Klamath River Cooperative Spawner Survey Overview Report

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Prepared by the California Department of Fish and Wildlife

Klamath River Project

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Foreword

In August of 2015 the CA Department of Fish and Wildlife (Department) entered into a financial agreement with the Yreka, CA office of the U.S Fish and Wildlife Service (Service) to provide a written report which details the cooperative salmonid spawner surveys which occur annually in the Klamath River Basin. The cooperative surveys have occurred since 1978 and, as the name implies, have been conducted by a number of different cooperating entities including local tribes, state, federal, non-governmental organizations (NGO) and volunteers.

A portion of the annual work has been funded by the Service, originally under the auspices of the Klamath River Basin Conservation Area Restoration Program (the Klamath Act) of 1986. This federal legislation expired in 2006. The Service has continued to fund the historical activities at varying levels to this day using discretionary funding from their annual budget. This report serves the purpose of summarizing the monitoring effort, data collection, and management uses associated with the cooperative surveys.

Escapement Surveys Scope of Work

- What USFWS seeks in a summary:
    - An information document that summarizes the purpose and process, including management hierarchy down to field cooperators, for the annual escapement surveys process. This would include how these surveys inform the Pacific Fishery Management Council annual salmon management/setting harvest quotas.
        - Components include:
            - Goals of work
            - Purpose and objectives of escapement surveys
            - Description of data collected and other sources of data necessary to inform the Pacific Fishery Management Council in setting harvest quotas
            - How survey data are used
            - Annual survey process/Survey timelines
            - List of cooperators
            - Maps (cooperator coverage zones, reaches surveyed, # of surveys conducted annually)
            - Harvest allocation
            - Management decision timelines
        - A summary document that is succinct, plain language and could be used for communications, as appropriate (maximum 30-40 pages)

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List of Abbreviations

AUC	Area-under-the-curve
CCC	California Coastal Chinook
CDFW	California Department of Fish and Wildlife
CWT	Coded Wire Tag
ESA	Endangered Species Act
FGC	(California) Fish and Game Commission
FMP	Fishery Management Plan
HCR	Harvest Control Rule
HVT	Hoopa Valley Tribe
IGH	Iron Gate Hatchery
KOHM	Klamath Ocean Harvest Model
KRFC	Klamath River Fall Chinook
KRP	Klamath River Project
KRTT	Klamath River Technical Team
KT	Karuk Tribe
MKWC	Mid-Klamath Watershed Council
MSA	Magnuson-Stevens Act
NCRC	Northern California Resource Center
NGO	Non-governmental Organization
PFMC	Pacific Fishery Management Council
QVT	Quartz Valley Tribe
SGS	Spawning Ground Survey
SRCD	Siskiyou Resource Conservation District
SRRC	Salmon River Restoration Council
SRFCF	Scott River Fish Counting Facility
STT	Salmon Technical Team
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
WCW	Willow Creek Weir
YT	Yurok Tribe

Executive Summary

The middle Klamath Cooperative Spawning Ground Surveys (SGS) originated in 1986 and were originally funded by the Klamath River Basin Conservation Area Restoration Program (the Klamath Act) as part of a comprehensive plan to restore anadromous fish in the Klamath Basin. Federal legislation supporting the Klamath Act expired in 2006 and was not reauthorized by Congress. Since that time the U.S. Fish and Wildlife Service has continued to contribute substantial funding to the SGS effort using discretionary funding from their annual budget. The SGS collect data annually on Klamath River Fall Chinook (KRFC) spawning in natural areas for fishery management purposes. SGS cooperators include the U.S. Forest Service, U.S. Fish and Wildlife Service, Yurok Tribe, Karuk Tribe, Quartz Valley Tribe, Northern California Resource Center, Siskiyou Resource Conservation District, Mid-Klamath Watershed Council, Salmon River Restoration Council, the California Department of Fish and Wildlife and local schools and volunteers.

Data generated through the SGS are presented annually to the Klamath River Technical Team and are incorporated into the annual *Klamath River Fall Chinook Age-Specific Escapement, River Harvest, and Run Size Estimate,* which includes sector-specific estimates and methodologies used by the cooperators as well as data from sectors outside of the scope of the SGS. Information from the KRTT report informs the KRFC salmon population forecast for the following season, which is presented annually in the *Ocean Abundance Projections and Prospective Harvest Levels for Klamath River Fall Chinook* (KRTT). This in turn is used by the Pacific Fishery Management Council (PFMC) for allocating fisheries for the following season. From 2006 to 2015 the proportion of Klamath Trinity Basin natural area spawners that are accounted for through the efforts of the cooperative SGS has averaged 32%. In the Klamath River upstream of the Trinity the proportion of natural area spawners that are accounted for through the efforts of the cooperative SGS has averaged 60%.

This report describes the areas surveyed by the SGS and how the data are generally obtained and applied in the annual management of KRFC.

Introduction

In 1986 The Klamath River Basin Conservation Area Restoration Program, the Klamath Act, was passed under Public Law 99-552. The Klamath Act authorized $21,000,000 to be distributed over a twenty year period to help restore anadromous fish, primarily salmon and steelhead, within the Klamath Basin. The U.S. Fish and Wildlife Service (Service) administered annual funding of the Klamath Act and distributed funding for various projects and programs that aligned with their recovery strategy of salmonids in the Klamath Basin. One of the many important projects that were identified for funding in part by the Klamath Act was the support of the Middle Klamath Cooperative Spawning Ground Survey (SGS) effort. The SGS collect data annually on Klamath River Fall Chinook (KRFC) spawning in natural areas for fishery management purposes. The SGS sectors include the miscellaneous Klamath mainstem tributaries upstream of the confluence with the Trinity, the Salmon River, the Scott River and the mainstem Klamath River upstream of Indian Creek (Figure 1). Formal estimation of KRFC escapement started in 1978, and as the SGS effort developed the method has become an integral part of estimating abundance in natural areas.

The SGS effort has occurred since 1986 and, as the name implies, has been conducted by a number of different cooperating entities including local tribes, state and federal agencies NGOs and volunteers. SGS cooperators include the U.S. Forest Service (USFS), Yurok Tribe (YT), Karuk Tribe (KT), Quartz Valley Tribe (QVT), Northern California Resource Center (NCRC), Siskiyou Resource Conservation District (SRCD), Mid-Klamath Watershed Council (MKWC), Salmon River Restoration Council (SSRC) and the Department along with various volunteers. With the exception of the Department and the volunteer participants, all cooperators receive funding from the Service to participate in the SGS effort. This federal legislation supporting the Klamath Act expired on October 1, 2006 and was not reauthorized by Congress. The Service has continued to contribute substantial funding to the SGS effort at varying levels to this day using discretionary funding from their annual budget in the absence of the Klamath Act (Figure 2).

The anadromous portions of the Klamath River Basin below Iron Gate Dam today cover 1,121 river miles, 701 of which are suitable for Chinook salmon (Hardy and Addley, 2006) and are under private, federal, tribal, state and county ownership. In an effort to monitor these 701 river miles and produce estimates of natural area spawning, tribal and sport harvest, and basin hatchery returns, the river has been separated into smaller and more manageable areas for effective monitoring. These areas are treated as distinct “units” or “sectors” for the purpose of reporting.

In August of 2015 the CA. Department of Fish and Wildlife (Department) entered into a financial agreement with the Service’s Yreka, CA office to provide a written report which details the SGS

Figure 1. Overview map of the Klamath River identifying SGS reaches surveyed annually.

Figure 2. Annual funding support in dollars provided to the Middle Klamath Cooperative Spawning Ground Survey effort from 1989 to 2015 (Erin Williams, USFWS 2015 personal communication).

efforts occurring annually in the Klamath River Basin. This report serves the purpose of summarizing the monitoring effort, data collection, and management uses associated with the cooperative surveys.

The Klamath River flows more than 250 miles through two states, Oregon and California, and drains approximately 12,000 square miles. Its headwaters are in Upper Klamath Lake, which lies in a high elevation basin (4,140 feet) in south-central Oregon. The Klamath River flows through sagebrush, marshes, forests and canyons before reaching its estuary near Requa on the northern California coast. Major tributaries to the Klamath include the Wood, Sycan, Sprague, and Williamson rivers in Oregon and the Shasta, Scott, Salmon and Trinity Rivers in California, as well as many smaller tributaries. The Klamath River Basin is the third largest salmon-producing watershed on the Pacific Coast, following the Columbia and Sacramento River basins. From 1918 to 1962, four dams were constructed on the Klamath River mainstem which blocked the migration of anadromous salmonids to the upper watershed. Currently Iron Gate Dam, at Klamath River mile 190, is the limit of anadromy on the Klamath River.

Area Specific Methods for Cooperative Survey

In addition to acquiring data on the spatial and temporal distribution of redds, the cooperative SGS obtain biological data from Chinook carcasses that are essential to the determination of the age, hatchery composition and sex composition of each year's run. These data include:

- Collection of scales for ageing,
- Fork length (for pre-season grilse/adult determination),
- Collection of coded-wire tags (CWT) from adipose fin-clipped carcasses,
- Inspection of marks and clips,
- Sex,
- Spawning success (for female carcasses), and
- Collection of tissue samples for genetic analysis and otolith samples for micro-chemical analysis.

Training of Cooperative Spawning Ground Survey Crews

Each fall, two training sessions are held for the cooperators prior to commencement of spawning ground surveys (early October). The first is held at Indian Scotty Campground located on the Scott River and hosted by the cooperators. Specific training stations cover salmon life

history, redd identification, carcass processing, species identification, survey safety and data recording procedures (Appendix 1). Attendees including new and returning employees, students and volunteers are divided into groups and rotate through all stations during the training. A second training, usually one day later, is held on the Salmon River for cooperators participating in the Salmon River survey. An annual training manual, prepared by CDFW and USFS, with detailed station descriptions, is provided to all participants (CDFW SGS Training Manual, 2015).

