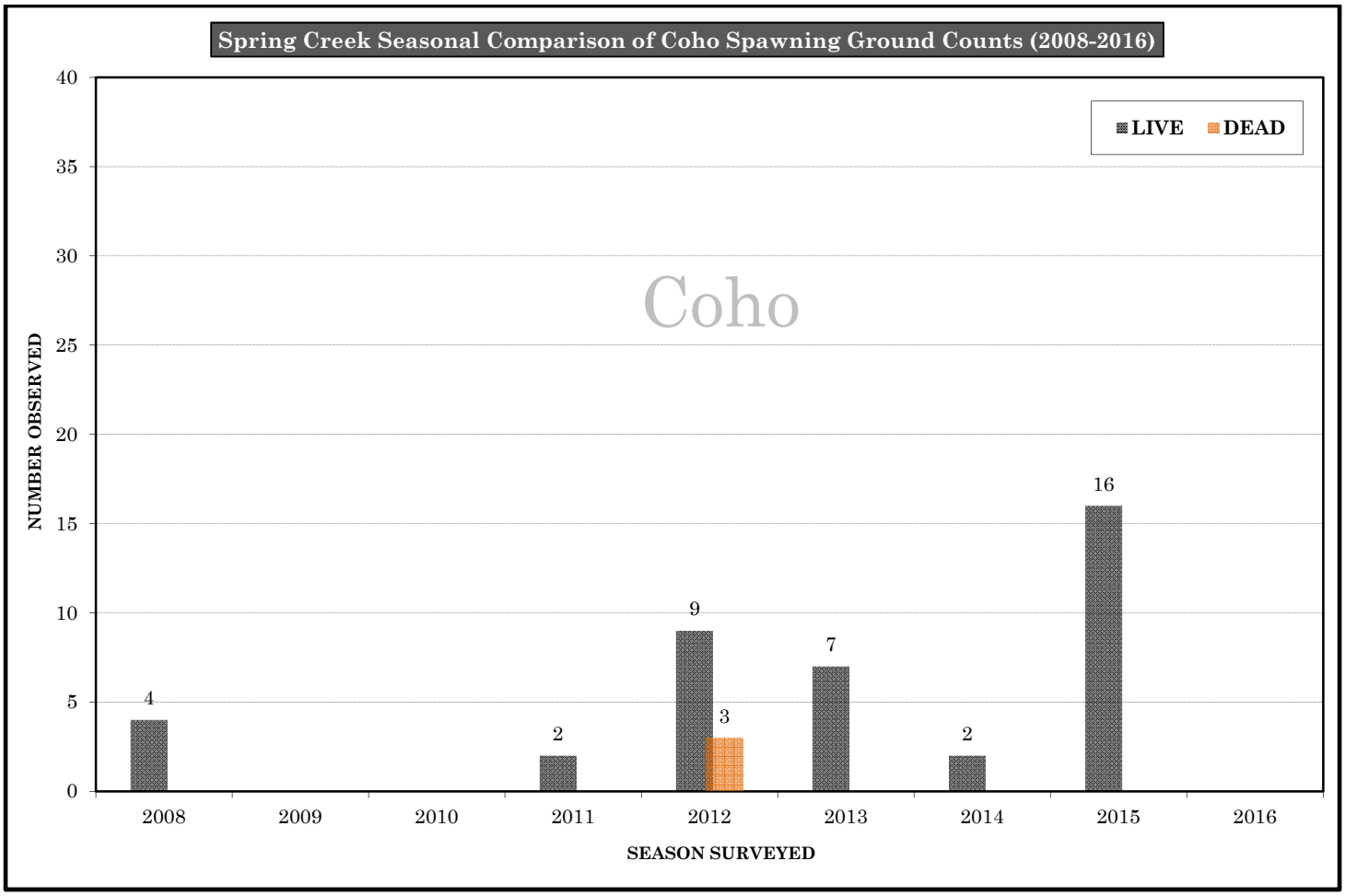
As part of a significant restoration project conducted by Pierce County; a new channel was completed along the lower stream reach in September 2010. The restoration project included increasing the mainstem channel and off-channel length by nearly 1,300'. In addition to increasing channel length, significant improvements were made to stream complexity, spawning and rearing habitat; as well as, the connectivity to tributaries and surrounding floodplain. The project involved regrading and enhancing nearly 13 acres of adjacent wetland habitat via the removal of non-native invasive weeds and plants, then instituting a substantial planting plan of native trees and ground cover.

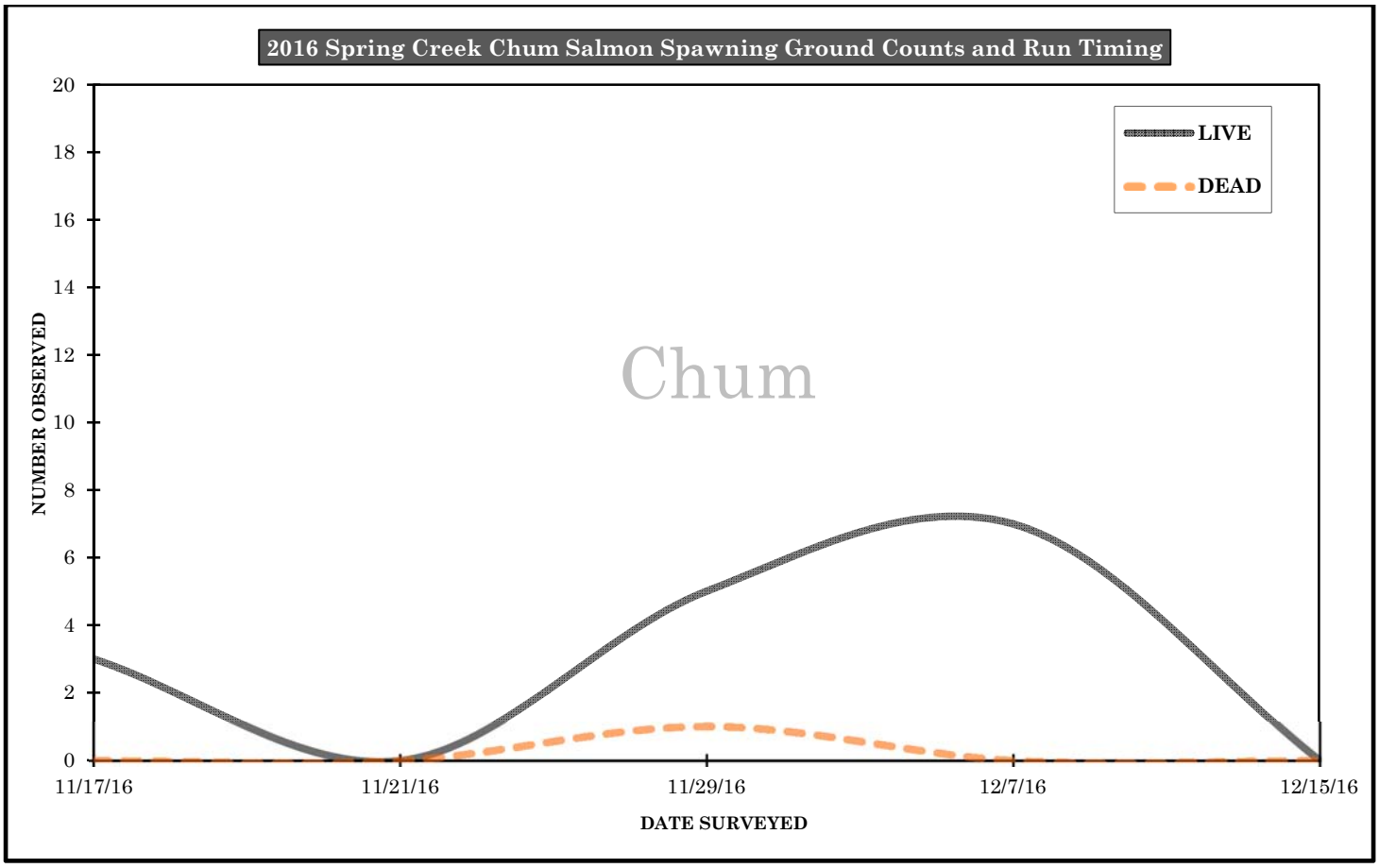
The spring currently offers improved spawning and rearing habitat for several species of salmonids including coho, chum, pink, rainbow and cutthroat. Adult chum have utilized the creek since the initial 2010 fall/winter spawning season; yet, the first adult pink and coho were not observed until the 2011 spawning season. However, the creek has already proven to be an invaluable overwintering source for juvenile coho since its restoration.

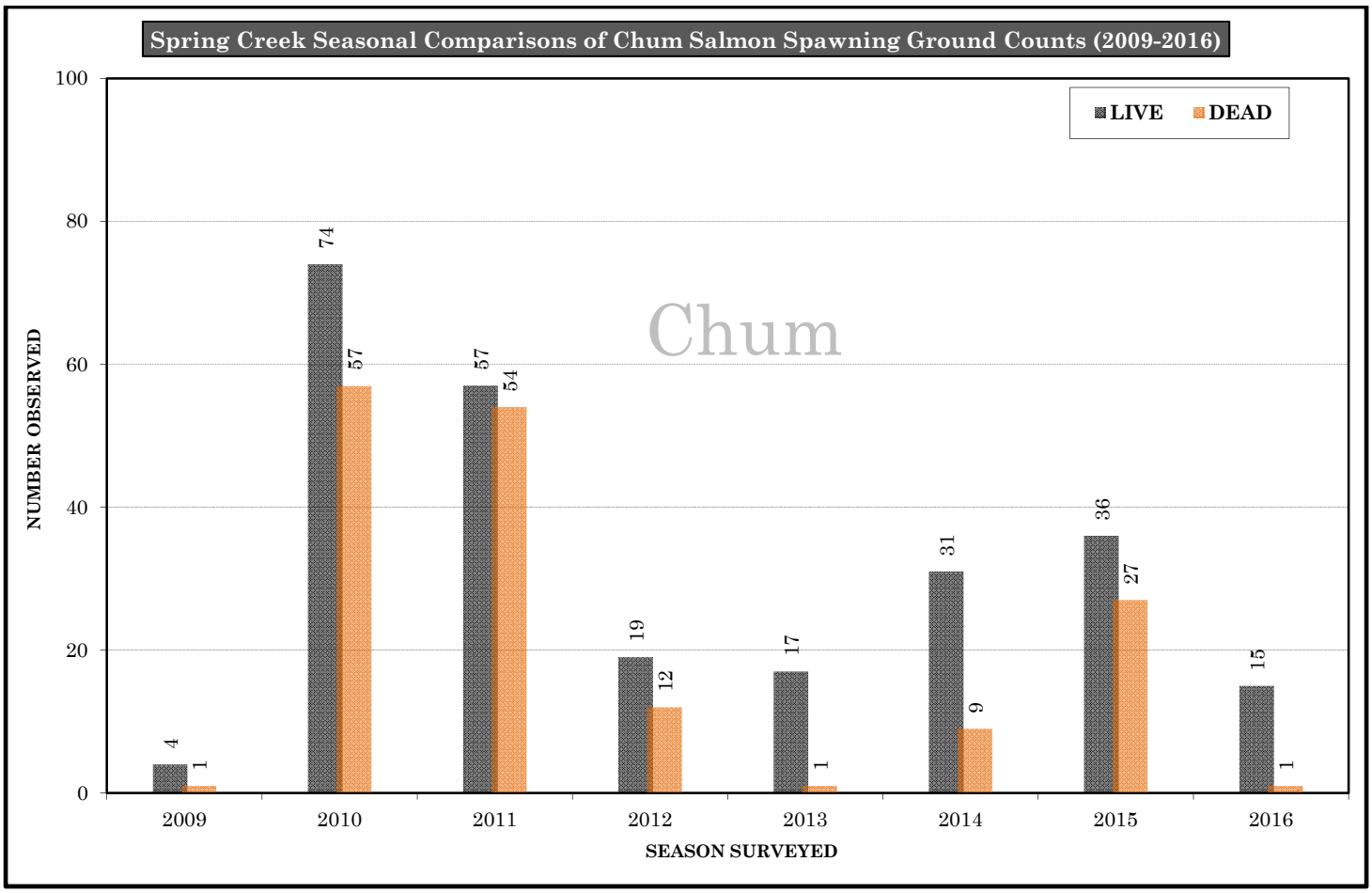
Erupting from a small bench along the forest floor; Spring Creek runs adjacent to Spring Site Rd E, just south of the town of South Prairie. Spring Creek flows for approximately 0.4 miles within a low gradient pool riffle channel. The creek contains a moderate amount of interactive in-stream LWD; in addition to significant long-term woody debris jams toed into the lower channel reach *(top photo)*. Additional flow is contributed via a small spring tributary flowing under Spring Site Rd. and entering Spring Creek at approximately RM 0.15. The overstory riparian along the upper reach consists largely of mature hardwoods and conifers; however, the lower reach is void of riparian cover until plantings from winter of 2011 mature. Since the project's completion, several hundred feet of the lower channel within the restoration area has become subjected to periodic influxes of watercress (*above)*. Typical of this stream type, the substrate is made up largely of fines and small gravel; though, several pockets of excellent spawning gravel are present throughout the lower spawning reach. The reach upstream of the restoration is heavily forested and vegetated, and is commonly the site of recurrent beaver (*Castor canadensis*) activity. This upper reach is dominated by cutthroat, which had been the primary species in the creek for many years.

Watercress inundated channel


Spring Creek Seasonal Comparison of Pink Salmon Spawning Ground Counts (2011-2015)
LIVE
DEAD
Pink
NUMBER OBSEREVED
SEASON SURVEYED
2011
2013
2015
275
132
60
40
100
37
0
50
100
150
200
250
300
350
400


Spring Creek Seasonal Comparison of Coho Spawning Ground Counts (2008-2016)
LIVE
DEAD
Coho
NUMBER OBSERVED
SEASON SURVEYED
2008
2009
2010
2011
2012
2013
2014
2015
2016
4
2
9
3
7
2
16
0
5
10
15
20
25
30
35
40


2016 Spring Creek Chum Salmon Spawning Ground Counts and Run Timing
LIVE
DEAD
Chum
NUMBER OBSERVED
0
2
4
6
8
10
12
14
16
18
20
11/17/16
11/21/16
11/29/16
12/7/16
12/15/16
DATE SURVEYED


Spring Creek Seasonal Comparisons of Chum Salmon Spawning Ground Counts (2009-2016)
LIVE
DEAD
Chum
NUMBER OBSERVED
0
20
40
60
80
100
4
1
74
57
57
54
19
12
17
1
31
9
36
27
15
1
2009
2010
2011
2012
2013
2014
2015
2016
SEASON SURVEYED

SOUTH PRAIRIE CREEK

WRIA 10.0429

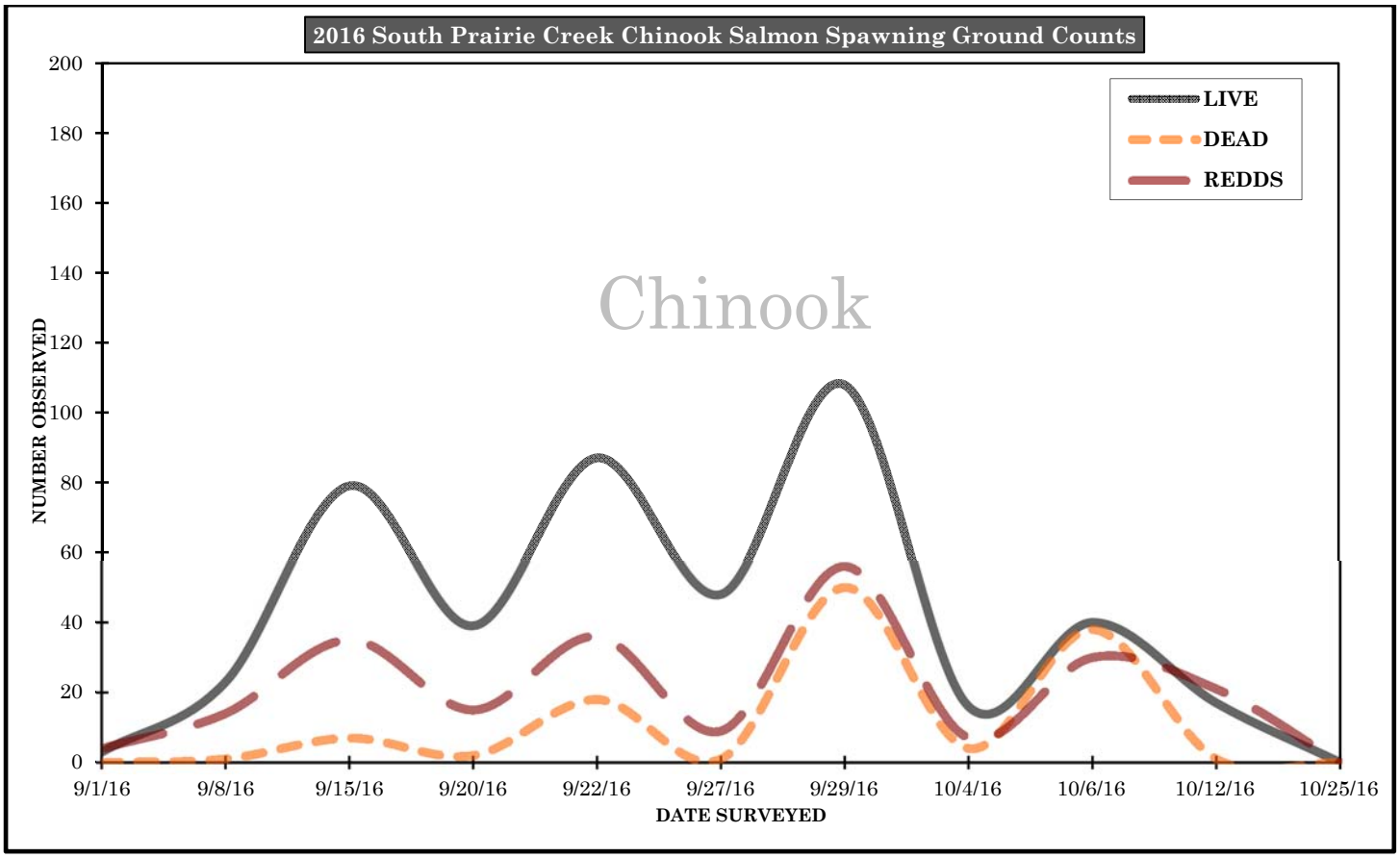
South Prairie Creek is a major tributary of the Carbon River, entering the Carbon near RM 6, just downstream of the Highway 162 and Foothills Trail bridge crossings. With a drainage area over 90 mi^2, South Prairie Creek is considered one of the most fish productive drainages in the Puyallup/White River Watershed. The headwaters originate along the northwest foothills of Mt. Rainier within the Mt. Baker-Snoqualmie National Forest. The mainstem creek flows for over 21.5 miles; coursing its way through or near the communities of Wilkeson, Burnett and South Prairie. The creek offers critical spawning and rearing habitat for adult and juvenile salmonids including; Chinook, pink, coho, chum and steelhead. Bull trout have been observed and captured in the creek; however, distribution, population size and overall utilization are unknown. Limiting factors associated with South Prairie include; low summer flows, channel confinement and narrowing, bank erosion, disconnected floodplain, water quality *(303 (d) listed for temperature)*, areas of deficient riparian cover, and invasive plant species.

The anadromous range extends roughly the first 15 miles of the mainstem; a series of impassable falls near RM 15.4 prevents any further upstream migration. Tributaries including Wilkeson, Spiketon, Beaver, plus several unnamed tributaries add miles of additional spawning and rearing habitat, as well as flow contributions.

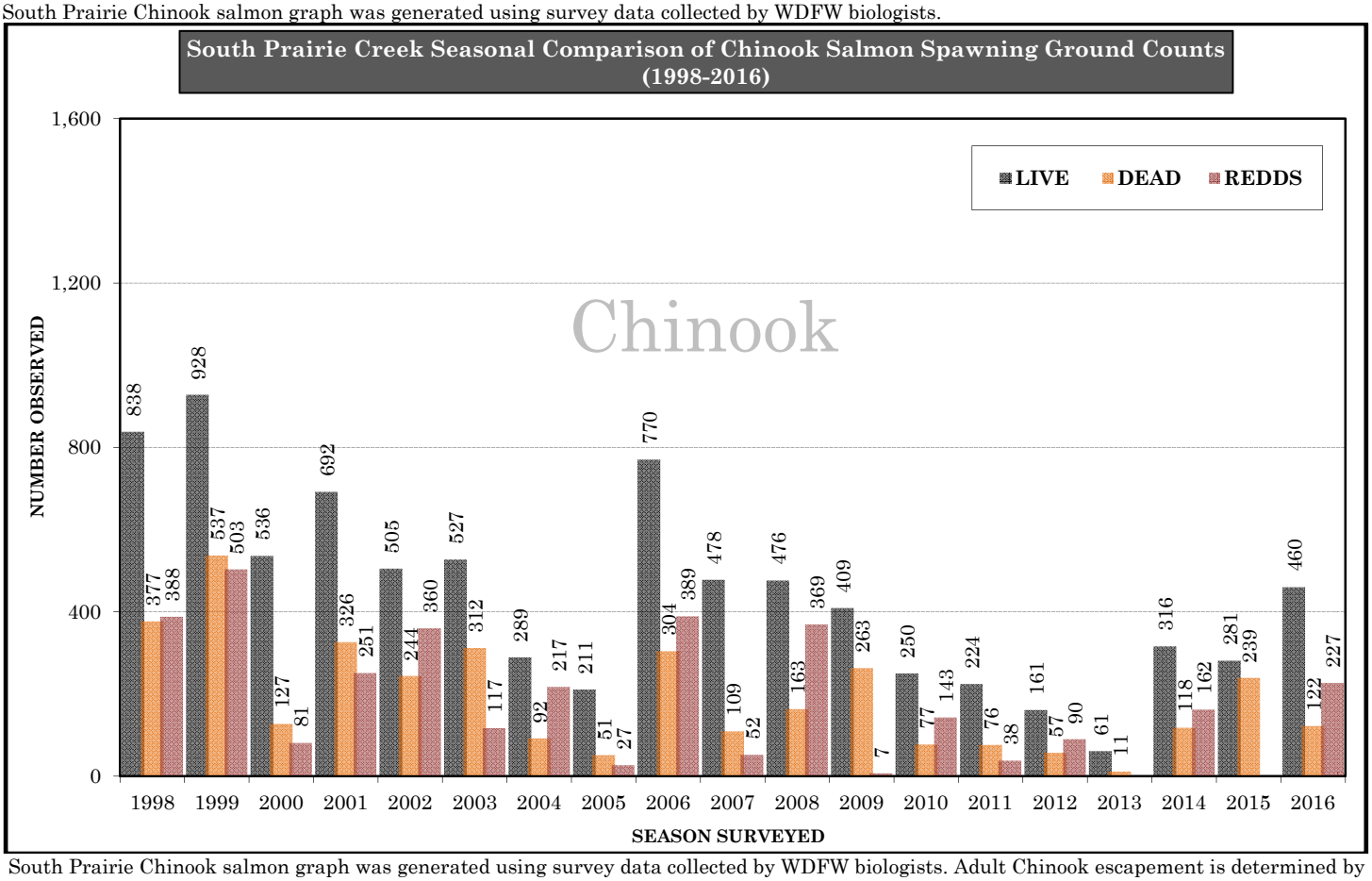
From the mouth, upstream to RM 12.6, the stream is typically a low to moderate gradient pool-riffle channel with many deep pools and a few short low gradient cascades. The lower 8 miles flows within a broad valley floor and spawning opportunities for all species is abundant throughout. Land use along this section is mainly agricultural and recreational. Chinook spawning occurs primarily within the lower 8 miles, while coho show increased usage throughout the middle and upper reaches of the 15 mile anadromous section of the creek. South Prairie experiences a unique late-run of coho, which often spawn into late February and early March. Chum regularly utilize the lower 3 miles heavily, but are frequently observed well above RM 10. Steelhead utilize areas along the entire stream below the barrier falls; however, usage is reduced in the canyon reach below the falls. The valley walls narrow significantly above RM 8; at this point the creek channel becomes more confined and the gradient increases. Spawning and rearing opportunities are still prevalent here, as is the increase in LWD and LWD inputs from the surrounding forest.

From RM 12.6 to the falls at RM 15.4, the channel gradient increases substantially and the creek channel becomes moderately to extremely confined within a steep canyon. Spawning and rearing opportunities are severely reduced or non-existent. Spawning gravel is scarce in this upper reach and many heavily scoured bedrock segments exist.

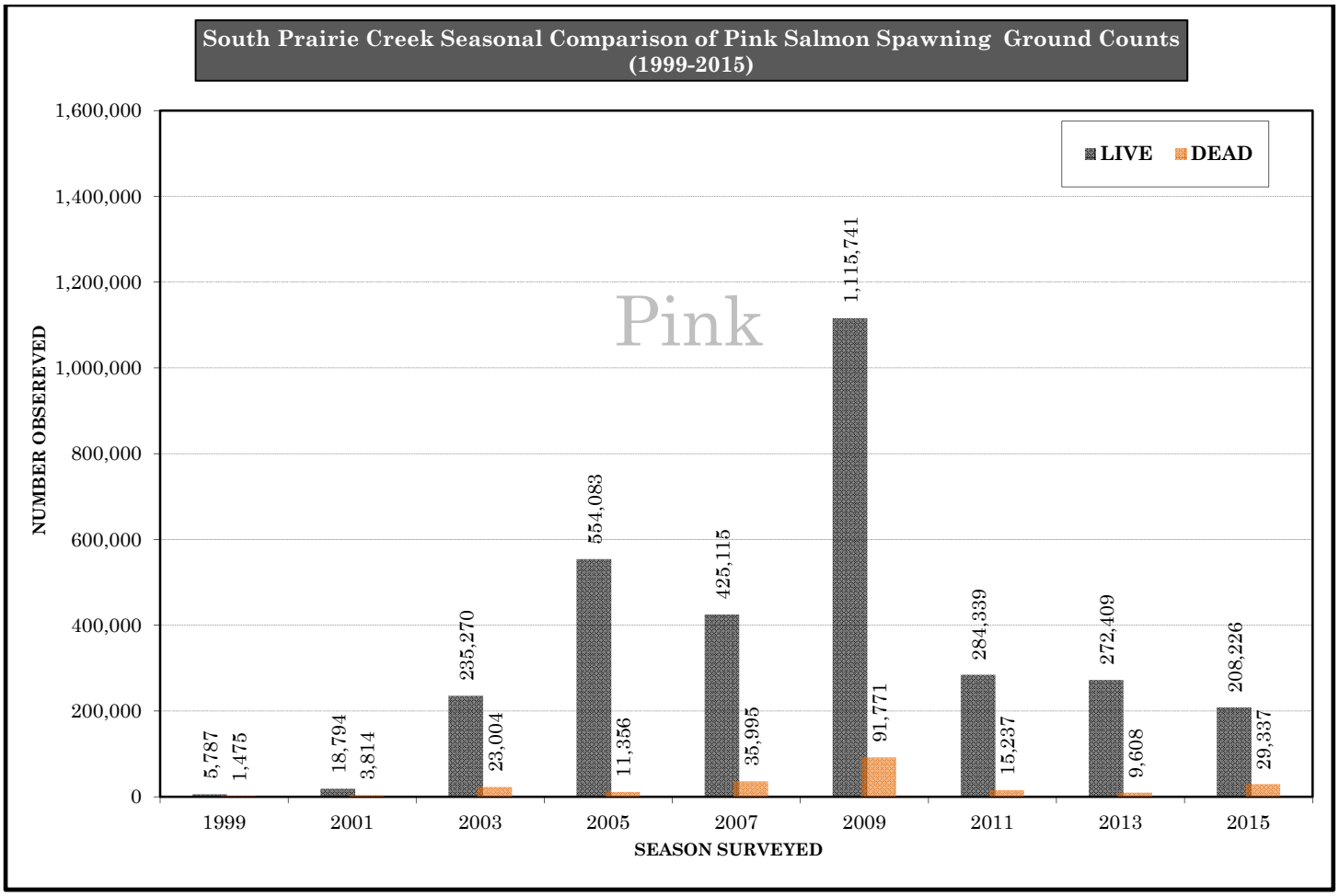
The riparian zone changes dramatically throughout the 15.4 miles of anadromous access. The upper canyon reach flows through a commercial forest and streamside vegetation consists of second growth fir and alder. Buffer widths along recent harvest areas are generally wider than the state regulated minimum due to steep, potentially unstable slopes along the canyon. From RM 12.6 down to RM 6.0, the riparian zone is relatively intact, consisting of mature hardwoods and firs. Below this point, to the confluence, significant portions of the banks are armored and streamside residential development is common. Much of the lower 6 miles flows through active agricultural land where alder and cottonwood are the most common streamside tree species.



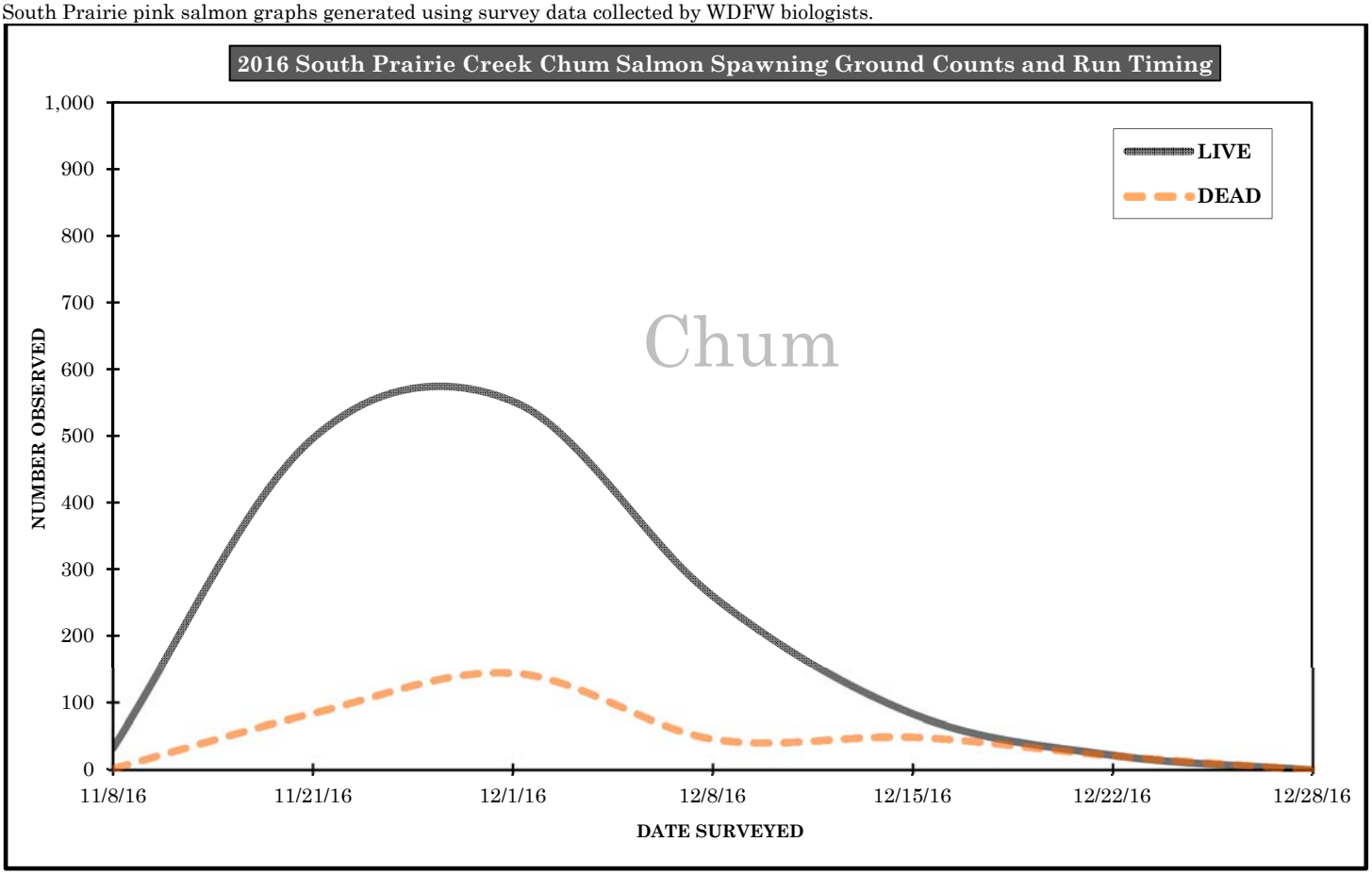
South Prairie Chinook salmon graph was generated using survey data collected by WDFW biologists.

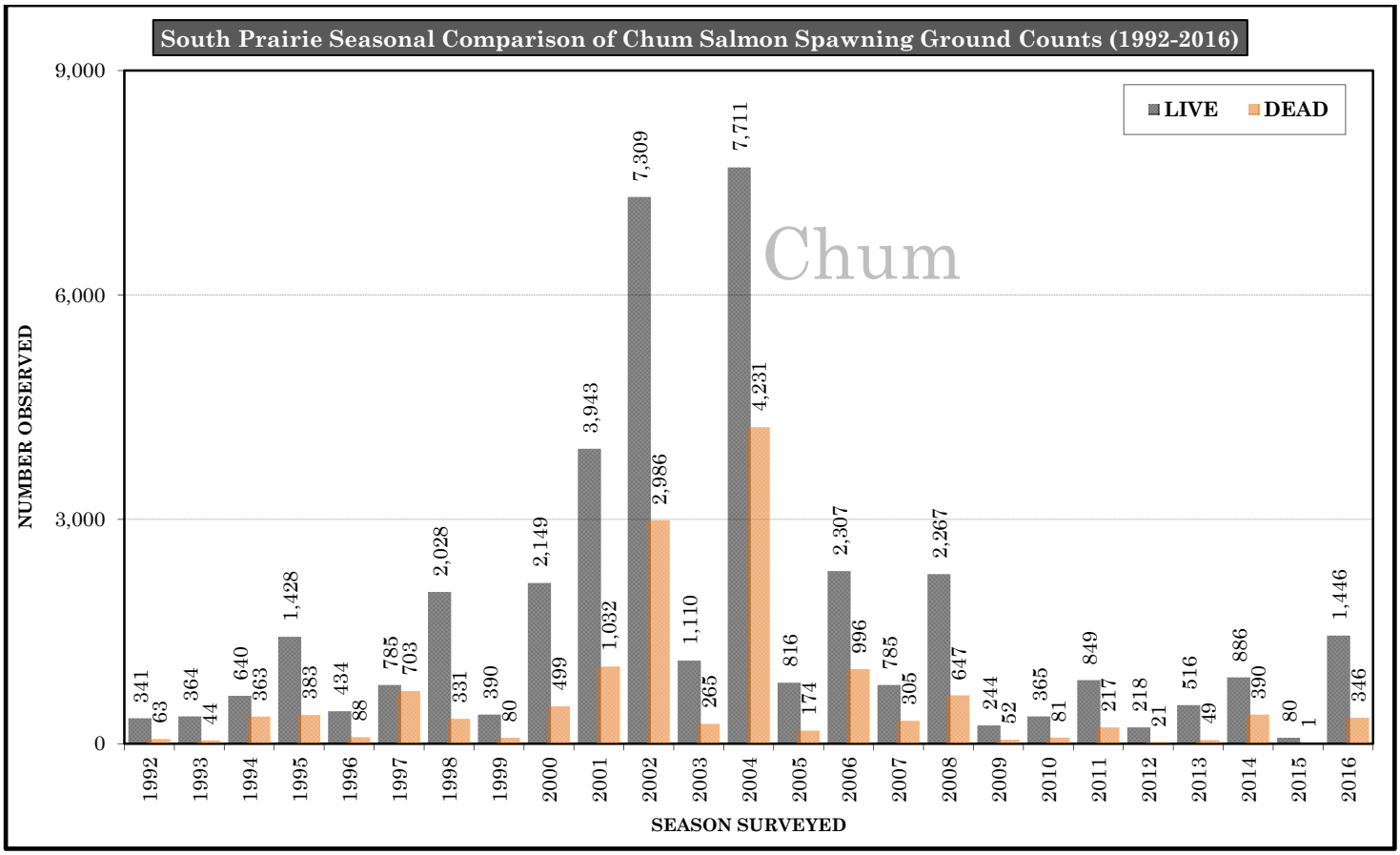


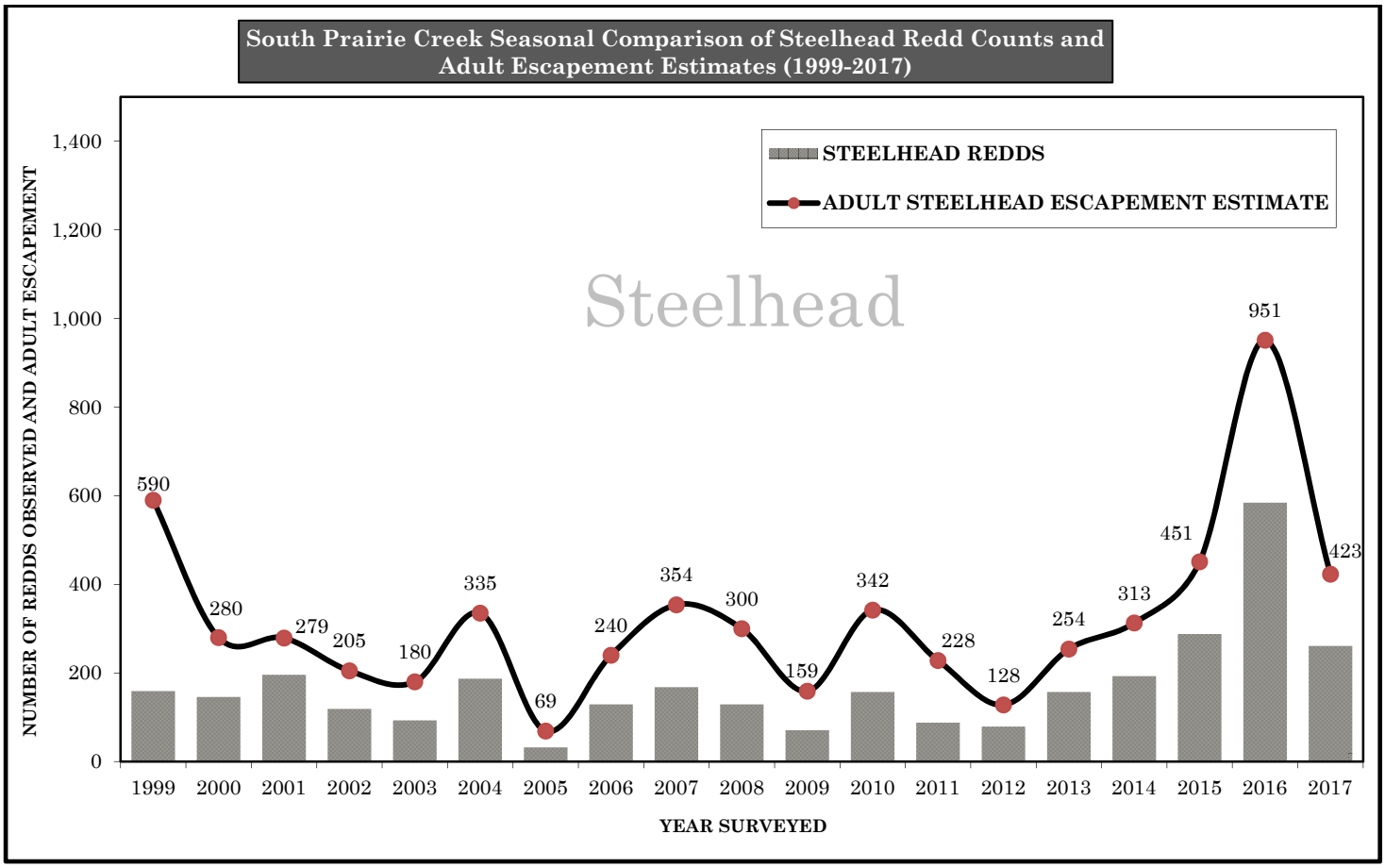
South Prairie Chinook salmon graph was generated using survey data collected by WDFW biologists. Adult Chinook escapement is determined by expanding the number of redds observed by 2.5 fish per redd (Smith and Castle, 1994). Due to the tremendous volume of pink salmon during odd years, the success of determining Chinook redds from pinks is vastly reduced. Therefore, The AUC method is used to determine escapement during pink runs (odd years).



South Prairie pink salmon graphs generated using survey data collected by WDFW biologists.







South Prairie steelhead graphs were generated using survey data collected by WDFW biologists. To determine the total escapement for steelhead, each redd is multiplied by a factor of 1.62 *(i.e. 42 redds x 1.62 steelhead per redd = total escapement of 68 steelhead).* Additional biological expansion factors are also applied to S. Prairie to estimate total escapement.

SQUALLY CREEK

WRIA 10.0024

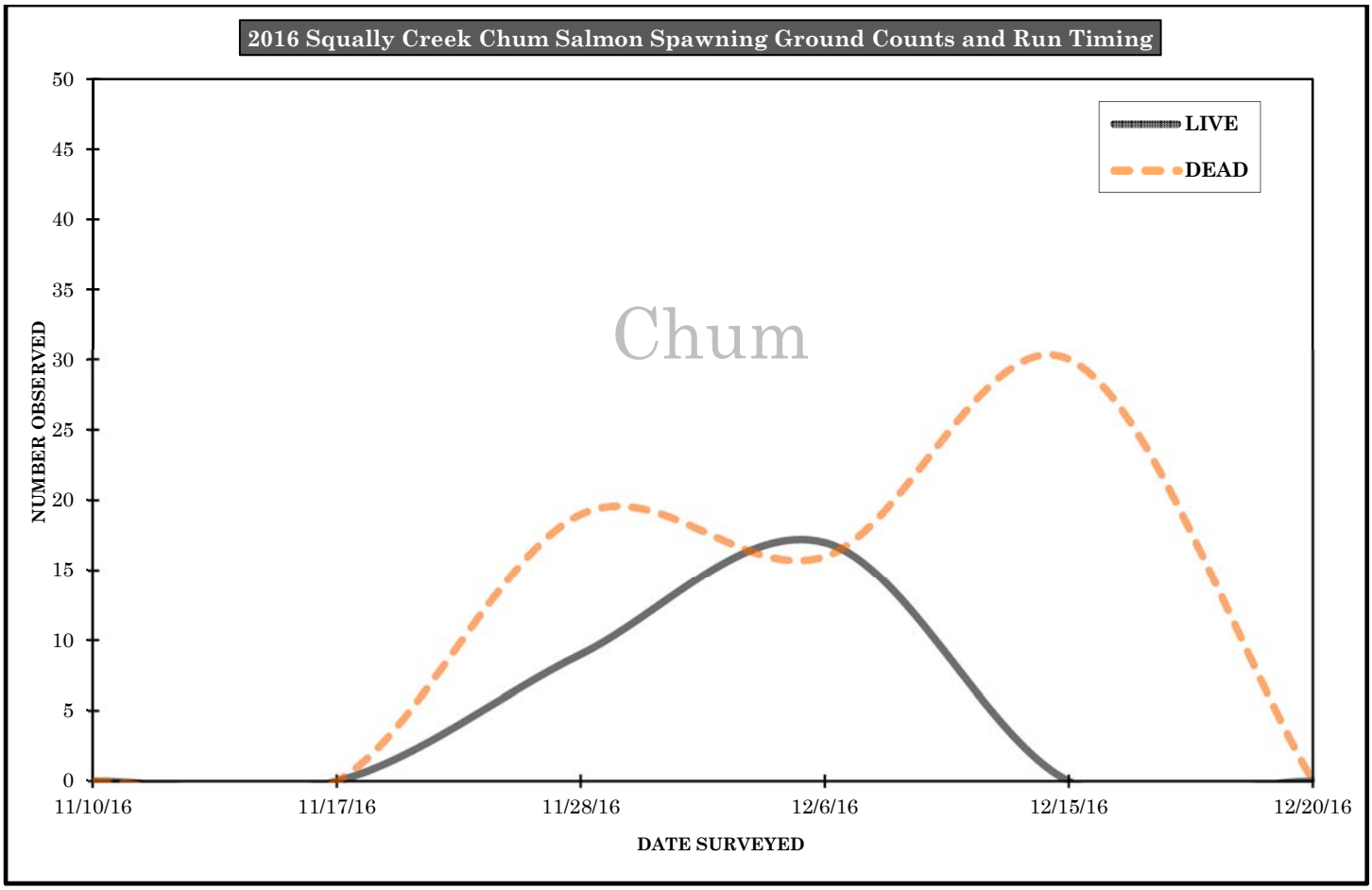
Squally Creek is a small tributary located within the larger 12.1 mi^2 Clear Creek Basin *(10.0022)*. The Clear Creek Basin drains the plateaus and flatlands running along the southern valley of the lower Puyallup River, just west of the city of Puyallup. Encompassing an area of nearly 1 square mile, Squally Creek is the smallest of three main tributaries feeding Clear Creek. Squally originates along the upper valley plateau near 72nd Street East and flows north, dropping through a steep narrow canyon along the valley wall. Near the foot of the valley the creek passes under Pioneer Way and the BNSF rail line before reaching Clear Creek.

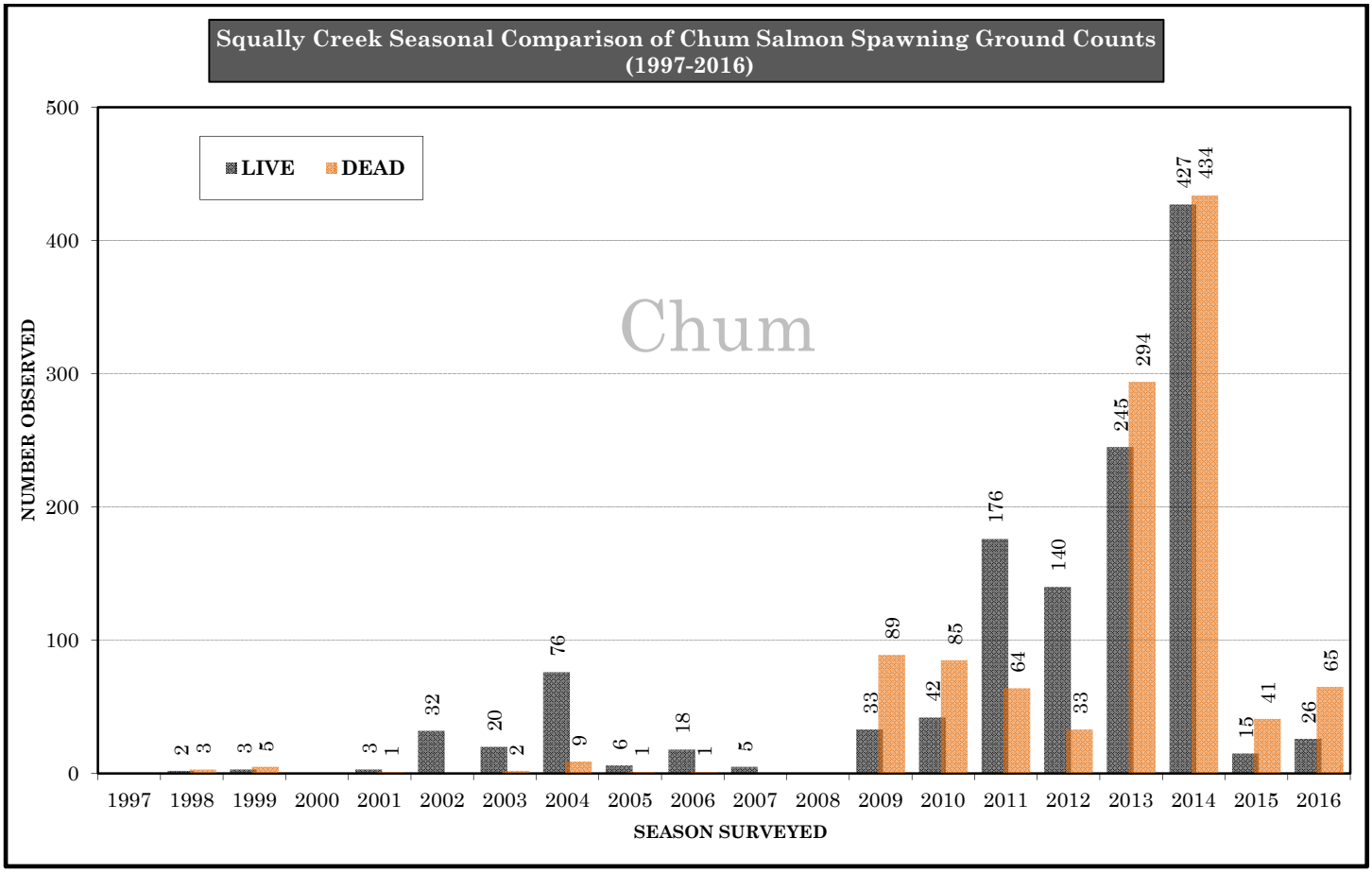
Squally supports Chinook, coho, chum, bull trout and cutthroat. The creek is mainly utilized by chum, although, coho adults are occasionally observed spawning in the lower stretch of the creek during December. No adult Chinook or steelhead usage has been documented; however, Chinook juvenile utilization has been documented. Squally also supports bull trout and cutthroat. Chum *(top photo*) have been observed spawning within the BNSF culvert; however, the current steel culvert no longer meets minimum standards for water crossing guidelines *(hydraulic/fishway)* and needs to be replaced; as does the culvert crossing under Pioneer Way.

Several of the fish and habitat limiting factors involved with Squally include; channel confinement; intermittent or complete fish barriers, noncompliant culverts; no off-channel habitat; compacted substrate; flooding and channel erosion; absent or deficient riparian cover; and the influx of reed canary grass *(Phalaris arundinacea)* and blackberry. In addition, there is some development along the creek; primarily private residential, as well as storm run-off that is channeled into the creek. A large detention pond built by Pierce County is located on the western tributary of upper Squally. The pond was constructed to address excessive storm run-off and sediment issues.

The anadromous reach has two short distinct segments, one below and one above Pioneer Way. Downstream of Pioneer Way, the channel is deeply incised with a substrate consisting of moderately compacted gravel, clay, and abundant fines. This substrate type is typical of the entire basin; a result of glacial deposits and compaction. Natural channel cutting through this hardened substrate created a two foot jump in the channel, preventing chum from ascending beyond the lower 200 feet for several seasons *(2002-2008)*. The riparian is sparse along the lower 300 feet, consisting mainly of a few small alders, blackberry, and reed canary grass. The last 80 feet of the creek runs through a culvert passing under the BNSF rail line, where Squally finally meets with Clear Creek.

Upstream of where the creek passes under Pioneer Way, the gradient increases and the less confined channel quickly becomes braided. Due to the channel braiding in this reach, the stream depth is often shallow. However, there are several pieces of hardwood debris present, as well as moderate quantities of suitable spawning gravel. The riparian along this section consists mostly of alder, mixed deciduous and coniferous trees. Excellent spawning gravel exists through much of the upper reach. Chum spawning is most consistent within this upper reach section that extends for approximately 0.4 miles upstream of Pioneer Way.


2016 Squally Creek Chum Salmon Spawning Ground Counts and Run Timing
LIVE
DEAD
Chum
NUMBER OBSERVED
0
5
10
15
20
25
30
35
40
45
50
11/10/16
11/17/16
11/28/16
12/6/16
12/15/16
12/20/16
DATE SURVEYED


Squally Creek Seasonal Comparison of Chum Salmon Spawning Ground Counts (1997-2016)
LIVE
DEAD
Chum
NUMBER OBSERVED
0
100
200
300
400
500
2 3
3 5
3 1
32
20 2
76 9
6 1
18 1
5
33 89
42 85
176 64
140 33
245 294
427 434
15 41
26 65
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
SEASON SURVEYED

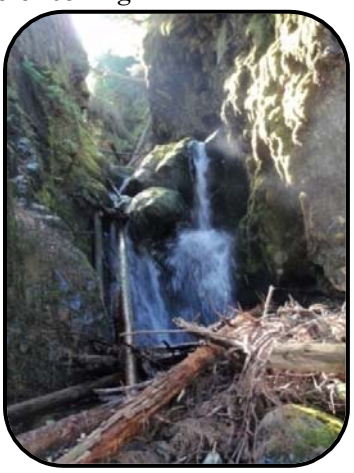
SUNRISE CREEK

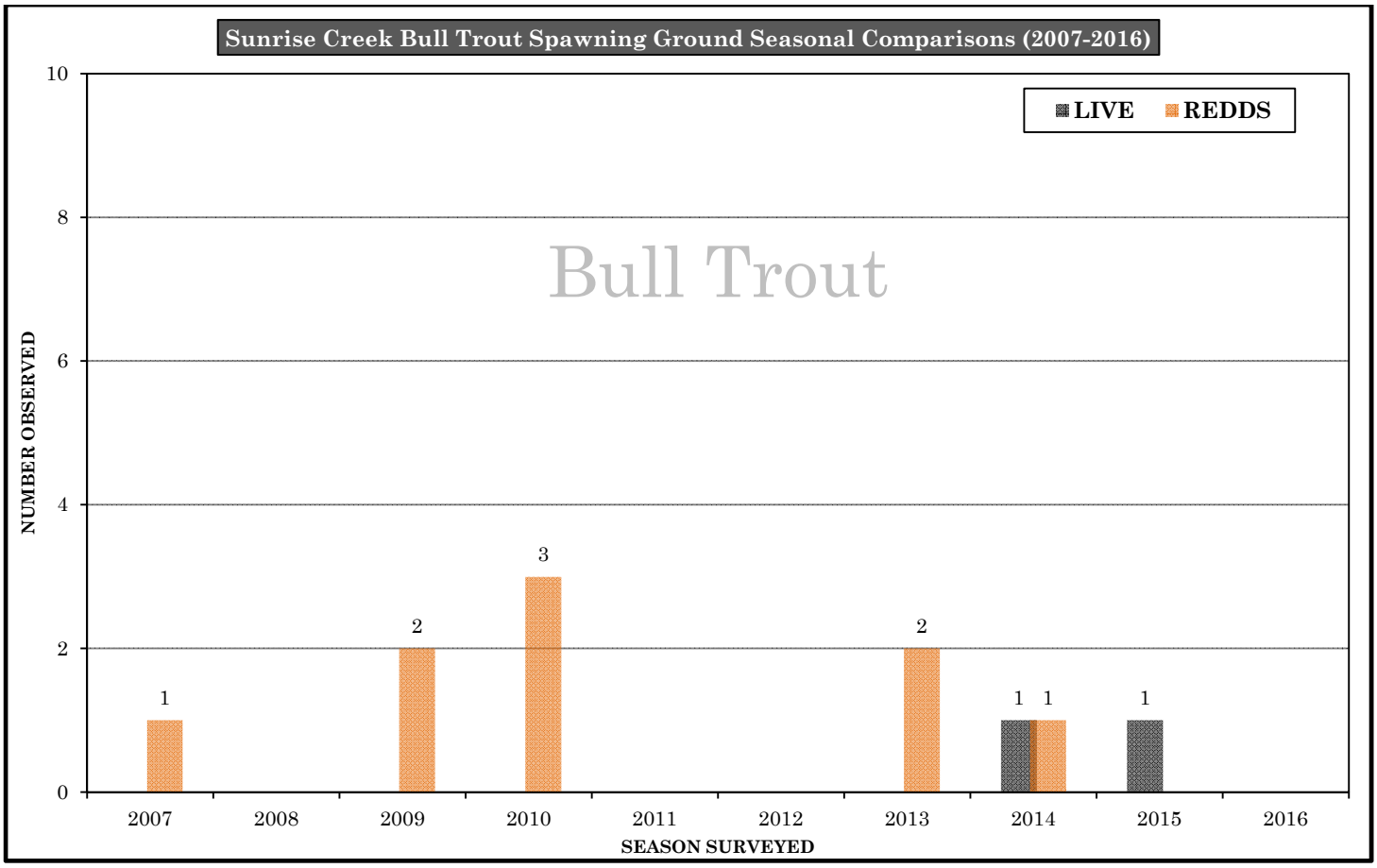
WRIA 10.0337

Sunrise Creek is a left bank headwater tributary to the White River. This mountain stream *(lowest elev. 2800')* flows northeast through the steep Sunrise Creek Valley, between the Sourdough Mountains to the northwest and Sunrise Ridge along the southeast. Located entirely within the boundaries of Mt. Rainier National Park *(NPS #W06-00a)*, the creek is non-glacial in origin; rather, its sources originate from several sub-alpine lakes including Clover Lake *(elev. 5732')* and Hidden Lake *(elev. 5915')*; as well as, snowpack accumulations within the White River Park region. White River Park is nestled into the eastern slopes of the Sourdough Mountain Range located along the northeastern edge of the park. Sunrise Creek flows for 4.5 miles from its headwaters before entering the White River at approximately RM 63; positioning the mouth of the creek just inside the National Park.

PTF surveys the creek for bull trout spawning activity from late August-to-early October. Bull trout telemetry studies and redd surveys were conducted during 2006 and 2007 along the upper White River and West Fork White River; the projects focused heavily on the headwater tributaries located within Mt. Rainier National Park. The study results showed that the cold high mountain streams located within the National Park, including Sunrise, provide the majority of the critical bull trout spawning habitat in the basin. In addition, bull trout spawning has been less frequent in this tributary compared to that observed in more significant headwater tributaries located along the White River, such as Klickitat Creek *(elev. 3300')* located 5 miles upstream. Other species known to utilize the creek include cutthroat, brook trout, and pink salmon. The brook trout are likely descendants from fish plants in Hidden and Clover lakes during the early to mid-part of the last century. Pink salmon have been observed in the creek since 2007. Over 300 pinks spawners were observed in 2015. Although Sunrise has not been surveyed for coho; it is reasonable to assume that coho have or do utilize this creek since it is located a short distance upstream from Silver Springs which is consistently exploited by adult coho spawners. Chinook and steelhead use is unknown.

The anadromous reach of Sunrise provides suitable habitat conditions for bull trout rearing and spawning. The lower reach of the creek *(RM 0-0.15)* is a low gradient channel flowing within the White River channel migration zone *(CMZ)*, and is repeatedly influenced by mainstem river incursions. There are moderate quantities of LWD present; as well as a beneficial riparian buffer zone of conifers and mixes deciduous trees along the majority of the creek. Although spawning does occur within this small stretch, it can be limited due the lack of quality spawning substrate created by the alluvial deposits *(sand & silt)* from the White River. Upstream of the CMZ, the creek enters the heavily forested lower slope of the valley floor, and then rapidly begins to climbs up the valley. From this point, the creek assumes a pool-riffle-cascade configuration up into the steep valley; this forested reach provides quality rearing habitat, but few spawning opportunities. An impassable falls at approximately RM 0.26, prevents any further upstream migration *(center)*.





Raw spawning data for Sunrise Creek can be found in Appendix C.

SWAN CREEK

WRIA 10.0023

Swan Creek is a moderate sized tributary located within the larger Clear Creek Basin *(10.0022)*. The Clear Creek Basin drains the plateaus and flatlands running along the southern valley of the lower Puyallup River, between the cities of Puyallup and Tacoma. The head waters of Swan Creek originate just south of Highway 512, and flow just over 6 miles north to meet up with Clear Creek near Pioneer Way E. The Swan Creek basin drains a moderately developed land area of nearly 4 mi^2. The land use along the creek is largely rural residential and recreational. The average water discharge recorded by the USGS flow gauge *(#12102190)* for a five year period *(1990-1991, 1995-1997)* was 4.78 ft^3 per second.

Several of the fish and habitat limiting factors involved with Swan Creek including; channel confinement, intermittent or complete fish barriers, unstable substrate, flooding and channel erosion, absent or deficient riparian cover, invasive non-native plants, and water quality *(bacteria)*. In addition, there is some development present along the creek; primarily private residential, as well as storm runoff that is channeled into the creek. A large detention pond built by Pierce County is located on the lower reach of the creek. The pond was constructed to address excessive sediment and gravel movement issues.

Although Swan Creek has been surveyed for several salmon species including Chinook, pink, coho, chum and steelhead; only chum are observed in relatively abundant numbers. In addition to chum, limited numbers of coho are observed spawning in the creek in December. However, substantial numbers of coho juveniles are often observed in the spring. Unfortunately, summer and early fall flows can prevent Chinook from accessing the creek; however, a few Chinook have spawned successfully *(2013 observation)*. Although bull trout utilization is unknown within Swan Creek; adult fluvial bull trout are known to forage in the smaller tributaries of the lower Puyallup. Swan also supports a large population of cutthroat, which can be observed spawning in the spring. Two steelhead redds were observed during the April 2004 survey season. They were the first steelhead redds seen in Swan Creek in several years. However, no steelhead redds have been observed since. Other species present in the creek include catfish, lamprey and sculpins.

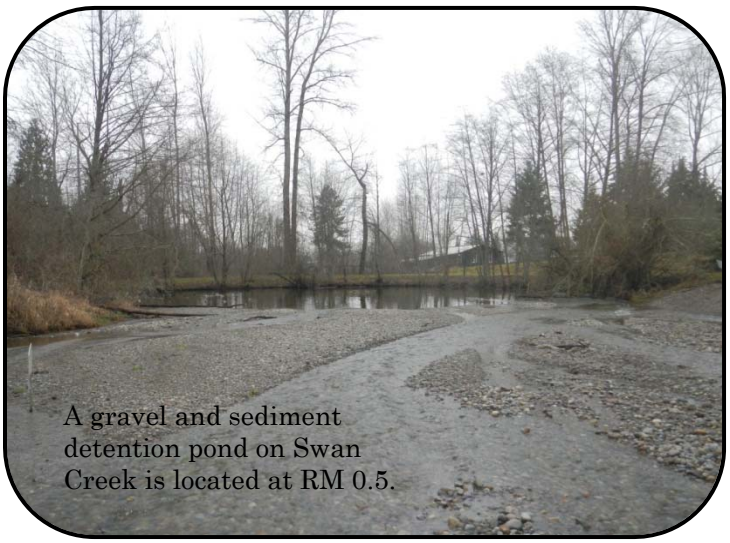
Lower Swan Creek

From its origins, the creek flows within a narrow distinct channel for approximately 3 miles through the upland plateau south of 72nd Street East. Near 72nd, the creek begins to drop into an increasingly narrow valley. The creek passes through a large concrete box culvert under 64th Street E.; then drops nearly three feet back into the creek channel. This jump in elevation is an upstream barrier to all species; with the exception of steelhead, which may be able to pass if flows are high enough. However, spawn-

Upper survey reach

ing opportunities are extremely limited and the habitat quality is poor upstream of this point.

Downstream of the culvert, the next 0.2 miles of the creek flows through a well-defined channel with little spawning habitat or complexity. Beyond this, the creek channel takes on more complexity due to the placement of sill logs which hold back bed load and create pool habitat through this narrow valley section *(previous page-lower right)*. Unfortunately, one of the structures has developed into a likely barrier to upstream migration during low flows. This narrow valley reach continues for approximately the next 1.8 miles until the gradient and the valley walls begin to ease around RM 0.8. The channel dynamics change considerable through this reach; from a single well defined channel to braided sections. There are several pieces of in-stream LWD; as well as several smaller pieces of wood and woody debris jams *(upper left)*. Several sections of the banks consist of actively eroding compacted glacial debris; contributing fine and small course materials into the stream channel. Spawning habitat is available throughout; yet, the substrate is largely made up of fine sand and undersized gravel. The RMZ is well intact along the valley section; consisting largely of mature Doulas fir, alder, cottonwood and maple. A rapid shift in the RMZ occurs around RM 1.5; at this point the surrounding forest consists primarily of a much thinner stand of alder, cottonwood and maple. To a large extent, the lower part of Swan Creek passes through the 290-acre Swan Creek Park. The park is largely undeveloped with a hiking trail paralleling the creek.

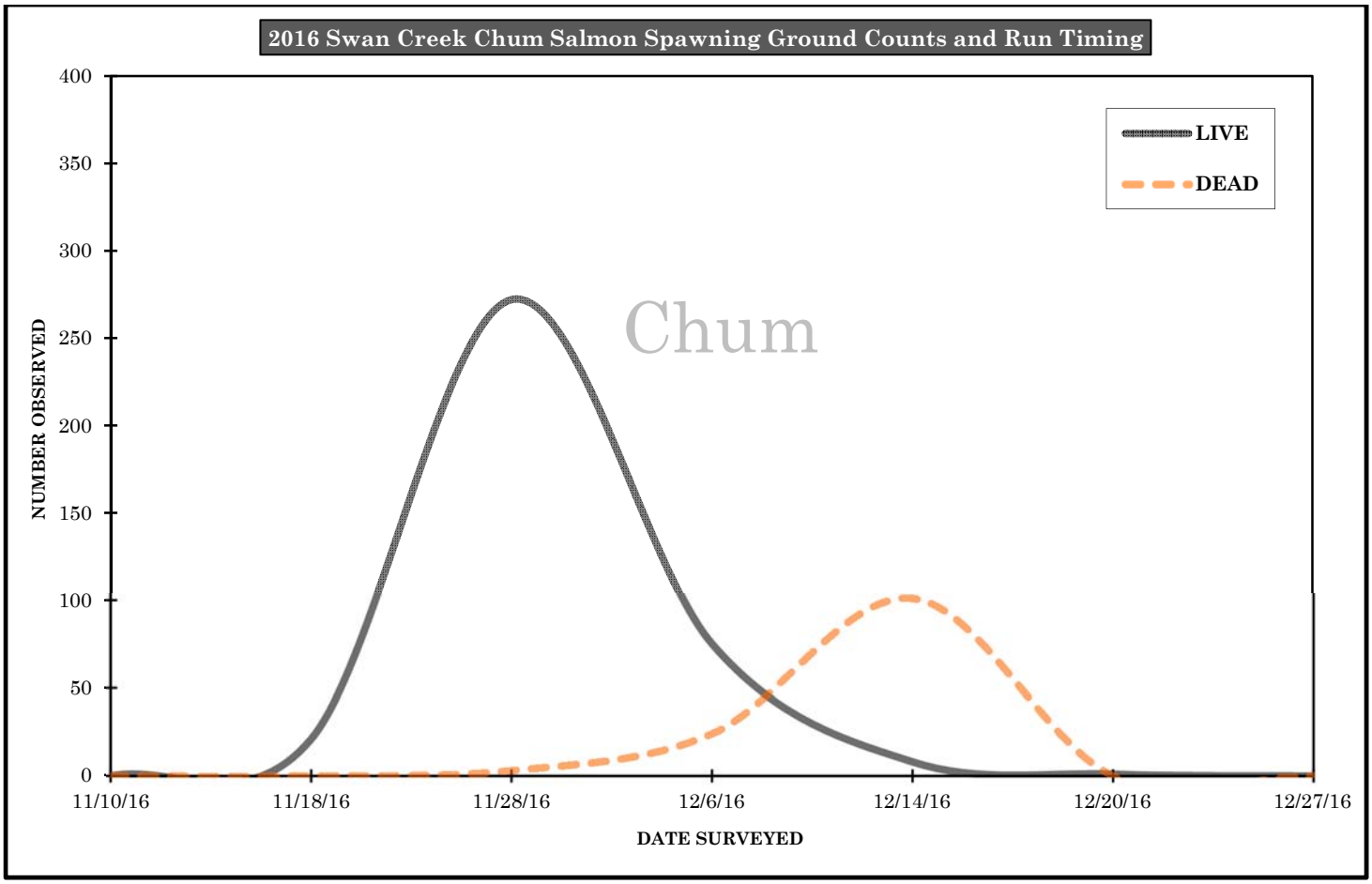


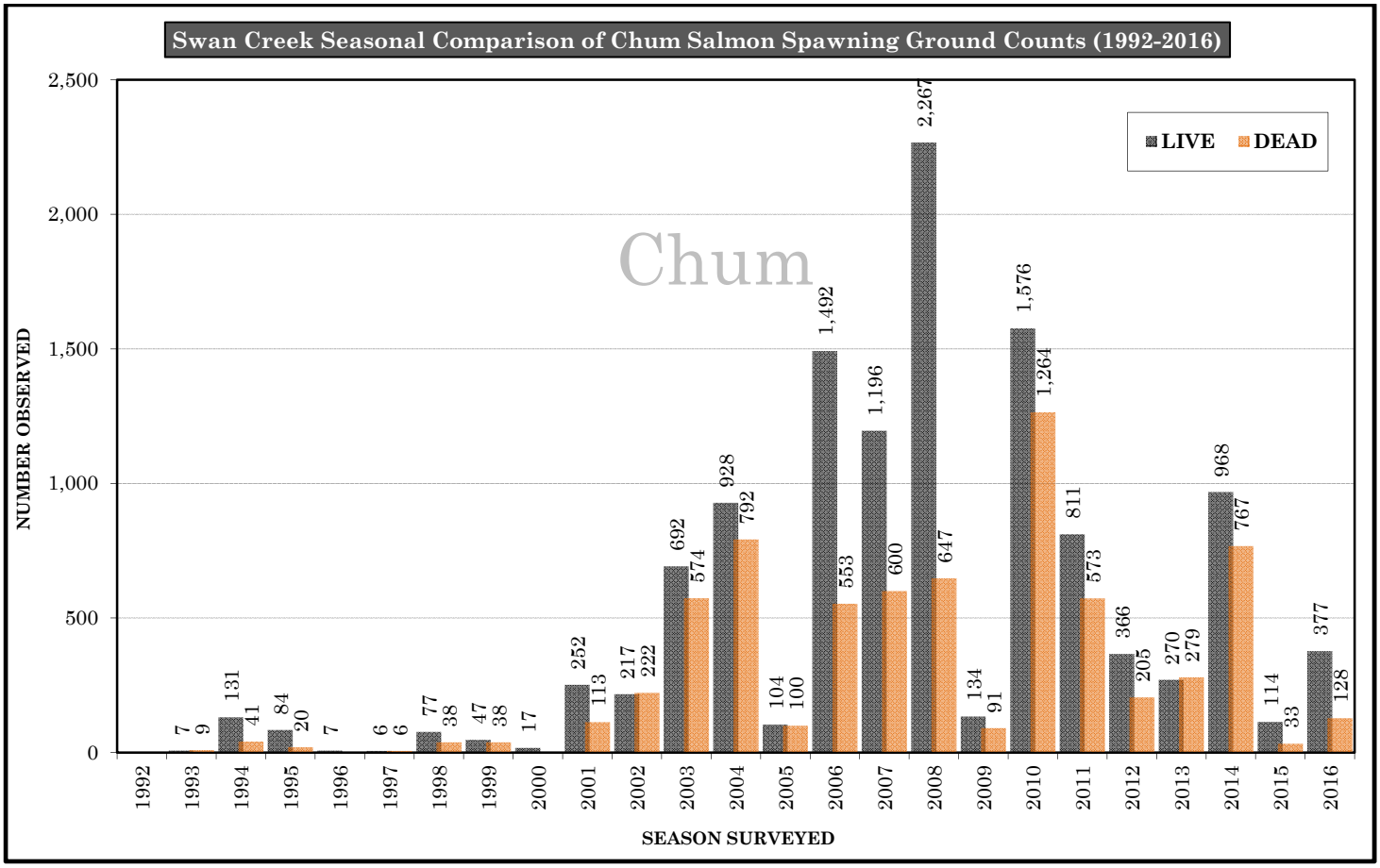
A gravel and sediment detention pond on Swan Creek is located at RM 0.5.

From RM 0.8 to 0.5, the stream is pool-riffle in character and contains good spawning gravel, riparian diversity and channel complexity. There is also a noticeable decrease in LWD and woody debris in the channel. Swan Creek is prone to high water events however, and the substrate is only moderately stable. A sediment detention pond is located at RM 0.5 *(bottom left)* and is dredged annually or bi-annually by Pierce County. During these events, fisheries staff from the Puyallup Tribe seines the pond before dredging to remove the majority of fish present, and relocates the fish captured downstream of the work site. A large wooden wing wall is in place at the head of the pond to direct the creek towards the detention pond.

Haire Wetland

Just downstream of the detention pond, the creek flows through a short narrow channel and under Pioneer Way E. Much of the channel is confined by rip-rap. The RMZ along this short stretch is extremely poor and heavy erosion is occurring along the left bank. The creek then flows a few hundred feet before reaching the Haire Wetlands *(right)*. Some restoration work has been completed in the past on the lower reach of the creek. In 2001, a 12-acre site located just downstream of Pioneer Way was utilized to develop a side channel for overwintering juveniles and as a means of reconnecting Swan Creek to the Haire Wetlands. In addition, the restoration included the removal of invasive and non-native plant species, and replanting the area with native trees and shrubs. The City of Tacoma financed the Haire Wetlands restoration site along Clear and Swan creeks through the Natural Resource Damages Assessment Program (NRDA).


2016 Swan Creek Chum Salmon Spawning Ground Counts and Run Timing
LIVE
DEAD
Chum
NUMBER OBSERVED
400
350
300
250
200
150
100
50
0
11/10/16
11/18/16
11/28/16
12/6/16
12/14/16
12/20/16
12/27/16
DATE SURVEYED


Swan Creek Seasonal Comparison of Chum Salmon Spawning Ground Counts (1992-2016)
LIVE
DEAD
Chum
NUMBER OBSERVED
2,500
2,000
1,500
1,000
500
0
1992 7 9
1993 131 41
1994 84 20
1995 7
1996 6 6
1997 77 38
1998 47 38
1999 17
2000 252 113
2001 217 222
2002 692 574
2003 928 792
2004 104 100
2005 1,492 553
2006 1,196 600
2007 2,267 647
2008 134 91
2009 1,576 1,264
2010 811 573
2011 366 205
2012 270 279
2013 968 767
2014 114 33
2015 377 128
2016
SEASON SURVEYED

VOIGHTS CREEK

WRIA 10.0414

Voights Creek is a tributary to the lower Carbon River, entering the Carbon at RM 4.0 just southeast of the community of Orting. Voights Creek originates along the northwest foothills of Mt. Rainier, just west of Martin Peak and north of the Mowich River. The creek flows for nearly 20 miles in a northwest direction until it joins the Carbon River. Encompassing a drainage area of nearly 23 mi², the mainstem creek offers nearly 4 miles of anadromous usage; in addition, a small tributary enters Voights at RM 0.7 *(Coplar Creek)*. Unfortunately, Coplar Creek does not contain suitable spawning habitat, but does offer good overwintering habitat for juveniles. The anadromous habitat available in Voights supports Chinook, coho and steelhead; as well as occasional pink and chum spawners. A range of fish and habitat limiting factors associated with Voights Creek include; erosion, flooding, water quality *(temperature)*, channel confinement, loss of off channel habitat and a disconnected flood plain on the lower reach.

Lower Voights Creek

The Washington Department of Fish and Wildlife operates a salmon hatchery located at RM 0.5. The newly constructed facility, which replaced the old flood prone facility, began operations in 2015. The current hatchery facility rears Fall Chinook and coho. The WDFW hatchery on Voights Creek has artificially propagated coho since 1917, having in the past incorporated fry and smolts from other drainages including Big Soos Creek, Minter Creek, Garrison Springs, George Adams Creek; as well as the Skagit and Washougal rivers. Voights Creek currently produces approximately 800K *(formally 1.2 million)*, 100% mass marked *(adipose fin clip)* coho pre-smolts annually; of which, 100K to 200K are customarily transferred to acclimation ponds in the upper Puyallup Watershed when available. Extreme high water temperatures in June and July of 2015 resulted in the loss of 60% of program coho pre-smolts. Ideally a ground water well can be installed in the future to temper peak temperatures. In addition, hatchery rearing 200K+ Fall Chinook *(current acclimation pond production is 100K)* for acclimation ponds in the upper Puyallup River is a key component to restoration goals. The Puyallup Tribe currently operates two acclimation ponds in the Upper Puyallup River Watershed. Acclimation ponds are a proven method for increasing fish numbers on the spawning grounds. The acclimation ponds are used for reestablishing Fall Chinook *(reared at PTI's Clarks Cr. hatchery)* and coho reared at WDFW's Voights Creek hatchery, into a 26+ mile reach of the Upper Puyallup River above Electron Dam *(RM 41.7)*. The Electron diversion dam had been an anadromous barrier for nearly a century *(1904-2000)*.

In addition to the rearing and acclimation of juveniles, surplus live adult Fall Chinook and coho from the WDFW Voights Creek hatchery are planted in the upper Puyallup River drainage when surplus fish are available. The Puyallup Tribe has been hauling surplus adults from Voights Creek and planting them in

the upper Puyallup Watershed since1997.

Voights Creek falls

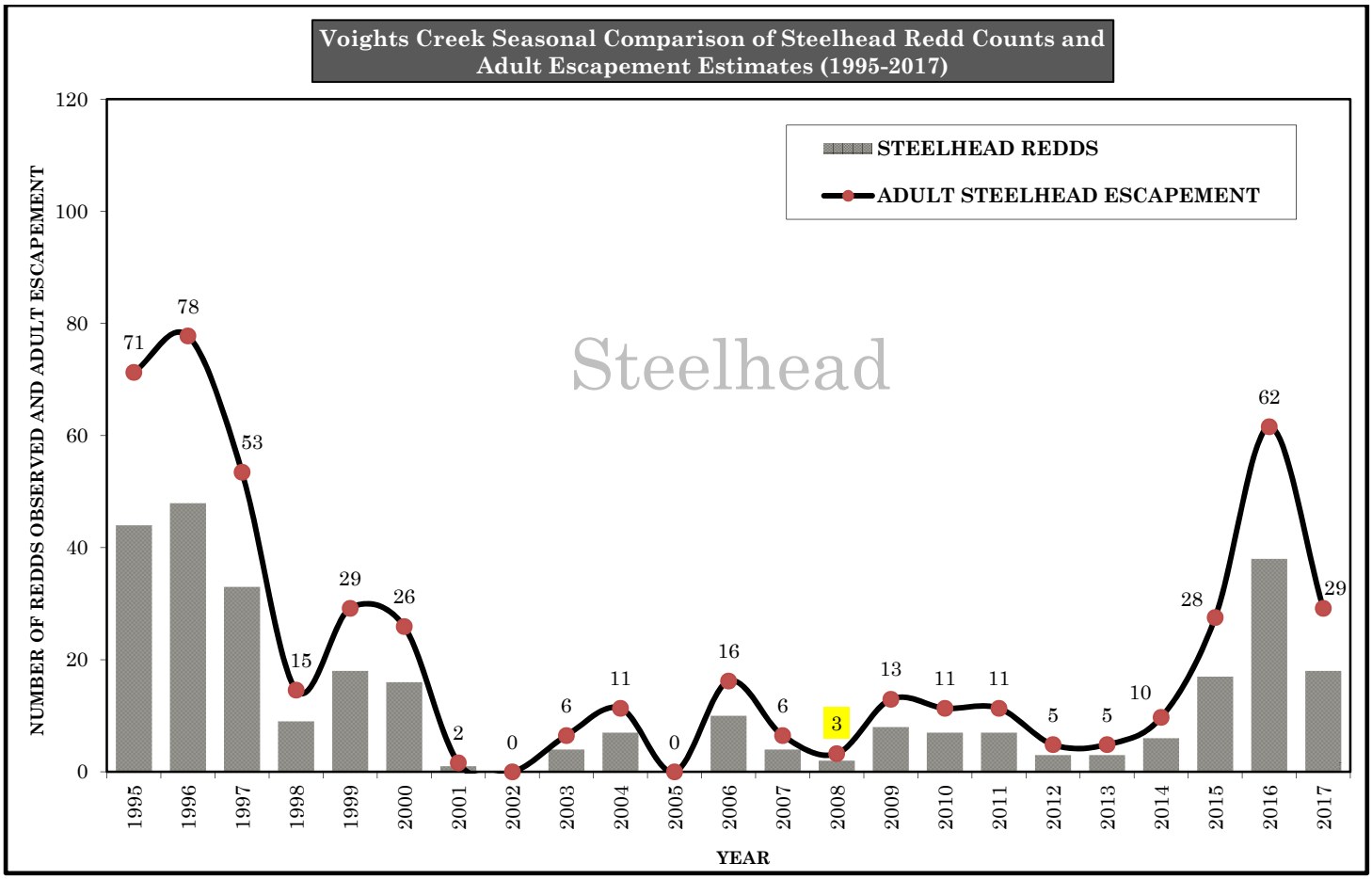
Puyallup River Fall Chinook are endemic throughout the Puyallup River, Carbon River, Lower White River, as well as several of the tributaries associated with these mainstem river systems. A large component of adult Fall Chinook spawners are hatchery origin from the WDFW Fall Chinook program operated on Voights Creek. In addition, over the past several operational seasons, the weir designed to prevent fish passage above the hatchery had proven to be ineffective, therefore, allowing hatchery fish to access the upper 3.4 miles of the creek to spawn naturally. Voights Creek is currently surveyed for steelhead only.

An impassable falls located at RM 3.9 blocks any further upstream migration *(top left)*. Steelhead spawning activity is observed throughout the entire 3.4 mile stretch above the hatchery. Unfortunately, steelhead escapement in Voights Creek has fallen considerably over the past two decades. Winter steelhead populations in the Puyallup basin have been declining for the better part of the past three decades. The steep decline observed in steelhead escapement over the past several years has created serious concern among fisheries managers. Factor(s) responsible for the decline in steelhead escapement are unknown.

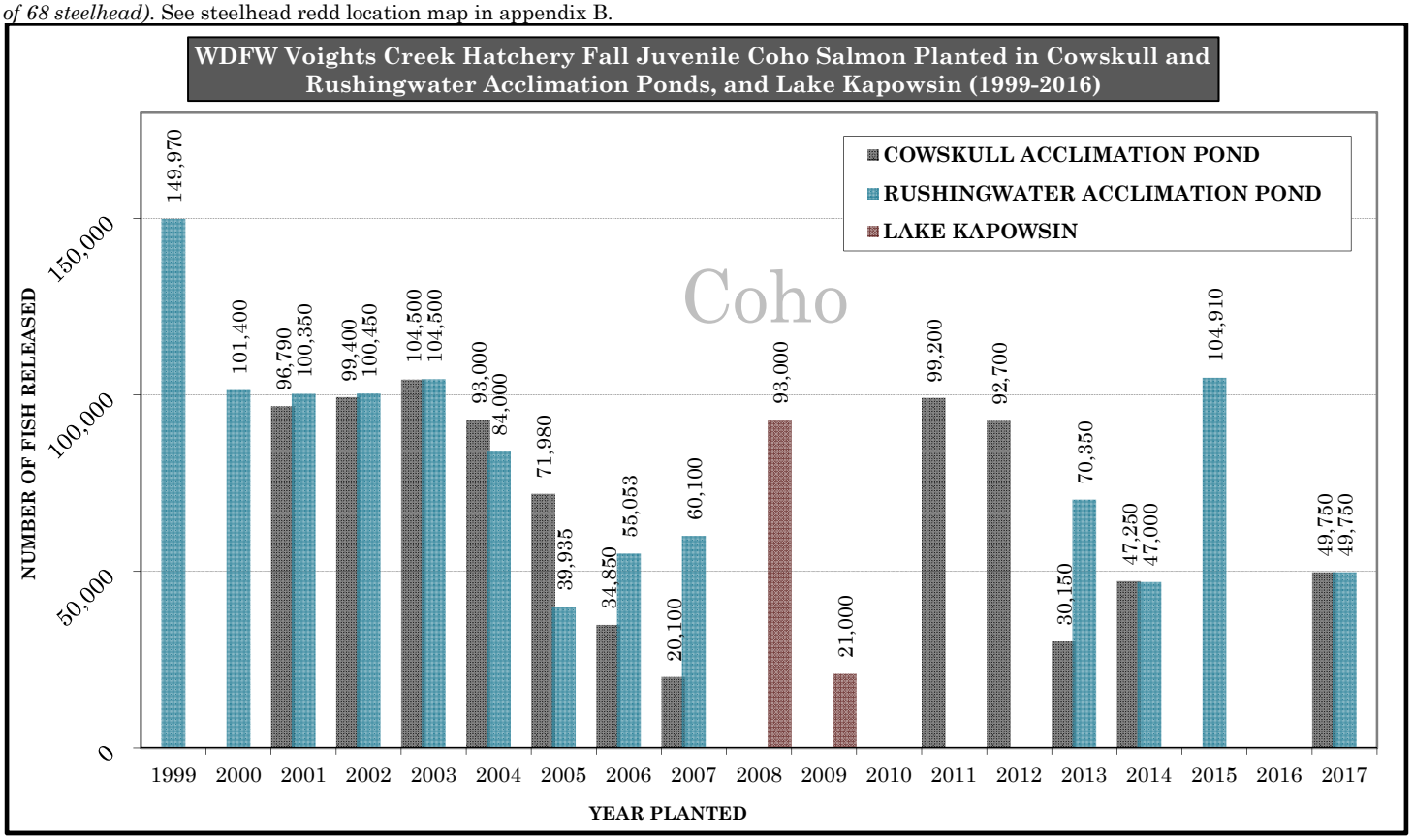
The stream channel varies a great deal in complexity throughout its length. The lower mile is confined by armored banks and levees, with large segments of significantly deficient riparian cover and negligible instream LWD. The extreme high water event of 2009 caused the creek channel to avulse just upstream of the former diversion dam/ hatchery water intake. The new channel currently runs just north of the old channel; then reconnects with the older established channel just upstream of Hyw162. The new channel provides few spawning opportunities. Continuing upstream, the channel begins to encounter the influences caused by increasing elevation as it ascends out of the valley floor. The gradient increases slightly; however, the channel is no longer confined, thereby allowing the creek to branch out creating several braids and significant side channels over the next 0.8 miles. The riparian throughout this section is well intact and there is a significant increase in LWD and debris jams.

Near RM 2, the valley walls close in tightly and the channel is naturally restricted to a defined, moderate sized channel and with narrow gorges. The surrounding riparian is primarily a mix of 2nd growth conifer and deciduous trees. Nearly the entire 2 mile reach, from the diversion to the falls, is a moderate gradient channel containing excellent, although somewhat sporadic patches of gravel. Several pieces of LWD and significant log jams are present throughout this reach as well. Several large mass wasting's *(bottom photo)* are present along the hills and slopes of the upper reach above the gorge, contributing substantially to LWD and gravel inputs downstream.

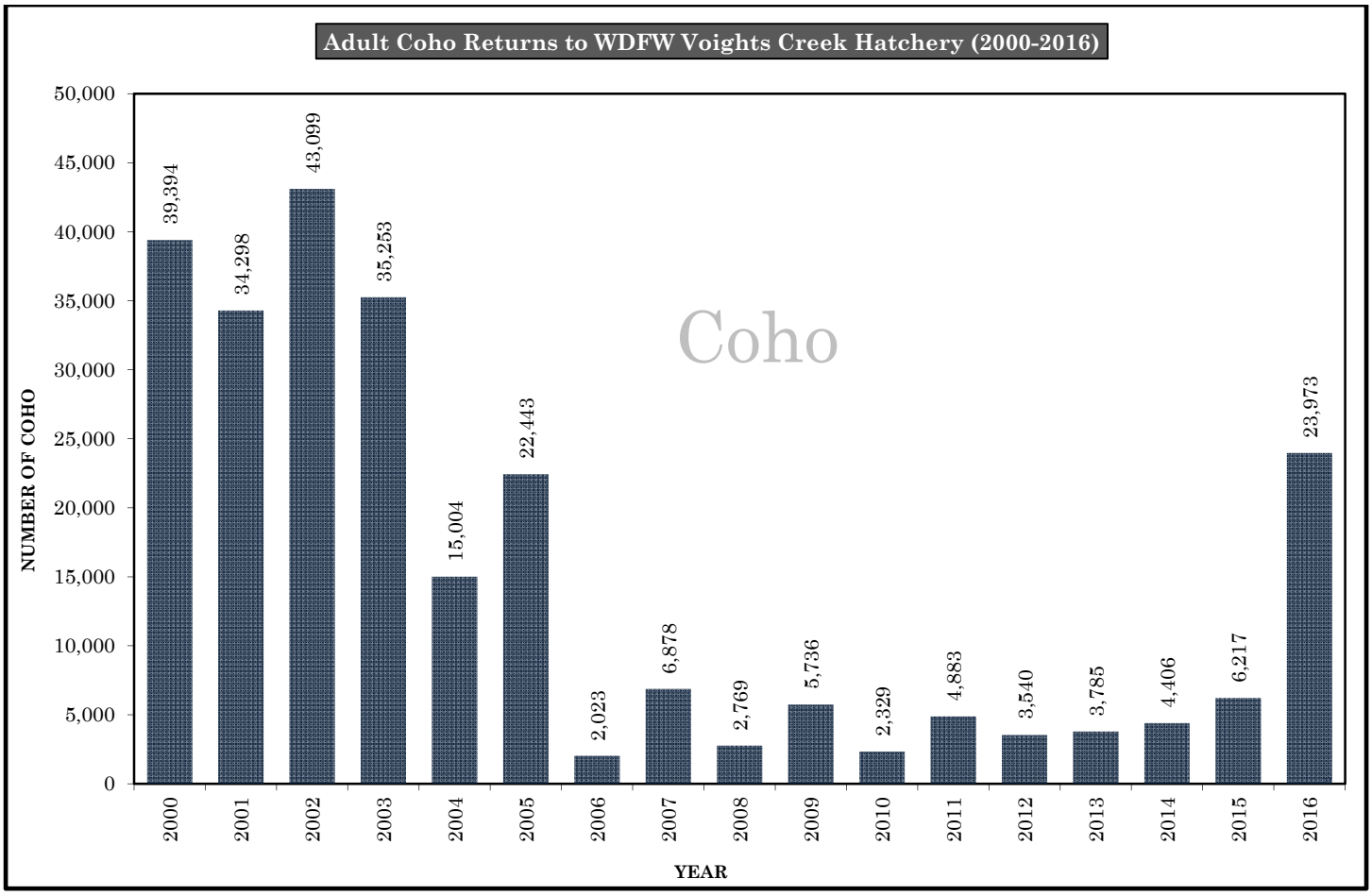
Wild juvenile coho in Voights Creek



The 2008 redd data is incomplete due to extremely poor survey conditions and access issues which prevented a regular full season of surveys. To determine the total escapement for steelhead, each redd is multiplied by a factor of 1.62 *(i.e. 42 redds x 1.62 steelhead per redd = total escapement of 68 steelhead)*. See steelhead redd location map in appendix B.



