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Summary of Abundance and Biological data Collected During Juvenile Salmonid Monitoring on the Mainstem Klamath River Below Iron Gate Dam, California, 2016

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Abstract.— This report summarizes results from the 2016 season of juvenile salmonid outmigrant monitoring on the mainstem Klamath River below Iron Gate Dam. Trapping occurred at three locations: below the confluence with Bogus Creek (river km 308), near where Interstate 5 crosses the Klamath River (river km 294), and near the Kinsman Creek confluence upstream of the confluence with the Scott River (river km 238). Both frame nets and rotary screw traps were used to sample juvenile salmonids and other fishes. Traps were deployed in late February and operated until early May (Bogus trap site), mid-May (I-5 trap site), and mid-June (Kinsman trap site). Juvenile salmonids were enumerated daily when traps were operating and subsamples of salmonids were measured for length, weight, and external symptoms of disease. Non-salmonid fishes were also enumerated and subsampled for length measurements. Mark-recapture studies were conducted periodically at each trap site during the season to estimate trap efficiency. Efficiency estimates were combined with catch data to estimate weekly and seasonal outmigration abundance of natural-origin age-0 juvenile Chinook Salmon migrating downstream past each trap site using a Bayesian time-stratified spline population estimation method. For the periods that traps were operated, abundance estimates of natural-origin age-0 Chinook Salmon were approximately 840,000 at the Bogus trap site and 480,000 at the I-5 trap site. Due to high flows and missed trapping days, the season-wide population abundance that moved past the Kinsman trap site was not estimated.

Introduction

The Klamath River Basin (Figure 1) historically supported large runs of Chinook Salmon (*Oncorhynchus tshawytscha*) and steelhead (*O. mykiss*), and smaller runs of Coho Salmon (*O. kisutch*) (USFWS 1960, 1983; Klamath River Basin Fisheries Task Force 1991). These species contribute to economically and culturally important subsistence, sport, and commercial fisheries. A drastic decline of anadromous fishes during the past century and a half has occurred in the Klamath River Basin as a result of a variety of flow- and non-flow-related factors (West Coast Chinook Salmon Biological Review Team 1997; Hardy and Addley 2001). These factors include water storage and transfer, disease, altered genetic integrity from hatchery-origin fish straying into natural spawning areas, overharvest, and land-use practices causing habitat loss and degradation.

The U.S. Fish and Wildlife Service (USFWS), in collaboration with the Karuk Tribe and U.S. Geological Survey (USGS), began trapping juvenile salmonids on the Klamath River between Iron Gate Dam and the Scott River confluence in 2000 to collect outmigration timing data and relative weekly numbers for the calibration of a young-of-the-year (age-0) Chinook Salmon production model, SALMOD (Bartholow et al. 2002). Beginning in 2006, the objectives of this ongoing monitoring project were directed towards generating estimates of production (Gough et al. 2015) and disease monitoring (Nichols and True 2007; Nichols et al. 2009; True et al. 2010, 2011, 2013; Bolick et al. 2012, 2013). Additionally, these data are used to develop and calibrate a new salmon production model, Stream Salmonid Simulator (S^3). Data from this project will also be useful for assessing the status and trends of salmonid populations in the Klamath River. Data collected by this project from 2000 through 2015 are summarized in Gough et al. (2015), David et al. (2016), and David et al. (2017). This report summarizes data collected during the 2016 trapping season.

Study Area

Monitoring was conducted at three sites on the mainstem Klamath River (Figure 1) between Iron Gate Dam [river kilometer (rkm) 309.65] and the Scott River confluence (rkm 232.95). The upstream-most site (rkm 307.75) was downstream of the Bogus Creek confluence on Blue Heron RV Park property (Bogus site). The middle site (rkm 293.55) was downstream of the Carson Creek confluence and upstream of where Interstate 5 crosses the Klamath River (I-5 site). The farthest downstream site (rkm 237.55) was just upstream of the Kinsman Creek confluence (Kinsman site).

Methods

River Conditions

River discharge and water temperature were monitored throughout the outmigrant trapping season. The USGS gaging station below Iron Gate Dam (# 11516530) was used to represent discharge at the Bogus and I-5 trap sites since accretions from tributaries between the gaging station and these sites are minimal. Discharge at the Kinsman trap site was estimated by subtracting the discharge of the Scott River near Fort Jones (USGS gaging station

11511950) from the discharge of the Klamath River near Seiad Valley (USGS gaging station 11520500). Water temperature was monitored near each trap site using digital water temperature loggers. For details on the loggers used and specific protocols see Magneson (2014).

Trap Design and Operation

At least one of two types of sampling methods, rotary screw traps (RSTs) and frame nets (3 m by 1.5 m opening), were used at the trap sites. Frame nets were placed closer to the bank in shallower, slower moving water compared to RST placement, and more efficiently captured younger and smaller age-0 salmonids along river margins earlier in the season (late winter to early spring). RSTs were set further from the bank in faster, deeper water and more efficiently captured older and larger age-0 and age-1 salmonids later in the season (late spring to early summer). Frame nets were placed near the bank at a location such that water velocity was ideally between 1.0 and 1.2 m/s at the center of the net and water depth was between 0.3 and 1.0 m. RSTs were placed further from the bank such that the cone would ideally spin between five and seven revolutions/min.

In 2016 one frame net was operated at the Bogus trap site, one frame net and two 2.4-m (8-ft) diameter RSTs were operated at the I-5 trap site, and one 1.5-m (5-ft) diameter RST was operated at the Kinsman trap site. These frame nets and RSTs were deployed in mid-February. An RST was not operated at the Bogus site because few larger, late-season juvenile Chinook Salmon pass by this location due to its proximity to Iron Gate Dam. The Bogus frame net was operated until early May, while the I-5 RSTs and frame net were operated until mid-May, when Iron Gate Hatchery (IGH) began its annual release of age-0 Chinook Salmon. The Kinsman RST was operated until mid-June.

All traps were typically operated over four consecutive nights each week (Monday–Thursday nights) throughout the sampling period and checked once per day. The following information was recorded for each trap on each day: date, site, trap type, crew members, air and water temperatures, trap check time, trap reset time, trap depth, and center velocity. Rotation rates at the times of checks and resets of RSTs were also measured as a count of complete cone revolutions in a minimum of 180 seconds. Air temperature was taken in the shade close to the river’s edge. Water temperature was taken at the surface in the shade and in moving water. Trap depth of RSTs was the submerged depth of the cone. Trap depth of frame nets was the water depth at the midpoint of the frame entrance. Center velocity was the water velocity at 60% of the trap depth. If a trap was relocated, RST rotations, depth, and velocity were re-measured.

All captured fish were identified and enumerated. A maximum daily biological sample (‘biosample’) for each trap type at each trap site of 30 fish from each salmonid species and 10 fish from each non-salmonid species were measured and examined, including up to 10 lamprey ammocoetes from each genus and 10 eyed lamprey from each species. The following data were recorded for all salmonids in the biosample: age (0 or 1+), development stage (sac fry, fry, parr, or smolt), fork length (FL), weight, presence/absence of a hatchery mark, presence of any external abnormalities, and abdomen condition (normal or distended). Gill color (red, pale/pink, white, or tan) and condition (normal, eroded, or fungal) were recorded for salmonids ≥45 mm FL. Salmonid gills were classified as healthy if they were red in color and free of fungus and erosion. Gills were classified as unhealthy if they were pale/white/tan in color, fungal, or eroded. The following data were recorded for non-salmonids in the biosample: species, development stage [lampreys only (ammocoete, eyed juvenile, or adult)], FL or total length (for species with pointed or round caudal fins), and presence of any external abnormalities.

Chinook Salmon Production Estimates

Weekly and season totals of natural-origin age-0 Chinook Salmon outmigrating past a trap site were estimated using a Bayesian time-stratified spline population estimation method (Bonner et al. 2009). This method requires the following weekly data: total age-0 Chinook Salmon with adipose fins, total adipose fin-clipped age-0 Chinook Salmon (and associated hatchery clip rate), trapping effort (weighted sample fraction, described below), and mark-recapture numbers. The numbers of age-0 Chinook Salmon with and without adipose fins were summarized from the weekly trapping data and fin-clip rates were reported by IGH.

Trapping effort, here termed weighted sample fraction, was based on the number of trap-days per week and the trap types operated. Traps were not operated a full seven days each week and due to operational logistics and disruptions (e.g., flawed sets due to debris), daily catches were not completed every day originally planned. Therefore, the number of days sampled per week of operation was always less than seven and sometimes varied for each trap within a site. Additionally, each trap and trap type catches outmigrants in different proportions, and those proportions fluctuate throughout the season. To account for variable and less than full effort, different catch proportions for the different traps, and changing catch proportions throughout the season, a weighted sample fraction was used to quantify trapping effort. First, the proportion (p) of total age-0 Chinook Salmon outmigrant catch (c) per number of days (d) each i^{th} trap was operated within a site was calculated for each j^{th} week in which all traps were operated:

$$p_{ij} = \frac{\left(\frac{c_{ij}}{d_{ij}}\right)}{\sum_{i=1}^{n}\left(\frac{c_{ij}}{d_{ij}}\right)}$$

Weighted sample fraction (s) was then calculated for each trap site in each j^{th} week by summing the number of days each i^{th} trap at a site was operated within each week multiplied by the associated catch proportion for each trap that week and then dividing that sum by the number of total possible sampling days in a week (seven):

$$s_j = \frac{\sum_{i=1}^{n}\left(p_{ij}d_{ij}\right)}{7}$$

When only a single trap was operated at a site during a season the above equation simplifies to the number of days the trap was operated within each j^{th} week divided by seven:

$$s_j = \frac{d_j}{7}$$

Catch proportions (p) for traps during weeks when not all traps at a site were operated were predicted using regressions of known catch proportions during the season as a function of calendar week (t). In 2016 this was relevant to the I-5 trap site during weeks 11 through 14 of sampling. The frame net was not operated during these four weeks and the upstream RST was not successfully operated during weeks 11 or 12. The regression equations used to predict the catch proportions for the I-5 RSTs during these sampling weeks were

$$p = 0.0059t + 0.2196 \ (R^2 = 0.19)$$

for the downstream RST and

$$p = 0.0129t + 0.3324 \ (R^2 = 0.48)$$

for the upstream RST.