Salmon River

There are 24 identified Fall Chinook Salmon survey reaches in the Salmon River watershed totaling 63.5 river miles (Figure 3). All mainstem, North Fork Salmon and South Fork Salmon reaches are, when possible, surveyed twice a week during the spawning season. The Fall Run Chinook spawning survey in the Salmon River generally starts near October 10th and runs through the end of November and occasionally extends to the middle of December based on flows and run timing. Due to the remoteness of the Wooley Creek drainage this tributary is only surveyed once after the peak of spawning and prior to onset of major winter storms. Annually, the lower 13.1 river miles of Wooley Creek (4 reaches) downstream of the confluence with the North Fork are surveyed by diving. The lowermost 4 mainstem reaches downstream of Nordheimer Creek (14.9 river miles) are surveyed by dive teams as swimming is required in this section of the river. The mainstem surveys downstream of Nordheimer Creek and the Wooley Creek survey are coordinated by the Six Rivers National Forest out of the Orleans Ranger District office. The upper extent of Fall Chinook surveys in the North Fork Salmon is Mile 12 for a total of 12 river miles of survey across 6 reaches. The upper extent of Fall Chinook surveys in the South Fork Salmon is the confluence with Matthews Creek for a total of 10.2 river miles across 4 reaches. It is not impossible for Fall Chinook to migrate upstream of Matthews Creek on the South Fork and Mile 12 on the North Fork but it is very uncommon; during those years efforts shift upstream to account for the change in distribution. If sufficient flows are present during the Fall Chinook spawning season to provide access to smaller tributaries the lowermost reaches of Knownothing Creek, Little North Fork Salmon, Methodist Creek and Nordheimer Creek are surveyed for a total of 9.3 river miles. The smaller tributaries are surveyed at a lower frequency and up to 4 surveys per season are conducted. The Salmon River Survey upstream of Nordheimer is led by the Salmon River Restoration Council, Klamath National Forest and the Department. Cooperators participating in the Salmon River survey effort include the Karuk Tribe, Yurok Tribe and Siskiyou County Schools.

Scott River

Since the beginning of the Cooperative Survey implementation in the Scott River, the survey has been divided into 16 reaches totaling 57.9 river miles (Figure 4). Most of the reaches have been consistent since 1992 but some minor changes have been made to balance reach lengths and account for monitoring changes such as the addition of the adult fish counting station. The river flows in a south-north direction though the relatively flat topography (upper reaches 9-16) of the Scott Valley, and continues downstream through the higher gradient, higher velocity canyon reaches (reaches 1-8). The surveys have been generally segregated into these two general areas. In 2015, CDFW policy changed with regard to navigability and the need to request landowner permission to conduct surveys in the river flowing through private lands.

Figure 3. Overview map of the Salmon River and SGS reaches surveyed annually.

For reaches 1 through 6, downstream of the Scott River Fish Counting Facility (SRFCF), letters of intent to survey were mailed to landowners instead of letters requesting access. For reaches upstream of the SRFCF, however, policy did not change and the ability to survey the river flowing through private lands is still subject to obtaining landowner permission.

The lower Scott River canyon area has been segregated into 8 different reaches from the mouth of the river upstream to Meamber Bridge, a distance of 24.4 miles. Specific reaches range in length from 2.3 to 4 miles in length. During the spawning season from mid-October through the end of the Chinook run, usually in mid-December, cooperators meet at the Indian Scotty Campground (River Mile 17) for staging and daily reach assignments. All mainstem reaches downstream of the counting facility (Reaches 1-6) are surveyed twice a week during the spawning season. Reaches 7-8 are surveyed weekly as labor and stream conditions allow. If the available labor pool will not allow for surveying reaches 1-8, priority is given to reaches 1-6, then 8 and 7 respectively. The Department and Klamath National Forest work cooperatively with the Karuk Tribe, Quartz Valley Tribe and Northern California Resource Management on the Scott River surveys.

The upper mainstem Scott River is separated into 8 reaches (Reaches 9-16) and extends from Meamber Bridge to the confluence of the East and South Forks, a distance of 29.2 river miles. Reaches 9, 10 and 11 are lower gradient valley reaches. Chinook spawning has been documented in reaches 9 and 10, however, due to limited access granted by landowners, the CDFW has not surveyed these reaches since 2006. Previous survey efforts revealed minimal spawning gravel in Reach 11. The reaches do, however, serve as an important corridor to more heavily used spawning areas in reaches 12 through 16. Reaches 12 through15 extends from Fay Lane downstream to Eller Bridge, a distance of 8.5 river miles and are surveyed twice weekly from late October through December. Reach 16 from the confluence of the East Fork Scott River downstream to Fay Lane, a distance of 4 river miles is surveyed every other week or as flow conditions allow. The upper extent of Fall Chinook surveys in the Scott River is the confluence with the East Fork. It is not impossible for Fall Chinook to migrate upstream of the confluence of the East Fork or into valley tributaries (Shackleford Creek, Kidder Creek, Etna Creek, French Creek and Sugar Creek) when sufficient flows are present during the Chinook migration but it is very uncommon and during those years effort will shift upstream to account for this change in distribution. The Siskiyou RCD works cooperatively with the Siskiyou County Schools on the upper Scott River surveys.

If sufficient flows are present during the Fall Chinook spawning season to provide access to smaller tributaries, the lowermost reaches of Canyon Creek, Kelsey Creek and Tompkins Creek are surveyed by the Department for a total of 4.3 river miles. The smaller tributaries are surveyed at a lower frequency and up to 4 surveys per season are conducted.

Klamath Tributaries

There are 22 tributaries to the mainstem Klamath that enter the Klamath upstream of the confluence of the Trinity and are surveyed annually for Fall Chinook escapement (Figure 5). This group consists of tributaries that are generally small but excludes the larger Salmon River, Scott River, Shasta River or the smaller Bogus Creek. These tributaries are generally divided in to two groups: One group near Orleans and one group near Happy Camp. There are 11 tributaries in each area and these streams are generally surveyed at least once every 10 days.

Figure 4. Overview map of the Scott River and SGS reaches surveyed annually.

The Orleans tributary survey effort is led by the Six Rivers National Forest based out of the Orleans Ranger District. There are eleven streams divided into 19 reaches totaling 40.7 river miles. Table 1 contains descriptions of the Orleans tributaries. Individual reach maps are shown in Appendix 3. Cooperators are Six Rivers National Forest, Karuk Tribe, Yurok Tribe, CDFW and Mid Klamath Watershed Council.

The Happy Camp tributary survey effort is led by the Klamath National Forest based out of the Happy Camp Ranger District. There are eleven streams divided into 29 reaches totaling 71.4 river miles. Table 2 contains descriptions of the 11 Happy Camp tributaries. Individual reach maps are shown in Appendix 3. Cooperators are Klamath National Forest, Karuk Tribe, CDFW and Mid-Klamath Watershed Council.

Figure 5. Overview map of the Klamath River Tributaries and SGS reaches surveyed annually.

Klamath Mainstem

The Klamath River mainstem is currently being surveyed for fall run Chinook salmon escapement from Iron Gate Dam downstream to the mouth of Indian Creek (Figure 6). The mainstem survey started in 1993 by the Service to help provide additional fall run Chinook escapement data from a critical area which was not being surveyed. It is the current understanding that very few fall run Chinook spawn in the mainstem downstream of the confluence of Indian Creek. In the future there may be a need to extend this survey downstream to account for changes in spawning distribution. Additionally, no survey is conducted in the 1.7 river miles between the confluences of the Shasta River and Ash Creek. Past surveys in this 1.7 mile area have documented little to no spawning and as a result has been omitted from the survey.

The uppermost area extends from the boat ramp across from Iron Gate Hatchery downstream to the confluence with the Shasta River, a distance of 13.2 river miles. The upper area has been segregated into 8 reaches ranging in length from .3 miles to 3.3 miles and is generally surveyed once a week starting in early October and continues through the first of December. Reach lengths have been developed based on work load and are the distance that can be covered in a regular work day. The Service works cooperatively with the YT while conducting this survey. The survey generally consists of two teams of three, with each team in a raft or cataraft floating downstream. Each team is assigned a side of the river or bank to cover for the season. Each team consists of a fish processor, data recorder and rower (Gough 2015).

The lower portion of the mainstem survey extends from the mouth of the Shasta River downstream to the mouth of Indian Creek, a distance of 71.2 river miles. The lower area has been segregated into 5 reaches ranging in length from 11.6 miles to 17.1 miles. Reach lengths have been developed based on availability of boat ramps and work load and are a manageable distance that can be covered in a regular work day. Crews attempt to survey reaches weekly through the spawning season starting in mid-October and extending through early December.

Two teams of two, a rower and observer, zig-zag downstream covering the entire width of the river documenting redds. The Service works cooperatively with the KT while conducting this survey (Magneson, 2014).

Table 1. Description of Klamath River tributary streams surveyed by the SGS in the Orleans Ranger District.

Stream Name	Reaches Surveyed	Description of Area Surveyed	River Miles Surveyed
Aikens Creek	1	Highway 96 bridge to mouth	0.5
Bluff Creek	2	Dragon Bar to mouth. Note: opportunity to survey Bluff Creek is limited to period prior to onset of rainfall, in effort to minimize spread of Port Orford Cedar Disease.	7.8
Slate Creek	1	Lower 2.0 miles	2.0
Red Cap Creek	4	Log jam 10.8 river miles upstream of Klamath to mouth.	10.8
Boise Creek	2	Cascade 3.7 miles upstream of Klamath to mouth.	3.7
Camp Creek	4	Cascade 10.9 miles upstream of Klamath confluence to mouth.	10.9
Pearch Creek	1	Confluence of South Fork downstream to mouth.	0.7
Rogers Creek	1	Slide 1.3 miles upstream of Klamath confluence to mouth.	1.3
Irving Creek	1	Lower 1.0 mile	1.0
Rock Creek	1	Lower 0.7 miles from a slide to mouth	0.7
Ti Creek	1	Lower 1.0 mile	1.0

Table 2. Description of Klamath River tributary streams surveyed by the SGS in the Happy Camp Ranger District.