Coho provided by WDFW when available. Acclimation ponds opperated by Puyallup Tribe. See map of acclimation pond location sites on page 41. No data indicates no fish were planted.



Voights creek hatchery returns data provided by WDFW (http://www.wdfw.wa.gov/hatcheries/escapement/)

WHITE RIVER

WRIA 10.0031

The White River *(Stuck)* is a vast and dynamic glacially driven river system. The headwaters of the White originate from the Emmons and Fryingpan glaciers on the north face of Mt. Rainier. Flowing 76.7 miles from its mountain source to its eventual confluence with the Puyallup River; the White River Watershed drains an area of nearly 494 mi^2, slightly larger than the Puyallup River drainage. However, the White and Puyallup drainages are often viewed and managed as two distinct and separate entities. This management approach is due in part because prior to 1906, the White River did not flow into the Puyallup. Salo and Jagielo *(1983)* described that prior to 1906; the majority of the White River flowed north towards Elliot Bay. Yet, some of the water from the White often flowed south to the Puyallup through the Stuck River channel. In November of 1906, a flood event mobilized a tremendous amount of wood debris that blocked the north flowing channel in what is now downtown Auburn. The blockage forced the river to avulse and find a new channel. This newly created diversion sent nearly the entire White River flow down through the Stuck River channel into the Puyallup, more than doubling the size of the Puyallup River drainage. In 1915, a concrete structure was constructed, thereby permanently diverting the White River into the Puyallup.

Spring Chinook spawning in mainstem

Significant tributaries of the White include the West Fork White River, Huckleberry Creek, Boise Creek, Clearwater River, and the Greenwater River. The White River Watershed provides critical spawning and rearing habitat for several salmonids including several ESA listed species such as; native White River Spring Chinook *(bottom photo)*, winter steelhead, and bull trout. Other non-listed species include coho, pink, chum, sockeye, rainbow, cutthroat, and whitefish. These tributaries, with the exception of the West Fork White River, are described in this report.

All adult salmon and steelhead that spawn in the Upper White River and its tributaries are initially captured in the USACE fish trap in Buckley; then transported above Mud Mountain dam *(RM 29.6)*. Since precise escapement numbers for the Upper White River drainage are known, surveys are conducted to determine fish distribution and spawning success. This is especially important regarding Spring Chinook, since adult production monitoring is part of the recovery plan.

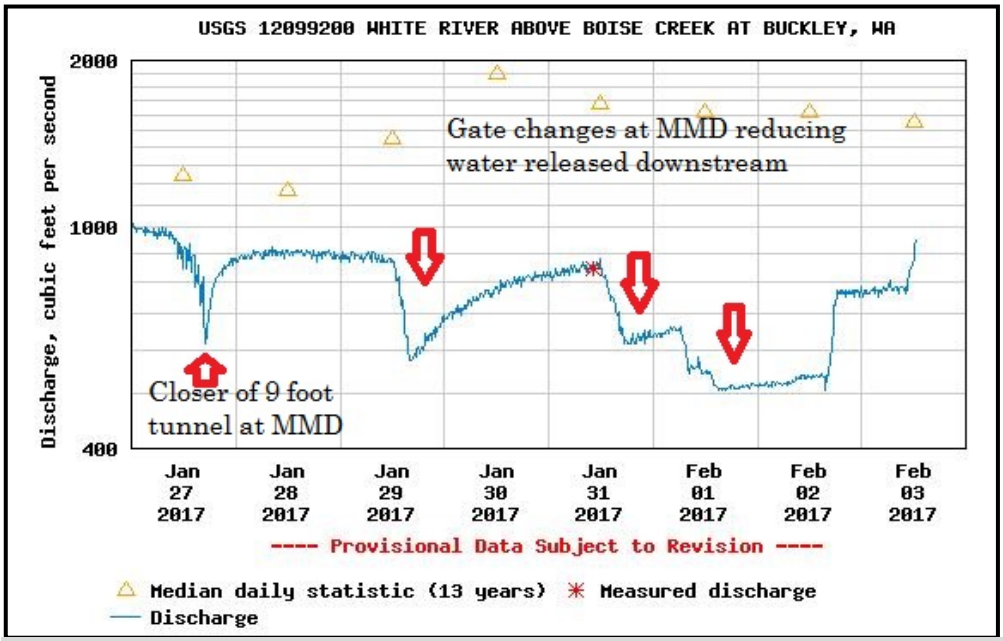
The availability and nature of fish and stream habitats are not static conditions and are frequently altered. The habitat descriptions in this report provide a general analysis of habitat conditions, and are not intended to fulfill the requirements of a rigorous biological assessment/evaluation. The systems glacial origin is responsible for the turbid conditions that are most noticeable during warmer weather experienced during late spring and summer. The White River conveys a tremendous volume of bed load material which contributes to the dynamic nature of the system. The high sediment loads are responsible for the anastomosing channel morphology characteristic of broad valley seg-

ments. This condition is most prevalent in the upper reaches within and immediately outside the National Park boundaries *(river mile 56 to 71 – top photo on previous page)*. The entire White River provides vital migrating, foraging and rearing habitat for bull trout. Although the upper headwaters provide reduced mainstem spawning opportunities, the pristine and unspoiled tributaries in the National Park provide the majority of the critical bull trout spawning and rearing habitat within the system. Mt. Rainier National Park protects/preserves over 369 square miles *(236,381 acres)* of wilderness and aquatic habitat. Sunrise Creek *(RM 63)*, located 2.5 miles inside Mt. Rainier National Park, marks the highest salmon *(pink)*migration point documented by PTF staff.

Mud Mountain Dam

Downstream of the NPS boundary near RM 61, the mainstem river; as well as many of its tributaries, course through industrial forestlands including National Forest, but primarily within private timber company ownership. Much of these forestlands have been harvested at least once and in many cases twice. Lands in timber production areas are often densely roaded with some sections approaching six lineal miles per square mile. Roads have contributed to many of their trademark problems such as landslides, slope failures, altered hydrology, culvert and bridge projects that can effect upstream migration, and of course higher levels if sedimentation within effected drainages. In contrast to the headwaters reach, mainstem spawning opportunities are frequently available throughout much of the upper mainstem from RM 55 downstream to Mud Mountain Dam *(MMD)* at RM 29.5. Chinook, coho and pink salmon have all been observed spawning in the lower velocity margins of the mainstem within this section.

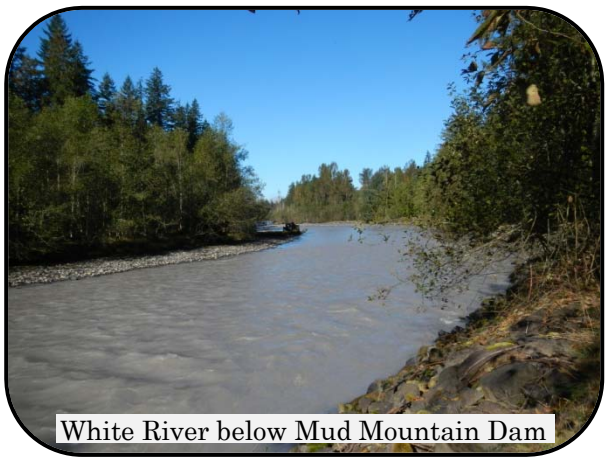
The West Fork White River entering at RM 49.2 on the left bank is glacially driven as well, and is characterized by generally unconfined, complex anastomized channels. Abundant spawning gravels are present in pool tail, as well as the margins and low velocity areas along the lower river. Woody debris is abundant, although much of it has been deposited too high to interact with the regular seasonal flows. To a great extent, the overstory riparian zone is either second growth conifer or hardwoods; except for the zone through Mt. National Park which consist of mostly old growth. Several tributaries including Pinochle, Cripple and Wrong creeks; frequently support Chinook, coho and pink spawners. In addition, the clear headwater tributaries of the West Fork, specifically Lodi Creek, provide several key



USGS graph showing White River mainstem flow manipulations downstream of Mud Mountain Dam. **Source: USGS Water Resources Gauge #12099200** https://waterdata.usgs.gov/wa/nwis/uv/?site_no=12099200&PARAmeter_cd=00060,00065

spawning and rearing opportunities for bull trout.

Mud Mountain Dam is an earthen dam built for flood control *(completed in 1948-top of previous page)* and is a complete blockage to upstream migration. Mud Mountain Dam is also suspected of causing increased mortality among downstream migrants, and is also the cause of frequent downstream flow manipulation *(previous page)*. Ongoing research is being conducted concerning impacts of Mud Mountain Dam on survival of downstream migrants passing through the dam. Upstream fish passage is accomplished by capturing fish downriver in Buckley and transported/releasing them back into the White River approximately 2 miles upstream of MMD. The Corps' trap & haul facility. The U.S. Army Corps of Engineers' *(USACE)* fish trapping facility *(circa 1948)* is located at RM 24.3 near the city of Buckley *(bottom photo)*. Salmon, steelhead, bull trout and other native fishes *(mountain whitefish, rainbow & cutthroat)* migrating to the upper White River enter this trap and are transported above Mud Mountain Dam. There is approximately 5 miles of suitable habitat between Mud Mountain Dam and the USACE Buckley trap at RM 24.3 *(center photo)*; unfortunately, only modest spawning at best takes place due to lack of fish access between the two sites. Since Puget Sound Energy *(PSE)* ceased power production *(2004)*, instream flows have increased considerably in the by-pass reach *(RM 3.6-24.3)*. Thus far, some measure of water has continued to be diverted from the river to maintain the water levels and water quality in Lake Tapps. However, the effect on fish passage is the same; a small percentage of fish will fall back downstream below Mud Mountain and utilize this disenfranchised reach of the river between the two fish passage barriers.

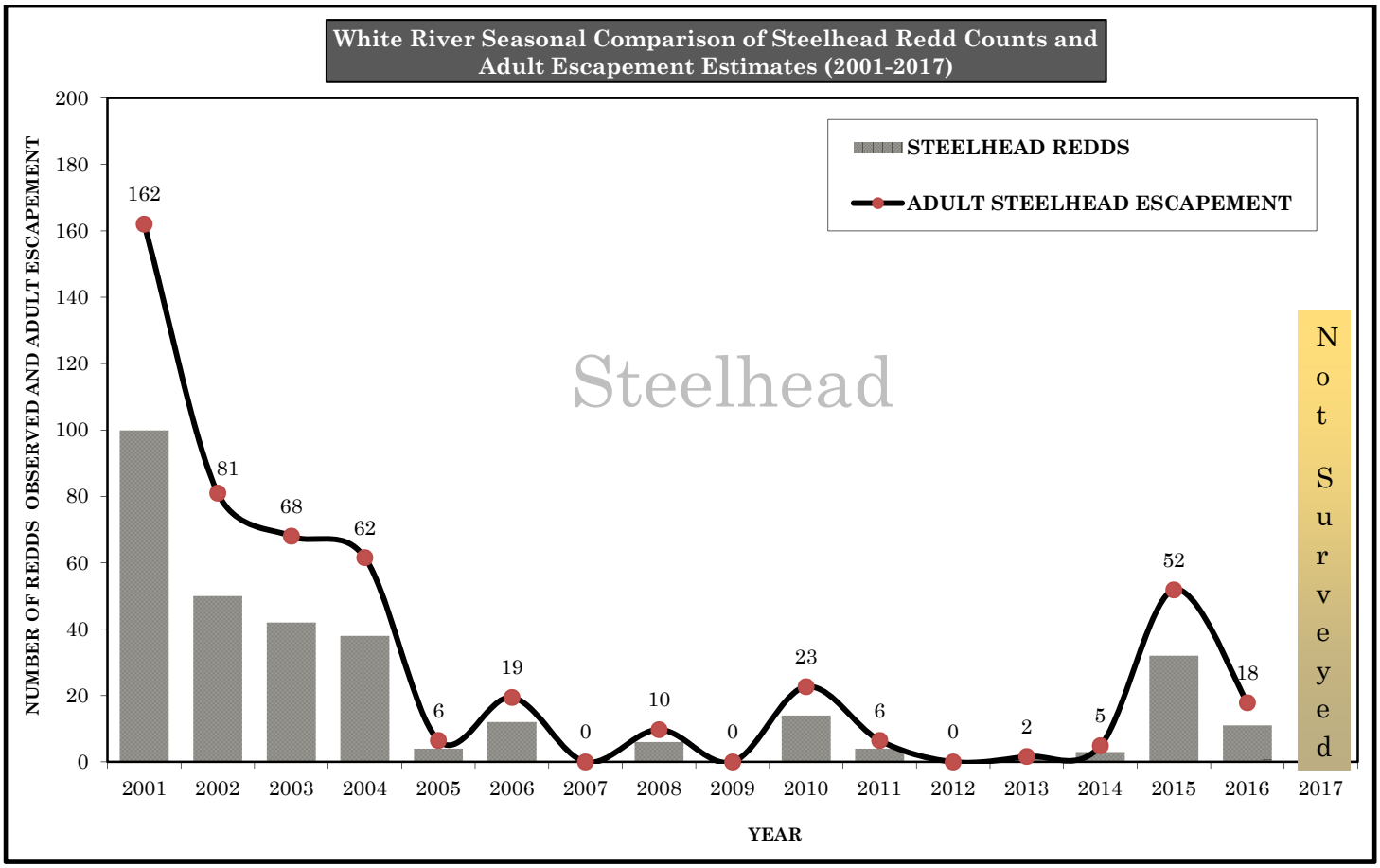


White River below Mud Mountain Dam

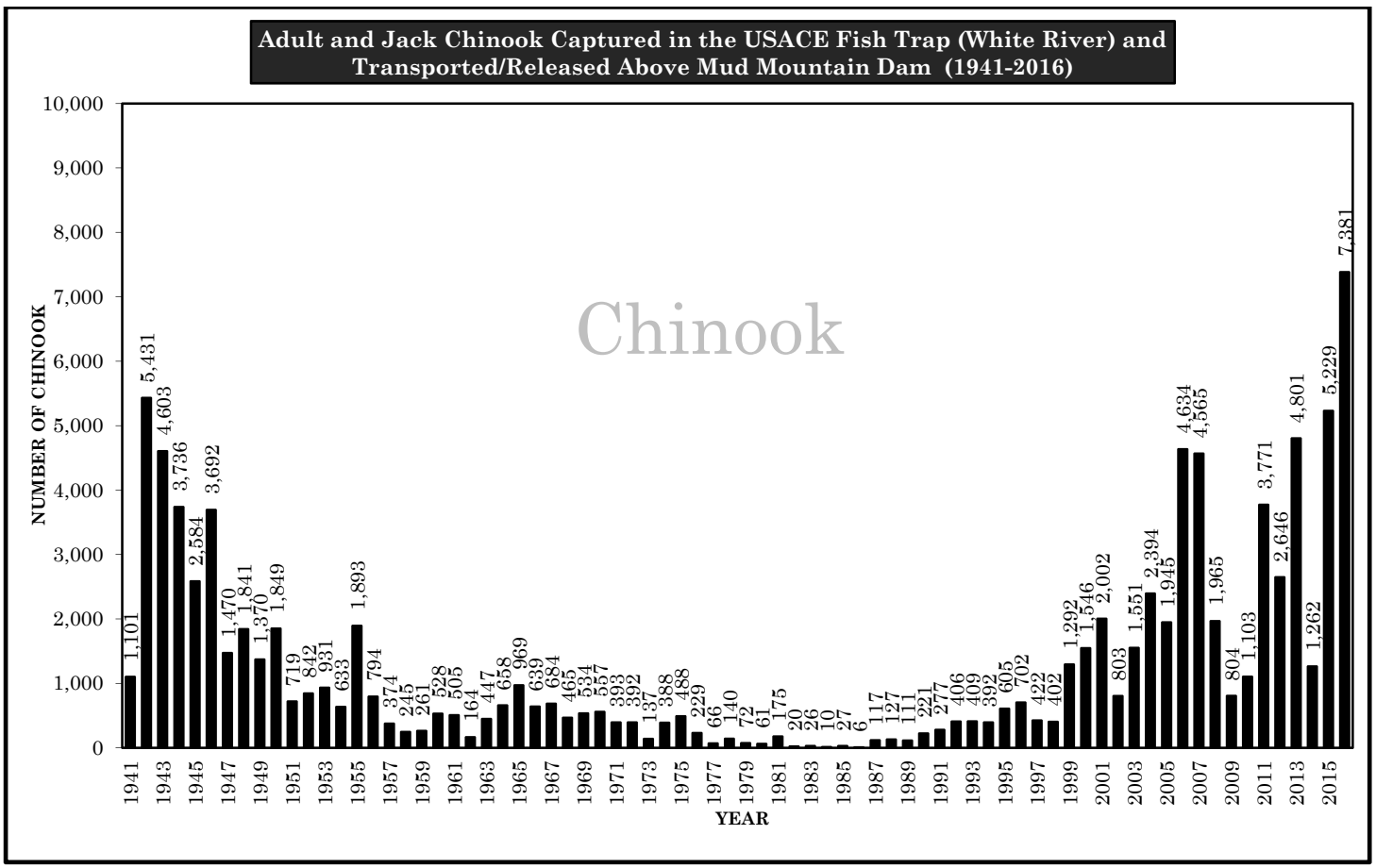
Downstream of the diversion dam at RM 24.3; to approximately RM 11, there is frequent and concentrated use by Chinook, pink, coho and steelhead. Some chum spawning activity takes place within this reach as well; however, the majority of chum spawn below RM 15. There are side channels, as well as LWD and log jams contributing to the complexity of the lower River. This reach provides numerous spawning and rearing opportunities. Downstream from approximately RM 11, the channel is constrained by levees. The channel from this point loses some complexity and there is a marked decrease in both spawning gravel and spawning activity of all species.

In 2016, the Puyallup Tribe initiated the White River Juvenile Salmonid Production Assessment Project *(see project description in following report section)*. Project funding is provided by the King county flood control district, through a cooperative watershed management grant. Puyallup Tribal Fisheries Department initiated the project to estimate juvenile production of native salmonids. The study project focuses on all salmon, with an emphasis on natural Spring and Fall Chinook salmon production and survival of hatchery and acclimation pond Chinook. In late winter of 2016, a newly constructed trapping platform employing an E. G. Solutions 8-ft diameter rotary screw was put into place on the lower White River.

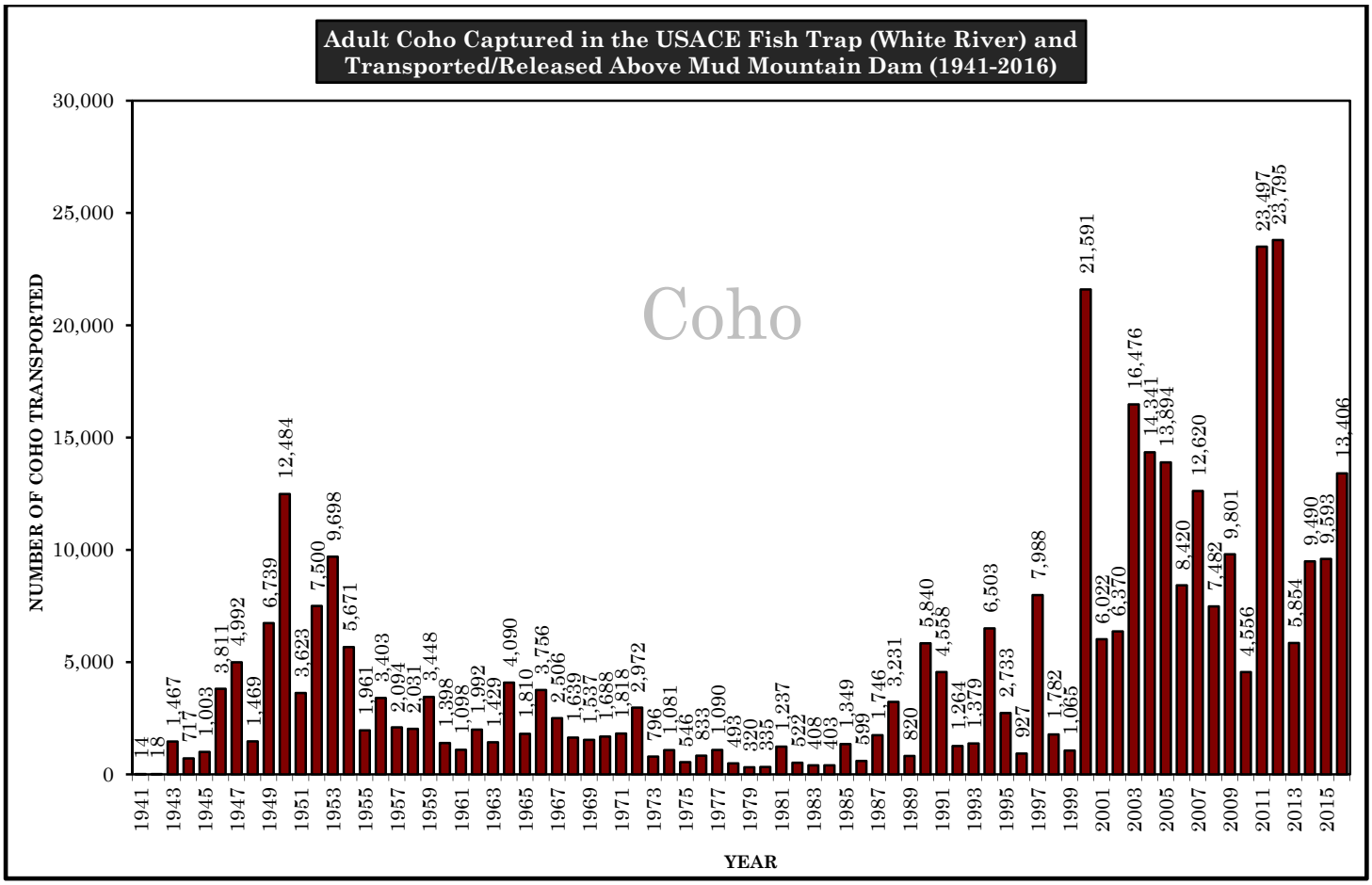
USACE fish trapping facility *(right side of photo)* and CWA's water diversion dam located on the White River *(RM*



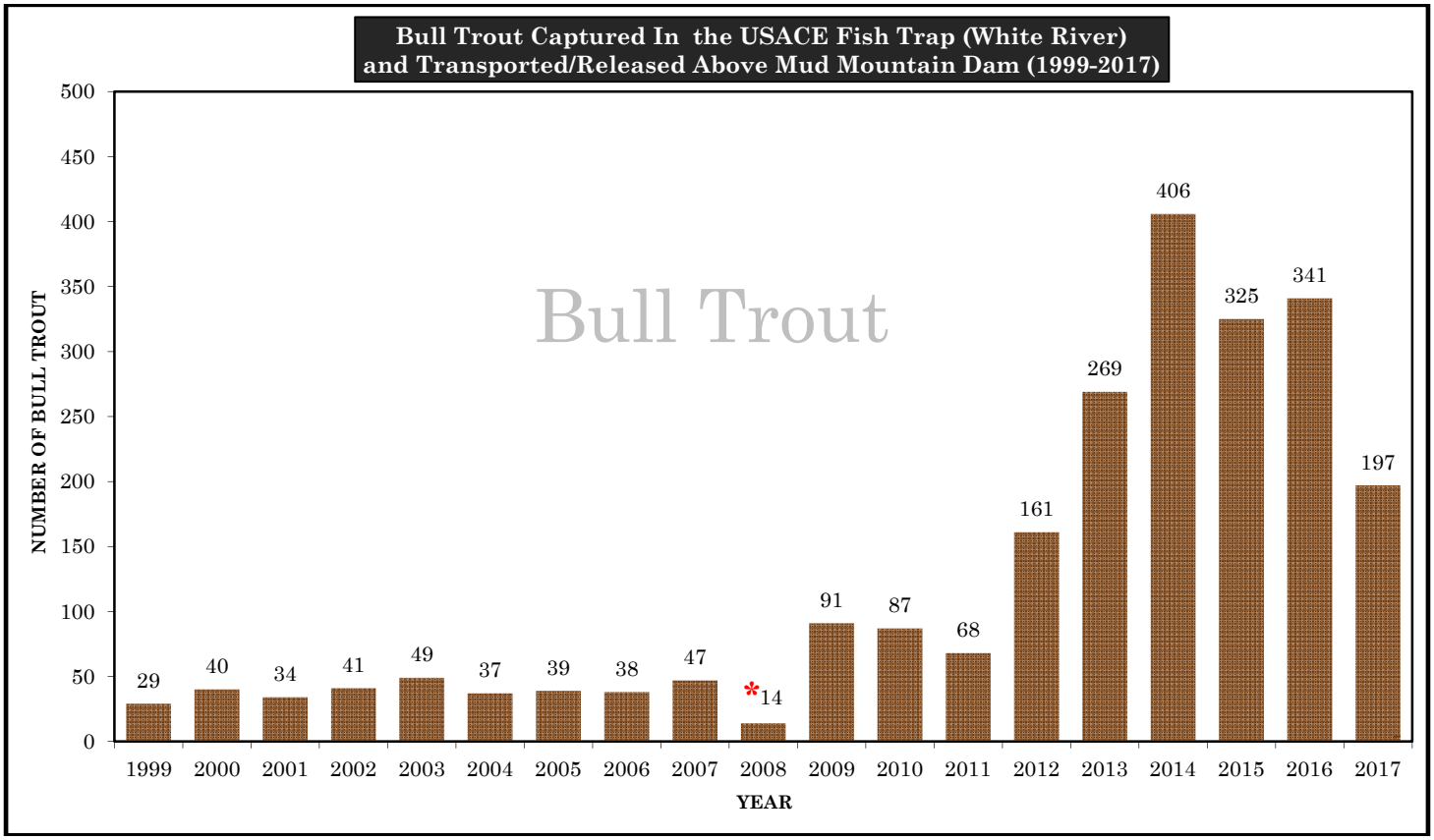
Post 2004 steelhead surveys were complicated by significanlty increased flows and turbitity due to decreased mainstem water withdrawls.



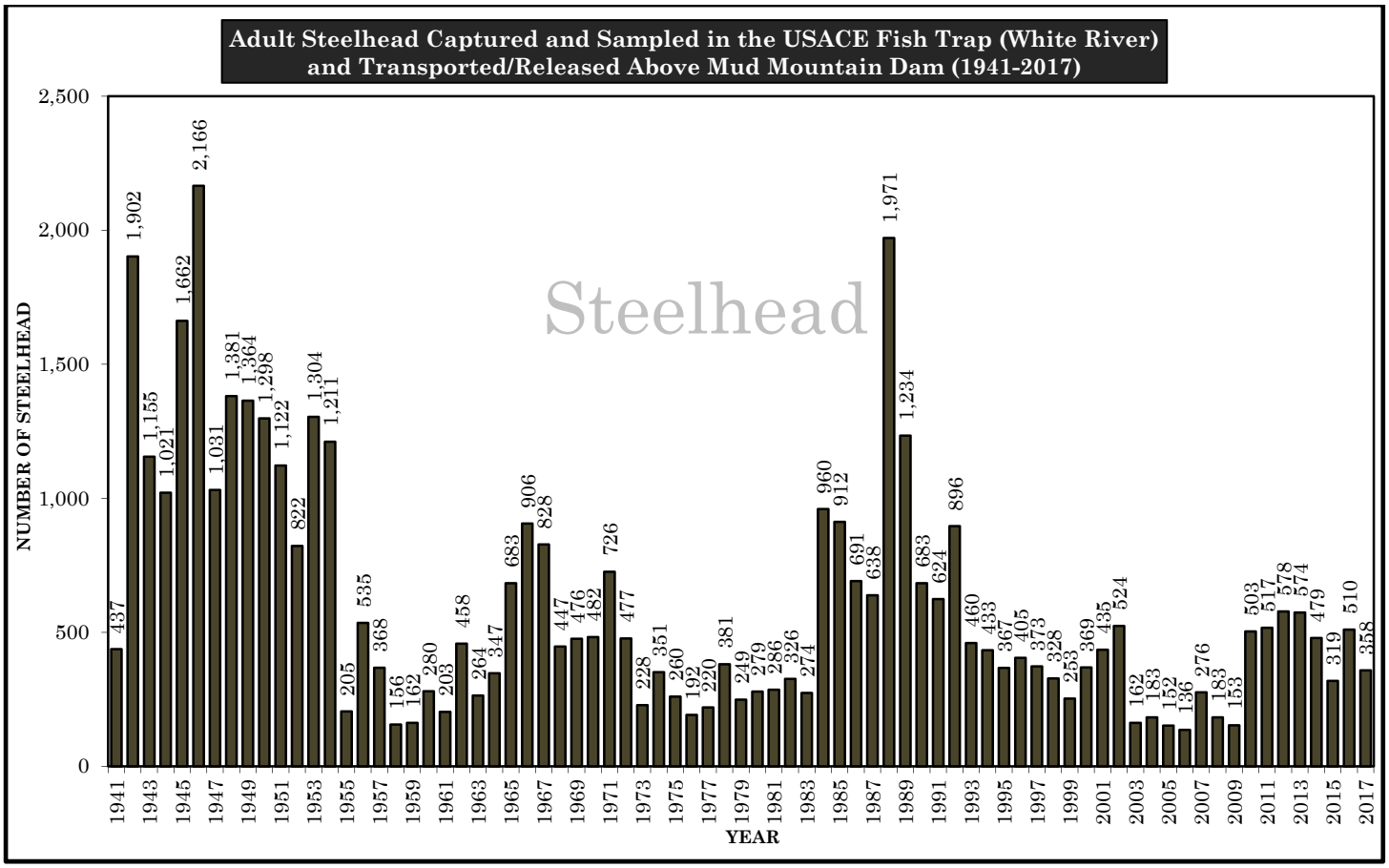
See Appendix F for data on Buckley Trap Chinook return and age compositions (NOR & hatchery).



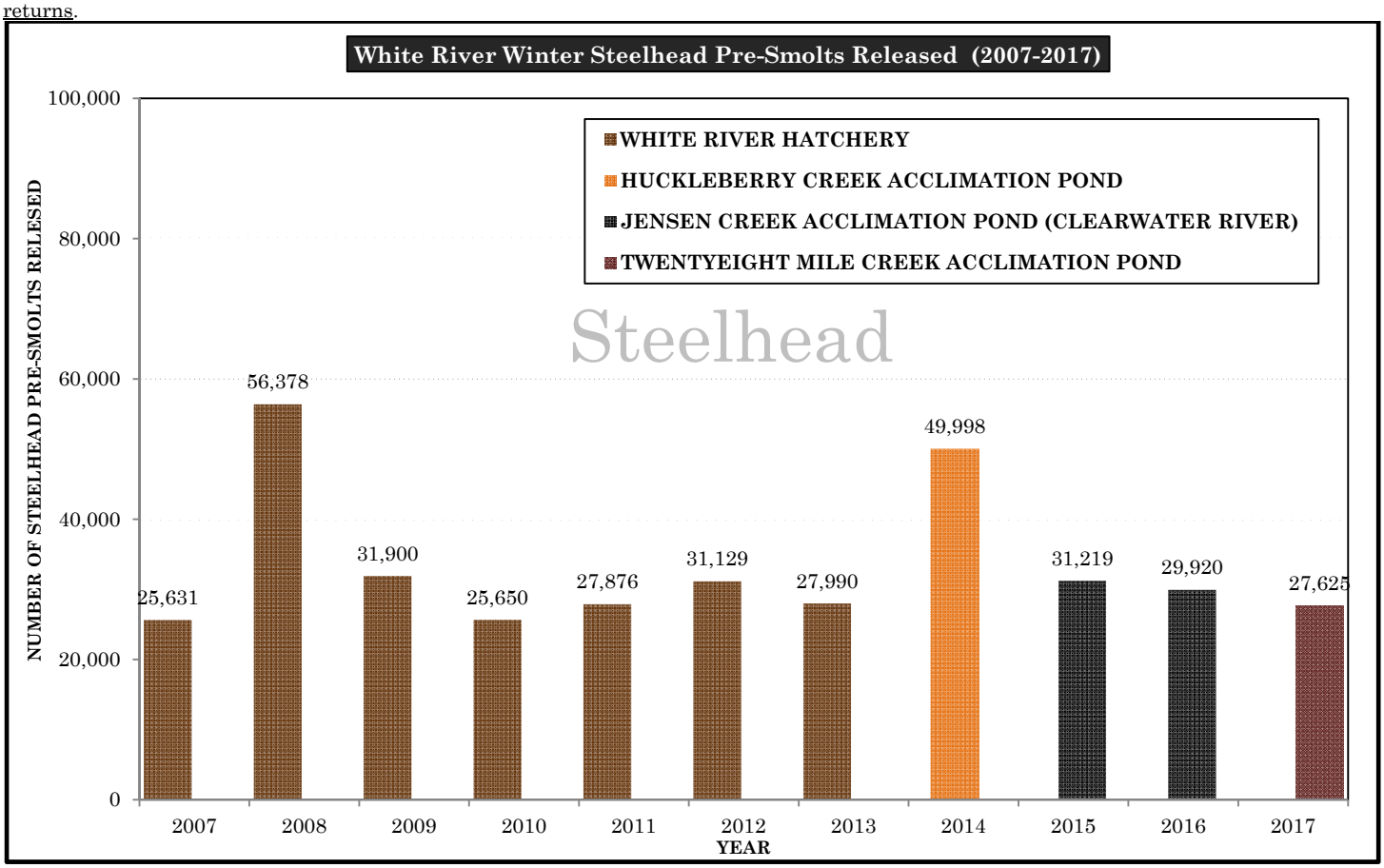
Data taken from USACE website: http://www.nws.usace.army.mil/Missions/CivilWorks/LocksandDams/MudMountainDam/FishCounts.aspx



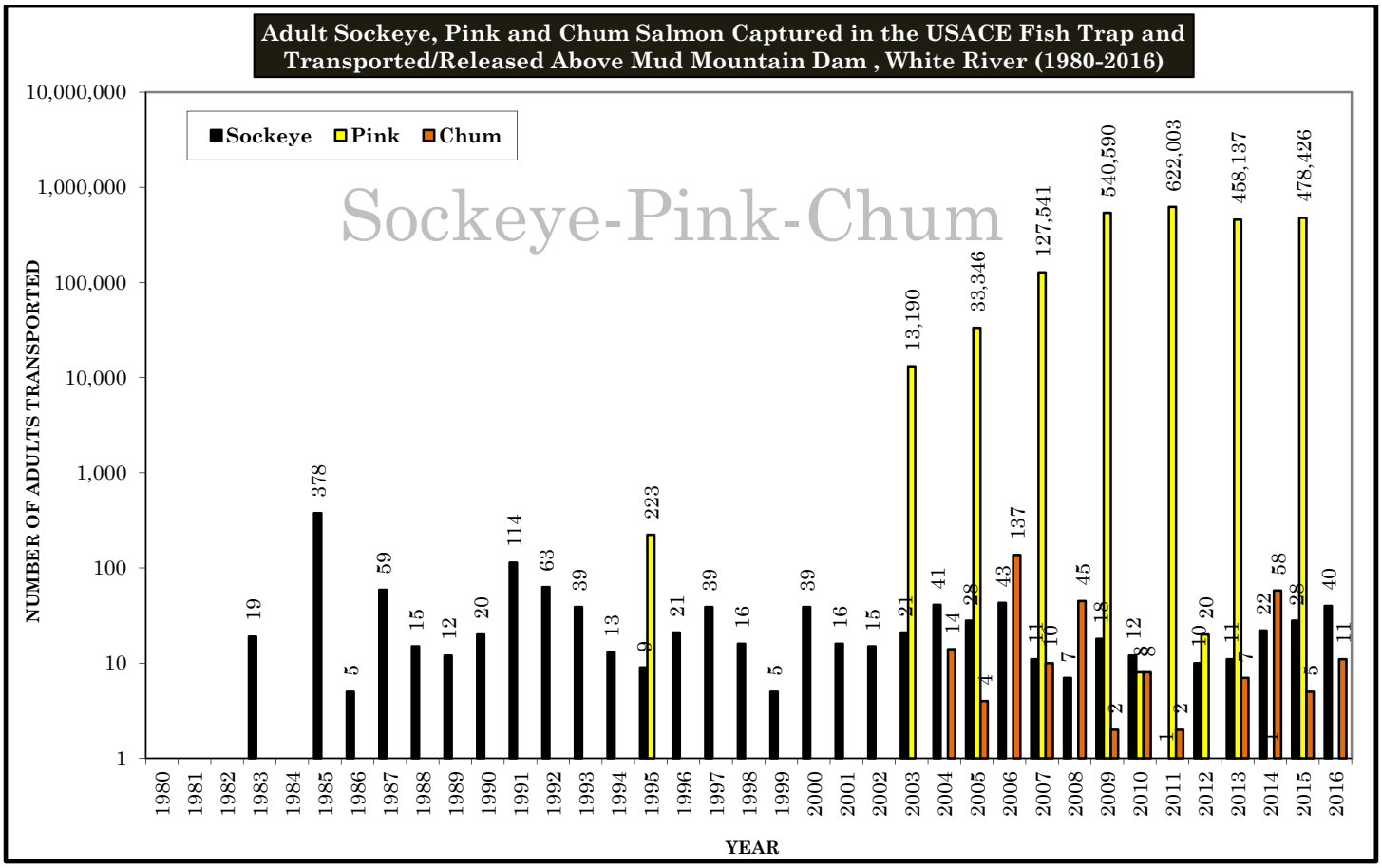
2017 data indicates the number of bull trout transported through August 31st (See Appendix E for sampling data). *The low number of bull trout captured in 2008 is likely due to significant complications which occurred with trapping operations; thereby, preventing capture and/or generating migratory delays.



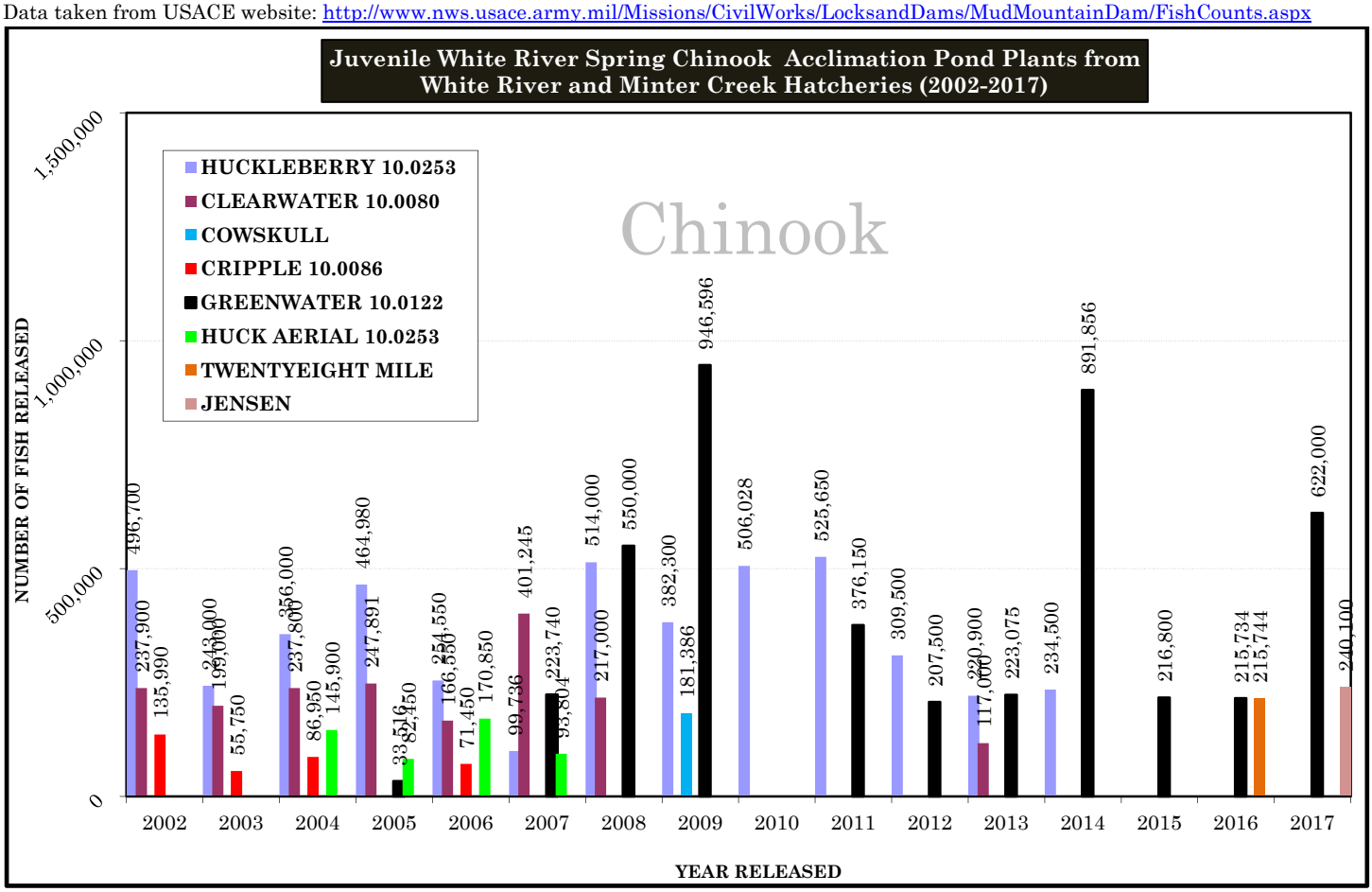
The graph above details the number of steelhead transported above Mud Mountain Dam. Additional steelhead captured in the trap since 2006 have been utilized as brood-stock for the White River steelhead supplementation pilot project. See Appendix G for the breakdown of steelhead returns.



Acclimation ponds opperated by Puyallup Tribe. See map of acclimation pond location sites on Page 41.



Data taken from USACE website: http://www.nws.usace.army.mil/Missions/CivilWorks/LocksandDams/MudMountainDam/FishCounts.aspx



Acclimation ponds opperated by Puyallup Tribe. See map of acclimation pond location sites on Page 41. No data indicates no fish were planted.

WHITE RIVER

JUVENILE SALMONID PRODUCTION ASSESSMENT PROJECT

Prepared by: Andrew Berger , Justin Paul & Julian Close

The White River Juvenile Salmonid Production Assessment Project began in 2016. Project funding was provided by the King County flood control district, through a cooperative watershed management grant. Puyallup Tribal Fisheries Department initiated the project to estimate juvenile production of native salmonids. The study project focuses on all salmon, with an emphasis on natural Spring and Fall Chinook salmon production and survival of hatchery and acclimation pond Chinook. In 2016, a newly constructed trapping platform employing an E. G. Solutions 8-ft diameter rotary screw was put into place on the lower White River.

As more data becomes available, juvenile production estimates may provide baseline information allowing managers to meet escapement objectives in the watershed create a production potential-based management strategy and accurately forecast future returns of hatchery and naturally produced adults. In addition, a basin spawner/recruit analysis will indicate stock productivity, helping to determine the overall health of the watershed and evaluate the contribution of enhancement projects.

Trapping Gear and Operations

The rotary screw-trap used in this study consists of a rotary cone suspended within a steel structure on top of twin, 40-foot pontoons. The opening of the rotary cone is 8 feet in diameter, allowing for a sampling depth of 4 feet. The cone and live box assembly are attached to a steel frame and may be raised or lowered by hand winches located at the front and rear of the assembly.

Three five-ton bow-mounted anchor winches with 3/8" steel cables were used to secure and adjust the direction of the trap and keep it in the thalweg. The cables were secured to trees on opposite banks.

The 8-ft diameter rotary screw trap was installed in the lower White River (RM 3.6) just downstream of the Dieringer tailrace outlet below Lake Tapps *(CWA facility)*. Trap operation continue, when feasible, 24 hours a day, seven days a week throughout the trapping season. The trap was checked for fish twice a day at dawn and dusk. In some instances, the trap was checked plus or minus two hours of dusk or dawn due to the availability of personnel. During hatchery releases and high flow events, personnel remained onsite through the night to clear the trap of debris and to keep fish from overcrowding and prevent mortalities.

Revolutions per minute (rpm), water temperature, secchi depth (cm), turbidity (NTU), weather conditions, and stream flow (cfs) were described for each completed trap check. A cross sectional area of the river at the smolt trap was taken to monitor channel morphology at the site.

Goals and Objectives

The goal of this project is to report production estimates, characterize juvenile migration timing, describe length distribution for all wild salmonid, out-migrants and fulfill the objectives of the Puyallup River Fall Chinook Recovery Plan.
To reach these goals, this study will produce population estimates of out-migrating smolts, estimate species specific migration timing, compare natural versus hatchery production and run timing, analyze mean fork length of wild smolts and detail species composition of the sample population. The objectives of this project are to:

1. Estimate juvenile production for salmonids in the White River and determine freshwater survival for unmarked juvenile Chinook.
2. Estimate in-river mortality of hatchery and acclimation pond Chinook.
3. Investigate physical factors such as, light (day vs. night), flow and turbidity and their importance to trap efficiency.

Sampling Procedures

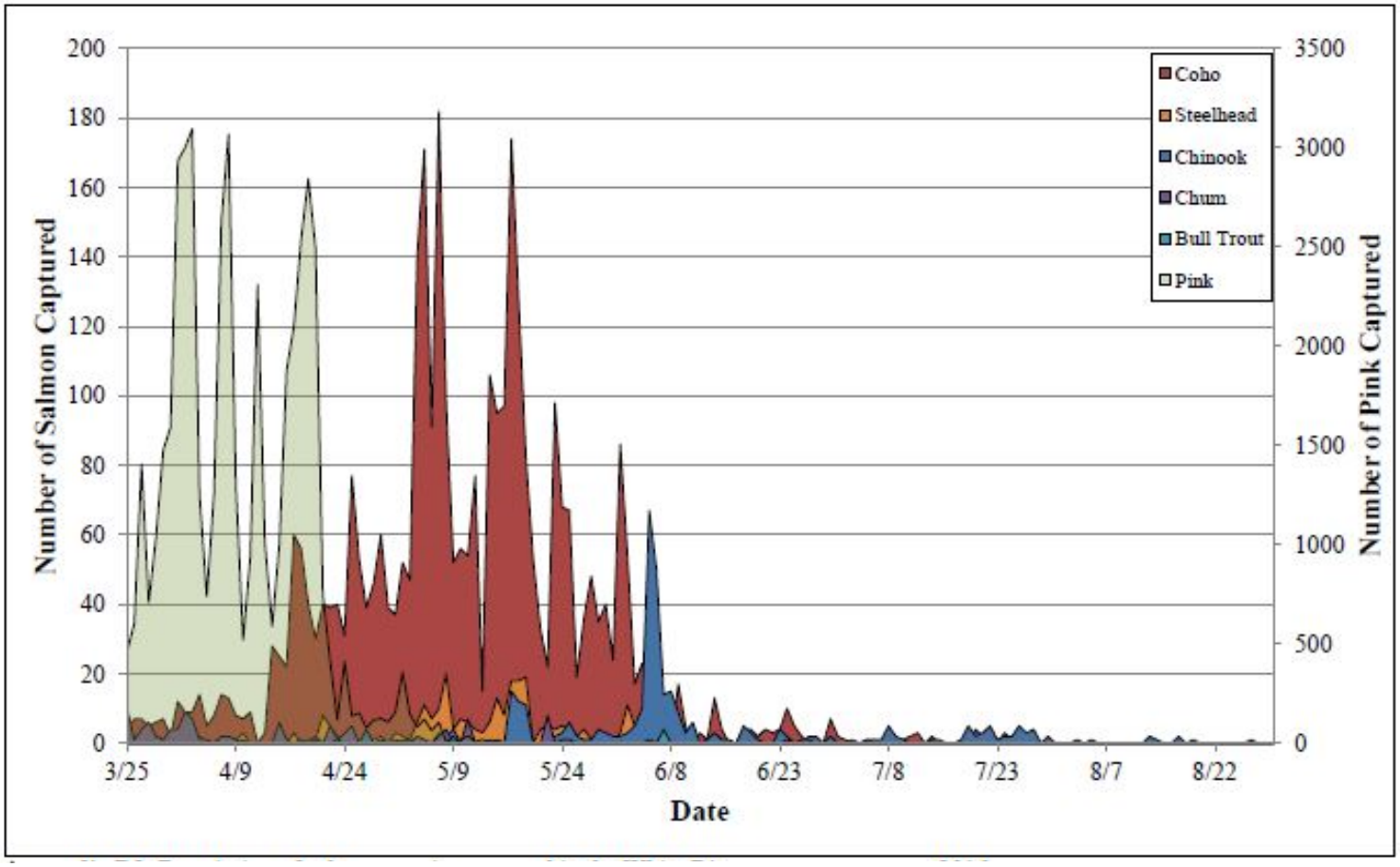
Smolts were anesthetized with MS-222 (tricaine methanesulfonate) for handling purposes and subsequently placed in a recovery bin of river water before release back to the river. Juveniles were identified as natural or hatchery origin as unmarked or marked respectively. Fork length (mm) was measured and recorded for unmarked fish. When possible, 50 chum, 50 pinks, 50 age1+ coho, 25 age 0+ coho, 25 age 0+ Chinook, and 25 steelhead were measured per day. Scale samples were additionally taken on all wild steelhead smolts.

Species were separated by size/age class. Coho were identified as fry, age 0+ (<70mm) or smolts, age 1+ (>70mm). Chinook smolts were separated by age 0+ (<150mm) or age 1+ (>150mm). All chum and pinks were identified as age 0+. Trout fry age 0+ (<60mm) were not differentiated to species.

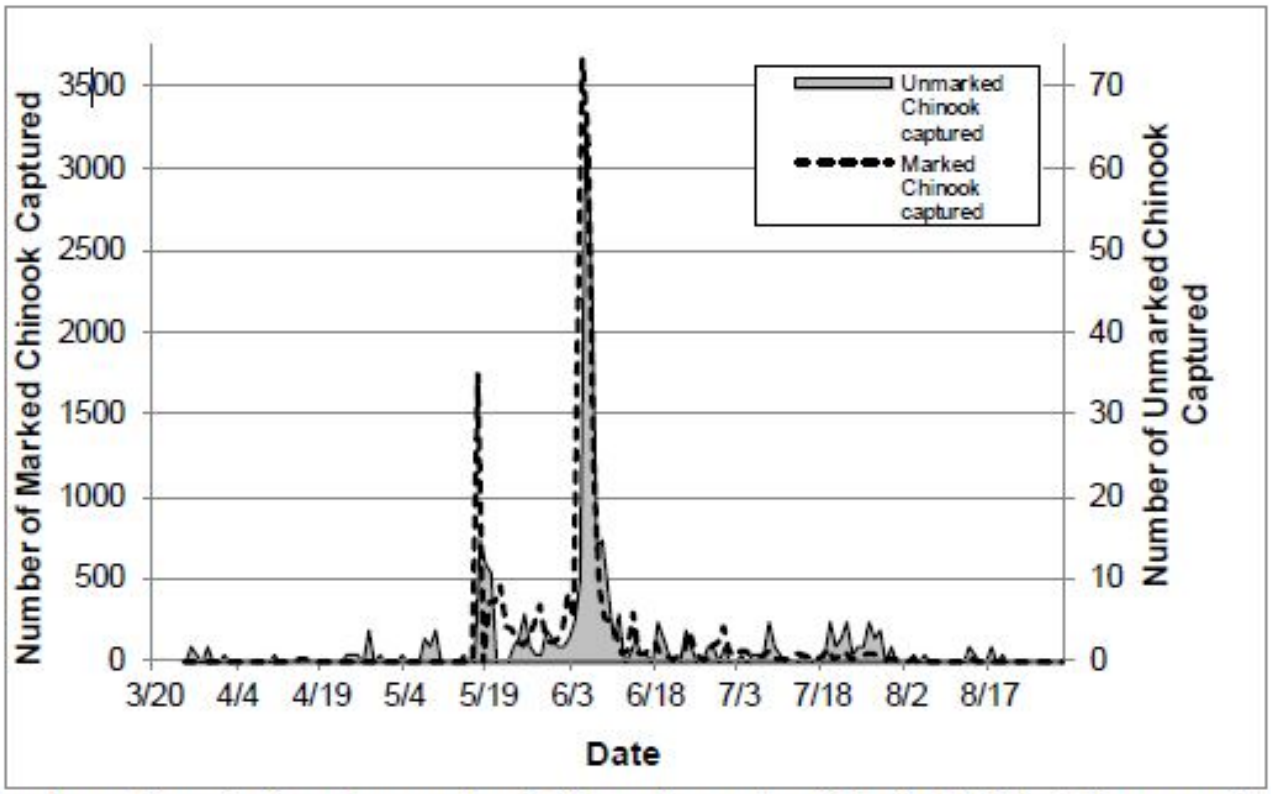
Hatchery origin fish were identified in three ways: 1) by visual inspection for adipose fin clips, 2) with a Northwest Marine Technology "wand" detector used for coded wire tag detection, and 3) with a Destron Fearing Portable Transceiver system for Passive Integrated Transponder (PIT) tagged fish.

To request a full copy of current or previous reports, contact:

-Puyallup Tribal Fisheries Department
253-680-5560
or
-Andrew Berger
Stock Assessment Biologist
adrew.berger@puyalluptribe.com
253-680-5569.

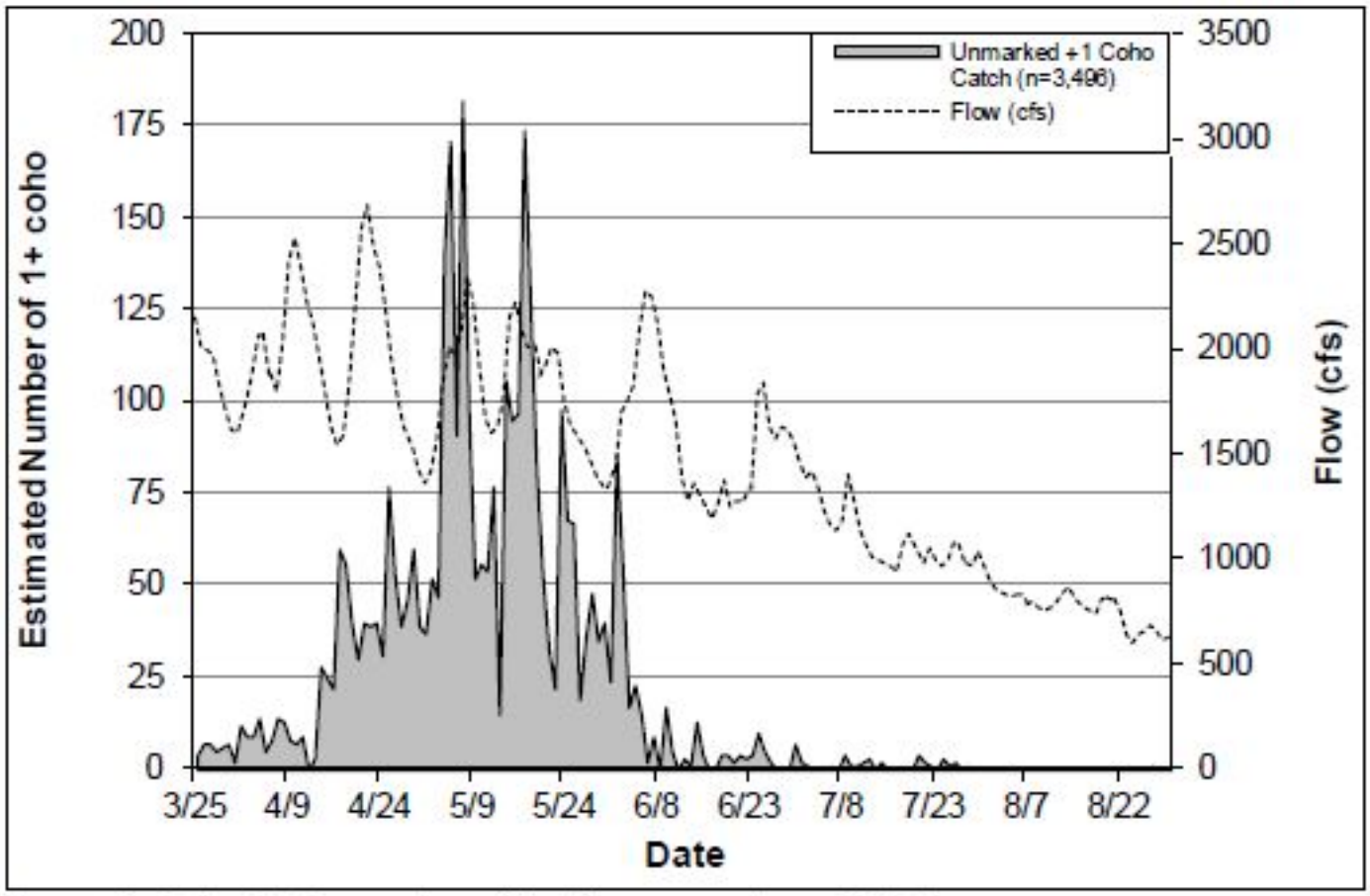


Run timing of salmon species captured in the White River rotary screw trap, 2016. **Source:** (Berger et al. 2016) White River Juvenile Salmon Production Assessment Project 2016



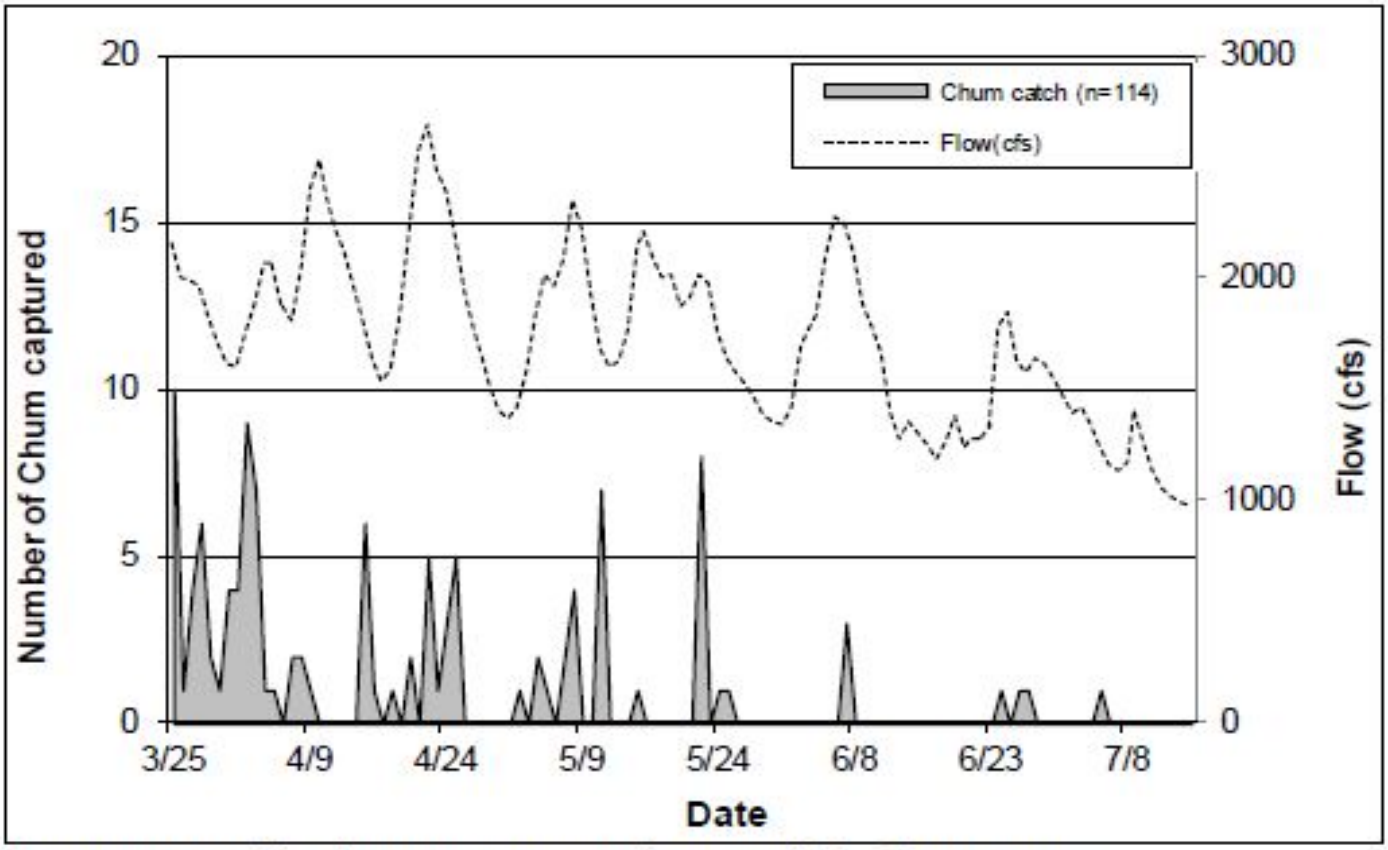
Number of marked and unmarked Chinook captured in the White River smolt trap, 2016.

Source: (Berger et al. 2016) White River Juvenile Salmon Production Assessment Project 2016



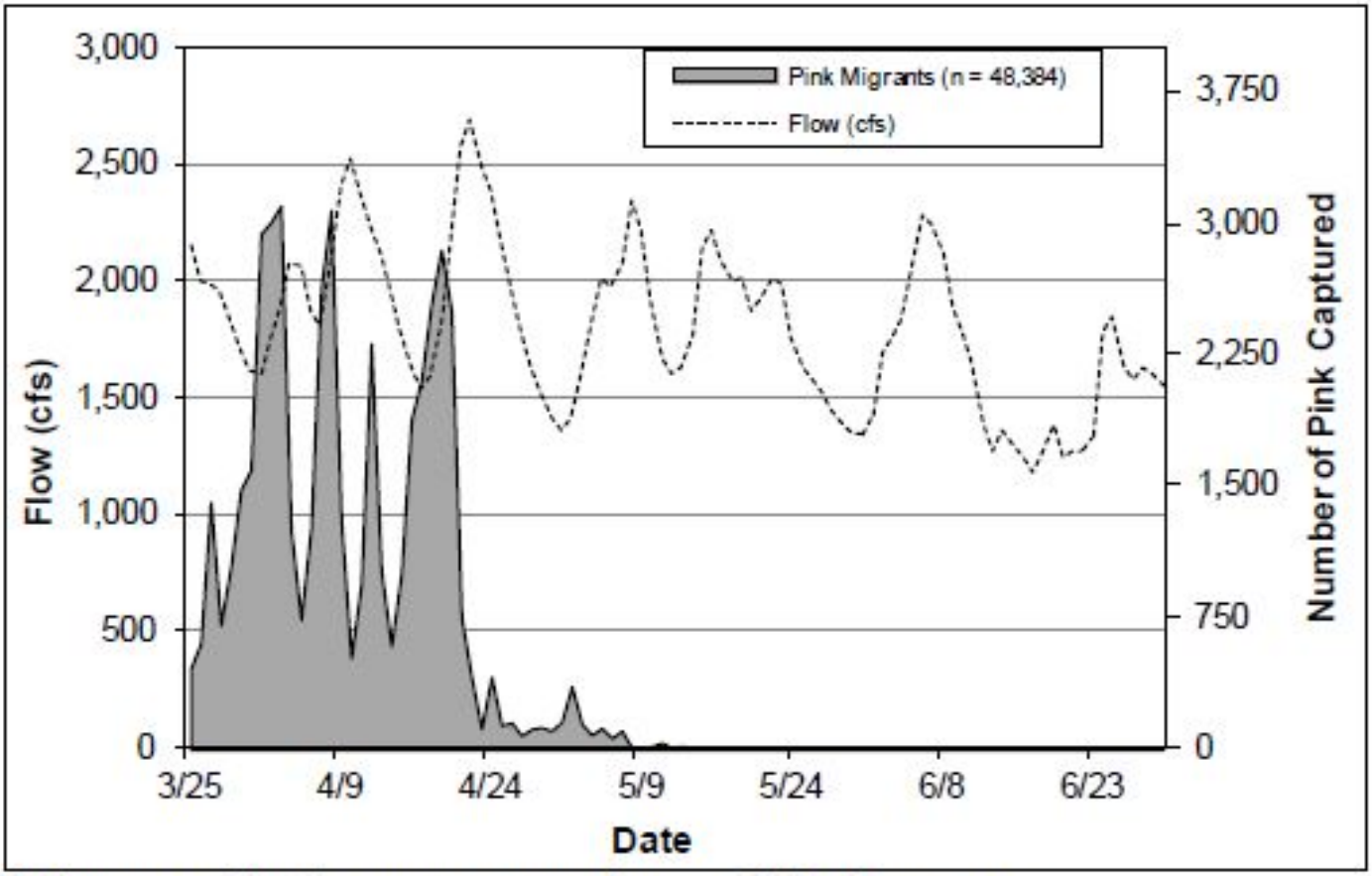
Unmarked 1+ Coho captured in the screw trap, 2016.

Source: (Berger et al. 2016) White River Juvenile Salmon Production Assessment Project 2016



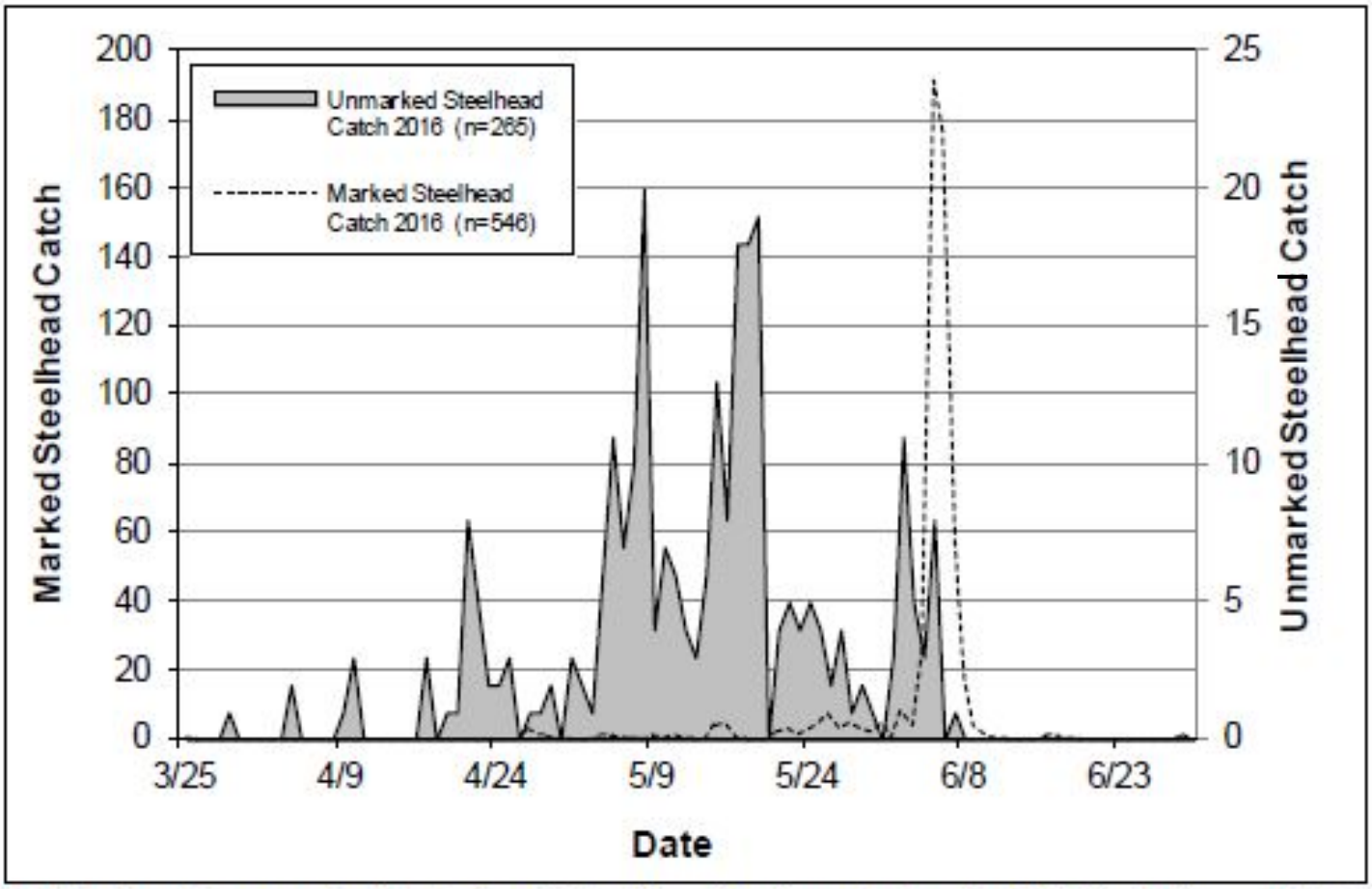
Chum captured in the screw trap and mean daily flow, 2016.

Source: (Berger et al. 2016) White River Juvenile Salmon Production Assessment Project 2016



Pink captured in the screw trap and mean daily flow, 2016.

Source: (Berger et al. 2016) White River Juvenile Salmon Production Assessment Project 2016



Marked and unmarked catch of Steelhead migrants in the White River, 2016.

Source: (Berger et al. 2016) White River Juvenile Salmon Production Assessment Project 2016

WILKESON CREEK

WRIA 10.0432

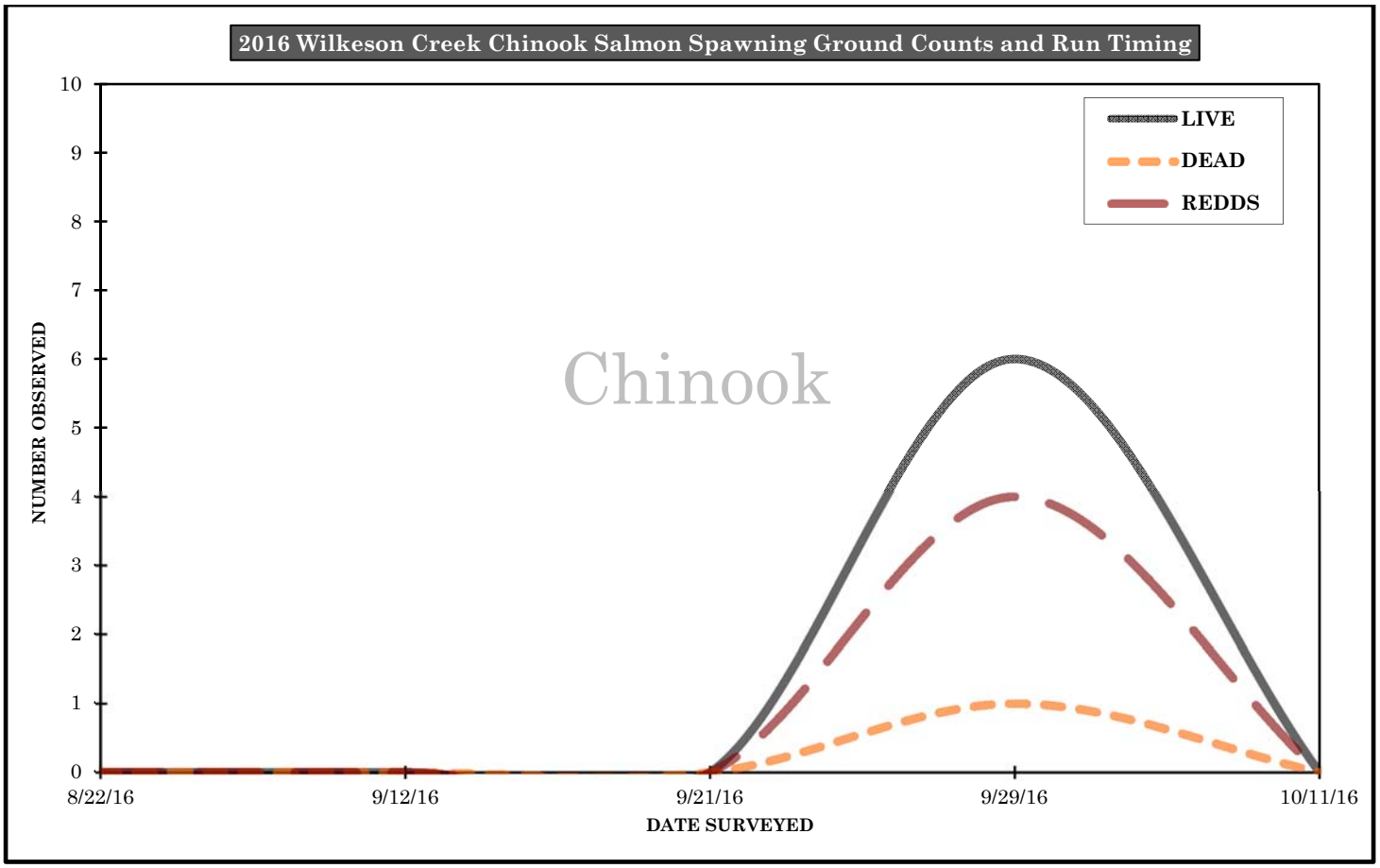
Wilkeson Creek is a large tributary to lower South Prairie Creek. Wilkeson flows for 12.3 miles from its source in the Mt. Baker-Snoqualmie National Forest; passing through the community of Wilkeson before meeting with South Prairie Creek *(RM 6.7)* just east of the town of South Prairie. Unfortunately, only the lower half of Wilkeson is accessible to salmon; a series of falls at RM 6.2 marks the upper extent of anadromous migration/access.

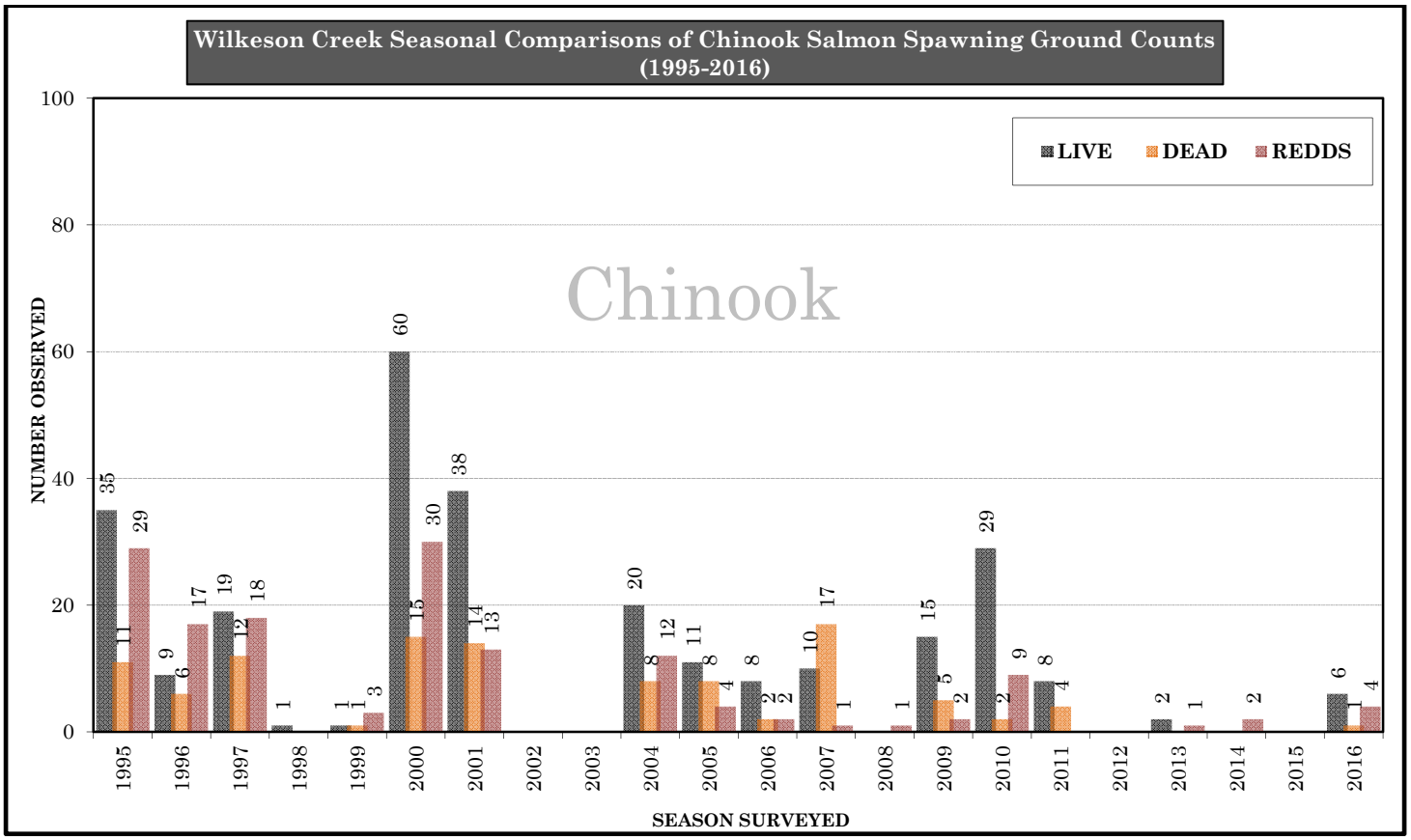
Despite its limitations, the Wilkeson Creek basin is a productive system providing suitable spawning and rearing habitat for Chinook, coho, pink, chum, steelhead, rainbow, cutthroat and bull trout. Several fish and habitat related issues associated with Wilkeson Creek include; erosion, water quality *(temperature)*, channel confinement, low flows, water withdrawal, and aquatic noxious weeds (*Japanese knotweed-Polygonum cuspidatum).* In addition, pieces of coal still visible in the creek channel continue to bring to light the regions coal mining history and its lasting impacts on the creek. Currently, the primary land use along Wilkeson is rural residential, recreational, light commercial, and forestry. Chinook use and access can be limited due to the extremely low flows common during late summer and early fall.

Upper Wilkeson Creek

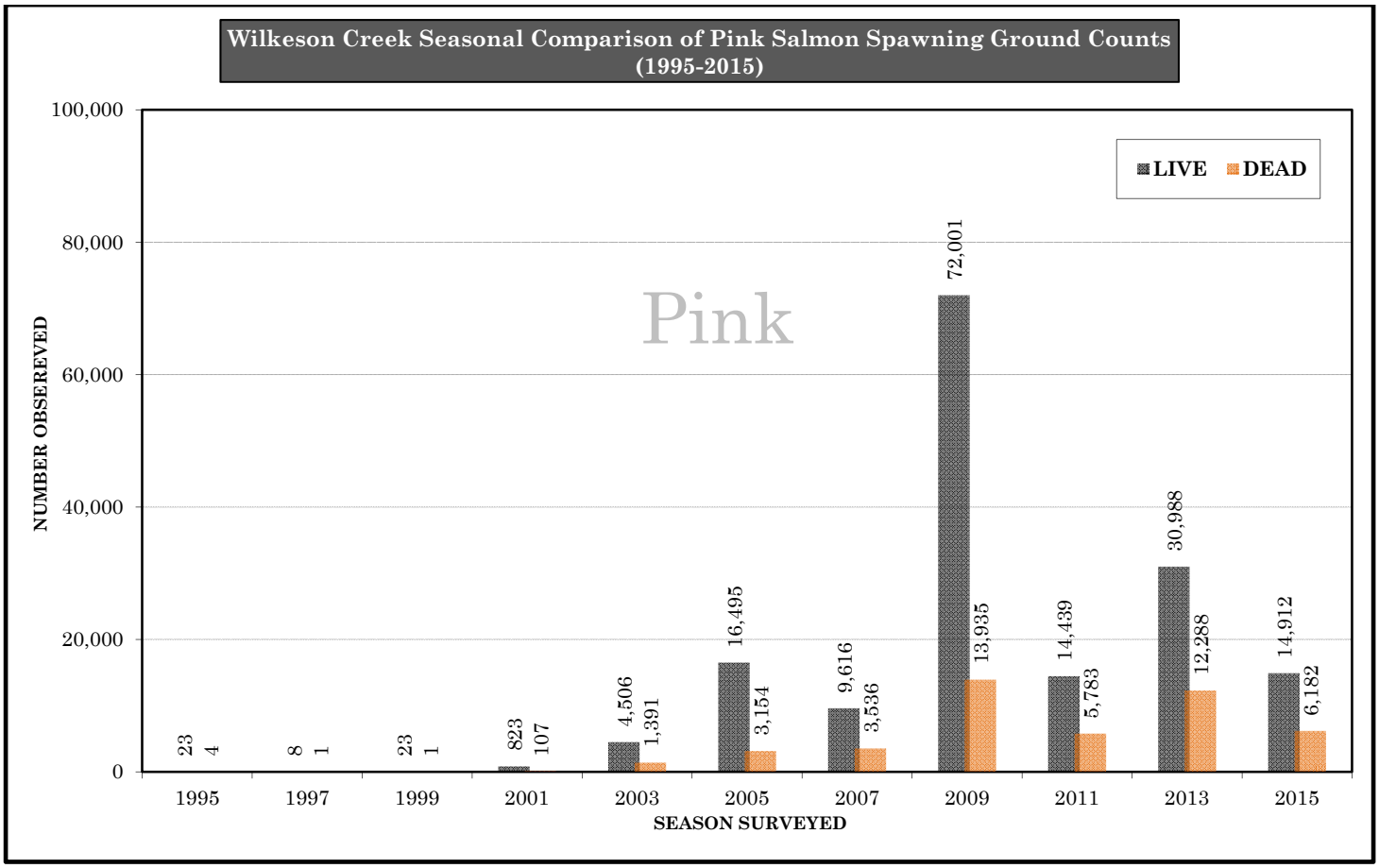
From the barrier falls at RM 6.2, down to approximately RM 5, the creek is confined by valley walls; yet the channel width and gradient are conducive to providing ample spawning opportunities for all species *(lower left).* Coal Mine Creek, entering near RM 5.7, is the only significant tributary entering the anadromous segment of Wilkeson Creek. Coal Mine Creek *(see description in this report)* supports coho, chum, and pink spawners and provides overwintering and foraging habitat for all life stages of salmonids.

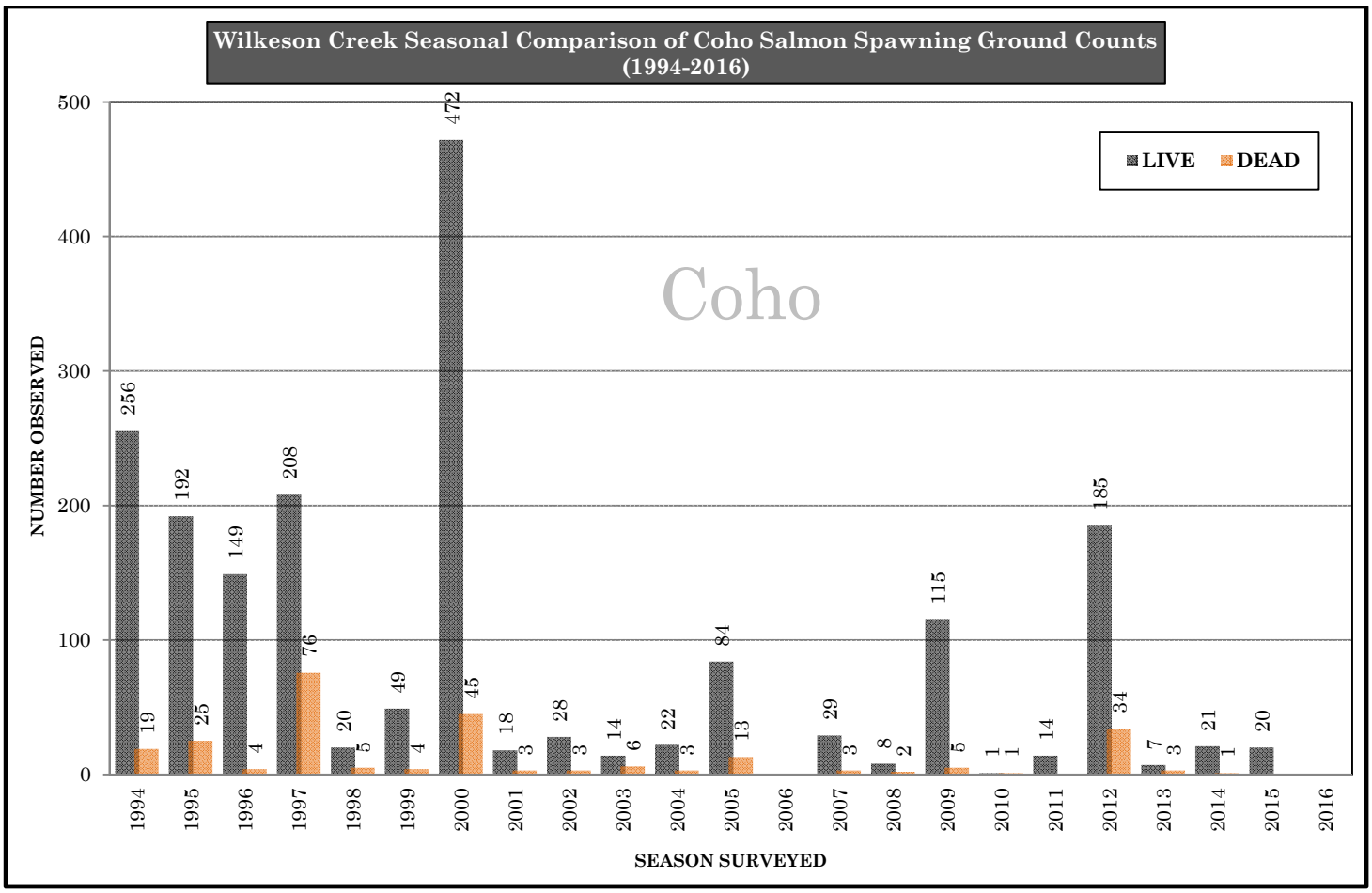
Between RM 5 and 4, Wilkeson Creek meanders through the town of Wilkeson. The channel is often deeply entrenched and the banks are generally riprapped and confined. Spawning opportunities throughout this section are available, although somewhat reduced compared to the rest of the creek. At RM 4.2, the Wilkeson Waste Water Treatment Plant discharges its treated domestic wastewater into the creek. Downstream of river mile 4, and the community of Wilkeson, the creek travels through generally undeveloped forested land until it reaches South Prairie Creek. The lower 4 miles of Wilkeson is a pool-riffle stream with a gravel/cobble substrate. With a few exceptions, abundant spawning gravel is present throughout this 4 mile section. The overstory riparian along lower Wilkeson consists of mixed hardwoods and conifers with a diverse understory of native shrubs and vegetation. Large swaths of Japanese knot weed are also present along much of the stream. Instream woody debris is plentiful providing both channel complexity and cover. The lower 3 miles has natural sinuosity, with a heavily wooded riparian zone. Debris jams and several side channels offering excellent spawning opportunities; as well as, overwintering habitat for juvenile coho, Chinook and steelhead. The lower 1.5-2 miles of the creek frequently supports the highest spawning densities of Chinook, pink, and chum. Whereas, coho and steelhead focus more heavily on the middle and upper reaches of the creek.





Adult Chinook escapement is determined by expanding the number of redds observed by 2.5 fish per redd (Smith and Castle, 1994). Due to the tremendous volume of pink salmon during odd years, the success of determining Chinook redds from pinks is vastly reduced. Therefore, The AUC method is used to determine escapement during pink runs (odd years).