Mark-recapture trap efficiency tests for age-0 Chinook Salmon were conducted at the three trap sites. Hatchery-produced age-0 Chinook Salmon provided by IGH were used for this process. Test fish were marked with Bismarck Brown stain (Rawson 1984) and released approximately 0.5–0.8 km upstream of the trap site to be tested. At least three meso-habitat units, including at least one riffle, were between the release site and the trap site to allow the fish enough time and space to distribute across the river channel similarly to a natural population passing the trap site. Two or three recapture days were available after the release of marked fish. The number of marked fish released and the number of marked fish recaptured for each efficiency test were used as inputs to the population estimation method. Mark-recapture efficiency tests could not be conducted for Coho Salmon or steelhead due to the limited catch of these species, so production estimates were not generated.

Results and Discussion

River Conditions

Discharge below Iron Gate Dam, most pertinent to the Bogus and I-5 trap sites, varied between 30 and 65 m^3/s from early February through early March (Figure 2). Discharge at the Kinsman trap site ranged between 80 and 180 m^3/s during this time. A series of wet storms combined with high water levels in Upper Klamath Lake resulted in a large discharge event out of Iron Gate Dam in mid-March. Mean daily discharge peaked above 270 m^3/s out of Iron Gate Dam on March 16 and over 330 m^3/s at the Kinsman trap site on March 17. Discharge declined rapidly following this event until mid-April. These high discharges prevented operation of the Kinsman RST for four weeks and resulted in reduced sampling effort at the I-5 and Bogus trap sites. Discharge at both Iron Gate Dam and the Kinsman trap site increased slightly again, then fell gradually to around 30 m^3/s (Iron Gate Dam) and 40 m^3/s (Kinsman) by the end of June. Water temperatures steadily increased through the trapping season at all three trap sites (Figure 2), however, day-to-day variation in water temperatures occurred. Notably, temperatures briefly cooled at the Kinsman trap site in mid-June (Figure 2).

Salmonid Abundance and Biological Data

Chinook Salmon

Significant catches of juvenile Chinook Salmon at all three trap sites during the first sampling week indicate that an unknown and potentially substantial number of fish had emigrated past the trap sites before trapping began (Table 1, Figure 3). Timing of natural-origin age-0 Chinook Salmon outmigration in 2016 appeared to be earlier than in most previous years, although sampling in 2016 was either tied for the earliest calendar start week (I-5 and Kinsman trap sites) or was the second earliest start week (Bogus trap site) compared to sampling in previous years. Eight mark-recapture efficiency tests were conducted between early April and mid-May at the three trap sites: two at the Bogus site, two at the I-5 site, and four at the Kinsman site (Table 1). Release groups ranged in size from 3,715 to 6,055 marked fish. Recapture rates at the three sites ranged between 0.22% and 2.84%. Abundance estimates of natural-origin age-0 Chinook Salmon during the sampled time periods were approximately 840,000 at the Bogus trap site and 480,000 at the I-5 trap site. Because four weeks of trapping at the Kinsman site were missed due to high discharges, we were unable to estimate a season-wide population abundance at this site with any confidence. We report weekly abundance estimates at the Kinsman trap site starting when trapping resumed in early April. Weekly estimates of natural-origin age-0 Chinook Salmon outmigrating past the three trap sites are presented in Table 1 and Figure 3. Peak outmigration occurred during calendar week 10 (late February) at the Bogus site and week 9 (late February) at the I-5 site (Table 1, Figure 3).

Three natural-origin age-1 Chinook Salmon were observed during 2016, all at the Kinsman trap site. Trapping at the Bogus site was concluded prior to the first age-0 Chinook Salmon release from IGH on May 17. Hatchery-origin age-0 Chinook Salmon were only caught during the final week of sampling at the I-5 trap site and during two of the three final weeks of sampling at the Kinsman trap site. Weekly raw catch information for juvenile Chinook Salmon is presented in Appendix A.

No natural-origin age-0 Chinook Salmon exhibited distended abdomens (an indication of infection with the parasite *Ceratonova shasta*) at the Bogus trap site in 2016 (Table 2). At both the I-5 and Kinsman trap sites, no fish with distended abdomens were observed through calendar week 19 (early May). In total only three (0.3%) of the Chinook Salmon examined had distended abdomens at the I-5 trap site. A total of 21 (2.8%) of the Chinook Salmon examined had distended abdomens at the Kinsman trap site, which was sampled later into the Spring than the I-5 trap site. No natural-origin age-0 Chinook Salmon with visibly unhealthy gills were observed prior to week 14 (late March) at any of the trap sites (Table 2). Overall, 5.1%, 5.4%, and 4.0% of examined natural-origin age-0 Chinook Salmon had visibly unhealthy gills at the Bogus, I-5, and Kinsman trap sites, respectively. Abdomen and gill condition are useful real-time indicators of fish health and disease prevalence. However, prevalence of infection is better determined through genetic analysis and histological examination (e.g., True et al. 2013). To more accurately determine prevalence of infection for the juvenile Chinook Salmon population passing the Kinsman trap site, weekly-stratified random samples were collected, preserved, and delivered to the California–Nevada Fish Health Center (CA–NV FHC) to process using qPCR assays. The CA–NV FHC investigates infection rates of *C. shasta*, *Parvicapsula minibicornis*, and other pathogens in juvenile salmonids annually in the Klamath River below Iron Gate Dam.

Natural-origin age-0 Chinook Salmon mean weekly fork lengths were relatively stable throughout most of the trapping season at the Bogus and I-5 site frame nets, then began increasing during the last three weeks of sampling (Figure 4, Figure 5, Appendix B, Appendix C). Mean weekly fork lengths were relatively stable early in the trapping season at the I-5 and Kinsman RSTs, then began steadily increasing in early April (Figure 6, Figure 7, Appendix D, Appendix E). Length–weight relationships for Chinook Salmon are presented in Figure 8.

Coho Salmon

Natural-origin age-0 Coho Salmon were first captured at the beginning of April at all three trap sites and were observed in low numbers, in comparison to previous years, through the remainder of the trapping season (Appendix A). Peak age-0 Coho Salmon catches occurred during calendar week 15 (early April) at all three trap sites. Natural-origin age-1 Coho Salmon were observed in low numbers, in comparison to previous years, at all three sites: one at the Bogus site, seven at the I-5 site, and eight at the Kinsman site (Appendix A). IGH releases yearling (age-1) Coho Salmon, 100% marked with a left maxillary clip, annually between mid-March and early April. In 2016, this release occurred on April 5 (calendar week 15). Hatchery-origin Coho Salmon were only captured at the I-5 and the Kinsman trap sites following the release, between calendar weeks 15 and 21. All catch data for Coho Salmon provided in Appendix A are raw catches and are not adjusted for effort or trap efficiency and do not encompass the entire outmigration period.

There were insufficient data to assess patterns of Coho Salmon mean weekly fork lengths, except for ago-0 natural-origin fish at the I-5 trap site, where fork lengths gradually increased through the season (Figure 4, Figure 5, Figure 6, Figure 7, Appendix B, Appendix C, Appendix D, Appendix E). Length–weight relationships for Coho Salmon are presented in Figure 8.

Steelhead

Natural-origin age-0 steelhead were observed in low numbers, compared to previous years, starting in mid-April at all three sites: 4 at the Bogus site, 17 at the I-5 site, and 3 at the Kinsman site (Appendix A). Natural-origin age-1+ steelhead were also observed in low numbers at the three sites: 5 at the Bogus site, 18 at the I-5 site, and 91 at the Kinsman site (Appendix A). Peak age-1+ steelhead catches at the Kinsman trap site occurred during calendar week 22 (late May). All catch data for steelhead provided in Appendix A are raw catches and are not adjusted for effort or trap efficiency and do not encompass the entire outmigration period.

Low sample sizes precluded identifying any trend in mean weekly fork lengths of steelhead, except for natural-origin age-1+ steelhead at the Kinsman trap site, which increased during April before leveling out (Figure 4, Figure 5, Figure 6, Figure 7, Appendix F, Appendix G, Appendix H, Appendix I). Length–weight relationships for steelhead are presented in Figure 8.

Other Species

Sampling efforts were designed to target juvenile salmonids, but a variety of other fishes were also captured in the traps. In total, 15 non-target species were captured. The most common non-target fishes captured at the Bogus and I-5 sites were non-native Yellow Perch (*Perca flavescens*) and sunfish (*Lepomis* spp.), and native Marbled Sculpin (*Cottus klamathensis*) (Table 3). Notably, a single Miller Lake Lamprey (*Entosphenus minimus*) was also caught at the Bogus site. This species is rarely observed downstream of Iron Gate Dam. The most common non-target fishes captured at the Kinsman site were native Speckled Dace (*Rhinichthys osculus*), Klamath River Lamprey (*Entosphenus similis*), and undifferentiated lamprey ammocoetes (*Entosphenus* spp.) (Table 3).

Table 1. Mainstem Klamath River weekly age-0 juvenile Chinook Salmon outmigrant abundance estimates and mark-recapture information, 2016.

