U.S. Fish & Wildlife Service

Arcata Fisheries Data Series Report DS 2017-48

Summary of Abundance and Biological Data Collected During Juvenile Salmonid Monitoring on the Mainstem Klamath River Below Iron Gate Dam, California, 2015

Aaron T. David, Stephen A. Gough, and William D. Pinnix

U.S. Fish and Wildlife Service
Arcata Fish and Wildlife Office
1655 Heindon Road
Arcata, California 95521
(707) 822-7201

January 2017

Funding for this study was provided by the Klamath River Basin Conservation Area Restoration Program under Project Number 05-FP-13 and the Klamath River Habitat Assessment Study administered by the Arcata Fish and Wildlife Office.

The Arcata Fish and Wildlife Office Fisheries Program reports its study findings through two publication series. The **Arcata Fisheries Data Series** was established to provide timely dissemination of data to local managers and for inclusion in agency databases. The **Arcata Fisheries Technical Reports** publishes scientific findings from single and multi-year studies that have undergone more extensive peer review and statistical testing. Additionally, some study results are published in a variety of professional fisheries and aquatic habitat conservation journals.

To ensure consistency with Service policy relating to its online peer-reviewed journals, Arcata Fisheries Data Series and Technical Reports are now completely electronic and made available in the public domain. Paper copies will no longer be distributed.

Key words: Klamath River, Salmon, Chinook, Coho, Steelhead, Frame Net, Rotary Screw Trap, Juvenile, Outmigrant, Mark-Recapture, Trap Efficiency, Stream Salmonid Simulator

The correct citation for this report is:

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.

Table of Contents

List of Tables

List of Figures

List of Appendices

Page intentionally blank.

Summary of Abundance and Biological Data Collected During Juvenile Salmonid Monitoring on the Mainstem Klamath River Below Iron Gate Dam, California, 2015

Aaron T. David, Stephen A. Gough, and William D. Pinnix

U.S. Fish and Wildlife Service
Arcata Fish and Wildlife Office
1655 Heindon Road, Arcata, California 95521
Aaron_David@fws.gov
Steve_Gough@fws.gov
Bill_Pinnix@fws.gov

Abstract.— This report summarizes results from the 2015 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), 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 or early June. Juvenile salmonids were enumerated daily when traps were operating and subsamples of salmonids were measured for length and weight. Non-salmonid fishes were also enumerated. Mark-recapture studies were conducted periodically at each trap site throughout the season to estimate trap efficiency. The efficiency estimates were combined with the catch data to estimate weekly and seasonal outmigration abundance of natural-origin age-0 juvenile Chinook Salmon at 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 5.8 million at the Bogus trap site, 5.0 million at the I-5 trap site, and 3.6 million at the Kinsman trap site.

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, changed 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 2014 are summarized in Gough et al. (2015) and David et al. (2016). This report summarizes data collected during the 2015 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 downstream-most 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 gauging station below Iron Gate Dam (# 11516530) was used to represent discharge at the Bogus and I-5 trap sites as there are minimal accretions from tributaries between the gauging station and these sites. Discharge at the Kinsman trap site was estimated by subtracting the discharge of the Scott River near Fort Jones (USGS

gauging station 11511950) from the discharge of the Klamath River near Seiad Valley (USGS gauging station 11520500). We monitored water temperatures at 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 2015 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 late 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 and I-5 frame nets were operated through early May, while the I-5 RSTs 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 early June. When late spring fish health threats raised concern, monitoring effort was increased at the Kinsman site from late May to early June. Two frame nets were added along the main channel margin with the intent of improving population estimates and better determining how many fish were affected by disease during this time period.

All traps were typically operated 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 sets 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 is the submerged depth of the cone. Trap depth of frame nets is the water depth at the midpoint of the frame entrance. Center velocity is 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 ammocetes from each genus and 10 eyed lamprey from each species. The following data were recorded for all salmonids in the biosample: 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 (ammocete, eyed juvenile, or adult)], FL or total length (for species with pointed or round tales), 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, is 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 made 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 change 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, we used a weighted sample fraction 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 2015 this was only relevant to the I-5 site during the last week of sampling when the frame net was not operated. The regression equations used to predict the catch proportions for the I-5 RSTs during the last week of sampling were

$$p = 0.1039t^{0.4673} \ (R^2 = 0.27)$$

for the downstream RST and

$$p = 0.0191t + 0.1767 \ (R^2 = 0.23)$$

for the upstream RST.

Due to very small catch numbers, insufficient recapture numbers from efficiency tests, and a short operation period, we did not incorporate catch data or effort from the frame nets deployed during the last weeks of sampling at the Kinsman site into the population estimates.

Mark-recapture trap efficiency tests for age-0 Chinook Salmon were conducted at the three trap sites throughout the trapping season. Both hatchery-produced age-0 Chinook Salmon provided by IGH and natural-origin age-0 Chinook Salmon captured in the frame nets and RSTs and via supplementary seining 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

Prior to trap installation, discharge below Iron Gate Dam, most pertinent to the Bogus and I-5 sites, peaked dramatically in mid-February during a large storm event (Figure 2). Daily mean discharge crested around 90 m^3/s. After this event, discharge declined rapidly to around 30 m^3/s and then slowly climbed to a peak of almost 50 m^3/s in early April. Discharge then gradually declined through the remainder of the trapping season. Discharge at the Kinsman site followed a similar pattern, peaking dramatically in mid-February at 500 m^3/s, falling rapidly after this event, and then remained relatively stable through the trapping season (Figure 2). Overall, discharge was quite low during the trapping season relative to the historic record due to nearly record-low snowpack and a dry spring. Water temperature generally increased through the trapping season at all three trap sites (Figure 2). Temperatures were generally warmer and more variable at the Kinsman site than at the Bogus and I-5 sites (Figure 2).