Wilkeson Creek Seasonal Comparison of Pink Salmon Spawning Ground Counts (1995-2015)
LIVE
DEAD
Pink
NUMBER OBSEREVED
SEASON SURVEYED
100,000
80,000
60,000
40,000
20,000
0
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
23
4
8
1
23
1
823
107
4,506
1,391
16,495
3,154
9,616
3,536
72,001
13,935
14,439
5,783
30,988
12,288
14,912
6,182


Wilkeson Creek Seasonal Comparison of Coho Salmon Spawning Ground Counts (1994-2016)
LIVE
DEAD
Coho
NUMBER OBSERVED
SEASON SURVEYED
500
400
300
200
100
0
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
256
19
192
25
149
4
208
76
20
5
49
4
472
45
18
3
28
3
14
6
22
3
84
13
29
3
8
2
115
5
1
1
14
185
34
7
3
21
1
20

Wilkeson Creek Seasonal Comparison of Chum Salmon Spawning Ground Counts (2001-2016)
LIVE
DEAD
Chum
NUMBER OBSERVED
SEASON SURVEYED
0
100
200
300
400
500
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
219
136
409
180
127
182
138
161
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6
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27
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3
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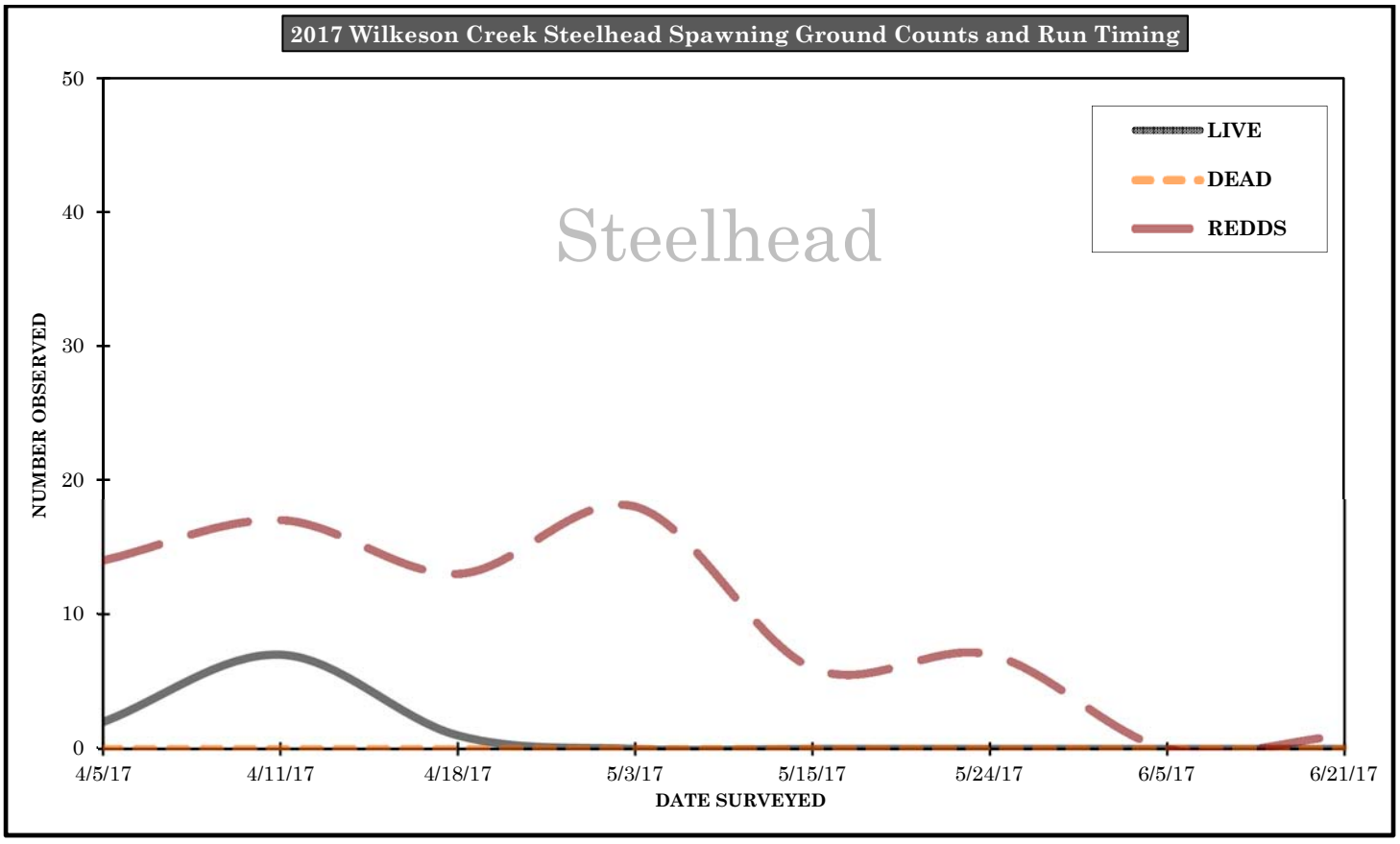
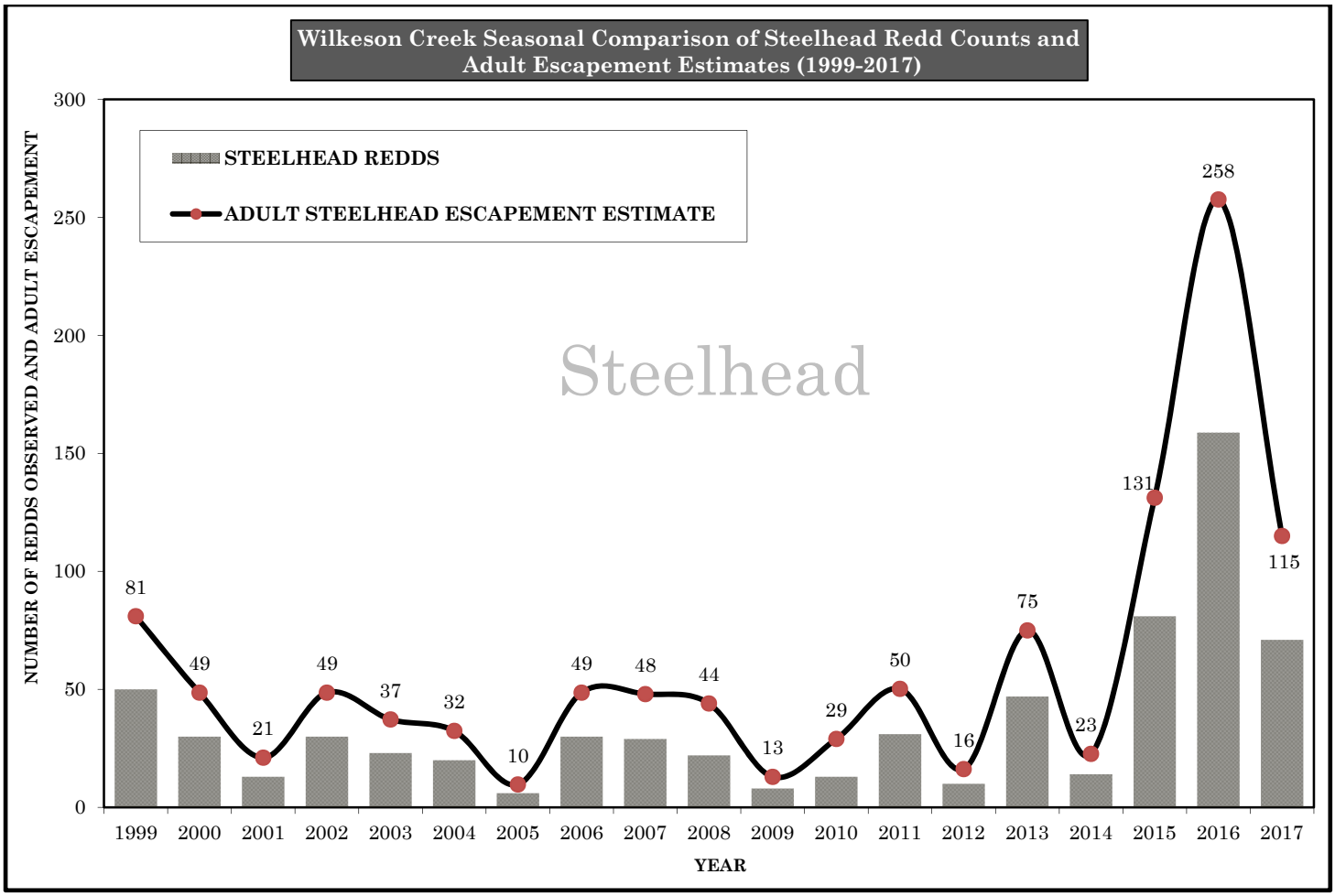
1
22
4
23
12


2017 Wilkeson Creek Steelhead Spawning Ground Counts and Run Timing
LIVE
DEAD
REDDS
Steelhead
NUMBER OBSERVED
DATE SURVEYED
0
10
20
30
40
50
4/5/17
4/11/17
4/18/17
5/3/17
5/15/17
5/24/17
6/5/17
6/21/17



Wilkeson Creek steelhead graph was generated using survey data collected by WDFW biologists. To determine the total escapement for steelhead, each redd is multiplied by a factor of 1.62 *(i.e. 42 redds x 1.62 steelhead per redd = total escapement of 68 steelhead).*

WINZIG CREEK

Winzig Creek is not officially named by the Washington State Board on Geographic Names, nor is it identified on topographical maps; however, for easy identification the creek is referred to as "Winzig" by PTF staff. Located within Mt. Rainier National Park, Winzig is a small right bank tributary to Fryingpan Creek. This tiny *(winzig means tiny in German)* mountain stream, likely intermittent or seasonal, did not exist during prior seasonal bull trout surveys and was surveyed for the first time in 2009. The mouth of Winzig Creek, which is located at nearly 4000' elevation, is too high for most Pacific salmon species. Despite its lack of anadromous length or initial bull trout spawner escapement, the lower reach of Winzig does provide suitable habitat for bull trout rearing and spawning.

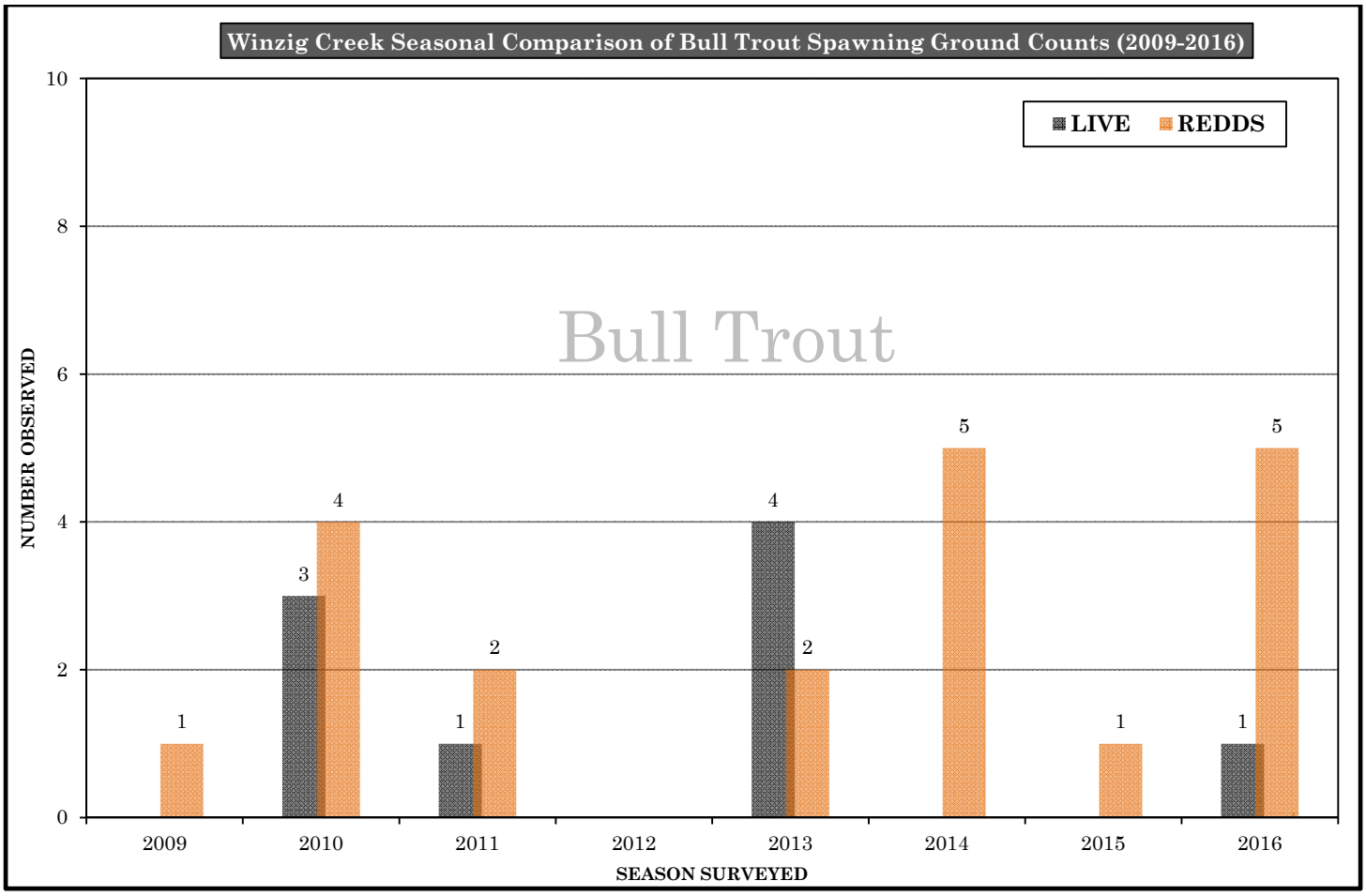
Spawning bull trout

Nearly the entire anadromous reach of the creek *(approximately 800')* is low gradient. There are small quantities of LWD present within this stretch, in addition to a beneficial riparian buffer zone of primarily conifers exists along the right bank of the creek. Even though spawning has been documented within this small stretch *(depending on mainstem influence);* it is limited due the lack of quality spawning substrate created by the alluvial deposits *(sand & silt)* from Fryingpan Creek. The habitat within this section is the least conducive for spawning due to a primarily cobble and sandy substrate. In addition, this reach of the creek is highly subjected to the possibility of redd scouring or heavy silt deposition due to the influence of Fryingpan creek. Upstream of the anadromous reach, the creek enters the heavily forested lower slope of the valley as it begins to climbs up the valley wall. From this point, the creek assumes a pool-riffle-cascade configuration up the steepening valley wall.

Winzig Creek enters Fryingpan at approximately RM 1.3; less than a mile upstream of the Sunrise Park Road crossing, and approximately 0.2 miles below Wright creek. The total length of the creek is unknown; however, only the lower 0.15 miles is accessible by salmonids. A series of bedrock cascades and falls blocks any further upstream migration. The lower creek is almost entirely bordered by an old growth coniferous forest.

The first 0.1 mile of the creek consists of a narrow, moderate gradient channel flowing *(late summer flow app. 2-3 cfs.)* within the open Fryingpan Creek channel migration zone. Spawning opportunities in this newly established channel have improved since 2009. There is no significant LWD or natural cover present in this portion of the channel.

Beyond the open channel migration zone, the creek enters the forested slope along Fryingpan. The channel assumes a step-pool configuration from this point on. Throughout this final reach of fish usage, spawning opportunities are reduced due to the increased gradient, predominately larger substrate, and rapid flows encountered. Approximately 0.1 miles after entering the forested area, the creek climbs rapidly up a series of bedrock cascades and small falls; marking the end of fish utilization.



See Appendix B for bull trout redd locations.

WRIGHT CREEK

WRIA 10.0370

Bull trout

Wright Creek, located within Mt. Rainier National Park, is a small right bank tributary to Fryingpan Creek. This small mountain stream is surveyed for bull trout from late August through the first part of October. The mouth of Wright Creek, which is located at nearly 4000' elevation, is too high for most Pacific salmon species. Wright Creek does provide excellent rearing and spawning habitat for a host of resident and fluvial bull trout. In 2006 and 2007, Puyallup Tribal Fisheries staff radio tagged bull trout captured in the USACE fish trap near Buckley. Subsequently, a few of these bull trout were tracked from their release site at RM 45 on the White River (*near the town of Greenwater*) to Fryingpan Creek and Wright Creek. Spawning was observed in both creeks during September. The telemetry studies and redd surveys along the upper White River and West Fork White River; focused heavily on the headwaters located within Mt. Rainier National Park. The study results showed the cold high mountain streams located within the National Park, including Wright Cr., provide the majority of the critical bull trout spawning habitat in the basin.

Wright Creek enters Fryingpan at approximately RM 1.5; less than a mile upstream of the Sunrise Park Road crossing. Of its 1.7 mile length, Wright Creek provides approximately 0.2 miles of accessible salmonids usage. A series of bedrock cascades and falls blocks any further upstream migration. The creek is almost entirely bordered by an old growth coniferous forest and the water is cooled year round by snow and glacial melt water from Sarvant Glacier, which is located on the northern slopes of the Cowlitz Chimneys *(Sarvant Glacier is named after Henry M. Sarvant, (1869-1940), an engineer and early surveyor of the mountain).* Additional flow is contributed by a small non-glacial tributary entering on the left bank at RM 1.4.

The first 0.1 mile of the Wright Creek consists of a narrow, moderate gradient channel flowing within the open Fryingpan Creek channel migration zone. Several patches of excellent spawning gravel are available throughout this section of the creek and the majority of spawning has occurred within this segment. There is no significant LWD or natural cover present in this portion of the channel; however, spawning activity is often observed within close proximity of the few pieces of small woody debris present.

Beyond the open channel, Wright Creek enters the heavily forested slope bordering Fryingpan and assumes a step-pool configuration for the next 0.1 miles. Throughout this final reach of fish usage, spawning opportunities are reduced due to the increased gradient, predominately larger substrate, and rapid flows encountered. Although the majority of this short upper section provides excellent rearing habi-

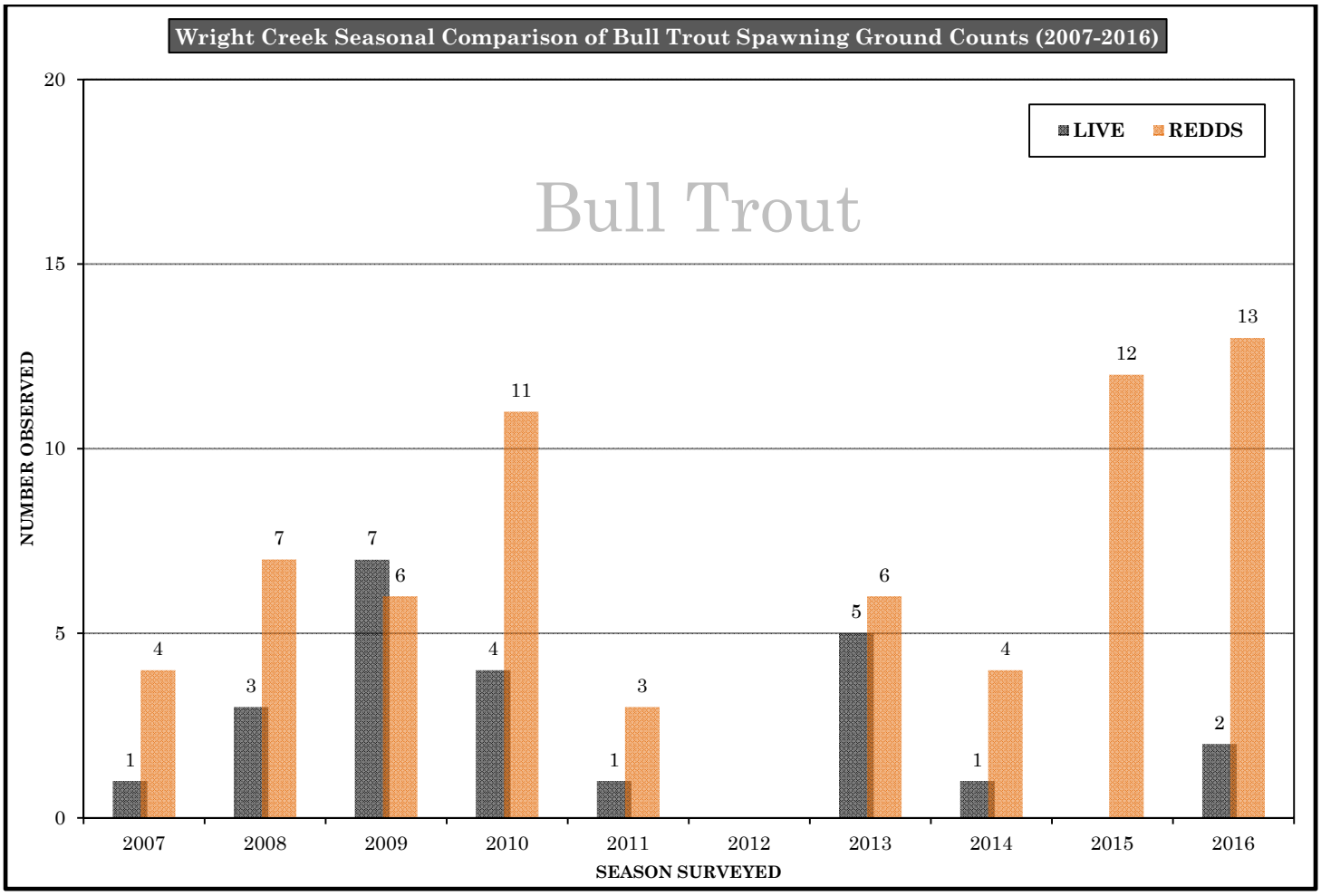
tat, it doesn't offer much in the way of spawning opportunities. Approximately 0.1 miles after entering the forested area, the creek climbs rapidly up a series of bedrock cascades and small falls *(lower left)*; marking the end of habitat accessible by salmonids.

Resident bull trout reside in smaller headwater tributaries, while migratory bull trout frequently travel long distances; utilizing the mainstem rivers and larger tributaries to forage and overwinter. During the fall, migratory forms of bull trout journey from spawning and rearing habitats in the upper watershed to foraging and overwintering habitats located lower in the river system. Beginning in spring and early summer *(May-July)*, they begin the return journey back to spawning and rearing areas high in the watershed. In response to changing habitat and reproductive needs, migratory bull trout in the White River travel up to 75 miles or more between the lower river and headwaters located in or near Mt. Rainier N.P. To accomplish this, bull trout require unobstructed migration corridors and connectivity of streams and rivers in order to provide them with access to spawning, rearing, foraging, and overwintering habitats.

Bull trout are primarily piscivorous *(fish eaters)*. However, they are opportunistic feeders, feeding on a variety of prey items depending on their particular life history strategy and stage of development. Adults feed almost exclusively on other fish, including a range of salmon and trout species; as well as other resident fish species. Juveniles feed on aquatic invertebrates, including stoneflies *(Plecoptera)*, caddisflies *(Trichoptera)*, and mayflies *(Ephemeroptera)*. Bull trout require a healthy aquatic environment in order to survive and prosper. They need an environment that provides the prey base; in addition to the rearing and reproductive habitat necessary to ensure their continued survival and reproductive success.

Bull trout spawning occurs primarily during the first three weeks in September, however, spawning has been observed taking place from the last week of August through the first week of October. Bull trout are iteroparous *(have the ability to spawn more than once)*; therefore, recovering pre-or-post spawn mortalities for examination is extremely rare. Spawners in the upper White River tributaries are observed utilizing various sized substrate from small gravels to small cobble. Redds are often constructed in the tail-out of pools and along channel margins. Embryonic development is slow *(depending on water temperatures)*; it may take between 165-235 days for eggs to hatch and for alevin to absorb their yolk (Pratt 1992). Bull trout fry emerge in late winter and early spring. Young fry can often be seen by mid-March foraging in the lateral habitat along the upper mainstem White River and associate tributaries.

Bull trout habitat throughout the Puyallup and White rivers has been severely impacted by over a century of land and water resource exploitation; including, damming and substantial water diversions, considerable riparian alterations *(deforestation)*, dewatering and low instream flow regimes, as well as significant channel manipulation. These impacts have lead to a marked deterioration in land and hydrological behavior within these river systems by causing water flow of poorer quality, quantity and timing. Several limiting factors are involved with regards to the healthy function of stream habitat and bull trout populations in the watershed; including lost or diminished habitat connectivity and migration corridors *(human-made fish passage barriers)*, fragmentation and reduction of habitat quality *(entrainment, transportation networks, forest management practices and operations, direct water withdrawal)*; in addition to, water quality, fish entrainment and entrapment, unknown species interactions, and potential climate change impacts *(changes in flow regimes, scour effects, thermal variations, changes in water chemistry)*. The USFWS finalized bull trout recover plan is available at: *https://www.fws.gov/pacific/bulltrout/pdf/Final_Bull_Trout_Recovery_Plan_092915.pdf*



See Appendix B for bull trout redd locations. Raw spawning data for Wright Creek can be found in Appendix C.

WRONG CREEK

WRIA 10.0205

Wrong Creek is a small tributary entering Pinochle Creek, approximately 0.2 miles above Pinochle's confluence with the West Fork White River. Wrong Creek originates along Clear West Peak around 4,500 feet. The lower, approximately 2.5 miles, flows within the West Fork White River's floodplain. There is no development along Wrong Creek, with the exception of the USFS bridge crossing at approximately RM 0.4. There are small patches of suitable spawning gravel present primarily in the lower 0.5 miles of the creek. The riparian zone consists of mature second growth hardwoods and conifers with an understory of blueberry and salmonberry. Wrong Creek hosts several sizable log jams containing numerous key components. Coho are the most abundant and common species observed in Wrong Creek. Other species known to utilize the creek include Chinook, pink, sockeye, cutthroat and rainbow; however, steelhead utilization is unknown. Bull trout utilization is presumed since they are known to occupy several other habitats throughout the West Fork drainage. Unfortunately, low flows can make it problematic for Chinook to access the creek in August and September to spawn; as a result, Chinook escapement in Wrong is often low or absent.

In the past, Wrong was surveyed for adult salmon escapement; unfortunately, flood damage to Forest Service Road 74 has prevented access to the creek since early 2006; so, no escapement surveys or fish plants in the nearby acclimation pond located on Cripple Creek have occurred since. When escapement surveys were conducted, coho were often observed each season holding in two large pools in Pinochle, just below the confluence with Wrong Creek. Many of these coho would ascend Cripple and Wrong a couple of weeks after entering Pinochle Creek.

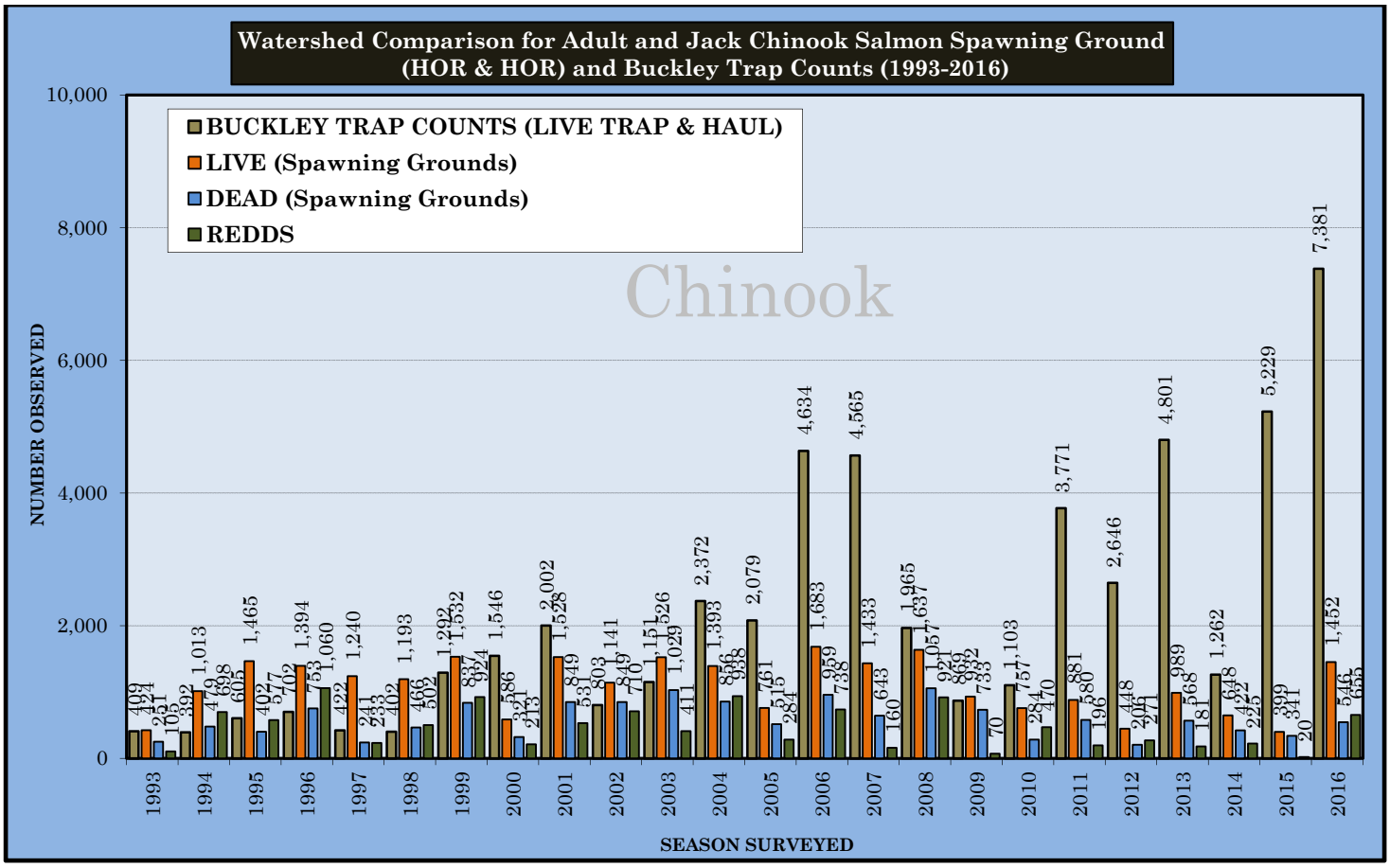
All adult salmon that spawn in Wrong Creek were initially captured at the USACE fish trap in Buckley, and transported above Mud Mountain dam. Salmonid escapement numbers for the upper White River drainage are known; therefore, surveys were conducted to determine fish distribution and spawning success. This is especially important regarding Spring Chinook, since adult production monitoring is part of the White River Spring Chinook Recovery Plan. Also, as part of the Spring Chinook Recovery Plan, the Puyallup tribe operated a Spring Chinook acclimation pond located at RM 0.3 on Cripple Creek. Spring Chinook were reared and released from Cripple Creek for several years *(1994-2006)*. Approximately 50,000 plus Spring Chinook from the Muckleshoot White River hatchery were transported annually to the Cripple Creek acclimation pond in early spring, and released in late spring. Returns to Pinochle; as well as Cripple and Wrong creeks, is likely the result of these earlier plantings. The current state of the acclimation pond is unknown; however, when access is reestablished, it is anticipated that the pond can be reutilized and spawning surveys will resume.

2016-2017

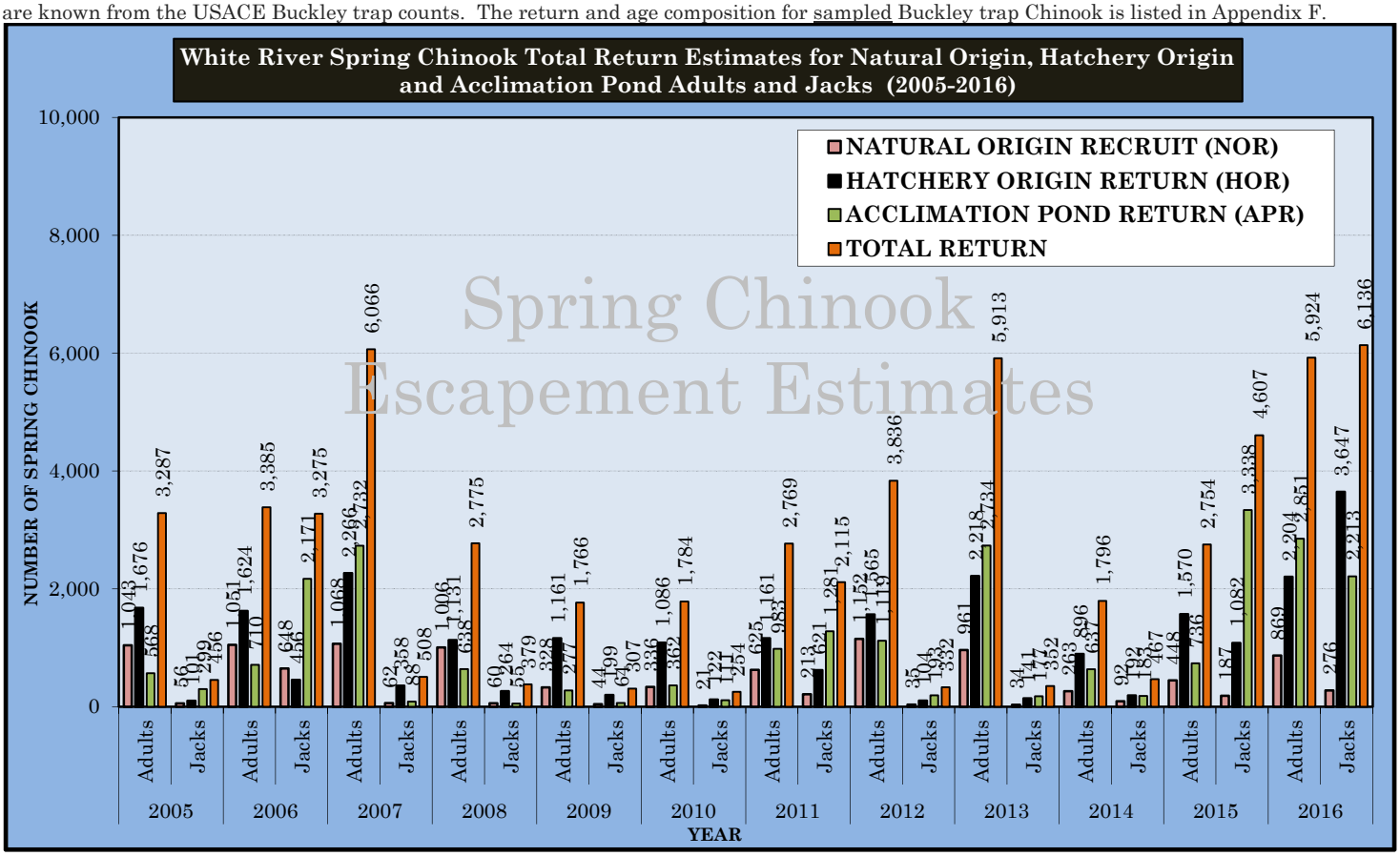
Annual Comparisons of Salmon and Steelhead Spawning Ground Counts; Escapement Estimates; USACE FishTrap Counts (White River) and Hatchery Returns.

The following charts are separated by species and include both wild (NOR) and hatchery (HOR) origin escapements. They are a compilation of the yearly survey totals conducted by the Puyallup Tribe Fisheries Department, Washington Department of Fish and Wildlife and the Army Corps of Engineers' Buckley trap counts. These data yield an estimated and empirical representation of total natural/hatchery escapement for the entire WRIA 10: Puyallup/White River Watershed. It's important to note that the number of live fish observed and represented in the graphs is an accumulation of all fish seen throughout the survey season. The total number of live fish observed does not depict the estimated escapement which is derived through statistical analysis. The live and redds totals in the following graphs do not include the fish or redds observed above RM 24.3 on the White River, since these actual escapement totals are known from the USACE Buckley trap counts. Due to the tremendous number of pink salmon during odd years, the success of determining Chinook redds from pinks is significantly reduced.

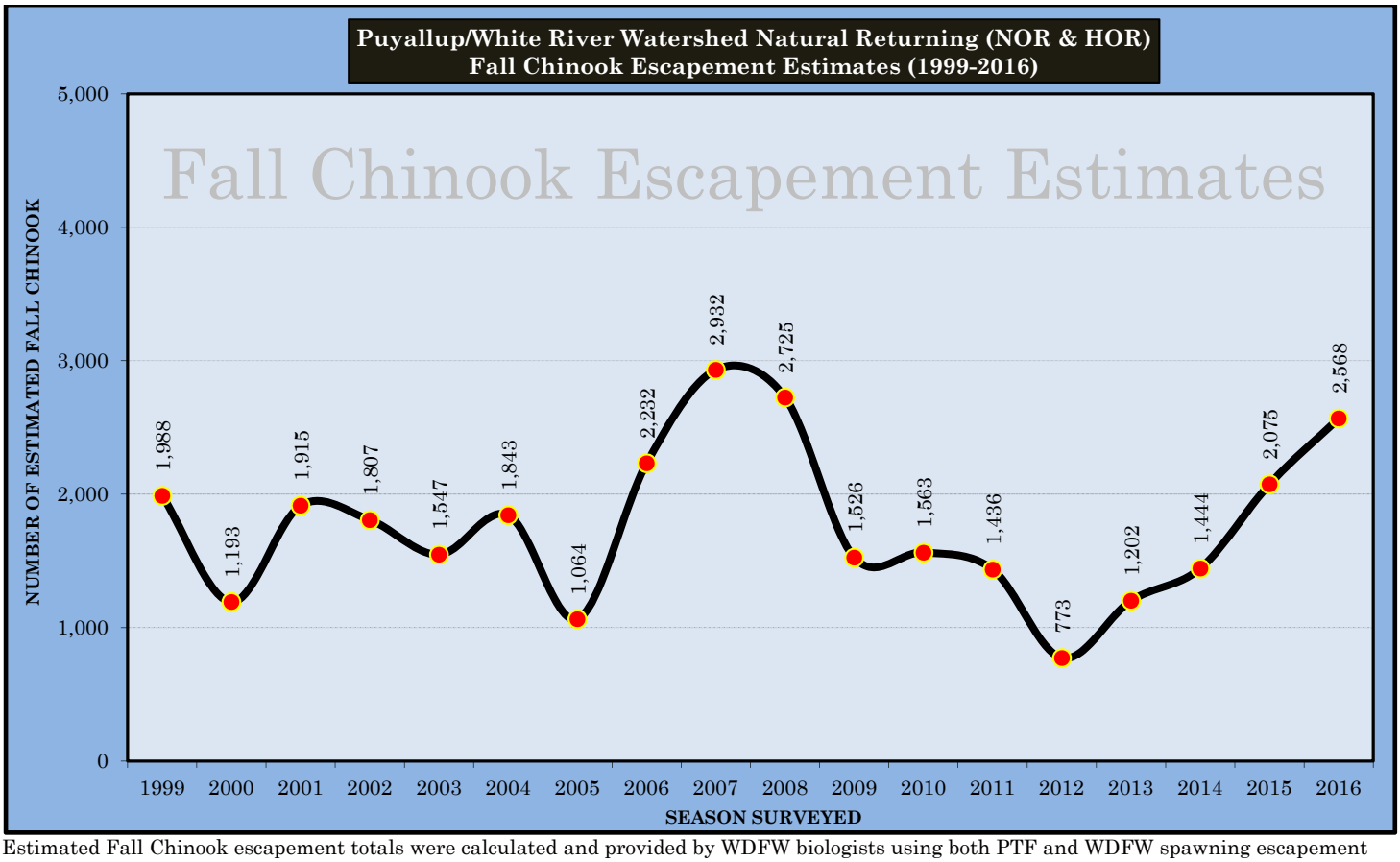
APPENDIX A



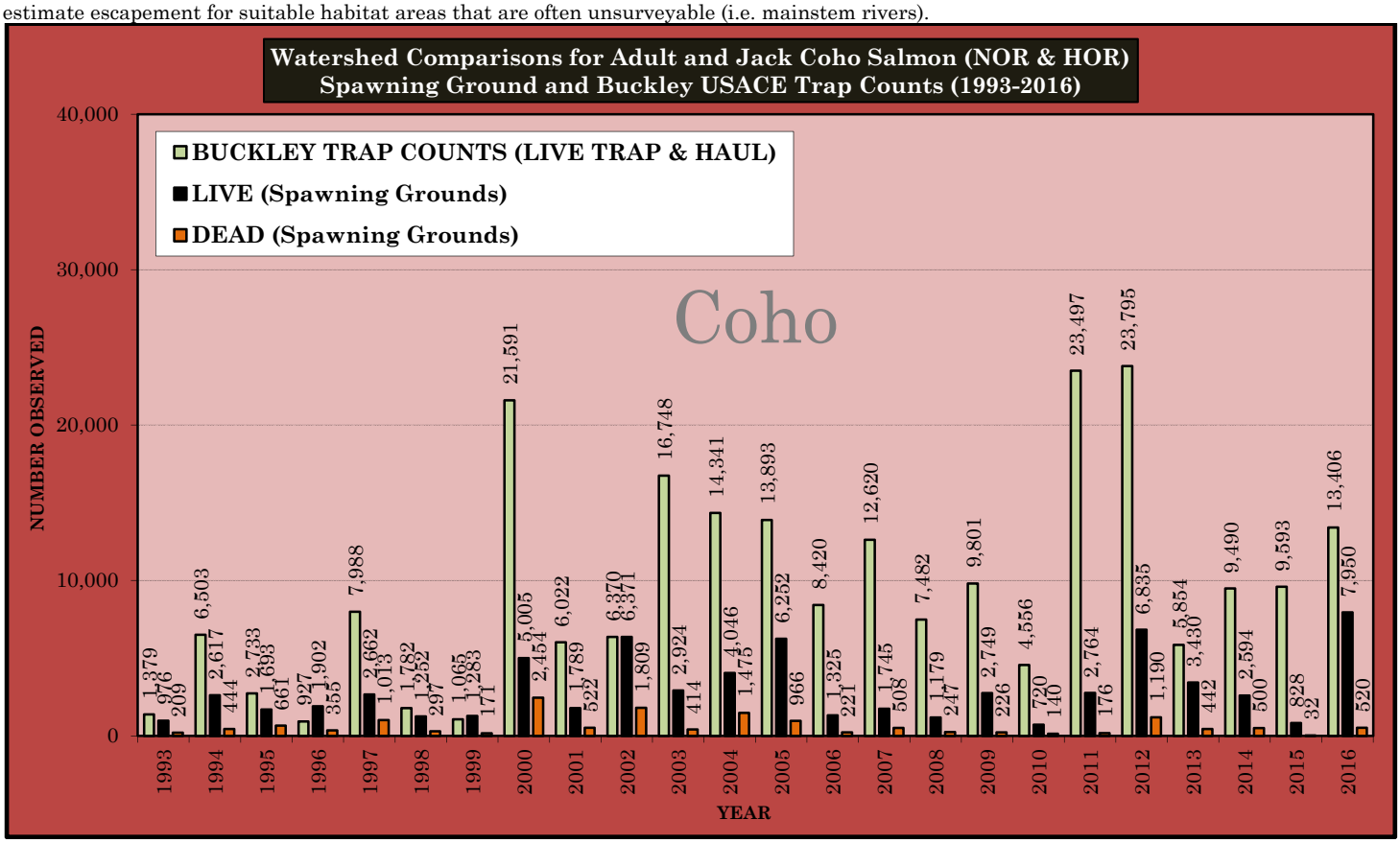
Live, dead and redds totals in this graph do not include Chinook or redds observed above RM 24.3 on the White River; actual escapement totals are known from the USACE Buckley trap counts. The return and age composition for sampled Buckley trap Chinook is listed in Appendix F.



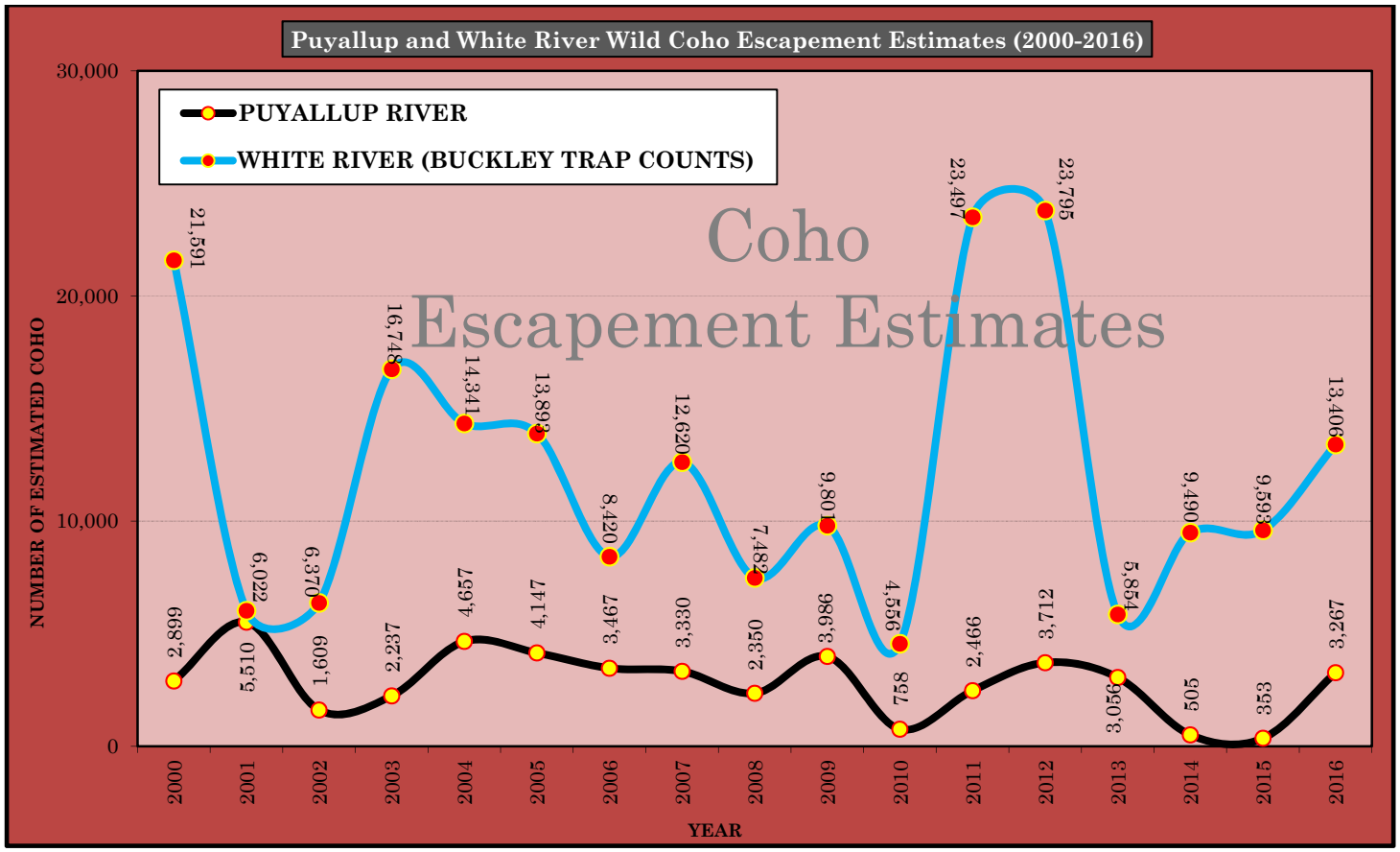
Return estimates generated by WDFW based on USACE Buckley trap data and Muckleshoot White River hatchery returns. The return and age composition for sampled Buckley trap Chinook are listed in Appendix F.



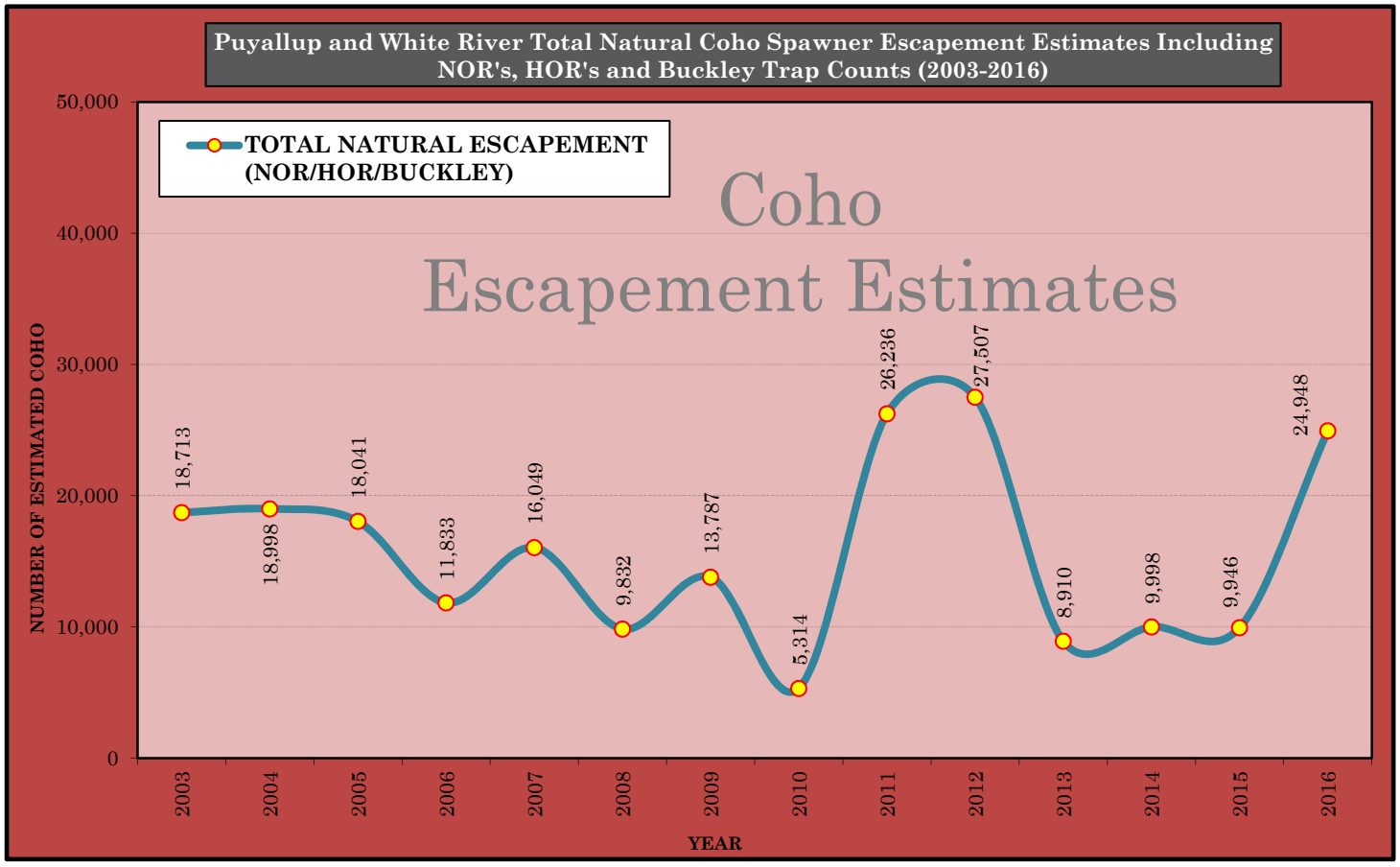
Estimated Fall Chinook escapement totals were calculated and provided by WDFW biologists using both PTF and WDFW spawning escapement data. Due to the tremendous volume of pink salmon during odd years, the success of determining Chinook redds from pinks is vastly reduced. Therefore, The AUC method is used to determine escapement during pink runs (odd years). Addition biological expansion factors are applied to estimate escapement for suitable habitat areas that are often unsurveyable (i.e. mainstem rivers).



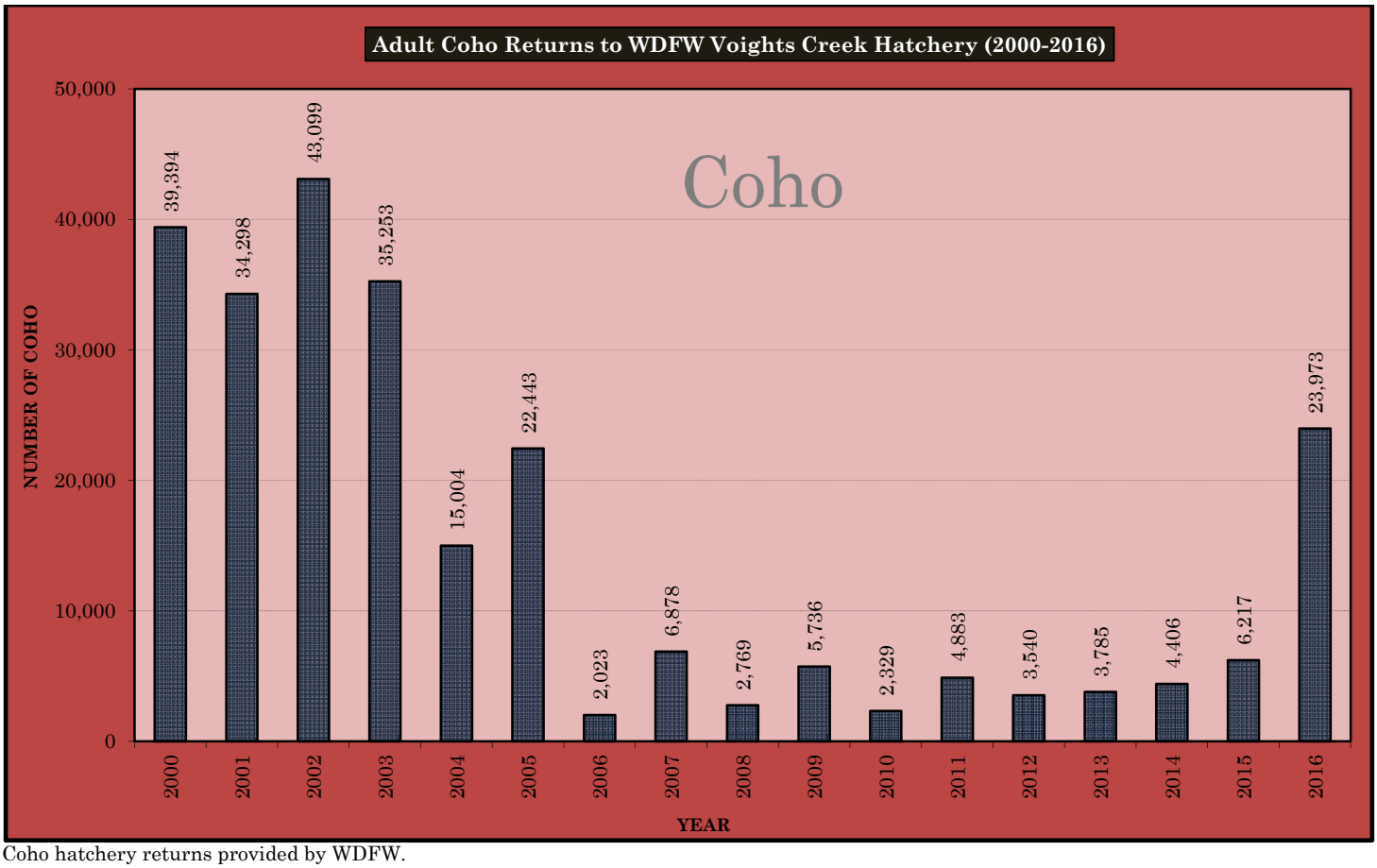
The live and dead totals in this graph do not include the coho observed above RM 24.3 on the White River; actual escapement totals are known from the USACE Buckley trap counts. Buckley trap data taken from USACE website:
http://www.nws.usace.army.mil/Missions/CivilWorks/LocksandDams/MudMountainDam/FishCounts.aspx



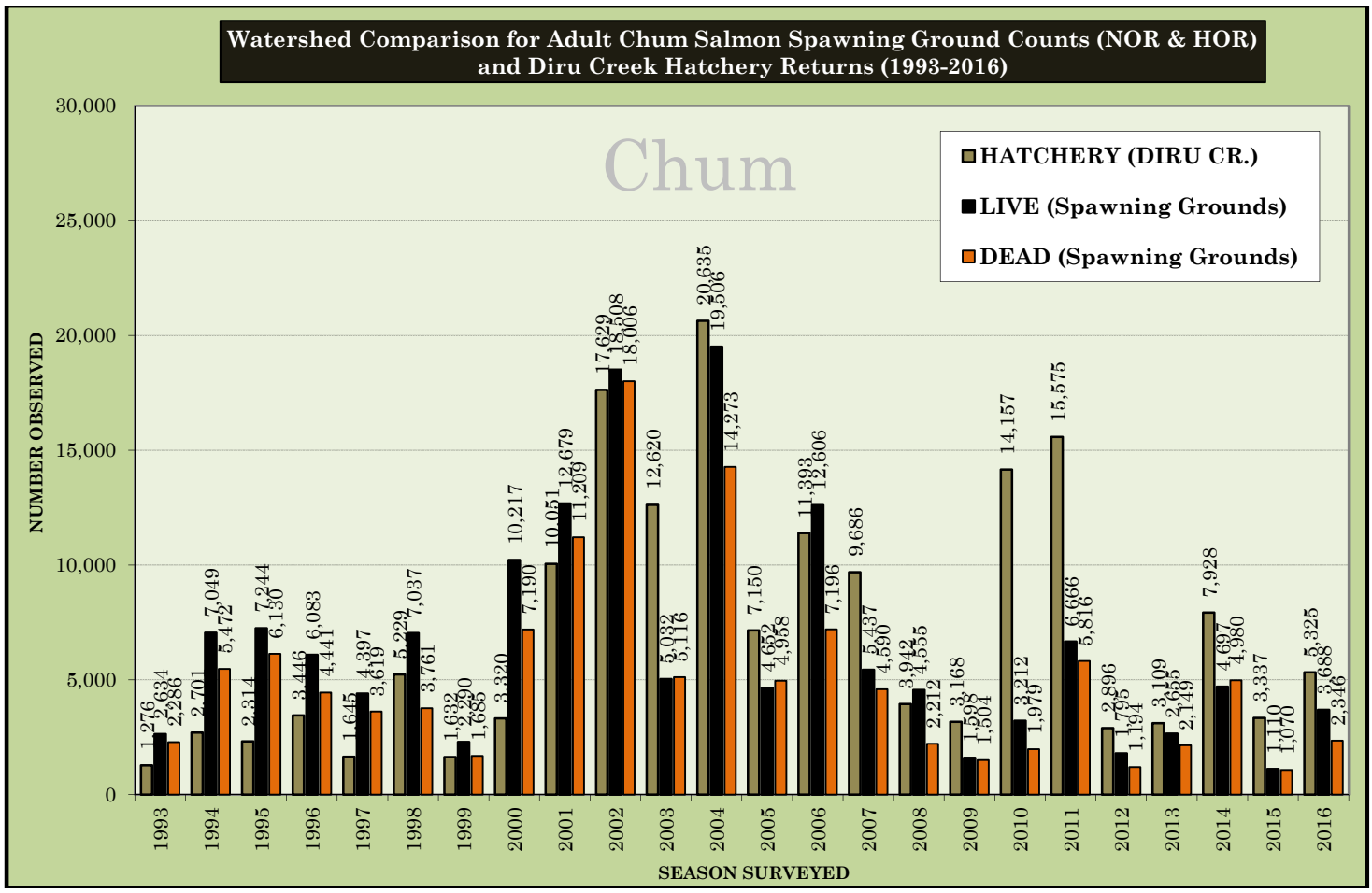
Estimated escapements for wild coho spawners provided by WDFW. Estimates do not include hatchery origin natural spawners.

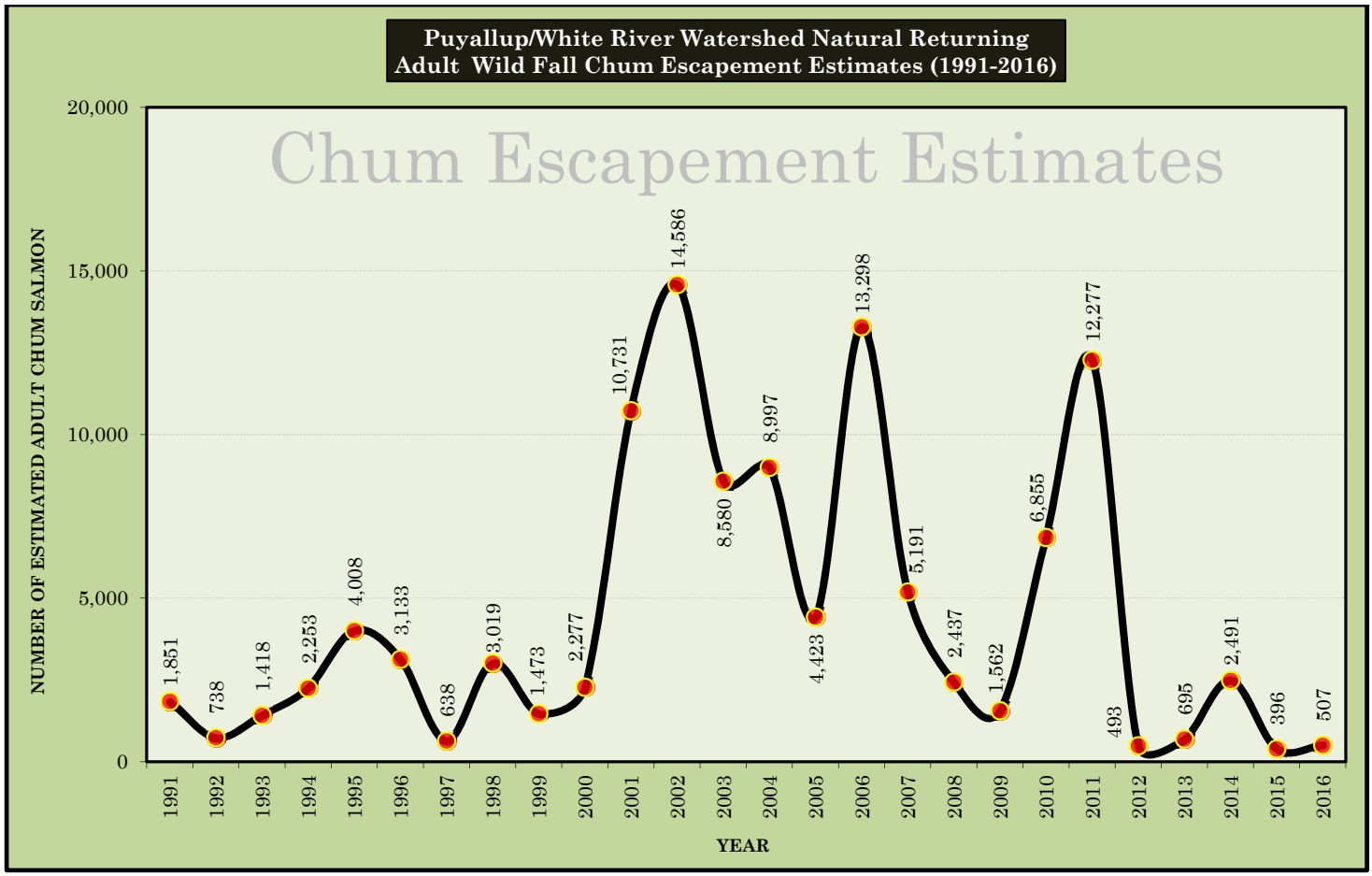


Estimated escapements provided by WDFW

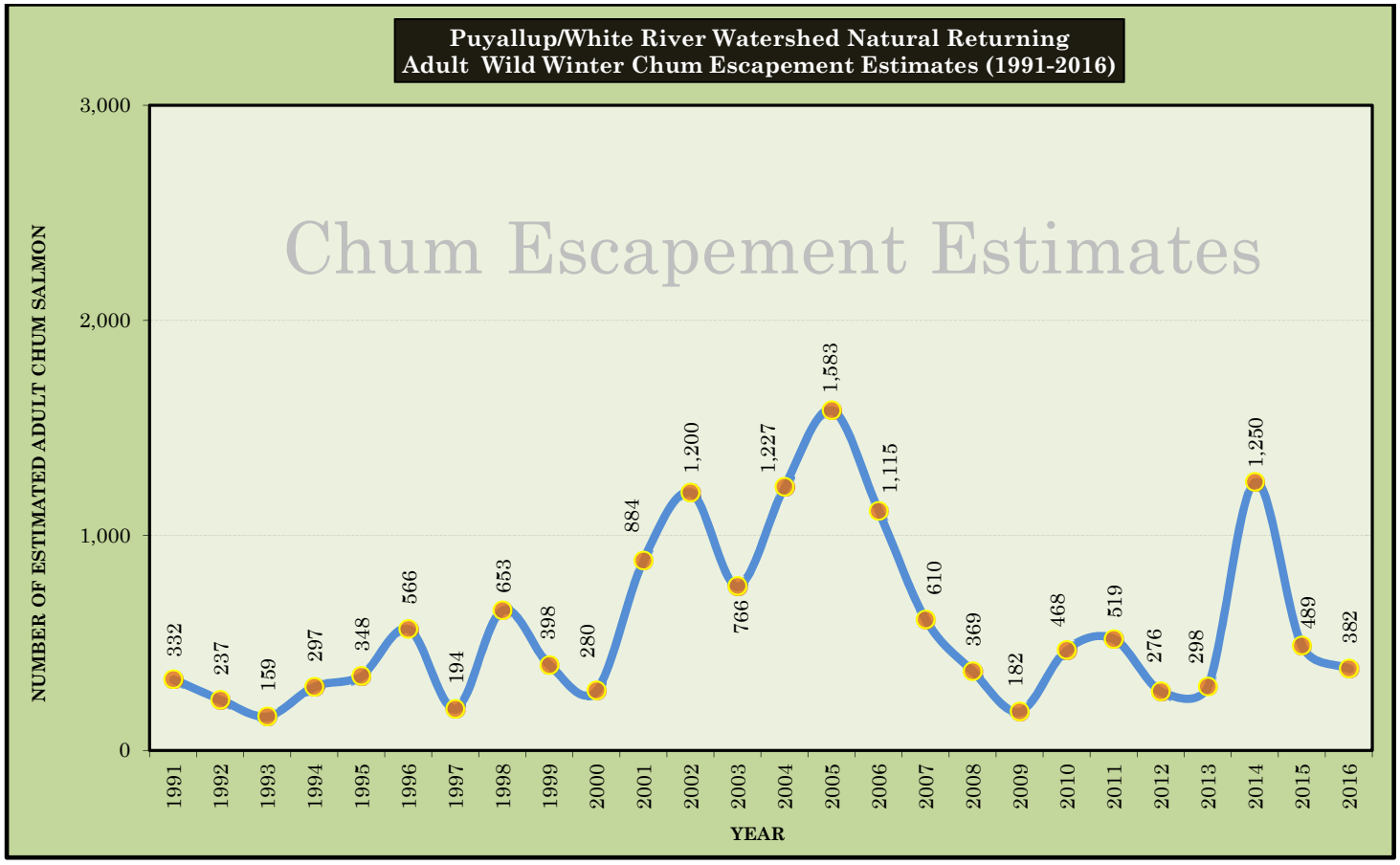


Coho hatchery returns provided by WDFW.

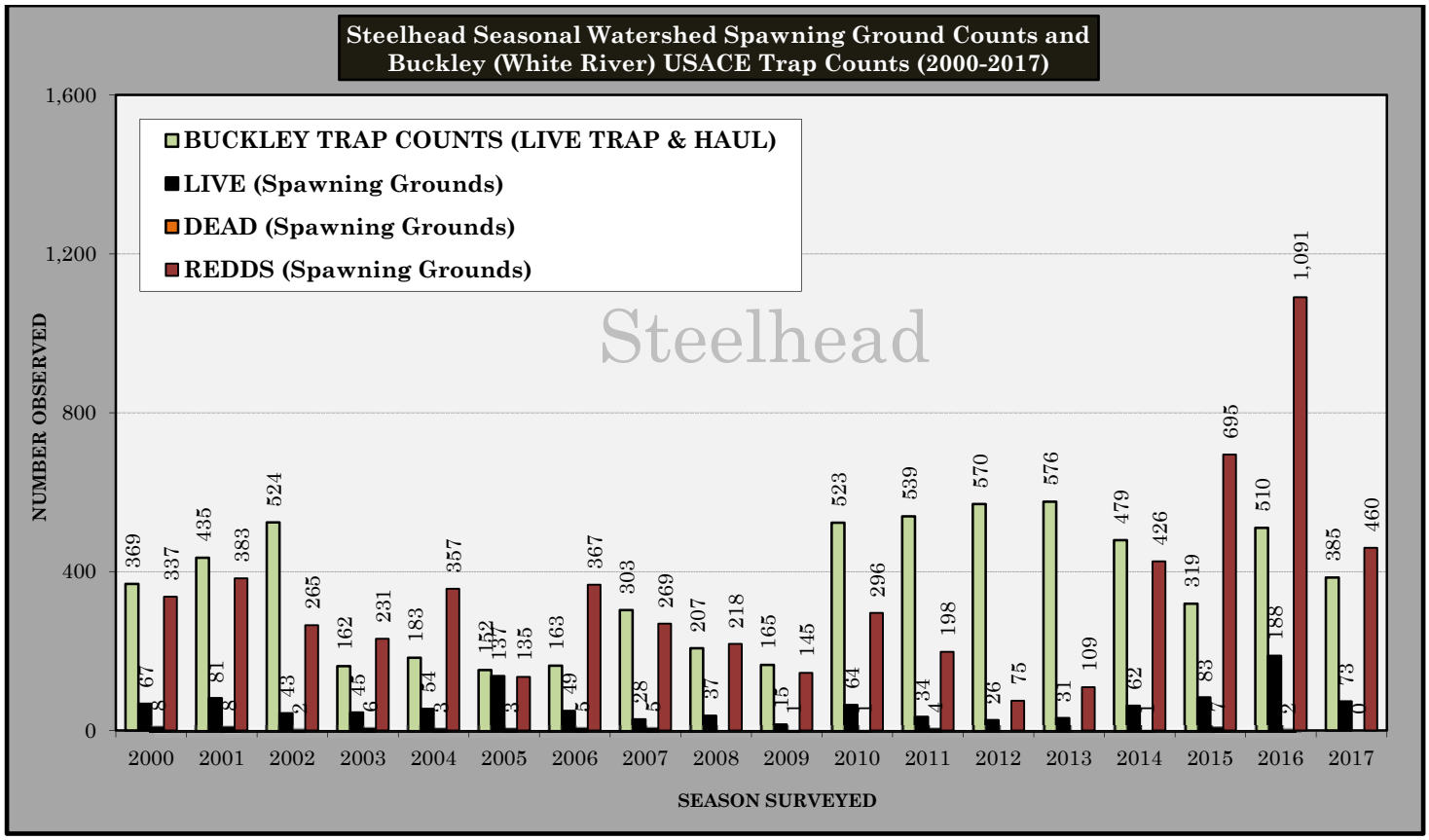




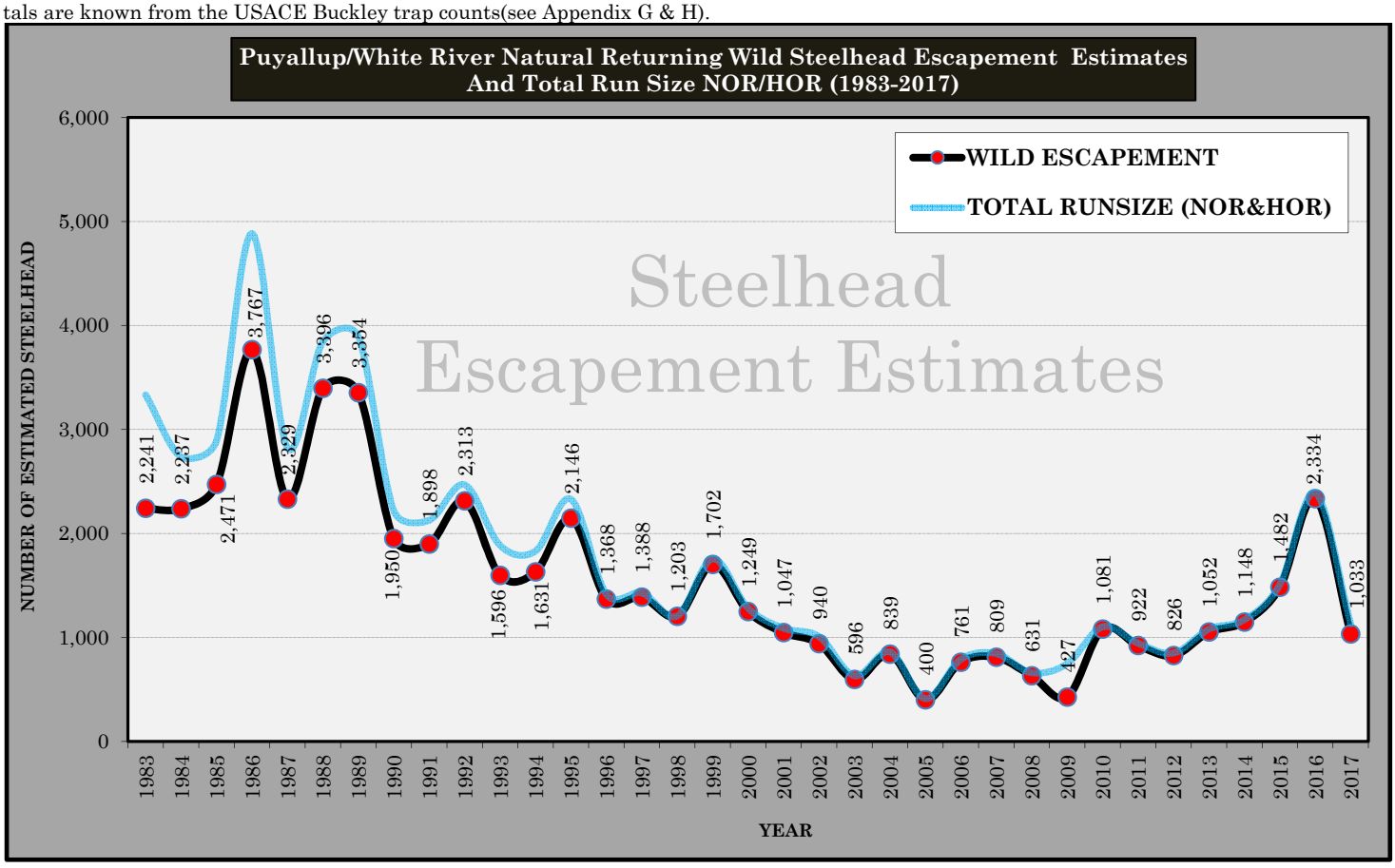
Estimated fall chum escapement totals were calculated by WDFW by means of PTF and WDFW spawning ground escapement data.



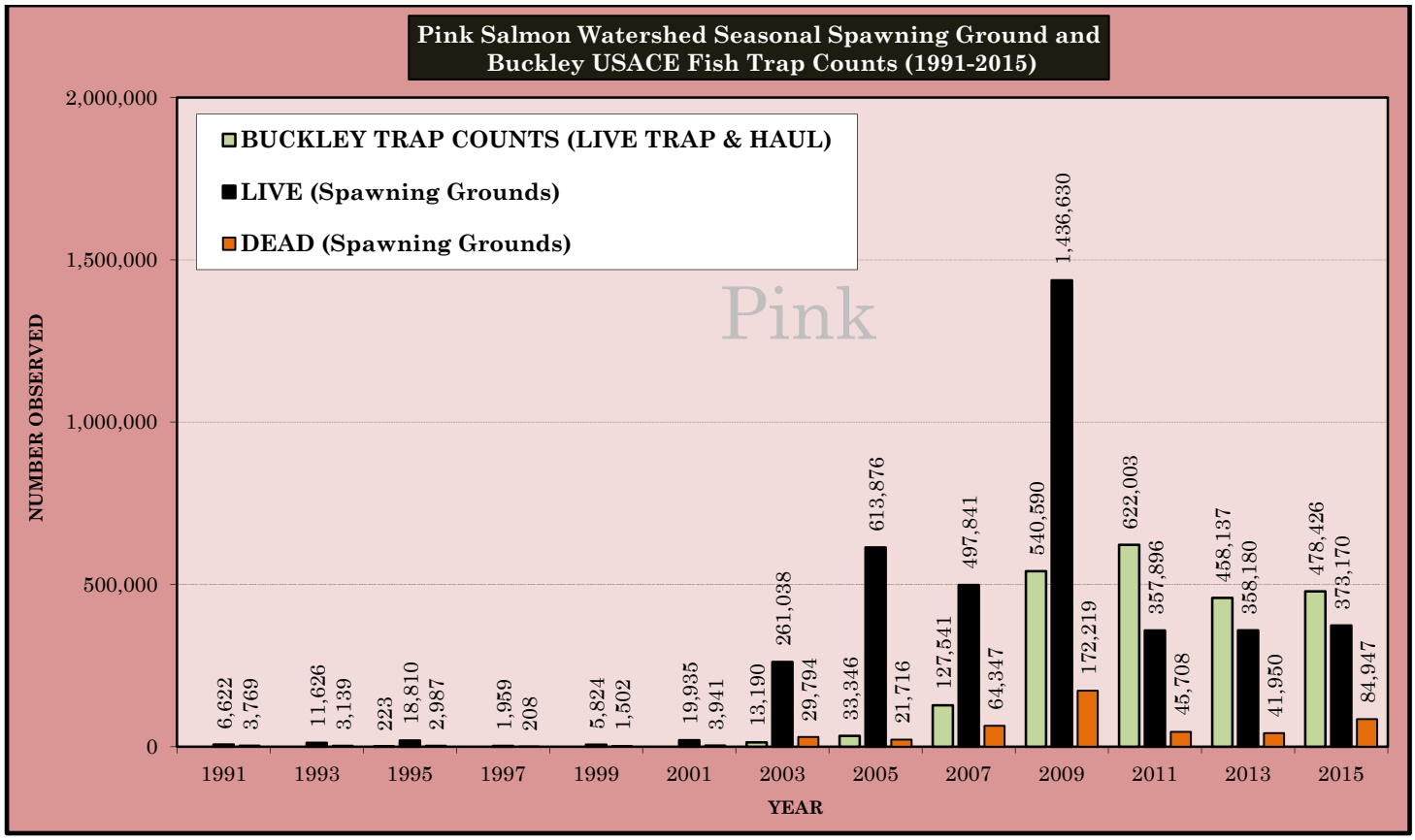
Estimated winter chum escapement totals were calculated by WDFW



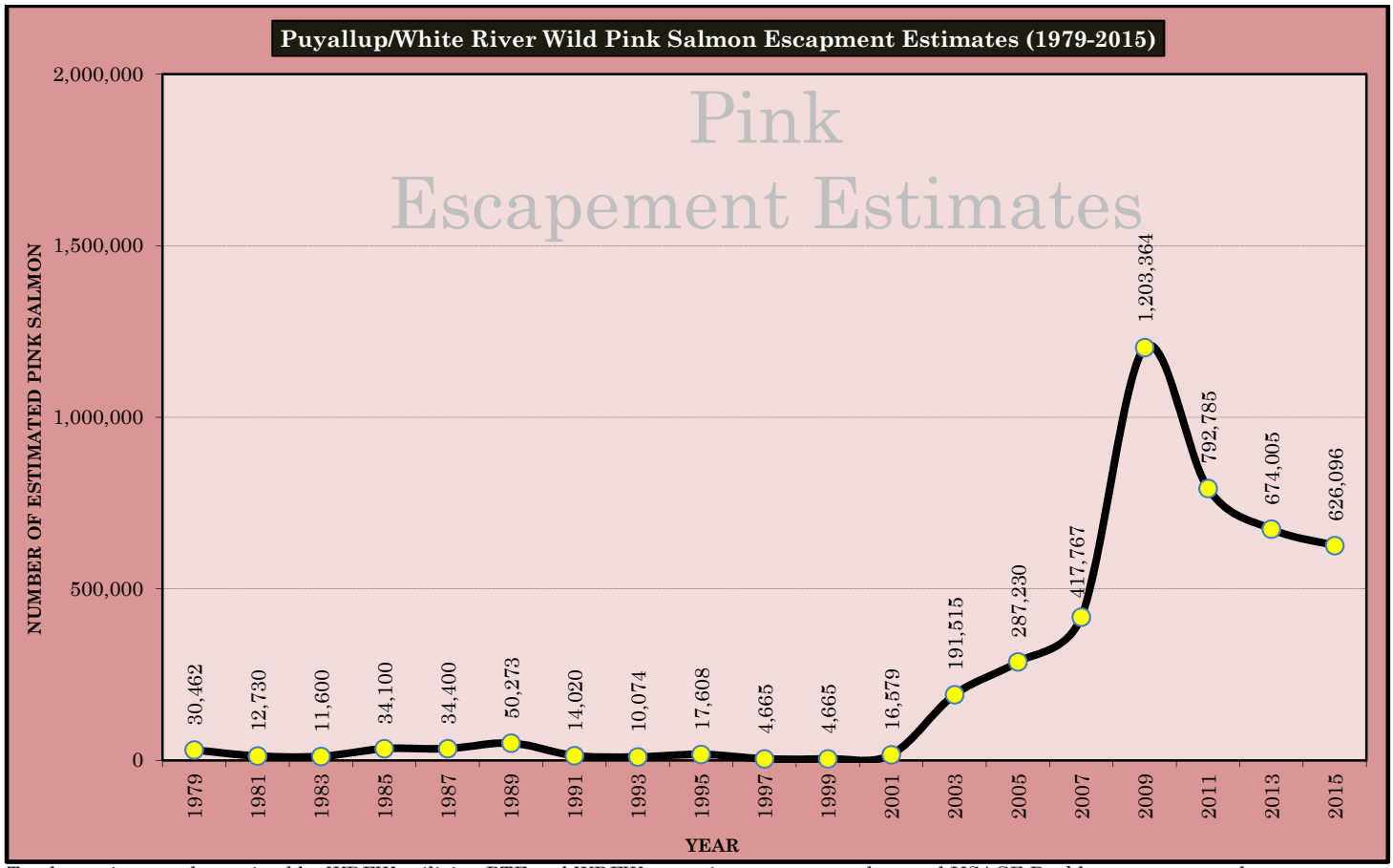
The live, dead and redd totals in this graph do not include steelhead or redds observed above RM 24.3 on the White River; actual escapement totals are known from the USACE Buckley trap counts(see Appendix G & H).



Estimated steelhead escapement totals were calculated and provided by WDFW biologists. Escapement and total run size was determined by utilizing both PTF and WDFW spawning escapement data; Buckley trap capture/sampling data and biological expansion factors. Addition biological expansion factors are applied to estimate escapement for suitable habitat areas that are often unsurveyable (i.e. mainstem rivers and tributary headwaters).



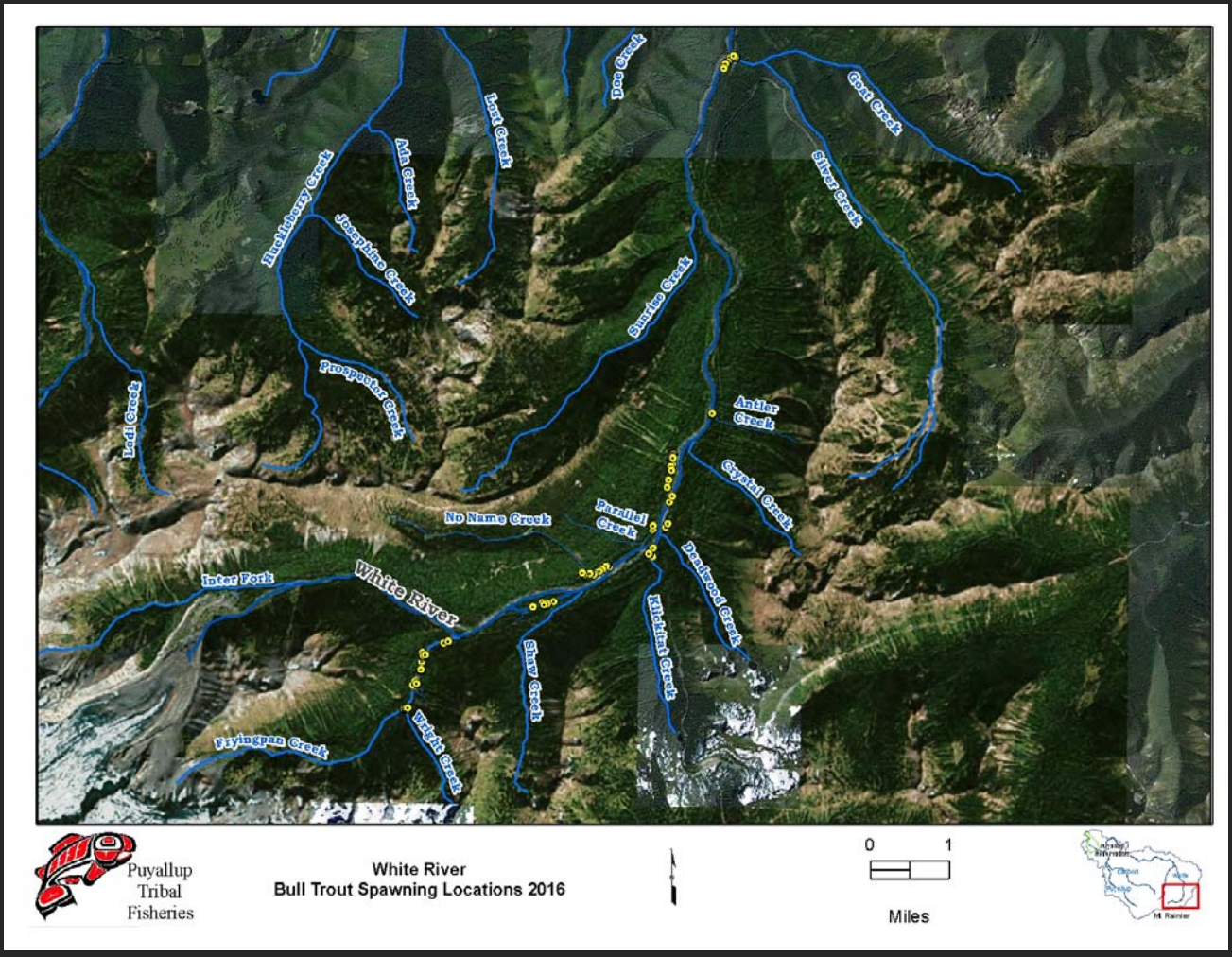
The live and dead totals in this graph do not include the pink salmon observed above RM 24.3 on the White River; actual escapement totals are known from the USACE Buckley trap counts. Buckley trap data taken from USACE website:
http://www.nws.usace.army.mil/Missions/CivilWorks/LocksandDams/MudMountainDam/FishCounts.aspx



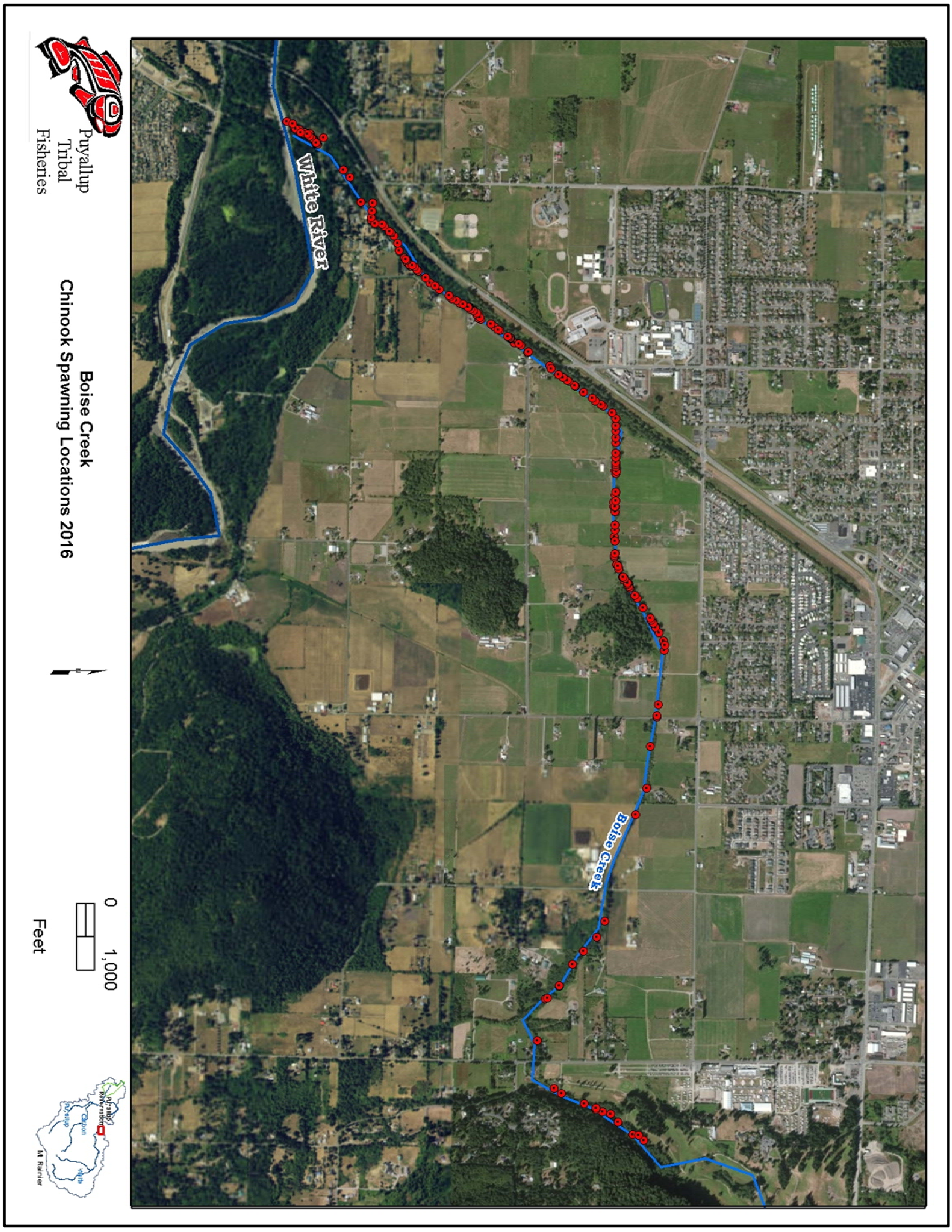
Total run size was determined by WDFW utilizing PTF and WDFW spawning escapement data and USACE Buckley trap capture data.