Trap site	Week	Week starting	Raw catch	Marks released	Marks recovered	Sample fraction	Mean population estimate	SD of population estimate	0.025 bound	0.975 bound
Bogus	9	2/22/2016	299	0	--	0.5714	169,611	136,052	44,006	565,911
	10	2/29/2016	1,256	0	--	0.5714	178,425	74,409	79,939	375,506
	11	3/7/2016	390	0	--	0.4286	124,852	57,897	51,144	271,488
	12	3/14/2016	125	0	--	0.1429	96,376	41,368	27,616	198,250
	13	3/21/2016	163	0	--	0.5714	66,956	29,476	22,063	135,314
	14	3/28/2016	426	0	--	0.5714	66,104	23,959	26,988	121,463
	15	4/4/2016	1,069	3,973	113	0.5714	65,140	6,148	54,274	78,332
	16	4/11/2016	222	0	--	0.5714	32,172	12,777	12,727	62,549
	17	4/18/2016	58	3,715	23	0.5714	17,591	3,958	11,332	26,669
	18	4/25/2016	20	0	--	0.5714	9,609	5,355	2,680	22,997
	19	5/2/2016	11	0	--	0.4286	4,867	3,528	973	13,970
	Total						839,400	280,245	498,952	1,640,151
I-5	9	2/22/2016	429	0	--	0.5714	78,256	16,103	51,638	125,339
	10	2/29/2016	290	0	--	0.4199	70,512	14,410	47,008	102,617
	11	3/7/2016	15	0	--	0.0406	40,061	10,656	28,022	68,404
	12	3/14/2016	3	0	--	0.0415	10,060	8,753	5,606	38,211
	13	3/21/2016	12	0	--	0.3122	6,357	8,181	2,925	32,060
	14	3/28/2016	75	0	--	0.4658	18,204	6,389	11,803	37,888
	15	4/4/2016	328	0	--	0.4286	74,531	14,749	39,348	100,319
	16	4/11/2016	295	4,989	47	0.5714	53,232	5,497	43,003	65,209
	17	4/18/2016	75	0	--	0.4043	20,459	5,726	14,047	36,424
	18	4/25/2016	158	5,574	56	0.5714	28,206	3,074	22,478	34,725
	19	5/2/2016	158	0	--	0.5666	28,205	5,241	16,698	39,605
	20	5/9/2016	89	0	--	0.5714	16,906	4,257	11,172	27,625
	21	5/16/2016	123	0	--	0.5714	25,991	6,046	15,662	39,166
	Total						481,555	51,097	416,792	637,197
Kinsman	15	4/4/2016	2,966	5,055	11	0.5714	2,118,449	618,761	1,250,222	3,602,010
	16	4/11/2016	1,154	0	--	0.4286	480,771	679,617	47,455	1,844,305
	17	4/18/2016	324	6,055	14	0.5714	235,894	63,091	142,348	386,693
	18	4/25/2016	76	0	--	0.4286	68,441	104,382	6,895	288,881
	19	5/2/2016	78	4,984	64	0.5714	11,225	1,709	8,264	14,911
	20	5/9/2016	82	4,382	67	0.5714	9,879	1,462	7,369	13,079
	21	5/16/2016	79	0	--	0.5714	32,710	48,104	3,158	129,307
	22	5/23/2016	96	0	--	0.4286	39,281	80,337	2,730	157,106
	23	5/30/2016	48	0	--	0.2857	19,404	34,908	1,325	75,558
	24	6/6/2016	15	0	--	0.1429	1,020	2,284	20	5,722
	25	6/13/2016	2	0	--	0.1429	3,413	7,575	179	14,677
	Total						--	--	--	--

Table 2. Mainstem Klamath River weekly natural-origin age-0 Chinook Salmon health information, 2016. Salmonid gills were classified as healthy if they were red in color and free of fungus and erosion. Gills were classified as unhealthy if they were pale/white/tan in color, fungal, or eroded. A distended abdomen is an indication of potential infection with the parasite *Ceratonova shasta*. These data are also collected for juvenile Coho Salmon and steelhead but are not reported here.

			Gill condition			Abdomen condition		
Trap site	**Calendar Week**	**Sample dates**	**Number examined**	**Number unhealthy**	**Percent unhealthy**	**Number examined**	**Number distended**	**Percent distended**
Bogus	9	2/23-2/26	0	0	--	60	0	0.0%
	10	3/1-3/4	0	0	--	90	0	0.0%
	11	3/9-3/11	0	0	--	60	0	0.0%
	12	3/15-3/15	0	0	--	30	0	0.0%
	13	3/22-3/25	0	0	--	86	0	0.0%
	14	3/29-4/1	13	0	0.0%	90	0	0.0%
	15	4/5-4/8	30	0	0.0%	90	0	0.0%
	16	4/12-4/15	18	2	11.1%	90	0	0.0%
	17	4/19-4/22	20	0	0.0%	33	0	0.0%
	18	4/26-4/29	12	3	25.0%	13	0	0.0%
	19	5/3-5/5	6	0	0.0%	8	0	0.0%
	Total		99	5	5.1%	650	0	0.0%
I-5	9	2/23-2/26	0	0	--	106	0	0.0%
	10	3/1-3/4	3	0	0.0%	141	0	0.0%
	11	3/9-3/9	0	0	--	15	0	0.0%
	12	3/15-3/15	0	0	--	3	0	0.0%
	13	3/22-3/25	0	0	--	6	0	0.0%
	14	3/29-4/1	17	1	5.9%	50	0	0.0%
	15	4/5-4/8	94	0	0.0%	132	0	0.0%
	16	4/12-4/15	89	2	2.2%	107	0	0.0%
	17	4/19-4/22	52	2	3.8%	57	0	0.0%
	18	4/26-4/29	78	5	6.4%	79	0	0.0%
	19	5/3-5/6	94	8	8.5%	95	0	0.0%
	20	5/10-5/13	56	10	17.9%	57	2	3.5%
	21	5/17-5/20	73	2	2.7%	75	1	1.3%
	Total		556	30	5.4%	923	3	0.3%
Kinsman	9	2/25-2/26	1	0	0.0%	30	0	0.0%
	10	3/1-3/2	3	0	0.0%	60	0	0.0%
	15	4/5-4/8	78	2	2.6%	90	0	0.0%
	16	4/12-4/14	87	1	1.1%	90	0	0.0%
	17	4/19-4/22	87	0	0.0%	90	0	0.0%
	18	4/26-4/28	75	2	2.7%	76	0	0.0%
	19	5/3-5/6	50	0	0.0%	50	0	0.0%
	20	5/10-5/13	53	1	1.9%	57	8	14.0%
	21	5/17-5/20	63	3	4.8%	64	4	6.3%
	22	5/24-5/26	76	10	13.2%	77	3	3.9%
	23	6/1-6/2	43	5	11.6%	43	5	11.6%
	24	6/8-6/8	12	1	8.3%	12	1	8.3%
	Total		628	25	4.0%	739	21	2.8%

Table 3. Catch totals of non-target fish species in the mainstem Klamath River at the three trap sites (all traps within a site combined), 2016.

Common name	Scientific name	Trap site		
		Bogus	**I-5**	**Kinsman**
Ammocoete (*Entosphenus*)	*Entosphenus* spp.	10	9	37
Bullhead[a]	*Ameiurus* spp.	11	53	30
Crappie[a]	*Pomoxis* spp.	10	6	0
Fathead Minnow[a]	*Pimphales promelas*	1	13	2
Golden Shiner[a]	*Notemigonus crysoleucas*	17	34	5
Klamath River Lamprey	*Entosphenus similis*	14	53	91
Largemouth Bass[a]	*Micropterus salmoides*	2	0	0
Marbled Sculpin	*Cottus klamathensis*	27	88	2
Miller Lake Lamprey	*Entosphenus minimus*	1	0	0
Pacific Lamprey	*Entosphenus tridentatus*	0	0	8
Prickly Sculpin	*Cottus asper*	0	0	1
Speckled Dace	*Rhinichthys osculus*	4	14	245
Sucker spp.	*Catostomus* spp.	2	3	18
Sunfish[a]	*Lepomis* spp.	63	64	6
Yellow Perch[a]	*Perca flavescens*	428	310	15

[a] Non-native

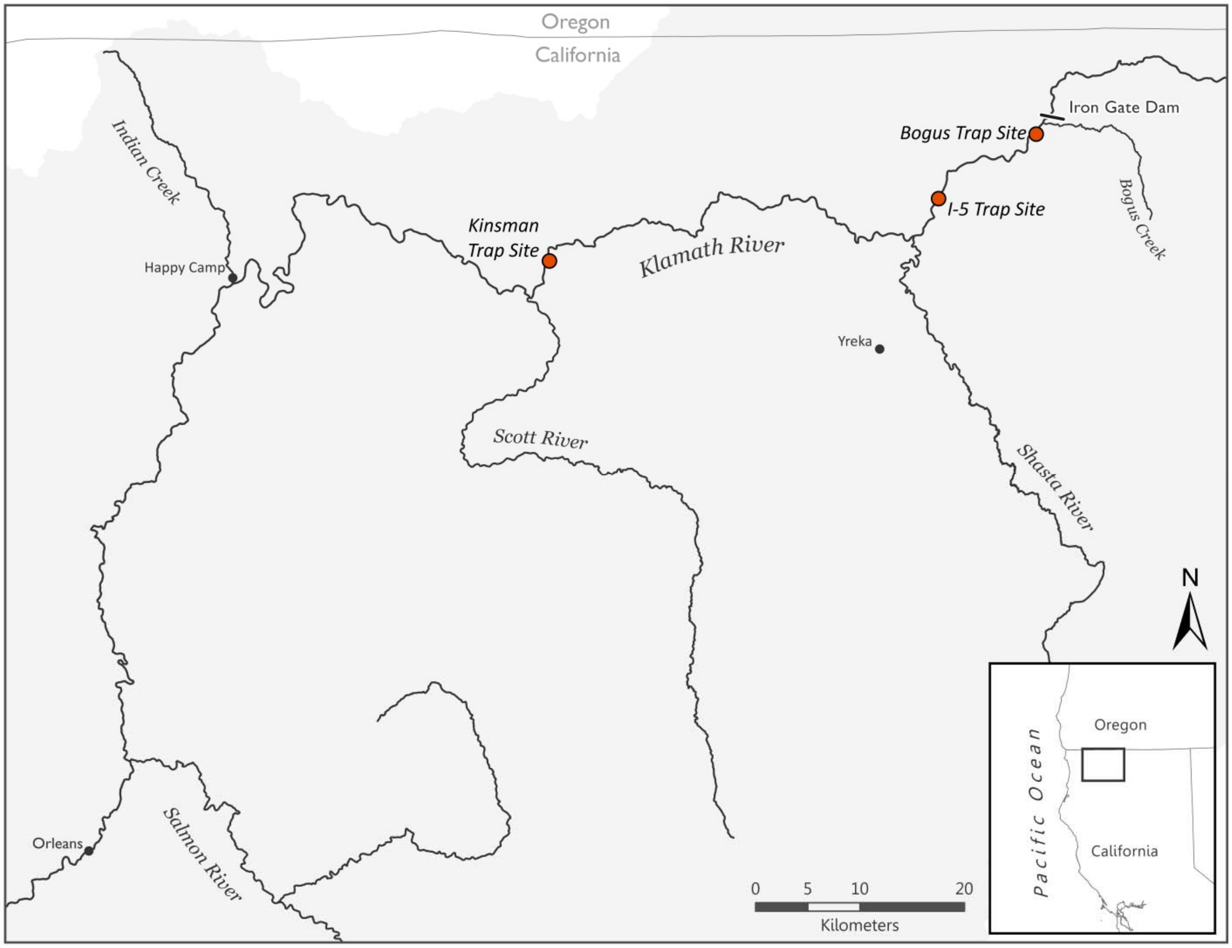

Figure 1. The middle Klamath River basin with trap sites identified.