Stream Name	Reaches Surveyed	Description of Area Surveyed	River Miles Surveyed
Dillon Creek	1	Confluence of Mill Creek to mouth	2.0
Ukonomn Creek	1	Waterfall barrier to mouth	0.5
Independence Creek	1	Lower 0.7 miles	0.7
Clear Creek	3	Reaches 1 and 2 mainstem from .43 miles upstream from Slipper View to mouth for 4.5 miles, 3rd reach is lower mile of South Fork Clear Creek	5.5
Elk Creek	4	Bear Creek to mouth	13.0
Indian Creek	5	4 reaches on mainstem from 1.15 RM upstream of confluence with west branch to mouth, 5th reach is South Fork Indian Creek from Cole Creek to mouth for distance of 3 miles	15
Thompson Creek	3	Lower 6 miles	6.0
Fort Goff Creek	1	Lower 2 miles	2.0
Grider Creek	2	Bark Shanty Creek to mouth	6.0
Horse Creek	3	1.25 miles upstream of Salt Creek to mouth	6.25
Beaver Creek	5	3 reaches on mainstem from Soda Creek to mouth (8.2 miles), 2 reaches on West Fork Beaver from first bridge to mouth (3.2 miles)	11.4

Figure 6. Overview map of the Klamath River Mainstem and SGS reaches surveyed annually.

Methods for Estimating Total Escapement

Over the years since the inception of the cooperative surveys, methodologies have evolved that are best suited to each sector. Details of methods used in the different sectors are shown in Table 3. Redd-based estimates are more effective for reaches where carcasses are rarely recovered, or for years when high flows remove carcasses from the spawning grounds. Some of the larger tributary streams are more effectively surveyed by diving and smaller ones by foot surveys. For years when unusually large runs are forecast, sampling methods may need to be adapted to handle larger numbers of fish within labor and funding constraints. For example, adoption of the area-under-the-curve (AUC) method was implemented for the 2012 mainstem Klamath survey, described in the Methods section to follow.

Sectors supported by SGS

Salmon River

Estimation methods in the Salmon River have remained fairly consistent over the past decade. A carcass based mark-recapture estimate has been the primary method for estimating total for all of the non-dive reaches above Nordheimer Creek with the exception of the smaller tributaries of Knownothing Creek, Little North Fork Salmon, Methodist Creek and Nordheimer Creek. These smaller tributaries rely on redd counts as the basis for estimating total, as carcass recovery in these very small streams is difficult due to predation and survey frequency. The mainstem downstream of Nordheimer Creek and Wooley Creek surveys rely on a redd based method to estimate total. A carcass based estimate in these areas would be preferred but due to the difficulty of recovering carcasses while diving, a redd based method has been adopted. The carcass mark-recapture estimator has evolved over the years from a simple Peterson mark-recapture estimator to a Shaffer mark-recapture estimator to the current preferred method, the Cormack-Jolly-Seber mark-recapture estimator (Bergman 2012). The Cormack-Jolly-Seber estimator has been used to estimate total since 2014. For the areas that rely on a redd based method, an expanded redd count (2*total redd count)/(1-proportion jacks) has been used to estimate total. The proportion of jacks is generally but not always determined based on a representative scale sample collection generated from the areas where foot surveys can be successfully conducted and carcasses recovered. Upon rare occasions when high flow discharge events occur during the spawning season and there is a concern that the majority of carcasses are flushed out of the survey area, a redd based method for the entire watershed has been implemented.

Scott River

From 1992 through 2007 the cooperative spawning ground survey was the primary method for estimating escapement. In 2007, due to limited access to private property in the valley reaches (reaches 9-16), the Department began operating a video fish counting station (Scott River Fish Counting Facility or SRFCF) at River Mile 18, near the upper extent of the canyon and below the valley reaches. The SRFCF allows for estimating abundance of salmon migrating through the counting station. For areas downstream of the SRFCF a carcass based mark-recapture estimate is utilized. The estimator has evolved over the years from a simple Peterson mark-recapture estimator to a Shaffer mark-recapture estimator to the current preferred method the Cormack-Jolly-Seber mark-recapture estimator. The Cormack-Jolly-Seber estimator has been used to estimate total downstream of the counting facility since 2012. The lower river mainstem tributaries Tompkins, Canyon and Kelsey rely on an expanded redd count method

Table 3. Estimation and sampling methods used for the 2015 Klamath River fall Chinook run assessment (KRTT 2016).

Sampling Location	Estimation and Sampling Methods	Agency
Hatchery Spawners		
Iron Gate Hatchery (IGH)	Direct count. All fish examined for fin clips, tags, and marks. Bio-data collected from a systematic random sample of 10% of the fish. Additionally, all ad-clipped fish were bio-sampled.	CDFW
Trinity River Hatchery (TRH)	Direct count. All fish examined for fin clips, tags, and marks. Bio-data collected from a systematic random sample of 20% of the fish.	CDFW, HVT
Natural Spawners		
Salmon River Basin	Carcass mark-recapture survey (Cormack-Jolly-Seber) within the mainstem above Nordheimer Campground combined with redd surveys of the lower mainstem and tributaries. Total run based on mark-recapture estimate and expanded redd count (2*total redd count)/(1-proportion of jacks) + live fish observed on last day surveyed. Jacks estimated from scale-age data from this area.	CDFW, USFS, YT, KT, SRRC, SCS
Scott River Basin	Video count above weir at river mile 18 and carcass mark-recapture (Cormack-Jolly-Seber) below weir. Total run based on video count through the weir and mark-recapture estimate below the weir. Bio-samples were obtained from all non-deteriorated carcasses recovered above and below the weir with a daily maximum scale sample collection of 25 per reach.	CDFW, QVIR, USFS, KT, NCRC, SRCD
Shasta River Basin	Video count above weir. Bio-data collected from all carcasses upstream of video weir site, and 10% mortalities stranded on weir.	CDFW
Bogus Creek Basin	Video count above weir and twice weekly direct carcass count below weir. Bio-data collected from a systematic random sample (1:4) of all carcasses observed during surveys above and below weir. Additionally, all ad-clipped fish were bio-sampled.	CDFW, SCS
Klamath River mainstem (IGH to Shasta R.)	Area-under-the-curve estimate from weekly carcass surveys. Bio-data collected from fresh	USFWS, YT
Klamath River mainstem (Shasta R. to Indian Cr.)	Weekly redd survey. Total run = (2*total redd count)/(1-proportion jacks). Jacks estimated from the Klamath River mainstem (IGH to Shasta R.) scale-age data.	USFWS, KT
Klamath Tributaries above Trinity River	Periodic redd surveys, the majority of which were performed weekly. Total run = (2*total redd count)/(1-proportion jacks) + live fish observed on last day surveyed. Jacks estimated from Klamath tributary scale-age data. Bio-data collected from all carcasses recovered.	USFS,CDFW, KT, YT, SRRC, MKWC
Blue Creek	Weekly dive counts. Total estimated as the peak count during surveys. Bio-data collected from carcasses and gill-netted and released live fish.	YT
Trinity River (mainstem above WCW)	Mark-recapture (Petersen); marks applied at WCW and recovered at TRH. All fish bio-sampled and scales collected by systematic random sampling (1:2). Age composition of total run past WCW based on scale-age data from the weir. Natural spawning escapement estimated by subtracting age-specific estimates of hatchery returns and recreational harvest above WCW from	CDFW, HVT
Trinity River (mainstem below WCW)	Bi-weekly redd survey. Total run = (2*total redd count)/(1-proportion jacks). Jacks estimated from the natural area above WCW. Bio-data from all recovered carcasses.	HVT, USFWS
Trinity Tributaries (above Reservation; below WCW)	Periodic redd survey. Total run = (2*total redd count)/(1-proportion jacks) + live fish observed during last survey. Jacks estimated from the natural area above WCW. Bio-data collected from	USFS
Hoopa Reservation Tributaries	Periodic redd survey. Total run = (2*total redd count)/(1-proportion jacks). Jacks estimated from the natural area above WCW. Bio-data collected from all recovered carcasses.	HVT
Recreational Harvest		
Klamath River (below Hwy 101 bridge)	Jack and adult estimates based on access point creel survey during three randomly selected days per statistical week. Bio-data collected during angler interviews.	CDFW
Klamath River (Hwy 101 to Weitchpec)	Jack and adult estimates based on access point creel survey during three randomly selected days per statistical week. Bio-data collected during angler interviews.	CDFW
Klamath River (Weitchpec to IGH)	No survey. Upper Klamath adult harvest estimated using the ratio of lower river to total adult river harvest during the years 1999-2002 (Appendix B). Upper river adult harvest = total adult harvest minus lower river adult harvest. Total harvest = adults/(1-proportion jacks). Jacks estimated from IGH, Klamath mainstem, Shasta River, and Bogus Creek weighted average age	CDFW
Trinity River Basin (above WCW)	Jack and adult harvest estimates based on estimated harvest rates from angler return of reward tags applied at WCW.	CDFW
Trinity River Basin (below WCW)	Roving access creel survey during three randomly selected days per statistical week stratified by weekdays and weekend days (1 weekday and 2 weekend days). Bio-data collected during	HVT
Tribal Harvest		
Klamath River (below Hwy 101)	Daily harvest estimates based on effort and catch-per-effort surveys. Bio-data collected during harvest and buying station interviews.	YT
Klamath River (Hwy 101 to Trinity mouth)	Daily harvest estimates based on effort and catch-per-effort surveys. Bio-data collected during	YT
Trinity River (Hoopa Reservation)	Effort and catch-per-effort surveys during four randomly selected days per statistical week. Bio-data collected during net harvest interviews.	HVT
Fishery Dropoff Mortality		
Recreational Angling Dropoff Mortality: 2.04%	Not directly estimated. Assumed rate relative to fishery impacts = .02; relative to fishery harvest	KRTAT
Tribal Net Dropoff Mortality: 8.7%	Not directly estimated. Assumed rate relative to fishery impacts = .08; relative to fishery harvest	KRTAT

[a] Bio-data generally includes: fork length, scale, sex, tags or marks, and CWT recovery from dead ad-clipped fish.