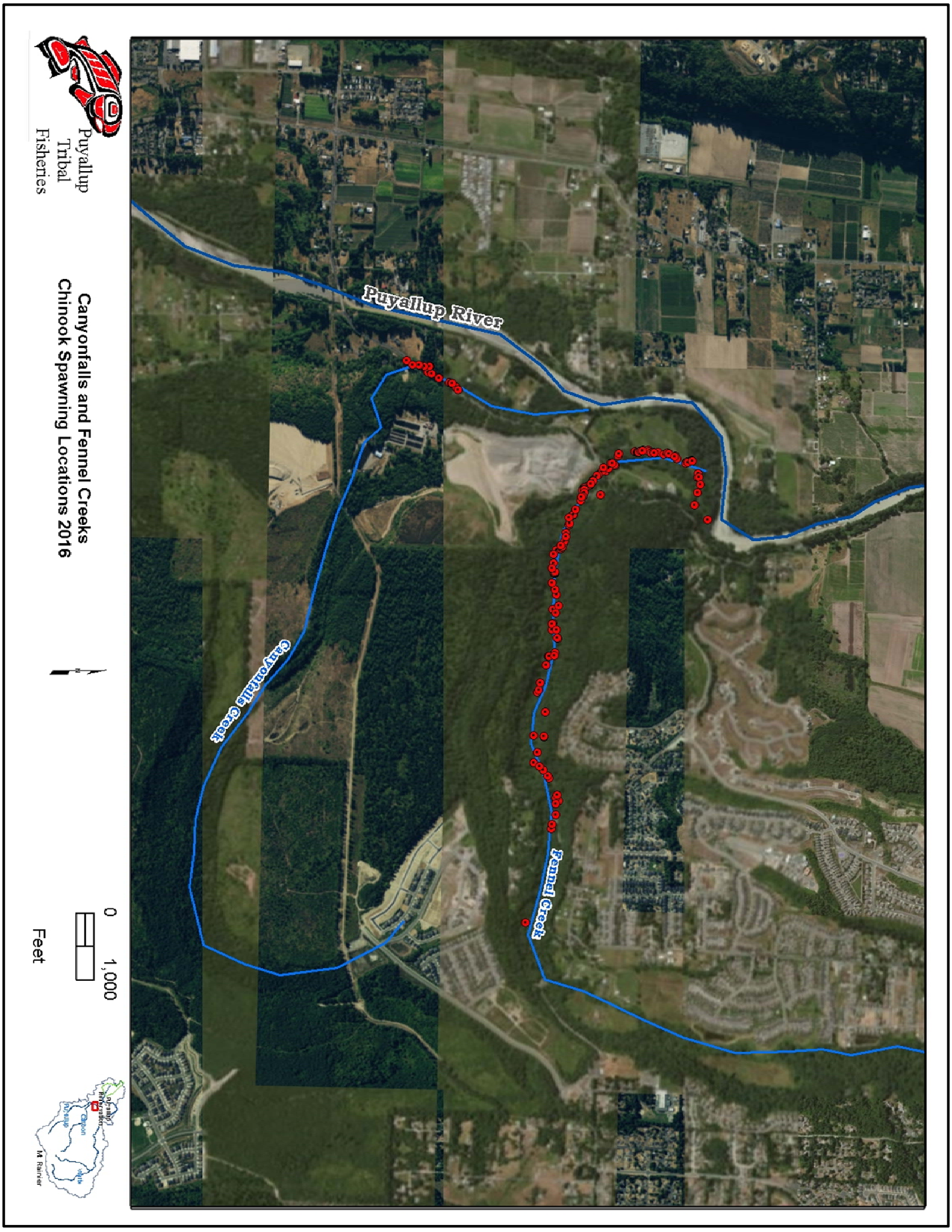
2016-2017

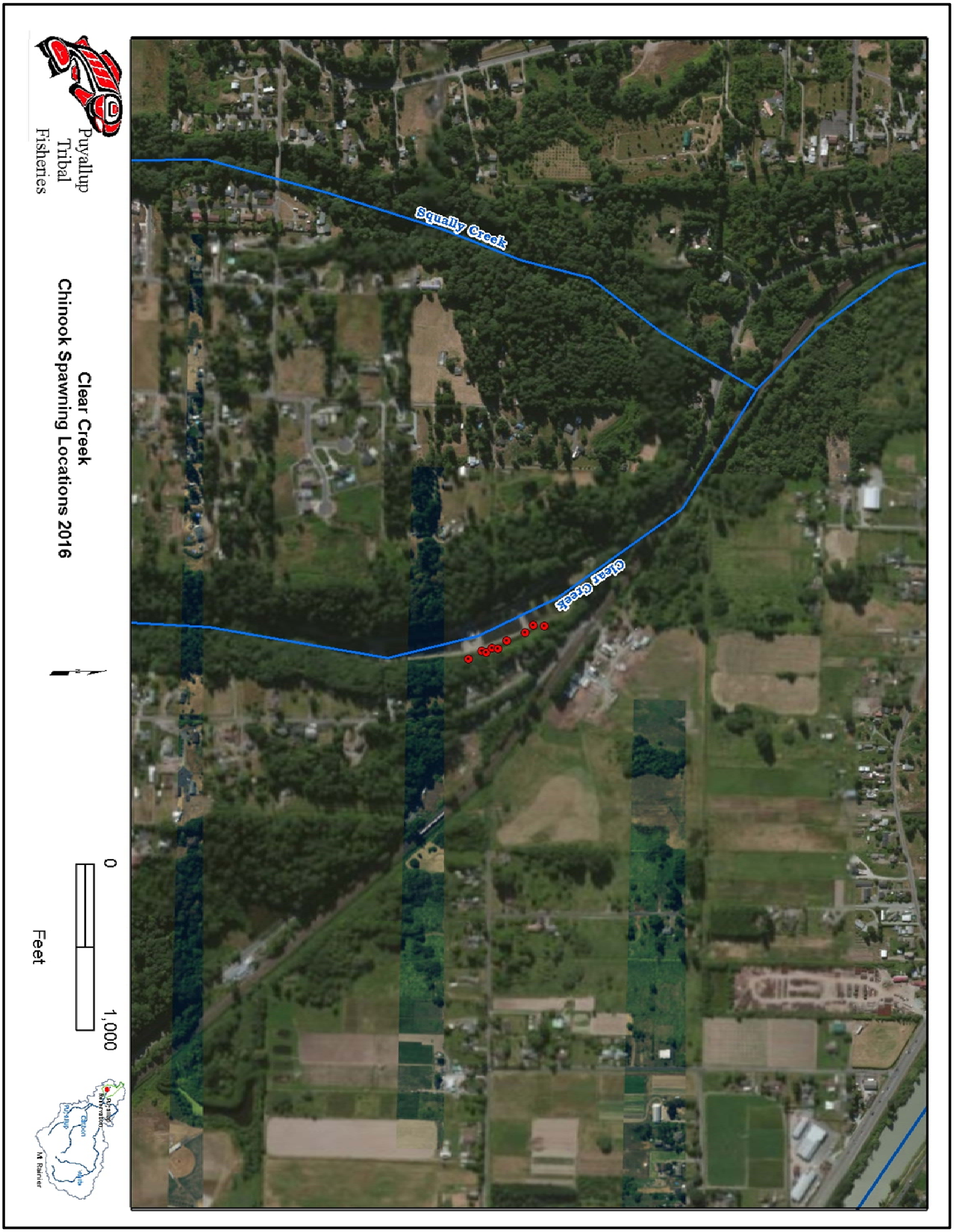
Chinook, Bull Trout and Steelhead Redd Locations (GIS)

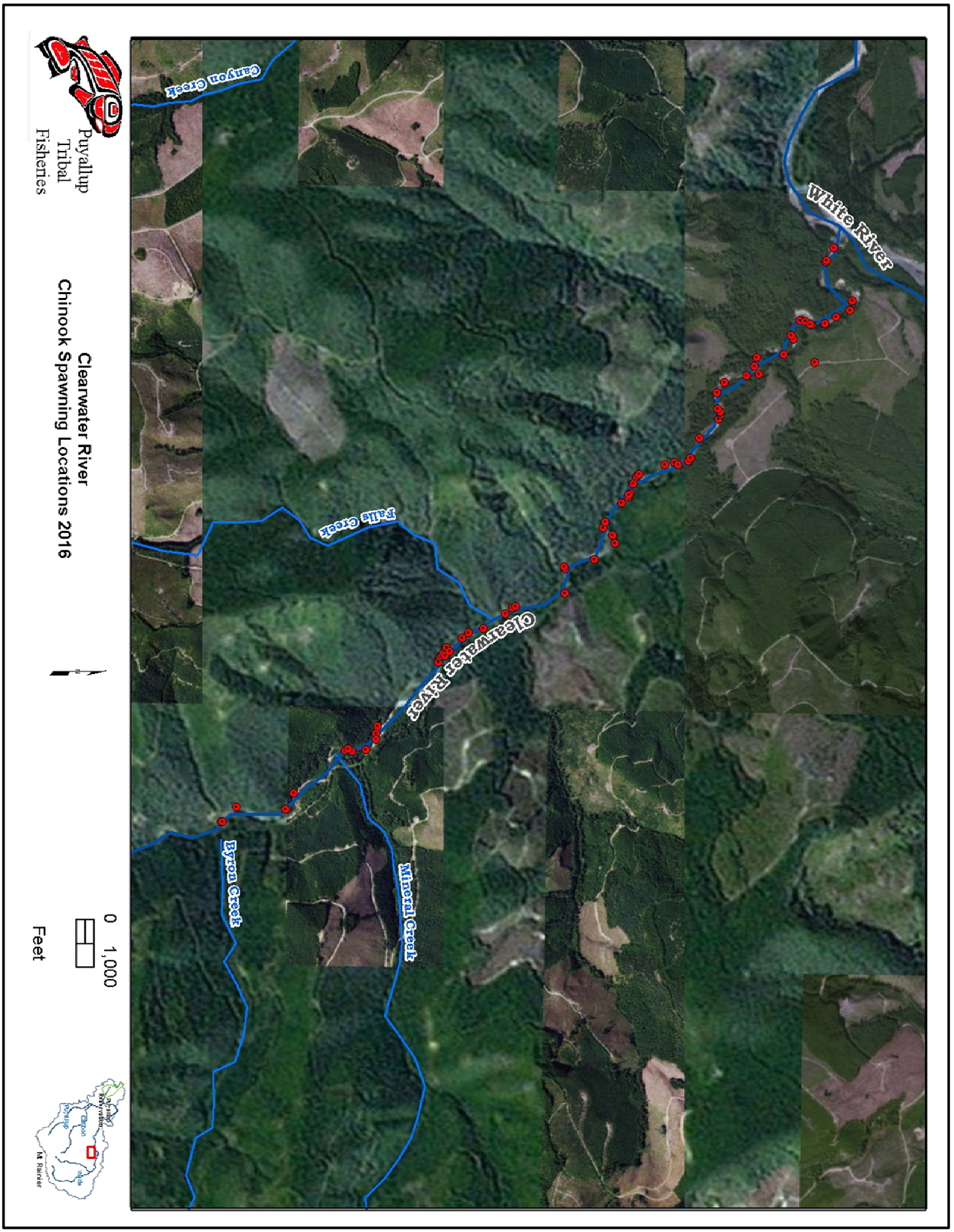


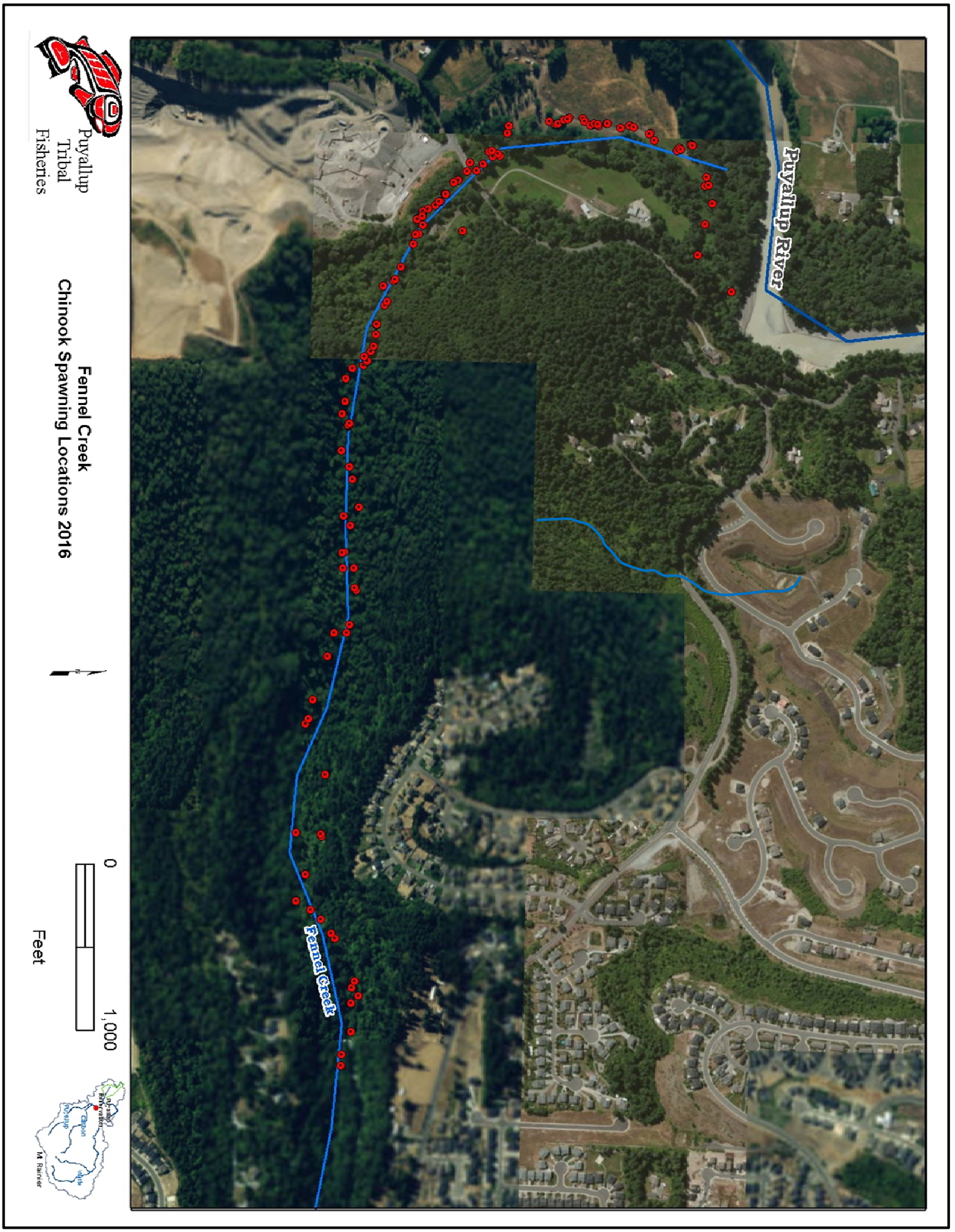
APPENDIX B

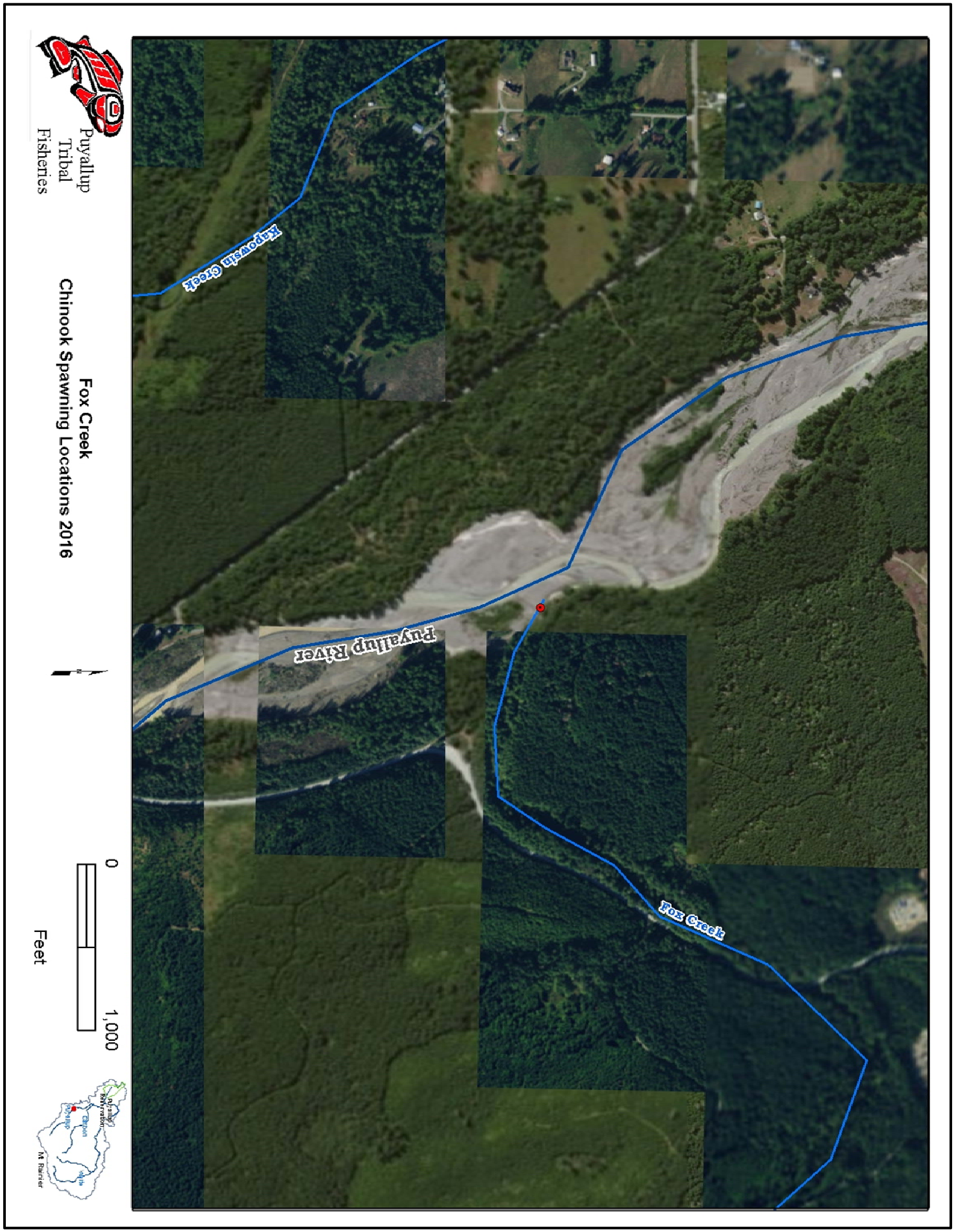

Puyallup Tribal Fisheries
Boise Creek
Chinook Spawning Locations 2016
White River
Boise Creek
0
1,000
Feet
Mt. Rainier

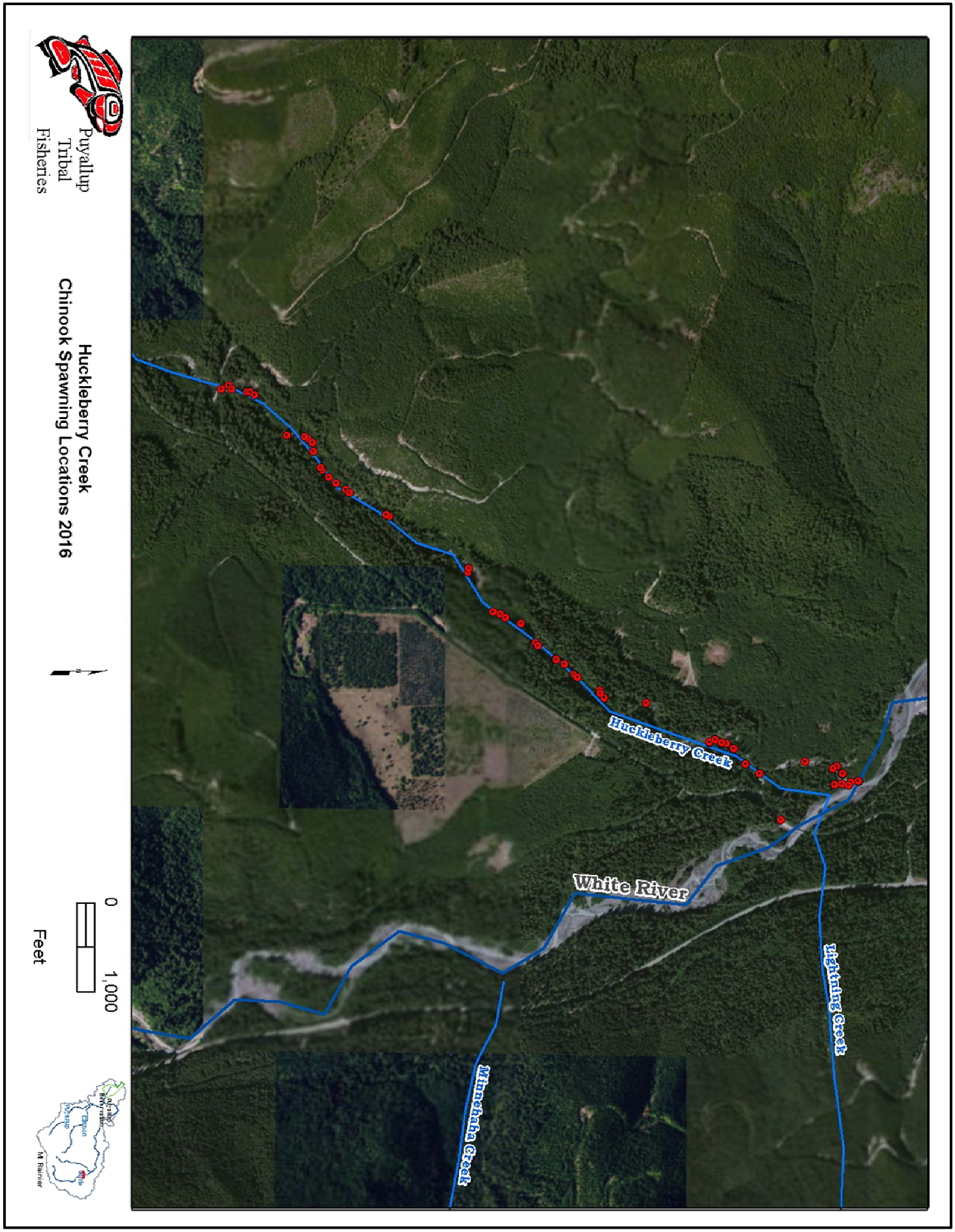

Puyallup Tribal Fisheries
Canyonfalls and Fennel Creeks
Chinook Spawning Locations 2016
Puyallup River
Canyonfalls Creek
Fennel Creek
0
1,000
Feet

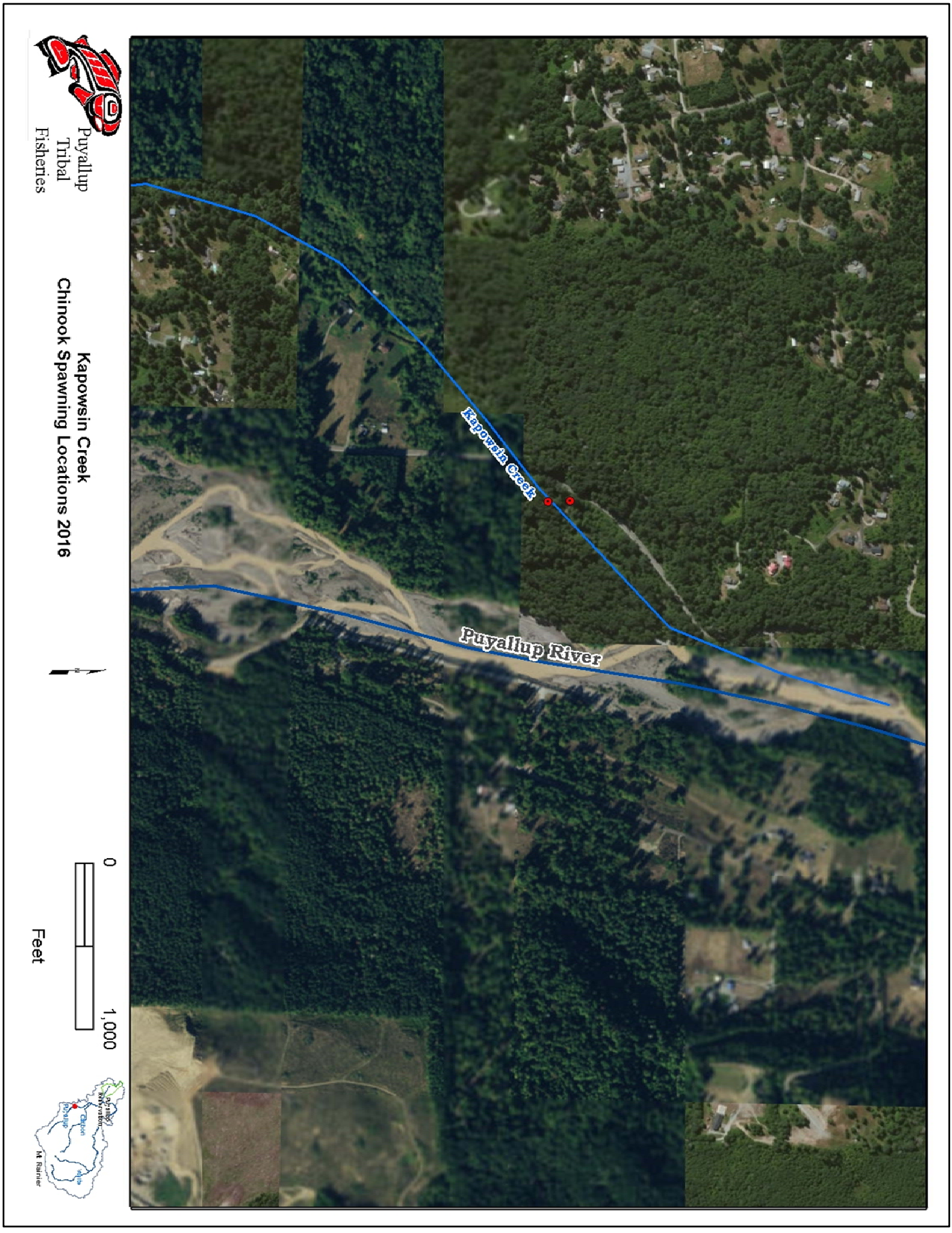

Puyallup Tribal Fisheries
Clear Creek
Chinook Spawning Locations 2016
Squally Creek
Clear Creek
0
1,000
Feet

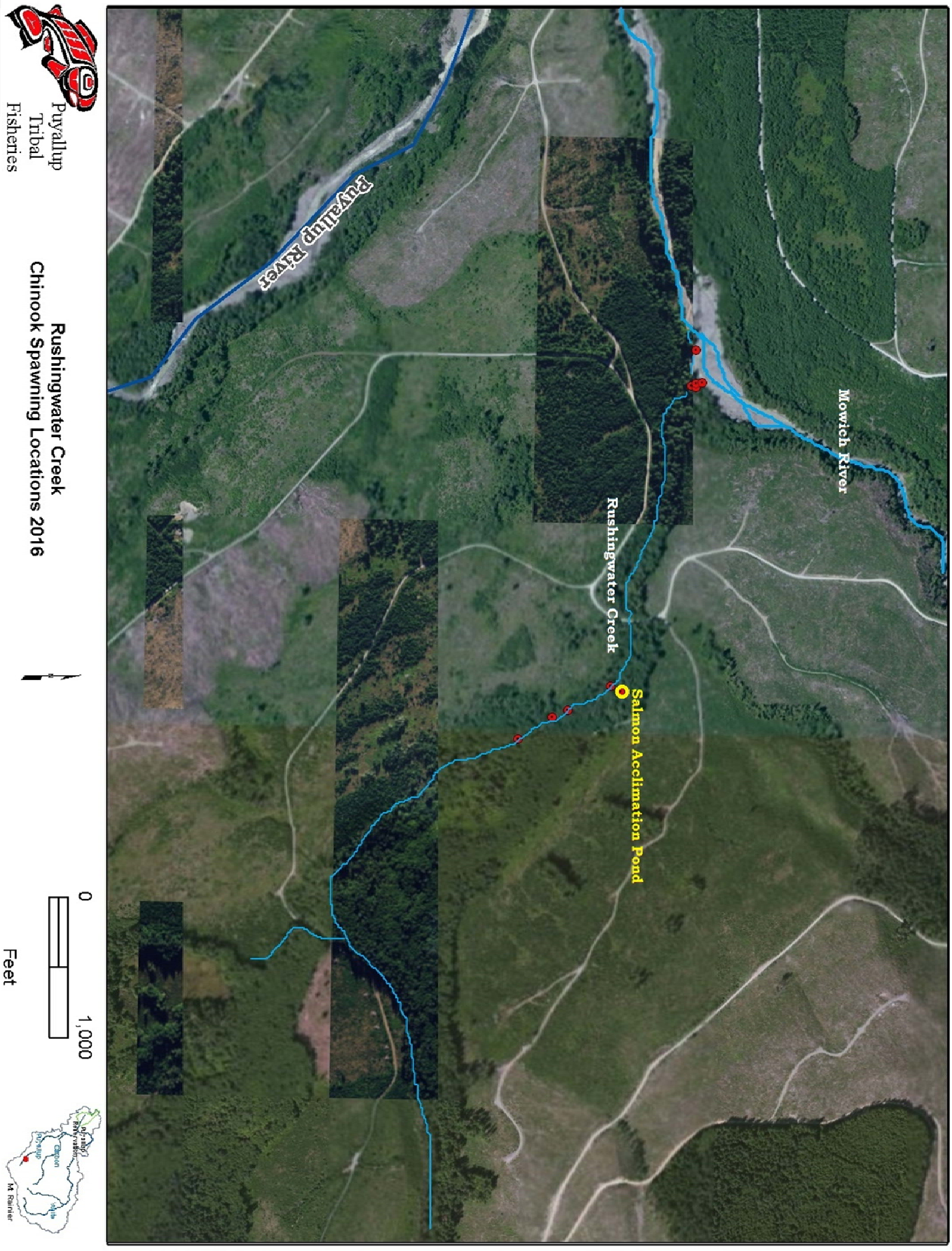

Puyallup Tribal Fisheries
Clearwater River
Chinook Spawning Locations 2016
Canyon Creek
White River
Falls Creek
Clearwater River
Byron Creek
Mineral Creek
0 1,000
Feet

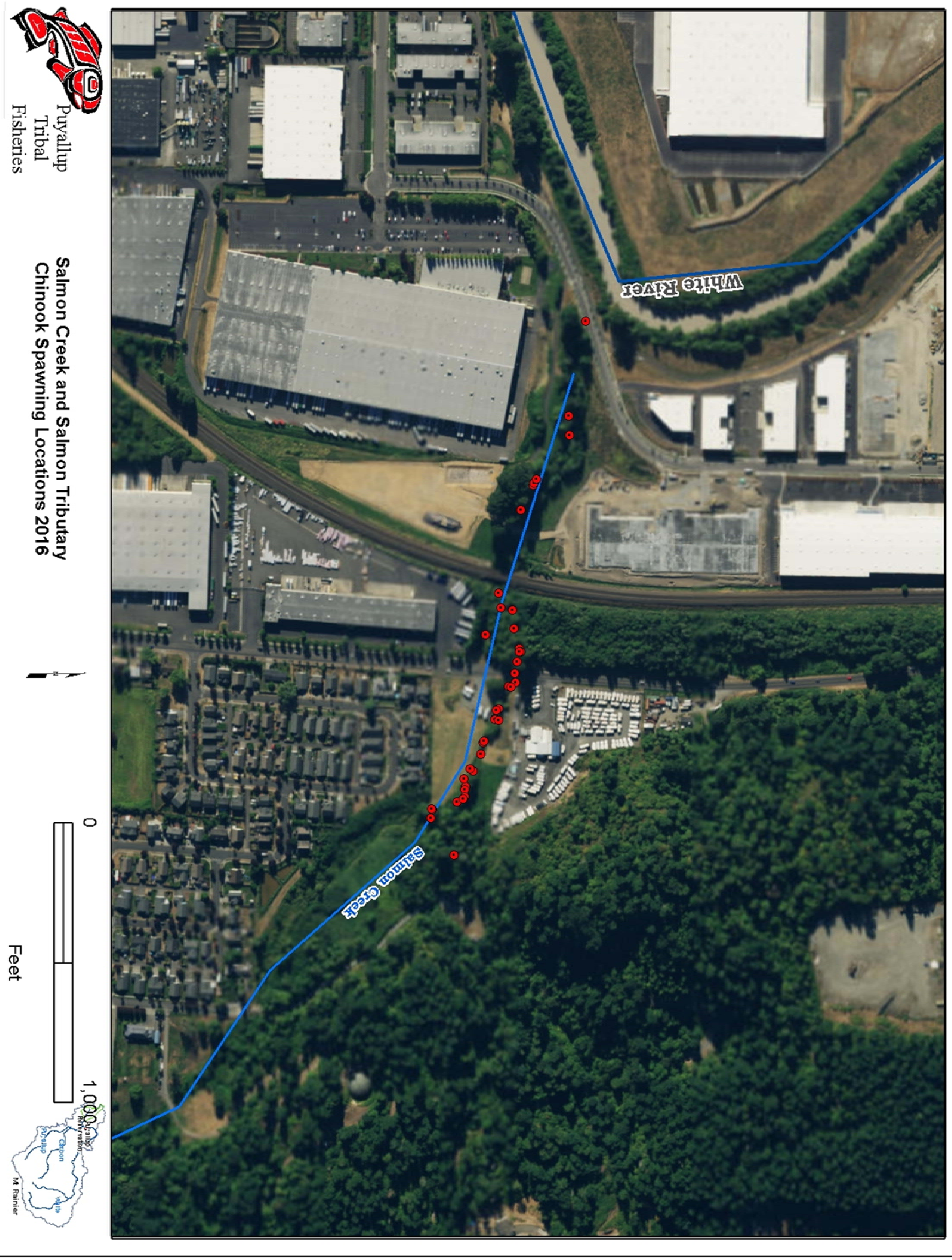

Puyallup Tribal Fisheries
Fennel Creek
Chinook Spawning Locations 2016
Puyallup River
Fennel Creek
0
1,000
Feet

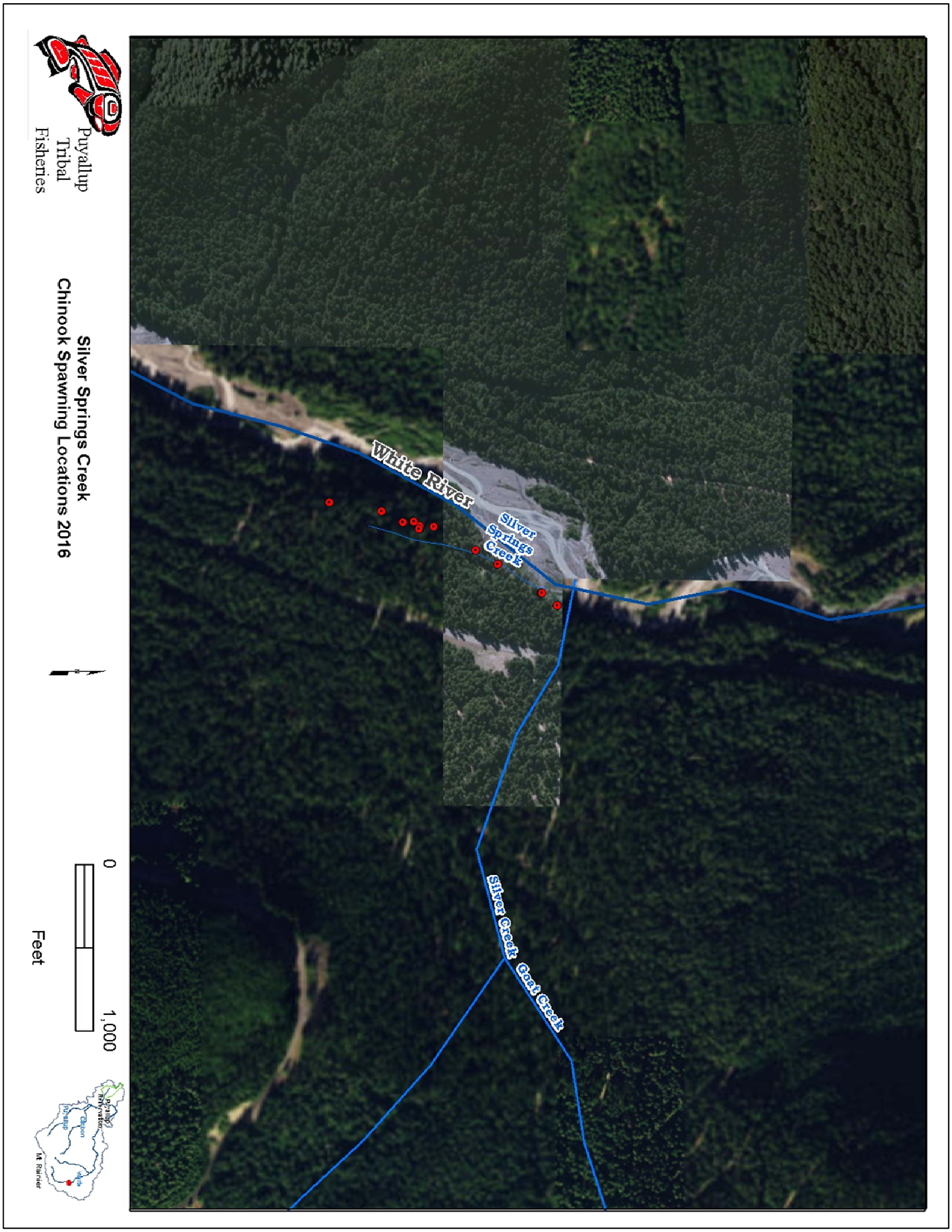

Puyallup Tribal Fisheries
Fox Creek
Chinook Spawning Locations 2016
Kapowsin Creek
Puyallup River
Fox Creek
0
1,000
Feet

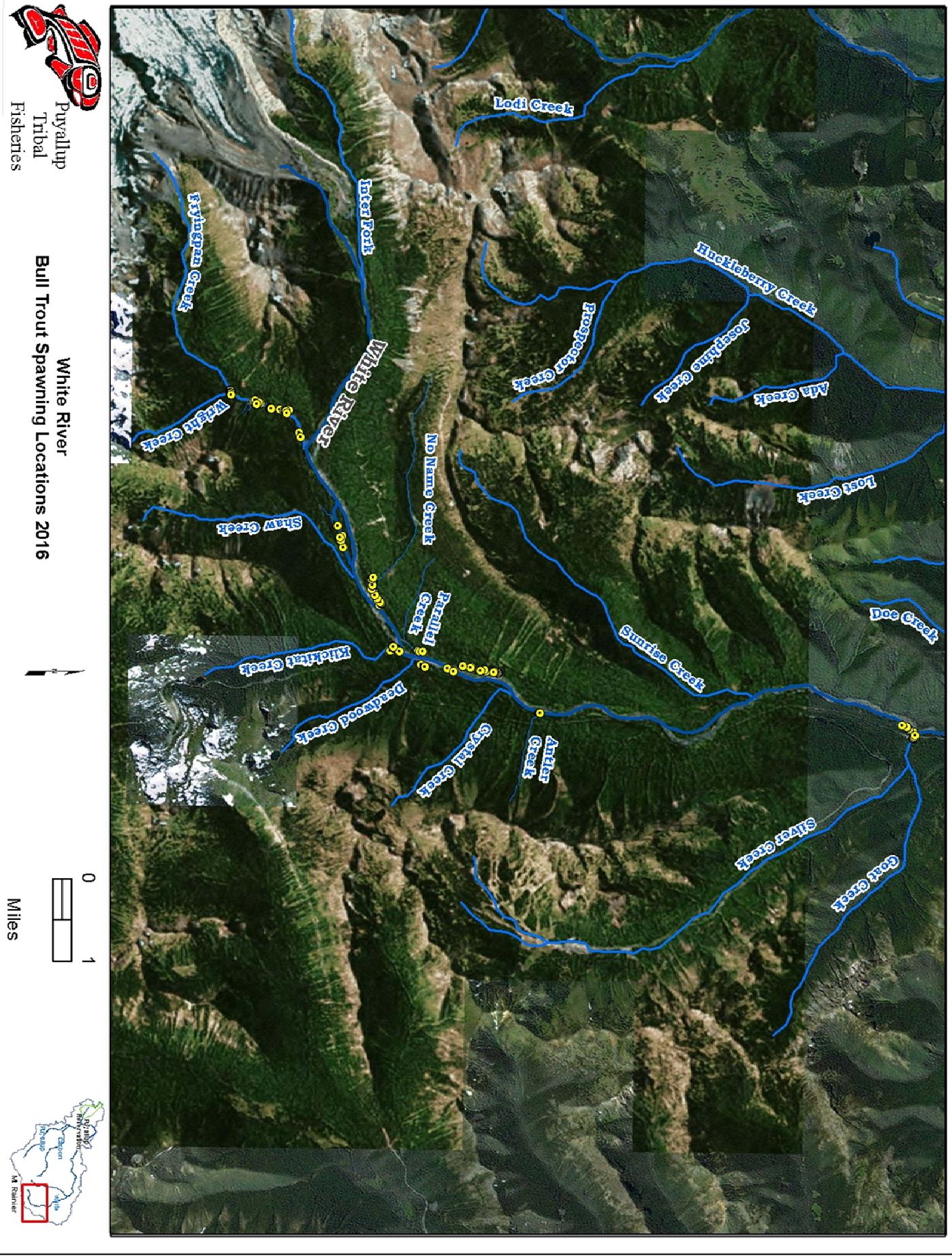

Puyallup Tribal Fisheries
Huckleberry Creek
Chinook Spawning Locations 2016
0
1,000
Feet
Huckleberry Creek
White River
Lightning Creek
Minnehaha Creek

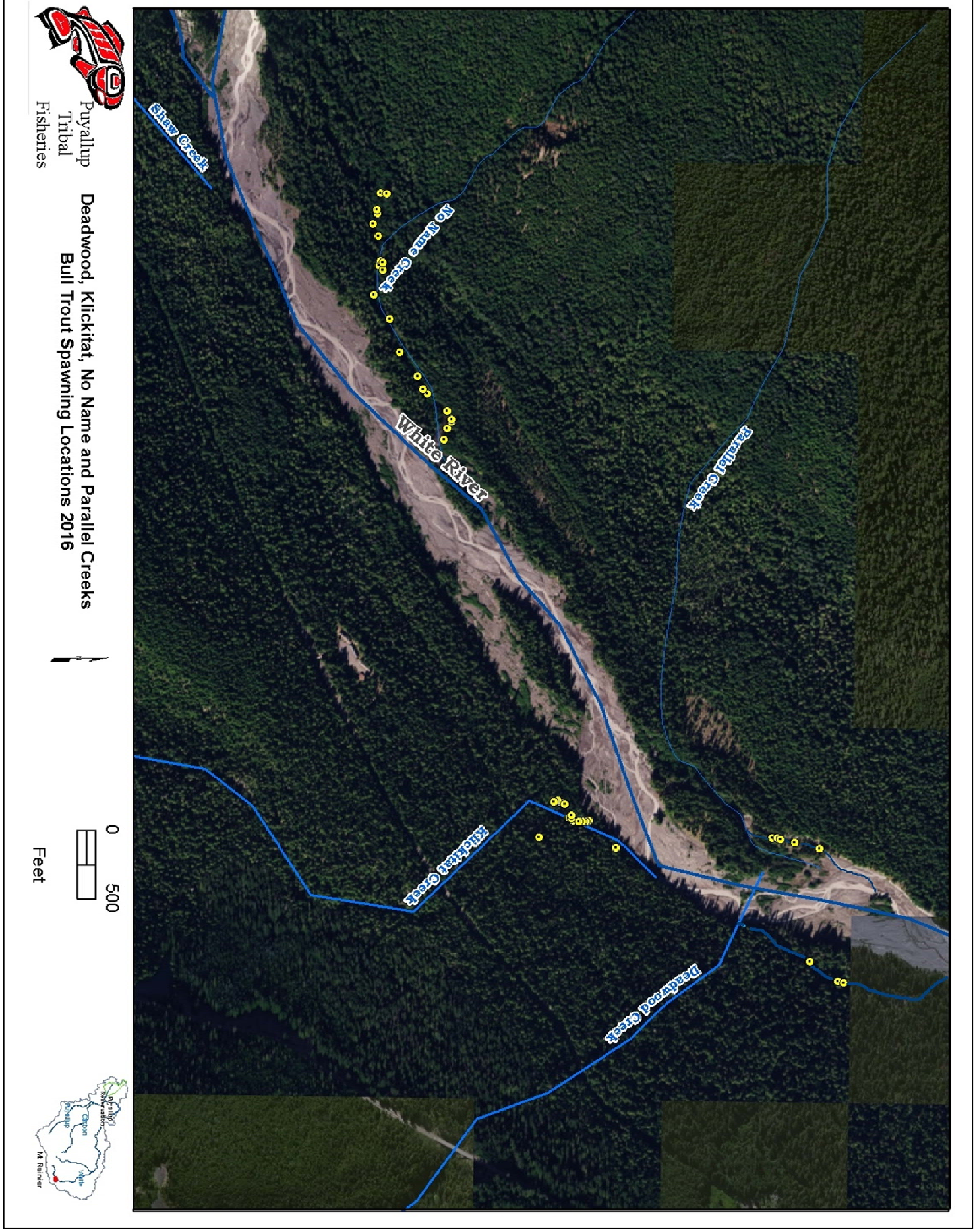

Puyallup Tribal Fisheries
Kapowsin Creek
Chinook Spawning Locations 2016
Kapowsin Creek
Puyallup River
0
1,000
Feet

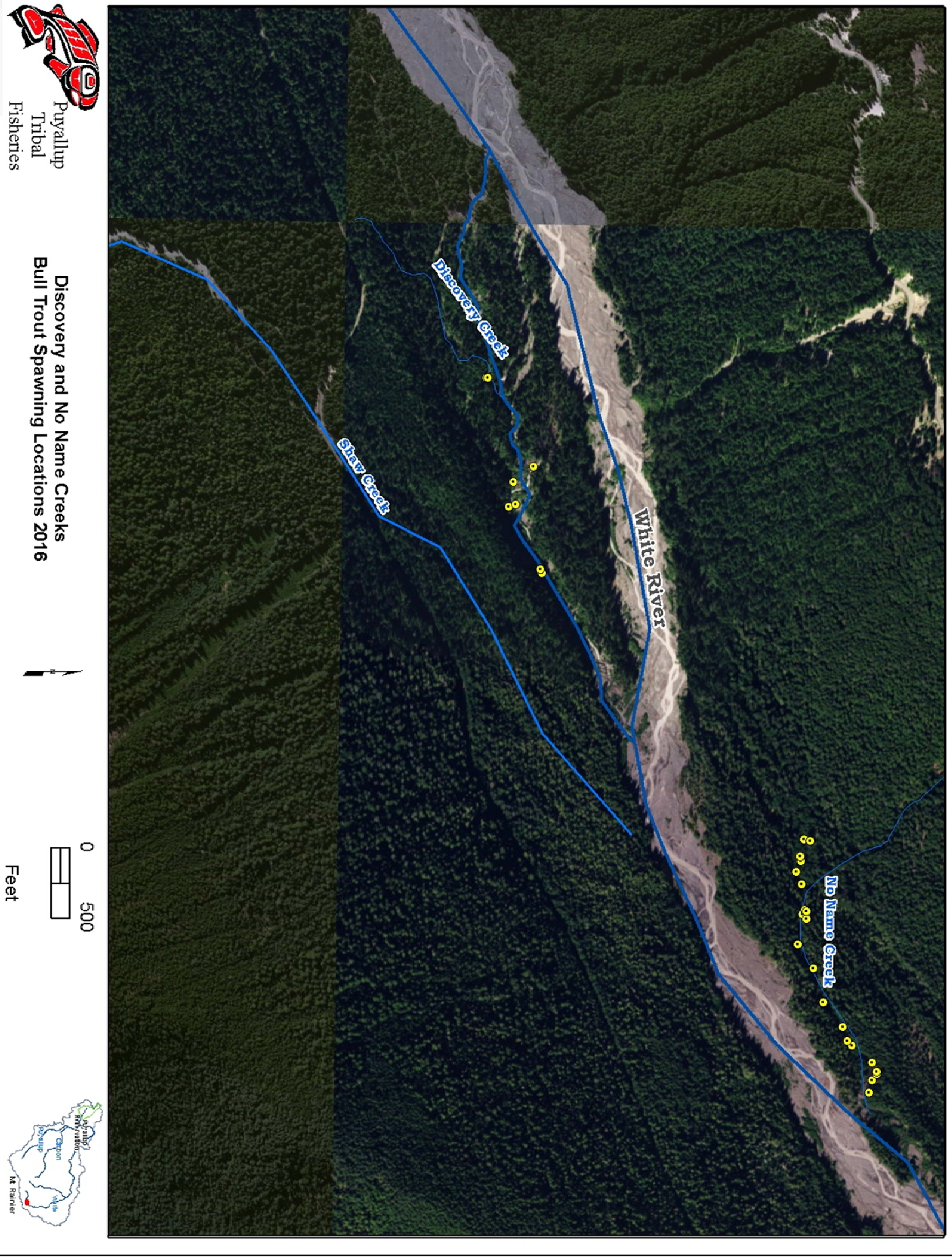

Puyallup Tribal Fisheries
Rushingwater Creek
Chinook Spawning Locations 2016
Puyallup River
Mowich River
Rushingwater Creek
Salmon Acclimation Pond
0
1,000
Feet

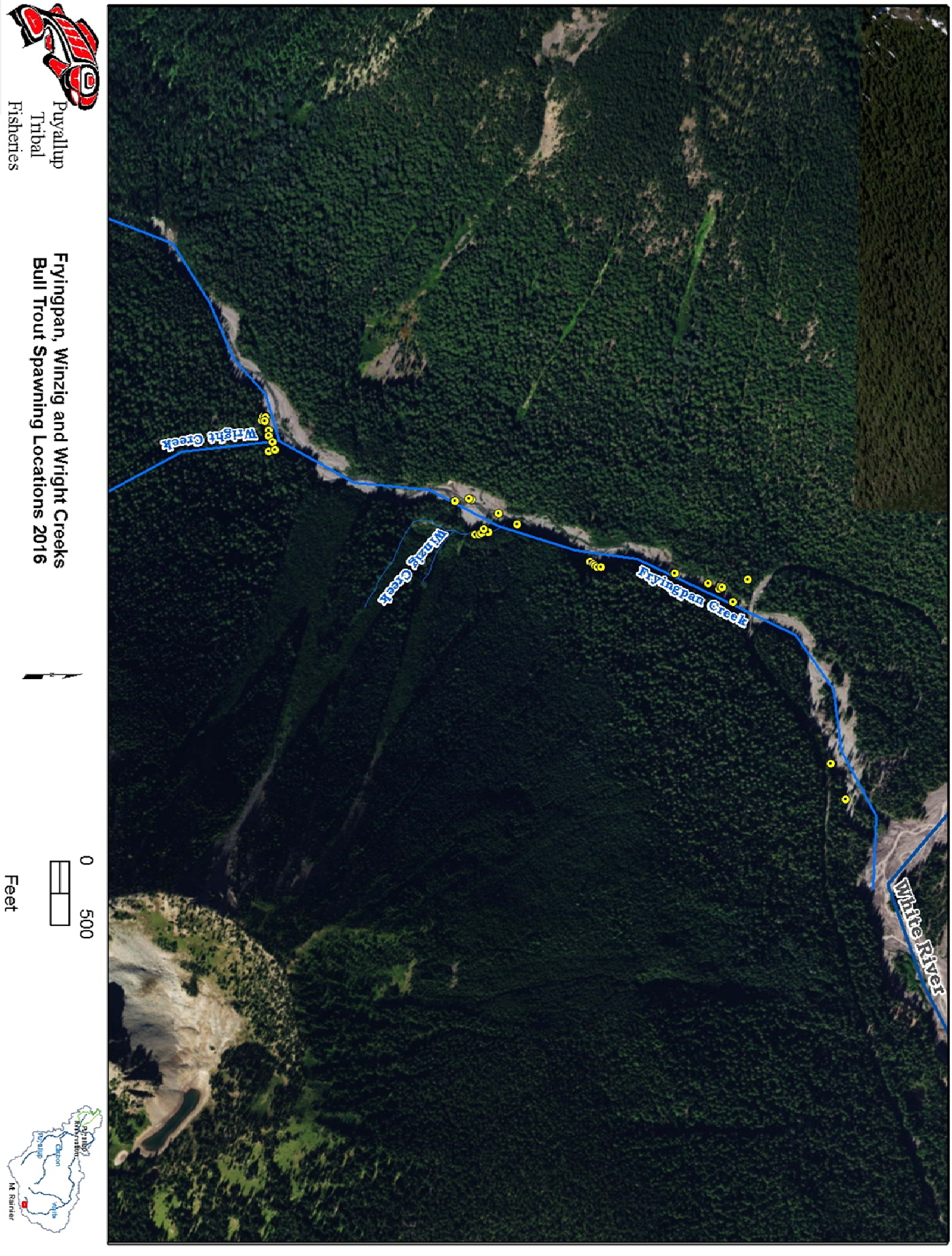

Puyallup Tribal Fisheries
Salmon Creek and Salmon Tributary Chinook Spawning Locations 2016
White River
Salmon Creek
0
1,000
Feet

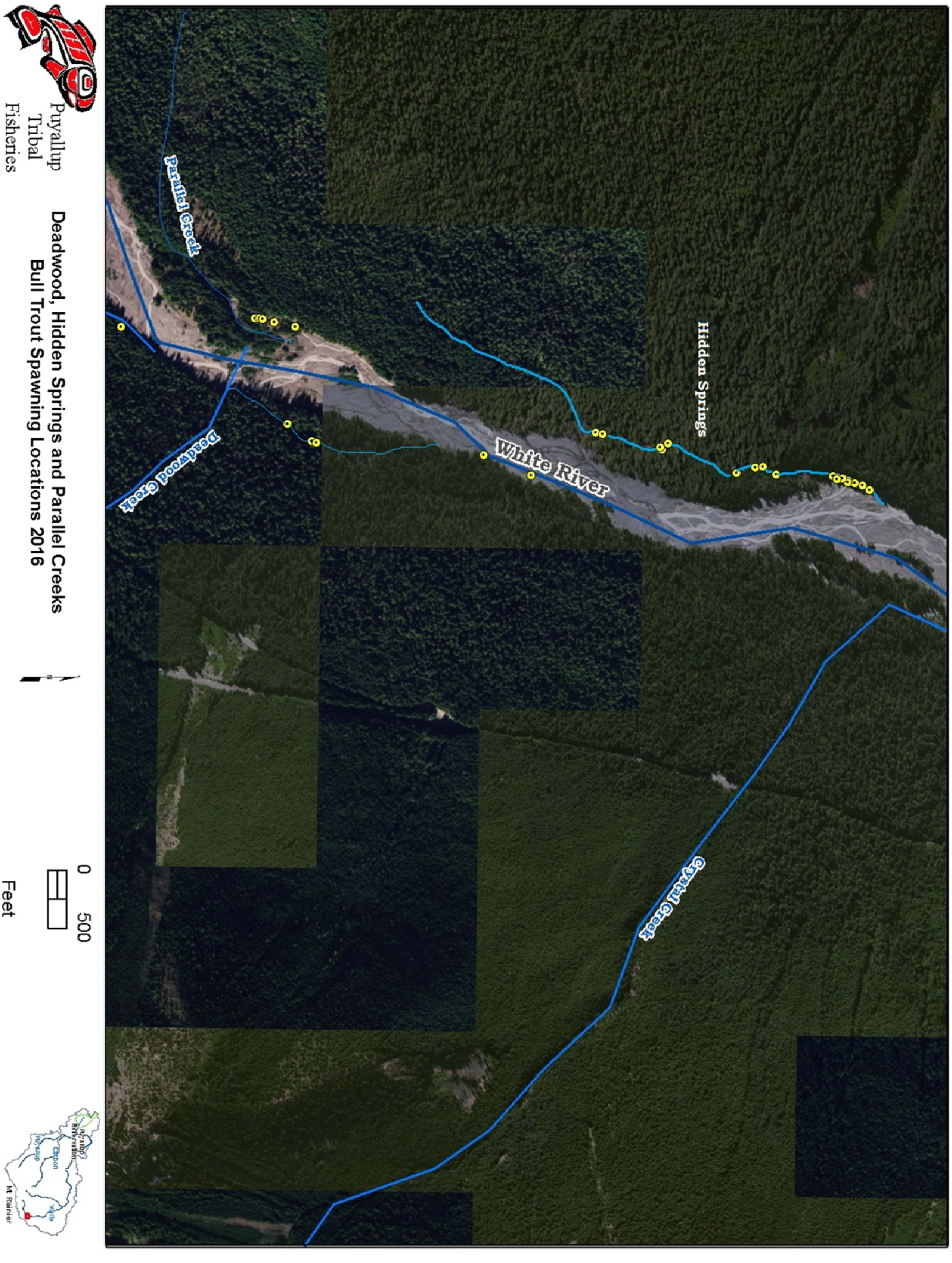

Puyallup Tribal Fisheries
Silver Springs Creek
Chinook Spawning Locations 2016
White River
Silver Springs Creek
Silver Creek
Goat Creek
0
1,000
Feet
Mt. Rainier

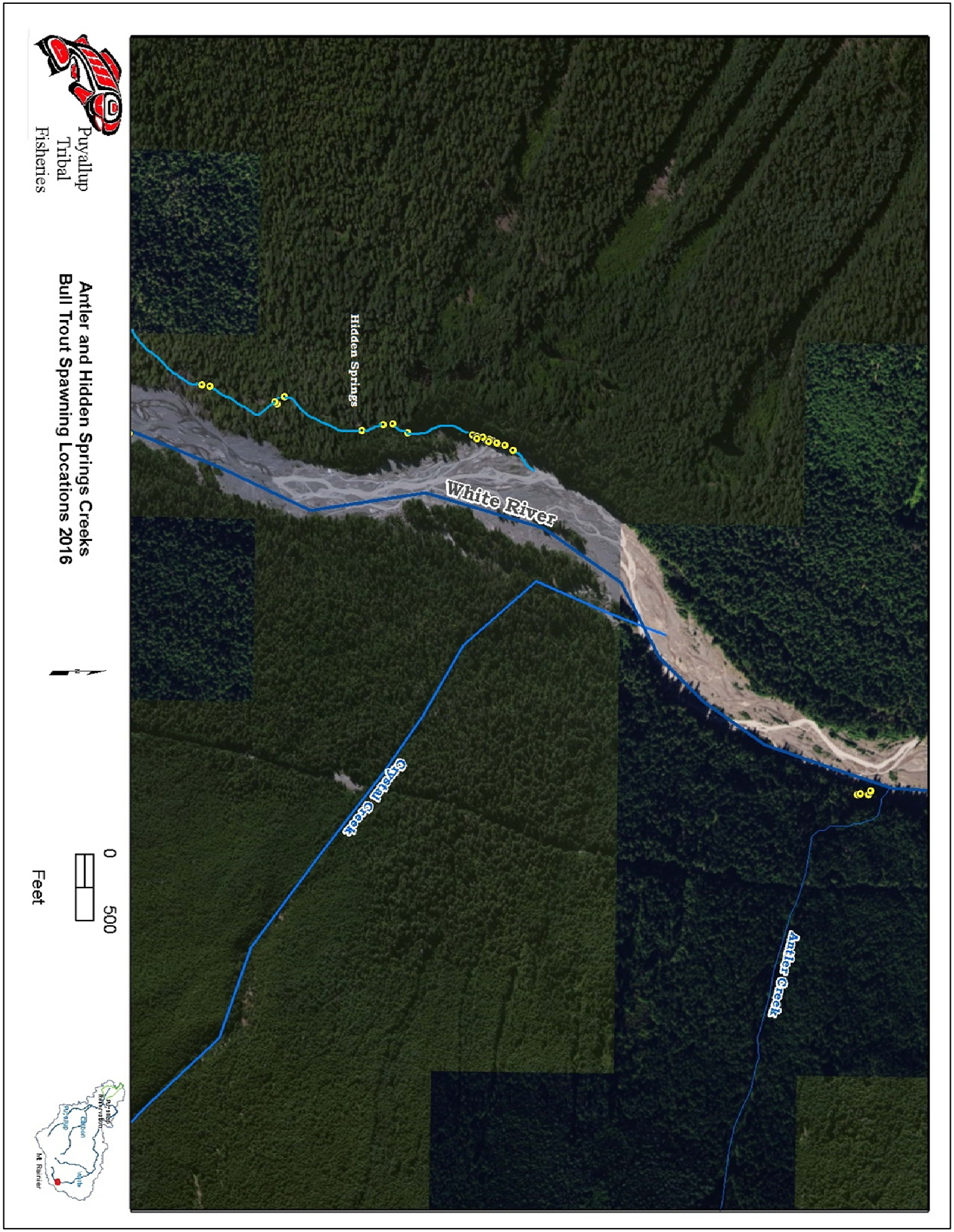

Puyallup Tribal Fisheries
White River
Bull Trout Spawning Locations 2016
Lodi Creek
Inter Fork
Fryingpan Creek
White River
Huckleberry Creek
Prospector Creek
Josephine Creek
Ada Creek
Lost Creek
Wright Creek
No Name Creek
Shaw Creek
Pratt River
Sunrise Creek
Doe Creek
Kilchis Creek
Deadwood Creek
Crystal Creek
Antler Creek
Silver Creek
Goat Creek
0
1
Miles

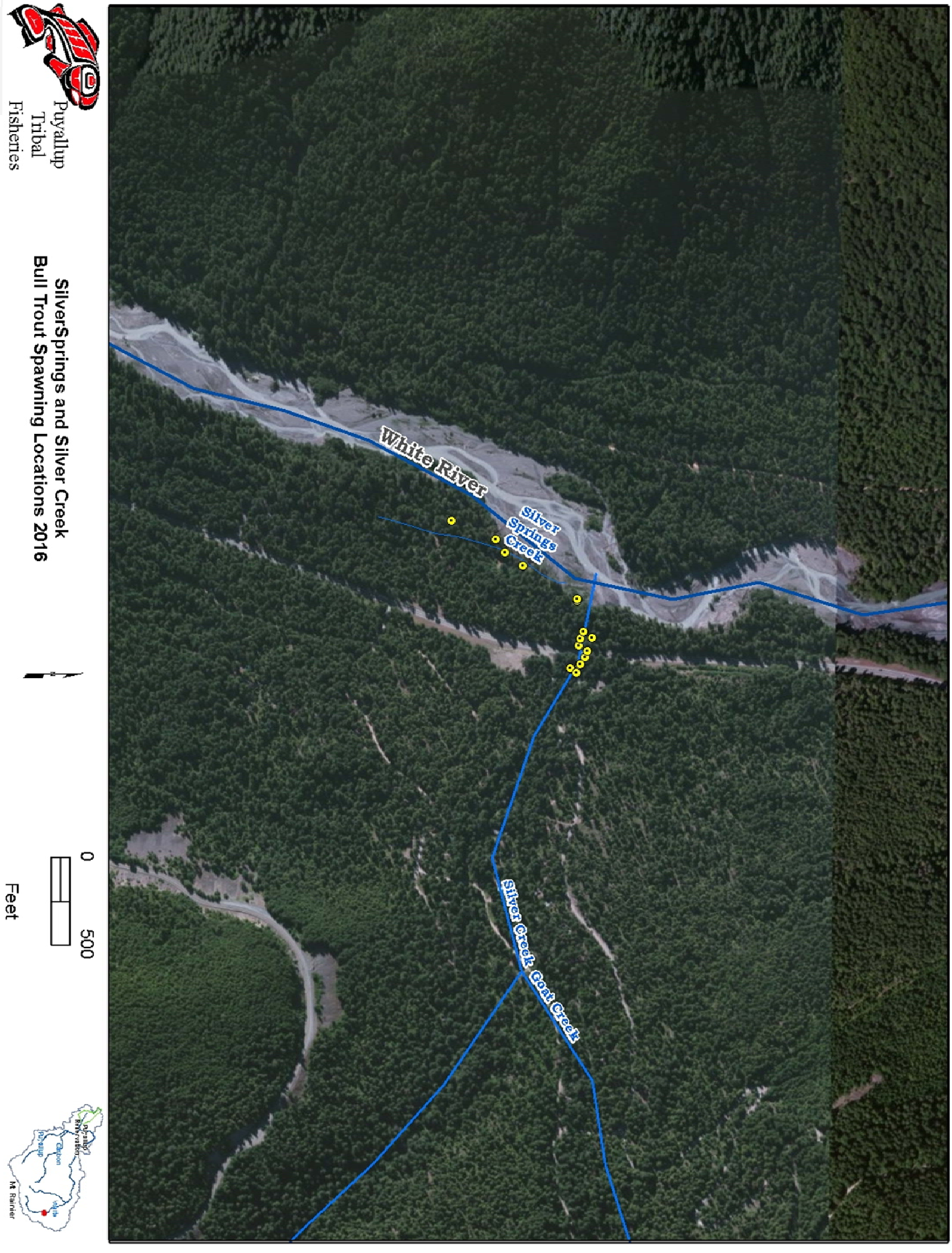

Puyallup Tribal Fisheries
Deadwood, Klickitat, No Name and Parallel Creeks
Bull Trout Spawning Locations 2016
0
500
Feet
Shaw Creek
No Name Creek
White River
Parallel Creek
Klickitat Creek
Deadwood Creek
Puyallup Reservation
Puyallup
Carbon
White
Mt Rainier

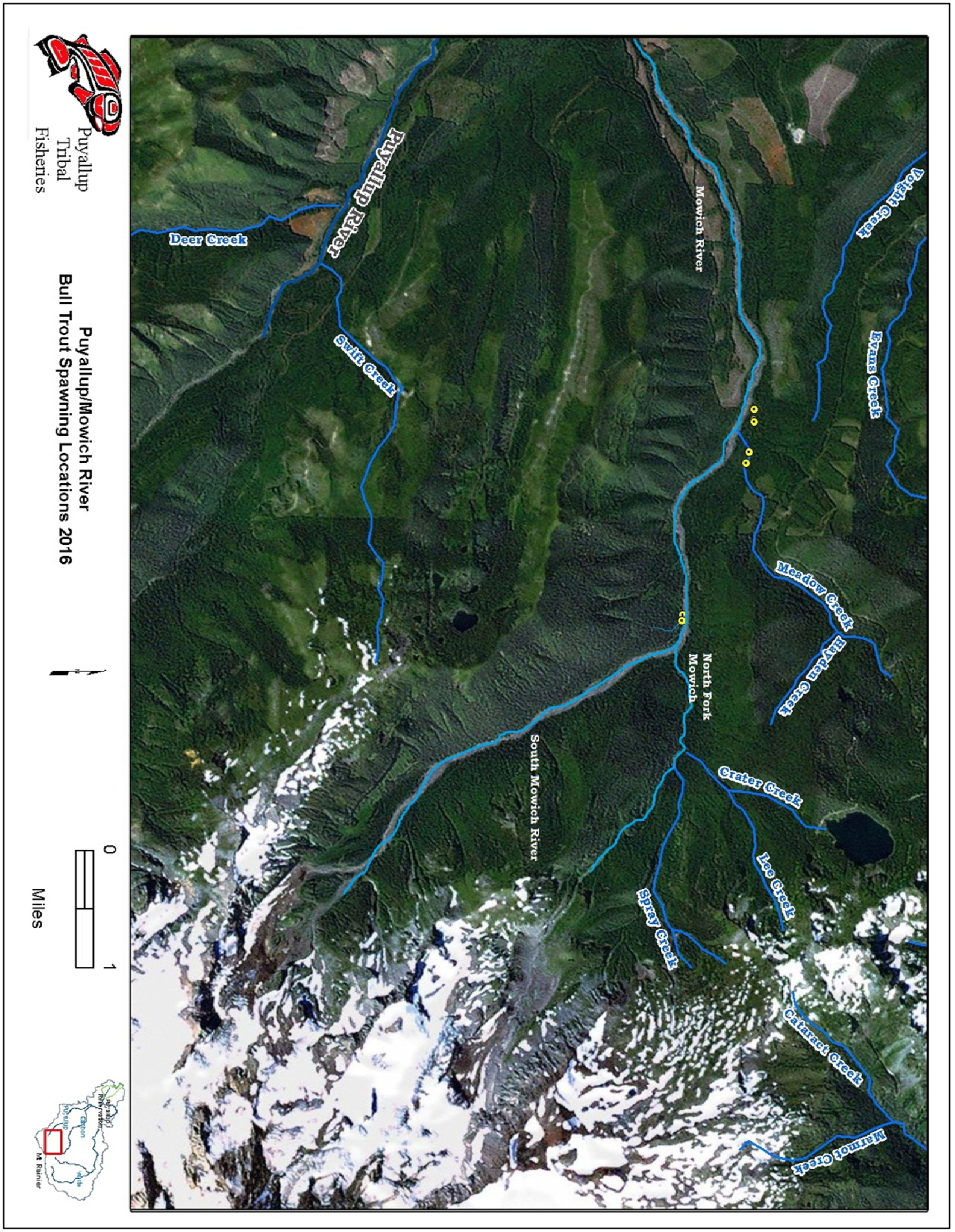

Puyallup Tribal Fisheries
Discovery and No Name Creeks
Bull Trout Spawning Locations 2016
Discovery Creek
Shaw Creek
White River
No Name Creek
0
500
Feet

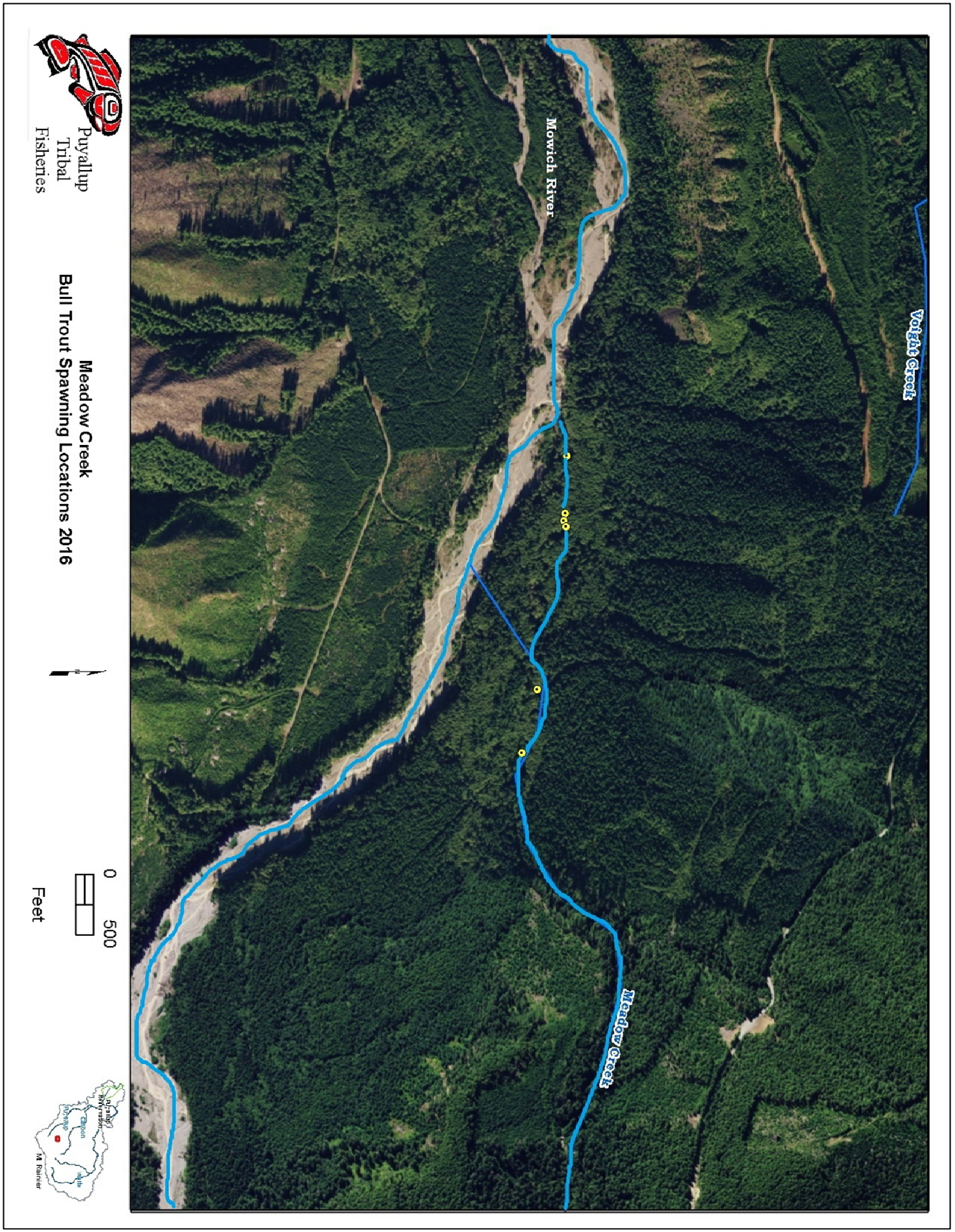

Puyallup Tribal Fisheries
Fryingpan, Winzig and Wright Creeks
Bull Trout Spawning Locations 2016
Wright Creek
Winzig Creek
Fryingpan Creek
White River
0
500
Feet

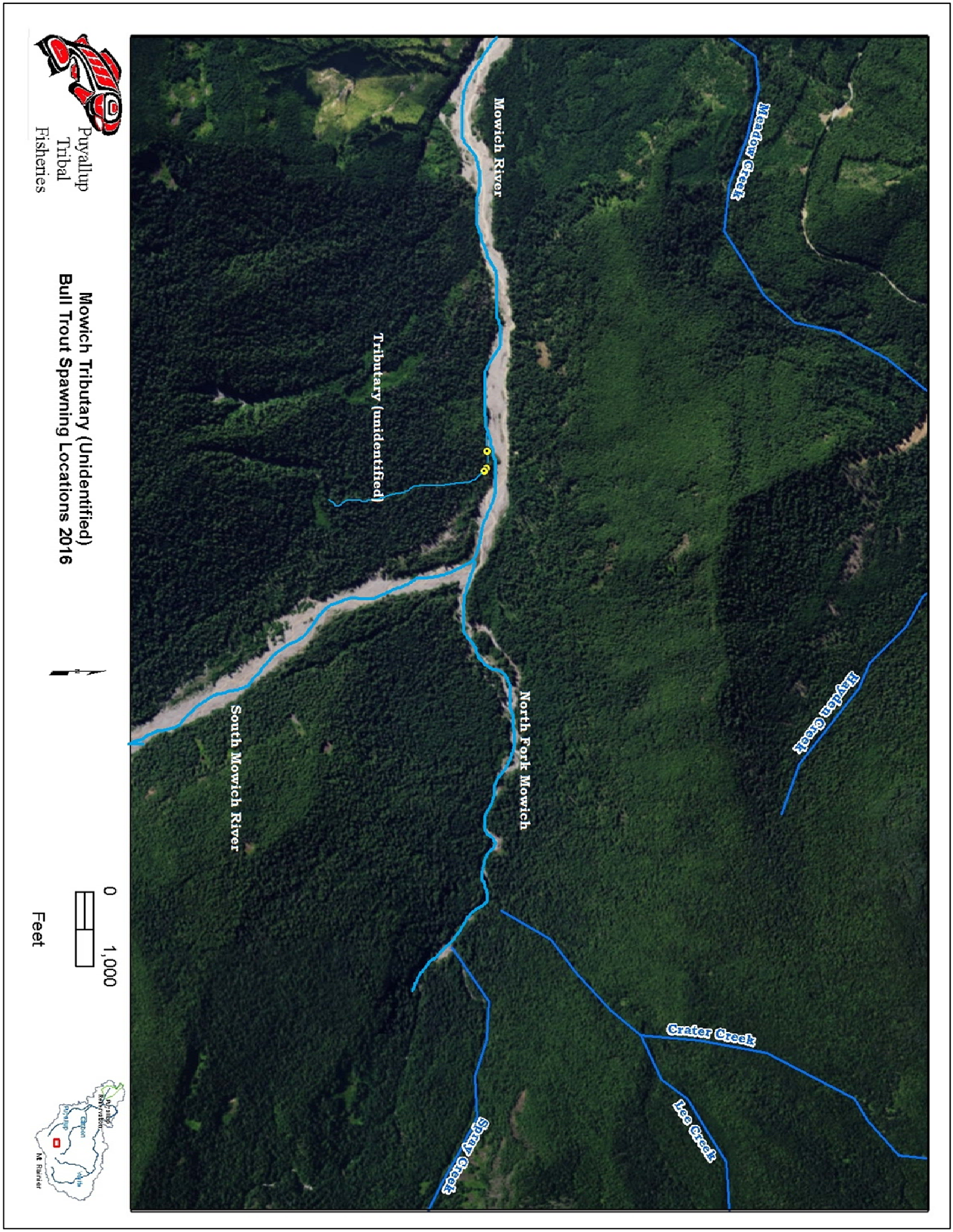

Puyallup Tribal Fisheries
Deadwood, Hidden Springs and Parallel Creeks
Bull Trout Spawning Locations 2016
0
500
Feet
Parallel Creek
Deadwood Creek
White River
Hidden Springs
Crystal Creek
Mt Rainier

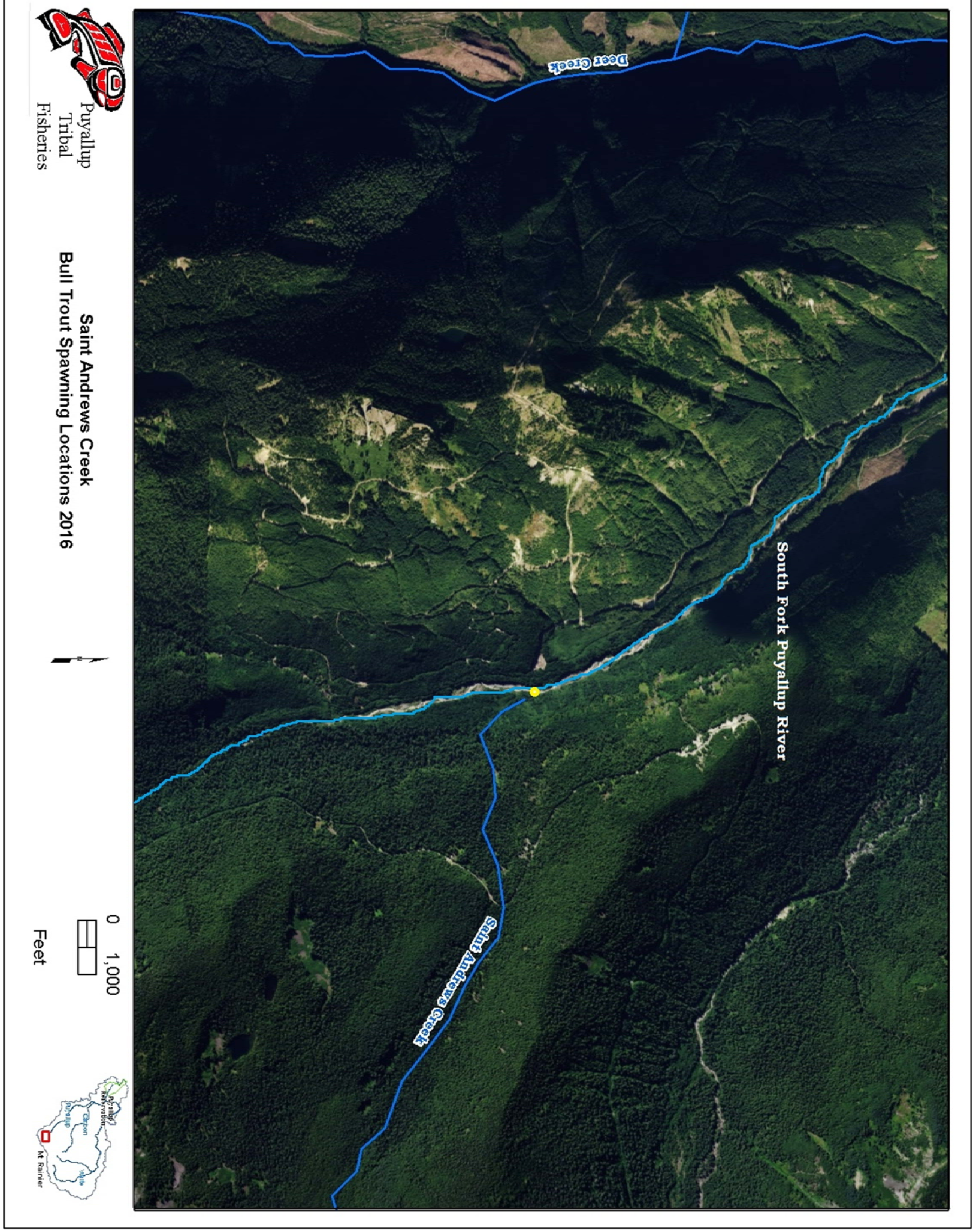

Puyallup Tribal Fisheries
Antler and Hidden Springs Creeks
Bull Trout Spawning Locations 2016
Hidden Springs
White River
Crystal Creek
Antler Creek
0
500
Feet

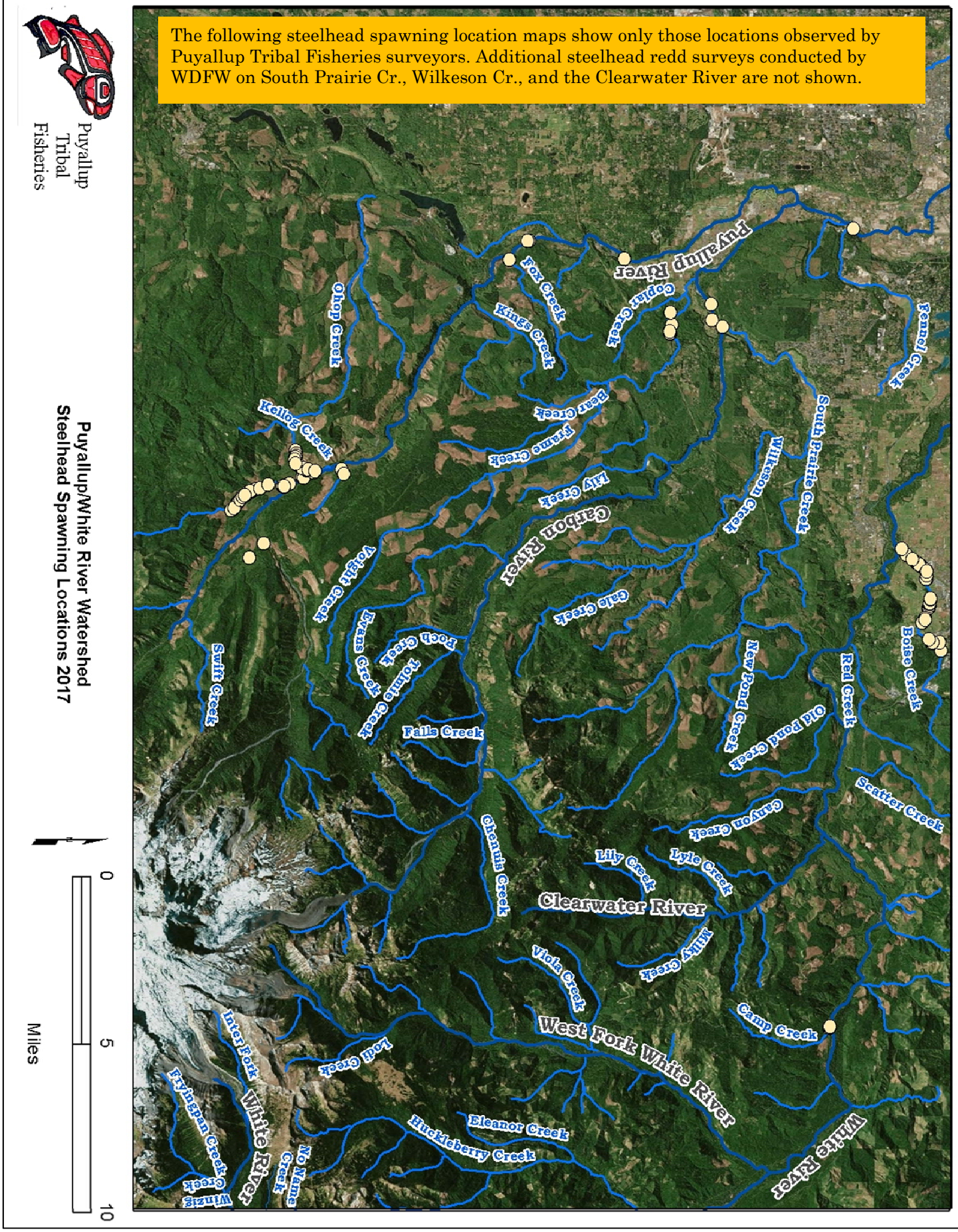

Puyallup Tribal Fisheries
SilverSprings and Silver Creek
Bull Trout Spawning Locations 2016
White River
Silver Springs Creek
Silver Creek
Goat Creek
0
500
Feet
Mt Rainier

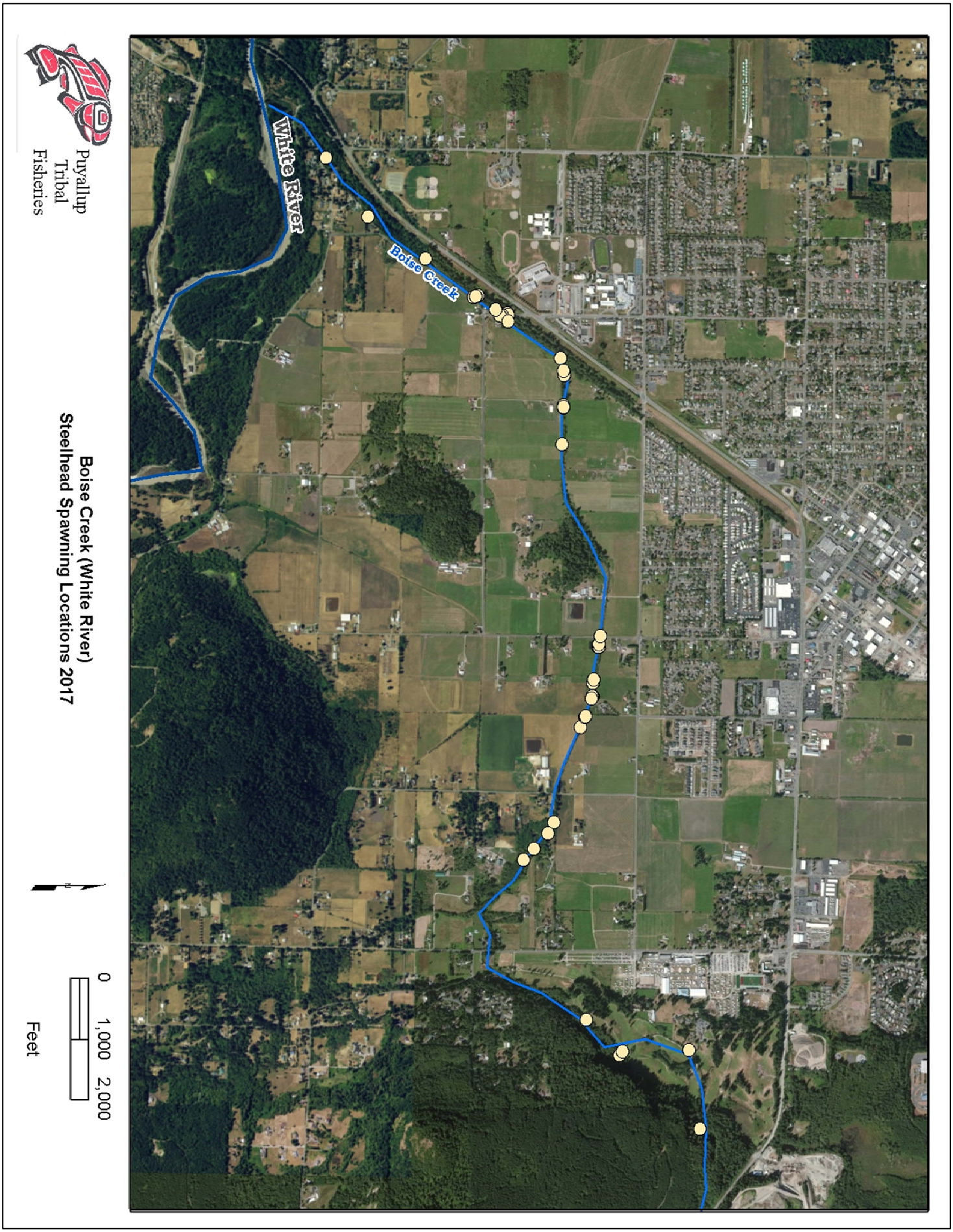

Puyallup Tribal Fisheries
Puyallup/Mowich River
Bull Trout Spawning Locations 2016
Deer Creek
Puyallup River
Swift Creek
Mowich River
Yoman Creek
Evans Creek
Meadow Creek
Hayden Creek
North Fork Mowich
South Mowich River
Crater Creek
Lee Creek
Spray Creek
Cataract Creek
Klamot Creek
0
1
Miles

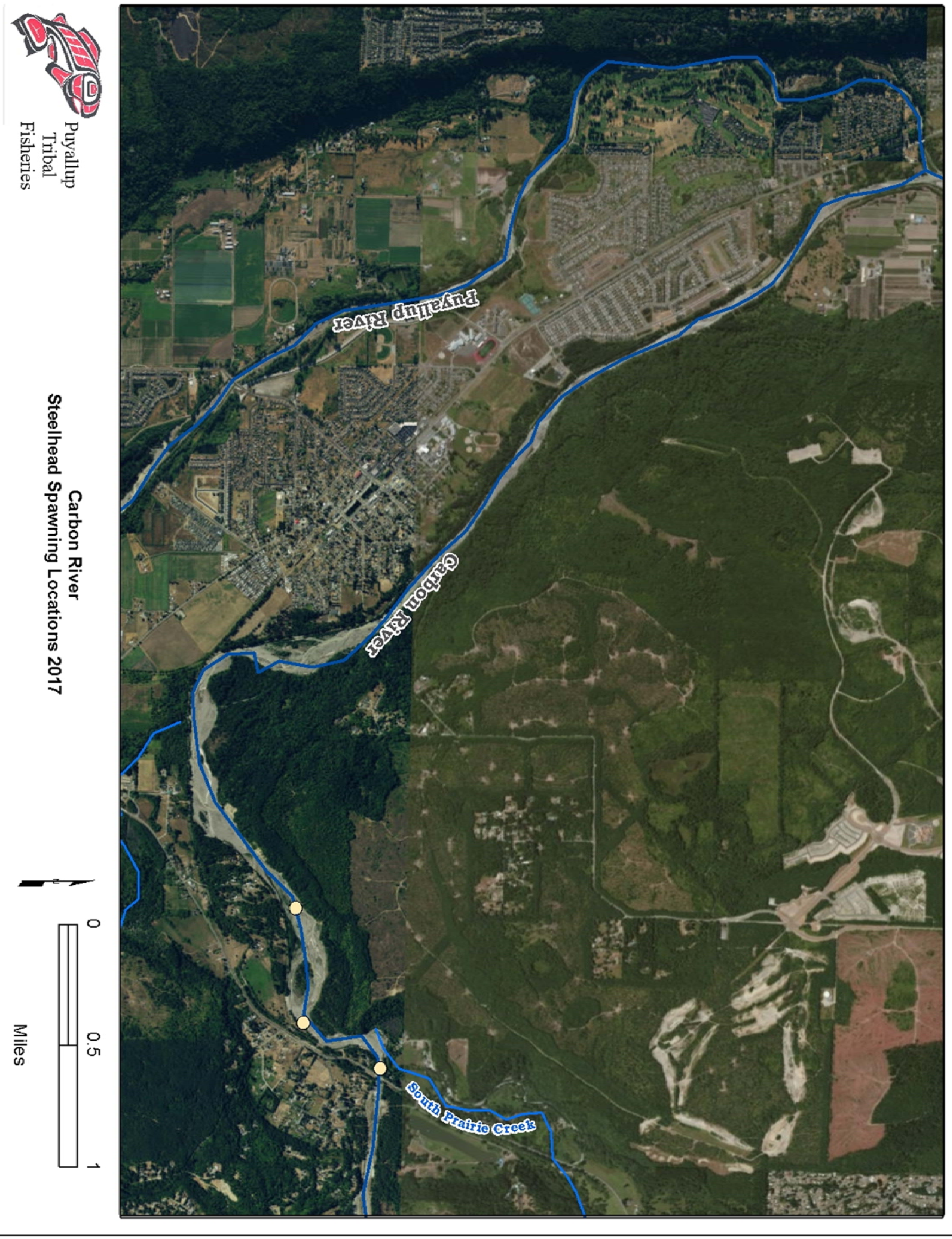

Puyallup Tribal Fisheries
Meadow Creek
Bull Trout Spawning Locations 2016
0
500
Feet
Mowich River
Voight Creek
Meadow Creek
Puyallup
Carbon
White
Mt. Rainier


Puyallup Tribal Fisheries
Mowich Tributary (Unidentified)
Bull Trout Spawning Locations 2016
0
1,000
Feet
Mowich River
Tributary (unidentified)
Meadow Creek
Hayden Creek
North Fork Mowich
South Mowich River
Crater Creek
Lee Creek
Spray Creek


Puyallup Tribal Fisheries
Saint Andrews Creek
Bull Trout Spawning Locations 2016
0 1,000
Feet
Deer Creek
South Fork Puyallup River
Saint Andrews Creek
Mt Rainier


The following steelhead spawning location maps show only those locations observed by Puyallup Tribal Fisheries surveyors. Additional steelhead redd surveys conducted by WDFW on South Prairie Cr., Wilkeson Cr., and the Clearwater River are not shown.
Puyallup Tribal Fisheries
Puyallup/White River Watershed
Steelhead Spawning Locations 2017
Puyallup River
Carbon River
Clearwater River
West Fork White River
White River
White River
Inter Fork
Fox Creek
Kings Creek
Copier Creek
Fennel Creek
Chop Creek
Kellog Creek
Bear Creek
Frame Creek
Lily Creek
Wilkeson Creek
South Prairie Creek
Voight Creek
Evans Creek
Rock Creek
Tolmie Creek
Gale Creek
Swift Creek
Falls Creek
New Pond Creek
Old Pond Creek
Red Creek
Boise Creek
Scatter Creek
Canyon Creek
Chenuis Creek
Lily Creek
Lyle Creek
Viola Creek
Milky Creek
Camp Creek
Lodi Creek
Fryingpan Creek
Wintz Creek
No Name Creek
Eleanor Creek
Huckleberry Creek
0
5
10
Miles


Puyallup Tribal Fisheries
White River
Boise Creek
Boise Creek (White River)
Steelhead Spawning Locations 2017
0 1,000 2,000
Feet


Puyallup Tribal Fisheries
Carbon River
Steelhead Spawning Locations 2017
Puyallup River
Carbon River
South Prairie Creek
0
0.5
1
Miles

Puyallup Tribal Fisheries

Fennel Creek (Puyallup River)
Steelhead Spawning Locations 2017

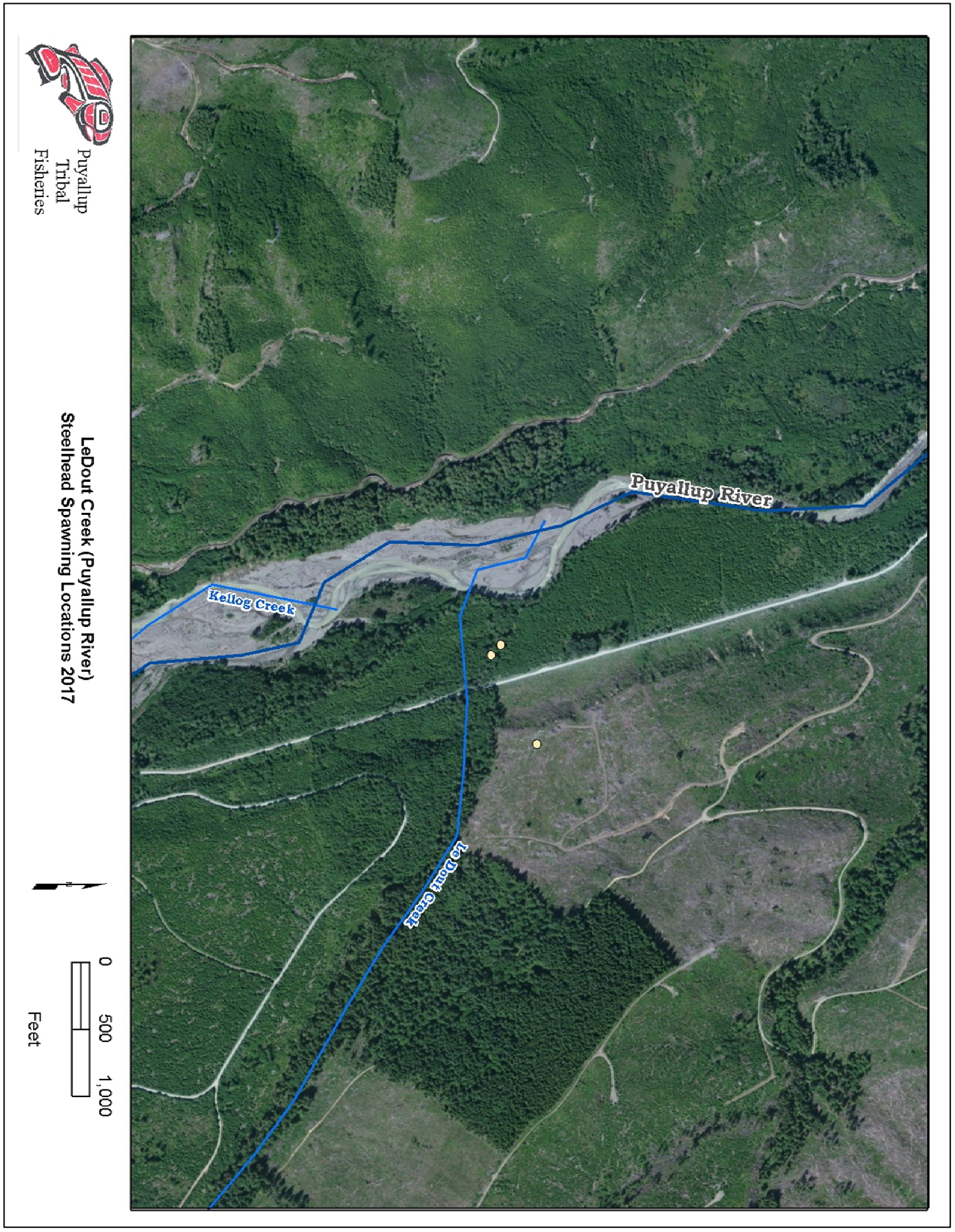
0 500 1,000
Feet

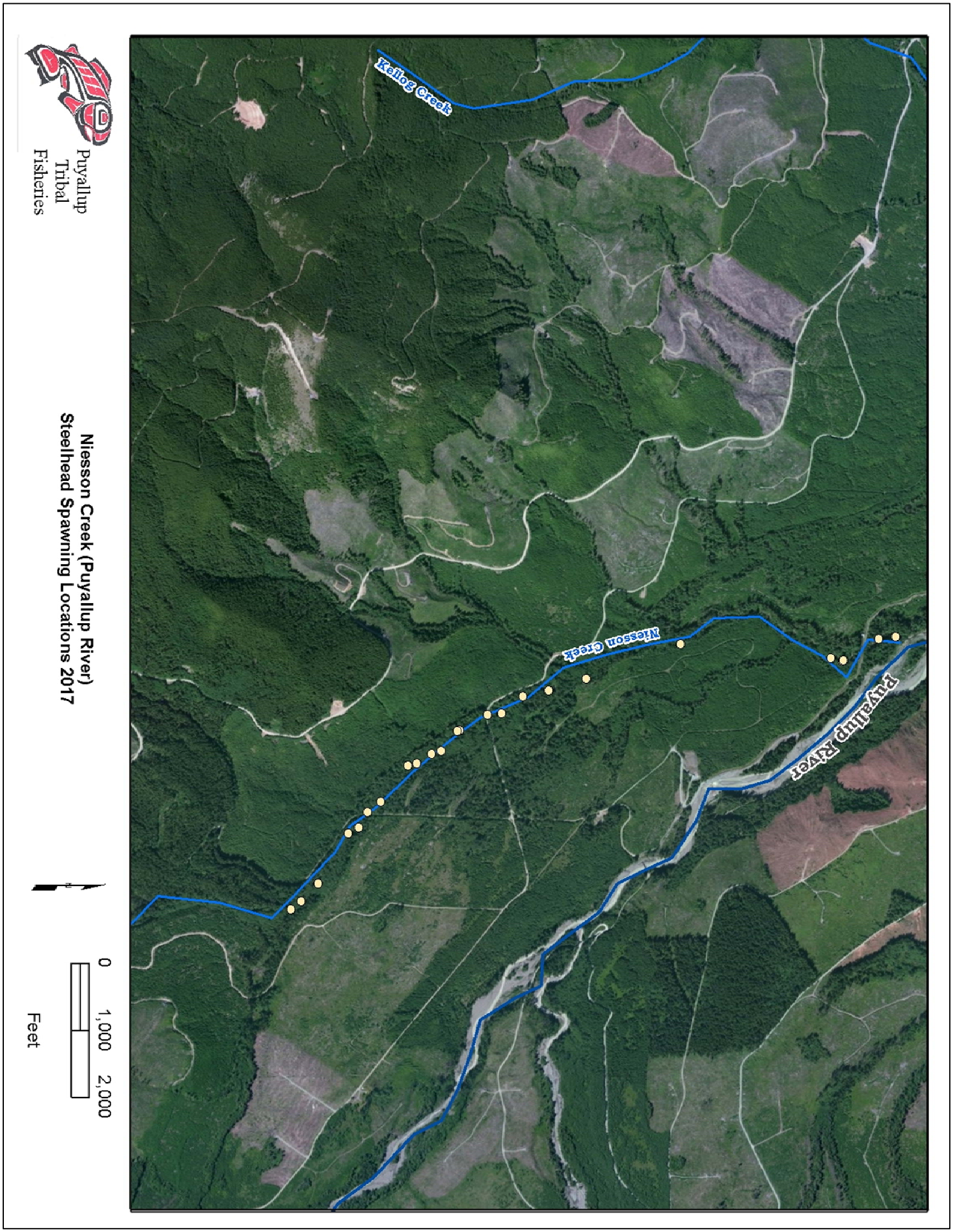
The following steelhead spawning location maps show only those locations observed by Puyallup Tribal Fisheries surveyors. Additional steelhead redd surveys conducted by WDFW on South Prairie Cr., Wilkeson Cr., and the Clearwater River are not shown.