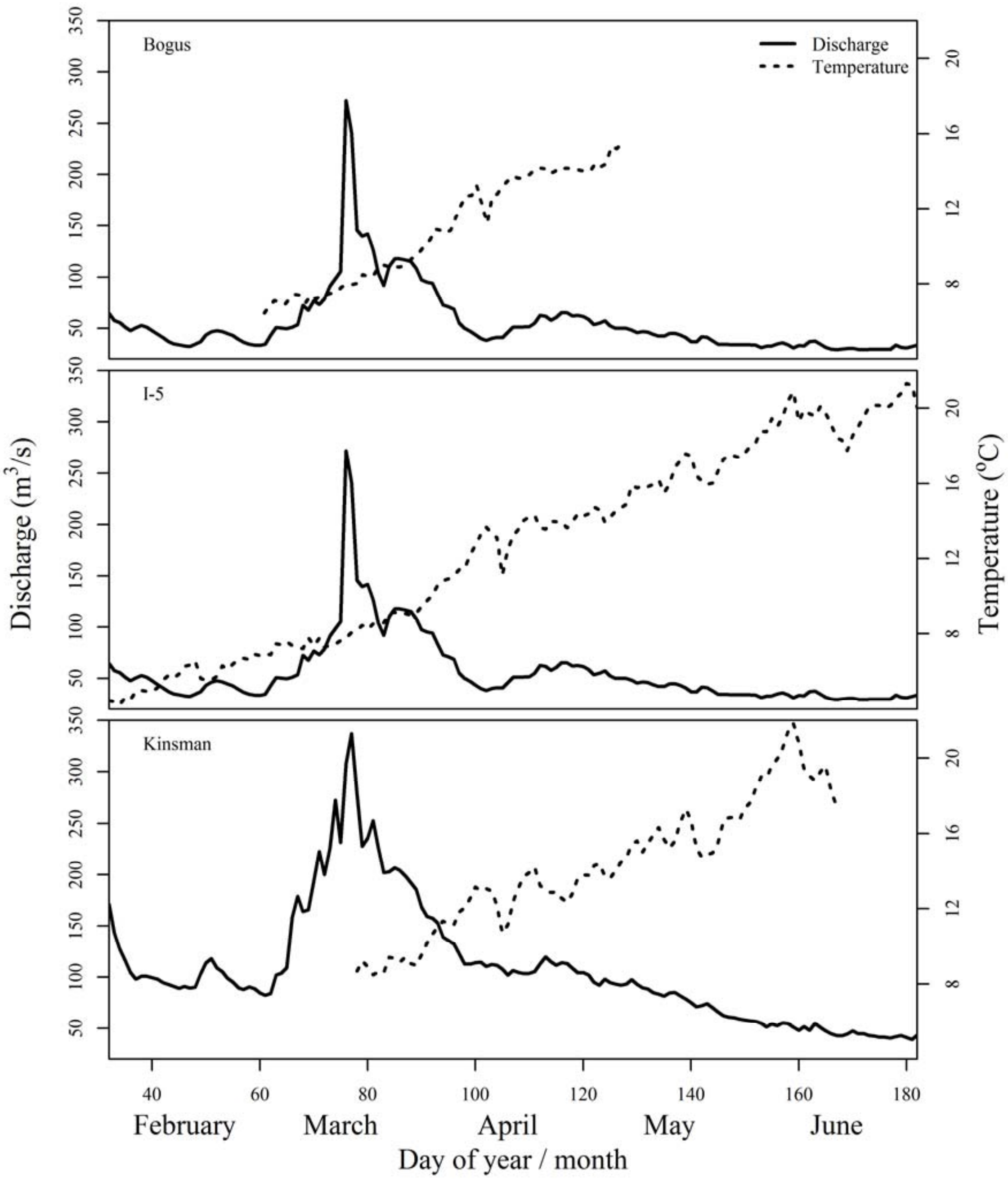

Figure 2. Klamath River mean daily discharge (m^3/s) and mean daily temperature (°C) at the three trap sites for February through the end of June, 2016.

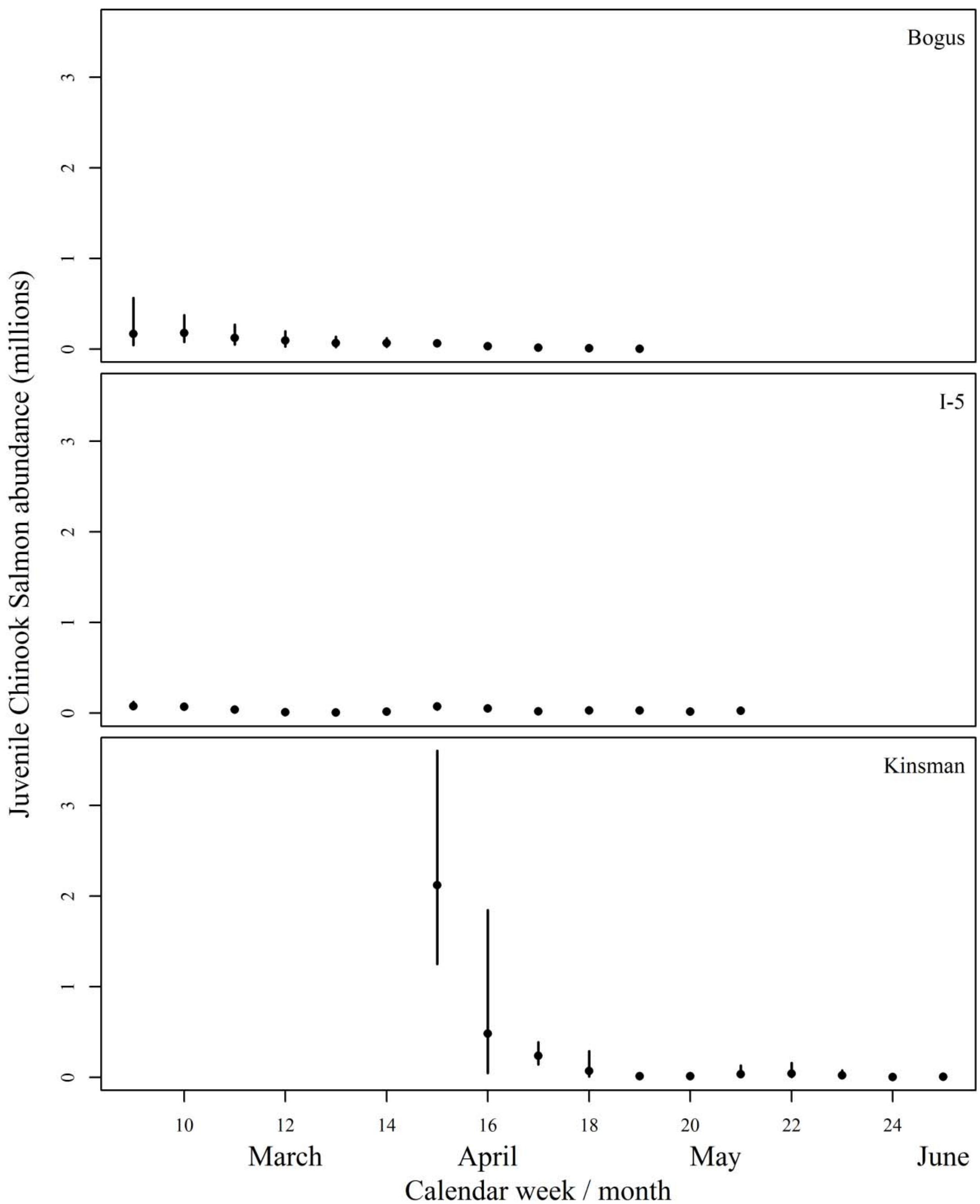

Figure 3. Weekly mean, lower (2.5% credible interval), and upper (97.5% credible interval) bound estimates for natural-origin, age-0 juvenile Chinook Salmon outmigrant abundance at the three trap sites, 2016. Trapping did not occur after calendar weeks 19 and 21 at the Bogus and I-5 trap sites, respectively.