(2*total redd count)/(1-proportion jacks) to estimate total. The proportion of jacks is generally but not always determined based on a representative scale sample collection generated from the areas where foot surveys can be successfully conducted and carcasses recovered. Upon rare occasions when high flow discharge events occur during the spawning season and there is a concern that the majority of carcasses are flushed out of the survey area, a redd based method for the entire watershed has been implemented. Total escapement in the Scott River is derived from adding the Cormack-Jolly-Seber (reaches 1-6) estimate to the total count derived from the video counting facility (reaches 7-16) and the expanded redd count from any tributary streams downstream of the counting facility.

In most years a high proportion of the Chinook in the Scott River spawn above the counting station (Table 4)(Knechtle 2015). Due to the high proportion of Chinook spawning above the counting station and the need to collect bio-samples to generate accurate age structure, parts of reaches 7 through 16 continue to be surveyed for bio-sample collection. In addition to providing critical bio-samples the upper basin surveys help document the distribution of spawners within the upper Scott River watershed. Watershed recovery efforts in the upper basin use the annual spawning distribution information to target specific areas for restoration.

Klamath River mainstem (IGH to Shasta River)

Escapement for the upper area was initially estimated through an expanded redd count and in 2001 transitioned to a carcass based mark-recapture survey (Gough 2015). As a result of a large forecast run in 2012 and a concern over the ability to conduct traditional mark-recapture survey methodology the Service developed an alternative method based on an AUC escapement estimate (Gough 2015). The AUC escapement estimator has been used as the primary method to estimate escapement in the mainstem from Iron Gate Dam to the Shasta River since 2012.

Table 4. Scott River Chinook salmon abundance estimates by area and percentages of the total above and below the Counting Station during the 2008-2015 seasons.

Year	Downstream of Counting Station	Upstream of Counting Station	% Downstream of Counting Station	% Upstream of Counting Station	Total Basin Estimate
2008	1,439	3,234	31%	69%	4,673
2009	1,014	1,197	46%	54%	2,211
2010	280	2,228	11%	89%	2,508
2011	983	4,538	18%	82%	5,521
2012	1,208	8,144	13%	87%	9,352
2013	1,252	3,372	27%	73%	4,624
2014	2,995	9,476	24%	76%	12,471
2015	1,741	372	82%	18%	2,113
Average	1,364	4,070	32%	68%	5,434

Klamath River mainstem (Shasta River to Indian Creek)

Due to low carcass capture rates and the inability to generate a carcass based estimate of total, a redd based estimate has been used to estimate total since the survey inception in 1993. The redd based method relies on an expanded redd count (2*total redd count)/(1-proportion jacks) to estimate total. Insufficient scale samples are collected from this survey directly and a surrogate scale sample collection is used to estimate the jack proportion and age structure. The surrogate traditionally used to estimate age structure in the lower redd survey is the upper mainstem carcass survey (Magneson, 2014).

Klamath Tributaries (above Trinity River)

Estimation methods in both the Orleans and Happy Camp tributaries have exclusively relied on a redd based method for estimating total. The low number of carcasses encountered due to presence of predators and scavengers and the frequency of surveys have prevented the use of a carcass based estimation method. The redd based method relies on an expanded redd count (2*total redd count)/(1-proportion jacks) to estimate the total. If sufficient carcasses are recovered during the tributary survey effort the proportion of jacks can be estimated from carcasses collected in the tributary survey. In most but not all years insufficient scale samples are collected from this survey directly and surrogate scale sample collection is used to estimate the jack proportion and age structure.

Blue Creek

Weekly snorkel surveys are conducted by the YT during the spawning season. Total escapement is estimated as the peak count during weekly dive surveys. Bio-data is collected from all fresh carcasses and is the basis for ageing the return in Blue Creek.

Klamath River Scale Ageing

All scales collected from the Klamath River mainstem and tributaries excluding the Trinity are processed by the Yurok Tribal Fisheries program in cooperation with the Service. Bias corrected (Kimura 1991) scale samples are processed to estimate area specific age proportions for each sector independently. Scale reading and interpretation are validated with known age, coded-wire tagged KRFC (i.e. scales collected from coded-wire tagged fish). Age assessment performed by the YT is an important component of the annual funding provided by the Service.

Sectors not supported by SGS

Iron Gate Hatchery

Iron Gate Hatchery is owned by PacifiCorp and managed by the Department. Yearly KRFC escapement estimates are produced by the staff of IGH (direct observation of fish entering the hatchery) and biological data are collected and presented by the Department's Klamath River Project (KRP), Yreka office. KRP staff conduct a systematic 1:10 biological sample of Chinook that enter the hatchery and collect all heads from adipose-clipped fish for CWT extraction and analysis. Scale samples are collected from all systematically sampled fish and are the basis for determining age structure. Tissue and otolith samples are collected from every 10th systematically sampled fish.

Trinity River Hatchery

Trinity River Hatchery (TRH) is owned by the Bureau of Reclamation and managed by the Department. Yearly Chinook escapement estimates are produced by the staff of TRH (direct observation of fish entering the hatchery) and biological data are collected and presented by the Department's Trinity River Project (TRP), with cooperation with the Hoopa Valley Tribal (HVT) Fisheries Department. TRP and HVT staff conduct a systematic 1:5 biological sample of Chinook that enter the hatchery and collect all heads from adipose-clipped fish for CWT extraction and analysis. Scale samples are collected from all systematically sampled fish and are the basis for determining age structure.

Shasta River

The Department operates a video fish counting facility in the Shasta River approximately 700 feet from its confluence with the Klamath River. It is operated twenty-fours per day and seven days per week from early September through late December or into January, if flows allow, to include coho salmon migration. The fish counting facility provides a total count of Chinook entering the Shasta River. Weekly spawning ground surveys are conducted above the weir to obtain biological data from the run. The surveys cover approximately 15% of the Shasta River basin and include canyon and valley reaches. All salmon carcasses encountered are processed. Bio-data collected include fork length, sex, spawning success, and clips or marks. Scale samples are collected from all carcasses, and tissue and otolith samples are collected from the first carcass processed on each reach on each survey day. Scale samples collected during the spawning ground survey effort are the primary foundation of ageing the return. After processing, all carcasses are cut in half. Estimates of hatchery straying are made annually. Heads are collected from all adipose-clipped carcasses encountered. In addition to the surveys,

carcasses that float downstream and become impinged on the weir panels (wash-backs) are sampled for bio data as described for the surveys, at a 1:10 sampling rate for Chinook salmon. All surveys are conducted by the Department's KRP, Yreka office.

Bogus Creek

A video fish counting facility is operated by the Department throughout the Chinook period. It is located approximately 0.3 miles from the confluence of Bogus Creek and the Klamath River. A spawning ground survey is conducted twice weekly for the 0.3 mile reach downstream of the facility, in which all Chinook carcasses are counted and added to the video count. A sample rate is determined annually to sub-sample carcasses during the survey effort for biological date. All recovered ad-clipped carcasses are included in the sample collection. Above the fish counting facility, reaches 2, 3 and 4 (0.6, 1.6 and 1.1 miles, respectively) are surveyed twice weekly. Scale samples are collected within the systematic sample, as well as tissue and otolith samples from the first fish from each reach on each survey day. Scale samples collected during the spawning ground survey effort are the primary foundation of ageing the return. All surveys are conducted by the Department's KRP, Yreka office.

Trinity River above Willow Creek Weir

The Department, in cooperation with the HVT, estimate total escapement above the Willow Creek Weir (WCW) utilizing mark-recapture methods. A sub sample of fish are captured and marked at the WCW and later recovered at Trinity River Hatchery (TRH) forming the basis for a mark-recapture abundance estimate. A systematic sample (1:2) of scales is collected to age the run upstream of WCW. Total natural escapement is estimated by subtracting age-specific estimates of hatchery returns and recreational harvest above WCW from the total estimate. Age structure of the total run is estimated from scales collected at the WCW.

Trinity River mainstem below WCW

Escapement in the Trinity River mainstem downstream of the WCW is estimated through bi-weekly redd surveys. The redd based method relies on an expanded redd count (2*total redd count)/(1-proportion jacks) to estimate total. Bio-data are collected from all recovered carcasses. All surveys are conducted by HVT.

Trinity Tributaries downstream of WCW

Escapement in the Trinity River tributaries downstream of the WCW is estimated through periodic redd surveys. The redd based method relies on an expanded redd count (2*total redd count)/(1-proportion jacks) to estimate total. Bio-data are collected from all recovered

carcasses. These surveys are primarily conducted by HVT (reservation tributaries and mainstem) and USFS (Horse Linto Creek and Cedar Creek). Tributaries upstream of WCW are surveyed by the USFS, however these surveys are infrequent and are not used to generate estimates since the estimate above WCW is a basin estimate inclusive of all tributaries upstream of the weir.

Recreational Harvest

Recreational harvest estimates in the Klamath River downstream of the confluence with the Trinity are conducted by the Department and are based on access point creel surveys conducted on three randomly selected days per statistical week. Jacks are built back into this estimate annually based on jack composition from sectors upstream and may also include the Shasta River. Due to the length of the upper Klamath (160 miles above Weitchpec to Iron Gate Dam), the sparsity of angling effort over much of this area, and the cost of implementing a creel census, the upper Klamath recreational harvest is estimated from the lower Klamath recreational harvest based on a "ratio" i.e. 1 fish harvested in the Lower Klamath equals 0.58 fish harvested in the Upper Klamath. The ratio was calculated on four years of data collected from simultaneous creel surveys performed in both areas from 1999 through 2002. Recreational harvest estimates in the Trinity River downstream of the WCW are conducted by HVT and are generated from roving access creel surveys during three randomly selected days per statistical week which are stratified by weekdays (two sample days) and weekends (one sample day). The recreational harvest in the Trinity River upstream of the WCW is estimated by the Department. Harvest rates are developed from the return of reward tags which are applied at WCW and are later returned by anglers. Area specific age structure is determined from scales collected within each sector when possible and when not possible surrogate age structures are utilized.