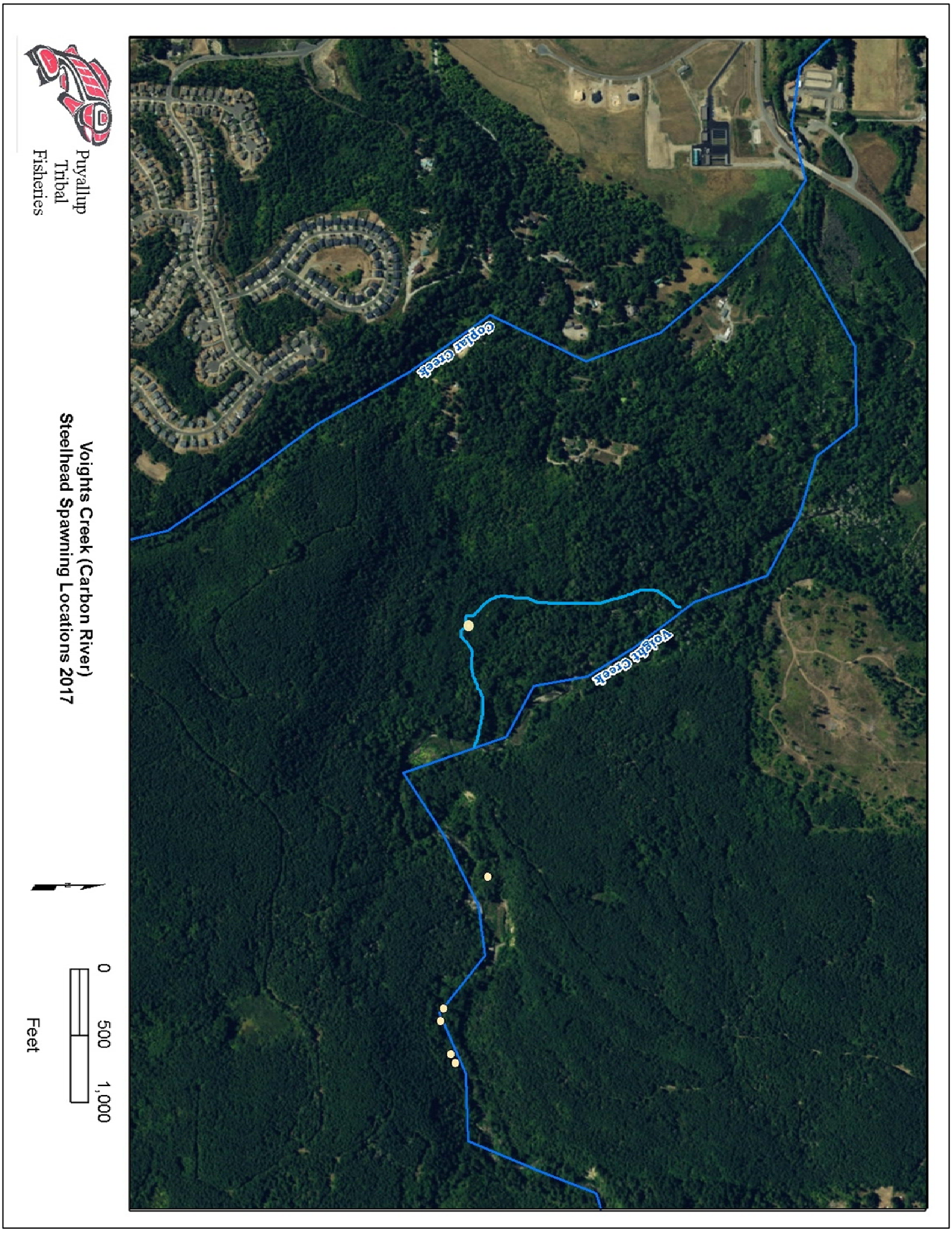
Puyallup Tribal Fisheries

Kellog Creek (Puyallup River)
Steelhead Spawning Locations 2017

0 500 1,000
Feet


Puyallup Tribal Fisheries
LeDout Creek (Puyallup River)
Steelhead Spawning Locations 2017
Puyallup River
Kellog Creek
LeDout Creek
0
500
1,000
Feet


Puyallup Tribal Fisheries
Niesson Creek (Puyallup River)
Steelhead Spawning Locations 2017
Kellog Creek
Niesson Creek
Puyallup River
0
1,000
2,000
Feet


Puyallup Tribal Fisheries
Voights Creek (Carbon River)
Steelhead Spawning Locations 2017
coplin creek
Voights Creek
0
500
1,000
Feet

2016-2017
Salmon, Steelhead and Bull Trout Spawning Ground Data

APPENDIX C

2016 CHINOOK SPAWNING DATA

STREAM	WRIA	DATE	LOWER R.M.	UPPER R.M.	LIVE	DEAD	REDDS
BOISE	10.0057	8/15/16	0.0	2.2	6	0	0
BOISE	10.0057	9/6/16	0.0	4.5	4	0	2
BOISE	10.0057	9/16/16	0.0	4.5	22	2	13
BOISE	10.0057	9/26/16	0.0	4.5	480	70	150
BOISE	10.0057	10/6/16	0.0	4.5	130	253	48
BOISE	10.0057	10/25/16	0.0	4.5	17	9	0
			BOISE	Total	659	334	213
					LIVE	DEAD	REDDS
CAMP	10.0112	9/20/16	0.0	0.6	0	0	0
			CAMP	Total	0	0	0
					LIVE	DEAD	REDDS
CANYON	10.XXXX	9/12/16	1.0	1.2	0	0	0
CANYON	10.XXXX	9/23/16	1.0	1.2	0	0	0
CANYON	10.XXXX	10/24/16	1.0	1.2	0	0	0
			CANYON	Total	0	0	0
					LIVE	DEAD	REDDS
CANYON FALLS	10.0410	8/23/16	0.3	0.6	0	0	0
CANYON FALLS	10.0410	9/8/16	0.3	0.6	0	0	0
CANYON FALLS	10.0410	9/19/16	0.3	0.6	0	0	2
CANYON FALLS	10.0410	9/28/16	0.3	0.6	9	0	11
CANYON FALLS	10.0410	10/19/16	0.3	0.6	0	2	0
			CANYON FALLS	Total	9	2	13
					LIVE	DEAD	REDDS
CLARKS	10.0027	9/12/16	3.4	3.7	0	0	0
CLARKS	10.0027	9/23/16	3.4	3.7	0	0	0
CLARKS	10.0027	10/3/16	3.4	3.7	16	0	0
CLARKS	10.0027	10/13/16	3.4	3.7	6	0	0
CLARKS	10.0027	10/24/16	3.4	3.7	0	0	0
			CLARKS	Total	22	0	0
					LIVE	DEAD	REDDS
CLEAR	10.0022	8/24/16	1.7	1.9	0	0	0
CLEAR	10.0022	9/12/16	1.7	1.9	3	0	0
CLEAR	10.0022	9/23/16	1.7	1.9	5	0	5
CLEAR	10.0022	10/3/16	1.7	1.9	2	1	5
CLEAR	10.0022	10/13/16	1.7	1.9	0	2	1
CLEAR	10.0022	10/24/16	1.7	1.9	0	0	0
			CLEAR	Total	10	3	11
					LIVE	DEAD	REDDS

CLEARWATER	10.0080	8/17/16	0.0	1.0	0	0	0
CLEARWATER	10.0080	9/1/16	0.0	1.5	0	0	0
CLEARWATER	10.0080	9/15/16	0.0	1.5	5	0	9
CLEARWATER	10.0080	9/27/16	0.0	2.8	75	8	61
CLEARWATER	10.0080	10/13/16	0.0	2.8	1	0	20
			CLEARWATER	**Total**	**81**	**8**	**90**
					LIVE	**DEAD**	**REDDS**
FENNEL	10.0406	8/23/16	0.0	0.5	0	0	0
FENNEL	10.0406	9/8/16	0.0	0.5	0	0	0
FENNEL	10.0406	9/19/16	0.0	1.7	70	3	21
FENNEL	10.0406	9/28/16	0.0	1.7	96	21	72
FENNEL	10.0406	10/7/16	0.0	1.7	31	40	31
FENNEL	10.0406	10/19/16	0.0	1.7	0	0	2
			FENNEL	**Total**	**197**	**64**	**126**
					LIVE	**DEAD**	**REDDS**
FOX	10.0608	9/6/16	0.0	0.5	0	0	1
FOX	10.0608	9/8/16	0.0	0.5	0	0	0
FOX	10.0608	9/12/16	0.0	0.5	0	0	0
FOX	10.0608	9/29/16	0.0	0.5	0	0	0
FOX	10.0608	10/12/16	0.0	0.5	0	0	0
			FOX	**Total**	**0**	**0**	**1**
					LIVE	**DEAD**	**REDDS**
***Data collected by WDFW**							
***GREENWATER**	10.0122	9/13/16	0.0	3.9	287	17	82
*GREENWATER	10.0122	9/15/16	11.5	12.5	9	0	0
***GREENWATER**	10.0122	9/23/16	0.0	3.9	400	51	86
			GREENWATER	**Total**	**696**	**68**	**168**
					LIVE	**DEAD**	**REDDS**
HYLEBOS	10.0006	9/12/16	0.3	0.5	0	0	0
			HYLEBOS		**0**	**0**	**0**
					LIVE	**DEAD**	**REDDS**
HUCKLEBERRY	10.0253	8/18/16	0.0	1.0	3	0	1
HUCKLEBERRY	10.0253	9/1/16	0.0	2.3	4	0	4
HUCKLEBERRY	10.0253	9/15/16	0.0	2.3	58	4	22
HUCKLEBERRY	10.0253	9/27/16	0.0	2.3	37	13	37
HUCKLEBERRY	10.0253	10/11/16	0.0	2.3	1	3	4
			HUCKLEBERRY	**Total**	**103**	**20**	**68**
					LIVE	**DEAD**	**REDDS**
KAPOWSIN	10.0600	8/22/16	0.0	0.7	0	1	1
KAPOWSIN	10.0600	9/8/16	0.0	0.7	0	0	0
KAPOWSIN	10.0600	9/19/16	0.0	0.7	0	0	0
KAPOWSIN	10.0600	9/29/16	0.0	3.2	0	0	1
KAPOWSIN	10.0600	10/13/16	0.0	3.2	0	3	2
KAPOWSIN	10.0600	10/28/16	0.0	3.2	0	0	0
			KAPOWSIN	**Total**	**0**	**4**	**4**
					LIVE	**DEAD**	**REDDS**

LEDOUT	10.0620	9/6/16	0.0	0.4	0	0	0
LEDOUT	10.0620	9/19/16	0.0	0.4	0	0	0
LEDOUT	10.0620	10/4/16	0.0	0.4	0	0	0
			LEDOUT	**Total**	**0**	**0**	**0**
					LIVE	**DEAD**	**REDDS**
RUSHINGWATER	10.0625	8/25/16	0.0	1.0	0	0	0
RUSHINGWATER	10.0625	9/6/16	0.0	1.0	2	0	4
RUSHINGWATER	10.0625	9/19/16	0.0	1.0	0	0	4
RUSHINGWATER	10.0625	10/4/16	0.0	1.0	0	0	1
			RUSHINGWATER	**Total**	**2**	**0**	**9**
					LIVE	**DEAD**	**REDDS**
SALMON	10.0035	8/23/16	0.0	0.5	0	0	0
SALMON	10.0035	9/12/16	0.0	0.5	0	0	2
SALMON	10.0035	9/21/16	0.0	0.5	28	2	21
SALMON	10.0035	9/29/16	0.0	0.5	29	4	13
SALMON	10.0035	10/12/16	0.0	0.5	19	3	6
SALMON	10.0035	10/24/16	0.0	0.5	0	0	0
			SALMON CREEK	**Total**	**76**	**9**	**42**
					LIVE	**DEAD**	**REDDS**
SALMON TRIB	10.0036	8/23/16	0.0	0.1	0	0	0
SALMON TRIB	10.0036	9/12/16	0.0	0.1	0	0	0
SALMON TRIB	10.0036	9/21/16	0.0	0.1	2	0	2
SALMON TRIB	10.0036	9/29/16	0.0	0.1	7	7	2
SALMON TRIB	10.0036	10/12/16	0.0	0.1	2	0	1
SALMON TRIB	10.0036	10/24/16	0.0	0.1	0	0	0
			SALMON TRIB	**Total**	**11**	**7**	**5**
					LIVE	**DEAD**	**REDDS**
SILVER SPRINGS	10.0332A	8/18/16	0.0	0.3	0	0	0
SILVER SPRINGS	10.0332A	9/9/16	0.0	0.3	0	0	0
SILVER SPRINGS	10.0332A	9/20/16	0.0	0.3	26	0	11
SILVER SPRINGS	10.0332A	10/3/16	0.0	0.3	4	2	3
			SILVER SPRINGS	**Total**	**30**	**2**	**14**
					LIVE	**DEAD**	**REDDS**
***Data collected by WDFW**							
***SOUTH PRAIRIE**	10.0429	9/1/16	0.3	3.8	3	0	4
***SOUTH PRAIRIE**	10.0429	9/8/16	0.3	5.6	23	1	14
***SOUTH PRAIRIE**	10.0429	9/15/16	0.3	8.0	79	7	35
***SOUTH PRAIRIE**	10.0429	9/20/16	8.0	12.6	39	2	15
***SOUTH PRAIRIE**	10.0429	9/22/16	0.3	8.0	87	18	36
***SOUTH PRAIRIE**	10.0429	9/27/16	8.0	12.6	48	1	9
***SOUTH PRAIRIE**	10.0429	9/29/16	0.3	8.0	108	50	56
***SOUTH PRAIRIE**	10.0429	10/4/16	0.3	8.0	16	4	7
***SOUTH PRAIRIE**	10.0429	10/6/16	0.3	8.0	40	38	30

SOUTH PRAIRIE	10.0429	10/12/16	0.3	12.6	17	1	21
SOUTH PRAIRIE	10.0429	10/25/16	0.3	8.0	0	0	0
			SOUTH PRAIRIE	**Total**	**460**	**122**	**227**
					LIVE	**DEAD**	**REDDS**
SQUALLY	10.0024	9/12/16	0.0	0.1	0	0	0
SQUALLY	10.0024	9/23/16	0.0	0.1	0	0	0
SQUALLY	10.0024	10/24/16	0.0	0.1	0	0	0
			SQUALLY	**Total**	**0**	**0**	**0**
					LIVE	**DEAD**	**REDDS**
WILKESON	10.0432	8/22/16	0.0	1.0	0	0	0
WILKESON	10.0432	9/12/16	0.0	1.0	0	0	0
WILKESON	10.0432	9/21/16	0.0	0.5	0	0	0
WILKESON	10.0432	9/29/16	0.0	1.0	6	1	4
WILKESON	10.0432	10/11/16	0.0	2.1	0	0	0
			WILKESON	**Total**	**6**	**1**	**4**
					LIVE	**DEAD**	**REDDS**

	LIVE	DEAD	REDDS
TOTAL SPAWNING GROUND COUNTS (Excluding fish transported above Mud Mountain Dam on White River-See Buckley trap):	**1,452**	**546**	**655**

2016 BULL TROUT SPAWNING DATA (WHITE RIVER)

Survey conducted by PTF (Black) | Survey conducted by NPS (Red) | Survey conducted by USFWS (Blue)

STREAM	WRIA	DATE	LOWER R.M.	UPPER R.M.	LIVE	DEAD	REDDS
ANTLER CREEK	10.0352	9/13/16	0.0	0.2	3	0	3
ANTLER CREEK	10.0352	9/30/16	0.0	0.2	2	0	2
			ANTLER CREEK	Total	5	0	5
					LIVE	DEAD	REDDS
DEADWOOD	10.0355	9/13/16	0.0	0.5	1	0	0
DEADWOOD	10.0355	9/21/16	0.0	0.5	12	0	9
DEADWOOD	10.0355	9/28/16	0.0	0.5	7	0	2
DEADWOOD	10.0355	10/12/16	0.0	0.5	0	0	1
			DEADWOOD CREEK	Total	20	0	12
					LIVE	DEAD	REDDS
DISCOVERY (Unidentified)	White River	9/13/16	0.0	1.0	6	0	5
DISCOVERY (Unidentified)	White River	9/28/16	0.0	1.0	1	0	2
			DISCOVERY	Total	7	0	7
					LIVE	DEAD	REDDS
FRYINGPAN	10.0369	9/13/16	0.0	1.9	5	0	4
FRYINGPAN	10.0369	9/19/16	0.0	0.8	1	0	1
FRYINGPAN	10.0369	9/23/16	0.0	0.5	1	0	1
FRYINGPAN	10.0369	9/30/16	0.0	1.9	1	0	15
FRYINGPAN	10.0369	10/4/16	0.0	1.9	0	0	7
FRYINGPAN	10.0369	10/12/16	0.0	0.5	0	0	8
			FRYINGPAN CREEK	Total	8	0	36
					LIVE	DEAD	REDDS
HIDDEN SPRINGS (Unidentified)	White River	9/13/16	0.0	0.6	2	0	4
HIDDEN SPRINGS (Unidentified)	White River	9/21/16	0.0	0.6	1	0	9
HIDDEN SPRINGS (Unidentified)	White River	9/28/16	0.0	0.6	0	0	2
HIDDEN SPRINGS (Unidentified)	White River	9/30/16	0.0	0.6	3	0	2
			HIDDEN SPRINGS	Total	6	0	17
					LIVE	DEAD	REDDS
KLICKITAT / KLICKITAT	10.0357	9/9/16	0.0	0.3	9	0	6
KLICKITAT	10.0357	9/13/16	0.0	0.3	8	0	2
KLICKITAT	10.0357	9/21/16	0.0	0.3	1	0	6
KLICKITAT	10.0357	9/28/16	0.0	0.3	4	0	6
KLICKITAT	10.0357	10/3/16	0.0	0.3	0	0	2

KLICKITAT	10.0357	10/12/16	0.0	0.3	0	0	1
			KLICKITAT	Total	22	0	23
					LIVE	DEAD	REDDS
NO-NAME CREEK	10.0364	9/13/16	0.0	0.6	3	0	14
NO-NAME CREEK	10.0364	9/28/16	0.0	0.6	1	0	11
			NO-NAME CREEK	Total	4	0	25
					LIVE	DEAD	REDDS
PARALLEL CREEK (Unidentified)	White River	10/3/16	0.0	0.6	2	0	6
PARALLEL CREEK (Unidentified)	White River	10/12/16	0.0	0.6	0	0	2
			PARALLEL CREEK	Total	2	0	8
					LIVE	DEAD	REDDS
SILVER CREEK	10.0313	9/9/16	0.0	0.1	0	0	0
SILVER CREEK	10.0313	9/20/16	0.0	0.1	0	0	3
SILVER CREEK	10.0313	10/3/16	0.0	0.1	2	0	7
			SILVER CREEK	Total	2	0	10
					LIVE	DEAD	REDDS
SHAW CREEK	10.0365	9/13/16	0.0	0.1	0	0	0
SHAW CREEK	10.0365	9/28/16	0.0	0.1	0	0	0
			SHAW CREEK	Total	0	0	0
					LIVE	DEAD	REDDS
SILVER SPRINGS	10.0332A	9/9/16	0.0	0.3	1	0	1
SILVER SPRINGS	10.0332A	9/20/16	0.0	0.3	4	0	8
SILVER SPRINGS	10.0332A	10/3/16	0.0	0.3	0	0	0
			SILVER SPRINGS	Total	5	0	9
					LIVE	DEAD	REDDS
SUNRISE CREEK	10.0337	9/13/16	0.0	0.1	0	0	0
SUNRISE CREEK	10.0337	9/21/16	0.0	0.1	0	0	0
			SUNRISE CREEK	Total	0	0	0
					LIVE	DEAD	REDDS
TRIBUTARY (Unidentified)	White River	9/13/16	0.0	0.1	0	0	0
TRIBUTARY (Unidentified)	White River	9/28/16	0.0	0.3	2	0	1
			UNIDENTIFIED TRIB	Total	2	0	1
					LIVE	DEAD	REDDS

TRIBUTARY (Unidentified)	Fryingpan Tributary	9/30/16	0.0	0.0	0	0	1
			UNIDENTIFIED TRIB	Total	0	0	1
					LIVE	DEAD	REDDS
WINZIG CREEK (Unidentified)	Fryingpan Tributary	9/13/16	0.0	0.1	1	0	1
WINZIG CREEK (Unidentified)	Fryingpan Tributary	9/30/16	0.0	0.1	0	0	4
			WINZIG CREEK	Total	1	0	5
					LIVE	DEAD	REDDS
WRIGHT CREEK	10.0370	9/13/16	0.0	0.2	1	0	3
WRIGHT CREEK	10.0370	9/30/16	0.0	0.2	1	0	10
			WRIGHT CREEK	Total	2	0	13
					LIVE	DEAD	REDDS
				Total:	84	0	172
					LIVE	DEAD	REDDS

Survey conducted by Puyallup Tribal Fisheries (Black)

2016 BULL TROUT SPAWNING DATA (MOWICH RIVER)

STREAM	WRIA	DATE	LOWER R.M.	UPPER R.M.	LIVE	DEAD	REDDS
MEADOW CREEK (@RM 3.9/RB)	10.0630	9/22/16	0.0	1.0	2	0	1
MEADOW CREEK (@RM 3.9/RB)	10.0630	10/5/16	0.0	1.0	0	0	5
			MEADOW	Total	2	0	6
					LIVE	DEAD	REDDS
TRIBUTARY (S. Mowich River @RM 8.9)	10.0668	9/22/16	0.0	0.2	0	0	0
			TRIBUTARY	Total	0	0	0
					LIVE	DEAD	REDDS
TRIBUTARY (Unidentified @RM 7.5/RB)	Mowich River	9/22/16	0.0	0.1	2	0	0
			UNIDENTIFIED TRIBUTARY	Total	2	0	0
					LIVE	DEAD	REDDS
TRIBUTARY (Unidentified @RM 7.0/LB)	Mowich River	9/22/16	0.0	0.3	3	0	3
			UNIDENTIFIED TRIBUTARY	Total	3	0	3
					LIVE	DEAD	REDDS

Survey conducted by Puyallup Tribal Fisheries (Black)

2016 BULL TROUT SPAWNING DATA (MOWICH RIVER)

STREAM	WRIA	DATE	LOWER R.M.	UPPER R.M.	LIVE	DEAD	REDDS
TRIBUTARY (@RM 6.2/LB)	10.0642	9/22/16	0.0	0.0	0	0	0
TRIBUTARY (@RM 6.2/LB)	10.0642	10/5/16	0.0	0.0	0	0	0
			TRIBUTARY	Total	0	0	0
					LIVE	DEAD	REDDS
TRIBUTARY (Unidentified @RM 4.2/LB)	Mowich River	10/5/16	0.0	0.2	0	0	0
			UNIDENTIFIED TRIBUTARY	Total	0	0	0
					LIVE	DEAD	REDDS
TRIBUTARY (Unidentified @RM 2.5/LB)	Mowich River	10/5/16	0.0	0.2	0	0	0
			UNIDENTIFIED TRIBUTARY	Total	0	0	0
				Total:	**7**	**0**	**9**
					LIVE	**DEAD**	**REDDS**

Survey conducted by Puyallup Tribal Fisheries (Black)

2016 BULL TROUT SPAWNING DATA (S.F. PUYALLUP RIVER)

STREAM	WRIA	DATE	LOWER R.M.	UPPER R.M.	LIVE	DEAD	REDDS
ST. ANDREWS CREEK	10.0714	9/29/16	0.0	0.3	0	0	1
			ST. ANDREWS CREEK	Total	0	0	1
					LIVE	DEAD	REDDS
TRIBUTARY (Unidentified @RM 47.3 RB)	S.F. Puyallup	9/29/16	0.0	0.0	0	0	0
			UNIDENTIFIED TRIBUTARY	Total	0	0	0
					LIVE	DEAD	REDDS
TRIBUTARY (Unidentified @RM 48 LB)	S.F. Puyallup	9/29/16	UNIDENTIFIED TRIBUTARY	Total	0	0	0
					LIVE	DEAD	REDDS
TRIBUTARY (Unidentified @RM 48.6 RB)	S.F. Puyallup	9/29/16	0.0	0.1	0	0	0
			UNIDENTIFIED TRIBUTARY	Total	0	0	0
					LIVE	DEAD	REDDS
TRIBUTARY (Unidentified @RM 48.7 RB)	S.F. Puyallup	9/29/16	0.0	0.2	0	0	0
			UNIDENTIFIED TRIBUTARY	Total	0	0	0
					LIVE	DEAD	REDDS

Survey conducted by Puyallup Tribal Fisheries (Black)

2016 BULL TROUT SPAWNING DATA (S.F. PUYALLUP RIVER)

STREAM	WRIA	DATE	LOWER R.M.	UPPER R.M.	LIVE	DEAD	REDDS
TRIBUTARY (Unidentified @RM 49.2 LB)	S.F. Puyallup	9/29/16	0.0	0.1	0	0	0
			UNIDENTIFIED TRIBUTARY	Total	0	0	0
					LIVE	DEAD	REDDS
				Total:	0	0	1
					LIVE	DEAD	REDDS

Survey conducted by National Park Service (Red)

2016 BULL TROUT SPAWNING DATA (CARBON RIVER)

STREAM	WRIA	DATE	LOWER R.M.	UPPER R.M.	LIVE	DEAD	REDDS
RANGER CREEK	10.0530	9/28/16	0.0	0.4	3	0	1
RANGER CREEK	10.0530	10/4/16	0.0	0.4	0	0	1
			RANGER CREEK	Total	3	0	2
					LIVE	DEAD	REDDS
IPSUT CREEK	10.0550	9/28/16	0.0	0.7	0	0	2
IPSUT CREEK	10.0550	10/4/16	0.0	0.7	0	0	3
			IPSUT CREEK	Total	0	0	5
					LIVE	DEAD	REDDS
CHENUIS CREEK	10.0534	10/4/16			0	0	0
			CHENUIS CREEK	Total	0	0	0
					LIVE	DEAD	REDDS
				Total:	3	0	7
					LIVE	DEAD	REDDS

2016 COHO SALMON SPAWNING DATA

STREAM	WRIA	DATE	LOWER R.M.	UPPER R.M.	LIVE	DEAD
BOISE	10.0057	10/6/16	0.0	4.5	0	0
BOISE	10.0057	10/25/16	0.0	4.5	797	5
BOISE	10.0057	Flows too high to continue surveys				
			BOISE	**TOTAL:**	**797**	**5**
					LIVE	**DEAD**
Surveys conducted by PTF / *Surveys conducted by WDFW*						
CANYONFALLS	10.0410	10/19/16	0.3	0.6	16	0
CANYONFALLS	10.0410	10/28/16	0.3	0.6	38	0
CANYONFALLS	10.0410	11/3/16	0.3	0.6	13	5
CANYONFALLS	10.0410	11/10/16	0.3	0.6	17	2
CANYONFALLS	10.0410	11/15/16	0.3	0.6	10	3
CANYONFALLS	10.0410	11/23/16	0.3	0.6	8	4
CANYONFALLS	10.0410	12/1/16	0.3	0.6	1	1
CANYONFALLS	10.0410	12/8/16	0.3	0.6	1	0
CANYONFALLS	10.0410	12/15/16	0.3	0.6	1	0
CANYONFALLS	10.0410	12/21/16	0.3	0.6	0	0
CANYONFALLS	10.0410	12/28/16	0.3	0.6	0	1
CANYONFALLS	10.0410	1/4/17	0.3	0.6	0	5
CANYONFALLS	10.0410	1/12/17	0.3	0.6	0	0
CANYONFALLS	10.0410	1/19/17	0.3	0.6	0	0
CANYONFALLS	10.0410	1/25/17	0.3	0.6	0	0
			CANYONFALLS	**TOTAL:**	**105**	**21**
					LIVE	**DEAD**
CARBON RIVER	10.0027	11/22/16	0.0	6.0	8	0
CARBON RIVER	10.0027	12/1/16	0.0	6.0	0	0
CARBON RIVER	10.0027	12/11/16	0.0	8.5	0	0
CARBON RIVER	10.0027	12/28/16	0.0	6.0	0	0
			CARBON RIVER	**TOTAL:**	**8**	**0**
					LIVE	**DEAD**
3,892 coho passed upstream from PTI Clarks Creek hatchery facility						
CLARKS	10.0027	11/10/16	3.4	3.7	127	
CLARKS	10.0027	11/18/16	3.4	3.7	281	
CLARKS	10.0027	11/28/16	3.4	3.7	95	
CLARKS	10.0027	12/6/16	3.4	3.7	16	
CLARKS	10.0027	12/14/16	3.4	3.7	0	
			CLARKS	**TOTAL:**	**519**	
					LIVE	**DEAD**
CLEAR	10.0022	11/3/16	1.7	1.9	0	0
CLEAR	10.0022	11/10/16	1.7	1.9	4	1
CLEAR	10.0022	11/18/16	1.7	1.9	0	1
CLEAR	10.0022	11/28/16	1.7	1.9	0	1
CLEAR	10.0022	12/6/16	1.7	1.9	0	0
CLEAR	10.0022	12/15/16	1.7	1.9	0	0
			CLEAR	**TOTAL:**	**4**	**3**
					LIVE	**DEAD**

Surveys conducted by WDFW						
COAL MINE	10.0432A	10/11/16	0.0	0.4	0	0
COAL MINE	10.0432A	10/21/16	0.0	0.4	7	0
COAL MINE	10.0432A	10/25/16	0.0	0.4	1	0
COAL MINE	10.0432A	10/31/16	0.0	0.4	2	0
COAL MINE	10.0432A	11/9/16	0.0	0.4	1	0
COAL MINE	10.0432A	11/15/16	0.0	0.4	0	0
COAL MINE	10.0432A	11/23/16	0.0	0.4	0	1
COAL MINE	10.0432A	12/1/16	0.0	0.4	0	0
COAL MINE	10.0432A	12/15/16	0.0	0.4	0	0
COAL MINE	10.0432A	12/21/16	0.0	0.4	0	0
COAL MINE	10.0432A	12/28/16	0.0	0.4	0	0
COAL MINE	10.0432A	1/4/17	0.0	0.4	0	0
COAL MINE	10.0432A	1/12/17	0.0	0.4	0	0
COAL MINE	10.0432A	1/19/17	0.0	0.4	8	0
COAL MINE	10.0432A	1/25/17	0.0	0.4	3	0
COAL MINE	10.0432A	1/30/17	0.0	0.4	4	0
COAL MINE	10.0432A	2/8/17	0.0	0.4	7	1
COAL MINE	10.0432A	2/14/17	0.0	0.4	48	1
COAL MINE	10.0432A	2/21/17	0.0	0.4	27	5
			COAL MINE	**TOTAL:**	**108**	**8**
					LIVE	**DEAD**
Surveys conducted by WDFW						
FENNEL CREEK	10.0406	10/19/16	0.0	1.9	14	0
FENNEL CREEK	10.0406	10/21/16	0.0	1.9	0	0
FENNEL CREEK	10.0406	10/28/16	0.0	1.9	43	1
FENNEL CREEK	10.0406	11/3/16	0.0	1.9	10	0
FENNEL CREEK	10.0406	11/10/16	0.0	1.9	5	9
FENNEL CREEK	10.0406	11/18/16	0.0	1.9	7	0
FENNEL CREEK	10.0406	11/23/16	0.0	1.9	0	0
FENNEL CREEK	10.0406	12/1/16	0.0	1.9	1	0
FENNEL CREEK	10.0406	12/8/16	0.0	1.9	0	0
FENNEL CREEK	10.0406	12/15/16	0.0	1.9	0	0
FENNEL CREEK	10.0406	12/21/16	0.0	1.9	0	0
FENNEL CREEK	10.0406	12/28/16	0.0	1.9	0	0
FENNEL CREEK	10.0406	1/4/17	0.0	1.9	0	0
			FENNEL CREEK	**TOTAL:**	**80**	**10**
					LIVE	**DEAD**
Surveys conducted by WDFW						
FISKE	10.0596	10/21/16	0.3	1.1	16	0
FISKE	10.0596	10/28/16	0.3	1.1	43	3
FISKE	10.0596	11/3/16	0.3	1.1	11	7
FISKE	10.0596	11/10/16	0.3	1.1	12	2
FISKE	10.0596	11/15/16	0.3	1.1	18	2
FISKE	10.0596	11/23/16	0.3	1.1	5	6
FISKE	10.0596	12/1/16	0.3	1.1	1	2
FISKE	10.0596	12/8/16	0.3	1.1	0	1
FISKE	10.0596	12/15/16	0.3	1.1	0	0
FISKE	10.0596	12/21/16	0.3	1.1	0	0
			FISKE CREEK	**TOTAL:**	**106**	**23**
					LIVE	**DEAD**

FOX	10.0608	9/29/16	0.0	0.5	0	0
FOX	10.0608	10/12/16	0.0	0.5	1	0
FOX	10.0608	10/25/16	0.0	1.0	345	38
FOX	10.0608	11/1/16	0.0	1.0	248	155
FOX	10.0608	11/9/16	0.0	1.0	108	230
FOX	10.0608	11/16/16	0.0	1.0	10	2
FOX	10.0608	11/29/16	0.0	1.0	0	0
			FOX	**TOTAL:**	**712**	**425**
					LIVE	**DEAD**
HYLOBOS	10.0014	9/12/16	0.1	0.7	1	0
			HYLOBOS	**TOTAL:**	**1**	**0**
					LIVE	**DEAD**
KAPOWSIN	10.0600	10/13/16	0.0	3.2	0	0
KAPOWSIN	10.0600	10/28/16	0.0	3.2	175	7
KAPOWSIN	10.0600	Flows too high to continue surveys				
			KAPOWSIN	**TOTAL:**	**175**	**7**
					LIVE	**DEAD**
MEEKER	10.-001	11/10/16	0.0	0.2	3	0
MEEKER	10.-001	11/18/16	0.0	0.2	0	2
MEEKER	10.-001	11/28/16	0.0	0.2	0	0
MEEKER	10.-001	12/14/16	0.0	0.2	0	0
			MEEKER	**TOTAL:**	**3**	**2**
					LIVE	**DEAD**
RODY	10.0028	11/3/16	0.4	0.5	0	0
RODY	10.0028	11/10/16	0.4	0.5	0	0
RODY	10.0028	11/17/16	0.4	0.5	0	0
RODY	10.0028	11/28/16	0.4	0.5	0	0
RODY	10.0028	12/6/16	0.4	0.5	0	0
			RODY	**TOTAL:**	**0**	**0**
					LIVE	**DEAD**
SALMON	10.0035	10/24/16	0.0	0.5	0	1
SALMON	10.0035	11/3/16	0.0	0.5	0	0
SALMON	10.0035	11/10/16	0.0	0.5	0	0
SALMON	10.0035	11/18/16	0.0	0.5	0	0
SALMON	10.0035	11/28/16	0.0	0.5	0	0
SALMON	10.0035	12/6/16	0.0	0.5	0	0
SALMON	10.0035	12/14/16	0.0	0.5	0	0
			SALMON	**TOTAL:**	**0**	**1**
					LIVE	**DEAD**
SALMON TRIB.	10.0036	10/24/16	0.0	0.1	0	0
SALMON TRIB.	10.0036	11/3/16	0.0	0.1	0	0
SALMON TRIB.	10.0036	11/10/16	0.0	0.1	0	0
SALMON TRIB.	10.0036	11/18/16	0.0	0.1	0	0
SALMON TRIB.	10.0036	11/28/16	0.0	0.1	0	0

SALMON TRIB.	10.0036	12/6/16	0.0	0.1	0	0
SALMON TRIB.	10.0036	12/14/16	0.0	0.1	0	0
			SALMON TRIB	**TOTAL:**	**0**	**0**
					LIVE	**DEAD**
Surveys conducted by PTF / *Surveys conducted by WDFW* : Coho were observed holding in pools; no active spawning.						
SOUTH PRAIRIE	10.0429	9/15/16	0.3	8.0	2	0
SOUTH PRAIRIE	10.0429	9/20/16	8.0	12.6	381	0
SOUTH PRAIRIE	10.0429	9/22/16	0.3	8.0	0	0
SOUTH PRAIRIE	10.0429	9/27/16	8.0	12.6	365	0
SOUTH PRAIRIE	10.0429	9/29/16	0.3	8.0	19	0
SOUTH PRAIRIE	10.0429	10/4/16	8.0	12.6	341	1
SOUTH PRAIRIE	10.0429	10/6/16	0.3	8.0	2	1
SOUTH PRAIRIE	10.0429	10/12/16	0.3	12.6	121	0
SOUTH PRAIRIE	10.0429	10/25/16	0.3	8.0	0	0
SOUTH PRAIRIE	10.0429	11/8/16	0.0	8.0	5	1
SOUTH PRAIRIE	10.0429	11/21/16	0.0	10.2	133	0
SOUTH PRAIRIE	10.0429	12/1/16	0.0	10.2	107	2
SOUTH PRAIRIE	10.0429	12/8/16	0.0	8.0	194	0
SOUTH PRAIRIE	10.0429	12/15/16	0.0	8.0	112	0
SOUTH PRAIRIE	10.0429	12/22/16	0.0	10.2	36	1
SOUTH PRAIRIE	10.0429	12/28/16	0.0	8.0	107	0
			SOUTH PRAIRIE	**TOTAL:**	**1,925**	**6**
					LIVE	**DEAD**
SWAN	10.0023	11/18/16	0.3	1.3	0	0
SWAN	10.0023	11/28/16	0.3	1.3	0	1
SWAN	10.0023	12/6/16	0.3	1.3	0	0
SWAN	10.0023	12/15/16	0.3	1.3	0	1
			SWAN	**TOTAL:**	**0**	**2**
					LIVE	**DEAD**
SQUALLY	10.0024	11/3/16	0.0	0.3	0	0
SQUALLY	10.0024	11/10/16	0.0	0.3	0	0
SQUALLY	10.0024	11/17/16	0.0	0.3	0	0
SQUALLY	10.0024	11/28/16	0.0	0.3	0	0
SQUALLY	10.0024	12/6/16	0.0	0.3	0	0
SQUALLY	10.0024	12/15/16	0.0	0.8	0	0
			SQUALLY	**TOTAL:**	**0**	**0**
					LIVE	**DEAD**
WILKESON	10.0432	10/11/16	0.0	2.1	0	0
WILKESON	10.0432	11/4/16	0.0	5.8	30	7
WILKESON	10.0432	11/22/16	0.0	5.8	5	0
WILKESON	10.0432	11/29/16	0.0	2.5	0	0
WILKESON	10.0432	12/7/16	0.0	2.5	0	0
			WILKESON	**TOTAL:**	**35**	**7**
					LIVE	**DEAD**

	LIVE	DEAD
TOTAL:	7,950	520

2016 CHUM SPAWNING DATA

STREAM	WRIA	DATE	LOWER RM	UPPER RM	LIVE	DEAD
CANYON	10.XXXX	11/10/16	1.0	1.2	0	0
CANYON	10.XXXX	11/18/16	1.0	1.2	0	0
CANYON	10.XXXX	11/28/16	1.0	1.2	41	12
CANYON	10.XXXX	12/6/16	1.0	1.2	12	21
CANYON	10.XXXX	12/15/16	1.0	1.2	0	16
CANYON	10.XXXX	12/20/16	1.0	1.2	0	0
			CANYON	**TOTAL:**	**53**	**49**
					LIVE	**DEAD**
Surveys conducted by WDFW						
CANYONFALLS	***10.0410***	11/3/16	0.3	0.6	0	0
CANYONFALLS	***10.0410***	11/10/16	0.3	0.6	0	0
CANYONFALLS	***10.0410***	11/15/16	0.3	0.6	0	0
CANYONFALLS	***10.0410***	11/23/16	0.3	0.6	0	0
CANYONFALLS	***10.0410***	12/1/16	0.3	0.6	0	0
CANYONFALLS	***10.0410***	12/8/16	0.3	0.6	13	1
CANYONFALLS	***10.0410***	12/15/16	0.3	0.6	18	2
CANYONFALLS	***10.0410***	12/21/16	0.3	0.6	18	3
CANYONFALLS	***10.0410***	12/28/16	0.3	0.6	7	3
CANYONFALLS	***10.0410***	1/4/17	0.3	0.6	0	0
CANYONFALLS	***10.0410***	1/12/17	0.3	0.6	0	0
CANYONFALLS	***10.0410***	1/19/17	0.3	0.6	0	0
CANYONFALLS	***10.0410***	1/25/17	0.3	0.6	0	0
			CANYONFALLS	**TOTAL:**	**56**	**9**
					LIVE	**DEAD**
CARBON	10.0413	11/22/16	0.0	6.0	135	8
CARBON	10.0413	12/1/16	0.0	6.0	105	15
CARBON	10.0413	12/13/16	0.0	8..5	77	79
CARBON	10.0413	12/28/16	0.0	6.0	30	14
			CARBON	**TOTAL:**	**347**	**116**
					LIVE	**DEAD**
CLARKS	10.0027	11/10/16	3.4	3.7	0	0
CLARKS	10.0027	11/18/16	3.4	3.7	36	0
CLARKS	10.0027	11/28/16	3.4	3.7	103	8
CLARKS	10.0027	12/6/16	3.4	3.7	115	85
CLARKS	10.0027	12/14/16	3.4	3.7	120	61
CLARKS	10.0027	12/20/16	3.4	3.7	55	NA
CLARKS	10.0027	12/27/16	3.4	3.7	29	NA
CLARKS	10.0027	1/6/17	3.4	3.7	12	NA
			CLARKS	**TOTAL:**	**470**	**154**
					LIVE	**DEAD**

CLEAR	10.0022	11/10/16	1.7	1.9	0	0
CLEAR	10.0022	11/18/16	1.7	1.9	64	4
CLEAR	10.0022	11/28/16	1.7	1.9	189	23
CLEAR	10.0022	12/6/16	1.7	1.9	158	132
CLEAR	10.0022	12/15/16	1.7	1.9	42	214
CLEAR	10.0022	12/20/16	1.7	1.9	25	8
CLEAR	10.0022	12/27/16	1.7	1.9	11	9
CLEAR	10.0022	1/6/17	1.7	1.9	4	2
			CLEAR	**TOTAL:**	**493**	**392**
					LIVE	**DEAD**
DIRU	10.0029	11/17/16	0.0	0.5		13
DIRU	10.0029	11/26/16	0.0	0.5		60
DIRU	10.0029	12/1/16	0.0	0.5		121
DIRU	10.0029	12/9/16	0.0	0.5		205
DIRU	10.0029	12/16/16	0.0	0.5		216
DIRU	10.0029	12/22/16	0.0	0.5		41
DIRU	10.0029	12/29/16	0.0	0.5		0
			DIRU	**TOTAL:**		**656**
					LIVE	**DEAD**
Surveys conducted by WDFW						
FENNEL (+tributary)	***10.0406***	10/21/16	0.4	0.4	0	0
FENNEL (+tributary)	***10.0406***	10/28/16	0.4	0.4	1	0
FENNEL (+tributary)	***10.0406***	11/3/16	0.0	1.9	5	0
FENNEL (+tributary)	***10.0406***	11/10/16	0.0	1.9	15	5
FENNEL (+tributary)	***10.0406***	11/18/16	0.0	1.9	44	3
FENNEL (+tributary)	***10.0406***	11/23/16	0.0	1.9	42	4
FENNEL (+tributary)	***10.0406***	12/1/16	0.0	1.9	68	11
FENNEL (+tributary)	***10.0406***	12/8/16	0.0	1.9	34	26
FENNEL (+tributary)	***10.0406***	12/15/16	0.0	1.9	25	33
FENNEL (+tributary)	***10.0406***	12/21/16	0.0	1.9	18	23
FENNEL (+tributary)	***10.0406***	12/28/16	0.0	1.9	2	14
FENNEL (+tributary)	***10.0406***	1/4/17	0.0	1.9	0	0
			FENNEL	**TOTAL:**	**254**	**119**
					LIVE	**DEAD**
MEEKER	10.-001	11/10/16	0.0	0.2	2	0
MEEKER	10.-001	11/18/16	0.0	0.2	0	0
MEEKER	10.-001	11/28/16	0.0	0.2	2	0
MEEKER	10.-001	12/14/16	0.0	0.2	0	2
			MEEKER	**TOTAL:**	**4**	**2**
					LIVE	**DEAD**

RODY	10.0028	11/10/16	0.4	0.6	0	0
RODY	10.0028	11/17/16	0.4	0.6	0	0
RODY	10.0028	11/28/16	0.4	0.6	38	15
RODY	10.0028	12/6/16	0.4	0.6	59	110
RODY	10.0028	12/15/16	0.4	0.6	1	142
RODY	10.0028	12/20/16	0.4	0.6	1	0
RODY	10.0028	12/27/16	0.4	0.6	0	0
			RODY	**TOTAL:**	**99**	**267**
					LIVE	**DEAD**
SALMON	10.0035	11/3/16	0.0	1.0	0	0
SALMON	10.0035	11/10/16	0.0	1.0	0	0
SALMON	10.0035	11/18/16	0.0	1.0	1	0
SALMON	10.0035	11/28/16	0.0	1.0	3	2
SALMON	10.0035	12/6/16	0.0	1.0	2	1
SALMON	10.0035	12/14/16	0.0	1.0	1	1
SALMON	10.0035	12/20/16	0.0	1.0	0	0
SALMON	10.0035	12/27/16	0.0	1.0	3	0
			SALMON	**TOTAL:**	**10**	**4**
					LIVE	**DEAD**
SALMON TRIB.	10.0036	11/3/16	0.0	0.1	0	0
SALMON TRIB.	10.0036	11/10/16	0.0	0.1	0	0
SALMON TRIB.	10.0036	11/18/16	0.0	0.1	3	0
SALMON TRIB.	10.0036	11/28/16	0.0	0.1	7	9
SALMON TRIB.	10.0036	12/6/16	0.0	0.1	3	6
SALMON TRIB.	10.0036	12/14/16	0.0	0.1	0	2
SALMON TRIB.	10.0036	12/20/16	0.0	0.1	0	0
			SALMON TRIB.	**TOTAL:**	**13**	**17**
					LIVE	**DEAD**
SOUTH PRAIRIE	10.0429	11/8/16	0.0	8.0	33	2
SOUTH PRAIRIE	10.0429	11/21/16	0.0	10.0	496	84
SOUTH PRAIRIE	10.0429	12/1/16	0.0	10.0	552	144
SOUTH PRAIRIE	10.0429	12/8/16	0.0	10.0	260	46
SOUTH PRAIRIE	10.0429	12/15/16	0.0	8.0	83	49
SOUTH PRAIRIE	10.0429	12/22/16	0.0	8.0	22	21
SOUTH PRAIRIE	10.0429	12/28/16	0.0	6.0	0	0
			SOUTH PRAIRIE	**TOTAL:**	**1,446**	**346**
					LIVE	**DEAD**

Surveys conducted by WDFW						
SPIKETON	**10.0453**	10/12/16	0.0	0.2	0	0
SPIKETON	**10.0453**	10/21/16	0.0	0.2	0	0
SPIKETON	**10.0453**	10/25/16	0.0	0.2	0	0
SPIKETON	**10.0453**	10/31/16	0.0	0.2	0	0
SPIKETON	**10.0453**	11/9/16	0.0	0.2	0	0
SPIKETON	**10.0453**	11/15/16	0.0	0.2	1	0
SPIKETON	**10.0453**	11/23/16	0.0	0.2	1	3
SPIKETON	**10.0453**	12/1/16	0.0	0.2	0	6
SPIKETON	**10.0453**	12/15/16	0.0	0.2	0	1
SPIKETON	**10.0453**	12/21/16	0.0	0.2	0	0
SPIKETON	**10.0453**	12/28/16	0.0	0.2	0	0
SPIKETON	**10.0453**	1/4/17	0.0	0.2	0	0
SPIKETON	**10.0453**	1/12/17	0.0	0.2	0	0
SPIKETON	**10.0453**	1/19/17	0.0	0.2	0	0
SPIKETON	**10.0453**	1/25/17	0.0	0.2	0	0
SPIKETON	**10.0453**	1/30/17	0.0	0.2	0	0
			SPIKETON	**TOTAL:**	**2**	**10**
					LIVE	**DEAD**
SPRING CREEK	10.0430	11/17/16	0.0	0.0	3	0
SPRING CREEK	10.0430	11/21/16	0.0	0.0	0	0
SPRING CREEK	10.0430	11/29/16	0.0	0.0	5	1
SPRING CREEK	10.0430	12/7/16	0.0	0.0	7	0
SPRING CREEK	10.0430	12/15/16	0.0	0.0	0	0
			SPRING CREEK	**TOTAL:**	**15**	**1**
					LIVE	**DEAD**
SQUALLY	10.0024	11/10/16	0.0	0.3	0	0
SQUALLY	10.0024	11/17/16	0.0	0.3	0	0
SQUALLY	10.0024	11/28/16	0.0	0.8	9	19
SQUALLY	10.0024	12/6/16	0.0	0.8	17	16
SQUALLY	10.0024	12/15/16	0.0	0.8	0	30
SQUALLY	10.0024	12/20/16	0.0	0.8	0	0
			SQUALLY	**TOTAL:**	**26**	**65**
					LIVE	**DEAD**
SWAN	10.0023	11/10/16	0.3	1.3	0	0
SWAN	10.0023	11/18/16	0.3	1.0	21	0
SWAN	10.0023	11/28/16	0.3	1.3	272	3
SWAN	10.0023	12/6/16	0.3	1.3	75	24
SWAN	10.0023	12/14/16	0.3	1.3	8	101

SWAN	10.0023	12/20/16	0.3	1.3	1	0
SWAN	10.0023	12/27/16	0.3	1.3	0	0
			SWAN	**TOTAL:**	**377**	**128**
					LIVE	**DEAD**
WILKESON	10.0432	11/4/16	0.0	5.8	0	0
WILKESON	10.0432	11/22/16	0.0	2.1	17	3
WILKESON	10.0432	11/29/16	0.0	2.5	6	9
WILKESON	10.0432	12/7/16	0.0	2.5	0	0
			WILKESON	**TOTAL:**	**23**	**12**
					LIVE	**DEAD**

TOTAL SPAWNING GROUND COUNTS:

LIVE	DEAD
3,688	2,346

2017 STEELHEAD SURVEY DATA

STREAM	WRIA	DATE	LOWER R.M.	UPPER R.M.	LIVE	DEAD	REDDS
BOISE	10.0057	4/7/17	0.0	4.5	7	0	12
BOISE	10.0057	4/17/17	0.0	4.5	7	0	14
BOISE	10.0057	5/1/17	0.0	4.5	0	0	5
BOISE	10.0057	5/8/17	0.0	4.5	2	0	7
BOISE	10.0057	5/22/17	0.0	4.5	1	0	6
BOISE	10.0057	6/6/17	0.0	4.5	0	0	1
			BOISE	TOTAL	17	0	45
					LIVE	DEAD	REDDS
CAMP CREEK*	10.0112	3/29/17	0.0	0.5	1	0	1
CAMP CREEK*	10.0112	4/7/17	0.0	0.5	0	0	0
CAMP CREEK*	10.0112	4/20/17	0.0	0.5	0	0	0
CAMP CREEK*	10.0112	5/12/17	0.0	0.5	0	0	2
			CAMP CREEK	TOTAL	1	0	3
					LIVE	DEAD	REDDS
CANYONFALLS	10.0410	4/3/17	0.3	0.6	0	0	0
CANYONFALLS	10.0410	4/12/17	0.3	0.6	0	0	0
CANYONFALLS	10.0410	4/24/17	0.3	0.6	0	0	0
CANYONFALLS	10.0410	5/9/17	0.3	0.6	0	0	0
CANYONFALLS	10.0410	5/23/17	0.3	0.6	0	0	0
			CANYONFALLS	TOTAL	0	0	0
					LIVE	DEAD	REDDS
CARBON	10.0413	4/4/17	0.0	6.0	2	0	1
CARBON	10.0413		6.0	10.2	0	0	0
CARBON	10.0413	4/18/17	0.0	6.0	0	0	1
CARBON	10.0413		6.0	9.0	0	0	0
CARBON	10.0413	5/9/17	0.0	6.0	0	0	0
CARBON	10.0413		6.0	9.0	0	0	1
			CARBON	TOTAL	2	0	3
					LIVE	DEAD	REDDS
CLARKS	10.0027	4/3/17	3.4	3.7	0	0	0
CLARKS	10.0027	4/13/17	3.4	3.7	0	0	0
CLARKS	10.0027	4/24/17	3.4	3.7	0	0	0
CLARKS	10.0027	5/9/17	3.4	3.7	0	0	0
CLARKS	10.0027	5/23/17	3.4	3.7	0	0	0
			CLARKS	TOTAL	0	0	0
					LIVE	DEAD	REDDS
CLEAR	10.0022	4/3/17	1.7	1.9	0	0	0
CLEAR	10.0022	4/13/17	1.7	1.9	0	0	0
CLEAR	10.0022	4/24/17	1.7	1.9	0	0	0
CLEAR	10.0022	5/9/17	1.7	1.9	0	0	0
CLEAR	10.0022	5/23/17	1.7	1.9	0	0	0
			CLEAR	TOTAL	0	0	0
					LIVE	DEAD	REDDS

Surveys conducted by WDFW							
CLEARWATER	10.0080	4/13/17	0.0	3.7	23	0	2
CLEARWATER	10.0080	5/25/17	0.0	3.7	13	0	0
			CLEARWATER	**TOTAL**	**36**	**0**	**2**
					LIVE	**DEAD**	**REDDS**
FENNEL	10.0406	4/3/17	0.0	0.5	0	0	1
FENNEL	10.0406	4/12/17	0.0	0.7	0	0	0
FENNEL	10.0406	4/24/17	0.0	0.7	0	0	0
FENNEL	10.0406	5/9/17	0.0	0.7	0	0	0
FENNEL	10.0406	5/23/17	0.0	0.7	0	0	0
			FENNEL	**TOTAL**	**0**	**0**	**1**
					LIVE	**DEAD**	**REDDS**
FOX	10.0608	4/6/17	0.0	0.6	0	0	0
FOX	10.0608	4/18/17	0.0	0.6	0	0	0
FOX	10.0608	4/27/17	0.0	0.6	0	0	0
FOX	10.0608	5/11/17	0.0	0.6	0	0	0
FOX	10.0608	5/25/17	0.0	0.6	0	0	1
			FOX	**TOTAL**	**0**	**0**	**1**
					LIVE	**DEAD**	**REDDS**
KAPOWSIN	10.0600	4/10/17	0.0	3.2	0	0	0
KAPOWSIN	10.0600	4/19/17	0.0	3.2	0	0	0
KAPOWSIN	10.0600	5/1/17	0.0	0.7	0	0	0
KAPOWSIN	10.0600	5/11/17	0.0	3.2	0	0	0
			KAPOWSIN	**TOTAL**	**0**	**0**	**0**
					LIVE	**DEAD**	**REDDS**
KELLOG	10.0621	3/28/17	0.0	2.0	0	0	3
KELLOG	10.0621	4/11/17	0.0	2.0	2	0	10
KELLOG	10.0621	4/25/17	0.0	2.0	0	0	3
KELLOG	10.0621	5/10/17	0.0	2.0	0	0	5
KELLOG	10.0621	6/2/17	0.0	2.0	0	0	3
			KELLOG	**TOTAL**	**2**	**0**	**24**
					LIVE	**DEAD**	**REDDS**
LEDOUT	10.0620	3/28/17	0.0	0.4	0	0	2
LEDOUT	10.0620	4/11/17	0.0	0.4	0	0	0
LEDOUT	10.0620	4/25/17	0.0	0.4	0	0	0
LEDOUT	10.0620	5/10/17	0.0	0.4	0	0	1
LEDOUT	10.0620	6/2/17	0.0	0.4	0	0	0
			LEDOUT	**TOTAL**	**0**	**0**	**3**
					LIVE	**DEAD**	**REDDS**

MEADOW	10.0630	4/26/17	0.0	0.6	0	0	0
MEADOW	10.0630	6/6/17	0.0	0.6	0	0	0
			MEADOW	TOTAL	0	0	0
					LIVE	DEAD	REDDS
MOWICH RIVER	10.0624	4/10/17	0.0	1.0	0	0	0
MOWICH RIVER	10.0624	4/18/17	0.0	1.3	0	0	1
			MOWICH RIVER	TOTAL	0	0	1
					LIVE	DEAD	REDDS
NIESSON	10.0622	3/28/17	0.0	3.2	0	0	1
NIESSON	10.0622	4/11/17	0.0	2.5	0	0	1
NIESSON	10.0622	4/25/17	0.0	3.2	6	0	11
NIESSON	10.0622	5/10/17	0.0	3.2	5	0	8
NIESSON	10.0622	6/1/17	0.0	3.2	0	0	5
			NIESSON	TOTAL	11	0	26
					LIVE	DEAD	REDDS
LOWER PUYALLUP							
PUYALLUP	10.0021	4/11/17	16.2	29.9	0	0	3
PUYALLUP	10.0021	4/21/17	10.6	20	0	0	0
PUYALLUP	10.0021	5/9/17	15.5	17.0	0	0	0
PUYALLUP	10.0021	5/10/17	10.6	16.2	0	0	0
			L. PUYALLUP	TOTAL	0	0	3
					LIVE	DEAD	REDDS
UPPER PUYALLUP							
PUYALLUP	10.0021	3/28/17	41.2	42.3	0	0	0
PUYALLUP	10.0021	4/14/17	36	41.7	0	0	1
PUYALLUP	10.0021	4/25/17	39.7	41.5	0	0	1
PUYALLUP	10.0021	4/28/17	36	41.5	0	0	0
			UPPER PUYALLUP	TOTAL	0	0	2
					LIVE	DEAD	REDDS
ROCKY RUN*	10.0117	3/29/17	0.0	0.6	0	0	0
ROCKY RUN*	10.0117	4/7/17	0.0	0.6	0	0	0
ROCKY RUN*	10.0117	4/20/17	0.0	0.6	0	0	0
ROCKY RUN*	10.0117	5/12/17	0.0	0.6	0	0	0
			ROCKY RUN	TOTAL	0	0	0
					LIVE	DEAD	REDDS
RUSHINGWATER	10.0265	4/10/17	0.0	1.0	0	0	0
RUSHINGWATER	10.0265	4/18/17	0.0	1.0	0	0	0
RUSHINGWATER	10.0265	4/26/17	0.5	1.0	0	0	0
RUSHINGWATER	10.0265	6/1/17	0.0	1.0	0	0	1
			RUSHINGWATER	TOTAL	0	0	1
					LIVE	DEAD	REDDS

SALMON	10.0035	4/3/17	0.5	1.0	0	0	0
SALMON	10.0035	4/13/17	0.5	1.0	0	0	0
SALMON	10.0035	4/24/17	0.5	1.0	0	0	0
SALMON	10.0035	5/9/17	0.5	1.0	0	0	0
SALMON	10.0035	5/23/17	0.5	1.0	0	0	0
			SALMON	**TOTAL**	**0**	**0**	**0**
					LIVE	**DEAD**	**REDDS**
Surveys conducted by WDFW							
SOUTH PRAIRIE	10.0429	3/7/17	8.0	10.2	0	0	0
SOUTH PRAIRIE	10.0429	3/21/17	3.8	8.0	0	0	0
SOUTH PRAIRIE	10.0429	4/4/17	0.3	10.2	7	0	27
SOUTH PRAIRIE	10.0429	4/11/17	0.3	12.6	7	0	63
SOUTH PRAIRIE	10.0429	4/18/17	0.3	12.6	6	0	46
SOUTH PRAIRIE	10.0429	5/2/17	0.3	12.6	5	0	79
SOUTH PRAIRIE	10.0429	5/8/17	3.8	8.0	0	0	8
SOUTH PRAIRIE	10.0429	5/9/17	0.3	3.8	1	0	5
SOUTH PRAIRIE	10.0429	5/12/17	8.0	10.2	0	0	11
SOUTH PRAIRIE	10.0429	5/22/17	5.6	10.2	0	0	7
SOUTH PRAIRIE	10.0429	5/23/17	0.3	5.6	0	0	1
SOUTH PRAIRIE	10.0429	5/24/17	0.0	12.6	0	0	8
SOUTH PRAIRIE	10.0429	5/30/17	5.6	10.2	0	0	3
SOUTH PRAIRIE	10.0429	5/31/17	0.3	5.6	0	0	2
SOUTH PRAIRIE	10.0429	6/1/17	10.2	12.6	0	0	1
SOUTH PRAIRIE	10.0429	6/7/17	10.2	12.6	0	0	0
SOUTH PRAIRIE	10.0429	6/9/17	0.3	5.6	0	0	0
SOUTH PRAIRIE	10.0429	6/19/17	5.6	10.2	0	0	0
			SOUTH PRAIRIE	**TOTAL**	**26**	**0**	**261**
					LIVE	**DEAD**	**REDDS**
VOIGHTS	10.0414	4/12/17	0.5	3.4	0	0	11
VOIGHTS	10.0414	4/21/17	0.5	3.4	4	0	4
VOIGHTS	10.0414	5/1/17	0.5	3.4	1	0	1
VOIGHTS	10.0414	5/24/17	0.5	3.4	0	0	2
			VOIGHTS	**TOTAL**	**5**	**0**	**18**
					LIVE	**DEAD**	**REDDS**
WHITE RIVER	10.0031	4/21/17	0	8.1	0	0	0
			WHITE RIVER	**TOTAL**	**0**	**0**	**0**
					LIVE	**DEAD**	**REDDS**
Surveys conducted by WDFW							
WILKESON	10.0432	4/5/17	0.0	6.5	2	0	14
WILKESON	10.0432	4/11/17	0.0	6.1	7	0	17
WILKESON	10.0432	4/18/17	0.0	6.5	1	0	13
WILKESON	10.0432	5/3/17	0.0	6.5	0	0	18
WILKESON	10.0432	5/15/17	0.0	6.1	0	0	4
WILKESON	10.0432	5/24/17	0.0	6.5	0	0	5

WILKESON	10.0432	6/5/17	0.0	6.5	0	0	0
WILKESON	10.0432	6/21/17	0.0	3.0	0	0	0
			WILKESON	TOTAL	10	0	71
					LIVE	DEAD	REDDS

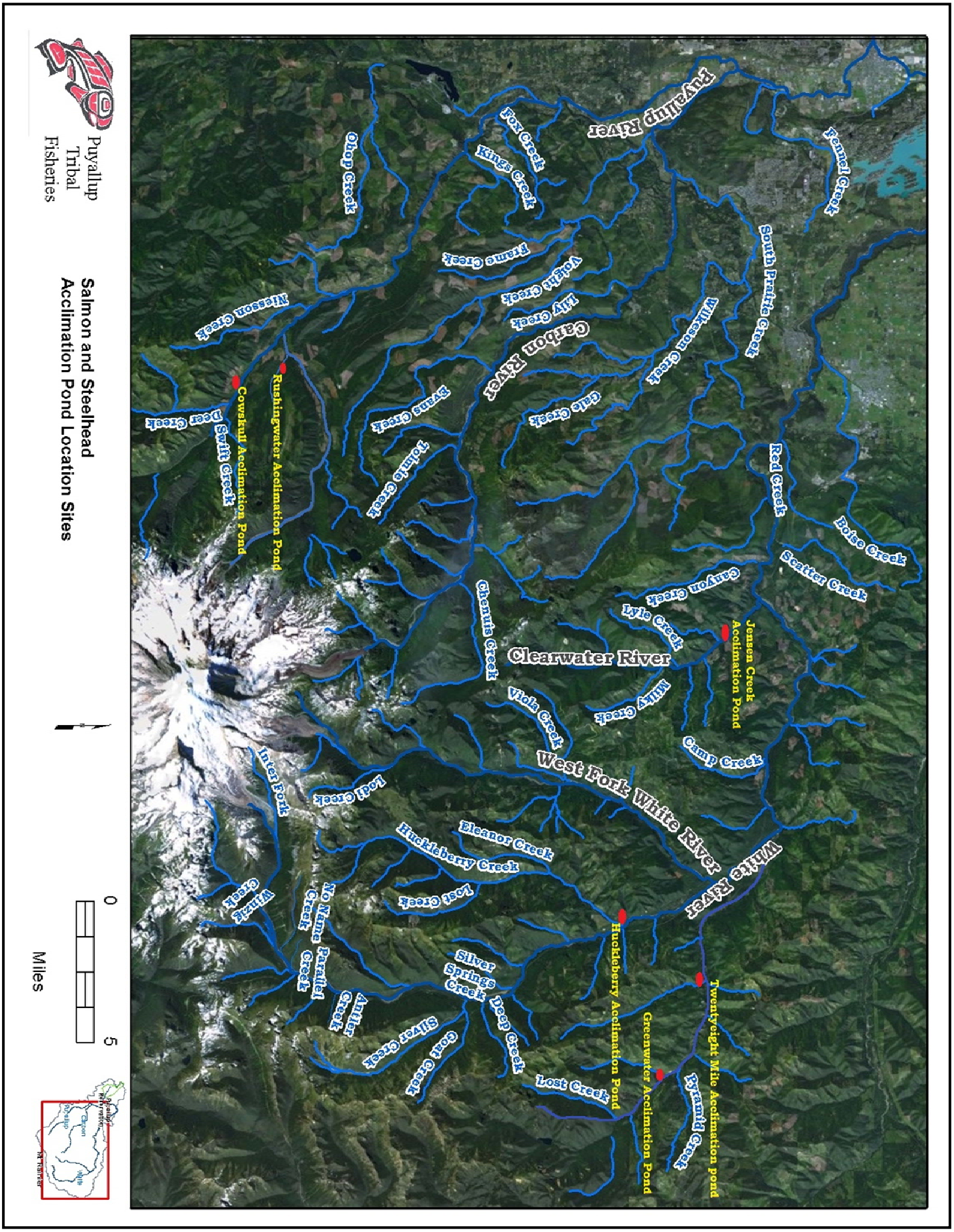
*Redd totals do not include redds observed above RM 24.3 (Buckley) on the White River

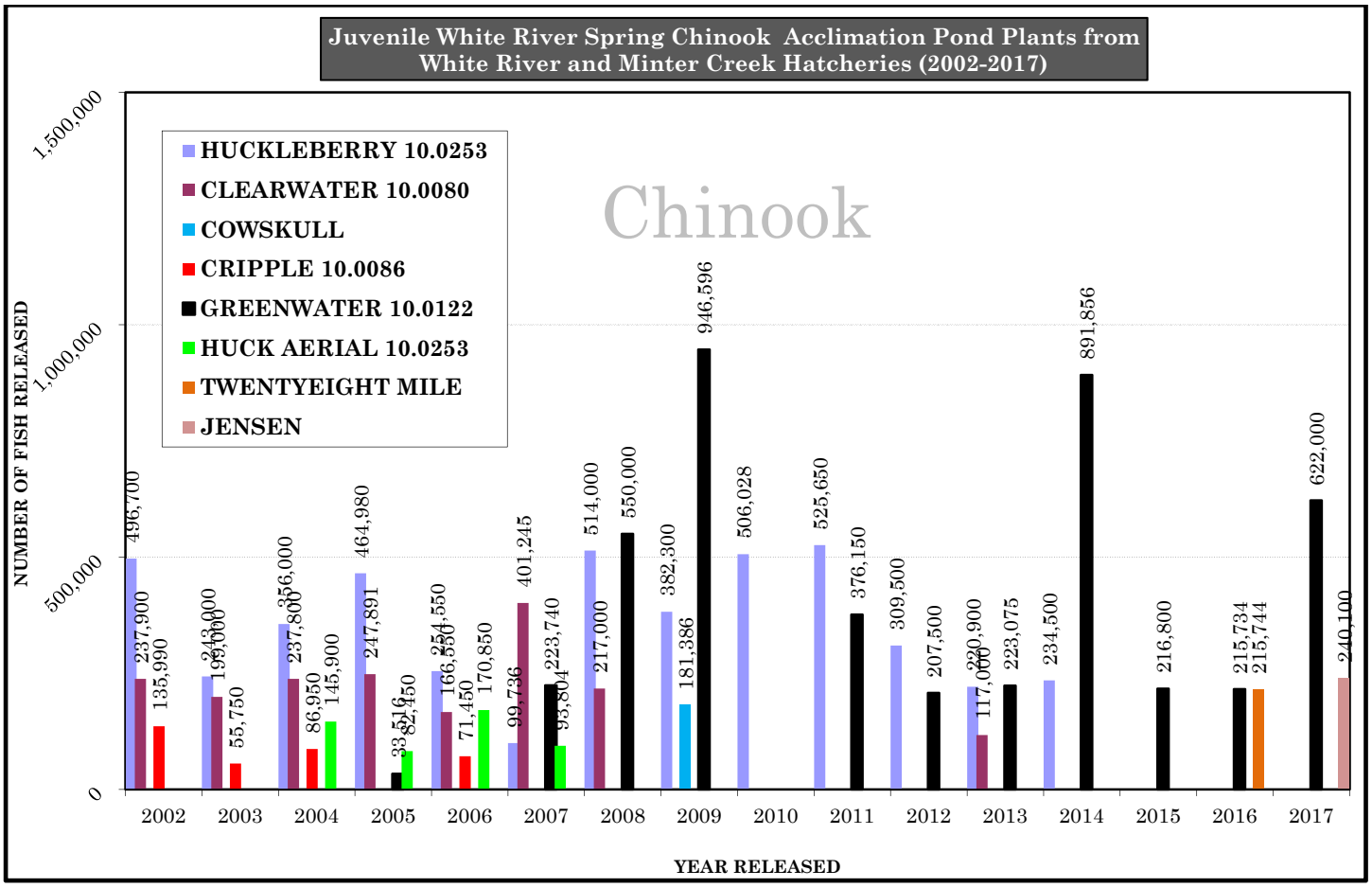
STEELHEAD SURVEY TOTALS:	LIVE	DEAD	REDDS
	73	0	460

1995-2017

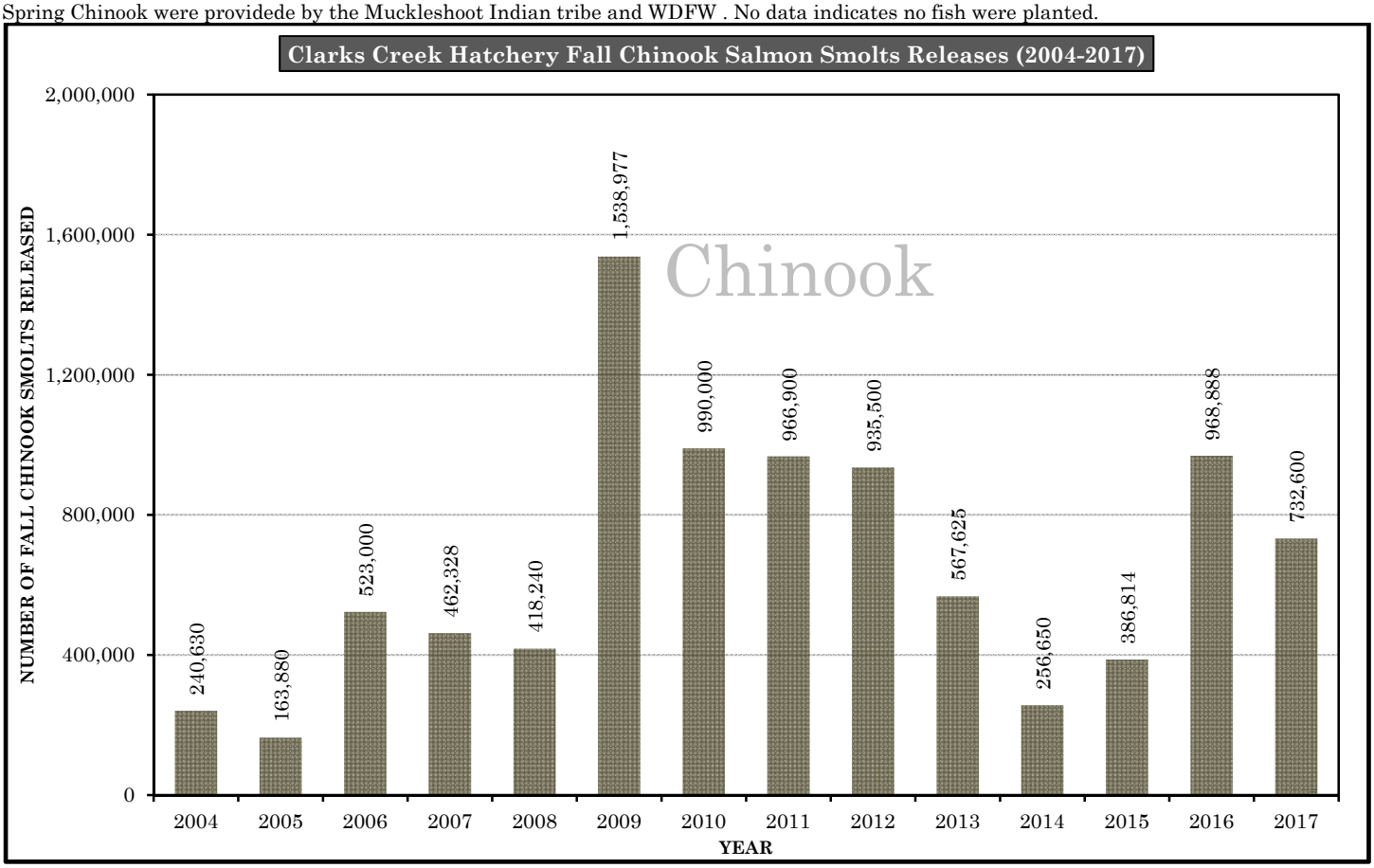
Puyallup Tribal Fisheries Juvenile and Adult Fish Plants and Releases

APPENDIX D

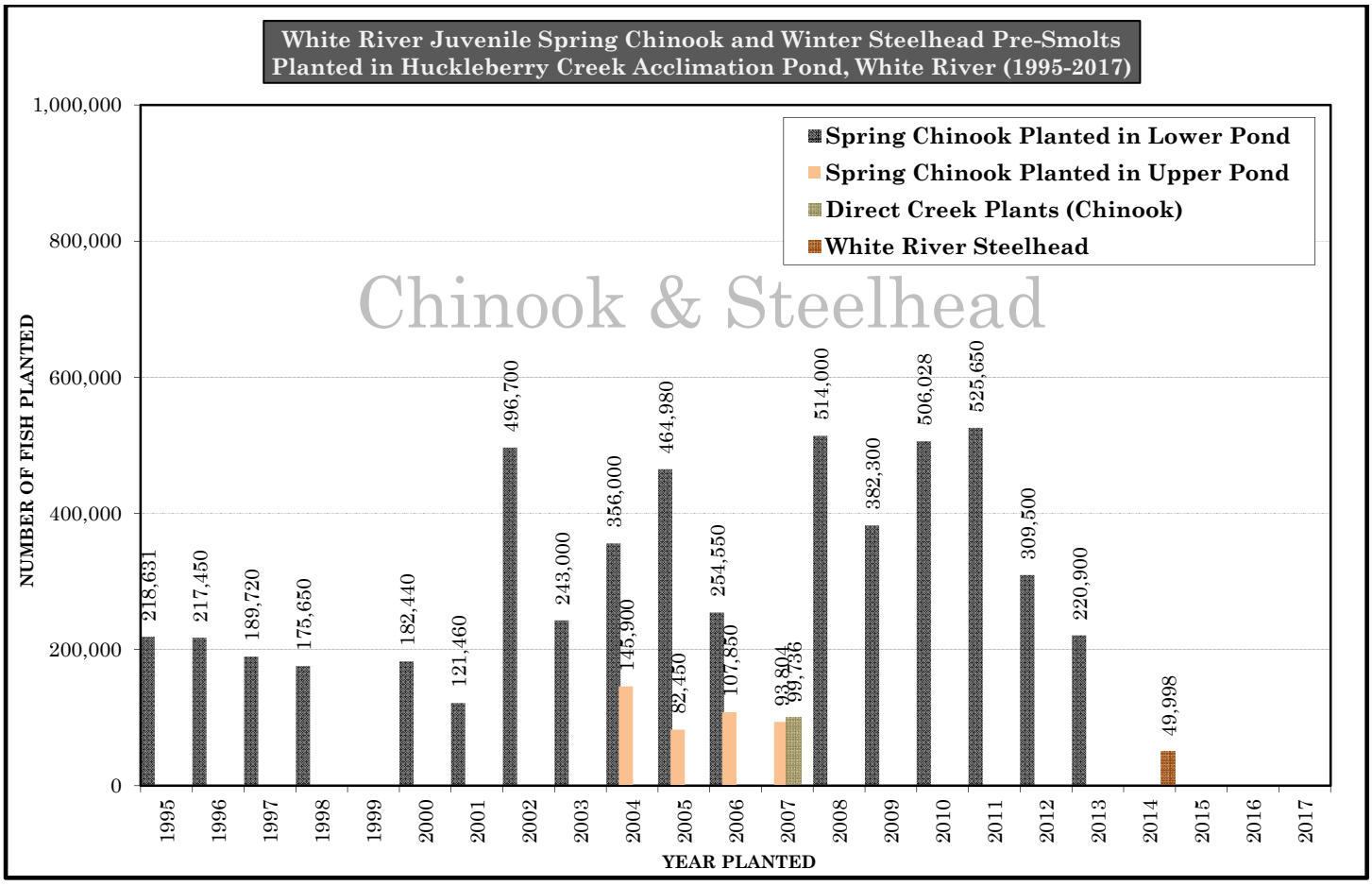

Puyallup Tribal Fisheries
Salmon and Steelhead
Acclimation Pond Location Sites
Miles
0
5
Puyallup River
Fox Creek
Kings Creek
Fennel Creek
Okop Creek
South Prairie Creek
Frame Creek
Voight Creek
Nisqually River
Nisqually Creek
Lily Creek
Wilkeson Creek
Carbon River
Deer Creek
Cowskull Acclimation Pond
Rushingwater Acclimation Pond
Swift Creek
Byrne Creek
Gale Creek
Tohnie Creek
Red Creek
Boise Creek
Canyon Creek
Scatter Creek
Chenuis Creek
Lyle Creek
Jensen Creek Acclimation Pond
Clearwater River
Milky Creek
Viola Creek
Camp Creek
West Fork White River
White River
Inter Fork
Indi Creek
Eleanor Creek
Huckleberry Creek
Wintz Creek
Lost Creek
No Name Creek
Huckleberry Acclimation Pond
Twentyeight Mile Acclimation pond
Silver Springs Creek
Parallel Creek
Deep Creek
Antler Creek
Greenwater Acclimation Pond
Pyramid Creek
Silver Creek
Goat Creek
Lost Creek



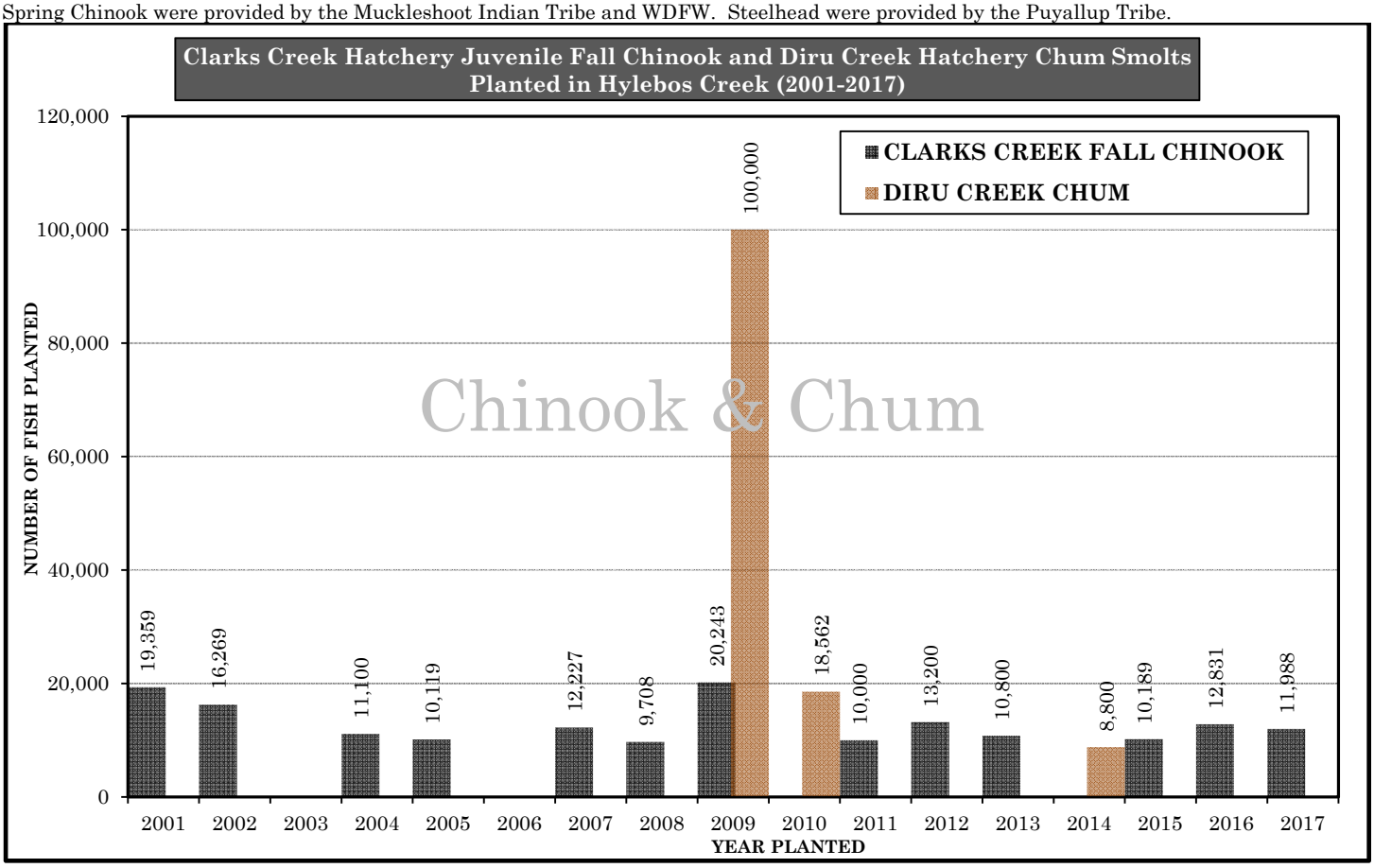
Spring Chinook were providede by the Muckleshoot Indian tribe and WDFW . No data indicates no fish were planted.