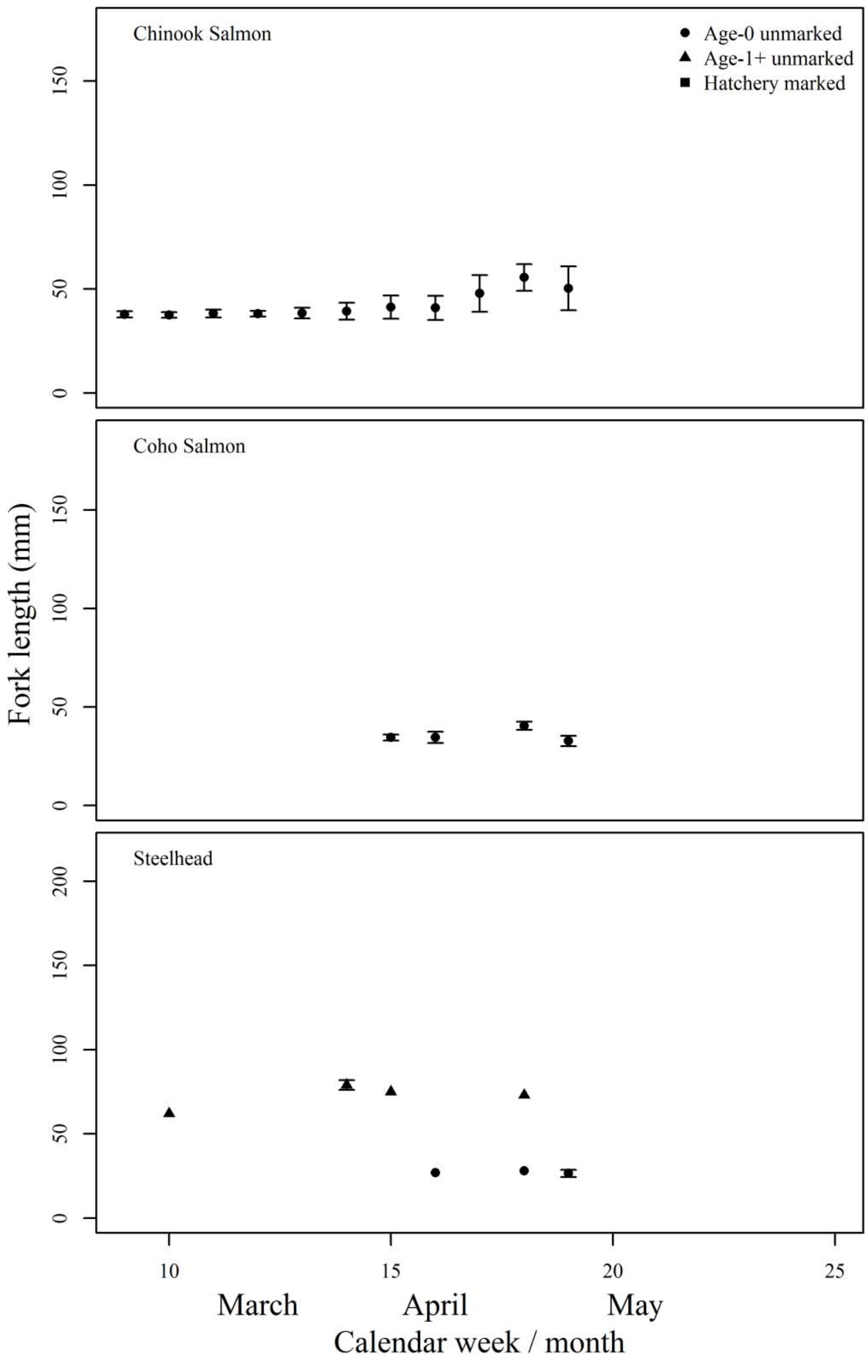

Figure 4. Weekly mean fork lengths (± one standard deviation) of unmarked age-0, unmarked age-1+, and hatchery-marked Chinook Salmon, Coho Salmon, and steelhead captured at the Klamath River Bogus frame net, 2016.

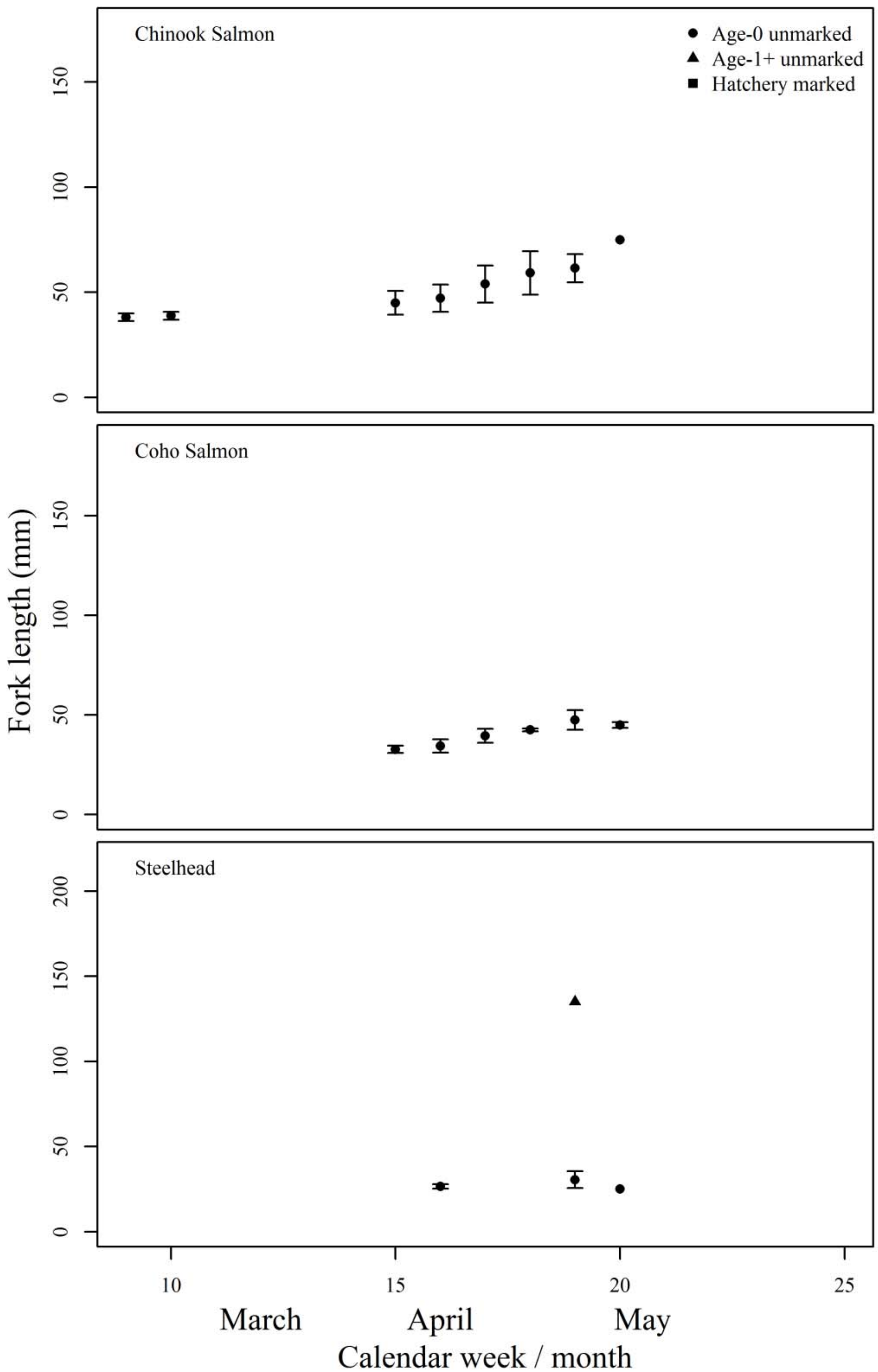

Figure 5. Weekly mean fork lengths (± one standard deviation) of unmarked age-0, unmarked age-1+, and hatchery-marked Chinook Salmon, Coho Salmon, and steelhead captured at the Klamath River I-5 frame net, 2016.

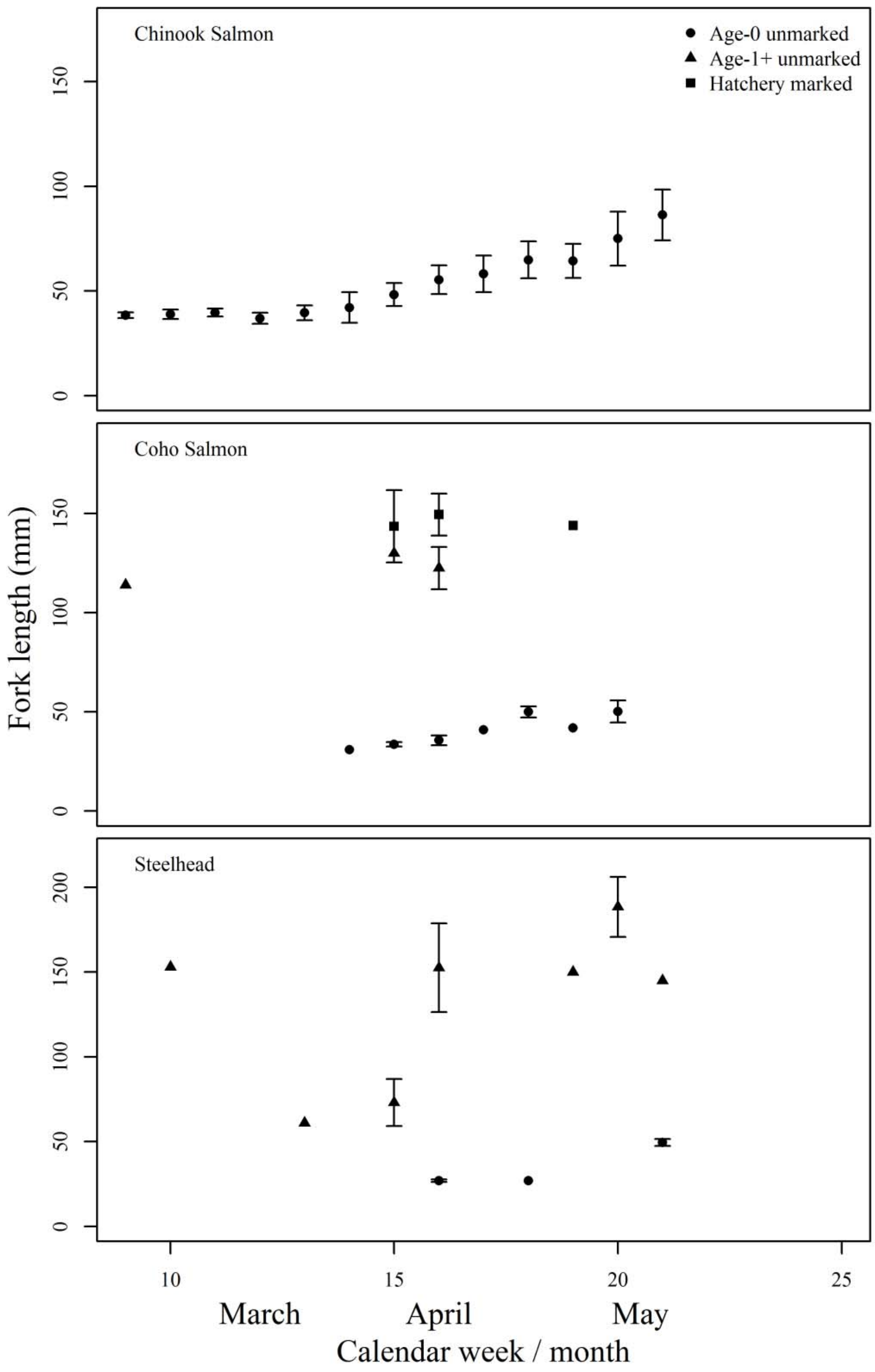

Figure 6. Weekly mean fork lengths (± one standard deviation) of unmarked age-0, unmarked age-1+, and hatchery-marked Chinook Salmon, Coho Salmon, and steelhead captured at the Klamath River I-5 RSTs, 2016.