Tribal Harvest

Total estimated tribal harvest in the Klamath River is estimated by the YT through daily effort and catch-per-effort surveys. In the Trinity River tribal harvest is estimated by the HVT through effort and catch-per-effort surveys conducted on four randomly selected days per statistical week. Age structure from tribal harvest is determined from area specific scale sample collections.

Harvest Dropoff Mortality

Tribal and recreational drop-off mortality is estimated indirectly each season by the KRTT to account for unseen mortality associated with fisheries. The current drop-off mortality rate applied to the tribal and recreational fisheries are 8.7% and 2.04% respectively (KRTT 2016).

Data Management

The four primary in-river variables used for the management of KRFC are total abundance (escapement plus harvest, also referred to as run-size), natural area spawner escapement, hatchery escapement and age structure. The age composition of the 2015 Chinook run is shown in Table 5. (KRTT 2016). This table is a result of an entire season's monitoring efforts and compiled at the annual Age Composition meeting held each January or early February, where agencies, tribes and other natural resource entities present their data on the preceding season's Chinook run in their sectors of responsibility. In addition to *Klamath River Fall Salmon Age-Specific Escapement, River Harvest, and Run Size Estimates,* many additional reports are produced annually which, in part, utilize data collected from this effort (Appendix 2). The SGS effort provides data to 5 of the 27 discrete sectors that are independently estimated on an annual basis. Natural area escapement is a critical metric for the long term viability of the KRFC stock. The proportion of Klamath Basin natural area spawners that are accounted for through the efforts of the cooperative SGS has averaged 32% for the years 2006-2015 (Table 6). If the Trinity River is excluded from the total the proportion of Klamath Basin natural area spawners that are accounted for through the efforts of the cooperative SGS has averaged 60% for the years 2006-2015. Without the cooperative SGS, a sizeable amount of critical information on the abundance and age composition of natural area spawners would be unaccounted for.

Table 5. Age composition of the 2015 Klamath Basin fall Chinook run (KRTT 2016).

Escapement & Harvest	AGE 2	3	4	5	Total Adults	Total Run
Hatchery Spawners						
Iron Gate Hatchery (IGH)	220	3,657	4,073	226	7,956	8,176
Trinity River Hatchery (TRH)	224	1,832	1,258	39	3,129	3,353
Hatchery Spawner subtotal	**444**	**5,489**	**5,331**	**265**	**11,085**	**11,529**
Natural Spawners						
Salmon River Basin	92	846	981	150	1,978	2,070
Scott River Basin	21	1,053	829	210	2,092	2,113
Shasta River Basin	133	5,752	658	202	6,612	6,745
Bogus Creek Basin	45	1,314	974	20	2,308	2,353
Klamath River mainstem (IGH to Shasta R)	84	1040	1261	123	2,423	2,507
Klamath River mainstem (Shasta R to Indian Cr)	175	2131	2601	252	4,984	5,159
Klamath Tributaries (above Trinity River)	50	1,265	870	109	2,244	2,294
Blue Creek	149	141	491	0	632	781
Klamath Basin subtotal	749	13,542	8,665	1,066	23,273	24,022
Trinity River (mainstem above WCW)	2,509	1,425	2,602	433	4,459	6,968
Trinity River (mainstem below WCW)	155	88	161	27	276	431
Trinity Tributaries (above Reservation; below WCW)	26	15	27	4	46	72
Hoopa Reservation tributaries	37	21	39	6	66	103
Trinity Basin subtotal	2,727	1,549	2,829	470	4,847	7,574
Natural Spawners subtotal	**3,476**	**15,091**	**11,494**	**1,535**	**28,120**	**31,596**
Total Spawner Escapement	**3,920**	**20,580**	**16,825**	**1,800**	**39,205**	**43,125**
Recreational Harvest						
Klamath River (below Hwy 101 bridge)	292	1,396	1,118	400	2,914	3,206
Klamath River (Hwy 101 to Weitchpec)	1,224	1,492	602	164	2,258	3,482
Klamath River (Weitchpec to IGH)	64	1,562	925	76	2,563	2,627
Trinity River Basin (above WCW)	21	18	17	0	35	56
Trinity River Basin (below WCW)	3	14	14	0	28	31
Subtotals	**1,604**	**4,482**	**2,676**	**640**	**7,798**	**9,402**
Tribal Harvest						
Klamath River (below Hwy 101)	405	8,945	9,923	3,615	22,483	22,888
Klamath River (Hwy 101 to Trinity mouth)	44	1,033	1,929	552	3,514	3,558
Trinity River (Hoopa Reservation)	47	614	1,294	112	2,020	2,067
Subtotals	**496**	**10,592**	**13,146**	**4,279**	**28,017**	**28,513**
Total Harvest	**2,100**	**15,074**	**15,822**	**4,919**	**35,815**	**37,915**
Totals						
Harvest and Escapement	6021	35690	32716	6737	75,143	81164
Recreational Angling Dropoff Mortality 2.04%	33	91	55	13	159	192
Tribal Net Dropoff Mortality 8.7%	43	921	1,143	383	2,447	2,490
Klamath River ICH disease testing	1	30	56	16	103	104
Trinity River ICH disease testing	0	6	13	1	20	20
Total River Run	**6,097**	**36,702**	**33,914**	**7,133**	**77,749**	**83,846**

Table 6. Proportion of Klamath Basin natural area spawners estimated by Cooperative Spawning Ground Surveys (SGS) effort, the total basin natural area escapement and the proportion of the total natural area escapement accounted for by the SGS for the years 2006 - 2015.

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average
Areas surveyd by SGS:											
Main stem Klamath River	5,391	6,955	7,029	8,240	3,959	7,203	16,303	12,875	24,287	7,666	
Salmon River	2,069	1,432	2,399	2,720	2,834	5,493	4,390	2,480	3,233	2,070	
Scott River	4,960	4,505	4,673	2,211	2,508	5,521	9,353	4,624	12,470	2,113	
Klamath Tributaries	1,904	1,440	2,918	3,269	1,937	6,331	3,883	2,510	8,375	2,294	
Sub-Total	14,324	14,332	17,019	16,440	11,237	24,548	33,928	22,489	48,365	14,143	
Areas not surveyed by SGS/1	30,176	47,468	31,081	36,060	37,763	83,952	99,372	47,411	63,935	17,457	
Total natural area spawners/1	44,546	61,741	48,073	52,499	49,031	73,913	133,361	69,466	112,343	31,596	
% Escapment estimated by SGS	32%	23%	35%	31%	23%	33%	25%	32%	43%	45%	**32%**

1/ Includes both Klamath and Trinity natural area spawners

Management Entities

The annual *Klamath River Fall Chinook Age-Specific Escapement, River Harvest, and Run Size Estimate* report (KRTT 2016), completed in mid-February, is largely based on data collected during efforts described in preceding sections. All Klamath basin fall Chinook harvest and escapement data are reported annually in the Department's *Klamath Basin Fall Chinook Salmon Spawner Escapement, In-river Harvest, and Run-size Estimates* (CDFW, 2016), also referred to as the "Megatable". The Klamath River Technical Team uses information from these reports to prepare the *Ocean Abundance Projections and Prospective Harvest Levels for Klamath River Fall Chinook* (KRTT 2016) report which is the basis for annual management decisions (Figure 7). The following sections present an overview of the annual management process and the entities associated with them.

Pacific Fishery Management Council (PFMC)

The PFMC is the entity responsible for managing and regulating Klamath Basin and other fish stocks in federal marine waters (3 - 200 miles) and the California Fish and Game Commission (FGC) is responsible for management and regulation of State marine areas and inland areas in California. Marine waters under state jurisdiction extend three miles from shore. The FGC has in recent years adopted a "concurrence policy" that facilitates mutual fishery regulations under both state and federal jurisdictions.

The PFMC, one of eight regional councils, was created by Congress to fulfill requirements of the 1976 Magnuson-Stevens Fishery Conservation and Management Act (MSA). The PFMC, as required by the MSA, was charged with preventing overfishing, complying with the Endangered Species Act (ESA), using the best available science, recommending harvest levels, and creating

Fishery Management Plans (FMPs) to name a few of their responsibilities. The PFMC manages ocean fishery stocks to achieve sustainability and to fairly allocate fishery resources throughout interstate boundaries to accommodate ocean commercial, ocean recreational, tribal and in-river recreational fishing entities. All pre-season modeling and subsequent ocean abundance projections, projected escapement levels and allowable harvest of KRFC are based on adult (age 3-5) projections. The abundance of two year old fish, called jacks or grilse, are not forecast since there is no precursor data that allows for this estimation i.e. smolt to age two survival relationship.

Currently, KRFC are one of only two California stocks managed by the PFMC for fall Chinook target escapement levels and the only stock managed for harvest allocations between tribal and non-tribal entities. Sacramento River fall Chinook are also managed for desired escapement levels. Additionally, KRFC stocks are used as a surrogate to help protect California Coastal Chinook (CCC) stocks (ESA threatened). A maximum harvest rate of 16% on age- four KRFC is a current constraint used to protect ESA threatened CCC when setting ocean seasons (PFMC 2011).

Harvestable surplus and fishery allocations

The term "harvestable surplus" is a term used to define what the available KRFC annual harvest levels will be. The harvestable surplus is the remainder of KRFC stocks that are allocated to ocean commercial, ocean recreational, in-river recreational, and tribal fisheries once conservation targets are modeled to be met. The current minimum conservation target for KRFC is an adult escapement level of 40,700 natural area spawners. This is a general rule that applies in most years, however if modeling indicates that the stock will not achieve this target level there are provisions for "*de minimus"* fisheries under the current Harvest Control Rule (HCR) outlined in amendment 16 of the fishery management plan (PFMC 2011). This most recently occurred in 2016 when the KRFC stock adult escapement projection was less than 40,700 natural area adult spawners. The control rule in amendment 16 allowed for a 25% exploitation rate on KRFC stock in 2016, which resulted in a projected escapement level of 30,900 adult natural spawners. The maximum allowable exploitation rate for the stock is 68%. This rate can only be achieved in very high abundance years when the stock can sustain this rate of harvest and still escape 40,700 natural area spawning adults.