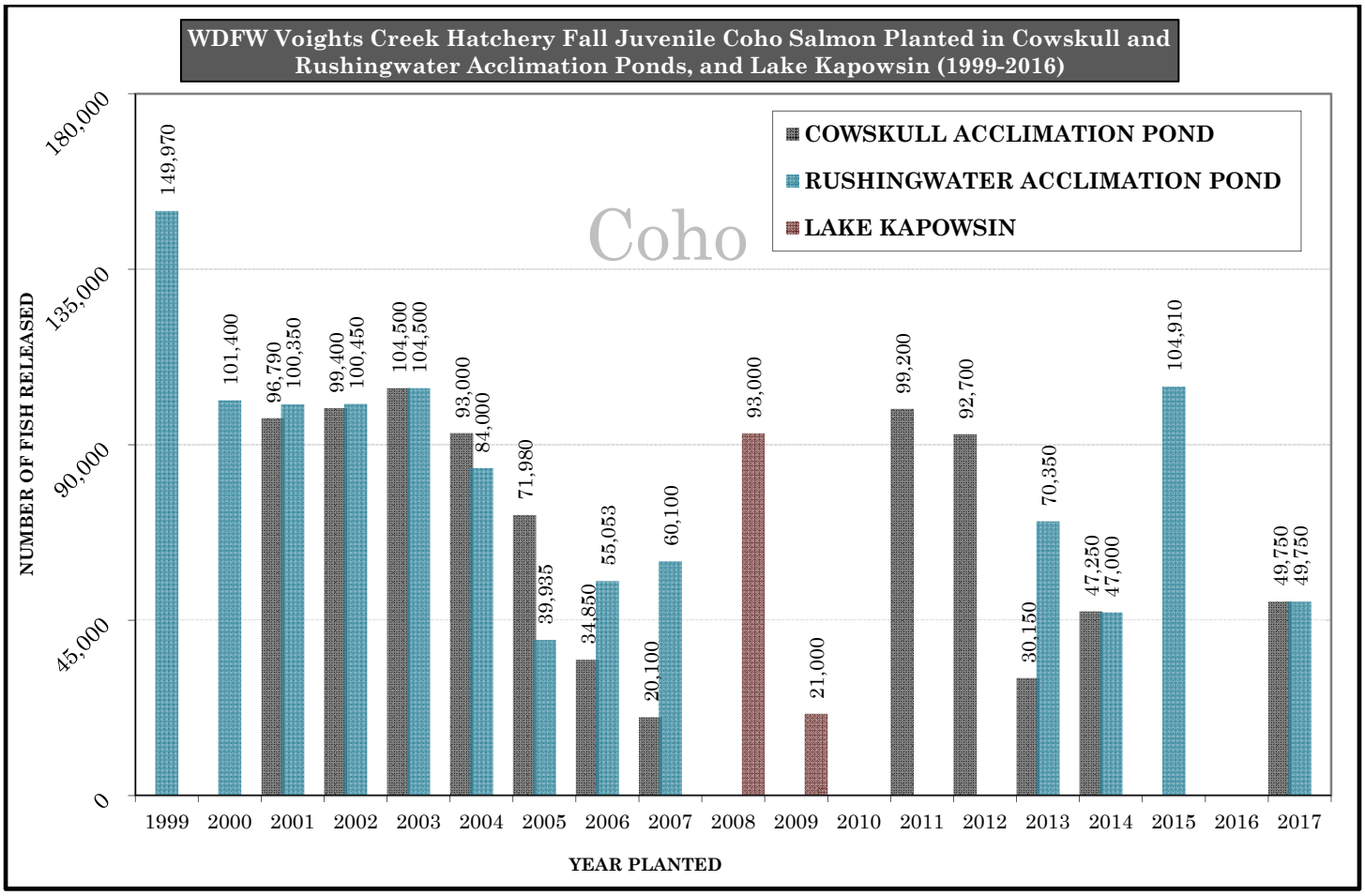
Clarks Creek Fall Chinook salmon hatchery opperated by the Puyallup Tribe.



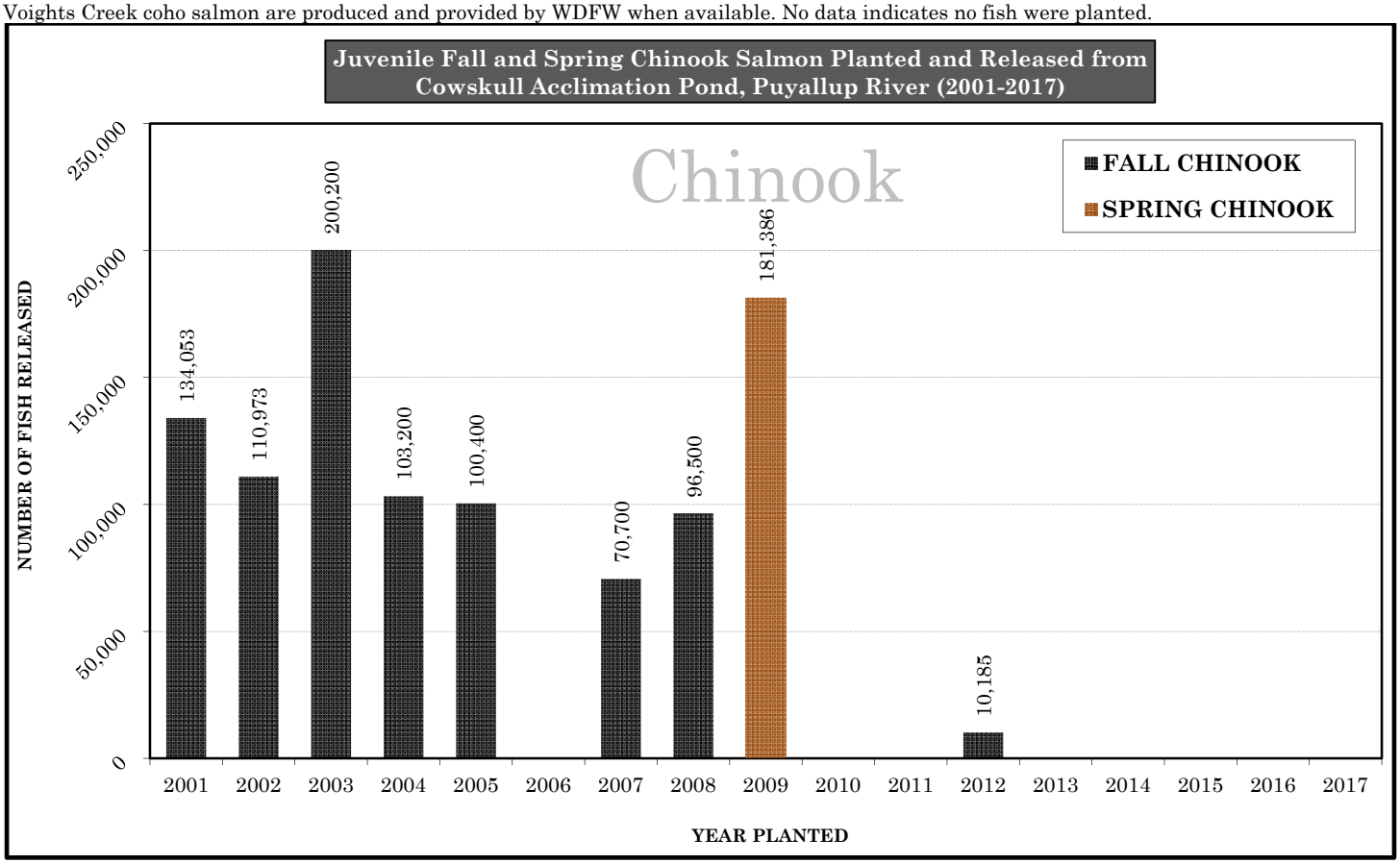
Spring Chinook were provided by the Muckleshoot Indian Tribe and WDFW. Steelhead were provided by the Puyallup Tribe.



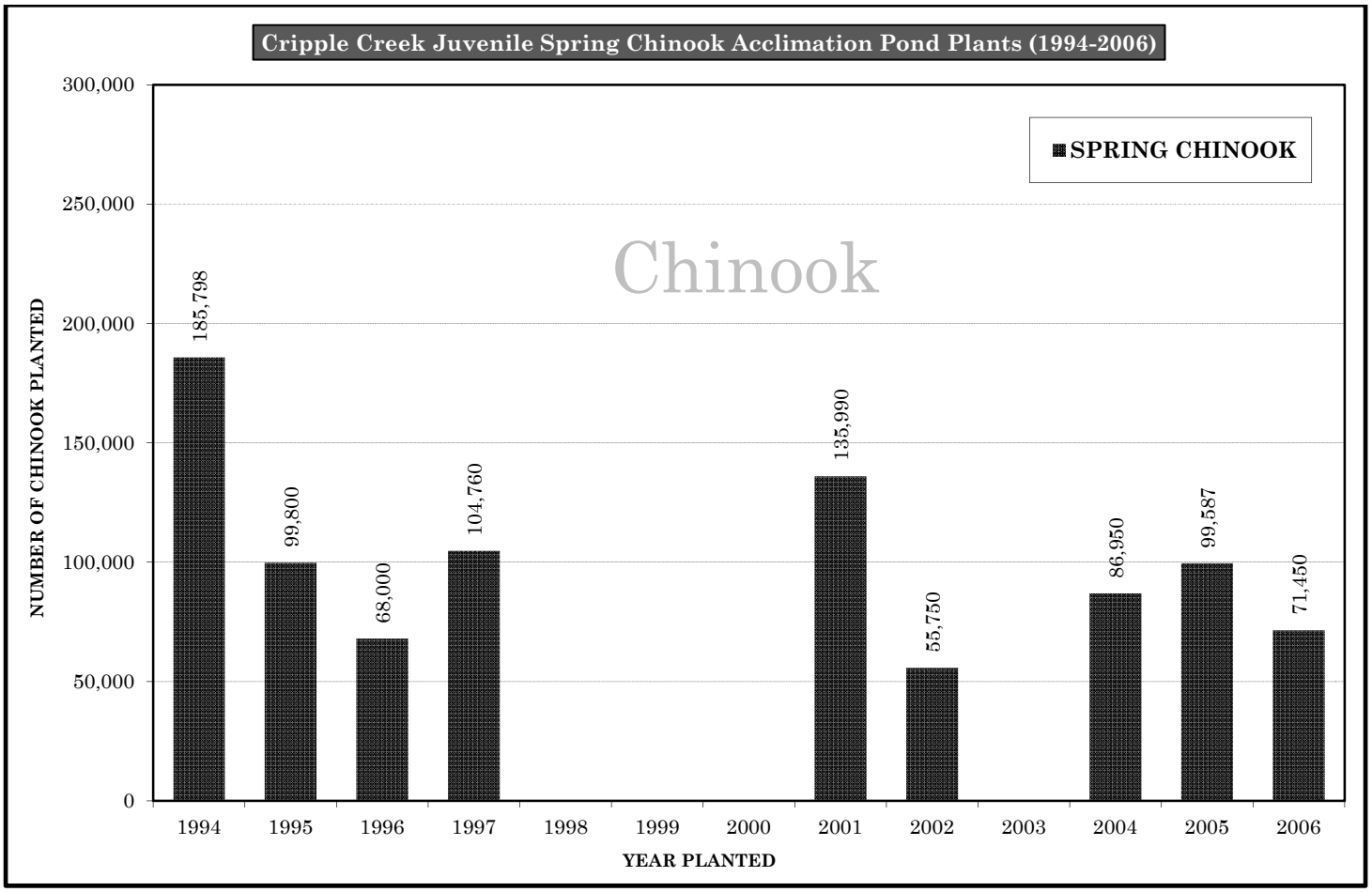
Fall Chinook and chum produced and provided by the Puyallup Tribe. No data indicates no fish were planted.



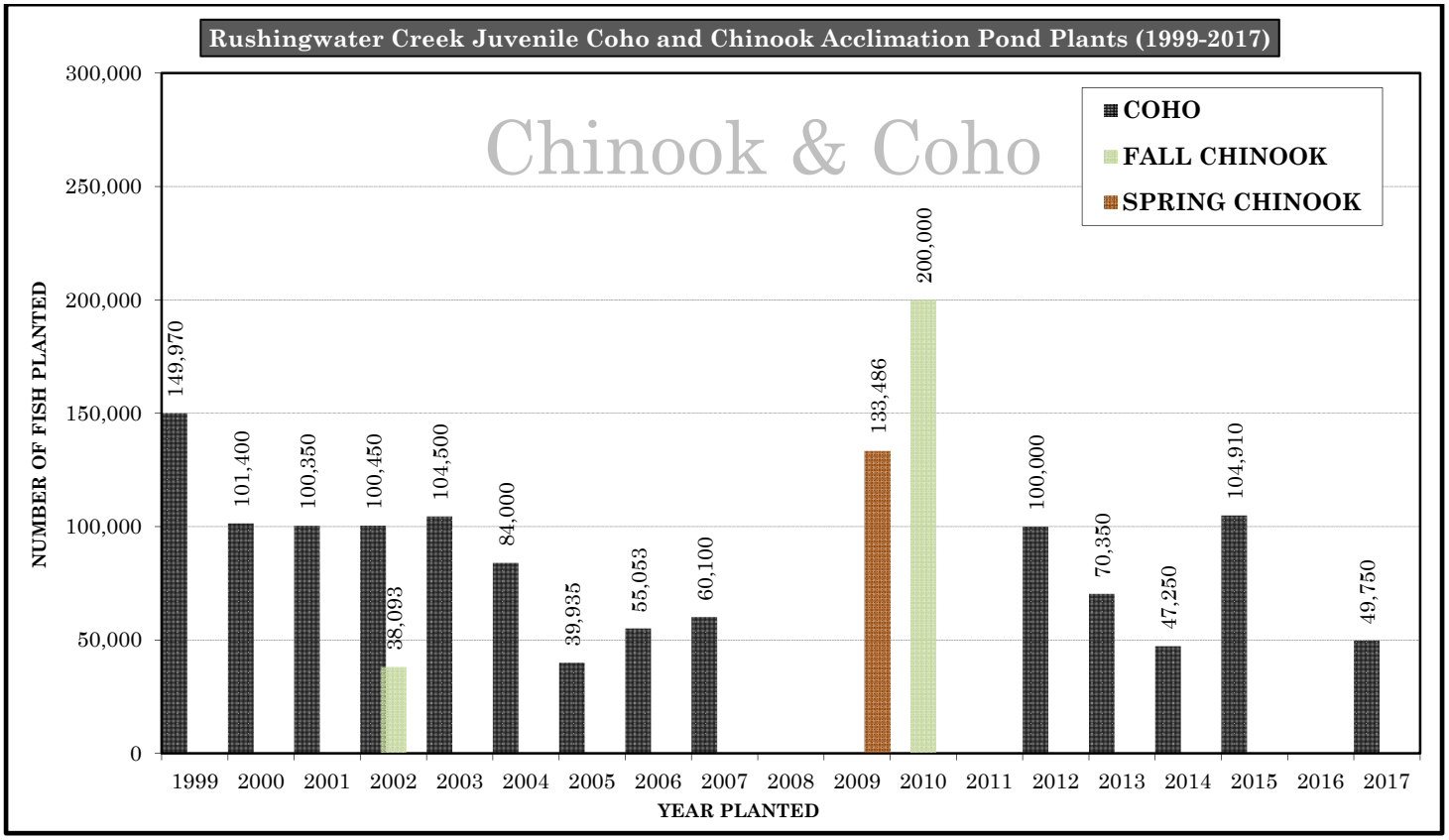
Voights Creek coho salmon are produced and provided by WDFW when available. No data indicates no fish were planted.



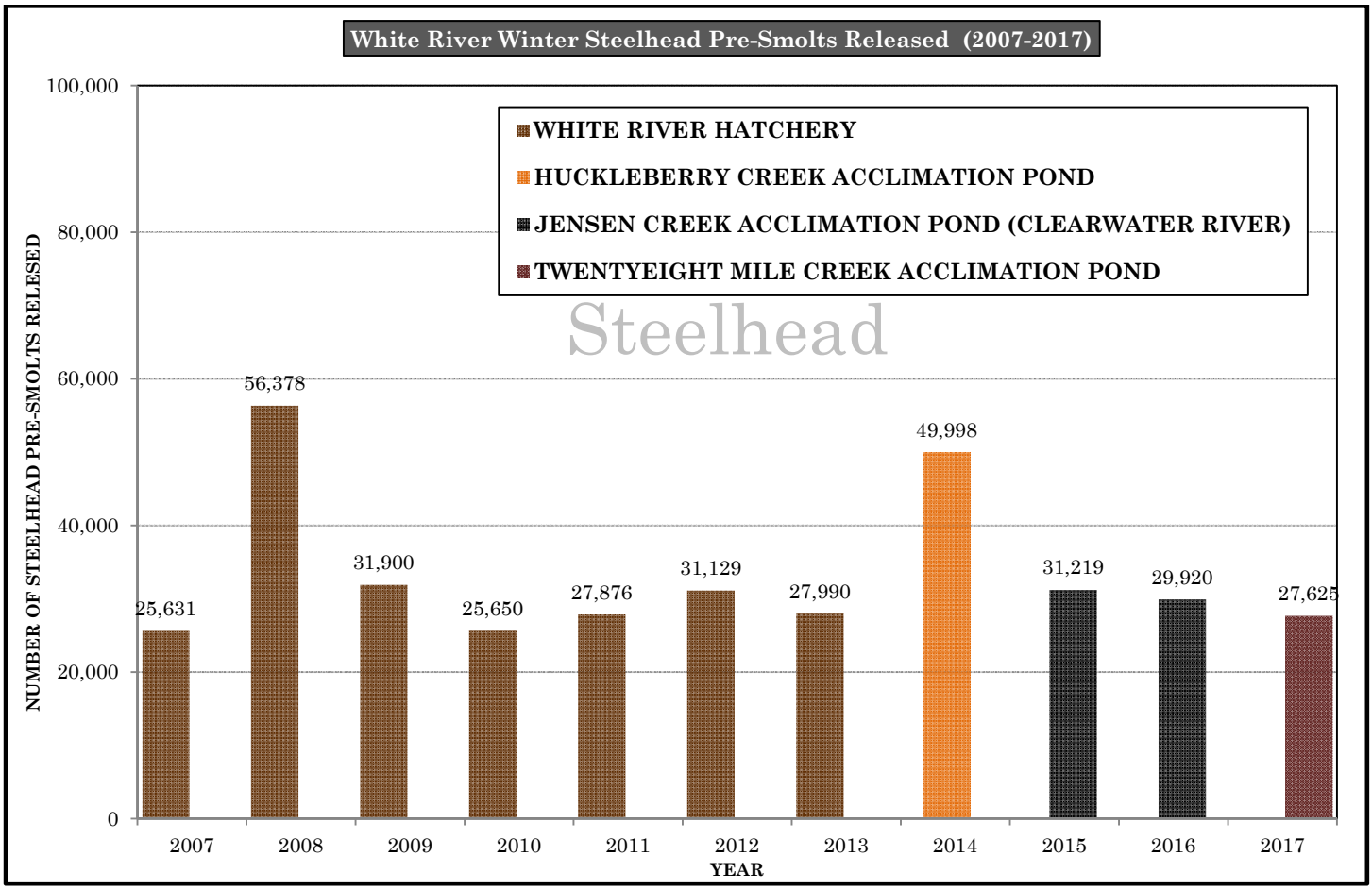
Spring Chinook were provided by the Muckleshoot Indian Tribe and WDFW. Fall Chinook were provided by the Puyallup Tribe and WDFW.



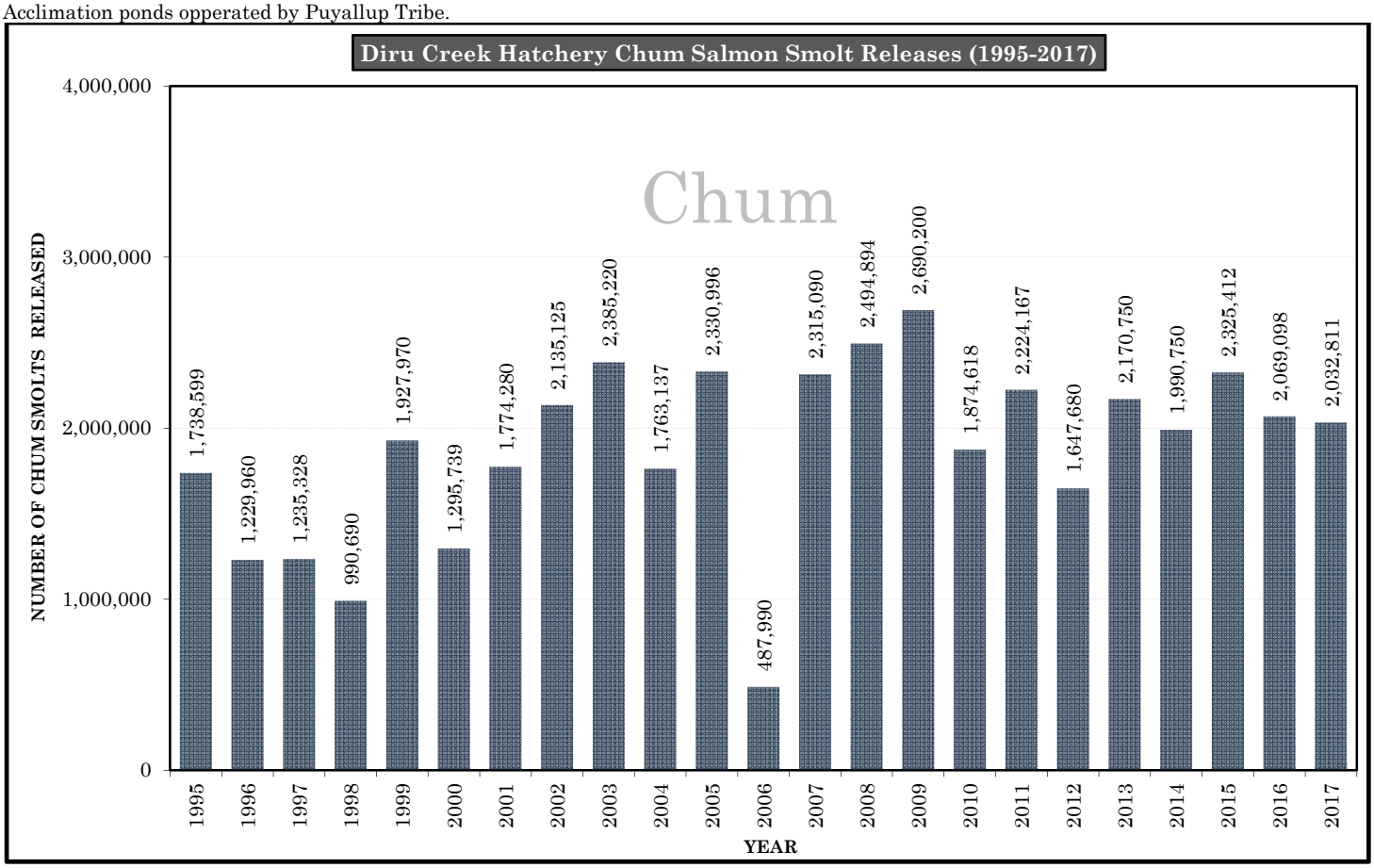
Spring Chinook were provided by the Muckleshoot Indian Tribe and WDFW. No data indicates no fish were planted.



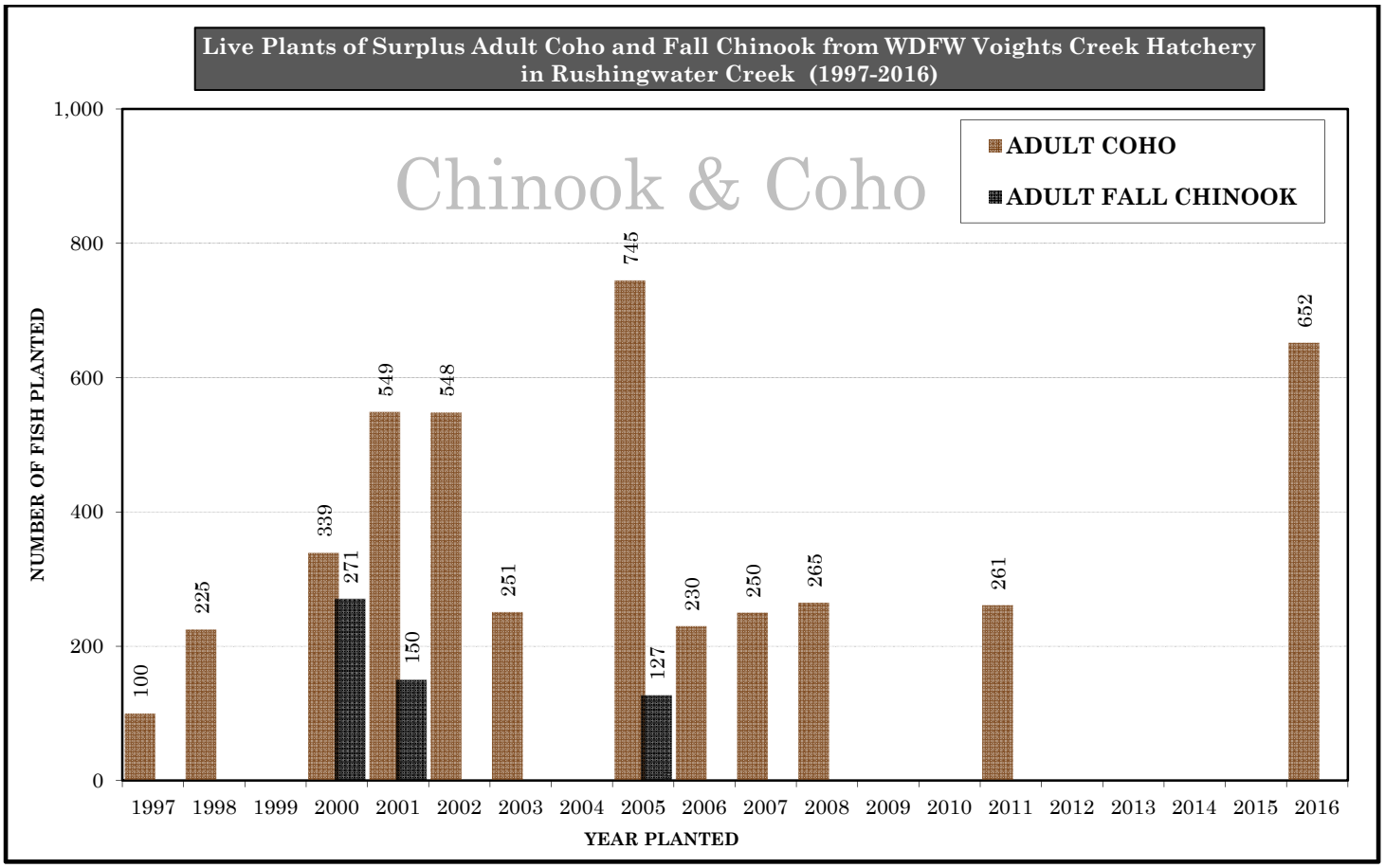
Spring Chinook were provided by the Muckleshoot Indian Tribe and WDFW. Fall Chinook were provided by the Puyallup Tribe and WDFW. Coho were provided by WDFW's Voights Creek hatchery. No data indicates no fish were planted.



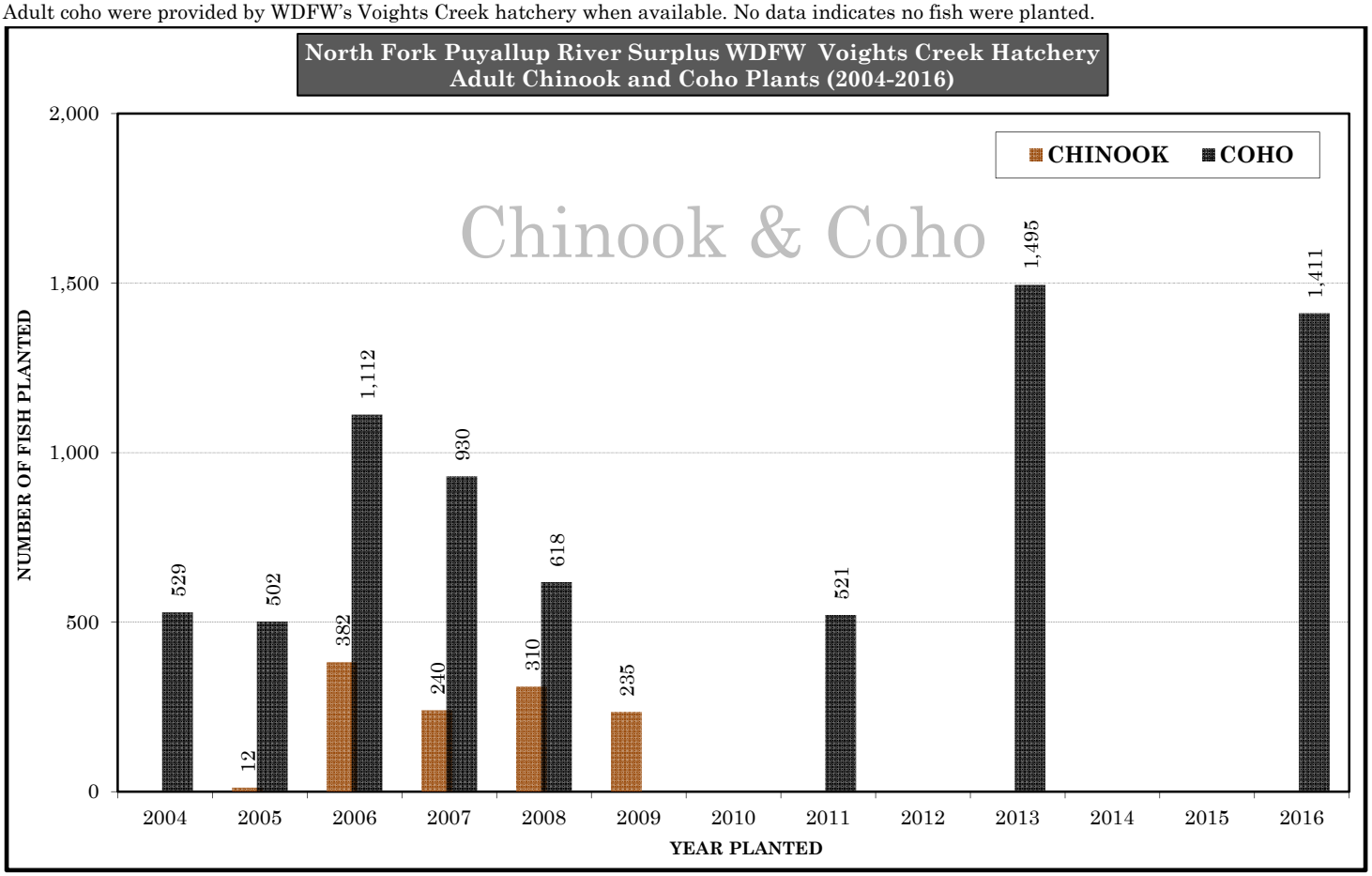
Acclimation ponds opperated by Puyallup Tribe.



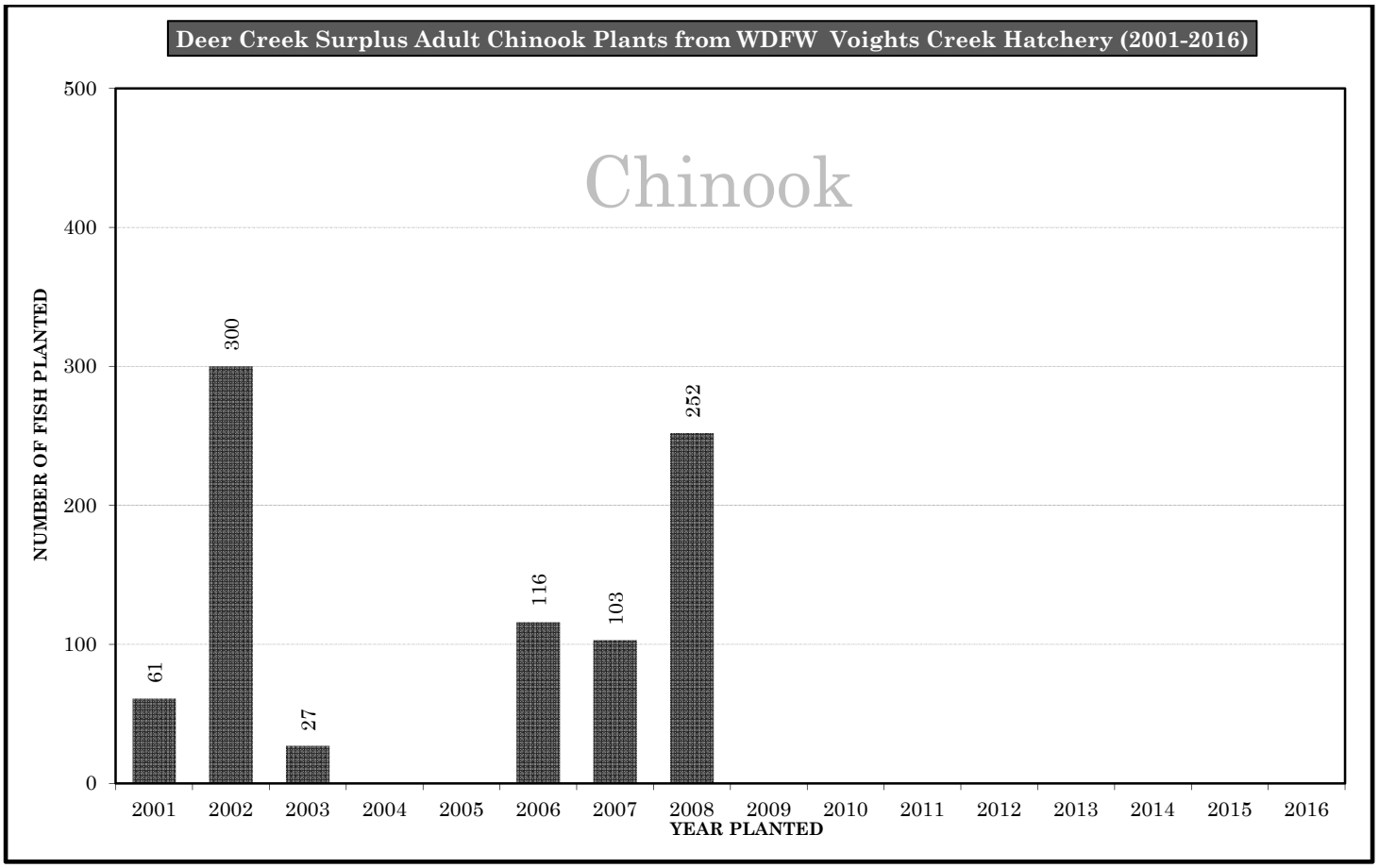
Diru Creek chum salmon hatchery opperated by the Puyallup Tribe.



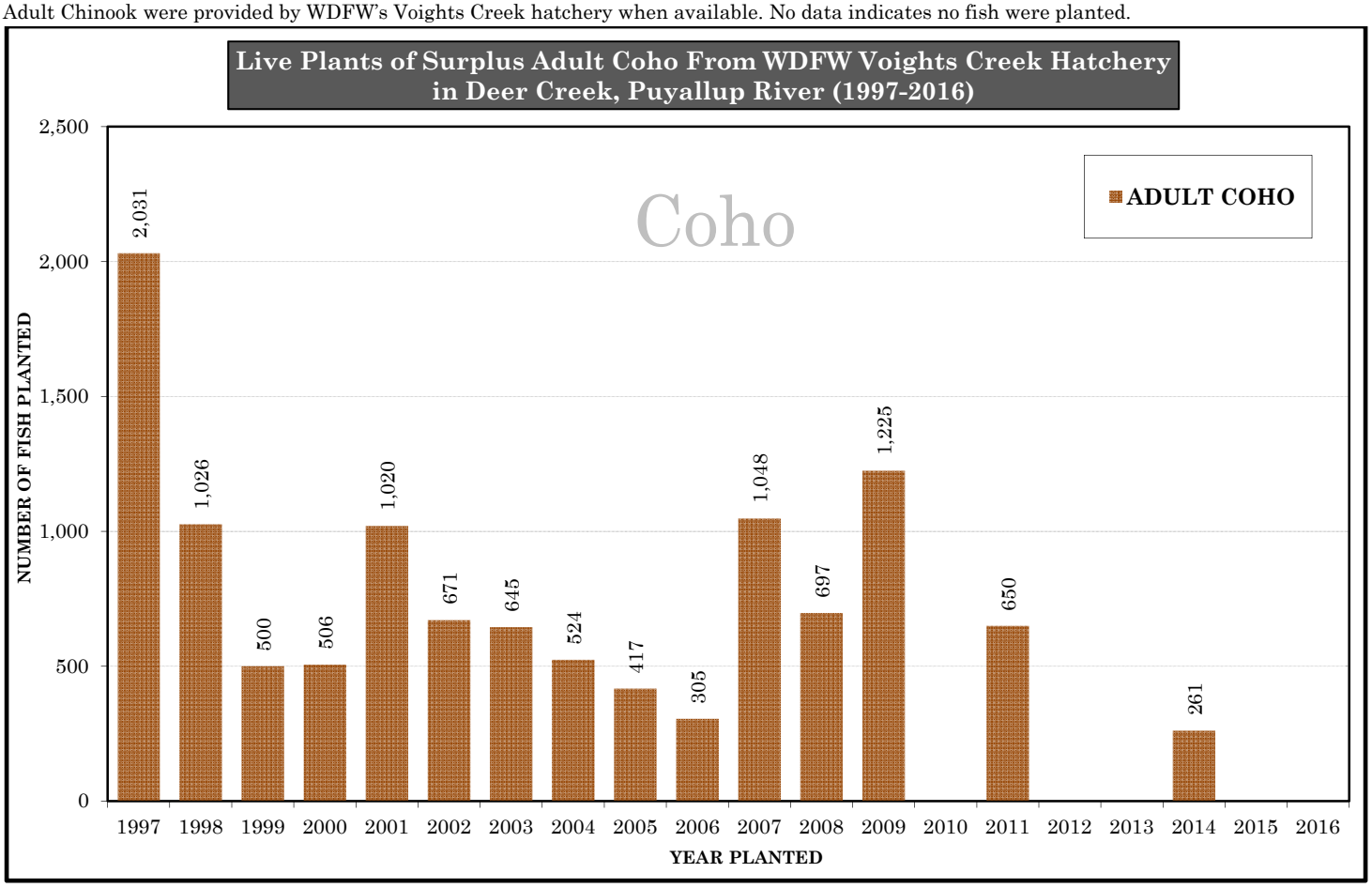
Adult coho were provided by WDFW's Voights Creek hatchery when available. No data indicates no fish were planted.



Adult Chinook and coho were provided by WDFW's Voights Creek hatchery when available. No data indicates no fish were planted.



Adult Chinook were provided by WDFW's Voights Creek hatchery when available. No data indicates no fish were planted.



Adult coho were provided by WDFW's Voights Creek hatchery when available. No data indicates no fish were planted.

2012-2017 Bull Trout Sampled at the USACE Fish Trap, White River.

APPENDIX E

2012 Buckley Bull Trout

	Date Captured	Fork Length (mm)/ Weight (g) / Sex	Recapture	Original Date(s) Captured
1	March 16, 2012	410mm / 783g / M	N	
2	April 30, 2012	360mm / 469g / M	N	
3	April 30, 2012	420mm / 812g / F	N	
4	April 30, 2012	373mm / 505g / M	N	
5	May 4, 2012	356mm / 463g	N	
6	May 14, 2012	475mm / 524g	N	
7	May 14, 2012	571mm / 1382g	N	
8	May 16, 2012	432mm / 891g / F	N	
9	May 16, 2012	430mm / 862g / F	N	
10	May 16, 2012	479mm / 1349g /F	N	
11	May 16, 2012	336mm / 390g / M	N	
12	May 16, 2012	392mm / 329g /M	N	
13	May 16, 2012	312mm / 329g / M	N	
14	June 6, 2012	463mm / 1102g / F	N	
15	June 18, 1012	470mm / 1455g / F	N	
16	June 18, 1012	595mm / 2281g /M	Y	August 5, 2011
17	June 18, 1012	442mm / 958g	N	
18	June 18, 1012	349mm / 438g / F	N	
19	June 22, 2012	491mm / 1365g / F	N	
20	June 22, 2012	390mm / 627g / M	N	
21	June 22, 2012	372mm / 627g / M	N	
22	June 29, 2012	439mm / 953g / M	N	
23	June 29, 2012	476mm / 1299g / F	N	
24	June 29, 2012	350mm / 465g / M	N	
25	June 29, 2012	368mm / 564g / M	N	
26	June 29, 2012	558mm / 1952g / F	Y	July 27, 2011
27	June 29, 2012	411mm / 798g / M	N	
28	June 29, 2012	520mm / 1612g / F	N	
29	June 29, 2012	460mm / 993g / M	N	
30	June 29, 2012	510mm / 1585g / F	Y	July 8, 2011
31	June 29, 2012	476mm / 1185g / M	N	
32	June 29, 2012	418mm / 789g / M	N	
33	June 29, 2012	370mm / 548g / F	N	
34	June 29, 2012	425mm / 936g / F	N	
35	July 2, 2012	367mm / 498g / M	N	
36	July 2, 2012	430mm / 889g / M	N	
37	July 2, 2012	552mm / 1920g / M	Y	July 5, 2011
38	July 2, 2012	401mm / 779g / M	N	
39	July 3, 2012	378mm / 519g / M	N	
40	July 6, 2012	410mm / 747g	N	

41	July 9, 2012	403mm / 771g	**N**	
42	July 9, 2012	490mm / 1714g /M	**Y**	July 20, 2011 & July 21, 2010
43	July 9, 2012	455mm / 1064g	**N**	
44	July 10, 2012	415mm / 778g / F	**N**	
45	July 10, 2012	478mm / 1184g / F	**N**	
46	July 11, 2012	626mm / 2948g / M	**Y**	August 9, 2009
47	July 11, 2012	462mm / 1198g / F	**N**	
48	July 16, 2012	460mm / 946g /M	**Y**	August 5, 2011 & July 26, 2010
49	July 16, 2012	415mm / 752g / M	**N**	
50	July 16, 2012	550mm / 1750g / M	**Y**	July 5, 2011 & May 14, 2010
51	July 16, 2012	385mm / 587g / M	**N**	
52	July 16, 2012	395mm / 684g / F	**N**	
53	July 16, 2012	400mm / 672g / M	**N**	
54	July 16, 2012	450mm / 968g / M	**N**	
55	July 16, 2012	360mm / 472g / M	**N**	
56	July 16, 2012	443mm / 902g / F	**N**	
57	July 19, 2012	523mm / 1627g / F	**Y**	July 18, 2011
58	July 19, 2012	431mm / 867g / F	**N**	
59	July 19, 2012	369mm / 530g / M	**N**	
60	July 19, 2012	466mm / 1177g / F	**N**	
61	July 19, 2012	400mm / 712g	**N**	
62	July 19, 2012	402mm / 720g	**N**	
63	July 19, 2012	474mm / 1172g / M	**N**	
64	July 19, 2012	389mm / 593g / M	**N**	
65	July 19, 2012	476mm / 1117g	**N**	
66	July 19, 2012	502mm / 1469g / M	**Y**	August 5, 2011
67	July 19, 2012	380mm / 576g / M	**N**	
68	July 19, 2012	383mm / 631g / M	**N**	
69	July 19, 2012	416mm / 753g / F	**N**	
70	July 19, 2012	518mm / 1538g / M	**N**	
71	July 19, 2012	427mm / 811g / F	**N**	
72	July 19, 2012	413mm / 719g / M	**N**	
73	July 19, 2012	304mm / 252g / M	**N**	
74	July 19, 2012	427mm / 839g / M	**N**	
75	July 19, 2012	531mm / 1742g / F	**Y**	July 5, 2011 & April 30, 2010
76	July 19, 2012	394mm / 745g / M	**N**	
77	July 19, 2012	317mm / 304g / M	**N**	
78	July 19, 2012	385mm / 637g / M	**N**	
79	July 20, 2012	433mm / 881g / F	**N**	
80	July 20, 2012	418mm / 861g / F	**N**	
81	July 20, 2012	460mm / 1062g /F	**N**	
82	July 20, 2012	525mm / 1667g / F	**N**	
83	July 20, 2012	452mm / 1031g / F	**N**	

84	July 20, 2012	471mm / 1173g / M	**N**	
85	July 20, 2012	555mm / 1797g / F	**N**	
86	July 20, 2012	472mm / 1174g / F	**N**	
87	July 20, 2012	416mm / 816g / M	**N**	
88	July 23, 1012	342mm / 432g / M	**N**	
89	July 23, 1012	418mm / 861g / F	**N**	
90	July 23, 1012	490mm / 1337g / F	**N**	
91	July 23, 1012	480mm / 1154g / F	**N**	
92	July 25, 2012	475mm / 1213g / M	**N**	
93	July 25, 2012	430mm / 879g / F	**N**	
94	July 25, 2012	484mm / 1175g / F	**N**	
95	July 30, 2012	427mm / 798g / M	**N**	
96	July 30, 2012	359mm / 454g / M	**N**	
97	July 30, 2012	423mm / 773g / F	**N**	
98	July 30, 2012	505mm / 1451g / F	**N**	
99	July 30, 2012	415mm / 757g / F	**N**	
100	July 30, 2012	410mm / 757g / M	**N**	
101	July 30, 2012	422mm / 805g / M	**N**	
102	July 30, 2012	380mm / 601g / F	**N**	
103	July 30, 2012	394mm / 600g / F	**N**	
104	July 30, 2012	421mm / 819g / M	**N**	
105	July 30, 2012	409mm / 680g / F	**N**	
106	July 30, 2012	495mm / 1291g / M	**Y**	June 29, 2010
107	July 30, 2012	430mm / 818g / M	**N**	
108	July 30, 2012	422mm / 810g / M	**N**	
109	July 30, 2012	386mm / 528g / M	**N**	
110	July 30, 2012	400mm / 715g / M	**N**	
111	July 30, 2012	445mm / 948g / M	**N**	
112	July 30, 2012	450mm / 1040g / M	**N**	
113	July 30, 2012	475mm / 1090g / M	**N**	
114	July 30, 2012	465mm / 1080g / F	**N**	
115	July 30, 2012	410mm / 750g / M	**N**	
116	July 30, 2012	425mm / 805g / M	**N**	
117	July 30, 2012	575mm / 2221g / F	**Y**	August 10, 2009
118	July 30, 2012	510mm / 1467g / M	**N**	
119	July 31, 2012	480mm / 1153g / M	**N**	
120	July 31, 2012	531mm / 1672g	**Y**	June 8, 2011
121	July 31, 2012	536mm / 1676g / F	**Y**	June 29, 2011
122	August 1, 2012	488mm / 1221g / F	**N**	
123	August 1, 2012	518mm / 1462g / F	**Y**	June 4, 2010
124	August 1, 2012	401mm / 731g / M	**N**	
125	August 2, 2012	428mm / 792g / F	**N**	
126	August 2, 2012	391mm / 646g / M	**N**	

127	August 2, 2012	409mm / 685g / M	**N**	
128	August 2, 2012	439mm / 860g / M	**N**	
129	August 2, 2012	510mm / 1450g / M	**N**	
130	August 2, 2012	480mm / 1194g / F	**Y**	July 13, 2011 & June 11, 2010
131	August 2, 2012	387mm / 606g / F	**N**	
132	August 2, 2012	419mm / 788g / M	**N**	
133	August 2, 2012	415mm / 801g / M	**N**	
134	August 2, 2012	381mm / 598g / F	**N**	
135	August 3, 2012	590mm / 2192g / F	**Y**	July 9, 2010 & July 10, 2009
136	August 3, 2012	400mm / 667g / F	**N**	
137	August 3, 2012	418mm / 763g	**N**	
138	August 3, 2012	423mm / 774g	**N**	
139	August 3, 2012	521mm / 1597g / M	**Y**	July 5, 2011
140	August 3, 2012	493mm / 1247g / M	**Y**	July 8, 2011
141	August 3, 2012	550mm / 1832g / M	**Y**	June 16, 2010
142	August 3, 2012	404mm / 681g	**N**	
143	August 7, 2012	460mm / 987g / F	**N**	
144	August 9, 2012	405mm / 723g / F	**N**	
145	August 10, 2012	475mm/ 1098g	**N**	
146	August 10, 2012	478mm / 1138g / M	**Y**	July 8, 2011
147	August 13, 2012	455mm / 992g / M	**N**	
148	August 13, 2012	453mm / 991g / M	**N**	
149	August 13, 2012	410mm / 723g / F	**N**	
150	August 13, 2012	365mm / 495g / F	**N**	
151	August 13, 2012	465mm / 999g / M	**Y**	July 5, 2011
152	August 13, 2012	395mm / 671g / M	**N**	
153	August 13, 2012	516mm / 1441g / F	**Y**	July 19, 2010
154	August 13, 2012	417mm / 756g / M	**N**	
155	August 16, 2012	382mm / 604g / M	**N**	
156	August 16, 2012	392mm / 602g / F	**N**	
157	August 16, 2012	381mm / 543g	**N**	
158	August 17, 2012	415mm / 743g / F	**N**	
159	August 17, 2012	416mm / 718g / F	**N**	
160	August 20, 2012	376mm / 573g / F	**N**	

2013 Buckley Trap Bull Trout

	Date Captured	Fork Length (mm)/ Weight (g) / Sex	Recapture	Original Date(s) Captured
1	May 8, 2013	370mm / 487g / M	N	
2	May 8, 2013	515mm / 1233g / M	Y	May 14, 2012
3	May 10, 2013	400mm / 624g / M	N	
4	May 10, 2013	434mm / 787g / M	N	

5	May 13, 2013	493mm / 1061g	**N**	
6	May 13, 2013	453mm / 929g	**N**	
7	May 13, 2013	371mm / 511g / M	**N**	
8	May 13, 2013	290mm / 257g	**N**	
9	June 3, 2013	443mm / 977g / M	**N**	
10	June 3, 2013	432mm / 879g / M	**N**	
11	June 3, 2013	511mm / 1544g / M	**Y**	June 29, 2012
12	June 10, 2013	410mm / 830g / F	**N**	
13	June 13, 2013	483mm / 1281g / F	**N**	
14	June 19, 2013	460mm / 1076g / M	**Y**	July 16, 2012
15	June 19, 2013	483mm/1281g / F	**N**	
16	June 19, 2013	450mm / 1013g / M	**N**	
17	June 19, 2013	420mm / 843g / F	**N**	
18	June 19, 2013	455mm / 1057g / M	**N**	
19	June 19, 2013	420mm / 727g / M	**N**	
20	June 19, 2013	436mm / 951g / M	**N**	
21	June 19, 2013	325mm / 352g / M	**N**	
22	June 19, 2013	TRAP MORTALITY / 510mm / F	**Y**	June 29, 2012
23	June 20, 2013	450mm / 1146g / F	**N**	
24	June 21, 2013	322mm / 346g	**N**	
25	June 24, 2013	460mm / 1002g / M	**N**	
26	June 24, 2013	421mm / 1121g / M	**N**	
27	June 24, 2013	455mm / 1092g / M	**N**	
28	June 24, 2013	402mm / 691g / M	**N**	
29	June 25, 2013	410mm / 837g / M	**N**	
30	June 25, 2013	481mm / 1252g / F	**N**	
31	June 25, 2013	367mm / 505g / M	**N**	
32	June 25, 2013	456mm / 1119g / F	**N**	
33	June 25, 2013	487mm/ 1065g / M	**N**	
34	June 25, 2013	650mm / ~3000g / M	**N**	
35	June 25, 2013	455mm / 1077g / F	**N**	
36	June 25, 2013	415mm / 801g / F	**N**	
37	June 25, 2013	418mm / 824g / F	**N**	
38	June 26, 2013	398mm / 664g / F	**N**	
39	June 26, 2013	403mm / 658g / M	**N**	
40	June 26, 2013	490mm / 1297g / M	**Y**	August 2, 2012
41	June 26, 2013	430mm / 933g / F	**N**	
42	June 26, 2013	470mm / 1207g / M	**N**	
43	June 26, 2013	455mm / 1114g / M	**N**	
44	June 26, 2013	450mm / 974g / F	**N**	
45	June 27, 2013	450mm / 974g / F	**N**	
46	June 28, 2013	481mm / NA / M	**N**	
47	June 28, 2013	454mm / NA / F	**N**	
48	June 28, 2013	461mm / NA / F	**N**	

49	June 28, 2013	510mm / NA / M	**Y**	July 19, 2012
50	July 1, 2013	461mm / 1094g / F	**Y**	August 2, 2011
51	July 1, 2013	505mm / 1426g / F	**N**	
52	July 1, 2013	237mm / 217g / NA	**N**	
53	July 1, 2013	490mm / 1309g / NA	**N**	
54	July 1, 2013	470mm / 1100g / F	**N**	
55	July 1, 2013	410mm / 1088g / M	**N**	
56	July 1, 2013	492mm / 1261g / M	**N**	
57	July 1, 2013	440mm / 992g / NA	**N**	
58	July 1, 2013	488mm / 1077g / M	**N**	
59	July 1, 2013	490mm / 1247g / M	**N**	
60	July 1, 2013	453mm / 989g / M	**N**	
61	July 1, 2013	545mm / 1797g / F	**N**	
62	July 1, 2013	497mm / 1349g / M	**N**	
63	July 1, 2013	492mm / 1295g / F	**N**	
64	July 2, 2013	575mm / 2012g / F	**N**	
65	July 2, 2013	450mm / 1063g / M	**Y**	No Data
66	July 2, 2013	427mm / 1309g / M	**N**	
67	July 2, 2013	427mm / 819g / F	**N**	
68	July 2, 2013	409mm / 802g / NA	**N**	
69	July 2, 2013	372mm / 567g / NA	**N**	
70	July 3, 2013	534mm / 1817g / F	**N**	
71	July 5, 2013	502mm / 1396g / M	**N**	
72	July 5, 2013	412mm / 827g / F	**N**	
73	July 5, 2013	435mm / 884g / M	**N**	
74	July 5, 2013	457mm / 1091g / M	**N**	
75	July 8, 2013	429mm / NA/ F	**N**	
76	July 8, 2013	420mm / NA / NA	**N**	
77	July 8, 2013	463mm / NA / M	**Y**	July 30, 2012
78	July 8, 2013	434mm / NA / M	**N**	
79	July 8, 2013	371mm / NA / M	**N**	
80	July 8, 2013	403mm / NA / F	**N**	
81	July 8, 2013	423mm / NA / NA	**N**	
82	July 8, 2013	450mm / NA / M	**N**	
83	July 8, 2013	404mm / NA / M	**N**	
84	July 8, 2013	500mm / NA / F	**N**	
85	July 8, 2013	459mm / NA / F	**Y**	July 30, 2012
86	July 8, 2013	445mm / NA /F	**N**	
87	July 8, 2013	441mm / NA / M	**N**	
88	July 8, 2013	442mm / NA / F	**N**	
89	July 8, 2013	449mm / NA / M	**N**	
90	July 8, 2013	458mm / NA / M	**N**	
91	July 8, 2013	414mm / NA / F	**N**	

92	July 8, 2013	509mm / NA / M	**N**	
93	July 8, 2013	473mm / NA/ M	**N**	
94	July 10, 2013	398mm / 699g / F	**N**	
95	July 10, 2013	439mm / 899g / M	**N**	
96	July 10, 2013	357mm / 472g / F	**N**	
97	July 10, 2013	472mm / 1135g / M	**N**	
98	July 10, 2013	517mm / 1458g / F	**N**	
99	July 10, 2013	480mm / 1250g / F	**N**	
100	July 10, 2013	297mm / 253g / M	**N**	
101	July 10, 2013	464mm / 1125g / F	**N**	
102	July 10, 2013	440mm / 929g / M	**N**	
103	July 10, 2013	410mm / 759g / F	**N**	
104	July 10, 2013	474mm / 1144g / M	**N**	
105	July 10, 2013	434mm / 838g / M	**N**	
106	July 11, 2013	437mm / 1038g / M	**N**	
107	July 11, 2013	528mm / 1548g / M	**Y**	July 20, 2009
108	July 11, 2013	450mm / 1045g / M	**N**	
109	July 11, 2013	380mm / 658g / NA	**N**	
110	July 11, 2013	373mm / 543g / M	**N**	
111	July 11, 2013	488mm / 1258g / M	**N**	
112	July 11, 2013	442mm / 883g / M	**N**	
113	July 11, 2013	480mm / 1213g / M	**N**	
114	July 11, 2013	378mm / 558g / M	**N**	
115	July 11, 2013	467mm / 1171g / F	**N**	
116	July 11, 2013	438mm / 968g / M	**N**	
117	July 11, 2013	443mm / 941g / F	**N**	
118	July 11, 2013	460mm / 1004g / F	**N**	
119	July 11, 2013	483mm / 1278g / M	**N**	
120	July 12, 2013	450mm / NA / M	**N**	
121	July 12, 2013	364mm / 497g / M	**N**	
122	July 12, 2013	402mm / 616g / M	**N**	
123	July 12, 2013	438mm / 911g / M	**N**	
124	July 12, 2013	398mm / 684g / M	**N**	
125	July 12, 2013	395mm / 670g / M	**N**	
126	July 12, 2013	432mm / 865g / F	**N**	
127	July 12, 2013	391mm / 665g / M	**N**	
128	July 12, 2013	415mm / 816g / M	**N**	
129	July 15, 2013	354mm / 437g / M	**N**	
130	July 15, 2013	465mm / 1026g / M	**N**	
131	July 15, 2013	430mm / 851g / F	**N**	
132	July 15, 2013	390mm / 659g / F	**N**	
133	July 15, 2013	375mm / 509g / M	**N**	
134	July 15, 2013	540mm / 1819g / F	**Y**	July 30, 2012
135	July 15, 2013	355mm / 442g / M	**N**	

136	July 15, 2013	480mm / 1208g / F	**N**	
137	July 15, 2013	475mm / 1284g / F	**N**	
138	July 15, 2013	480mm / 1058g / F	**Y**	June 6, 2012
139	July 15, 2013	438mm / 985g / M	**N**	
140	July 15, 2013	504mm / 1408g / M	**N**	
141	July 15, 2013	460mm / 1108g / F	**N**	
142	July 15, 2013	444mm / 905g / F	**N**	
143	July 15, 2013	473mm / 1137g / M	**N**	
144	July 15, 2013	438mm / 1157g / F	**Y**	June 29, 2012
145	July 15, 2013	433mm / 564g / M	**Y**	July 19, 2012
146	July 15, 2013	482mm / 1242g / F	**Y**	July 30, 2012
147	July 15, 2013	455mm / 1012g / M	**N**	
148	July 15, 2013	503mm / 1378g / M	**N**	
149	July 15, 2013	405mm / 708g / F	**N**	
150	July 15, 2013	478mm / 1094g / NA	**N**	
151	July 15, 2013	456mm / 1005g / M	**N**	
152	July 15, 2013	462mm / 1084g / F	**N**	
153	July 15, 2013	452mm / 994g / F	**N**	
154	July 15, 2013	417mm / 775g / NA	**N**	
155	July 15, 2013	457mm / 954g / M	**Y**	August 16, 2012
156	July 16, 2013	474mm / 1133g / F	**N**	
157	July 16, 2013	580mm / 2124g / F	**N**	
158	July 16, 2013	470mm / 1187g / M	**N**	
159	July 16, 2013	492mm / 1425g / F	**N**	
160	July 16, 2013	462mm / 1036g / M	**N**	
161	July 16, 2013	430mm / 875g / F	**N**	
162	July 16, 2013	464mm / 1037g / M	**Y**	July 30, 2012
163	July 16, 2013	465mm / 1012g / M	**N**	
164	July 16, 2013	457mm / 1022g / M	**N**	
165	July 17, 2013	378mm / 547g / M	**N**	
166	July 17, 2013	417mm / 785g / M	**N**	
167	July 17, 2013	498mm / 1397g / F	**N**	
168	July 17, 2013	560mm / 2141g / M	**Y**	August 3, 2012 & June 16, 2010
169	July 17, 2013	444mm / 920g / M	**N**	
170	July 17, 2013	514mm / 920g / M	**N**	
171	July 17, 2013	510mm / 1404g / F	**N**	
172	July 17, 2013	470mm / 1069g / M	**N**	
173	July 17, 2013	413mm / 818g / F	**N**	
174	July 17, 2013	438mm / 964g / F	**N**	
175	July 17, 2013	455mm / 1072g / M	**N**	
176	July 17, 2013	454mm / 1073g / F	**N**	
177	July 17, 2013	402mm / 733g / M	**N**	

178	July 17, 2013	428mm / 776g / M	**Y**	July 19, 2012
179	July 18, 2013	493mm / 1385g / M	**N**	
180	July 18, 2013	450mm / 1066g / M	**N**	
181	July 18, 2013	434mm / 967g / F	**N**	
182	July 18, 2013	451mm / 985g / F	**N**	
183	July 18, 2013	439mm / 942g / F	**N**	
184	July 18, 2013	444mm / 934g / F	**N**	
185	July 18, 2013	490mm / 1367g / F	**Y**	July 19, 2012
186	July 18, 2013	438mm / 903g / F	**N**	
187	July 18, 2013	409mm 836g / M	**N**	
188	July 18, 2013	395mm / 745g / F	**N**	
189	July 18, 2013	369mm / 564g / F	**N**	
190	July 19, 2013	410mm / 717g / M	**N**	
191	July 19, 2013	425mm / 823g / M	**N**	
192	July 19, 2013	462mm / 1027g / M	**Y**	August 1, 2012
193	July 19, 2013	477mm / 1146g / M	**Y**	July 30, 2012
194	July 19, 2013	397mm / 875g / F	**Y**	July 16, 2012
195	July 22, 2013	395mm / 718g / M	**N**	
196	July 22, 2013	428mm / 817g / F	**N**	
197	July 22, 2013	490mm / 1257g / F	**Y**	July 11, 2012
198	July 22, 2013	473mm / 1188g / M	**N**	
199	July 22, 2013	407mm / 748g / M	**N**	
200	July 22, 2013	553mm / 1794g / M	**Y**	June 29, 2010
201	July 22, 2013	506mm / 1440g / M	**Y**	July 30, 2012
202	July 22, 2013	488mm / 1308g / F	**N**	
203	July 22, 2013	465mm / 1077g / M	**N**	
204	July 22, 2013	467mm / 1144g / F	**N**	
205	July 22, 2013	390mm / 663g / M	**N**	
206	July 22, 2013	435mm / 903g / F	**N**	
207	July 22, 2013	402mm / 729g / F	**N**	
208	July 22, 2013	517mm / 1854g / F	**N**	
209	July 22, 2013	368mm / 539g / F	**N**	
210	July 22, 2013	380mm / 584g / M	**N**	
211	July 23, 2013	482mm / 1219g / F	**Y**	July 30, 2012
212	July 23, 2013	440mm / 999g / M	**Y**	April 30, 2012
213	July 24, 2013	470mm / 1064g / M	**N**	
214	July 24, 2013	445mm / 910g / M	**N**	
215	July 24, 2013	455mm / 1083g / F	**N**	
216	July 24, 2013	435mm / 1016g / F	**N**	
217	July 24, 2013	405mm / 708g / F	**N**	
218	July 24, 2013	367mm / 531g / M	**N**	

219	July 24, 2013	405mm / 710g / F	**N**	
220	July 24, 2013	432mm / 883g / M	**N**	
221	July 24, 2013	420mm / 789g / M	**N**	
222	July 25, 2013	445mm / 1002g / M	**N**	
223	July 25, 2013	414mm / 780g / F	**N**	
224	July 25, 2013	460mm / 997g / M	**Y**	August 2, 2012
225	July 25, 2013	410mm / 736g / M	**N**	
226	July 25, 2013	420mm / 852g / M	**N**	
227	July 25, 2013	400mm / 639g / M	**N**	
228	July 25, 2013	478mm / 590g / F	**N**	
229	July 25, 2013	490mm / 1160g / M	**Y**	August 13, 2012
230	July 29, 2013	495mm / 1399g / F	**N**	
231	July 29, 2013	435mm / 821g / M	**N**	
232	July 29, 2013	435mm / 830g / M	**Y**	August 2, 2012
233	July 29, 2013	482mm / 1257g / M	**N**	
234	July 29, 2013	414mm / 744g / M	**N**	
235	July 29, 2013	446mm / 966g / M	**N**	
236	July 29, 2013	398mm / 703g / F	**N**	
237	July 29, 2013	367mm / 462g / M	**N**	
238	July 29, 2013	427mm / 807g / M	**N**	
239	July 29, 2013	384mm / 600g / M	**N**	
240	July 29, 2013	542mm / 1795g / F	**N**	
241	July 29, 2013	450mm / 1075g / M	**N**	
242	July 29, 2013	415mm / 817g / M	**N**	
243	July 30, 2013	471mm / 1099g / M	**N**	
244	July 30, 2013	479mm / 1101g / F	**N**	
245	July 30, 2013	493mm / 1261g / F	**Y**	August 2, 2012 & July 13, 2011 & June 11, 2010
246	July 30, 2013	437mm / 917g / M	**N**	
247	July 30, 2013	407mm / 708g / M	**N**	
248	July 31, 2013	470mm / 1198g / M	**N**	
249	July 31, 2013	426mm / 833g / F	**N**	
250	July 31, 2013	385mm / 595g / M	**N**	
251	July 31, 2013	553mm 1873g / F	**N**	
252	July 31, 2013	414mm / 797g / F	**N**	
253	July 31, 2013	440mm / 858g / F	**N**	
254	July 31, 2013	414mm / 765g / F	**N**	
255	July 31, 2013	325mm / 343g / M	**N**	
256	August 1, 2013	462mm / 1045g / F	**N**	
257	August 1, 2013	512mm / 1441g / F	**Y**	June 22, 2012
258	August 1, 2013	420mm / 826g / F	**N**	
259	August 2, 2013	434mm / 931g / F	**N**	
260	August 2, 2013	461mm / 996g / F	**N**	
261	August 2, 2013	364mm / 525g / F	**N**	

262	August 5, 2013	458mm / 1063g / F	**N**	
263	August 5, 2013	404mm / 735g / M	**N**	
264	August 5, 2013	430mm / 898g / F	**N**	
265	August 5, 2013	392mm / 676g / M	**N**	
266	August 5, 2013	506mm / 1349g / F	**N**	
267	August 5, 2013	365mm / 617g / F	**N**	
268	August 5, 2013	395mm / 662g / F	**N**	
269	August 7, 2013	500mm / 1325g / F	**Y**	August 1, 2012

2014 Buckley Bull Trout

	Date Captured	Fork Length (mm)/ Weight (g) / Sex	Recapture	Original Date(s) Captured
1	January 29, 2014	290mm / 249g / M	**N**	
2	January 31, 2014	327mm / 249g / M	**N**	
3	January 31, 2014	335mm / 393g / M	**N**	
4	March 5, 2014	382mm / 647g / M	**N**	
5	March 10, 2014	349mm / 416g / M	**N**	
6	March 10, 2014	390mm / 675g / F	**N**	
7	March 17, 2014	339mm / 411g / F	**N**	
8	April 2, 2014	530mm / 1494g / M	**Y**	July 5, 2013
9	April 7, 2014	327mm / 330g / M	**N**	
10	April 7, 2014	339mm / 377g / M	**N**	
11	April 9, 2014	509mm / 1605g / M	**N**	
12	April 9, 2014	468mm / 1047g / M	**N**	
13	April 9, 2014	375mm / 524g / M	**N**	
14	April 9, 2014	407mm / 691g / M	**N**	
15	April 11, 2014	345mm / 424g / --	**N**	
16	April 11, 2014	321mm / 414g / F	**N**	
17	April 14, 2014	490mm / 1368g / F	**N**	
18	April 16, 2014	480mm / 1140g / M	**N**	
19	April 18, 2014	448mm / 902g / M	**N**	
20	April 23, 2014	398mm / 638g / F	**N**	
21	May 2, 2014	400mm / 671g / M	**N**	
22	May 2, 2014	347mm / 453g / M	**N**	
23	May 9, 2014	510mm / 1487g / F	**N**	
24	May 14, 2014	382mm / 600g / F	**N**	
25	May 14, 2014	690mm / 5443g / M	**Y**	June 18, 1012 & August 5, 2011
26	May 16, 2014	342mm / 371g / F	**N**	
27	May 16, 2014	302mm / 286g / M	**N**	
28	May 16, 2014	435mm / 854g / M	**N**	
29	May 23, 2014	380mm / 549g /M	**N**	
30	May 23, 2014	608mm / 2590g /F	**Y**	June 29, 2012 & July 27, 2011
31	May 23, 2014	497mm / 1350g / M	**N**	
32	May 23, 2014	438mm / 929g / M	**N**	

33	May 23, 2014	535mm / 1803g / M	**Y**	July 15, 2013
34	May 23, 2014	400mm / 713g / M	**N**	
35	May 23, 2014	393mm / 1796 / M	**N**	
36	May 23, 2014	358mm / 493g / M	**N**	
37	May 23, 2014	595mm / 2610g / F	**Y**	July 31, 2013
38	May 23, 2014	534mm / 1796g / M	**N**	
39	May 23, 2014	480mm / 1368g / M	**Y**	June 24, 2013
40	May 27, 2014	498mm / 1344g / F	**N**	
41	May 27, 2014	485mm / 1453g / F	**N**	
42	May 28, 2014	462mm / 1061g / M	**N**	
43	May 28, 2014	494mm / 1397g / M	**Y**	July 1, 2013
44	May 30, 2014	488mm / 1404g / M	**N**	
45	May 30, 2014	573mm / 2254g / F	**N**	
46	June 4, 2014	540mm / 1748g / F	**Y**	June/29/2012 & July 8, 2011
47	June 4, 2014	572mm / 2056g / M	**Y**	July 19, 2012
48	June 4, 2014	504mm / 1551g / F	**N**	
49	June 4, 2014	482mm / 1358g / F	**N**	
50	June 4, 2014	385mm / 637g / M	**N**	
51	June 4, 2014	510mm / 1461g / F	**N**	
52	June 4, 2014	512mm / 1682g / F	**N**	
53	June 6, 2014	494mm / 1343g / M	**N**	
54	June 9, 2014	506mm/ /1564g / F	**N**	
55	June 9, 2014	526mm / 1766g / M	**Y**	June 25, 2013
56	June 9, 2014	469mm / 1192g / F	**Y**	June 19, 2013
57	June 9, 2014	481mm / 1428g / F	**N**	
58	June 9, 2014	483mm / 1316g / M	**N**	
59	June 9, 2014	450mm / 1166g / F	**Y**	July 12, 2013
60	June 9, 2014	455mm / 1061g / M	**N**	
61	June 9, 2014	325mm / 355g / M	**N**	
62	June 11, 2014	539mm / 1926g / F	**Y**	July 1, 2013
63	June 16, 2014	311mm / 290g / M	**N**	
64	June 18, 2014	527mm / 1693g / F	**N**	
65	June 18, 2014	406mm / 710g / M	**N**	
66	June 20, 2014	427mm / 847g / F	**N**	
67	June 20, 2014	513mm / 1460g / F	**N**	
68	June 20, 2014	513mm / 1517g / M	**N**	
69	June 20, 2014	431mm / 968g / M	**N**	
70	June 20, 2014	505mm / 1478g / F	**N**	
71	June 20, 2014	467mm / 1172g / M	**N**	
72	June 20, 2014	480mm / 1345g / M	**N**	
73	June 20, 2014	437mm / 933g / M	**N**	
74	June 20, 2014	542mm / 1762g / M	**N**	
75	June 20, 2014	483mm / 1322g / M	**N**	
76	June 20, 2014	521mm / 1701g / F	**Y**	July 17, 2013
77	June 20, 2014	502mm / 1541g / F	**N**	

78	June 20, 2014	470mm / 1273g / M	**N**	
79	June 20, 2014	449mm / 1098g / F	**N**	
80	June 23, 2014	480mm / 1154g / M	**N**	
81	June 23, 2014	531mm / 1732g / M	**Y**	July 9, 2012
82	June 23, 2014	553mm / 2048 / M	**N**	
83	June 23, 2014	504mm / 1381g / M	**Y**	July 15, 2013 & August 16, 2012
84	June 23, 2014	511mm / 1533g / M	**Y**	June 26, 2013
85	June 23, 2014	514mm / 1470g	**N**	
86	June 23, 2014	601mm / 2763 / M	**Y**	July 17, 2013 & August 3, 2012 & June 16, 2010
87	June 23, 2014	518mm / 1632g / F	**Y**	July 30, 2013 & August 2, 2012 & July 13, 2011 & June 11, 2010
88	June 23, 2014	375mm / 472g / F	**N**	
89	June 23, 2014	487mm / 1268g / F	**N**	
90	June 23, 2014	456mm / 1054g / M	**N**	
91	June 23, 2014	410mm / 783g	**N**	
92	June 23, 2014	452mm / 1184g / F	**N**	
93	June 23, 2014	430mm / 850g / M	**N**	
94	June 23, 2014	554mm / 1920g / F	**Y**	July 10, 2013
95	June 23, 2014	465mm / 1072g / M	**N**	
96	June 23, 2014	435mm / 997g / F	**N**	
97	June 25, 2014	456mm / 1039g / M	**N**	
98	June 25, 2014	495mm / 1508g / M	**N**	
99	June 25, 2014	405mm / 734g / M	**N**	
100	June 25, 2014	510mm / 1460g / F	**N**	
101	June 25, 2014	411mm / 654g / M	**N**	
102	June 25, 2014	523mm / 1510g / M	**Y**	July 11, 2013
103	June 25, 2014	400mm / 792g / M	**N**	
104	June 25, 2014	479mm / 1211g / M	**N**	
105	June 25, 2014	445mm / 1035g / F	**N**	
106	June 25, 2014	438mm / 936g / F	**N**	
107	June 25, 2014	417mm / 890g / M	**N**	
108	June 25, 2014	415mm / 714g / M	**N**	
109	June 25, 2014	370mm / 531g / F	**N**	
110	June 25, 2014	428mm / 951g / F	**N**	
111	June 27, 2014	570mm / 1995g / M	**N**	
112	June 27, 2014	345mm / 442g / M	**N**	
113	June 27, 2014	541mm / 1778g / F	**Y**	August 1, 2013 & June 22, 2012
114	June 27, 2014	383mm / 570g / M	**N**	
115	June 27, 2014	385mm / 576g / M	**N**	
116	June 27, 2014	502mm / 1430g / F	**N**	
117	June 27, 2014	470mm / 1117g / M	**Y**	July 31, 2013
118	June 27, 2014	480mm / 1178g / F	**N**	
119	June 27, 2014	419mm / 768g / M	**N**	
120	June 27, 2014	368mm / 498g / F	**N**	
121	June 27, 2014	530mm / 1511g / F	**N**	
122	June 27, 2014	460mm / 1055g / F	**N**	

123	June 27, 2014	480mm / 1239g / F	**Y**	July 1, 2013
124	June 27, 2014	412mm / 794g / F	**N**	
125	June 27, 2014	420mm / 865g / F	**N**	
126	June 27, 2014	466mm / 1187g / M	**N**	
127	June 27, 2014	433mm / 944g / F	**N**	
128	June 27, 2014	488mm / 1396g / F	**N**	
129	June 27, 2014	375mm / 592g / M	**N**	
130	June 27, 2014	538mm / 1800g / F	**N**	
131	June 27, 2014	422mm / 749g / F	**N**	
132	June 27, 2014	525mm / 1539g / M	**Y**	July 19, 2013 & July 30, 2012
133	June 27, 2014	500mm / 1440g / M	**N**	
134	June 27, 2014	480mm / 1249g / F	**Y**	July 16, 2013
135	June 27, 2014	385mm / 667g / F	**N**	
136	June 27, 2014	430mm / 908g / M	**N**	
137	June 27, 2014	438mm / 1043g / F	**N**	
138	June 27, 2014	374mm / 572g / M	**N**	
139	June 27, 2014	484mm / 1270g / M	**N**	
140	June 27, 2014	475mm / 1217g / F	**N**	
141	June 27, 2014	452mm / 1010g / F	**N**	
142	June 27, 2014	481mm / 1353g / F	**N**	
143	June 27, 2014	498mm / 1384g / M	**N**	
144	June 27, 2014	430mm / 833g / F	**N**	
145	June 27, 2014	485mm / 1216g / F	**N**	
146	June 27, 2014	410mm / 801g / F	**N**	
147	June 27, 2014	430mm / 813g / M	**Y**	June 25, 2013
148	June 27, 2014	387mm / 692g / F	**N**	
149	June 27, 2014	520mm / 1461g / M	**Y**	July 16, 2013
150	June 30, 2014	479mm / 1286g / M	**Y**	July 15, 2013
151	June 30, 2014	480mm / 1155g / M	**Y**	July 12, 2013
152	June 30, 2014	454mm / 1140g / F	**Y**	July 11, 2013
153	June 30, 2014	520mm / 1809g / M	**Y**	July 16, 2012
154	July 1, 2014	543mm / 1753g / M	**Y**	July 17, 2013
155	July 2, 2014	473mm / 1117g / M	**Y**	July 11, 2013
156	July 2, 2014	558mm / 1925g / M	**Y**	July 22, 2013 & July 30, 2012
157	July 2, 2014	559mm / 1872g / M	**Y**	July 15, 2013
158	July 7, 2014	380mm / 610g / M	**N**	
159	July 7, 2014	590mm / 2350g / M	**N**	
160	July 7, 2014	470mm / 1080g / M	**Y**	July 19, 2012
161	July 7, 2014	545mm / 1630g / M	**Y**	July 1, 2013
162	July 7, 2014	485mm / 1135g / F	**N**	
163	July 7, 2014	470mm / 1180g / M	**N**	
164	July 7, 2014	480mm / 1150g / M	**N**	
165	July 7, 2014	485mm / 1298g / F	**Y**	July 8, 2013
166	July 7, 2014	535mm / 1570g / M	**Y**	July 29, 2013
167	July 7, 2014	525mm / 1650g / F	**Y**	July 10, 2013

168	July 8, 2014	510mm / 1450g / M	**Y**	June 19, 2013
169	July 8, 2014	505mm / 1320g / M	**Y**	July 18, 2013
170	July 8, 2014	495mm / 1350g / F	**N**	
171	July 8, 2014	480mm / 1150g / F	**N**	
172	July 8, 2014	420mm / 780g / F	**N**	
173	July 8, 2014	500mm / 1480g / F	**N**	
174	July 8, 2014	435mm / 850g / M	**N**	
175	July 8, 2014	530mm / 1550g / M	**Y**	July 15, 2013
176	July 8, 2014	505mm / 1350g / M	**Y**	July 24, 2013
177	July 8, 2014	475mm / 1210g / F	**N**	
178	July 8, 2014	475mm / 1050g / F	**Y**	July 22, 2013
179	July 8, 2014	440mm / 820g / F	**N**	
180	July 8, 2014	445mm / 950g / M	**Y**	
181	July 9, 2014	483mm / 1336g / F	**Y**	July 25, 2013
182	July 9, 2014	494mm / 1284g / M	**Y**	July 15, 2013 & July 19, 2012
183	July 11, 2014	516mm / 1554g / F	**Y**	August 1, 2013
184	July 11, 2014	587mm / 2230g / F	**Y**	July 15,2013 & July 30, 2012
185	July 11, 2014	529mm / 1575g / F	**Y**	March 30, 2011
186	July 14, 2014	530mm / 1450g / M	**Y**	
187	July 14, 2014	400mm / 950g / F	**N**	
188	July 14, 2014	425mm / 840g / M	**N**	
189	July 17, 2014	570mm / 1788g / M	**Y**	July 8, 2013
190	July 17, 2014	455mm / 1020g / F	**Y**	July 18, 2013
191	July 17, 2014	488mm / 1248g / F	**Y**	August 2, 2013
192	July 17, 2014	497mm / 1387g / F	**Y**	July 24, 2013
193	July 18, 2014	475mm / 1200g / M	**N**	
194	July 21, 2014	425mm / 900g / F	**N**	
195	July 21, 2014	490mm / 1350g / M	**N**	
196	July 21, 2014	395mm / 700g / M	**N**	
197	July 28, 2014	455mm 1200g / F	**N**	
198	July 28, 2014	470mm / 1250g / M	**Y**	June 24, 2013
199	July 28, 2014	455mm / 1150g / M	**Y**	
200	July 28, 2014	435mm / 900g / M	**N**	
201	July 28, 2014	510mm / 1450g / M	**N**	
202	July 28, 2014	375mm / 400g / F	**N**	
203	July 28, 2014	375mm / 600g / M	**N**	
204	July 28, 2014	430mm / 700g / M	**N**	
205	July 28, 2014	405mm / 610g / M	**N**	
206	July 28, 2014	370mm / 480g / M	**N**	
207	July 29, 2014	463mm / 994g / M	**Y**	July 25, 2013
208	July 29, 2014	465mm / 1014g / M	**Y**	June 3, 2013
209	July 29, 2014	508mm / 1267g / M	**Y**	July 22, 2013
210	July 30, 2014	405mm / 600g / F	**N**	
211	July 30, 2014	435mm / 700g / F	**N**	
212	July 30, 2014	360mm / 375g / F	**N**	

213	July 30, 2014	425mm / 740g / F	**N**	
214	July 30, 2014	410mm / 620g / M	**N**	
215	July 30, 2014	390mm / 480g / M	**N**	
216	August 4, 2014	435mm / 800g / M	**N**	
217	August 4, 2014	450mm / 800g / M	**N**	
218	August 4, 2014	475mm / 1150g / M	**N**	
219	August 4, 2014	485mm / 1240g / M	**N**	
220	August 4, 2014	520mm / 1450g / F	**N**	
221	August 4, 2014	455mm / 1100g / M	**N**	
222	August 4, 2014	425mm / 670g / M	**N**	
223	August 5, 2014	525mm / 1392g / M	**Y**	July 5, 2011
224	August 8, 2014	580mm / 1985g / F	**Y**	July 29, 2013
225	August 8, 2014	510mm / 1500g / M	**Y**	
226	August 11, 2014	530mm / 1300g / F	**Y**	August 1, 2012
227	August 11, 2014	490mm / 1100g / M	**N**	
228	August 11, 2014	490mm / 1100g / F	**N**	
229	August 20, 2014	525mm / F	**Y**	July 16, 2013
230	August 21, 2014	510mm / M	**Y**	July 10, 2013
231	August 22, 2014	496mm / M	**Y**	July 29, 2013

The 2014 table only contains data on bull trout sampled. A total of 406 bull trout were captured and hauled in 2014.