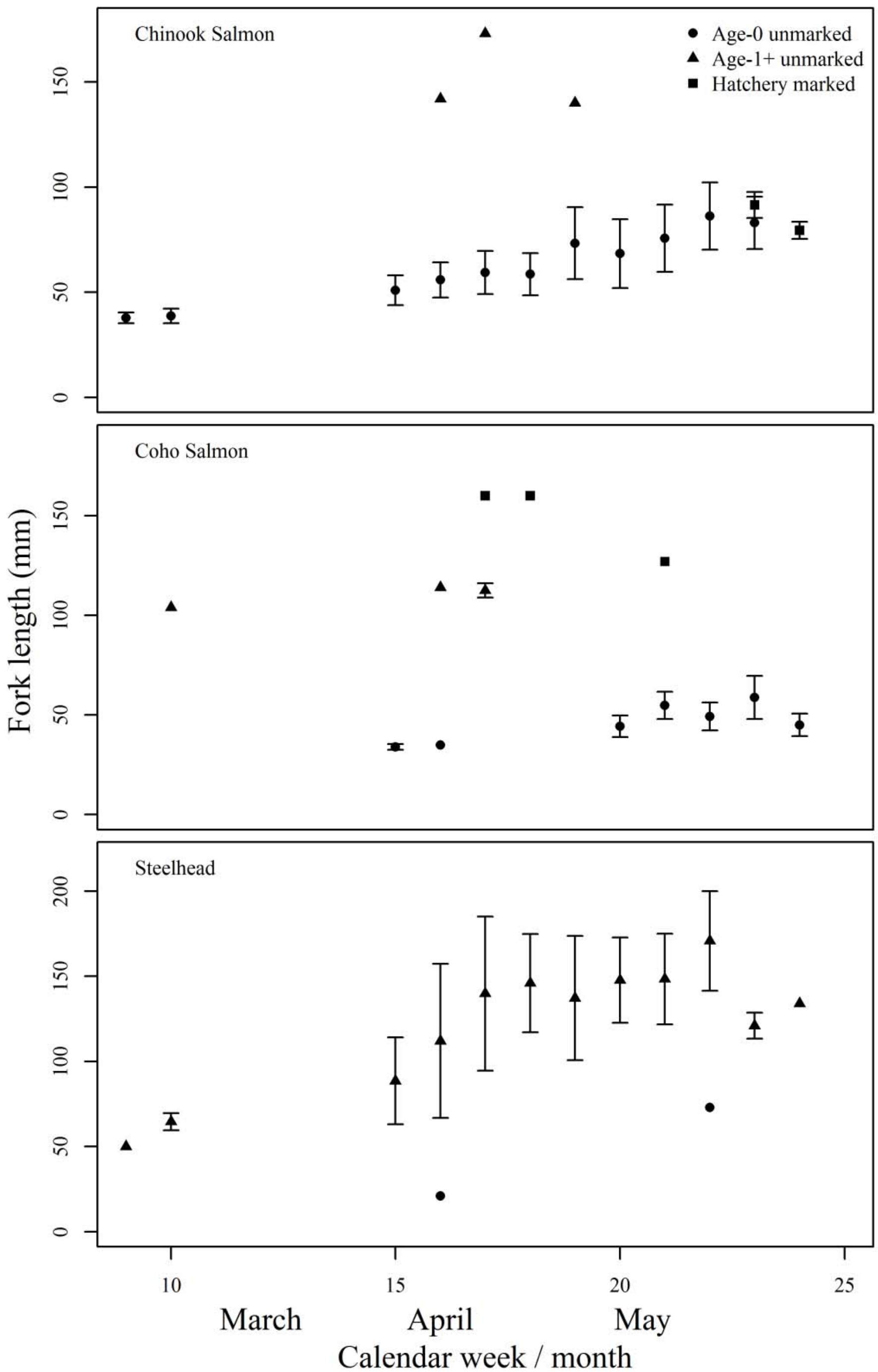

Figure 7. Weekly mean fork lengths (± one standard deviation) of unmarked age-0, unmarked age-1+, and hatchery-marked Chinook Salmon, Coho Salmon, and steelhead captured at the Klamath River Kinsman RST, 2016.

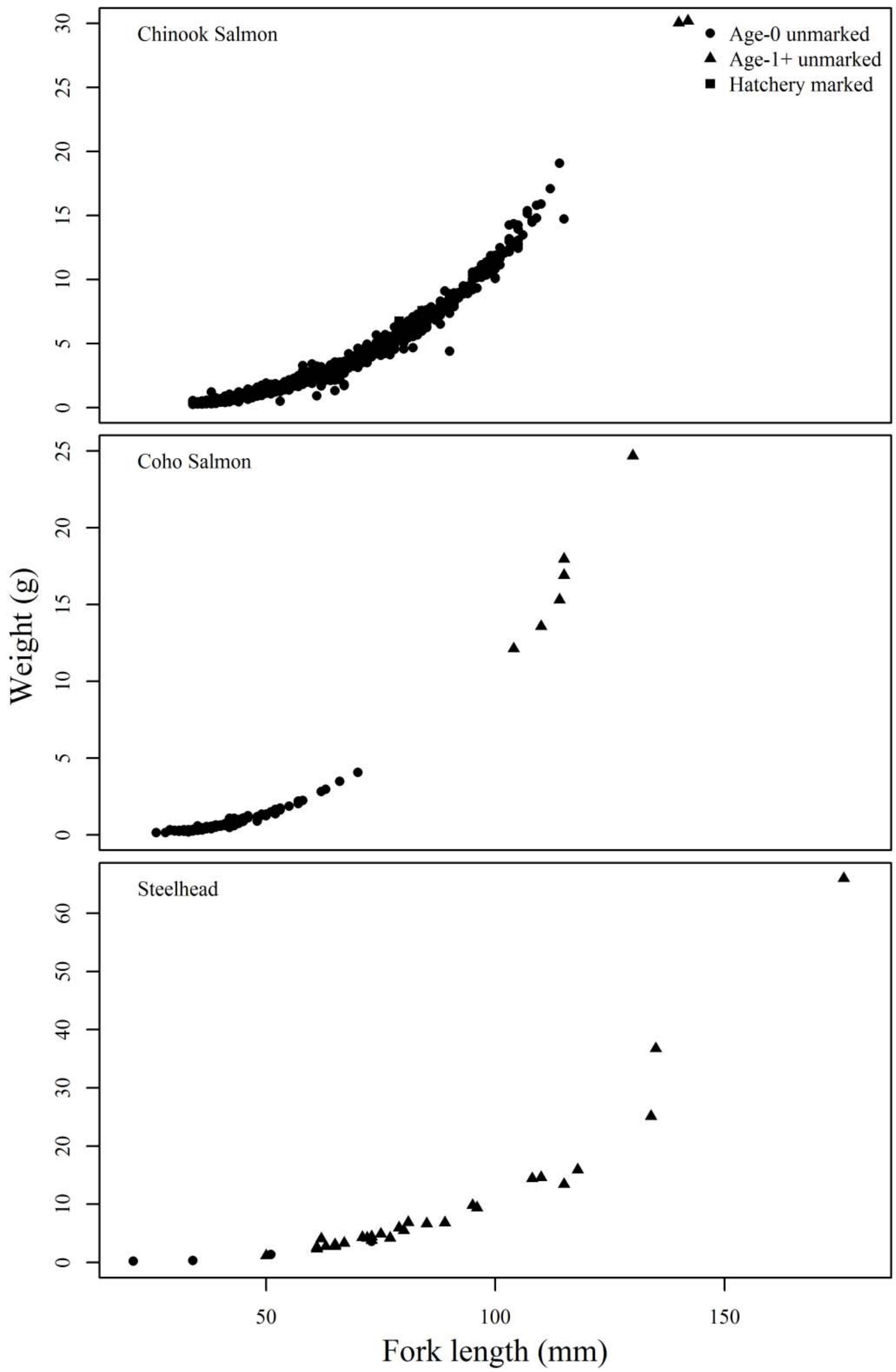

Figure 8. Weight plotted against fork length for individual juvenile Chinook Salmon, Coho Salmon, and steelhead, all trap sites combined, 2016.

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We particularly thank the Karuk Tribe for their annual participation in this project. Data were collected by AFWO personnel: Savannah Bell, Thomas Bland, Aaron David, Matt Drummond, Sterling Fulford, and Michael Sundman. Data were collected by Karuk Tribe personnel: Kenneth "Binks" Brink and Clayton Tuttle. Finally, we thank Dr. Nicholas Som (AFWO) for assistance deriving the population estimates and Savannah Bell for feedback on earlier drafts of this report.

Literature Cited

Bartholow, J., J. Heasley, J. Laake, J. Sandelin, B. A. K. Coughlan, and A. Moos. 2002. SALMOD, a population model for salmonids: user's manual. Version W3. U.S. Geological Survey, Fort Collins, Colorado.

Bolick, A., K. True, and J. S. Foott. 2012, 2013. Myxosporean parasite (*Ceratomyxa shasta* and *Parvicapsula minibicornis*) annual prevalence of infection in Klamath River Basin juvenile Chinook Salmon, 2 reports. U.S. Fish and Wildlife Service California-Nevada Fish Health Center, Anderson, California. Available online: http://www.fws.gov/canvfhc/CANVReports.html.

Bonner, S. J., D. Thomson, and C. J. Schwarz. 2009. Time-varying covariates and semi-parametric regression in capture-recapture: an adaptive spline approach. Pages 659–678 *in* D. L. Thomson, E. G. Cooch, and M. J. Conroy, editors. Modeling Demographic Processes in Marked Populations: Environmental and Ecological Statistics, Vol. 3, Springer, New York.

David, A. T., S. A. Gough, and W. D. Pinnix. 2016. Summary of abundance and biological data collected during juvenile salmonid monitoring on the mainstem Klamath River below Iron Gate Dam, California, 2014. U.S. Fish and Wildlife Service. Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2016-47.

David, A. T., S. A. Gough, and W. D. Pinnix. 2017. Summary of abundance and biological data collected during juvenile salmonid monitoring on the mainstem Klamath River below Iron Gate Dam, California, 2015. U.S. Fish and Wildlife Service. Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2017-48.

Gough, S. A., A. T. David, and W. D. Pinnix. 2015. Summary of abundance and biological data collected during juvenile salmonid monitoring in the mainstem Klamath River below Iron Gate Dam, California, 2000–2013. U.S. Fish and Wildlife Service. Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2015-43.