The PFMC also sets tribal allocations of KRFC stock, which is currently 50% of the harvestable surplus or allowable harvest under the HCR when in a de minimus mode. Two tribes, the HVT and YT, have recognized federal fishing rights in the anadromous portions of the Klamath Basin and currently split this allocation between them. The tribes, as sovereign entities, both manage and enforce regulatory control of their respective fisheries.

California Fish and Game Commission (FGC)

As previously mentioned, the FGC is charged with managing in-river and ocean stocks of KRFC. As stated, the FGC generally concurs with recommendations made by the PFMC pertaining to KRFC fishery allocations and ocean seasons. The FGC does however oversee annual regulations for bag and possession limit, closures, and gear restrictions for both the in-river recreational and marine fisheries. Annual in-river recreational bag and possession limits are generally tied to the annual quota level. In high quota years the bag and possession limits are liberalized and in low quota years they are reduced. The range of bag limits and possession limits in recent years have been from 1 to 4 fish and 3 to 12 fish, respectively. Additionally, “sub-quota” areas have been established in the Klamath Basin to distribute harvest opportunity equitably throughout the basin. The FGC considers annual changes to Klamath River basin sport fishing regulations in a formalized process that allows for three public meetings that include a notice meeting, discussion meeting and adoption meeting. Final regulations are adopted in April of each year.

Management Cycle

The management of KRFC stocks is very well defined in terms of data needs, timelines, modeling, and ultimately in-river harvest allocation and escapement projections. A thorough review of the management and allocation process can be found in *Klamath Salmon: Understanding Allocation* (Pierce 1998).

The time frame for the complete management of KRFC begins with the annual return of KRFC stocks in August and ends in the following April, when regulatory options are selected and approved by the PFMC and FGC (Figure 7).

Figure 7. Annual timeline overviewing the KRFC Management Cycle.

KRFC entry and fishery monitoring

The management cycle of KRFC stocks begins in August when fish enter the lower Klamath River and harvest commences in the lower tribal and recreational fisheries. Harvest is monitored by the Yurok and Hoopa Tribes and the Department using a variety of methods previously described in this document. Biological data are collected from sampled KRFC to estimate age (scale collections), hatchery composition (CWT), and other metrics of importance. As the KRFC run migrates upstream, harvest is monitored by several different methods including creel surveys (Lower Trinity River), Tribal harvest net monitoring (lower Klamath and lower Trinity River), ratio estimators (upper Klamath River), and tag returns (Trinity River above Willow Creek). Biological data are collected in each of these sectors with the exception of the upper Klamath River. All in-river adult KRFC harvest (tribal and recreational) is based on an allocation (quota), hence the fishery is monitored closely and closed when quotas have been attained.

Escapement surveys

Spawner surveys for KRFC, including SGS funded surveys, commence in October and generally continue through December. The preceding sections of this report describe the cooperators, survey areas and methodology for each sector or stream, including SGS sectors. The commonality for all sectors is the collection of biological data, where possible, to assess age structure of each KRFC escapement area. Hatchery escapement is monitored by the Department at Trinity and Iron Gate Hatcheries and is a direct count of KRFC entering these facilities.

Data review and age composition meeting

All KRFC harvest, escapement, and age data are reviewed in an annual three day meeting hosted by CDFW, which is typically held during the last week of January. The meeting generally has representation by all agencies, tribes or NGOs involved in the collection of KRFC harvest and escapement data. A core team comprised of individuals from agencies and tribes, the Klamath River Technical Team (KRTT), was created under the Klamath River Fishery Management Council (Klamath Act) and has the responsibility of running and reporting on results of the meeting. The Klamath Act expired in 2006, however, the KRTT has continued to function and meets on an ad hoc basis. The purpose of the meeting is to review, discuss and validate all harvest and escapement and age structure estimates for the Klamath/Trinity Basin. The goal of the meeting is to provide two draft documents; an annual *Klamath River Fall Chinook Salmon Age-Specific Escapement, River Harvest, and Run Size Estimates* for the PFMC's salmon technical team (STT) and Department's "mega table" (*Klamath River Basin Fall Chinook Salmon Spawner Escapement, In-river Harvest and Run-size Estimates, 1978- current year*). The latter document contains KRFC grilse and adult sector estimates dating from 1978.

Ocean stock projections

The next step in the management process is to estimate the abundance of KRFC stocks in the ocean as of September 1 of the current data year. This date was selected because it is felt that most KRFC that were destined to enter the Klamath Basin in any given year have done so by this date. The age structured KRFC in-river data collected over the last 20 years form the basis for a "cohort" reconstruction. A cohort is the class of fish that result from one year's spawning escapement. Chinook salmon return at age 2 through 5 from a single cohort in the Klamath Basin, thus there are four ages of return from a single cohort. Data collected over the past 20 years has demonstrated that there is a "sibling' relationship within cohorts that can be estimated using linear regression. Thus, in-river age 2 KRFC are used to estimate the abundance of age 3 KRFC in the ocean, in-river age 3 KRFC are used to estimate age 4 KRFC in the ocean

and in-river age 4 KRFC are used to estimate age 5 KRFC in the ocean. Each year in February the Department (Ocean Salmon Project) and STT of the PFMC runs the ocean KRFC stock projection models to estimate the total abundance by adult ages (3-5) as of September 1 from the previous year. This constitutes the starting point for evaluating the upcoming KRFC stock strength by age, conservation targets, and potential "harvestable surplus".

Fishery model runs

Once KRFC ocean abundance forecasts have been compiled, the STT models marine age specific natural survival rates and age specific maturation rates to estimate the number of KRFC that will return to the Klamath River, absent fishing. These estimates also include the number of KRFC that are destined for natural areas and basin hatcheries. If the estimated number of natural area adult spawners exceeds 40,700 fish then the next step is to determine the harvestable surplus and begin running fishery models. The current management structure allows that 50% of all harvestable surplus KRFC are allocated to the Yurok and Hoopa Tribes. The other half is allocated to non-tribal ocean commercial, ocean recreational and in-river recreational fisheries. The current model in use, the Klamath Ocean Harvest Model (KOHM,) is used to predict KRFC impact rates (harvest and non-landed mortality) in various marine areas. These impact rates are based on historical effort and contact rates that have been determined through ocean fishery catch and effort monitoring and the associated recovery of KRFC coded-wire tags. The KOHM is then used to examine different levels of fishing effort by ocean sector (time and area fisheries). Note that KRFC are most abundant in ocean management zones closest to the mouth of the Klamath, and that KRFC impacts decrease the further north and south you go. Based on these model runs, various evaluations and fishing scenarios will be evaluated and presented in preseason reports published by the PFMC. The final result will be three fishing alternatives that conform to current ESA constraints for ocean fisheries, allow for 50:50 sharing between tribal and non-tribal entities and allow for escapement of 40,700 KRFC adult natural spawners. The exception to this is if model runs indicate that, absent fishing, there will not be enough returning KRFC to meet the 40,700 conservation threshold. If this is the case then one of two things may occur, either there will be no fishery allocation or a "*de minimus"* fishery will be allowed. This simply means that a fishing harvest rate will be determined based on a sliding scale of KRFC abundance outlined in the HCR. This occurred in 2016, when KRFC stocks were below the conservation threshold and a maximum KRFC exploitation rate of 25% was implemented.

Fishery Alternatives and Regulatory Adoption

As mentioned in the previous section, the PFMC will develop three alternatives for marine KRFC fisheries. These alternatives will be discussed and vetted in public meetings and the resultant

input from the public will help guide the preferred alternative. Similarly, the FGC will also conduct meetings to solicit public input for ocean and in-river recreational fisheries. Generally, the FGC will adopt concurrence regulations that conform to PFMC guidelines for ocean fisheries. In-river recreational regulations (season length, quotas and sub-quotas, daily bag limits and possession limits) will be introduced, discussed and adopted over the course of three public meetings held throughout the state. Both federal and state regulations are adopted in April of each year.

Discussion

This document was compiled by CDFW to satisfy a contract with the Service. The scope and intent of this document is to describe how the Service's funding, and the field work supported by this funding, is carried out in the Klamath basin as it relates to KRFC monitoring and management. We have described the essential elements of the SGS in terms of cooperators, spatial, temporal, methodology, and management context.

The SGS surveys and the data obtained from these surveys are an essential component of the current management paradigm. The escapement data in the smaller tributaries of the Klamath River and other areas supported by SGS funding constitute a large percentage of basin KRFC escapement. Current KRFC management and regulatory processes are reliant on all harvest and escapement sectors being estimated to continue use of a cohort based model. Absence of these data will prohibit the proper estimation of ocean abundance, allocation of harvest, and projections of escapement through modeling currently employed by federal and state managers. Additionally, the absence of these data will cause a negative bias in ocean abundance projections and the resulting impact will be a loss in fishery opportunity for tribal and non-tribal entities, assuming Klamath Basin escapement objectives were destined to be met in any given year. The lack of annual distribution and abundance of KRFC by discrete area may compromise the ability to evaluate ESA concerns or reviews, hinder restoration prioritization, and contribute to KRFC stock uncertainty.

The methods utilized in the basin have been fairly consistent since 1978 but changes have been implemented to utilize the best available science. Changes to the environment such as the potential removal of 4 mainstem dams on the Klamath River will require expansion of these estimation methods as salmon migrate into areas currently not accessible to anadromous fish. The lessons learned by the cooperative SGS over the past 30 years could serve as a basis for implementing monitoring in areas upstream of Iron Gate Dam.

Finally, a large portion of annual SGS funding is granted to tribal and NGO partners. This allows these groups to have meaningful participation in KRFC resource evaluations which they might

not have otherwise. Local and tribal participation in the program is key to obtaining land owner permission, retaining local knowledge and experience, and reinforces the sense of community that leads to trust among the many cooperators that engage in the surveys.