2015 Buckley Trap Bull Trout

	Date Captured	Fork Length (mm) / Sex	Recapture	Original Date(s) Captured	Fork Length/Original Capture
1	March 2, 2015	358mm / M	**N**		
2	March 5, 2015	357mm / M	**N**		
3	March 13, 2015	357mm / M	**N**		
4	May 4, 2015	530mm / F	**N**		
5	May 4, 2015	515mm / M	**Y**	June 9, 2014 **&** July 12, 2013	450mm / 1166g **&** 395mm / 670g
6	May 4, 2015	470mm / M	**N**		
7	May 11, 2015	518mm / M	**Y**	July 12, 2013 **&** June 30, 2014	391mm / 665g **&** 480mm / 1155g
8	May 11, 2015	540mm / M	**Y**	May 30, 2014	488mm / 1404g
9	May 11, 2015	418mm / F	**N**		
10	May 11, 2015	490mm / M	**N**		
11	May 20, 1015	483mm / M	**N**		
12	May 22, 2015	518mm / F	**N**		
13	May 22, 2015	531mm / M	**N**		
14	May 26, 2015	535mm / M	**N**		
15	May 26, 2015	440mm / F	**N**		
16	May 26, 2015	440mm	**N**		

17	May 26, 2015	498mm / M	**N**		
18	May 26, 2015	535mm / M	**Y**	June 20, 2014	513mm / 1517g
19	May 26, 2015	488mm / M	**N**		
20	May 26, 2015	535mm / M	**N**		
21	May 26, 2015	495mm / M	**N**		
22	May 26, 2015	460mm / F	**N**		
23	May 26, 2015	420mm / M	**N**		
24	May 27, 2015	418mm / M	**Y**	May 2, 2014	400mm / 671g
25	May 27, 2015	507mm / F	**N**		
26	May 27, 2015	474mm / F	**N**		
27	May 27, 2015	470mm / F	**N**		
28	May 29, 2015	424mm / F	**N**		
29	May 29, 2015	472mm / F	**N**		
30	May 29, 2015	546mm / M	**N**		
31	May 29, 2015	508mm / M	**N**		
32	May 29, 2015	463mm / F	**N**		
33	May 29, 2015	471mm / M	**N**		
34	May 29, 2015	570mm / F	**Y**	July 30, 2012 **&** July 1, 2013 **&** June 11, 2014	422mm / 810g **&** 490mm/1309g **&** 539mm/1926g
35	May 29, 2015	440mm / M	**N**		
36	May 29, 2015	472mm / F	**N**		
37	June 1, 2015	418mm / F	**N**		
38	June 1, 2015	505mm / M	**Y**	June 27, 2014	430mm / 833g
39	June 1, 2015	545mm / F	**Y**	June 23, 2014	514mm / 1470g
40	June 1, 2015	527mm / F	**N**		
41	June 1, 2015	468mm / F	**N**		
42	June 1, 2015	426mm / M	**N**		
43	June 1, 2015	459mm / F	**N**		
44	June 1, 2015	347mm / M	**N**		
45	June 1, 2015	429mm	**N**		
46	June 1, 2015	467mm	**N**		
47	June 1, 2015	300mm	**N**		
48	June 1, 2015	429mm / M	**N**		
49	June 1, 2015	536mm	**N**		
50	June 1, 2015	402mm	**Y**	June 27, 2014	374mm / 572g
51	June 1, 2015	449mm / M	**Y**	June 4, 2014	385mm / 637g
52	June 1, 2015	524mm / M	**Y**	June 9, 2014	483mm / 1316g

53	June 1, 2015	472mm / M	**Y**	June 27, 2014	385mm / 576g
54	June 2, 2015	505mm / M	**Y**	June 9, 2014	455mm / 1061g
55	June 2, 2015	427mm / M	**Y**	July 30, 2014	405mm / 600g
56	June 2, 2015	515mm / F	**Y**	June 9, 2014 **&** June 19, 2013	481mm/1192g **&** 420mm/843g
57	June 3, 2015	358mm / F	**N**		
58	June 3, 2015	480mm / M	**Y**	July 24, 2013	367mm / 531g
59	June 4, 2015	480mm / F	**N**		
60	June 4, 2015	494mm / F	**N**		
61	June 4, 2015	377mm / F	**N**		
62	June 4, 2015	292mm / M	**N**		
63	June 4, 2015	426mm / M	**N**		
64	June 4, 2015	530mm / M	**Y**	July 19, 2012	385mm / 637g
65	June 4, 2015	487mm / F	**Y**	June 27, 2014	466mm / 1187g
66	June 8, 2015	460mm / F	**N**		
67	June 8, 2015	528mm / M	**N**		
68	June 8, 2015	452mm / F	**N**		
69	June 8, 2015	372mm / M	**N**		
70	June 8, 2015	450mm / M	**N**		
71	June 8, 2015	432mm / F	**N**		
72	June 8, 2015	344mm / M	**N**		
73	June 8, 2015	540mm / M	**Y**		
74	June 8, 2015	577mm / M	**Y**	June 18, 2014	527mm / 1693g
75	June 10, 2015	450mm / F	**N**		
76	June 10, 2015	450mm / F	**N**		
77	June 10, 2015	415mm / M	**N**		
78	June 10, 2015	430mm / M	**N**		
79	June 12, 2015	440mm / F	**N**		
80	June 12, 2015	500mm / F	**N**		
81	June 12, 2015	420mm / M	**N**		
82	June 12, 2015	470mm / M	**N**		
83	June 12, 2015	452mm / F	**N**		
84	June 12, 2015	439mm / M	**N**		
85	June 12, 2015	444mm / M	**N**		
86	June 12, 2015	397mm / M	**N**		
87	June 12, 2015	555mm / M	**Y**	July 16, 2013	474mm / 1133g
88	June 15, 2015	488mm / F	**N**		

89	June 15, 2015	508mm / M	**N**		
90	June 15, 2015	545mm / M	**N**		
91	June 15, 2015	470mm / M	**N**		
92	June 15, 2015	523mm / M	**N**		
93	June 15, 2015	479mm / M	**N**		
94	June 15, 2015	478mm / M	**N**		
95	June 15, 2015	385mm / M	**N**		
96	June 15, 2015	490mm / M	**N**		
97	June 15, 2015	424mm / M	**N**		
98	June 15, 2015	465mm / M	**N**		
99	June 15, 2015	465mm / M	**N**		
100	June 15, 2015	589mm / F	**Y**		
101	June 15, 2015	560mm/ F	**Y**	May 13, 2013	493mm / 1061g
102	June 15, 2015	540mm / M	**Y**	June 27, 2014	502mm / 1430g
103	June 15, 2015	460mm / M	**Y**	June 20, 2014	431mm / 968g
104	June 15, 2015	485mm / M	**Y**	June 23, 2014	430mm / 850g
105	June 17, 2015	399mm / F	**N**		
106	June 17, 2015	449mm / M	**N**		
107	June 17, 2015	303mm / M	**N**		
108	June 17, 2015	550mm / M	**N**		
109	June 17, 2015	505mm / F	**N**		
110	June 17, 2015	492mm / F	**N**		
111	June 17, 2015	440mm / M	**N**		
112	June 17, 2015	432mm / F	**N**		
113	June 17, 2015	455mm / F	**N**		
114	June 17, 2015	420mm / F	**N**		
115	June 17, 2015	328mm / M	**N**		
116	June 17, 2015	544mm / M	**Y**	June 20, 2014	513mm / 1460g
117	June 17, 2015	413mm / M	**Y**	July 30, 2014	360mm / 375g
118	June 17, 2015	545mm / M	**Y**	June 23, 2014 **&** June 26, 2013	511mm/1533g **&** 470mm/1207g
119	June 19, 2015	407mm / M	**N**		
120	June 19, 2015	473mm / F	**N**		
121	June 19, 2015	402mm / M	**N**		
122	June 19, 2015	485mm / M	**N**		
123	June 19, 2015	434mm / F	**N**		
124	June 19, 2015	349mm / M	**N**		

125	June 19, 2015	428mm / F	**N**		
126	June 19, 2015	500mm / F	**N**		
127	June 19, 2015	445mm / F	**N**		
128	June 19, 2015	465mm / M	**N**		
129	June 19, 2015	435mm / F	**Y**	July 8, 2014 **&** July 23, 2013	440mm / 1050g **&** 368mm / 1144g
130	June 19, 2015	490mm / M	**Y**	May 23, 2014	358mm / 493g
131	June 19, 2015	448mm / M	**N**		
132	June 22, 2015	515mm / M	**N**		
133	June 22, 2015	455mm / M	**N**		
134	June 22, 2015	380mm/ M	**N**		
135	June 22, 2015	445mm / M	**N**		
136	June 22, 2015	400mm / M	**N**		
137	June 22, 2015	432mm / F	**N**		
138	June 22, 2015	424mm / F	**N**		
139	June 22, 2015	404mm / M	**N**		
140	June 22, 2015	359mm / M	**N**		
141	June 22, 2015	502mm / F	**N**		
142	June 22, 2015	454mm / M	**N**		
143	June 22, 2015	470mm / M	**Y**	May 23, 2014	400mm / 713g
144	June 23, 2015	478mm / F	**N**		
145	June 23, 2015	419mm / F	**N**		
146	June 23, 2015	475mm / F	**N**		
147	June 23, 2015	428mm / F	**N**		
148	June 23, 2015	408mm / F	**N**		
149	June 23, 2015	370mm / M	**N**		
150	June 23, 2015	482mm / M	**Y**	July 19, 2013	410mm / 717g
151	June 23, 2015	530mm / M	**Y**	August 21, 2014 **&** July 10, 2013	510mm **&** 474mm / 1144g
152	June 24, 2015	467mm / M	**N**		
153	June 24, 2015	401mm / M	**N**		
154	June 25, 2015	532mm / M	**N**		
155	June 25, 2015	425mm / F	**N**		
156	June 25, 2015	480mm / F	**N**		
157	June 25, 2015	480mm / M	**N**		
158	June 25, 2015	420mm / F	**N**		
159	June 25, 2015	454mm / M	**N**		
160	June 25, 2015	412mm / M	**N**		

161	June 25, 2015	474mm / F	**N**		
162	June 25, 2015	520mm / M	**N**		
163	June 25, 2015	365mm / M	**N**		
164	June 25, 2015	493mm / F	**N**		
165	June 25, 2015	383mm / M	**N**		
166	June 25, 2015	434mm/ F	**N**		
167	June 25, 2015	428mm / F	**N**		
168	June 25, 2015	370mm / F	**N**		
169	June 25, 2015	558mm / F	**Y**	June 9, 2014	506mm/1564g
170	June 26, 2015	364mm / M	**N**		
171	June 26, 2015	404mm / M	**N**		
172	June 26, 2015	370mm / M	**N**		
173	June 26, 2015	342mm / M	**N**		
174	June 26, 2015	481mm / F	**N**		
175	June 26, 2015	349mm / M	**N**		
176	June 26, 2015	395mm / F	**N**		
177	June 26, 2015	383mm / M	**N**		
178	June 26, 2015	440mm / M	**N**		
179	June 26, 2015	415mm / M	**N**		
180	June 26, 2015	343mm / M	**N**		
181	June 29, 2015	421mm / F	**N**		
182	June 29, 2015	475mm	**N**		
183	June 29, 2015	530mm	**N**		
184	June 29, 2015	455mm	**N**		
185	June 29, 2015	435mm	**N**		
186	June 29, 2015	385mm	**N**		
187	June 29, 2015	430mm	**N**		
188	June 29, 2015	482mm	**N**		
189	June 29, 2015	435mm	**N**		
190	June 29, 2015	445mm	**N**		
191	June 30, 2015	397mm / M	**N**		
192	June 30, 2015	470mm / F	**N**		
193	June 30, 2015	435mm / M	**N**		
194	July 1, 2015	392mm / M	**N**		
195	July 2, 2015	504mm / F	**N**		
196	July 6, 2015	332mm / M	**N**		

197	July 6, 2015	423mm / F	**N**		
198	July 6, 2015	444mm / M	**N**		
199	July 6, 2015	362mm / M	**N**		
200	July 6, 2015	417mm / M	**N**		
201	July 6, 2015	334mm / M	**N**		
202	July 6, 2015	438mm / F	**N**		
203	July 6, 2015	410mm / M	**N**		
204	July 6, 2015	454mm / M	**N**		
205	July 6, 2015	430mm / M	**N**		
206	July 6, 2015	421mm / M	**N**		
207	July 6, 2015	607mm / M	**Y**	June 16, 2010 & August 3, 2012 & July 17, 2013 & June 23, 2014	415mm / 900g & 550mm/1832g & 560mm/2141g & 601mm/2763g
208	July 6, 2015	476mm / M	**Y**	June 25, 2014	456mm / 1039g
209	July 6, 2015	490mm / M	**N**		
210	July 7, 2015	480mm / M	**Y**	August 4, 2014	455mm / 1100g
211	July 7, 2015	410mm /M	**N**		
212	July 7, 2015	310mm / M	**N**		
213	July 7, 2015	410mm / F	**N**		
214	July 8, 2015	438mm / F	**N**		
215	July 8, 2015	395mm / M	**N**		
216	July 8, 2015	291mm / M	**N**		
217	July 8, 2015	393mm / F	**N**		
218	July 8, 2015	424mm / M	**N**		
219	July 8, 2015	465mm / M	**N**		
220	July 10, 2015	422mm / F	**N**		
221	July 10, 2015	373mm / M	**N**		
222	July 13, 2015	420mm / F	**N**		
223	July 13, 2015	348mm / M	**N**		
224	July 13, 2015	410mm / M	**N**		
225	July 13, 2015	405mm / M	**N**		
226	July 13, 2015	430mm / F	**N**		
227	July 13, 2015	427mm / M	**Y**	May 11, 2015	418mm
228	July 13, 2015	505mm / F	**Y**	July 16, 2013 & June 27, 2014	430mm / 875g & 480mm/1249g
229	July 13, 2015	560mm / M	**Y**	July 9, 2012 & June 23, 2014	403mm/771g & 531mm/1732g
230	July 13, 2015	540mm / M	**Y**	June 20, 2014	505mm / 1478g
231	July 14, 2015	395mm / F	**N**		
232	July 14, 2015	420mm / M	**N**		

233	July 15, 2015	362mm / M	**N**		
234	July 15, 2015	348mm / M	**N**		
235	July 16, 2015	423mm / M	**N**		
236	July 16, 2015	385mm / M	**N**		
237	July 16, 2015	417mm / M	**N**		
238	July 20, 2015	450mm / F	**N**		
239	July 20, 2015	422mm / F	**N**		
240	July 20, 2015	434mm / F	**N**		
241	July 20, 2015	355mm / F	**N**		
242	July 20, 2015	410mm / F	**Y**	July 28, 2014	375mm / 400g
243	July 20, 2015	483mm / M	**Y**	June 25, 2014	479mm / 1211g
244	July 21, 2015	405mm / M	**N**		
245	July 21, 2015	430mm / F	**N**		
246	July 21, 2015	387mm / M	**N**		
247	July 21, 2015	528mm / M	**Y**	August 1, 2013	462mm / 1045g
248	July 22, 2015	440mm / F	**N**		
249	July 22, 2015	405mm / F	**N**		
250	July 22, 2015	468mm / M	**N**		
251	July 22, 2015	318mm / M	**N**		
252	July 23, 2015	425mm / M	**N**		
253	July 27, 2015	428mm / M	**N**		
254	July 27, 2015	426mm / F	**N**		
255	July 27, 2015	388mm / F	**N**		
256	July 27, 2015	398mm / M	**N**		
257	July 28, 2015	434mm/ M	**N**		
258	July 28, 2015	477mm / M	**Y**	June 20, 2014	470mm / 1273g
259	July 29, 2015	423mm / F	**N**		
260	July 29, 2015	488mm / M	**N**		
261	July 30, 2015	428mm / M	**N**		
262	July 30, 2015	395mm / M	**N**		
263	July 31, 2015	473mm / F	**N**		
264	July 31, 2015	407mm / M	**N**		
265	August 3, 2015	372mm / M	**N**		
266	August 3, 2015	405mm / F	**N**		

The 2015 table only contains data on bull trout sampled; not the total number of bull trout captured and transported.

2016 Buckley Trap Bull Trout

	Date Captured	Fork Length (mm)/ Sex	Recapture	Original Date(s) Captured	Fork Length & Weight/Original Capture
1	February 2, 2016	535mm / M	N		
2	February 2, 2016	335mm / M	N		
3	March 3. 2016	430mm / M	N		
4	March 4, 2016	495mm / F	N		
5	March 4, 2016	460mm / M	N		
6	March 11, 2016	444mm / F	Y	June 1, 2015	429mm
7	March 23, 2016	593mm / F	N		
8	March 23, 2016	365mm / M	N		
9	March 23, 2016	503mm / M	N		
10	March 23, 2016	399mm / M	N		
11	March 25, 2016	388mm / M	N		
12	March 25, 2016	502mm / M	Y	June 23, 2014	410mm / 783g
13	April 4, 2016	392mm / M	N		
14	April 4, 2016	427mm / F	N		
15	April 4, 2016	335mm	N		
16	April 4, 2016	421mm / F	N		
17	April 4, 2016	404mm / F	N		
18	April 4, 2016	555mm / M	Y	June 20, 2014	483mm / 1322g
19	April 8, 2016	435mm / F	N		
20	April 8, 2016	488mm / M	Y	June 20, 2014 & June 15, 2015	431mm / 968g & 460mm
21	April 11, 2016	362mm / F	N		
22	April 22, 2016	352mm / M	N		
23	May 2, 2016	500mm / F	N		
24	May 2, 2016	405mm / F	N		
25	May 2, 2016	590mm / M	N		
26	May 2, 2016	514mm / M	N		
27	May 2, 2016	520mm / M	Y	May 4, 2015	470mm
28	May 2, 2016	575mm / F	Y	June 15, 2015	523mm
29	May 4, 2016	365mm / M	N		
30	May 9, 2016	583mm / M	N		
31	May 9, 2016	517mm / F	N		
32	May 9, 2016	530mm / M	N		
33	May 9, 2016	320mm / M	N		
34	May 9, 2016	540mm / F	N		
35	May 11, 2016	461mm / F	N		
36	May 13, 2013	410mm / F	N		
37	May 13, 2013	549mm / F	Y	May 22, 2015	518mm
38	May 13, 2013	430mm / F	N		
39	May 13, 2013	371mm / M	N		
40	May 13, 2013	495mm / M	N		
41	May 13, 2013	458mm / F	N		
42	May 16, 2016	511mm / M	N		

43	May 16, 2016	542mm / M	**N**		
44	May 16, 2016	568mm / M	**N**		
45	May 16, 2016	391mm / M	**N**		
46	May 16, 2016	394mm / F	**N**		
47	May 16, 2016	535mm / M	**Y**	June 1, 2015	467mm
48	May 16, 2016	593mm / M	**Y**	June 9, 2014 & June 25, 2015	506mm/1564g & 558mm
49	May 16, 2016	552mm / M	**Y**	July 12, 2013 **&** June 30, 2014 & May 11, 2015	391mm / 665g **&** 480mm / 1155g & 518mm
50	May 26, 2016	481mm / F	**N**		
51	May 26, 2016	565mm / M	**N**		
52	May 26, 2016	456mm / M	**N**		
53	May 31, 2016	540mm / M	**N**		
54	May 31, 2016	484mm / M	**Y**	June 22, 2015	380mm
55	June 1, 2016	558mm / M	**N**		
56	June 1, 2016	545mm / F	**N**		
57	June 1, 2016	550mm / F	**Y**	May 26, 2015	498mm
58	June 3, 2016	478mm / F	**N**		
59	June 3, 2016	502mm / F	**Y**	June 29, 2015	435mm
60	June 3, 2016	482mm / F	**Y**	July 6, 2015	410mm
61	June 6, 2016	473mm / F	**N**		
62	June 6, 2016	468mm / F	**N**		
63	June 6, 2016	461mm / M	**N**		
64	June 6, 2016	464mm / F	**N**		
65	June 6, 2016	482mm / M	**N**		
66	June 6, 2016	492mm F	**N**		
67	June 6, 2016	535mm / M	**N**		
68	June 6, 2016	440mm / M	**N**		
69	June 6, 2016	420mm / F	**Y**	June 12, 2015	439mm
70	June 6, 2016	485mm / M	**Y**	July 30, 2014 & June 2, 2015	405mm / 600g & 427mm
71	June 6, 2016	580mm / M	**Y**	July 30, 2012 & July 1, 2013 & June 16, 2014 & May 29, 2015	422mm / 810g & 490mm/1100g & 539mm/1916g & 570mm
72	June 6, 2016	592mm / F	**Y**	June 25, 2015	532mm
73	June 7, 2016	477mm / F	**N**		
74	June 7, 2016	438mm / F	**N**		
75	June 8, 2016	534mm / F	**N**		
76	June 8, 2016	510mm / F	**N**		
77	June 8, 2016	563mm / F	**N**		
78	June 8, 2016	507mm / F	**Y**	June 15, 2015	465mm
79	June 10, 2016	361mm / M	**N**		
80	June 10, 2016	501mm / F	**N**		
81	June 10, 2016	510mm / M	**N**		
82	June 10, 2016	478mm / F	**N**		
83	June 10, 2016	480mm / M	**N**		
84	June 10, 2016	427mm / F	**N**		
85	June 10, 2016	488mm / F	**Y**	June 19, 2015	445mm
86	June 10, 2016	565mm / F	**Y**	July 2, 2015	504mm
87	June 13, 2016	503mm / M	**N**		

88	June 13, 2016	410mm / F	**N**		
89	June 13, 2016	495mm / M	**N**		
90	June 13, 2016	414mm / M	**N**		
91	June 13, 2016	460mm / M	**N**		
92	June 13, 2016	502mm / F	**N**		
93	June 13, 2016	435mm / F	**N**		
94	June 13, 2016	455mm / F	**N**		
95	June 13, 2016	470mm / F	**N**		
96	June 13, 2016	472mm / F	**N**		
97	June 13, 2016	512mm / M	**N**		
98	June 13, 2016	505mm / F	**N**		
99	June 13, 2016	475mm / M	**N**		
100	June 13, 2016	436mm / F	**N**		
101	June 13, 2016	418mm / M	**N**		
102	June 13, 2016	540mm / M	**N**		
103	June 13, 2016	476mm / F	**N**		
104	June 13, 2016	441mm / F	**N**		
105	June 13, 2016	466mm / F	**N**		
106	June 13, 2016	470mm / F	**N**		
107	June 13, 2016	481mm / M	**N**		
108	June 13, 2016	492mm / M	**N**		
109	June 13, 2016	456mm / F	**N**		
110	June 13, 2016	550mm / M	**Y**	June 19, 2013 & June 9, 2014 & June 2, 2015	420mm / 843g & 481mm/1428g & 515mm
111	June 13, 2016	576mm / M	**Y**	June 29, 2015	530mm
112	June 13, 2016	585mm / M	**Y**	July 16, 2013 & June 27, 2014 & June 12, 2015	474mm/1133g & 520mm/1461g & 555mm
113	June 13, 2016	525mm / F	**Y**	June 25, 2015	480mm
114	June 13, 2016	495mm / F	**Y**	June 23, 2015	408mm
115	June 13, 2016	475mm / M	**Y**	June 23, 2015	370mm
116	June 13, 2016	535mm / F	**Y**	July 31, 2015	473mm
117	June 13, 2016	540mm / M	**Y**	June 25, 2015	480mm
118	June 13, 2016	450mm / M	**Y**	June 22, 2015	404mm
119	June 13, 2016	574mm / M	**Y**	May 13, 2013 & June 16, 2015	493mm / 1061g & 550mm
120	June 13, 2016	524mm / M	**Y**	June 29, 2015	475mm
121	June 13, 2016	476mm / F	**Y**	June 12, 2015	440mm
122	June 13, 2016	469mm / M	**Y**	June 8, 2015	372mm
123	June 14, 2016	491mm / F	**N**		
124	June 14, 2016	389mm / F	**N**		
125	June 14, 2016	469mm / M	**Y**	June 8, 2015	372mm
126	June 15, 2016	482mm / F	**N**		
127	June 15, 2016	422mm / F	**N**		
128	June 17, 2016	460mm / F	**N**		
129	June 17, 2016	444mm / F	**N**		
130	June 17, 2016	347mm / M	**N**		
131	June 20, 2016	486mm / M	**N**		
132	June 20, 2016	480mm / F	**N**		

133	June 20, 2016	518mm / F	**Y**	June 15, 2015	490mm
134	June 20, 2016	538mm / M	**Y**	June 27, 2014	475mm / 1217g
135	June 20, 2016	458mm / M	**Y**	June 24, 2015	401mm
136	June 20, 2016	590mm / M	**Y**	June 23, 2015 & June 1, 2015	514mm / 1470g & 545mm
137	June 21, 2016	380mm / M	**N**		
138	June 21, 2016	482mm / M	**N**		
139	June 21, 2016	488mm / M	**Y**	June 12, 2015	420mm
140	June 21, 2016	501mm / M	**N**		
141	June 22, 2016	520mm / M	**N**		
142	June 22, 2016	270mm / NA	**N**		
143	June 23, 2016	445mm / M	**N**		
144	June 24, 2016	442mm / M	**N**		
145	June 24, 2016	478m / F	**N**		
146	June 24, 2016	402mm / M	**N**		
147	June 24, 2016	430mm / M	**N**		
148	June 24, 2016	451mm / M	**Y**	July 27, 2015	388mm
149	June 27, 2016	299mm / M	**N**		
150	June 28, 2016	402mm / M	**N**		
151	June 28, 2016	395mm / M	**N**		
152	June 28, 2016	478mm / F	**N**		
153	June 28, 2016	490mm / F	**N**		
154	June 28, 2016	499mm / F	**N**		
155	June 28, 2016	468mm / M	**Y**	July 21, 2015	405mm
156	June 29, 2016	352mm / M	**N**		
157	June 29, 2016	385mm / M	**N**		
158	June 29, 2016	427mm / M	**N**		
159	June 29, 2016	437mm / M	**N**		
160	June 29, 2016	463mm / F	**N**		
161	June 29, 2016	348mm / M	**N**		
162	June 29, 2016	458mm / F	**N**		
163	June 29, 2016	371mm / M	**N**		
164	June 29, 2016	335mm / M	**N**		
165	June 29, 2016	374mm / F	**N**		
166	June 29, 2016	377mm / M	**N**		
167	June 29, 2016	370mm / F	**N**		
168	June 29, 2016	430mm / F	**N**		
169	June 29, 2016	477mm / F	**Y**	July 8, 2015	395mm
170	June 29, 2016	545mm / F	**Y**	July 16, 2013 & June 27, 2014 & July 13, 2015	430mm / 875g & 480mm/1249g & 505mm
171	June 29, 2016	499mm / F	**Y**	June 17, 2015	440mm
172	June 29, 2016	480mm / F	**Y**	June 4, 2015	426mm / M
173	June 29, 2016	437mm / M	**Y**	June 17, 2015	328mm
174	June 29, 2016	460mm / F	**Y**	June 23, 2015	428mm
175	June 29, 2016	495mm / F	**Y**	June 27, 2014	412mm / 794g
176	June 30, 2016	505mm / M	**Y**	July 8, 2015	438mm
177	June 30, 2016	465mm / M	**Y**	July 10, 2015	373mm

178	June 30, 2016	460mm / M	**Y**	July 21, 2015	430mm
179	June 30, 2016	350mm / F	**N**		
180	June 30, 2016	391mm / F	**N**		
181	June 30, 2016	445mm / M	**N**		
182	June 30, 2016	418mm / F	**N**		
183	June 30, 2016	500mm / M	**N**		
184	June 30, 2016	485mm / M	**N**		
185	June 30, 2016	395mm / F	**N**		
186	June 30, 2016	403mm / M	**N**		
187	June 30, 2016	345mm / F	**N**		
188	June 30, 2016	503mm / M	**N**		
189	June 30, 2016	371mm / M	**N**		
190	June 30,2016	472mm / M	**Y**	July 16, 2015	417mm
191	July 1, 2016	489mm / M	**N**		
192	July 1, 2016	355mm / F	**N**		
193	July 1, 2016	466mm / M	**N**		
194	July 1, 2016	434mm / M	**N**		
195	July 1, 2016	435mm / M	**N**		
196	July 1, 2016	449mm / F	**N**		
197	July 1, 2016	425mm / F	**N**		
198	July 1, 2016	467mm / M	**N**		
199	July 1, 2016	412mm / F	**N**		
200	July 1, 2016	365mm / M	**N**		
201	July 1, 2016	363mm / M	**N**		
202	July 1, 2016	435mm / F	**Y**	June 19, 2015	349mm
203	July 1, 2016	509mm / F	**Y**	May 29, 2015	472mm
204	July 1, 2016	48mm / F	**Y**	June 8, 2015	452mm
205	July 1, 2016	455mm / M	**Y**	June 26, 2015	342mm
206	July 3, 2016	453mm / F	**N**		
207	July 3, 2016	440m / F	**N**		
208	July 3, 2016	475mm / F	**N**		
209	July 3, 2016	470mm / M	**N**		
210	July 3, 2016	370mm / M	**N**		
211	July 3, 2016	520mm / F	**N**		
212	July 3, 2016	462mm / M	**Y**	June 19, 2015	402mm
213	July 3, 2016	470mm / M	**Y**	June 30, 2015	435mm
214	July 3, 2016	447mm / M	**N**		
215	July 5, 2016	458mm / M	**N**		
216	July 5, 2016	445mm / F	**N**		
217	July 5, 2016	375mm / M	**N**		
218	July 5, 2016	468mm / M	**N**		
219	July 5, 2016	413mm / M	**N**		
220	July 5, 2016	414mm / M	**N**		
221	July 5, 2016	484mm / M	**N**		
222	July 5, 2016	395mm / F	**N**		

223	July 5, 2016	438mm / F	**N**		
224	July 5, 2016	427mm / M	**N**		
225	July 5, 2016	566mm / F	**Y**	June 22, 2012 & August 1, 2013 **&** June 27, 2014	512mm / 1441g **&** 491mm / 1365g & 541mm / 1778g
226	July 6, 2016	354mm / M	**N**		
227	July 7, 2016	452mm / F	**N**		
228	July 7, 2016	405mm / F	**N**		
229	July 7, 2016	504mm / F	**N**		
230	July 7, 2016	518mm / M	**N**		
231	July 7, 2016	498mm / F	**N**		
232	July 7, 2016	468mm / M	**Y**	July 13, 2015	405mm
233	July 7, 2016	524mm / F	**Y**	June 8, 2015	460mm
234	July 7, 2016	528mm / M	**Y**	August 4, 2014 & July 7, 2015	455mm /1100g & 480mm
235	July 8, 2016	394mm / F	**N**		
236	July 8, 2016	471mm / F	**N**		
237	July 8, 2016	451mm / M	**N**		
238	July 8, 2016	345mm / F	**N**		
239	July 8, 2016	399mm / M	**N**		
240	July 8, 2016	469mm / M	**N**		
241	July 8, 2016	456mm / M	**N**		
242	July 8, 2016	435mm / M	**N**		
243	July 8, 2016	461mm / M	**N**		
244	July 8, 2016	475mm / M	**Y**	July 1, 2015	392mm
245	July 8, 2016	511mm / F	**Y**	June 19, 2015	465mm
246	July 9, 2016	367mm / M	**N**		
247	July 9, 2016	348mm / M	**N**		
248	July 9, 2016	441mm / F	**N**		
249	July 9, 2016	505mm / M	**N**		
250	July 9, 2016	514mm / M	**Y**	July 6, 2015	454mm
251	July 9, 2016	502mm / M	**Y**	June 25, 2015	474mm
252	July 9, 2016	450mm / F	**Y**	June 3, 2015	358mm
253	July 11, 2016	456mm / F	**N**		
254	July 11, 2016	439mm / F	**N**		
255	July 11, 2016	411mm / M	**N**		
256	July 11, 2016	415mm / F	**N**		
257	July 12, 2016	504mm / M	**N**		
258	July 12, 2016	430mm / F	**N**		
259	July 12, 2016	560mm / F	**Y**	June 22, 2015	502mm
260	July 13, 2016	456mm / M	**N**		
261	July 13, 2016	418mm / F	**N**		
262	July 13, 2016	319mm / M	**N**		
263	July 13, 2016	491mm / M	**Y**	Not Found	
264	July 14, 2016	452mm / F	**N**		
265	July 14, 2016	445mm / F	**N**		
266	July 14, 2016	396mm / F	**N**		
267	July 14, 2016	521mm / F	**Y**	May 29, 2015	463mm

268	July 14, 2016	497mm / F	**Y**	July 6, 2015	421mm
269	July 15, 2016	462mm / F	**N**		
270	July 15, 2016	383mm / M	**N**		
271	July 15, 2016	487mm / F	**Y**	June 23, 2015	419mm
272	July 15, 2016	568mm / M	**Y**	June 26, 2013 & June 23, 2014 **&** June 17, 2015	511mm/1533g **&** 470mm/1207g & 545mm
273	July 18, 2016	448mm / M	**N**		
274	July 18, 2016	517mm / M	**N**		
275	July 18, 2016	569mm / M	**Y**	June 4, 2015	494mm
276	July 19, 2016	359mm / M	**N**		
277	July 19, 2016	410mm / M	**Y**	May 13, 2013	410mm
278	July 19, 2016	439mm / M	**Y**	July 16, 2015	385mm
279	July 20, 2016	300mm / M	**N**		
280	July 20, 2016	536mm / F	**Y**	June 17, 2015	492mm
281	July 20, 2016	455mm / F	**Y**	Not Found	
282	July 21, 2016	498mm / F	**N**		
283	July 21, 2016	402mm / M	**N**		
284	July 21, 2016	450mm / F	**N**		
285	July 21, 2016	398mm / M	**N**		
286	July 21, 2016	435mm / M	**Y**	July 13, 2015	348mm
287	July 21, 2016	429mm / M	**Y**	July 20, 2015	355mm
288	July 22, 2016	436mm / F	**N**		
289	July 23, 2016	378mm / M	**N**		
290	July 25, 2016	460mm / M	**N**		
291	July 25, 2016	415mm / F	**N**		
292	July 25, 2016	338mm / M	**N**		
293	July 26, 2016	472mm / M	**N**		
294	July 26, 2016	318mm / F	**N**		
295	July 26, 2016	588mm / F	**Y**	June 27, 2014	530mm / 1511g
296	July 26, 2016	451mm / M	**Y**	June 26, 2015	395mm
297	July 27, 2016	331mm / F	**N**		
298	July 27, 2016	451mm / M	**N**		
299	July 27, 2016	379mm / F	**N**		
300	July 28, 2016	352mm / F	**N**		
301	July 28, 2016	348mm / F	**N**		
302	July 29, 2016	342mm / F	**N**		
303	July 29, 2016	376mm / F	**N**		
304	July 30, 2016	386mm / M	**N**		
305	July 31, 2016	483mm / M	**Y**	July 10, 2015	422mm
306	August 1, 2016	348mm / F	**N**		
307	August 2, 2016	385mm / M	**N**		
308	August 2, 2016	400mm / M	**N**		
309	August 2, 2016	429mm / F	**N**		
310	August 4, 2016	456mm / M	**N**		
311	August 4, 2016	390mm / F	**N**		
312	August 4, 2016	464mm / M	**N**		

313	August 4, 2016	471mm / F	**NA**		
314	August 4, 2016	449mm / M	**Y**	July 28, 2014 & July 20, 2015	375mm / 400g & 410mm
315	August 5, 2016	360mm / F	**N**		
316	August 5, 2016	362mm / F	**N**		
317	August 5, 2016	385mm/ F	**N**		
318	August 6, 2016	500mm / F	**N**		
319	August 6, 2016	424mm / F	**N**		
320	August 6, 2016	420mm / F	**N**		
321	August 7, 2016	541mm / M	**N**		
322	August 8, 2016	373mm / M	**N**		
323	August 8, 2016	396mm / F	**N**		
324	August 8, 2016	411mm / F	**N**		
325	August 10, 2016	393mm / F	**N**		
326	August 10, 2016	451mm / M	**N**		
327	August 10, 2016	465mm / M	**N**		
328	August 11, 2016	421mm / M	**N**		
329	August 11, 2016	404mm / F	**N**		
330	August 12, 2016	477mm / M	**N**		
331	August 12, 2016	404mm / M	**N**		
332	August 13, 206	383mm / F	**N**		
333	August 16, 206	362mm / M	**N**		
334	August 21, 2016	546mm / M	**N**		
335	August 22, 2016	399mm / M	**N**		
336	August 30, 2016	429mm / F	**N**		
337	August 30, 2016	391mm / F	**N**		

2017 Buckley Trap Bull Trout Sampled

	Date Captured	Fork Length (mm)/ Sex	Recapture	Original Date(s) Captured	Fork Length & Weight/Original Capture
1	January 20, 2017	316mm / F	**N**		
2	February 13, 2017	441mm / M	**N**		
3	February 27, 2017	463mm / M	**N**		
4	March 10, 2017	382mm / M	**N**		
5	March 15, 2017	459mm / M	**N**		
6	March 20, 2017	441mm / M	**N**		
7	March 20, 2017	449mm / M	**N**		
8	March 22, 2017	438mm / M	**N**		
9	March 24, 2017	445mm / M	**N**		
10	March 24, 2017	385mm / M	**N**		
11	March 24, 2017	388mm / M	**N**		
12	March 31, 2017	445mm / M	**N**		
13	May 22, 2017	495mm / F	**N**		
14	May 22, 2017	619mm / F	**Y**	June, 15, 2015 & May, 2, 2016	523mm & 575mm
15	May 22, 2017	590mm / F	**Y**	May 26, 2015 & June 1, 2016	498mm & 550mm
16	May 22, 2017	475mm / F	**N**		

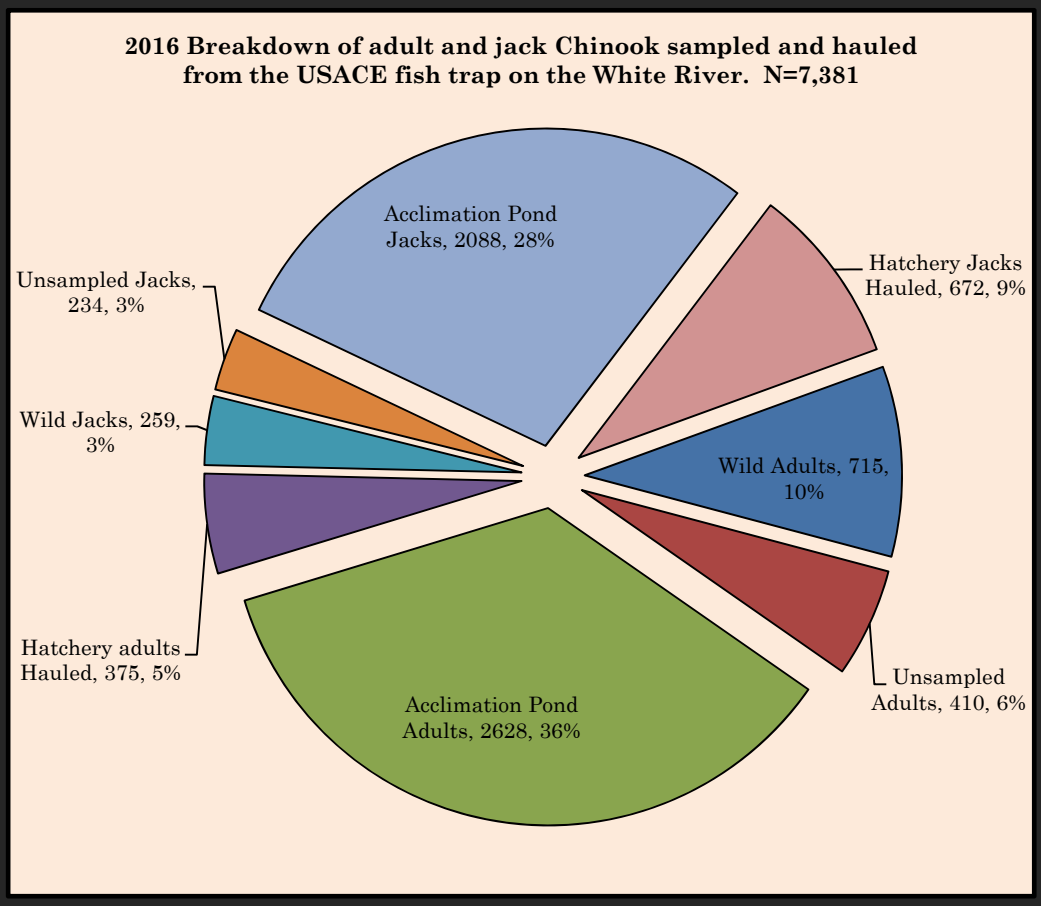
17	May 24, 2017	450mm / M	N		
18	May 24, 2017	590mm / M	Y	July 12, 2013 & June 30, 2014 & May 11, 2015 & May 16, 2016	391mm/665g & 480mm/1155g & 518mm & 593mm
19	May 24, 2017	568mm / M	Y	May 16, 2016	542mm
20	May 26, 2017	595mm / M	Y	May 13, 2013 & June 15, 2015 & June 13, 2016	493mm & 560mm & 574mm
21	May 30, 2017	465mm / F	N		
22	May 30, 2017	508mm / F	N		
23	May 30, 2017	530mm / F	Y	May 26, 2016	481mm
24	June 5, 2017	549mm / F	Y	May 16, 2016	511mm
25	June 5, 2017	535mm / M	Y	June 22, 2015 & May 31, 2016	380mm & 484mm
26	June 5, 2017	498mm / M	Y	July 30, 2014 & June 17, 2015	360mm & 413mm
27	June 5, 2017	535mm / F	Y	June 3, 2016	478mm
28	June 7, 2017	376mm / F	N		
29	June 7, 2017	406mm / F	N		
30	June 9, 2017	499mm / M	N		
31	June 9, 2017	469mm / F	N		
32	June 9, 2017	492mm / M	N		
33	June 9, 2017	465mm / F	N		
34	June 9, 2017	445mm / F	N		
35	June 9, 2017	629mm /M	Y	May 2, 2016	590mm
36	June 9, 2017	543mm / F	Y	June 25, 2015	434mm
37	June 16, 2017	457mm / M	N		
38	June 16, 2017	492mm /F	N		
39	June 16, 2017	484mm / F	N		
40	June 16, 2017	447mm / F	N		
41	June 16, 2017	520mm / F	N		
42	June 16, 2017	498mm / M	N		
43	June 16, 2017	460mm / M	N		
44	June 16, 2017	459mm / F	N		
45	June 16, 2017	484mm	N		
46	June 16, 2017	448mm / F	N		
47	June 16, 2017	440mm / M	N		
48	June 16, 2017	503mm / M	N		
49	June 16, 2017	592mm / M	Y	June 1, 2015 & May 16, 2016	467mm & 535mm
50	June 16, 2017	570mm / M	Y	June 8, 2016	534mm
51	June 16, 2017	520mm / F	Y	June 13, 2016	502mm
52	June 16, 2017	490mm / M	Y	May 16, 2016	568mm
53	June 19, 2017	503mm / M	N		
54	June 19, 2017	490mm / M	N		
55	June 19, 2017	464mm / F	N		
56	June 19, 2017	456mm / M	N		
57	June 19, 2017	415mm / M	Y	June 30, 2016	371mm
58	June 19, 2017	425mm / M	Y	August 30, 2016	391mm
59	June 20, 2017	545mm / F	N		
60	June 20, 2017	536mm / M	N		
61	June 20, 2017	445mm / F	N		

62	June 20, 2017	431mm / F	**N**		
63	June 20, 2017	585mm / F	**Y**	May 9, 2016	540mm
64	June 20, 2017	475mm / F	**Y**	July 12, 2016	430mm
65	June 20, 2017	615mm/ F	**Y**	July 2, 2015 & June 10, 2016	504mm & 565mm
66	June 20, 2017	499mm / F	**Y**	June 7, 2016	438mm
67	June 20, 2017	505mm / M	**Y**	June 6, 2016	473mm
68	June 21, 2017	498mm / F	**N**		
69	June 21, 2017	479mm / F	**N**		
70	June 21, 2017	454mm / F	**N**		
71	June 21, 2017	414mm / M	**N**		
72	June 21, 2017	521mm / F	**Y**	May 2, 2016	500mm
73	June 22, 2017	480mm / M	**N**		
74	June 22, 2017	460mm / F	**N**		
75	June 22, 2017	453mm / F	**N**		
76	June 22, 2017	528mm / M	**N**		
77	June 22, 2017	476mm / M	**Y**	June 13, 2016	456mm
78	June 22, 2017	552mm / M	**Y**	June 13, 2016	540mm
79	June 24, 2017	503mm / F	**N**		
80	June 24, 2017	470mm / M	**N**		
81	June 24, 2017	461mm / F	**N**		
82	June 24, 2017	465mm / F	**N**		
83	June 24, 2017	475mm / M	**Y**	July 7, 2016	405mm
84	June 26, 2017	455mm / F	**N**		
85	June 26, 2017	430mm / F	**N**		
86	June 26, 2017	479mm / M	**Y**	June 21, 2016	482mm
87	June 26, 2017	415mm / M	**Y**	June 28, 2016	402mm
88	June 26, 2017	539mm / F	**Y**	June 13, 2016	472mm
89	June 26, 2017	531mm / M	**Y**	July 7, 2016	518mm
90	June 26, 2017	598mm / F	**Y**	March 23, 2016	593mm
91	June 26, 2017	595mm / M	**Y**	June 25, 2015 & June 13, 2016	480mm & 540mm
92	June 26, 2017	490mm / F	**Y**	June 13, 2016	466mm
93	June 27, 2017	429mm / M	**N**		
94	June 27, 2017	405mm / M	**N**		
95	June 27, 2017	409mm / M	**N**		
96	June 27, 2017	412mm / M	**N**		
97	June 27, 2017	518mm / F	**Y**	June 13, 2016	476mm
98	June 27, 2017	613mm / M	**Y**	June 6, 2014 & June 25, 2015 & May 16, 2016	506mm/1766g & 558mm & 593mm
99	June 27, 2017	449mm / M	**Y**	July 3, 2016	370mm
100	June 28, 2017	419mm / M	**N**		
101	June 28, 2017	484mm / M	**N**		
102	June 28, 2017	412mm / M	**N**		
103	June 28, 2017	450mm / M	**N**		
104	June 28, 2017	395mm / M	**N**		
105	June 28, 2017	494mm / F	**N**		
106	June 28, 2017	491mm / F	**Y**	June 6, 2016	464mm

107	June 29, 2017	462mm / F	**N**		
108	June 29, 2017	574mm / M	**Y**	July 9, 2016	505mm
109	June 29, 2017	495mm / F	**Y**	June 23, 2016	445mm
110	June 29, 2017	521mm / M	**Y**	June 15, 2015 & June 8, 2016	465mm & 507mm
111	June 29, 2017	472mm / M	**Y**	July 21, 2016	402mm
112	June 30, 2017	472mm / F	**N**		
113	June 30, 2017	453mm / F	**N**		
114	June 30, 2017	373mm / F	**N**		
115	June 30, 2017	480mm / M	**Y**	June 13, 2016	436mm
116	June 30, 2017	490mm / F	**Y**	June 30, 2016	445mm
117	June 30, 2017	504mm / F	**Y**	June 12, 2015 & June 13, 2016	440mm & 476mm
118	June 30, 2017	515mm / M	**Y**	July 6, 2015 & June 3, 2016	410mm & 482mm
119	July 1, 2017	443mm / F	**N**		
120	July 1, 2017	390mm / F	**N**		
121	July 1, 2017	405mm / M	**N**		
122	July 1, 2017	519mm / F	**Y**	June 19, 2015 & June 10, 2016	445mm & 488mm
123	July 1, 2017	470mm / M	**Y**	July 8, 2016	435mm
124	July 1, 2017	468mm / F	**Y**	July 5, 2016	413mm
125	July 3, 2017	425mm / F	**N**		
126	July 3, 2017	445mm / F	**N**		
127	July 3, 2017	535mm / F	**Y**	June 19, 2015 & July 11, 2016	465mm & 511mm
128	July 3, 2017	496mm / M	**Y**	July 21, 2015 & June 28, 2016	405mm & 468mm
129	July 3, 2017	465mm / M	**Y**	June 29, 2016	377mm
130	July 3, 2017	510mm / M	**Y**	July 18, 2016	517mm
131	July 5, 2017	369mm / M	**N**		
132	July 5, 2017	548mm / M	**Y**	June 13, 2016	503mm
133	July 6, 2017	442mm / F	**N**		
134	July 6, 2017	514mm / F	**N**		
135	July 6, 2017	549mm / M	**Y**	July 6. 2015 & July 9, 2016	454mm & 514mm
136	July 7, 2017	453mm / F	**N**		
137	July 10, 2017	423mm / M	**N**		
138	July 11, 2017	431mm / F	**N**		
139	July 11, 2017	433mm / M	**N**		
140	July 11, 2017	454mm / F	**N**		
141	July 11, 2017	481mm / M	**Y**	July 9, 2016	441mm
142	July 11, 2017	457mm / M	**Y**	June 28, 2016	395mm
143	July 12, 2017	437mm / M	**N**		
144	July 12, 2017	299mm / M	**N**		
145	July 12, 2017	464mm / F	**N**		
146	July 12, 2017	429mm / F	**N**		
147	July 13, 2017	521mm / M	**N**		
148	July 13, 2017	485mm / F	**N**		
149	July 14, 2017	452mm / M	**N**		
150	July 17, 2017	439mm / F	**N**		
151	July 17, 2017	491mm / M	**N**		

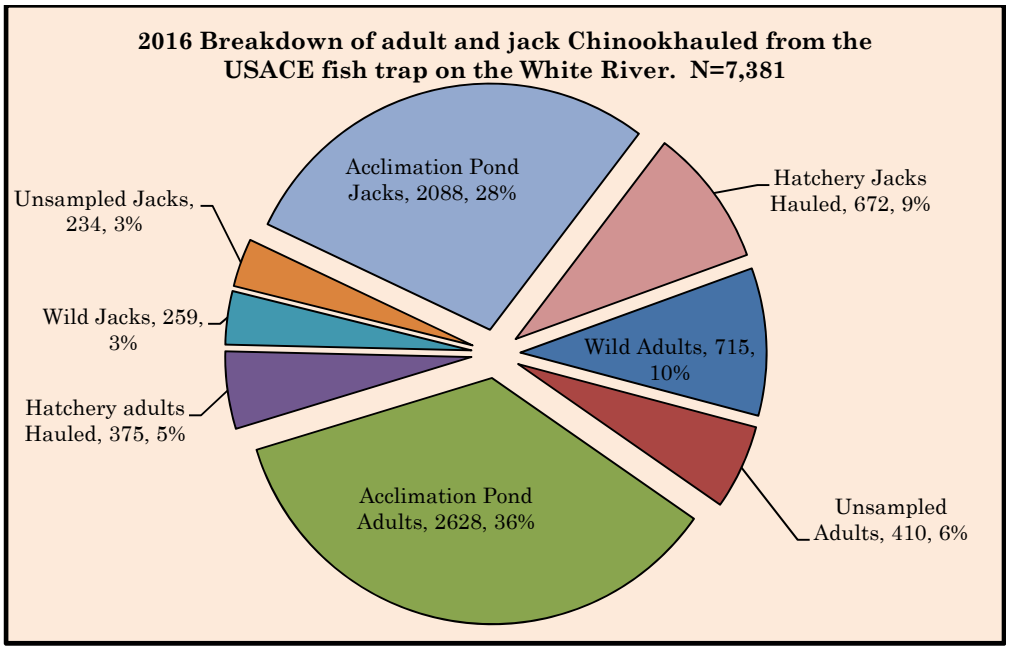
152	July 17, 2017	465mm / M	**N**		
153	July 17, 2017	453mm / M	**Y**	July 30, 2016	386mm
154	July 18, 2017	351mm / M	**N**		
155	July 18, 2017	424mm / F	**N**		
156	July 18, 2017	404mm / F	**N**		
157	July 18, 2017	476mm / M	**N**		
158	July 18, 2017	500mm / M	**N**		
159	July 18, 2017	543mm / M	**Y**	May 2, 2016	514mm
160	July 18, 2017	483mm / F	**Y**	July 20, 2016	455mm
161	July 19, 2017	354mm / M	**N**		
162	July 20, 2017	420mm / F	**N**		
163	July 20, 2017	415mm / F	**N**		
164	July 20, 2017	435mm / M	**Y**	July 11, 2016	411mm
165	July 20, 2017	525mm / M	**Y**	June 25, 2015 & July 09, 2016	474mm & 505mm
166	July 20, 2017	485mm / M	**Y**	June 26, 2015 & July 26, 2016	395mm & 451mm
167	July 20, 2017	415mm / F	**Y**	August 1, 2016	348mm
168	July 24, 2017	503mm / M	**Y**	June 13, 2016	470mm
169	July 25, 2017	434mm / M	**N**		
170	July 25, 2017	458mm / M	**Y**	August 11, 2016	421mm
171	July 25, 2017	465mm / M	**Y**	July 15, 2016	383mm
172	July 25, 2017	561mm / M	**Y**	June 20, 2014 & April 4, 2016	483mm & 555mm
173	July 26, 2017	470mm / M	**N**		
174	July 26, 2017	455mm / F	**N**		
175	July 26, 2017	505mm / M	**N**		
176	July 26, 2017	563mm / M	**Y**	May 29, 2015 & July 14, 2016	463mm & 521mm
177	July 26, 2017	505mm / M	**Y**	June 10, 2016	478mm
178	July 26, 2017	455mm / M	**Y**	June 10, 2016	427mm
179	July 27, 2017	410mm / F	**N**		
180	July 27, 2017	467mm / M	**N**		
181	July 27, 2017	441mm / M	**N**		
182	July 27, 2017	480mm / M	**N**		
183	July 27, 2017	409mm / M	**N**		
184	July 27, 2017	456mm / F	**N**		
185	July 27, 2017	452mm / F	**N**		
186	July 27, 2017	467mm / M	**Y**	July 8, 2016	456mm
187	July 28, 2017	375mm / F	**N**		
188	July 31, 2017	399mm / F	**N**		
189	July 31, 2017	495mm / M	**Y**	July 16, 2015 & June 30, 2016	417mm & 472mm
190	August 1, 2017	457mm / M	**N**		
191	August 1, 2017	420mm / M	**N**		
192	August 1, 2017	407mm / M	**N**		
193	August 1, 2017	478mm / M	**Y**	July 28, 2014 & July 20, 2015 & August 4, 2016	375mm & 410mm & 449mm
194	August 1, 2017	462mm / M	**Y**	July 16, 2015 & June 19, 2016	385mm & 439mm
195	August 2, 2017	484mm / M	**N**		
196	August 3, 2017	454mm / F	**N**		

2007-2016
Return and Age Composition of Chinook *Sampled/Transported at the USACE Fish Trap, White River.

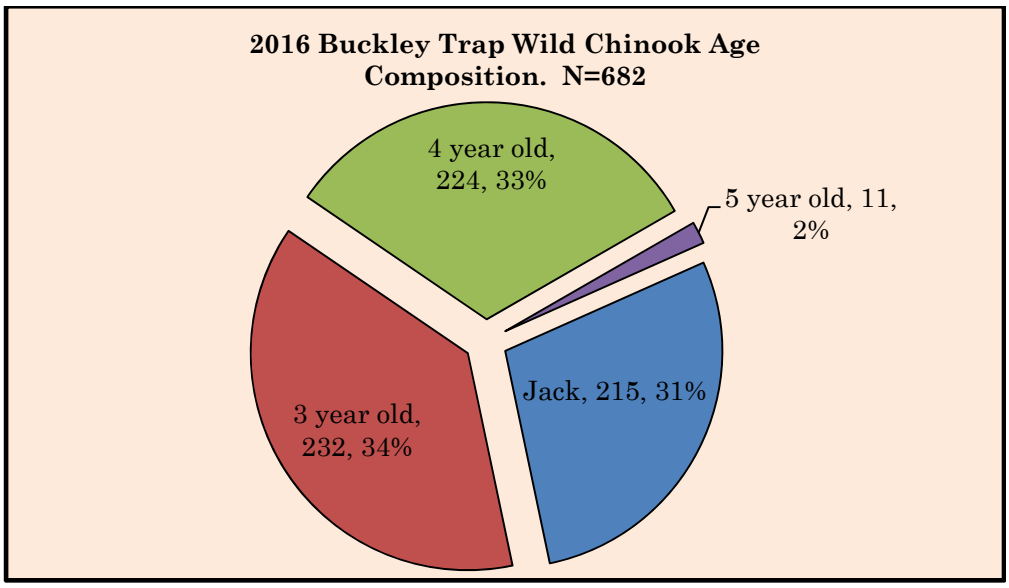


***The following data represents Chinook sampled for CWT's and external fin clips at the USACE fish trap. Although efforts are made to sample all Chinook passed, not all fish captured and transported can be physically sampled. Chinook sampled/transported are primarily Spring Chinook; however, some Fall Chinook are transported during periods when sampling isn't conducted.**

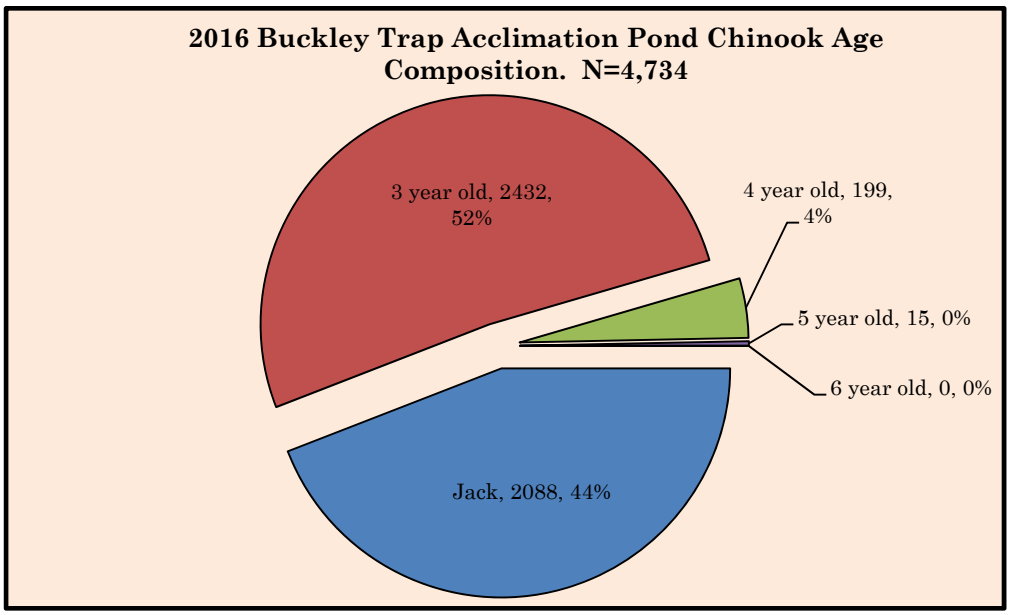
APPENDIX F



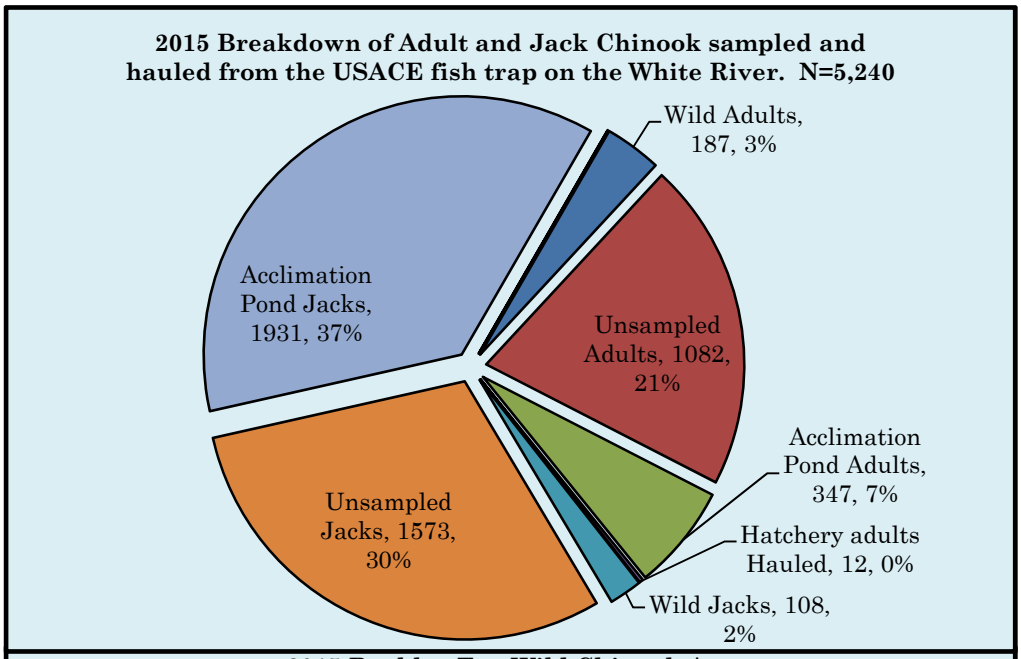
2016: Total number of Chinook hauled from the USACE fish trap including wild, acclimation and White River hatchery.



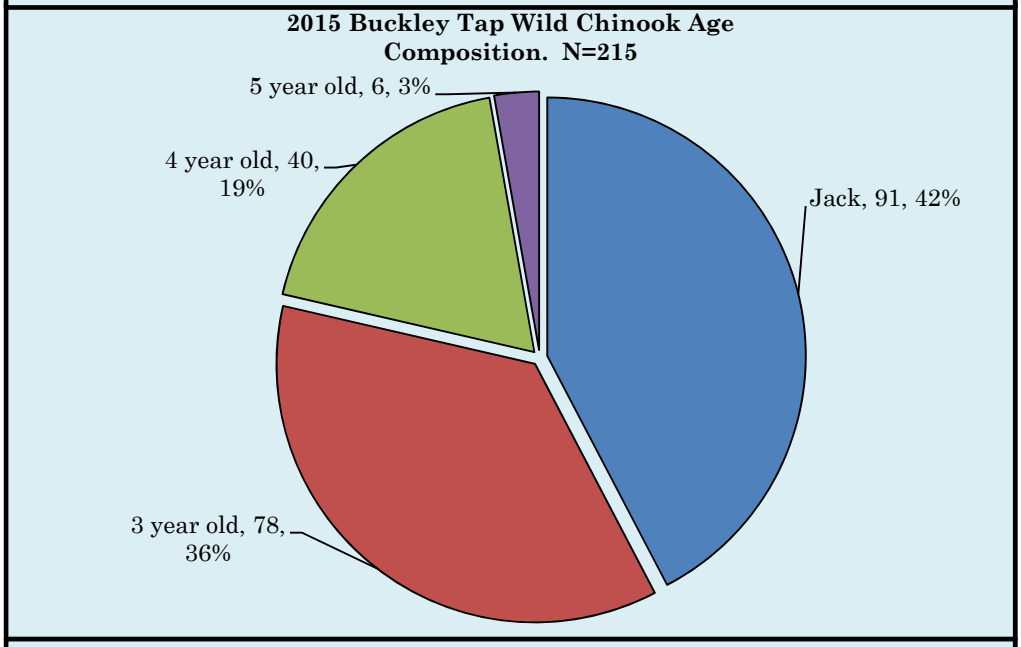
2016: Age breakdown of wild adult and jack Chinook sampled in the USACE fish trap.



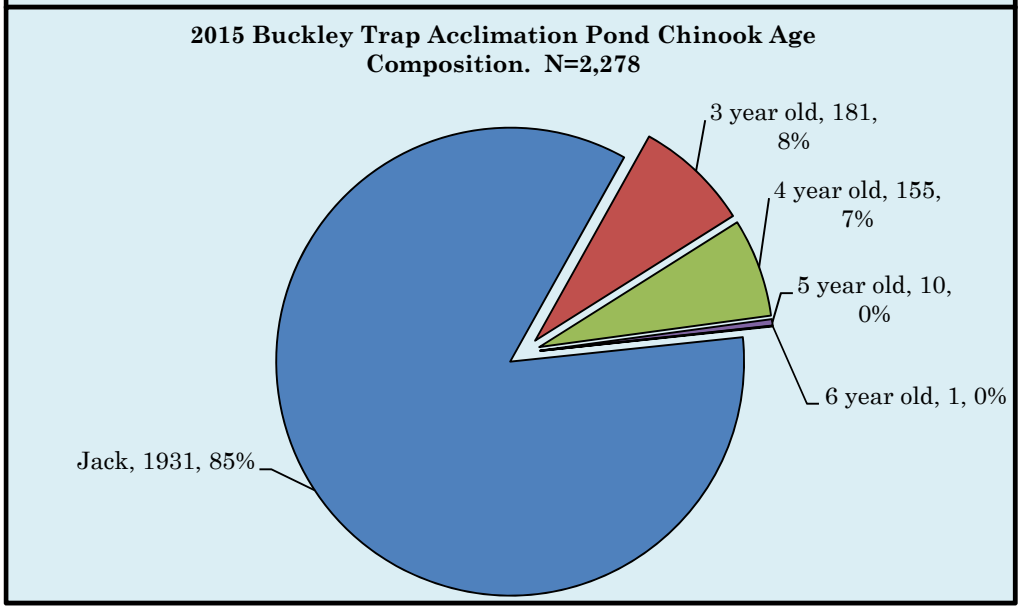
2016: Breakdown of adult and jack acclimation pond Chinook sampled in the USACE fish trap.



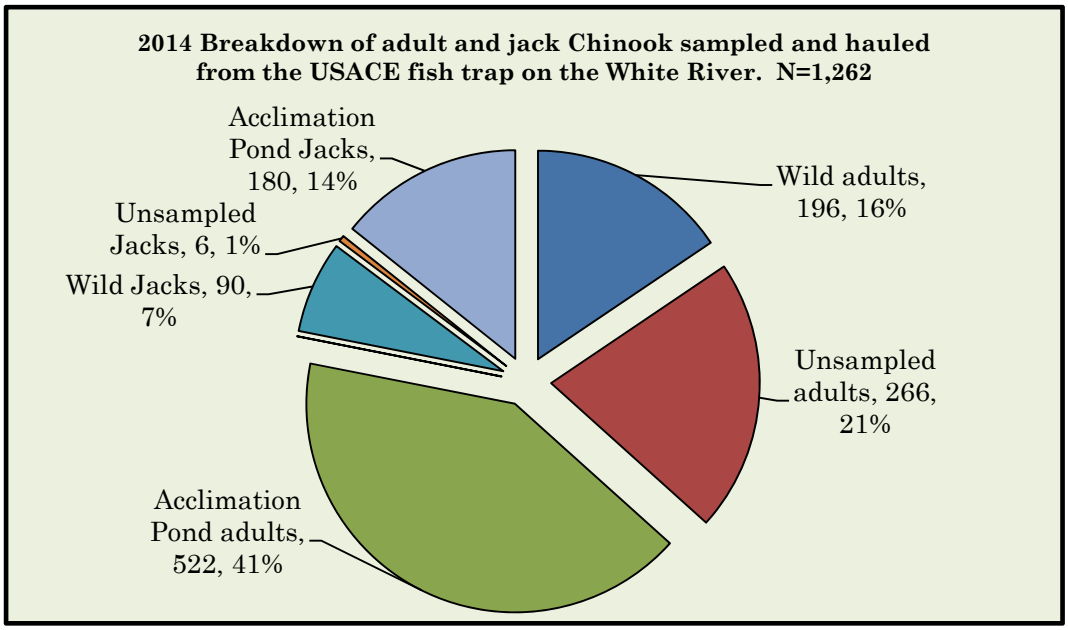
2015: Total number of Chinook sampled/unsampled and hauled from the USACE fish trap including wild, acclimation and White River hatchery.



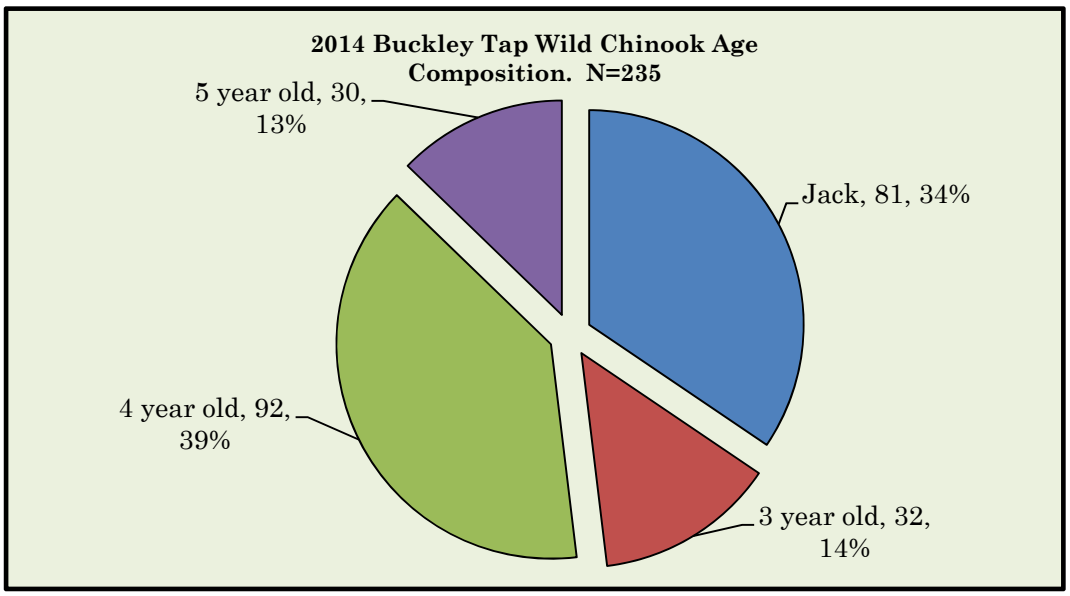
2015: Age breakdown of wild adult and jack Chinook sampled in the USACE fish trap.



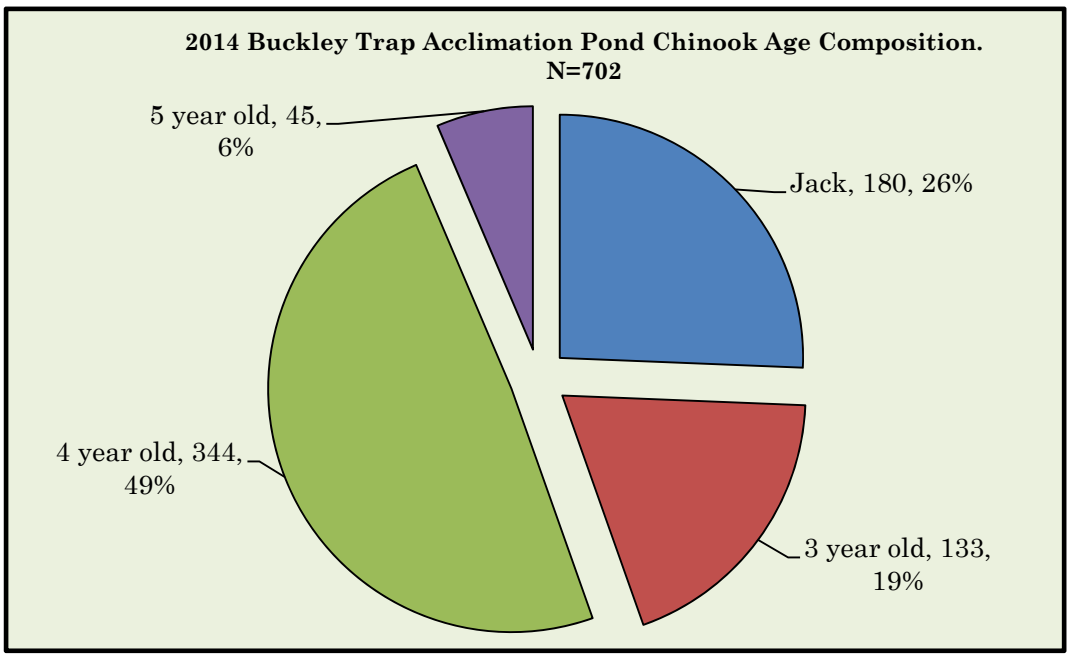
2015: Breakdown of adult and jack acclimation pond Chinook sampled in the USACE fish trap.



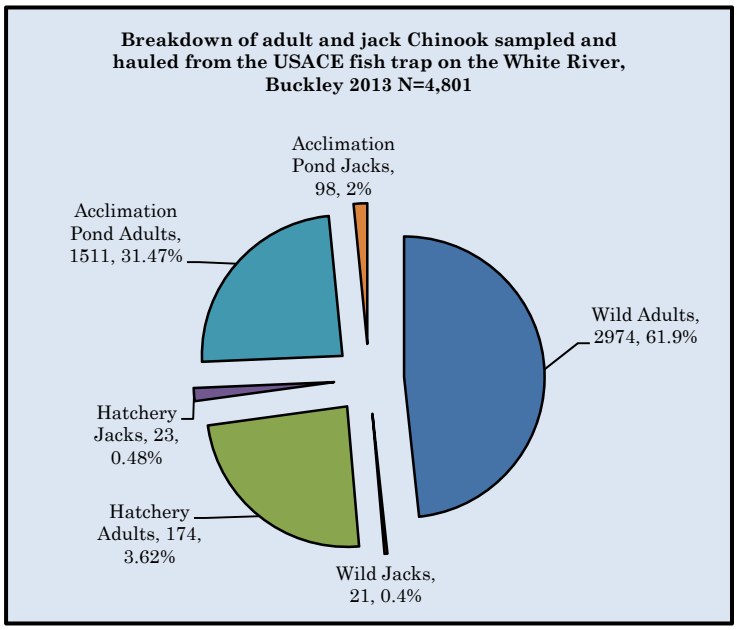
2014: Total number of Chinook sampled/unsampled and hauled from the USACE fish trap including wild, acclimation and White River hatchery.



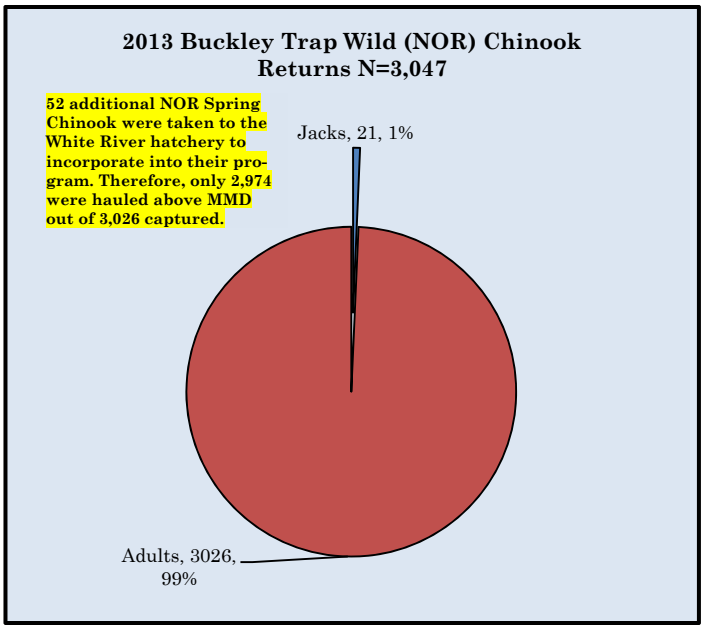
2014: Age breakdown of wild adult and jack Chinook sampled in the USACE fish trap.



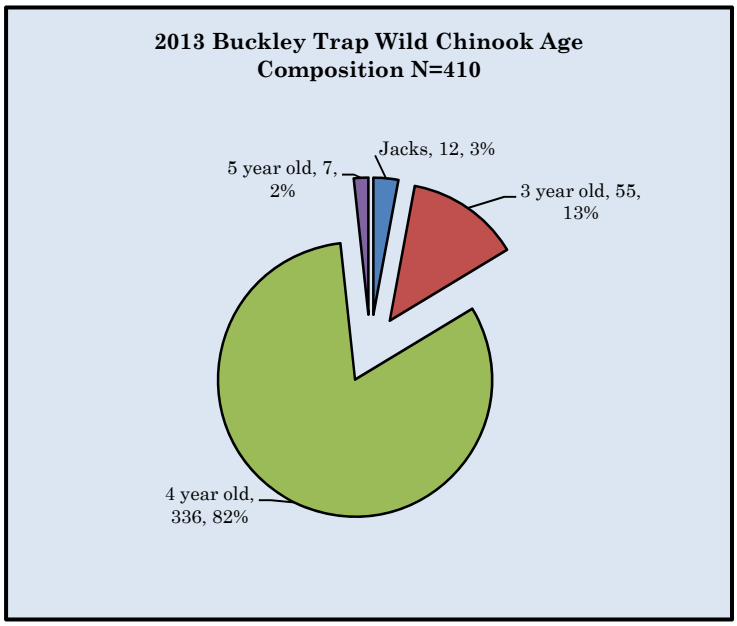
2014: Breakdown of adult and jack acclimation pond Chinook sampled in the USACE fish trap.



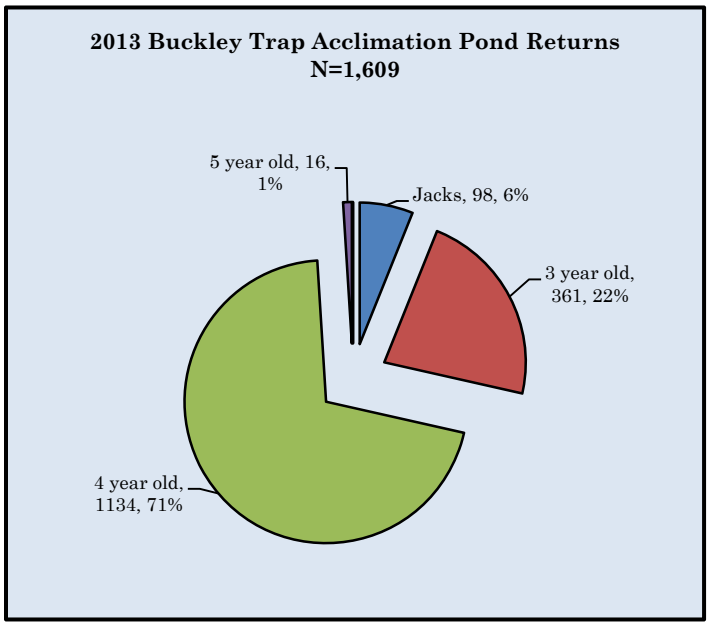
2013: Total number of Chinook sampled in the USACE fish trap including wild, acclimation and White River hatchery.



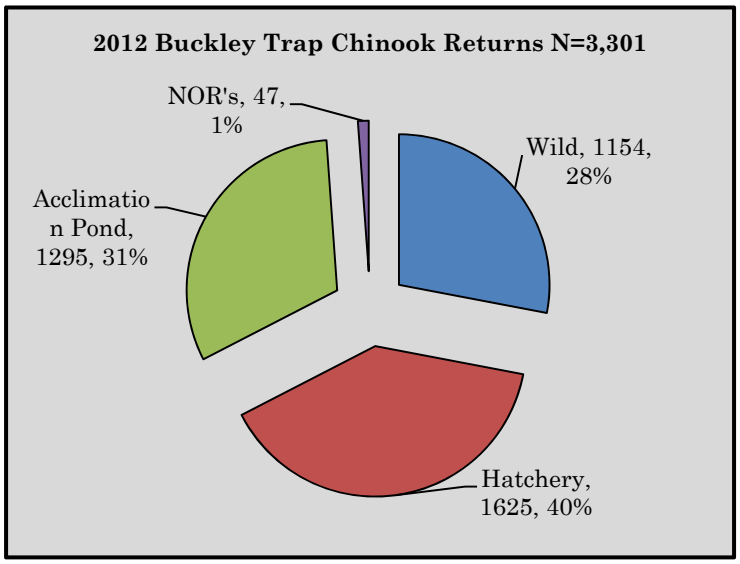
2013: Breakdown of adult and jack NOR's *(natural origin return)* sampled in the USACE fish trap.



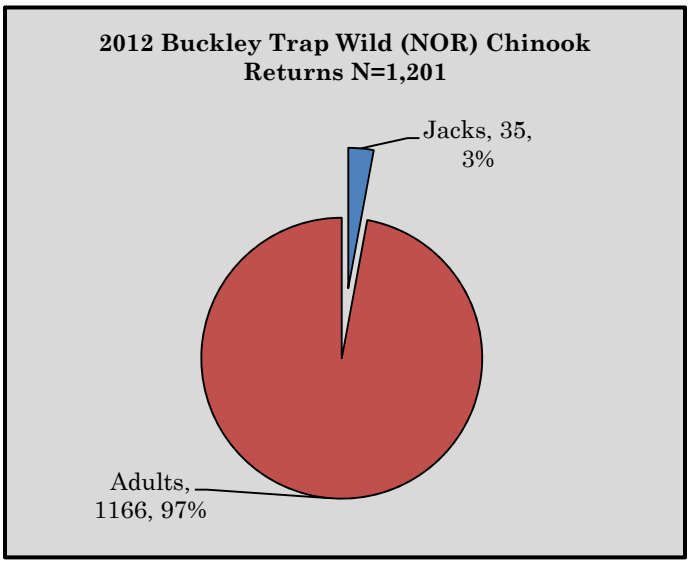
2013: Age breakdown of wild adult and jack Chinook sampled in the USACE fish trap.



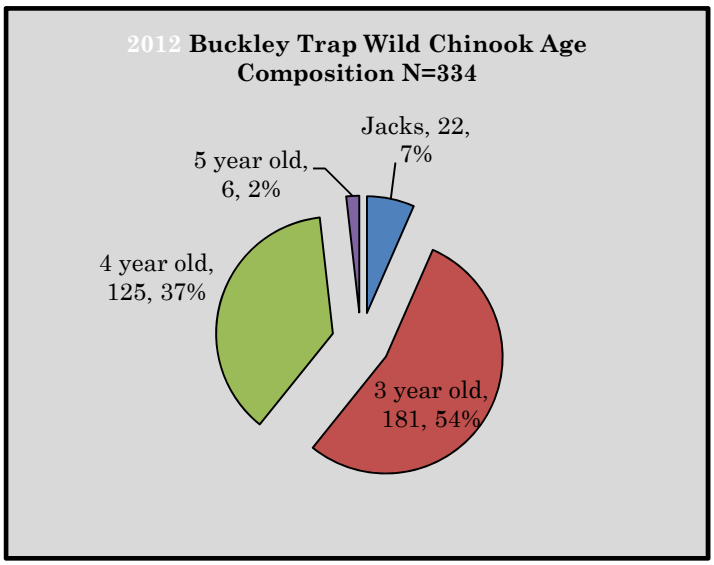
2013: Breakdown of adult and jack acclimation pond Chinook sampled in the USACE fish trap.



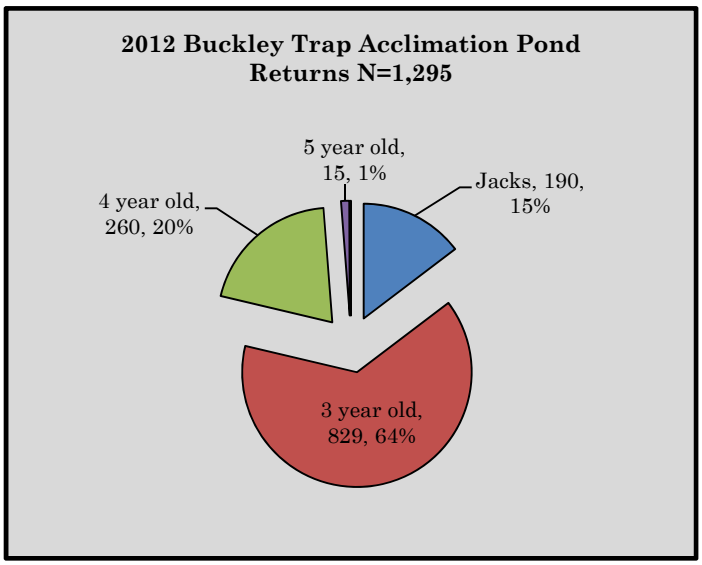
2012: Total number of Chinook sampled in the USACE fish trap including wild, acclimation and White River hatchery.



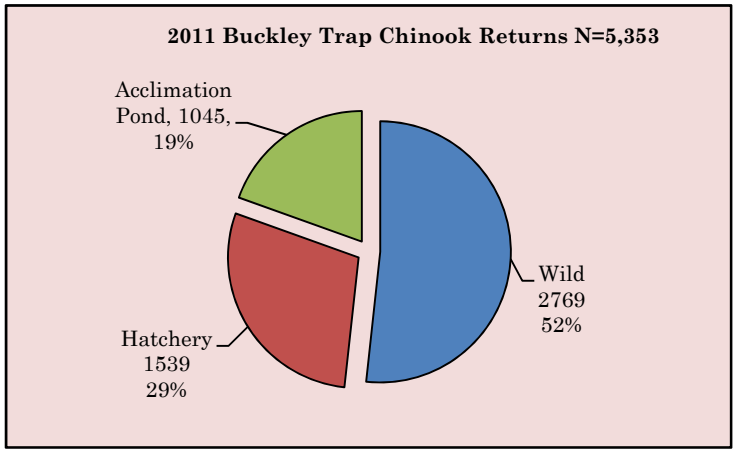
2012: Breakdown of adult and jack NOR's *(natural origin return)* sampled in the USACE fish trap.



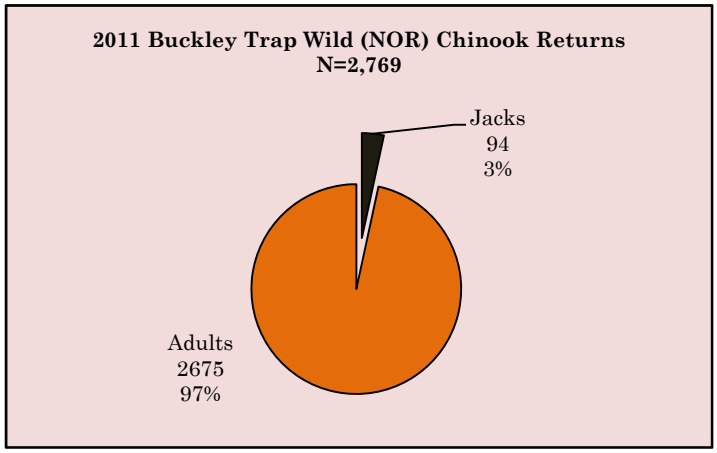
2012: Age breakdown of wild adult and jack Chinook sampled in the USACE fish trap.



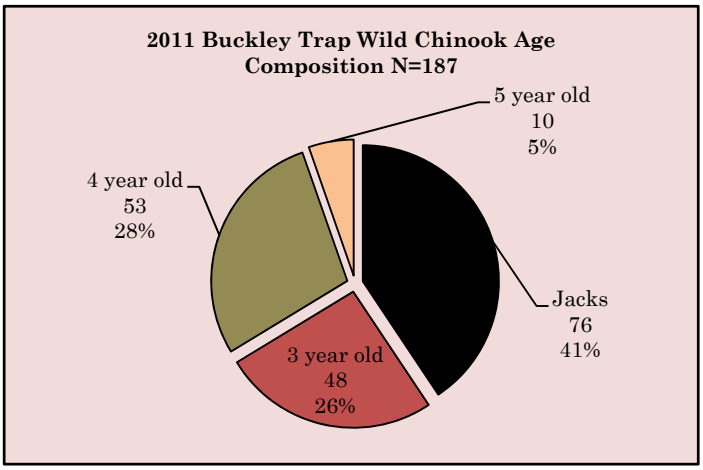
2012: Breakdown of adult and jack acclimation pond Chinook sampled in the USACE fish trap.



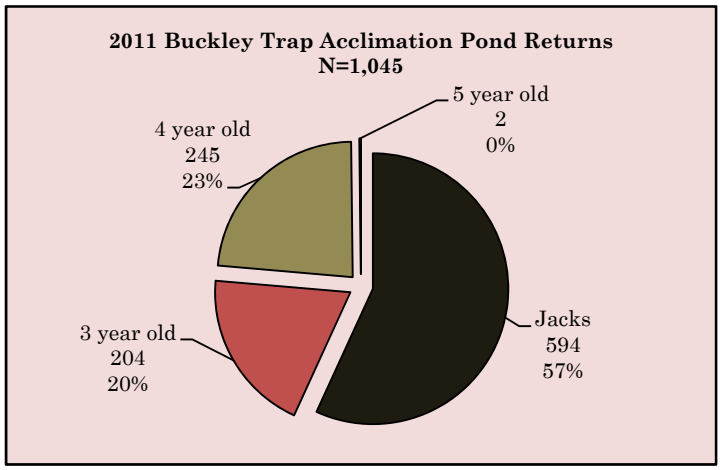
2011: Total number of Chinook sampled in the USACE fish trap including wild, acclimation and White River hatchery.



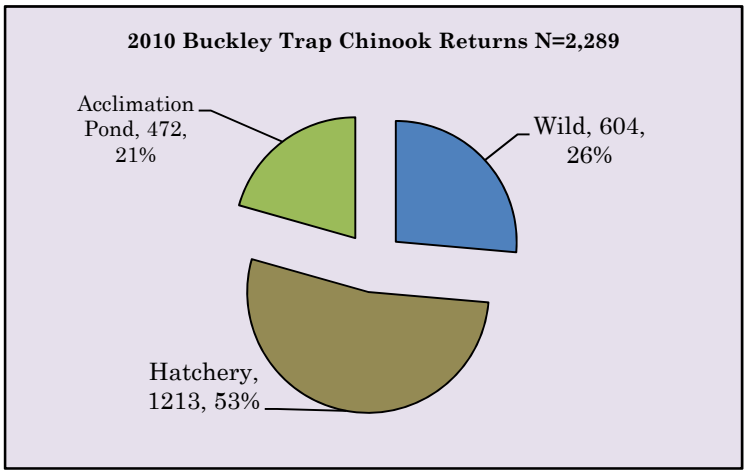
2011: Breakdown of adult and jack NOR's *(natural origin return)* sampled in the USACE fish trap.



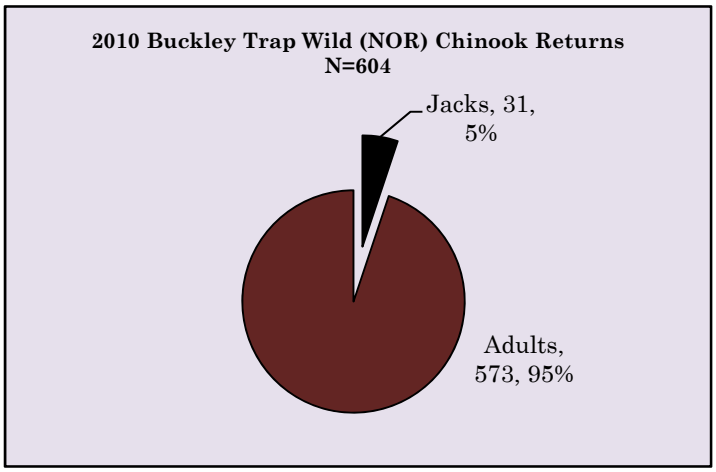
2011: Age breakdown of wild adult and jack Chinook sampled in the USACE fish trap.