Hardy, T. B., and R. C. Addley. 2001. Evaluation of interim instream flow needs in the Klamath River: Phase II Final Report. Institute for Natural Systems Engineering, Utah Water Research Laboratory, Utah State University, Logan, Utah.

Klamath River Basin Fisheries Task Force. 1991. Long range plan for the Klamath River Basin conservation area fishery restoration program. Prepared with assistance from William M. Kier Associates. Yreka, California.

Magneson, M. D. 2014. The influence of Lewiston Dam releases on water temperatures of the Trinity River and lower Klamath River, CA, April to October 2013. U. S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2014-36.

Nichols, K., and K. True. 2007. Monitoring incidence and severity of *Ceratomyxa shasta* and *Parvicapsula minibicornis* infections in juvenile Chinook Salmon (*Oncorhynchus tshawytscha*) and Coho Salmon (*Oncorhynchus kisutch*) in the Klamath River, 2006. U.S. Fish and Wildlife Service California-Nevada Fish Health Center, Anderson, California.

Nichols, K., K. True, R. Fogerty, L. Ratcliff, and A. Bolick. 2009. Myxosporean parasite (*Ceratomyxa shasta* and *Parvicapsula minibicornis*) incidence and severity in Klamath River Basin juvenile Chinook and Coho Salmon, April-August 2008. U.S. Fish and Wildlife Service California-Nevada Fish Health Center, Anderson, California. Available online: http://www.fws.gov/canvfhc/CANVReports.html.

Rawson, K. 1984. An estimate of the size of a migrating population of juvenile salmon using an index of trap efficiency obtained by dye marking. Alaska Department of Fish and Game, Division of Fisheries Rehabilitation, Enhancement and Development, Juneau, Alaska, FRED Report Number 28.

True, K., J. S. Foott, A. Bolick, S. Benson, and R. Fogerty. 2010. Myxosporean parasite (*Ceratomyxa shasta* and *Parvicapsula minibicornis*) incidence and severity in Klamath River Basin juvenile Chinook Salmon, April–August 2009. U.S. Fish and Wildlife Service California-Nevada Fish Health Center, Anderson, California. Available online: http://www.fws.gov/canvfhc/CANVReports.html.

True, K., A. Bolick, and J. S. Foott. 2011, 2013. Myxosporean parasite (*Ceratomyxa shasta* and *Parvicapsula minibicornis*) annual prevalence of infection in Klamath River Basin juvenile Chinook Salmon, 2 reports. U.S. Fish and Wildlife Service California-Nevada Fish Health Center, Anderson, California. Available online: http://www.fws.gov/canvfhc/CANVReports.html.

USFWS (U.S. Fish and Wildlife Service). 1960. A preliminary survey of fish and wildlife resources. Report Appendix to Natural Resources of Northwestern California. U.S. Department of Interior, Pacific Southwest Field Committee.

USFWS (U.S. Fish and Wildlife Service). 1983. Environmental impact statement for the Trinity River basin fish and wildlife management program, Trinity River, northwestern California. U.S. Department of Interior.

West Coast Chinook Salmon Biological Review Team. 1997. Review of the status of Chinook Salmon (*Oncorhynchus tshawytscha*) from Washington, Oregon, California, and Idaho under the U.S. Endangered Species Act. NOAA Technical Memorandum NMFS-NWFSC-35.

Appendices

Appendix A. Mainstem Klamath River weekly juvenile salmonid outmigrant trap catch summary, 2016. (appendix continued on following page)

								Chinook Salmon			Coho Salmon			Steelhead	
	Calendar	Sample	Trap	Mean Q	Water temp (C)			Age-0		Age-1+	Age-0	Age-1+		Age-0	Age-1+
Trap	week	dates	days	(m^3/s)	Min	Max	Mean	No clip	AD clip	No clip	No clip	No clip	LM clip	No clip	No clip
Bogus Frame	9	2/23-2/26	4	42	--	--	--	299	0	0	0	0	0	0	0
	10	3/1-3/4	4	42	6.3	7.4	6.9	1,256	0	0	0	0	0	0	1
	11	3/9-3/11	3	68	6.7	7.6	7.2	390	0	0	0	0	0	0	0
	12	3/15-3/15	1	156	7.5	7.9	7.7	125	0	0	0	0	0	0	0
	13	3/22-3/25	4	116	8.4	8.9	8.6	163	0	0	0	0	0	0	0
	14	3/29-4/1	4	101	9.0	9.8	9.3	426	0	0	1	0	0	0	2
	15	4/5-4/8	4	58	10.3	11.8	11.1	1,069	0	0	17	1	0	0	1
	16	4/12-4/15	4	42	11.4	13.4	12.5	222	0	0	8	0	0	1	0
	17	4/19-4/22	4	56	13.0	14.2	13.6	58	0	0	0	0	0	0	0
	18	4/26-4/29	4	62	13.7	14.6	14.1	20	0	0	2	0	0	1	1
	19	5/3-5/5	3	53	13.7	14.8	14.2	11	0	0	5	0	0	2	0
I-5 Frame	9	2/23-2/26	4	42	5.5	7.6	6.4	99	0	0	0	0	0	0	0
	10	3/1-3/2	2	42	6.3	8.5	7.2	62	0	0	0	0	0	0	0
	15	4/6-4/8	3	58	10.4	13.2	11.5	57	0	0	57	0	0	0	0
	16	4/12-4/15	4	42	11.1	14.9	12.9	35	0	0	35	0	0	4	0
	17	4/19-4/22	4	56	12.5	15.8	13.9	19	0	0	8	0	0	0	0
	18	4/26-4/29	4	62	13.1	15.4	14.1	17	0	0	4	0	0	0	0
	19	5/4-5/6	3	53	13.5	15.9	14.5	4	0	0	0	0	0	1	1
	20	5/10-5/13	4	45	14.1	18.2	15.9	9	0	0	2	0	0	1	0
	21	5/17-5/20	4	41	15.6	18.6	16.8	8	0	0	0	0	0	0	0
I-5 RST	9	2/23-2/26	8	42	5.5	7.6	6.4	330	0	0	0	1	0	0	0
	10	3/1-3/4	7	42	6.3	8.5	7.2	228	0	0	0	0	0	0	1
	11	3/9-3/9	1	68	6.8	8.2	7.4	15	0	0	0	0	0	0	0
	12	3/15-3/15	1	156	7.4	8.6	7.9	3	0	0	0	0	0	0	0
	13	3/22-3/25	6	116	8.2	9.5	8.7	12	0	0	1	0	0	0	1
	14	3/29-4/1	8	101	8.8	10.7	9.6	75	0	0	5	0	0	0	0
	15	4/5-4/8	6	58	10.4	13.2	11.5	271	0	0	9	1	39	0	2
	16	4/12-4/15	8	42	11.1	14.9	12.9	260	0	0	3	2	2	6	4
	17	4/19-4/22	6	56	12.5	15.8	13.9	56	0	0	2	0	0	0	0
	18	4/26-4/29	8	62	13.1	15.4	14.1	141	0	0	2	1	3	2	1
	19	5/3-5/6	8	53	13.5	15.9	14.5	154	0	0	3	0	2	1	1
	20	5/10-5/13	8	45	14.1	18.2	15.9	80	0	0	5	1	0	0	3
	21	5/17-5/20	8	41	15.6	18.6	16.8	115	19	0	1	1	1	2	4

								Chinook Salmon			Coho Salmon			Steelhead	
	Calendar	Sample	Trap	Mean Q	Water temp (C)			Age-0		Age-1+	Age-0	Age-1+		Age-0	Age-1+
Trap	week	dates	days	(m^3/s)	Min	Max	Mean	No clip	AD clip	No clip	No clip	No clip	LM clip	No clip	No clip
Kinsman RST	9	2/25-2/26	2	97	--	--	--	1,061	0	0	0	1	0	0	10
	10	3/1-3/2	2	94	--	--	--	874	0	0	0	1	0	0	5
	15	4/5-4/8	4	124	10.9	12.7	11.9	2,966	0	0	10	0	8	0	5
	16	4/12-4/14	3	109	11.4	13.0	12.2	1,154	0	1	1	2	0	2	3
	17	4/19-4/22	4	109	12.6	14.2	13.4	324	0	1	0	3	1	0	8
	18	4/26-4/28	3	108	12.3	13.8	13.1	76	0	0	0	0	1	0	5
	19	5/3-5/6	4	94	13.6	14.8	14.2	78	0	1	0	1	0	0	6
	20	5/10-5/13	4	88	14.9	16.4	15.6	82	0	0	8	0	1	0	11
	21	5/17-5/20	4	78	15.0	16.8	15.9	79	0	0	5	0	1	0	11
	22	5/24-5/26	3	65	15.2	17.1	16.1	96	0	0	6	0	0	1	19
	23	6/1-6/2	2	55	17.5	20.0	18.7	48	6	0	5	0	0	0	6
	24	6/8-6/8	1	52	19.1	21.5	20.3	15	6	0	2	0	0	0	2
	25	6/15-6/15	1	46	17.6	19.8	18.6	2	0	0	0	0	0	0	0

Appendix B. Klamath River at Bogus site (frame net) weekly unmarked and hatchery-marked Chinook and Coho salmon fork lengths (mm), 2016.

		Unmarked Chinook Salmon										Unmarked Coho Salmon										Marked Coho Salmon				
Calendar	Sample	Age-0					Age-1+					Age-0					Age-1+					Age-1+				
week	dates	n	mean	min	max	sd	n	mean	min	max	sd	n	mean	min	max	sd	n	mean	min	max	sd	n	mean	min	max	sd
9	2/23-2/26	60	37.9	34	42	1.6	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
10	3/1-3/4	90	37.5	34	41	1.4	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
11	3/9-3/11	60	38.3	34	43	1.8	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
12	3/15-3/15	30	38.1	36	41	1.4	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
13	3/22-3/25	88	38.5	34	47	2.6	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
14	3/29-4/1	90	39.4	33	52	4.1	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
15	4/5-4/8	90	41.3	34	55	5.5	0	--	--	--	--	13	34.5	32	37	1.5	0	--	--	--	--	0	--	--	--	--
16	4/12-4/15	90	41.0	33	61	5.9	0	--	--	--	--	8	34.6	30	38	2.8	0	--	--	--	--	0	--	--	--	--
17	4/19-4/22	35	47.9	35	61	8.8	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
18	4/26-4/29	12	55.6	47	66	6.5	0	--	--	--	--	2	40.5	39	42	2.1	0	--	--	--	--	0	--	--	--	--
19	5/3-5/5	11	50.4	35	67	10.5	0	--	--	--	--	5	32.8	30	36	2.6	0	--	--	--	--	0	--	--	--	--

Appendix C. Klamath River at I-5 site (frame net) weekly unmarked and hatchery-marked Chinook and Coho salmon fork lengths (mm), 2016.