Acknowledgments

We would like to thank the USFWS Yreka office for its ongoing support of the Mid Klamath Fall Chinook spawning ground survey effort and the National Oceanic and Atmospheric Administration (NOAA) for continuing to support Klamath River Fisheries. We would also like to thank the Karuk Tribe, Mid Klamath Watershed Council, Northern California Resource Center, Quartz Valley Tribe, Salmon River Restoration Council, Siskiyou Resource Conservation District, USFS, USFWS Arcata office and the Yurok Tribe. Without the assistance of Sara Borok, Tom Christy, Alan Crocket, LeRoy Cry, Ryan Fogerty, Jon Grunbaum and Maija Meneks this report would not have been possible. We thank Brett Kormos, CDFW, for editorial review of KRFC management sections.

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Appendices

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Appendix 2. Reports prepared which include data generated from SGS

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Also available from U.S. Forest Service, Klamath National Forest, Salmon-Scott Rivers Ranger District, 11263 N. State Hwy 3, Fort Jones, CA 96032.

Appendix 3. 105 individual reach maps describing Klamath River Fall Chinook spawner survey effort. Reach maps are listed alphabetically and detail: reach name, upstream and downstream boundaries, scale and reference to location within Klamath basin.

Aikens Creek R1
Hwy 96 Bridge
Mouth
Klamath River
Aikens Creek
N
E
S
W
0
0.05
0.1
0.2
Kilometers

Beaver R1
Polly Gulch
Beaver Creek
Marble Creek
Klamath River
Mouth
0
0.3
0.6
1.2
Kilometers
N
E
S
W

Beaver R2
Dutch Creek
Beaver Creek
Polly Gulch
West Fork Beaver
W
N
S
E
0
0.325
0.65
1.3
Kilometers

Beaver R3
Soda Creek
West Fork Beaver
Beaver Creek
Fishtrap Creek
Bumblebee Creek
N
W
E
S
0
0.3
0.6
1.2
Kilometers

Bluff Creek R1
Slate Creek
Bluff Creek
Klamath River
Mouth
Wrights Ranch
Serpentine Creek
Red Mountain Creek
Slide Creek
N
E
S
W
0
0.425
0.85
1.7
Kilometers

Bluff Creek R2
Dragon Bar
Wrights Ranch
Bluff Creek
Bee Creek
0
0.45
0.9
1.8
Kilometers
N
E
S
W

Boise Creek R1
Swan Flat
Mouth
Boise Creek
Klamath River
Red Cap Creek
N
E
S
W
0
0.3
0.6
1.2
Kilometers

Boise Creek R2
Boise Creek
Swan Flat
Cascade
N
W
E
S
0
0.15
0.3
0.6
Kilometers

Camp Creek R1
Camp Creek
Rearing Facility
Mouth
Klamath River
Crawford Creek
0
0.25
0.5
1
Kilometers
N
E
S
W

Camp Creek R2
Wilder Creek
Camp Creek
Third Creek
3rd Creek
Rearing Facility
N
E
S
W
0
0.325
0.65
1.3
Kilometers

Camp Creek R3
China Creek
Head Camp
First Creek
Third Creek
3rd Creek
Camp Creek
Cedar Creek
0
0.25
0.5
1
Kilometers
N
E
S
W

Camp Creek R4
China Cree
Camp Creek
Head Camp
Cascade Barrier
0
0.1
0.2
0.4
Kilometers
N
E
S
W

Canyon Creek
Scott River
Mouth
1.2 Miles Upstream of Scott River
Canyon Creek
Boulder Creek
W
N
S
E
0
0.15
0.3
0.6
Kilometers

Clear R1
ourmile Creek
Slippery View
Daggett Creek
Clear Creek
Mouth
Klamath River
South Fork Clear Creek
N
E
S
W
0
0.425
0.85
1.7
Kilometers

Clear R2
.43 miles above Slippery View
Slippery View
Clear Creek
Slippery Creek
0
0.075
0.15
0.3
Kilometers
N
E
S
W

Dillon Creek R1
Mouth
Mill
Mill Creek
Klamath River
Dillon Creek
N
W
E
S
0
0.175
0.35
0.7
Kilometers

Elk R1
Elk Creek
Pumping station
5 Mile Bridge
0
0.325
0.65
1.3
Kilometers
N
E
S
W

Elk R2
5 Mile Bridge
Twins
Elk Creek
0
0.2
0.4
0.8
Kilometers
N
W
E
S

Elk R3
Cougar Creek
Doolittle
Elk Creek
Twins
Twin Creeks
Twin Creek
0
0.425
0.85
1.7
Kilometers
N
E
S
W

Elk R4
Doolittle Creek
Doolittle
Elk Creek
Bear Creek
Bear
Johnson Creek
Lick Creek
N
E
S
W
0
0.5
1
2
Kilometers

Fort Goff R1
Fort Goff Creek
2 mile trail Crossing
Mouth
Klamath River
N
S
W
E
0
0.225
0.45
0.9
Kilometers

Grider R1
West Grider Creek
Klamath River
Seiad Creek
Mouth
No Name
Grider Creek
Salt Creek
0
0.35
0.7
1.4
Kilometers
W
N
S
E

Grider R2
Grider Creek
Bark Shanty
Bark Shanty Creek
No Name
No Name Creek
0
0.375
0.75
1.5
Kilometers
W
N
S
E

Horse R1
Middle Creek
Buckhorn Creek
Horse Creek
Water Intake
Mouth
Klamath River
N
E
W
S
0
0.375
0.75
1.5
Kilometers

Horse R2
Water Intake
Salt Gulch
Horse Creek
0
0.35
0.7
1.4
Kilometers
N
E
W
S

Horse R3
1.25 Mi upstream of Salt Gulch
Salt Gulch
Horse Creek
0
0.125
0.25
0.5
Kilometers
N
E
S
W

Independence R1
Mouth
Mine
Independence Creek
Klamath River
0
0.075
0.15
0.3
Kilometers
N
E
S
W

Indian R1
Ikes Creek
Klamath River
Mouth
Buchanan Falls
Indian Creek
Doolittle Creek
Curley Jack Creek
N
E
S
W
0
0.5
1
2
Kilometers

Indian R2
Deer Lick Creek
Indian Creek
South Fork Indian Creek
South Fork Bridge
Buchanan Falls
N
E
S
W
0
0.5
1
2
Kilometers

Indian R3
Mill Creek
Indian Creek
West Branch
SF Bridge
Coon Run
0
0.5
1
2
Kilometers
N
E
S
W

Indian R4
1.15 mi above West Branch
Indian Creek
West Branch
West Branch Indian Creek
0
0.125
0.25
0.5
Kilometers
N
E
S
W

Irving Creek R1
Klamath River
Irving Creek
Mouth
One Mile
N
W
E
S
0
0.125
0.25
0.5
Kilometers

Kelsey Creek
mouth
Falls
Kelsey Creek
Scott River
N
W
E
S
0
0.075
0.15
0.3
Kilometers

Klamath Mainstem R1 Carcass
1st riffle below gaging station
Klamath River
Boat Ramp opposite IGH
Bogus Creek
0
0.0375
0.075
0.15
Kilometers
N
E
S
W

Klamath Mainstem R1 Redd
Ash Creek
Brush Creek
Klamath River
Dry Creek
Iron Gate Dam
Shasta River
Bogus Creek
Willow Creek
Maxwell Creek
N
W
E
S
0
1.5
3
6
Kilometers

Klamath Mainstem R2 Carcass
1st riffle below gaging station
Dry Creek
Dry Creek
Klamath River
0
0.15
0.3
0.6
Kilometers
N
E
S
W

Klamath Mainstem R2 Redd
Lungrey Creek
Empire Creek
Dutch Creek
Klamath River
Beaver Creek
Shasta River
Ash Creek
Skunk Creek
Badger Creek
Clear Creek
Dunns Gulch
Little Humbug Creek
0
1.5
3
6
Kilometers
N
E
S
W

Klamath Mainstem R3 Carcass
1st wooden foot bridge
Dry Creek
Klamath River
0
0.175
0.35
0.7
Kilometers
N
W
E
S

Klamath Mainstem R3 Redd
Horse Creek
Kohl Creek
Doggett Creek
Marble Creek
Klamath River
Everill Creek
Blue Heron
Beaver Creek
Collins Creek
Dona Creek
McKinney Creek
Little Humbug Creek
Barkhouse Creek
N
W
E
S
0
1.75
3.5
7
Kilometers

Klamath Mainstem R4 Carcass
KRCE green wooden foot bridge
1st wooden foot bridge
Klamath River
0
0.075
0.15
0.3
Kilometers
W
N
S
E

Klamath Mainstem R4 Redd
Schoolhouse Creek
Seiad Creek
Seiad Bar
Grider Creek
Gard Creek
Walker Creek
Salt Creek
East Walker Creek
Louie Creek
Klamath River
Negro Creek
Kuntz Creek
Jim Creek
Scott River
Kinsman Creek
Blue Heron
0
1.25
2.5
5
Kilometers
N
E
S
W

Klamath Mainstem R5 Carcass
Klamath River
Klamathon Bridge
KRCE green wooden foot bridge
Willow Creek
N
E
S
W
0
0.175
0.35
0.7
Kilometers

Klamath Mainstem R5 Redd
Shinar Creek
Portuguese Creek
East Fork Portuguese Creek
Seattle Creek
Ladds Creek
Schoolhouse Creek
Cade Creek
Joe Miles Creek
Seiad Creek
West Grider Creek
Klamath River
China Point
China Creek
Grider Creek
Seiad Bar
N
W
E
S
0
1.25
2.5
5
Kilometers

Klamath Mainstem R6 Carcass
Klamath River
3rd wooden foot bridge
Klamathon Bridge
0
0.35
0.7
1.4
Kilometers
N
W
E
S

Klamath Mainstem R6 Redd
Curley Jack Creek
Little Grider Creek
Klamath River
Indian Creek
Cade Creek
Elk Creek
Woods Creek
China Point
China Creek
Wolf Creek
Horse Creek
N
W
E
S
0
0.75
1.5
3
Kilometers

Klamath Mainstem R7 Carcass
Carson Creek
3rd wooden foot bridge
Klamath River
0
0.225
0.45
0.9
Kilometers
W
N
S
E