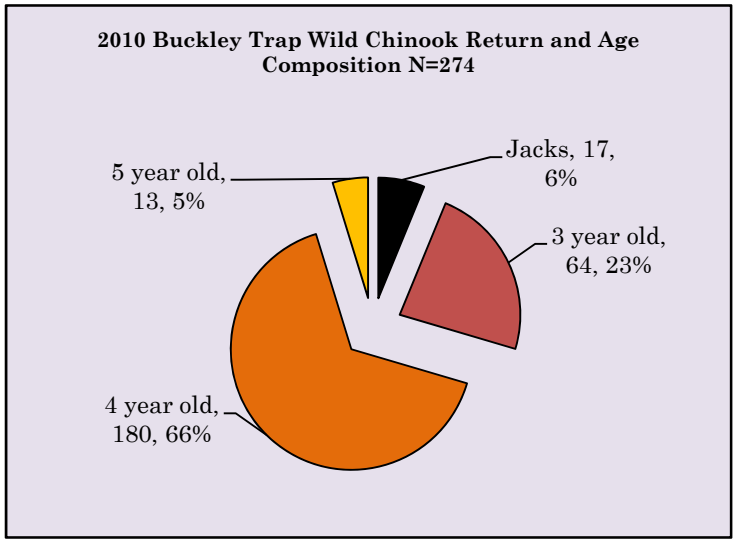
2011: Breakdown of adult and jack acclimation pond Chinook sampled in the USACE fish trap.



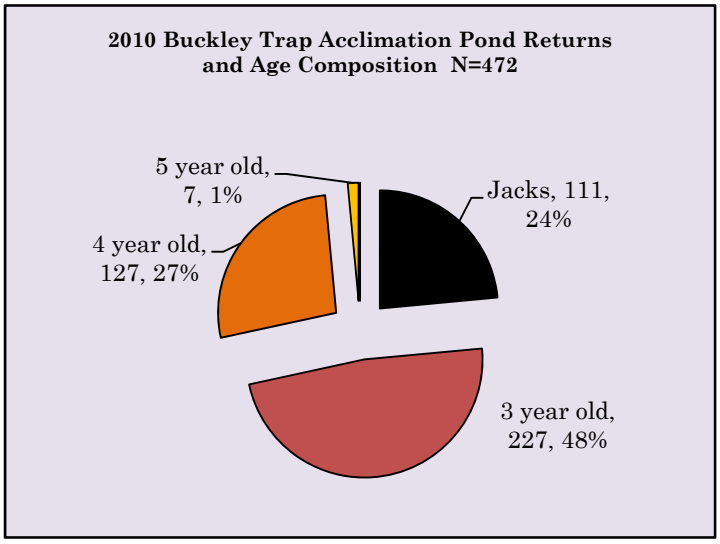
2010: Total number of Chinook sampled in the USACE fish trap including wild, acclimation and White River hatchery.



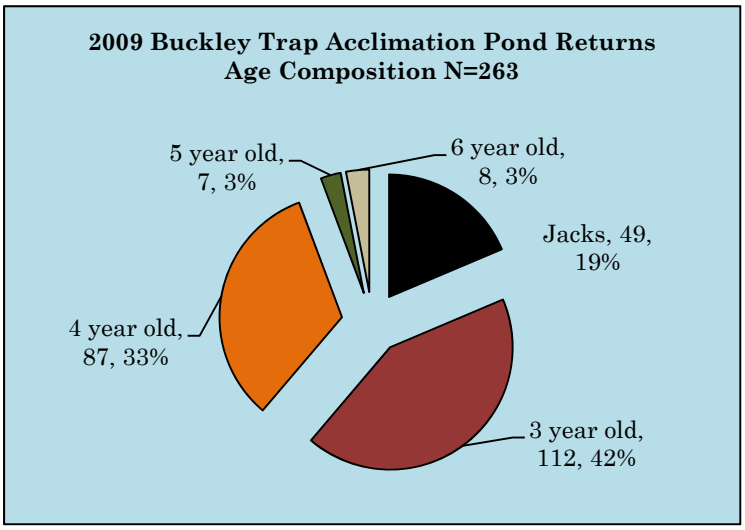
2010: Breakdown of adult and jack NOR's *(natural origin return)* sampled in the USACE fish trap.



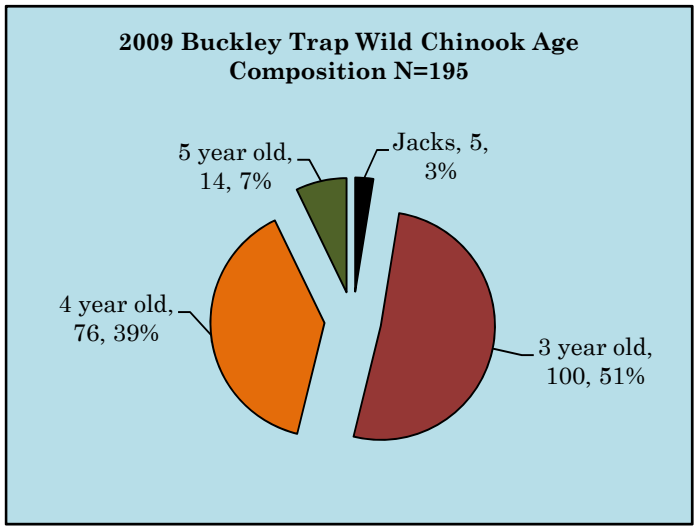
2010: Age breakdown of wild adult and jack Chinook sampled in the USACE fish trap.



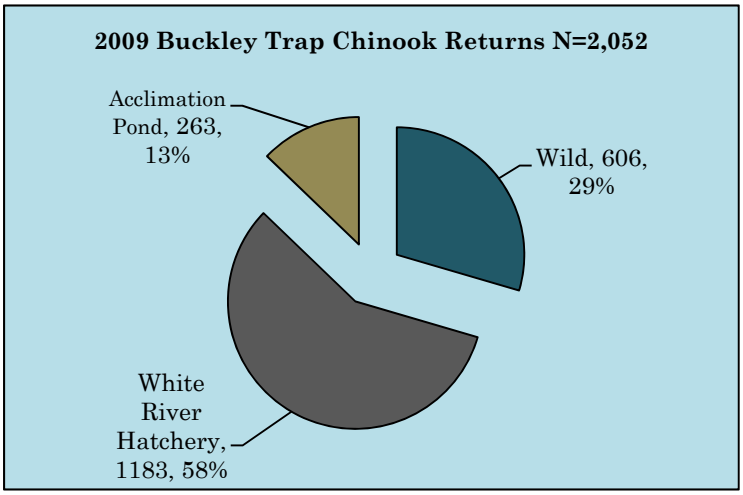
2010: Breakdown of adult and jack acclimation pond Chinook sampled in the USACE fish trap.



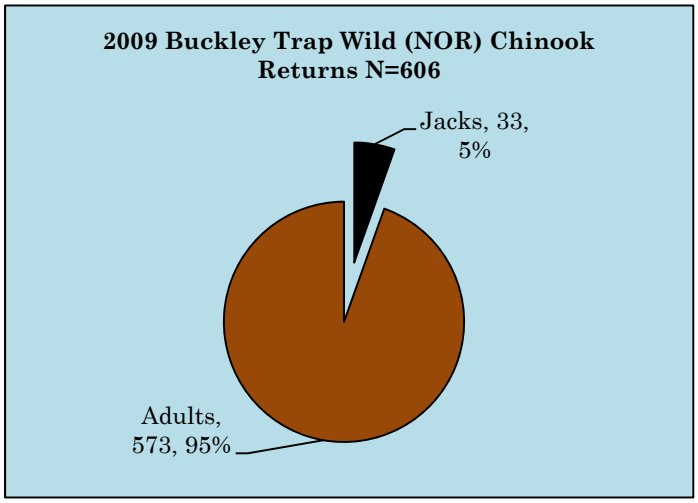
2009: Breakdown of adult and jack acclimation pond Chinook sampled in the USACE fish trap.



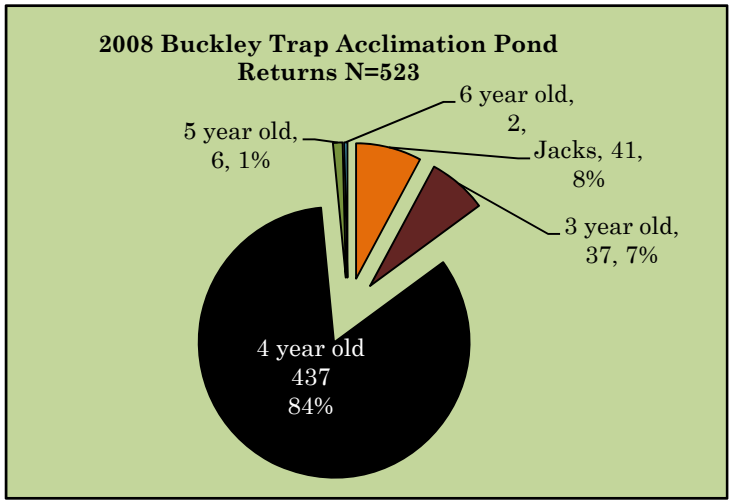
2009: Breakdown of adult and jack NOR's *(natural origin return)* sampled in the USACE fish trap.



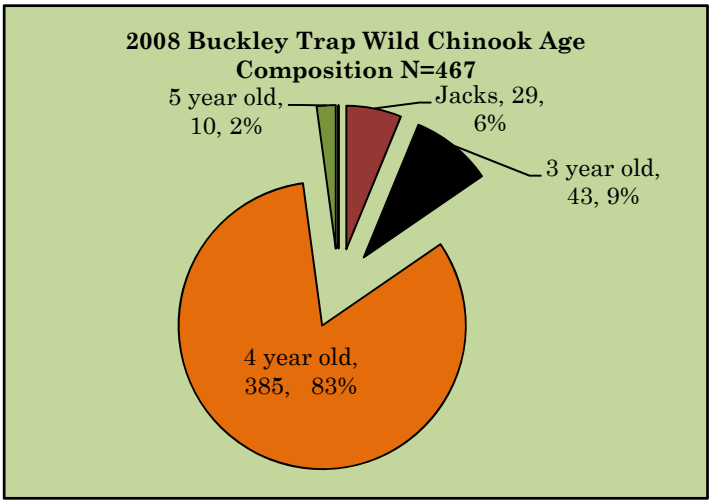
2009: Total number of Chinook sampled in the USACE fish trap including wild, acclimation and White River hatchery.



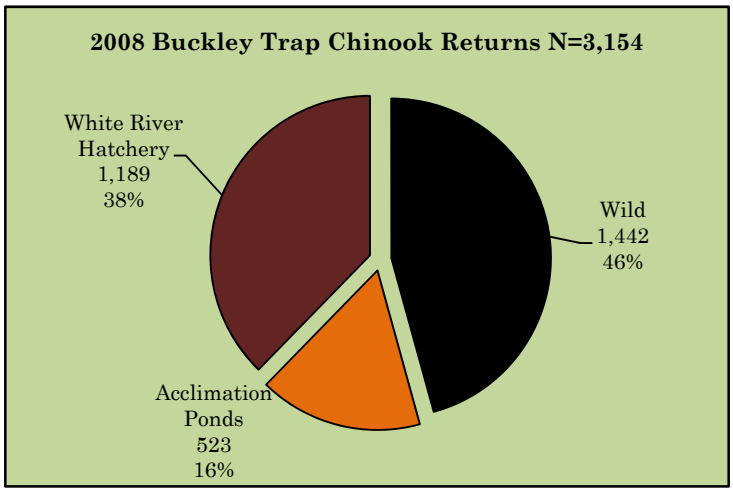
2009: Age breakdown of wild adult and jack Chinook sampled in the USACE fish trap.



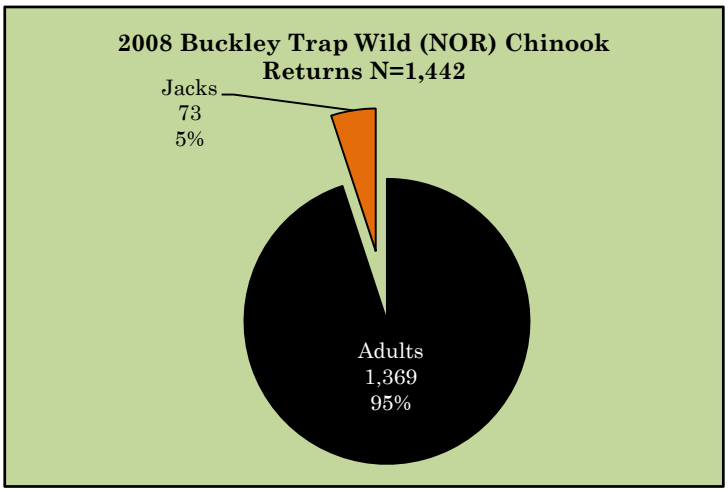
2008: Breakdown of adult and jack acclimation pond Chinook sampled in the USACE fish trap.



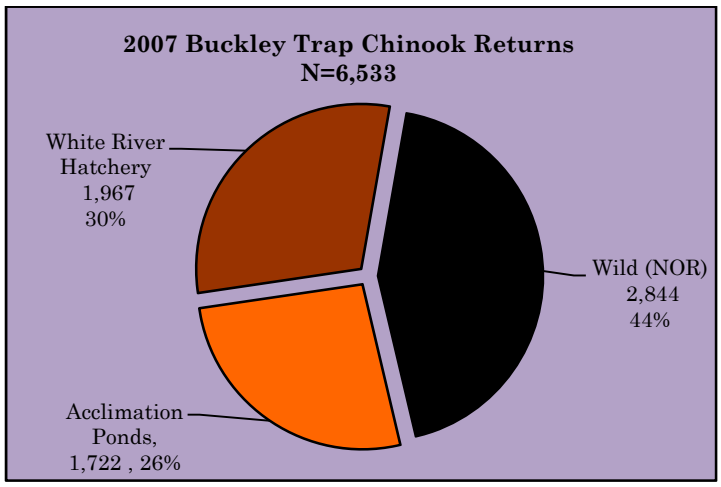
2008: Breakdown of adult and jack NOR's *(natural origin return)* sampled in the USACE fish trap.



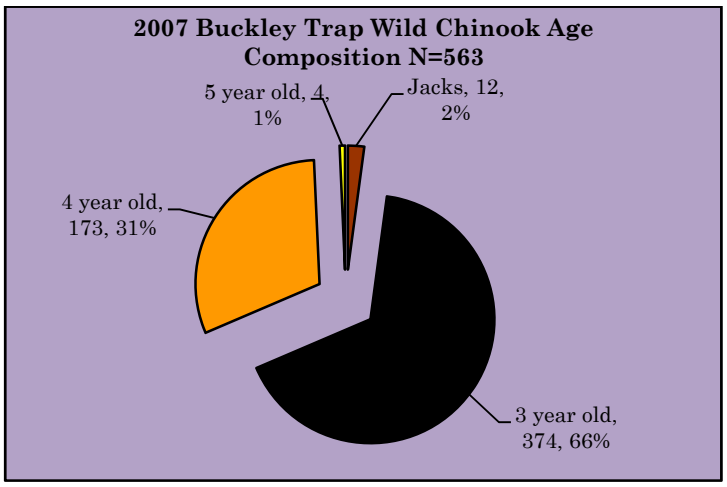
2008: Total number of Chinook sampled in the USACE fish trap including wild, acclimation and White River



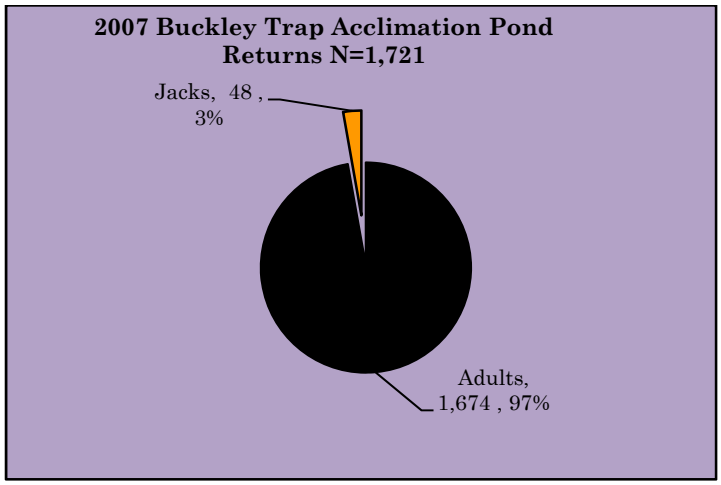
2008: Age breakdown of wild adult and jack Chinook sampled in the USACE fish trap.



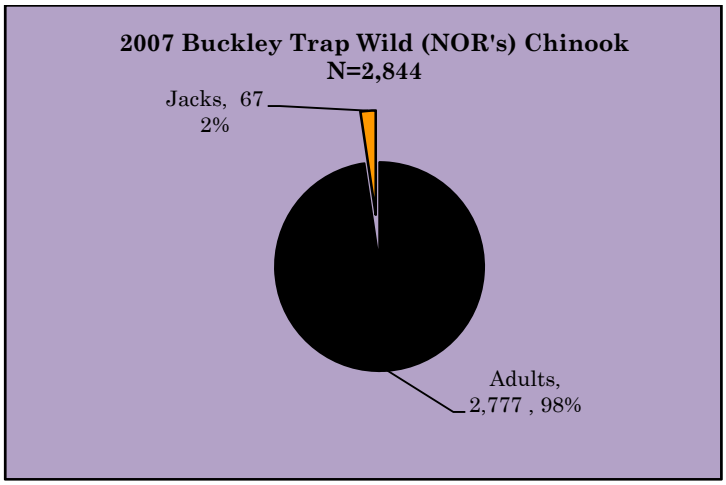
2007: Total number of Chinook sampled in the USACE fish trap including wild, acclimation and White River hatchery.



2007: Breakdown of adult and jack NOR's *(natural origin return)* sampled in the USACE fish trap.



2007: Age breakdown of wild adult and jack Chinook sampled in the USACE fish trap.



2007: Breakdown of adult and jack acclimation pond Chinook sampled in the USACE fish trap.

Breakdown of Adult Winter Steelhead Returns Sampled at the USACE Fish Trap and Pre-Smolt Releases, White River (2007-2017)

Steelhead smolt

APPENDIX G

Winter Steelhead Returns Sampled in USACE Fish Trap and Pre-Smolts Released, White River (2007-2017)

YEAR SAMPLED/ RELEASED	N=	WILD/NOR	*FISH TAKEN FOR BROOD-STOCK PROGRAM	STEELHEAD WITH ‡BWT (PROGAM FISH)	PRE-SMOLTS RELEASED (BROOD YEAR) [RELEASE SITE]
2017	385	288	26	71	27,625 (2016) [Twentyeight Mile Cr. Acclimation Pond]
†**2016**	533	476	23	34	29,920 (2015) [Jensen Cr. Acclimation Pond]
†**2015**	319	273	26	20	31,219 (2014) [Jensen Cr. Acclimation Pond]
2014	479	392	23	64	49,998 (2013) [Huckleberry Cr. Acclimation Pond]
2013	574	338	28	208	27,990 (2012) [Muckleshoot Hatchery]
2012	345	345	24	209	31,129 (2011) [Muckleshoot Hatchery]
2011	539	164	22	353	27,876 (2010) [Muckleshoot Hatchery]
2010	523	204	20	299	25,650 (2009) [Muckleshoot Hatchery]
2009	165	116	19	30	31,900 (2008) [Muckleshoot Hatchery]
2008	207	177	24	6	56,378 (2007) [Muckleshoot Hatchery]
2007	303	276	27	0	25,631 (2006) [Muckleshoot Hatchery]

Steelhead sampling was conducted by Puyallup Tribal Fisheries.

See page #40 or Appendix D for current acclimation pond location sites.

*During the spring of 2006, in response to the declining number of winter steelhead, the Puyallup and Muckleshoot Tribes; as well as the Washington Department of Fish and Wildlife, began a steelhead supplementation pilot project developed for the White River. The primary goal of this project is to restore the run to a strong self-sustaining population. The project is currently funded and managed by the Puyallup Tribe and utilizes captured wild brood stock from the USACE trap in Buckley to generate approximately 25K-35K+ yearling smolts.

†An undetermined number of adult steelhead ascended above the Buckley diversion dam due to missing panels.

‡ Blank Wire Tag (BWT): Small piece of wire implanted in the snout that is the same as a Coded Wire Tag (CWT) implant minus the binary code.

Return, Age Composition, and Recruit Per Spawner Estimates of Winter-Run Steelhead Sampled at the USACE Fish Trap, White River (1999-2017)

Adult female winter steelhead sampled for blank wire tag (BWT) implant.

APPENDIX H

Box 2-1. Ageing Steelhead (continued)

The Washington Department of Fish and Wildlife uses a modified version of the Narver and Withler (1971) scale aging method to age steelhead scales. This ageing method for steelhead consists of chronological arrangements of the following symbols:

"." = initial saltwater entry.

Arabic numerals = number of consecutive winters in freshwater or in saltwater. To qualify for a numeral the annulus must be followed by more widely spaced circuli (i.e.: spring or summer growth).

"+" = used for winter-run steelhead only, indicates less than one year in salt or freshwater, usually denotes spring and/or summer circuli but may include some winter circuli (after a period (".") a "+" denotes saltwater existence).

"S" = spawning check, represents approximately 1 to 6 months for winter-run fish or 6 to 12 months for summer-run fish.

"+S" = one chronological year for winter-run steelhead.

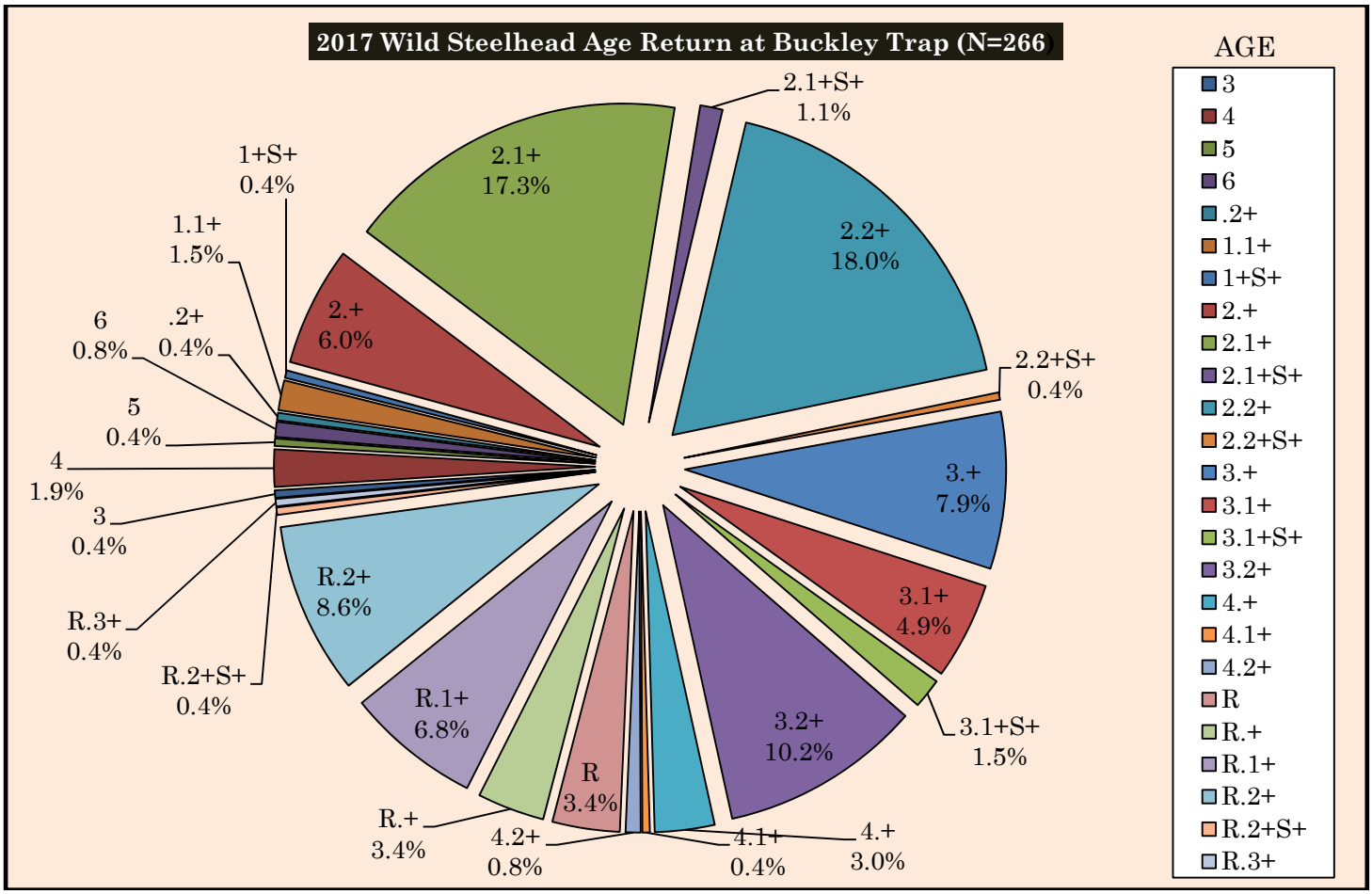
"W" = Wild designation, used to identify natural-origin steelhead that smolted and entered saltwater after one year in freshwater.

Combinations of freshwater age, total age, and the corresponding WDFW age designation for winter steelhead are illustrated in the table below.

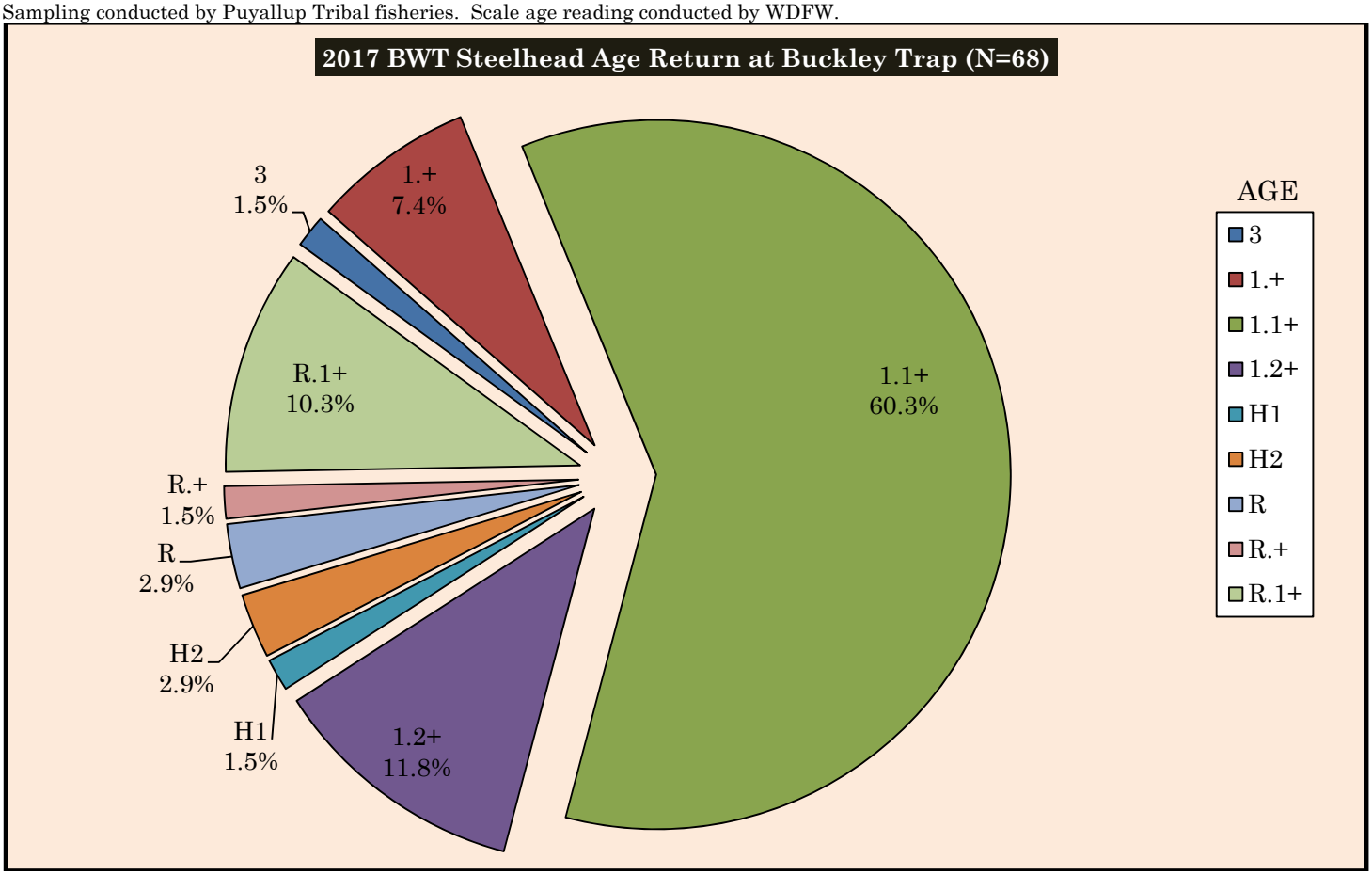
Freshwater winter(s)	Total age (years)				
	2	3	4	5	6
1	W1.+	W1.1+	W1.2+	W1.3+	
			W1.1+S+	W1.1+S+S+	W1.1+S+S+S+
				W1.2+S+	W1.2+S+S+
2		2.+	2.1+	2.2+	2.3+
			2.+S+	2.+S+S+	2.+S+S+S+
				2.1+S+	2.1+S+S+
					2.2+S+

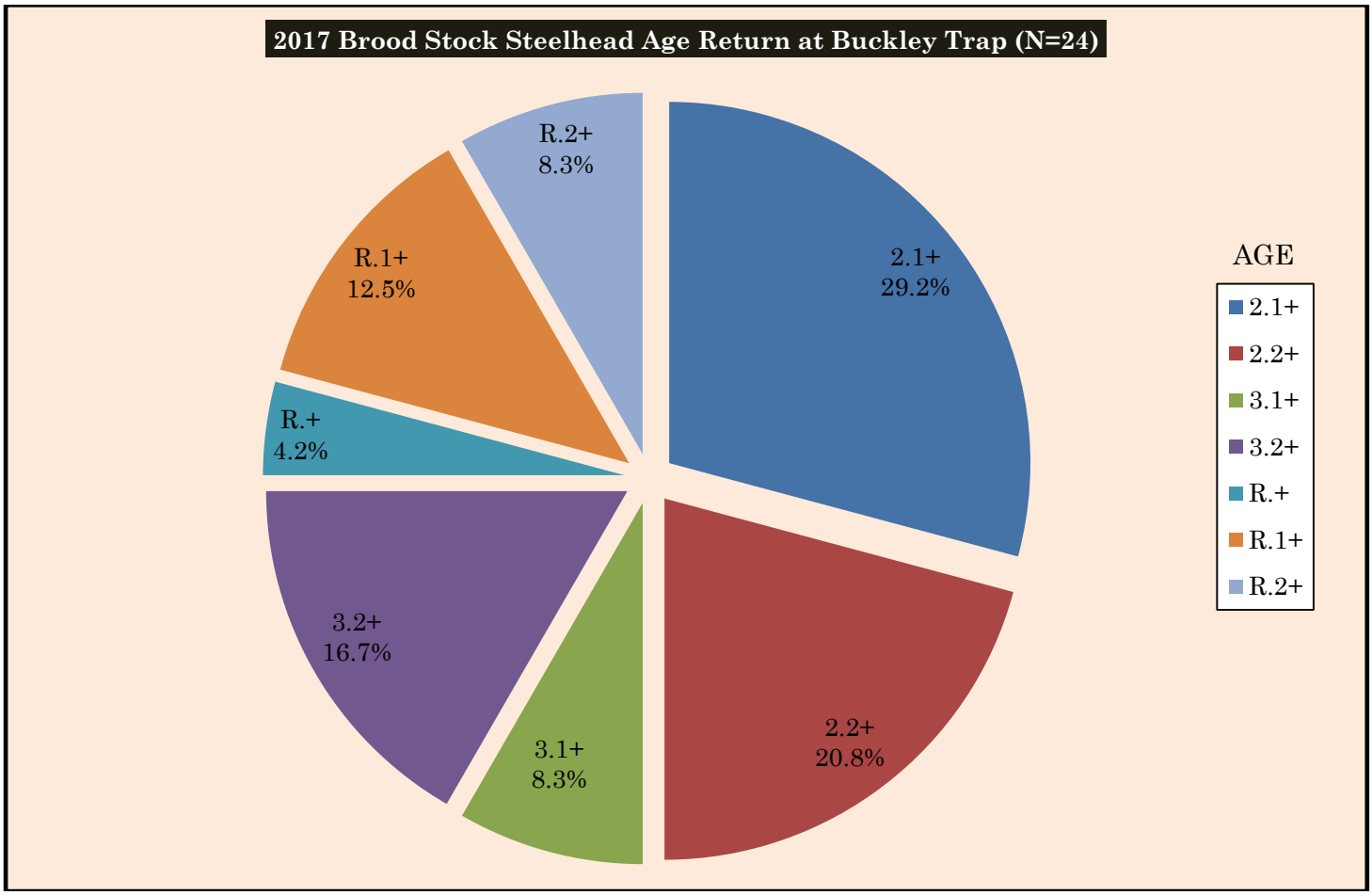
Source:
Oncorhynchus mykiss: Assessment of Washington State's Steelhead Populations and Programs. Edited by: James B. Scott, Jr. and William T. Gill
Washington Department of Fish and Wildlife Olympia, Washington. February 1, 2008

R= The slight regeneration of scales can result in the loss of this freshwater year.
H= Hatchery origin, program fish.

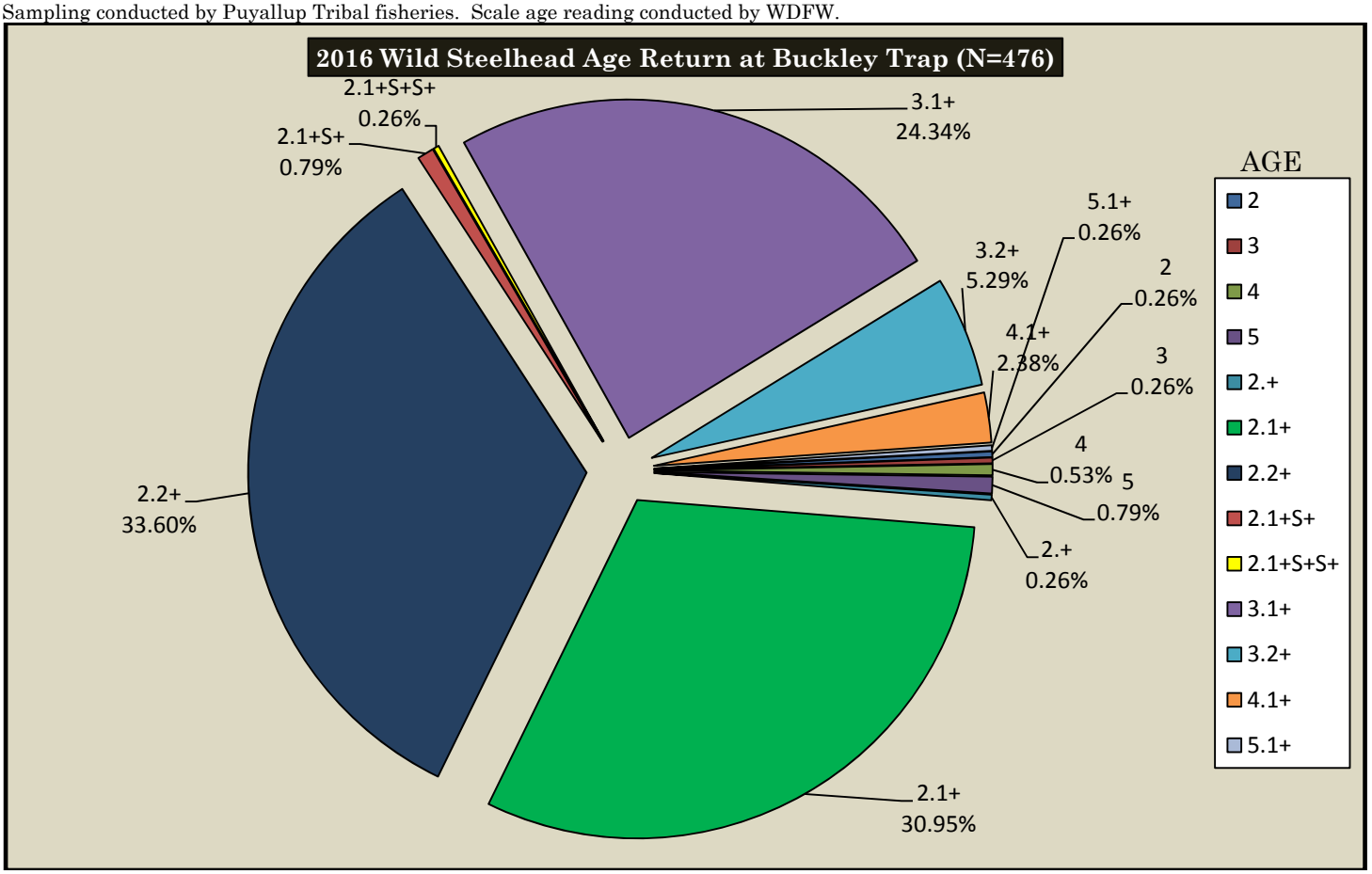


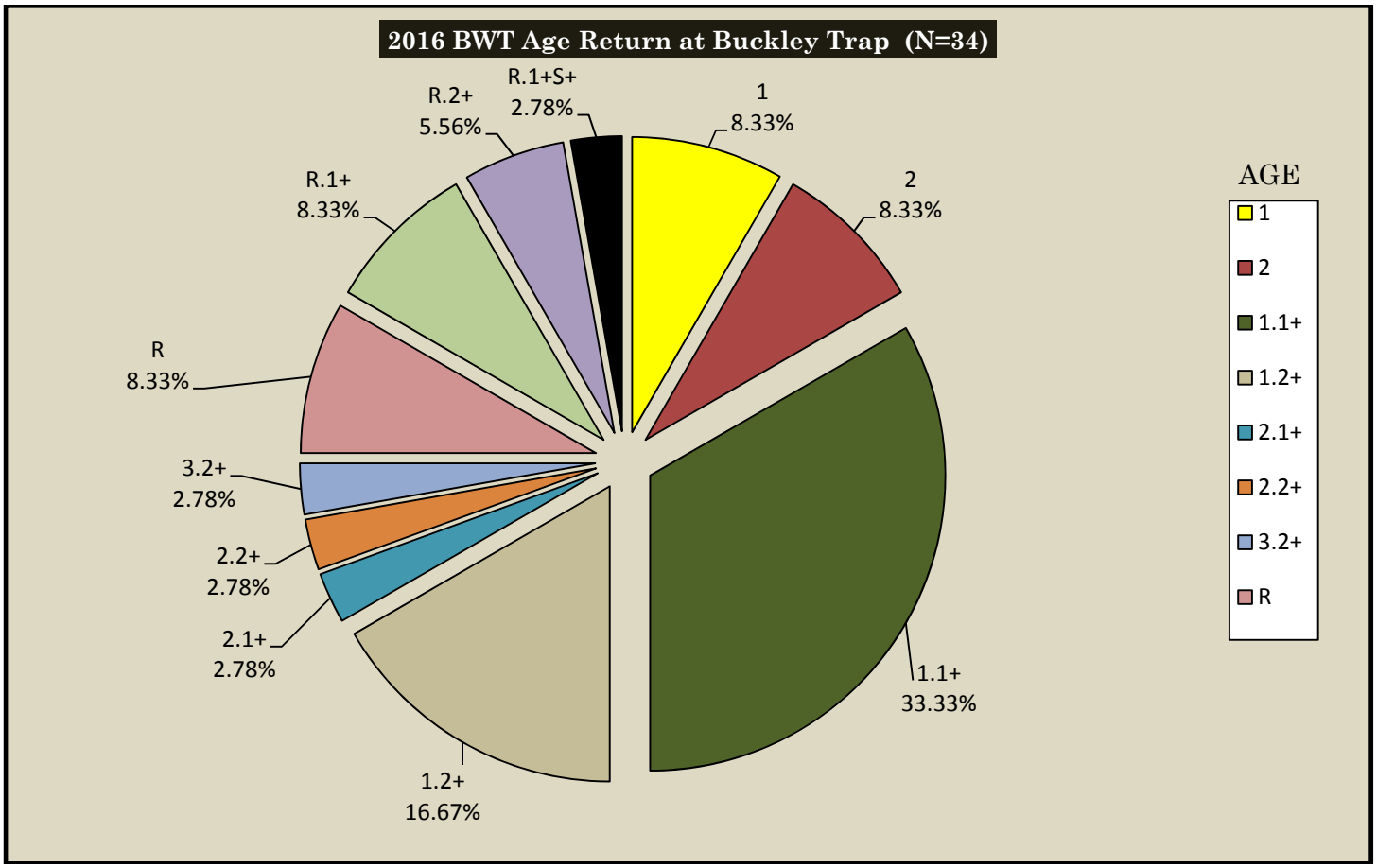
Sampling conducted by Puyallup Tribal fisheries. Scale age reading conducted by WDFW.



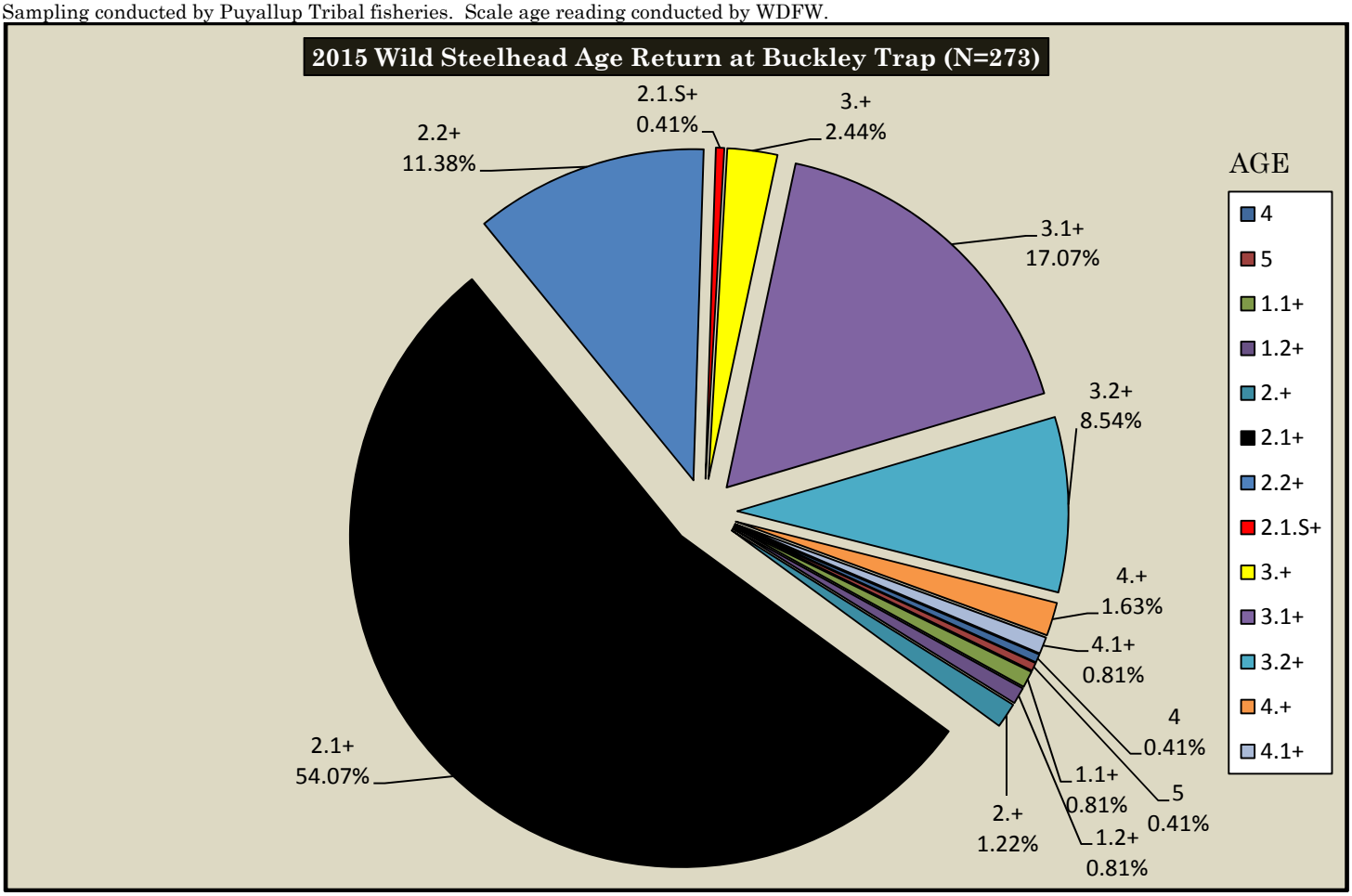


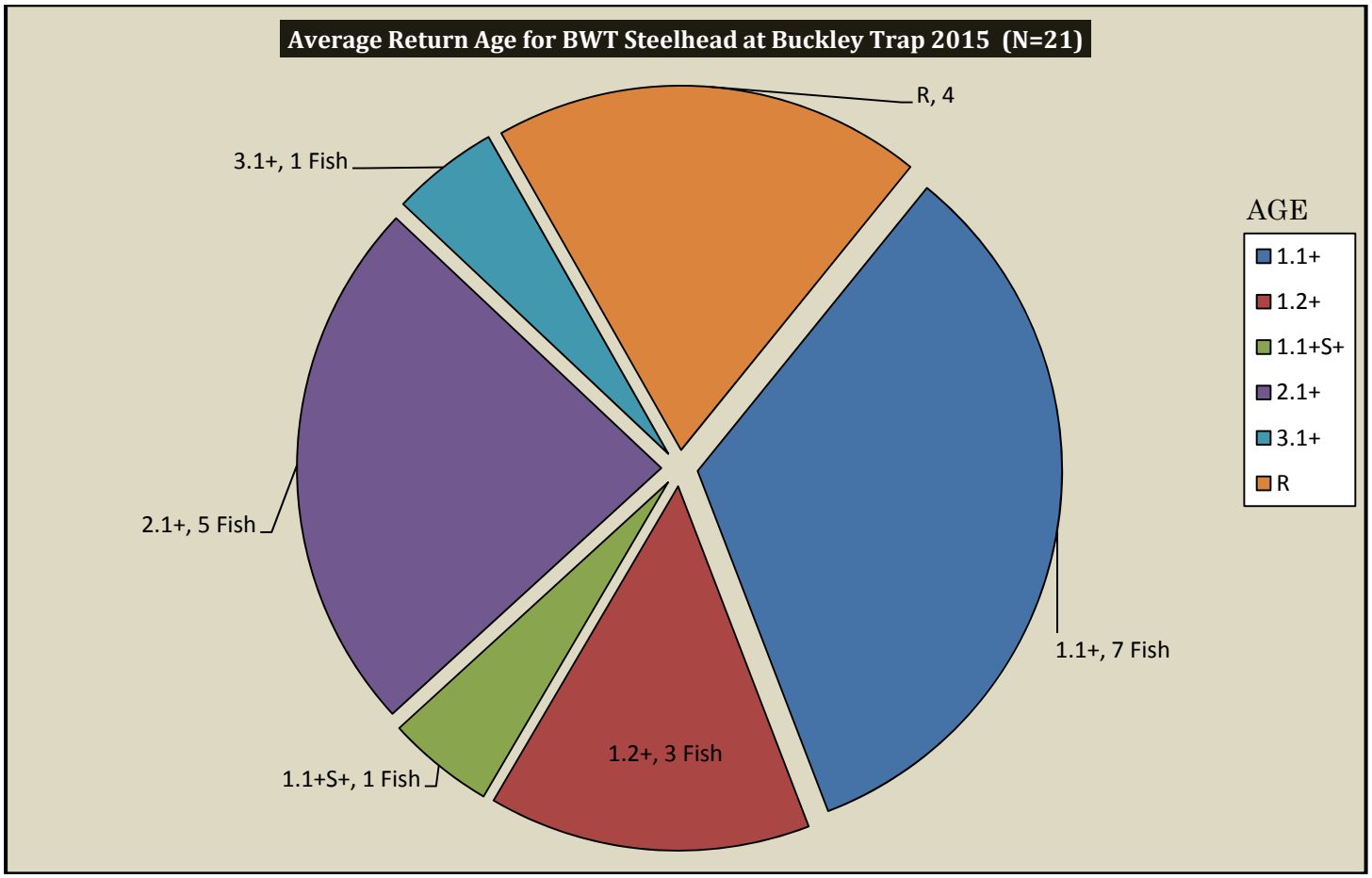
Sampling conducted by Puyallup Tribal fisheries. Scale age reading conducted by WDFW.



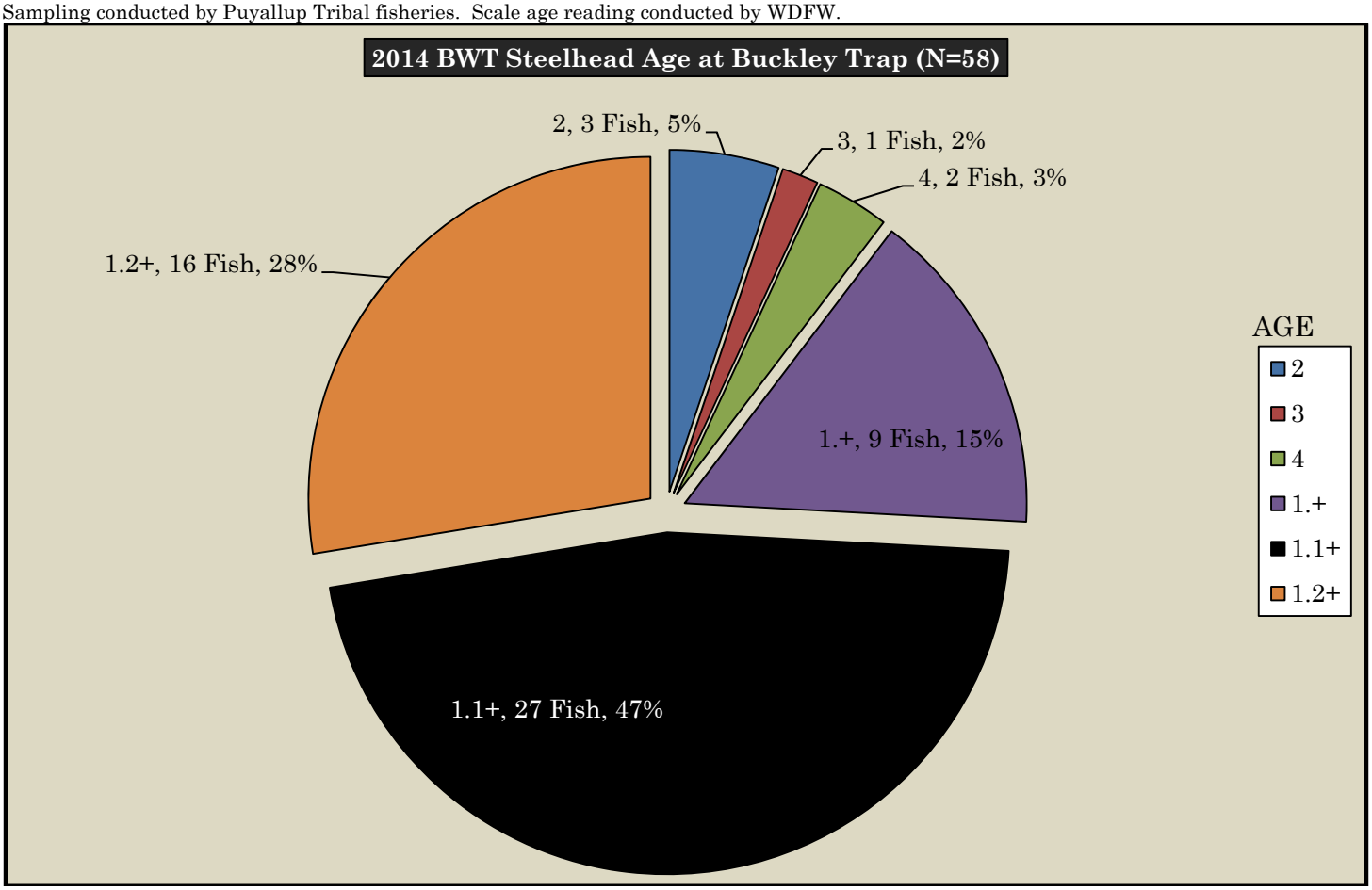


Sampling conducted by Puyallup Tribal fisheries. Scale age reading conducted by WDFW.

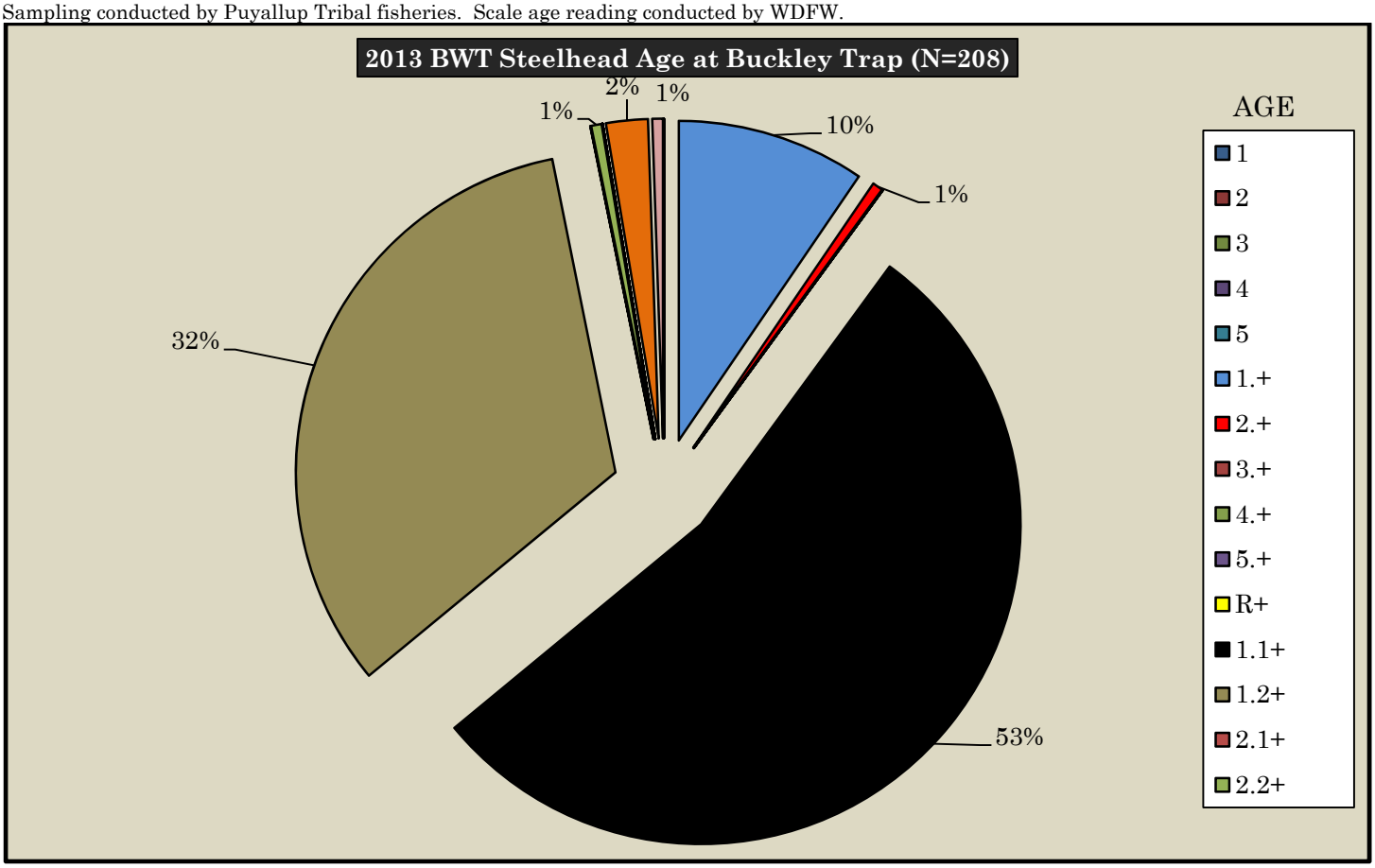




Sampling conducted by Puyallup Tribal fisheries. Scale age reading conducted by WDFW.



Sampling conducted by Puyallup Tribal fisheries. Scale age reading conducted by WDFW.



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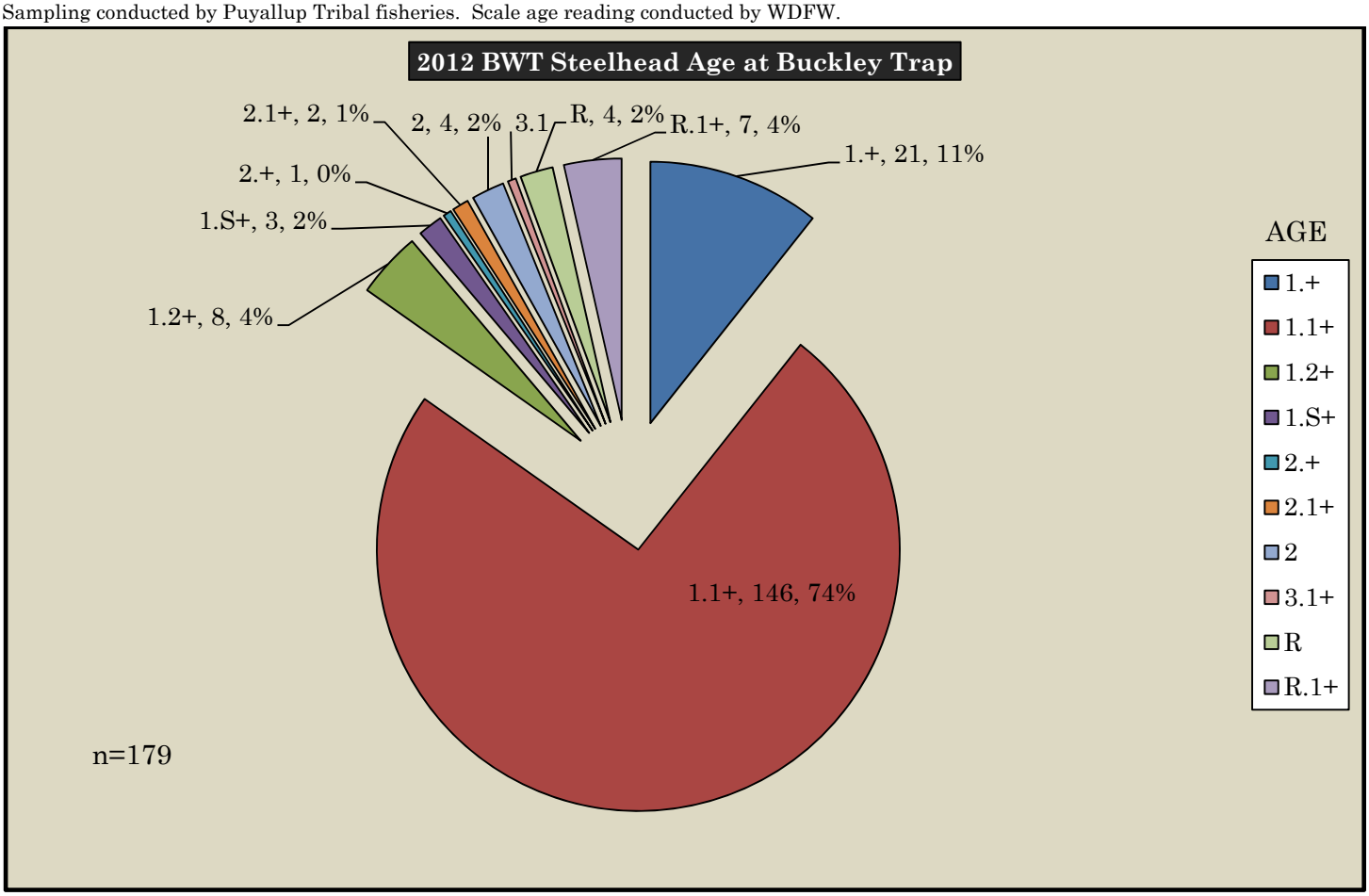
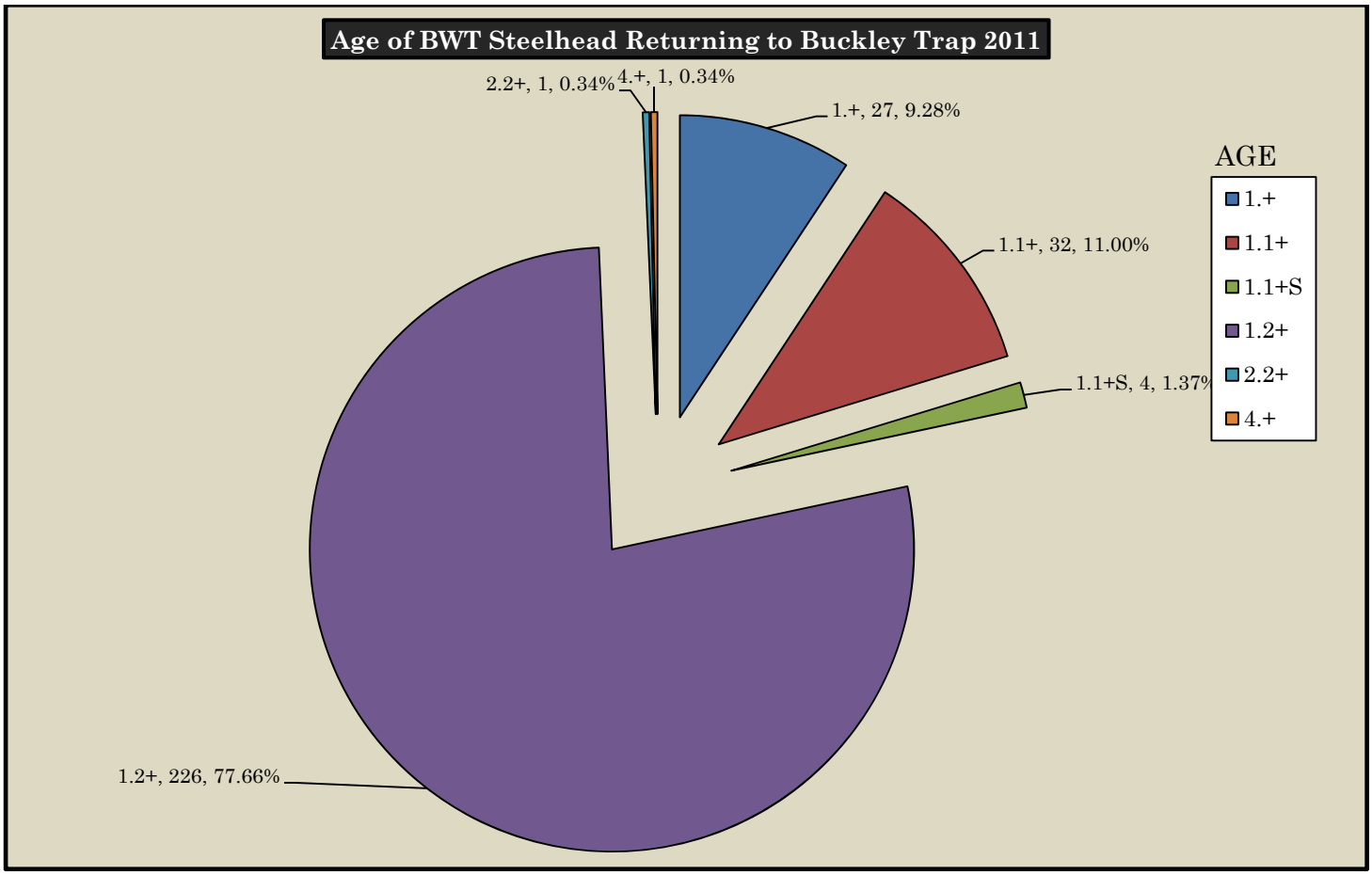
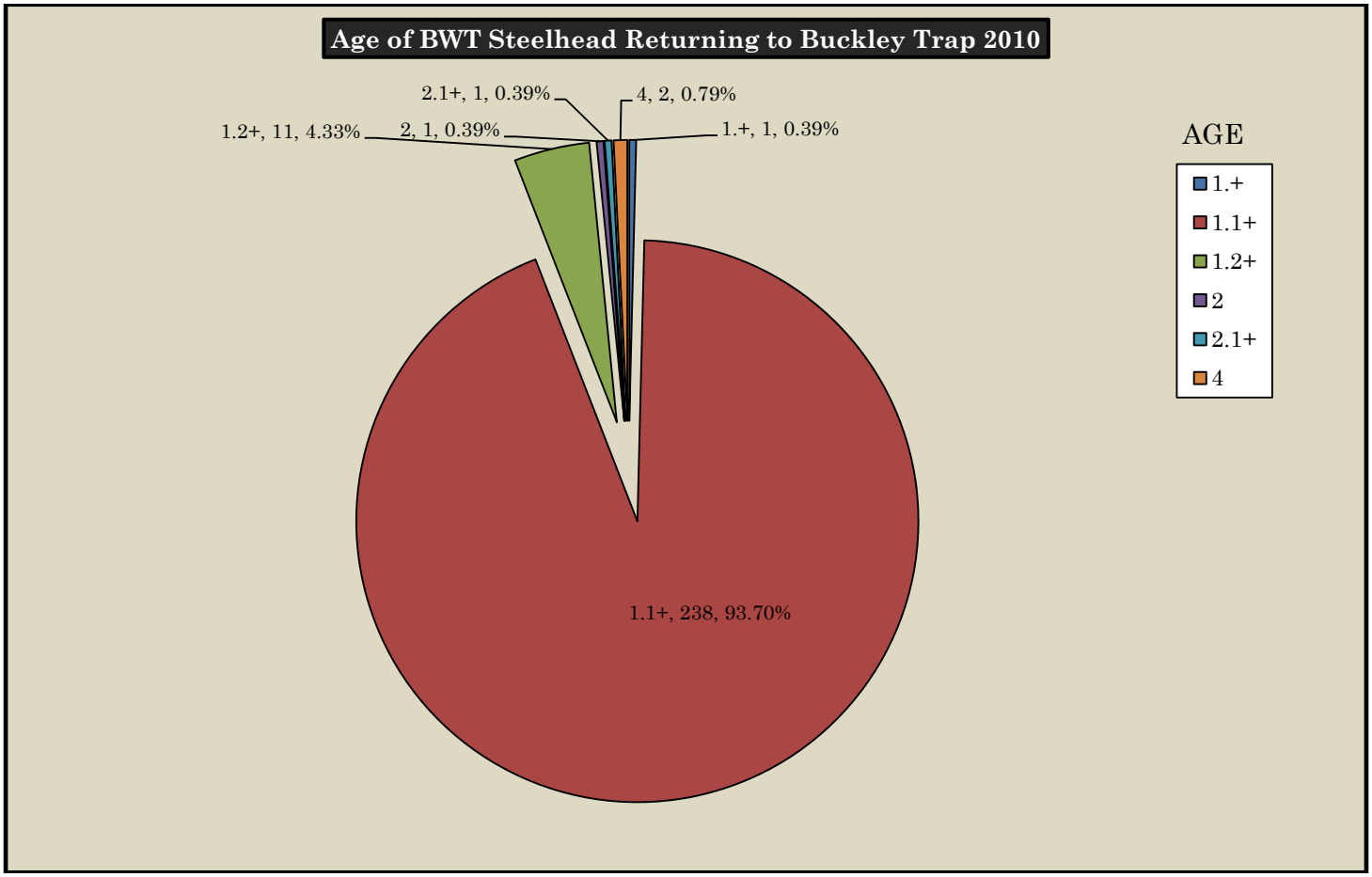
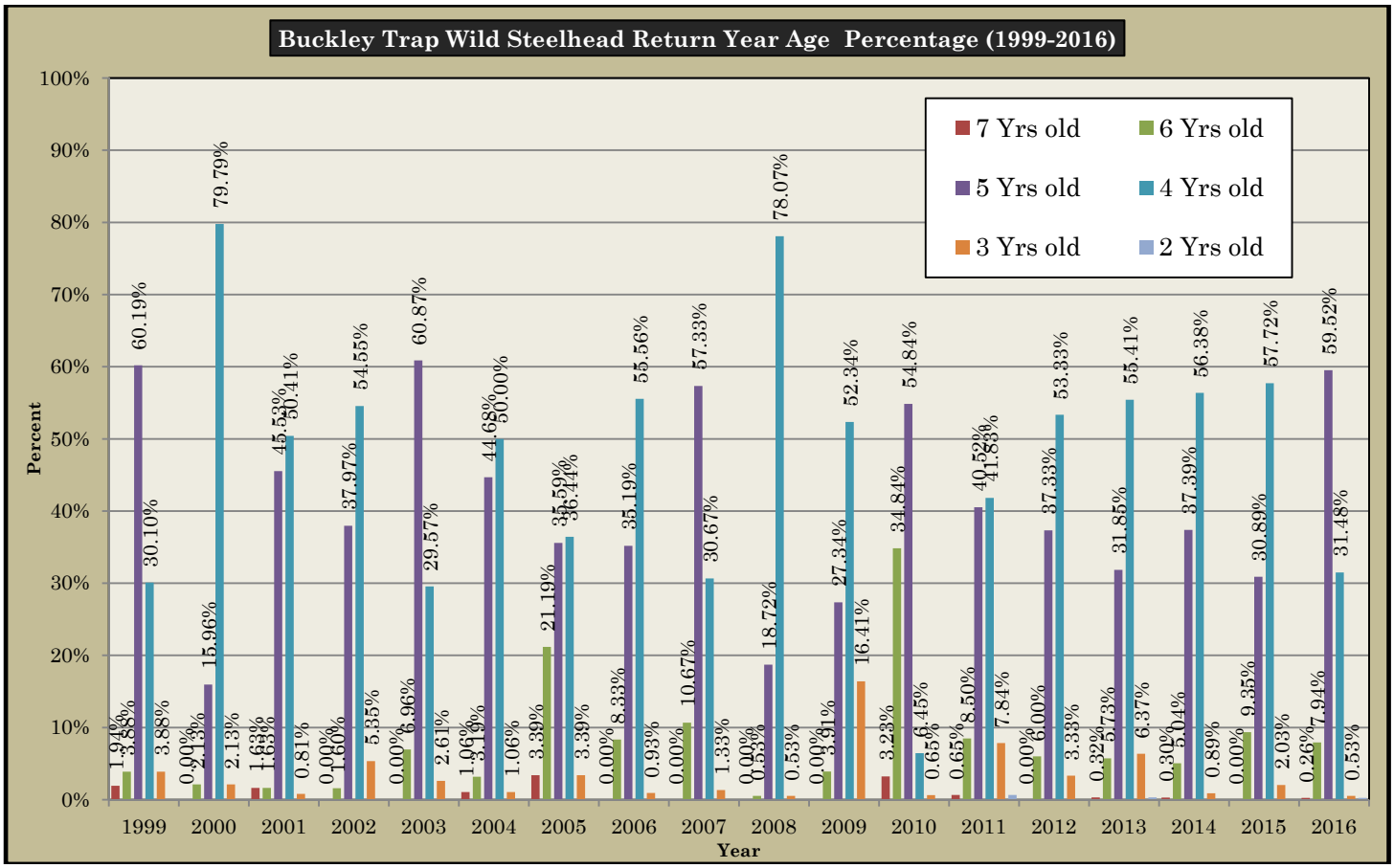


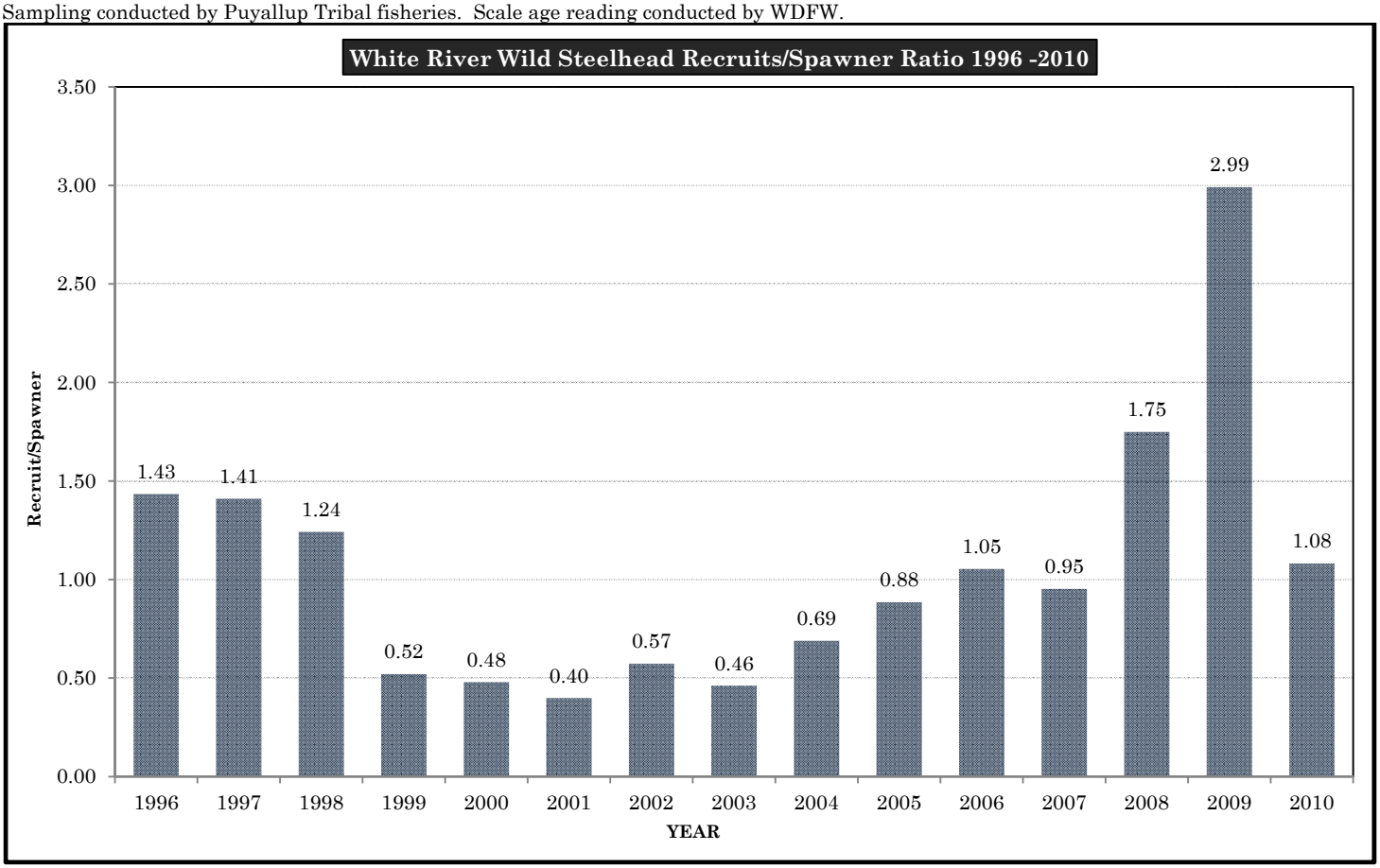


Sampling conducted by Puyallup Tribal fisheries. Scale age reading conducted by WDFW.



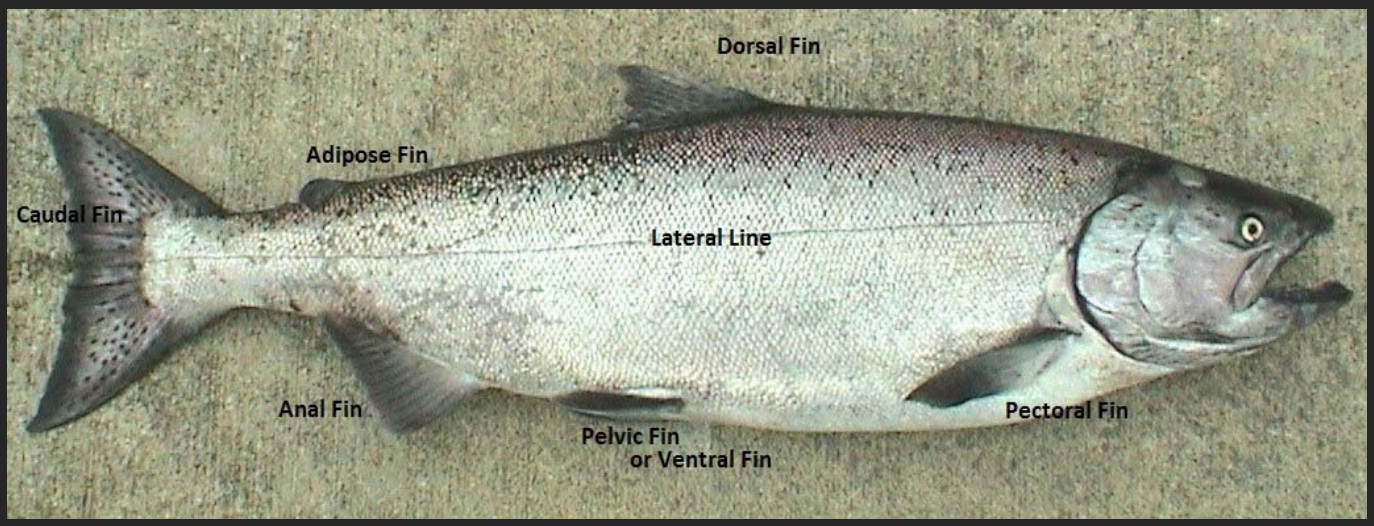


Sampling conducted by Puyallup Tribal fisheries. Scale age reading conducted by WDFW.

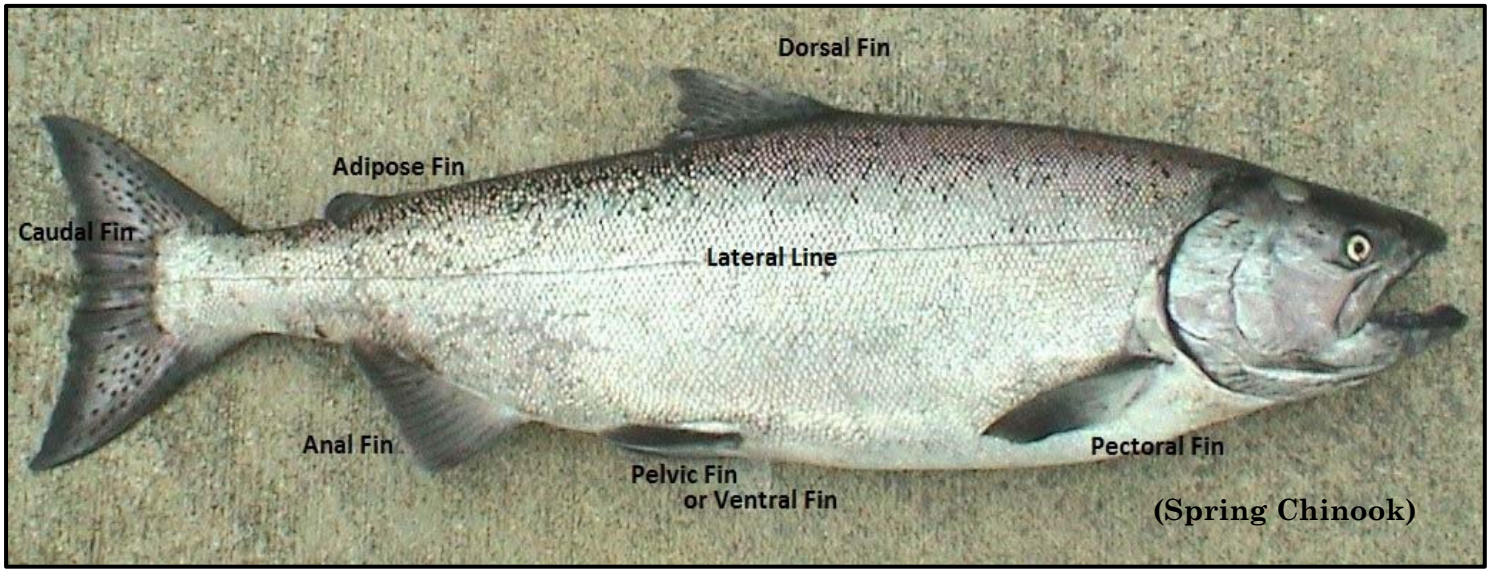


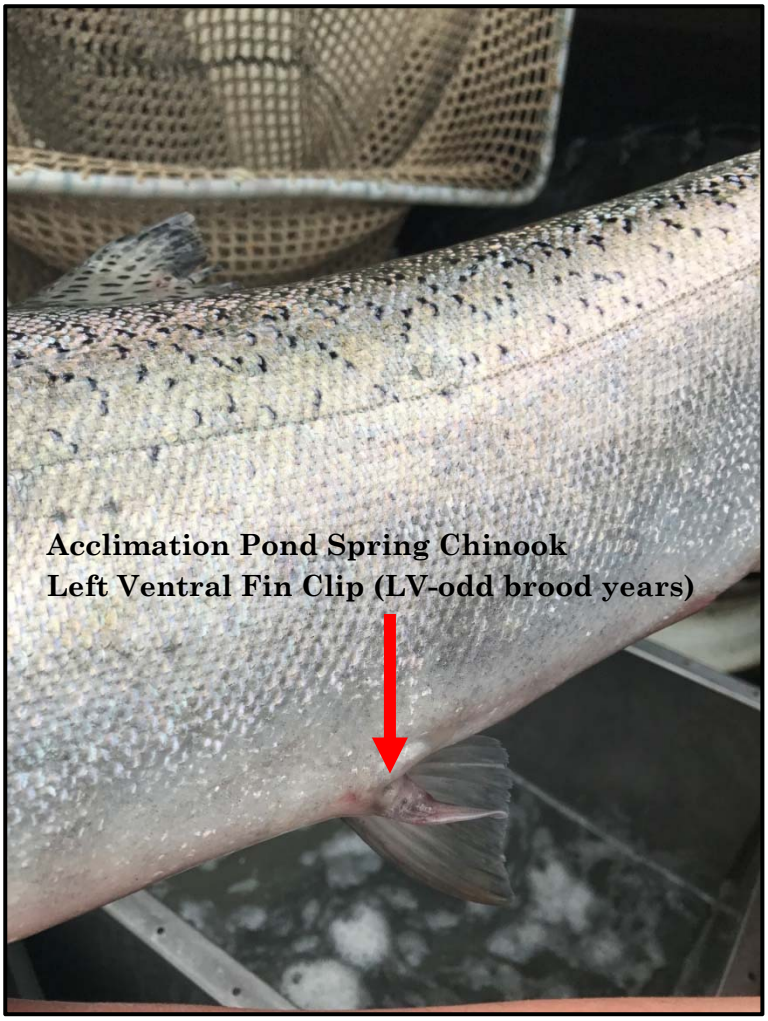
The steelhead recruits *(adults)* per spawner ratio *(R/S)* are an estimate of the natural productivity/success of the population. The lag–time in updating this graph can be 6-7 years due to the life history pattern of steelhead.

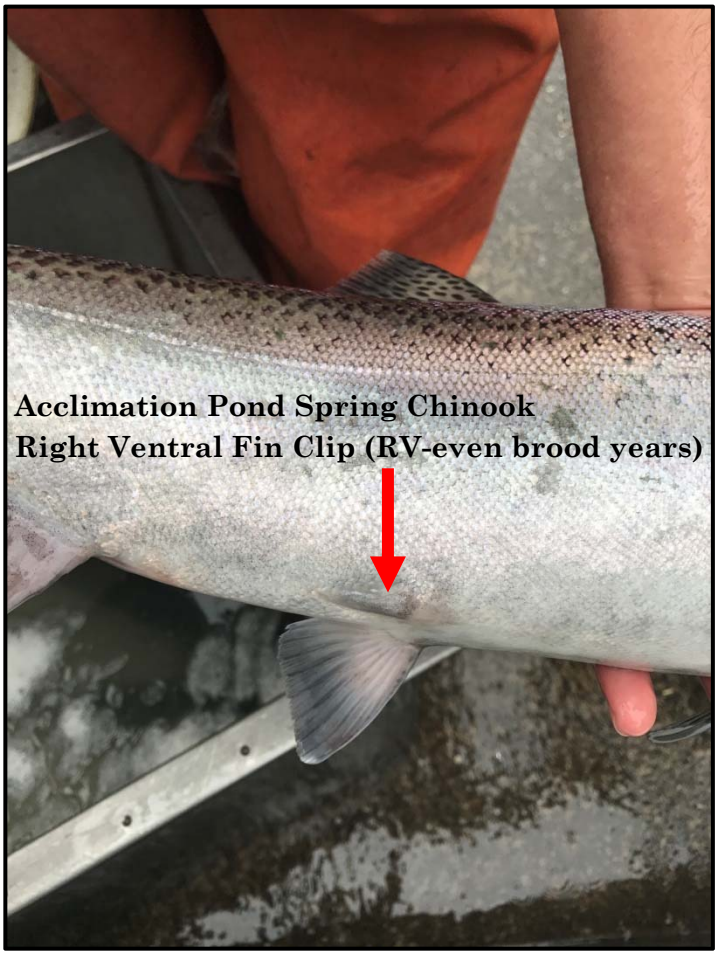
Fish Fin Identification/Marking



APPENDIX I


Dorsal Fin
Adipose Fin
Caudal Fin
Lateral Line
Anal Fin
Pelvic Fin
or Ventral Fin
Pectoral Fin
(Spring Chinook)


Acclimation Pond Spring Chinook
Left Ventral Fin Clip (LV-odd brood years)

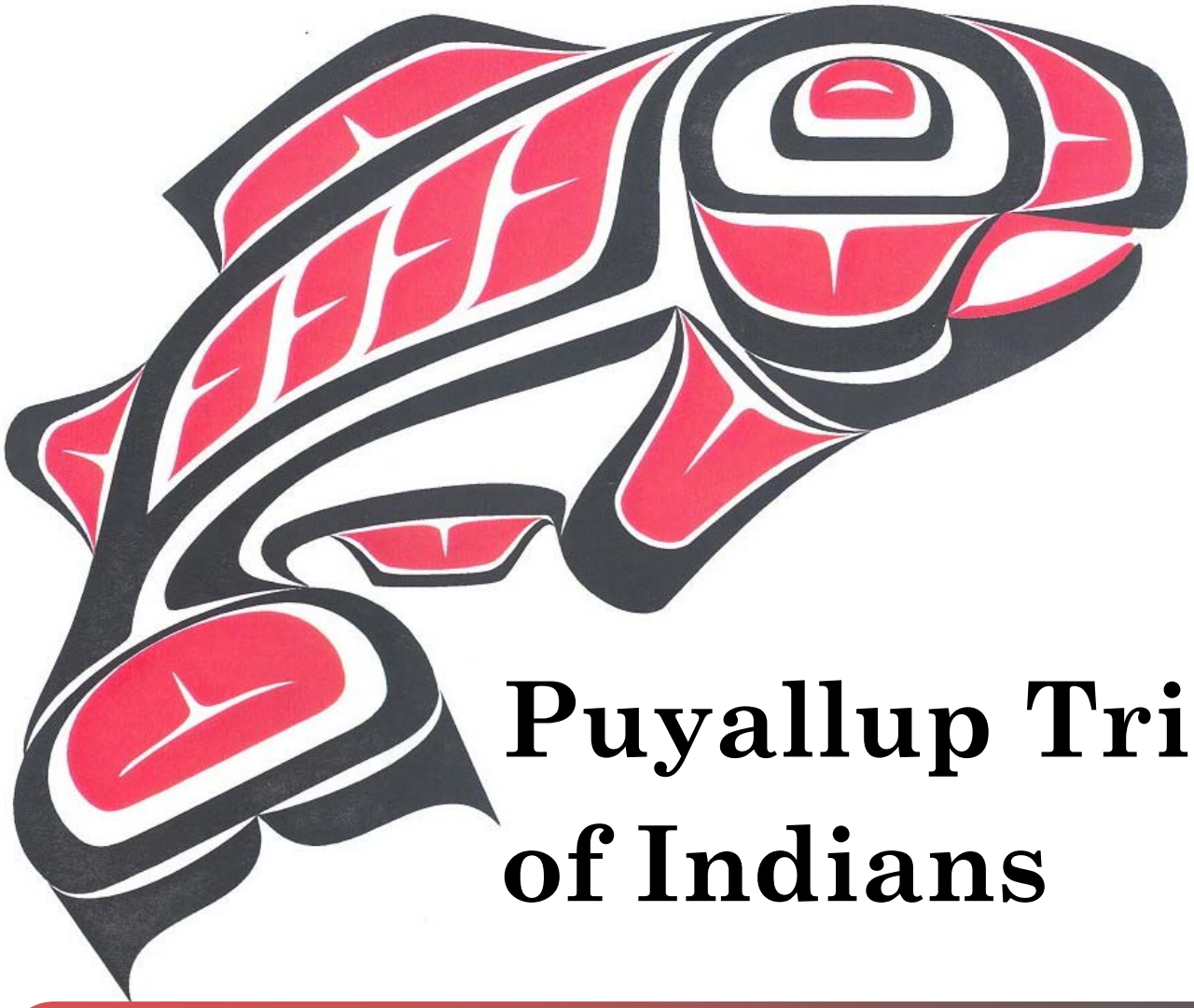

Acclimation Pond Spring Chinook
Right Ventral Fin Clip (RV-even brood years)

2016-2017

Annual Salmon, Steelhead And Bull Trout Report:

Puyallup/White River Watershed

Water Resource Inventory Area 10



Puyallup Tribe of Indians

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