		Unmarked Chinook Salmon										Unmarked Coho Salmon										Marked Coho Salmon				
Calendar	Sample	Age-0					Age-1+					Age-0					Age-1+					Age-1+				
week	dates	n	mean	min	max	sd	n	mean	min	max	sd	n	mean	min	max	sd	n	mean	min	max	sd	n	mean	min	max	sd
9	2/23-2/26	47	38.2	34	44	1.8	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
10	3/1-3/2	50	38.9	36	43	1.9	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
15	4/6-4/8	42	45.0	34	56	5.6	0	--	--	--	--	29	32.8	26	35	1.8	0	--	--	--	--	0	--	--	--	--
16	4/12-4/15	23	47.2	35	59	6.4	0	--	--	--	--	28	34.4	29	42	3.4	0	--	--	--	--	0	--	--	--	--
17	4/19-4/22	15	53.9	39	66	8.8	0	--	--	--	--	7	39.6	35	43	3.5	0	--	--	--	--	0	--	--	--	--
18	4/26-4/29	10	59.2	44	76	10.4	0	--	--	--	--	2	42.5	42	43	0.7	0	--	--	--	--	0	--	--	--	--
19	5/4-5/6	6	61.5	52	70	6.7	0	--	--	--	--	4	47.5	40	50	5.0	0	--	--	--	--	0	--	--	--	--
20	5/10-5/13	1	75.0	75	75	0.0	0	--	--	--	--	2	45.0	44	46	1.4	0	--	--	--	--	0	--	--	--	--
21	5/17-5/20	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--

Appendix D. Klamath River at I-5 site (RST) weekly unmarked and hatchery-marked Chinook and Coho salmon fork lengths (mm), 2016.

		Unmarked Chinook Salmon										Unmarked Coho Salmon										Marked Coho Salmon				
Calendar	Sample	Age-0					Age-1+					Age-0					Age-1+					Age-1+				
week	dates	n	mean	min	max	sd	n	mean	min	max	sd	n	mean	min	max	sd	n	mean	min	max	sd	n	mean	min	max	sd
9	2/23-2/26	60	38.5	36	42	1.4	0	--	--	--	--	0	--	--	--	--	1	114.0	114	114	0.0	0	--	--	--	--
10	3/1-3/4	90	38.9	33	48	2.3	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
11	3/9-3/9	15	39.7	36	43	1.9	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
12	3/15-3/15	3	37.0	34	39	2.7	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
13	3/22-3/25	8	39.6	34	44	3.5	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
14	3/29-4/1	50	42.1	34	56	7.3	0	--	--	--	--	1	31.0	31	31	0.0	0	--	--	--	--	0	--	--	--	--
15	4/5-4/8	89	48.3	35	57	5.5	0	--	--	--	--	13	33.7	32	35	1.1	1	130.0	130	130	0.0	38	143.6	108	183	18.2
16	4/12-4/15	84	55.4	36	68	6.8	0	--	--	--	--	3	35.7	33	38	2.5	2	122.5	115	130	10.6	2	149.5	142	157	10.6
17	4/19-4/22	50	58.2	35	77	8.7	0	--	--	--	--	1	41.0	41	41	0.0	0	--	--	--	--	0	--	--	--	--
18	4/26-4/29	69	64.9	38	80	8.8	0	--	--	--	--	2	50.0	48	52	2.8	0	--	--	--	--	0	--	--	--	--
19	5/3-5/6	90	64.4	48	81	8.1	0	--	--	--	--	1	42.0	42	42	0.0	0	--	--	--	--	1	144.0	144	144	0.0
20	5/10-5/13	56	75.1	48	103	12.9	0	--	--	--	--	4	50.3	44	57	5.6	0	--	--	--	--	0	--	--	--	--
21	5/17-5/20	12	86.3	74	107	12.1	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--

Appendix E. Klamath River at Kinsman site (RST) weekly unmarked and hatchery-marked Chinook and Coho salmon fork lengths (mm), 2016.

		Unmarked Chinook Salmon										**Unmarked Coho Salmon**										**Marked Coho Salmon**				
Calendar	**Sample**	**Age-0**					**Age-1+**					**Age-0**					**Age-1+**					**Age-1+**				
week	**dates**	**n**	**mean**	**min**	**max**	**sd**	**n**	**mean**	**min**	**max**	**sd**	**n**	**mean**	**min**	**max**	**sd**	**n**	**mean**	**min**	**max**	**sd**	**n**	**mean**	**min**	**max**	**sd**
9	2/25-2/26	30	37.8	35	45	2.6	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
10	3/1-3/2	60	38.8	35	59	3.5	0	--	--	--	--	0	--	--	--	--	1	104.0	104	104	0.0	0	--	--	--	--
15	4/5-4/8	90	51.0	35	70	7.0	0	--	--	--	--	2	34.0	33	35	1.4	0	--	--	--	--	0	--	--	--	--
16	4/12-4/14	89	55.9	43	79	8.4	1	142.0	142	142	0.0	1	35.0	35	35	0.0	1	114.0	114	114	0.0	0	--	--	--	--
17	4/19-4/22	89	59.4	41	86	10.2	1	173.0	173	173	0.0	0	--	--	--	--	2	112.5	110	115	3.5	1	160.0	160	160	0.0
18	4/26-4/28	76	58.6	42	83	10.0	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	1	160.0	160	160	0.0
19	5/3-5/6	49	73.3	46	105	17.1	1	140.0	140	140	0.0	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
20	5/10-5/13	57	68.4	36	98	16.3	0	--	--	--	--	5	44.4	36	51	5.4	0	--	--	--	--	0	--	--	--	--
21	5/17-5/20	63	75.7	47	115	16.0	0	--	--	--	--	5	54.8	44	62	6.8	0	--	--	--	--	1	127.0	127	127	0.0
22	5/24-5/26	76	86.2	49	114	16.0	0	--	--	--	--	6	49.3	40	57	7.0	0	--	--	--	--	0	--	--	--	--
23	6/1-6/2	43	83.0	49	110	12.5	0	--	--	--	--	5	58.8	45	70	10.8	0	--	--	--	--	0	--	--	--	--
24	6/8-6/8	0	--	--	--	--	0	--	--	--	--	2	45.0	41	49	5.7	0	--	--	--	--	0	--	--	--	--

Appendix F. Klamath River at Bogus site (frame net) weekly unmarked steelhead fork lengths (mm), 2016.

		Unmarked steelhead									
Calendar	Sample	Age-0					Age-1+				
week	dates	n	mean	min	max	sd	n	mean	min	max	sd
10	3/1-3/4	0	--	--	--	--	1	62.0	62	62	0.0
14	3/29-4/1	0	--	--	--	--	2	79.0	77	81	2.8
15	4/5-4/8	0	--	--	--	--	1	75.0	75	75	0.0
16	4/12-4/15	1	27.0	27	27	0.0	0	--	--	--	--
18	4/26-4/29	1	28.0	28	28	0.0	1	73.0	73	73	0.0
19	5/3-5/5	2	26.5	25	28	2.1	0	--	--	--	--

Appendix G. Klamath River at I-5 site (frame net) weekly unmarked steelhead fork lengths (mm), 2016.

		Unmarked steelhead									
Calendar	Sample	Age-0					Age-1+				
week	dates	n	mean	min	max	sd	n	mean	min	max	sd
16	4/12-4/15	4	26.5	25	28	1.3	0	--	--	--	--
19	5/4-5/6	2	30.5	27	34	5.0	1	135.0	135	135	0.0
20	5/10-5/13	1	25.0	25	25	0.0	0	--	--	--	--

Appendix H. Klamath River at I-5 site (RST) weekly unmarked steelhead fork lengths (mm), 2016.

		Unmarked steelhead									
Calendar	Sample	Age-0					Age-1+				
week	dates	n	mean	min	max	sd	n	mean	min	max	sd
10	3/1-3/4	0	--	--	--	--	1	153.0	153	153	0.0
13	3/22-3/25	0	--	--	--	--	1	61.0	61	61	0.0
15	4/5-4/8	0	--	--	--	--	3	73.0	65	89	13.9
16	4/12-4/15	5	27.0	26	28	0.7	2	152.5	134	171	26.2
18	4/26-4/29	1	27.0	27	27	0.0	0	--	--	--	--
19	5/3-5/6	0	--	--	--	--	1	150.0	150	150	0.0
20	5/10-5/13	0	--	--	--	--	2	188.5	176	201	17.7
21	5/17-5/20	2	49.5	48	51	2.1	1	145.0	145	145	0.0

Appendix I. Klamath River at Kinsman site (RST) weekly unmarked steelhead fork lengths (mm), 2016.

		Unmarked steelhead									
Calendar	Sample	Age-0					Age-1+				
week	dates	n	mean	min	max	sd	n	mean	min	max	sd
9	2/25-2/26	0	--	--	--	--	1	50.0	50	50	0.0
10	3/1-3/2	0	--	--	--	--	5	64.6	61	73	5.0
15	4/5-4/8	0	--	--	--	--	5	88.6	67	118	25.6
16	4/12-4/14	2	21.0	21	21	0.0	2	112.0	80	144	45.3
17	4/19-4/22	0	--	--	--	--	6	139.8	79	180	45.3
18	4/26-4/28	0	--	--	--	--	5	146.0	96	170	28.9
19	5/3-5/6	0	--	--	--	--	5	137.2	95	195	36.5
20	5/10-5/13	0	--	--	--	--	6	147.7	110	185	25.1
21	5/17-5/20	0	--	--	--	--	5	148.4	108	174	26.6
22	5/24-5/26	1	73.0	73	73	0.0	10	170.8	115	215	29.3
23	6/1-6/2	0	--	--	--	--	4	121.0	115	132	7.6
24	6/8-6/8	0	--	--	--	--	1	134.0	134	134	0.0