Klamath Mainstem R8 Carcass
Shasta River
Carson Creek
Klamath River
Williams Creek
0
0.375
0.75
1.5
Kilometers
W
N
S
E

Knownothing Creek
Knownothing Creek
Mile 2.8
confluence
0
0.3
0.6
1.2
Kilometers
W
N
S
E

Little NF Salmon
Little North Fork Salmon River
confluence
Mile 2.3
0
0.25
0.5
1
Kilometers
N
W
E
S

Methodist Creek
Mile 2.4
confluence
Methodist Creek
Sign Creek
Johnson Creek
0
0.275
0.55
1.1
Kilometers
N
E
S
W

NF Salmon 10A
Big Creek
North Fork Salmon River
Mile 4
Mile 6
0
0.2
0.4
0.8
Kilometers
N
W
E
S

NF Salmon 10B
North Fork Salmon River
Olsen Creek
Mile 6
Mile 8
0
0.2
0.4
0.8
Kilometers
N
W
E
S

NF Salmon 11A
North Fork Salmon River
Mile 8
Mile 10
0
0.225
0.45
0.9
Kilometers
N
E
S
W

NF Salmon 11B
North Fork Salmon River
Mile 10
Mile 12
N
W
E
S
0
0.15
0.3
0.6
Kilometers

NF Salmon 9A
Forks
North Fork Salmon River
Mile 2
McNeal Creek
0
0.225
0.45
0.9
Kilometers
N
W
E
S

NF Salmon 9B
Mile 2
Mile 4
North Fork Salmon River
0
0.225
0.45
0.9
Kilometers
N
W
E
S

Nordheimer Creek
Mile 1.8
Nordheimer Creek
confluence
Salmon River
Crapo Creek
N
W
E
S
0
0.175
0.35
0.7
Kilometers

Pearch Creek R1
Mouth
SF Pearch
Pearch Creek
Klamath River
0
0.1
0.2
0.4
Kilometers
N
E
S
W

Red Cap R1
Mouth
Klamath River
Red Cap Creek
Larsons Place
Allen Creek
Adams Creek
0
0.2
0.4
0.8
Kilometers
N
W
E
S

Red Cap R2
Boise Creek
FS Rd 10N02 Bridge
Red Cap Creek
Larsons
Captain Haun Creek
N
W
S
0
0.3
0.6
1.2
Kilometers

Red Cap R3
Leary Creek
Red Cap Creek
10N02 Bridge
Schnable
0
0.375
0.75
1.5
Kilometers
W
N
S
E

Red Cap R4
Red Cap Creek
Schnable
Log Jam
0
0.2
0.4
0.8
Kilometers
N
E
S
W

Rock Creek R1
Slide
Rock Creek
Klamath River
Mouth
N
W
E
S
0
0.075
0.15
0.3
Kilometers

Rogers Creek R1
Slide
Mouth
Rogers Creek
N
W
E
S
0
0.125
0.25
0.5
Kilometers

Salmon River R1
Salmon River
Mouth
Brannon Bar
Klamath River
Donahue Fork Creek
Somes Creek
Monte Creek
0
0.45
0.9
1.8
Kilometers
N
E
S
W

Salmon River R2
Salmon River
Brannon Bar
Butler Creek
0
0.4
0.8
1.6
Kilometers
N
E
S
W

Salmon River R3
Salmon River
Portuguese Creek
Tripp Point
Butler Creek
Grant Creek
N
E
S
W
0
0.3
0.6
1.2
Kilometers

Salmon River R4
Tripp Point
Nordheimer Creek
Morehouse Creek
Salmon River
Tripp Creek
0
0.35
0.7
1.4
Kilometers
N
E
S
W

Salmon River R4A
Otter Bar
ordheimer Creek
Salmon River
Crapo Creek
Nordheimer Cre
0
0.175
0.35
0.7
Kilometers
N
E
S
W

Salmon River R4B
Otter Bar
Salmon River
Forks
Horn Creek
N
E
S
W
0
0.275
0.55
1.1
Kilometers

Scott River R1
Mid Point
Mouth
Klamath River
Scott River
Muck-a-Muck Creek
0
0.275
0.55
1.1
Kilometers
N
E
S
W

Scott River R10
Indian Creek
Scott River
Moffett Creek
Dunlop
Hwy 3 Bridge
Kidder Creek
N
E
S
W
0
0.45
0.9
1.8
Kilometers

Scott River R11
Patterson Creek
Kidder Creek
Eller Bridge
Hwy 3 Bridge
Scott River
0
0.75
1.5
3
Kilometers
W
S
N
E

Scott River R12
Sweezy Bridge
Scott River
Eller Bridge
0
0.275
0.55
1.1
Kilometers
Cry
Creek
E
N
S
W

Scott River R13
Etna Creek
Scott River
Horn Lane
Sweezy Bridge
0
0.325
0.65
1.3
Kilometers
N
W
E
S

Scott River R14
Horn Lane
Youngs Dam
Scott River
0
0.175
0.35
0.7
Kilometers
N
E
S
W

Scott River R15
Youngs Dam
Fay Lane
Scott River
French Creek
0
0.425
0.85
1.7
Kilometers
N
E
S
W

Scott River R16
Fay Lane
Scott River
Sugar Creek
Wildcat Creek
East Fork Confluence
0
0.75
1.5
3
Kilometers
N
E
S
W

Scott River R2
Mill Creek
Scott River
Mid Point
Pat Ford Creek
Pat Ford Creek
Bill Berry Creek
0
0.3
0.6
1.2
Kilometers
N
E
S
W

Scott River R3
McGuffy Creek
Scott River
George Allen
Pat Ford Creek
South Fork Pat Ford Creek
W
N
S
E
0
0.325
0.65
1.3
Kilometers

Scott River R4
McCarthy Creek
Scott River
Gold Flat
George Allen
0
0.425
0.85
1.7
Kilometers
N
W
E
S

Scott River R5
Deep Creek
Middle Creek
Tompkins Creek
Scott River
Bridge Flat
Gold Flat
0
0.35
0.7
1.4
Kilometers
N
E
S
W

Scott River R6
Counting station
Bridge Flat
Kelsey Creek
Scott River
Boulder Creek
0
0.35
0.7
1.4
Kilometers
N
E
S
W

Scott River R7
Scott River
Counting Station
USGS Gage
Snow Creek
0
0.4
0.8
1.6
Kilometers
N
W
E
S

Scott River R8
USGS Gage
Marilyn Creek
Snikfaw Creek
Meamber Bridge
Scott River
N
E
S
W
0
0.425
0.85
1.7
Kilometers

Scott River R9
Rattlesnake Creek
Scott River
Dunlop
Meamber Bridge
N
E
S
W
0
0.4
0.8
1.6
Kilometers

SF Clear R1
Mouth
.25 mi upstream of barrier
Clear Creek
South Fork Clear Creek
N
W
E
S
0
0.05
0.1
0.2
Kilometers

SF Indian R1
Cole Creek
South Fork Indian Creek
Indian Creek
Mouth
Clauson Creek
Bald Hornet Creek
N
W
E
S
0
0.5
1
2
Kilometers

SF Salmon 6A
Indian Cr
Indian Creek
South Fork Salmon River
O'Farrell Gulch
N
E
S
W
0
0.275
0.55
1.1
Kilometers

SF Salmon 6B
Matthews Cree
South Fork Salmon River
Indian Creek
Matthews Cr
N
E
S
W
0
0.25
0.5
1
Kilometers

SF Salmon R5A
Forks
South Fork Salmon River
Henry Bell
McNeal Creek
0
0.325
0.65
1.3
Kilometers
N
E
S
W

SF Salmon R5B
South Fork Salmon River
Henry Bell
O'Farrell Gulch
0
0.2
0.4
0.8
Kilometers
N
E
S
W

Slate Creek
Mouth
2 Mile Creek
Slate Creek
Klamath River
0
0.275
0.55
1.1
Kilometers
W
N
S
E

Thompson R1
Mouth
Trail End
Bug Creek
Thompson Creek
lide Creek
0
0.2
0.4
0.8
Kilometers
N
E
S
W

Thompson R2
Bug Creek
Thompson Creek
Access Road
Trail End
Mill Creek
Slide Creek
N
E
S
W
0
0.275
0.55
1.1
Kilometers

Thompson R3
1 mile upstream of Access Road
Access Road
Thompson Creek
0
0.1
0.2
0.4
Kilometers
N
E
S
W

Ti Creek R1
Mouth
One Mile
Ti Creek
Klamath River
0
0.125
0.25
0.5
Kilometers
N
W
E
S

Tompkins Creek
Scioto River
mouth
Bridge 2.5 miles upstream of mouth
Tompkins Creek
0
0.325
0.65
1.3
Kilometers
N
E
S
W

Ukonomn R1
Klamath River
mouth
Ukonom Cre
Waterfall barrier
N
E
S
W
0
0.075
0.15
0.3
Kilometers

West Fork Beaver R1
Bear Creek
Little Soda Creek
West Fork Beaver Creek
Bear
Mouth
N
E
S
W
0
0.2
0.4
0.8
Kilometers

West Fork Beaver R2
1st Bridge
West Fork Beaver Creek
Bear
0
0.2
0.4
0.8
Kilometers
N
E
S
W

Wooley Creek R1
Wooley Creek
Mouth
Gates Creek
Gates Creek
Steinacher Creek
Salmon River
0
0.4
0.8
1.6
Kilometers
W
N
S
E

Wooley Creek R2
Bridge Creek
Bridge Creek
Wooley Creek
Gates Creek
0
0.375
0.75
1.5
Kilometers
N
E
S
W

Wooley Creek R3
Bridge Creek
Bridge Creek
Wooley Creek
Hancock Creek
Hancock Creek
N
W
E
S
0
0.35
0.7
1.4
Kilometers

Wooley Creek R4
Bear Skull Creek
Wooley Creek
Hancock Creek
North Fork
0
0.275
0.55
1.1
Kilometers
N
E
S
W