Salmonid Abundance and Biological Data

Chinook Salmon

Three efficiency tests were conducted at the Bogus trap site, four at the I-5 trap site, and seven at the Kinsman trap site in 2015 (Table 1). Release groups ranged in size from 1,805 to 6,934. Seasonal abundance estimates of natural-origin age-0 Chinook Salmon were 5.8 million at the Bogus trap site, 5.0 million at the I-5 trap site, and 3.6 million at the Kinsman trap site. Weekly estimates of natural-origin age-0 Chinook Salmon outmigrating past the three trap sites are presented in Figure 3 and Table 1. Peak outmigration occurred during calendar week 12 (mid-March) at the Bogus site, week 13 (late March) at the I-5 site, and week 9 (late February) at the Kinsman site (Figure 3, Table 1). These timings of peak outmigration were either tied for the earliest on record (Bogus), earlier than average (I-5), or the earliest on record (Kinsman) since sampling began in 2000 (Gough et al. 2015). At all three trap sites it appeared that outmigration was fully underway when sampling commenced (Figure 3, Table 1).

Weekly raw catch information for juvenile Chinook Salmon is presented in Appendix A. One natural-origin age-1 Chinook Salmon and one hatchery-origin age-1 Chinook Salmon were observed at the I-5 trap site. No known hatchery-origin age-0 Chinook Salmon were observed at the Bogus or I-5 trap sites due to the termination of sampling before the hatchery release, but a small number were observed at the Kinsman trap site during the final weeks of sampling.

No natural-origin age-0 Chinook Salmon exhibited distended abdomens (an indication of infection with the parasite *Ceratonova shasta*) at the Bogus trap site and only a single natural-origin age-0 Chinook Salmon exhibited a distended abdomen at the I-5 trap site (Table 2). At the Kinsman trap site, no fish with distended abdomens were observed through week 16 (mid-April), but during weeks 17–23 between 6% and 72% of sampled natural-origin age-0 Chinook Salmon had distended abdomens and 20% had distended abdomens over the entire trapping season. At the Bogus and I-5 trap sites, a small proportion of examined Chinook Salmon had unhealthy gills, 0.6% and 3.3%, respectively (Table 2). At the Kinsman trap site, 41% of examined fish had unhealthy gills. Most of the fish with unhealthy gills were observed after week 16. Abdomen and gill condition are useful real-time indicators of fish health and disease prevalence. However, infection rates are better determined through genetic analysis and histological examination of juvenile salmonids (e.g., True et al. 2013). To more accurately determine infection rates for the juvenile Chinook Salmon population passing the Kinsman trap site, weekly-stratified random samples are 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 in the Klamath River annually in the reach between Iron Gate Dam and the estuary.

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 trap sites, then gradually increased through the remainder of sampling (Figure 4, Figure 5, Figure 6, Appendix B, Appendix C, Appendix D). At the Kinsman trap site, natural-origin age-0 Chinook Salmon fork lengths were relatively stable early in the season, then gradually increased through the reminder of the sampling season with the exception of stable lengths from calendar weeks

16–18 (Figure 7, Figure 8, Appendix E, Appendix F). Length–weight data for Chinook Salmon are presented in Figure 9.

Coho Salmon

Natural-origin age-0 Coho Salmon were fist captured in mid-March at all three trap sites and continued through the remainder of the trapping season (Appendix A). Peak age-0 Coho Salmon catches occurred during calendar week 13 (late March) at the Bogus and I-5 sites and week 12 (mid-March) at the Kinsman site. Natural-origin age-1 Coho Salmon were observed in low numbers: 2 at the Bogus site, 23 at the I-5 site, and 45 at the Kinsman site (Appendix A). Iron Gate Hatchery releases yearling (age-1) Coho Salmon, 100% marked with a left maxillary clip, annually between mid-March and early April. In 2015, this release occurred on March 17 (calendar week 12). Hatchery-origin Coho Salmon were only captured at the Bogus site directly following the release, but were captured at the I-5 site between calendar weeks 12 and 20 and at the Kinsman site between calendar weeks 12 and 21. All catch data for Coho Salmon are merely raw catches and are not adjusted for effort or trap efficiency and do not encompass the entire outmigration period.

Natural-origin age-0 Coho Salmon mean weekly fork lengths were stable or increased only minimally until the final weeks of sampling when mean weekly fork lengths increased moderately (Figure 4, Figure 5, Figure 6, Figure 7, Figure 8, Appendix B, Appendix C, Appendix D, Appendix E, Appendix F). No clear trends in mean weekly fork lengths for age-1 natural-origin or hatchery-origin Coho Salmon were evident, potentially due to small sample sizes. Length–weight data for Coho Salmon are presented in Figure 9.

Steelhead

Natural-origin age-0 steelhead were first captured in late March at the Bogus and I-5 trap sites and in mid-April at the Kinsman trap site and continued through the remainder of the trapping season (Appendix A). Peak age-0 steelhead catches occurred during calendar week 16 (mid-April) at the Bogus trap site, week 17 (late April) at the I-5 trap site, and week 21 (late May) at the Kinsman trap site. Natural-origin age-1+ steelhead were observed in low numbers: 2 at the Bogus (2), 12 at the I-5 site, and 144 at the Kinsman site (Appendix A). Peak age-1+ steelhead catches at the Kinsman trap site occurred during week 21 (late May). All catch data for steelhead are merely raw catches and are not adjusted for effort or trap efficiency and do not encompass the entire outmigration period.

Age-0 steelhead mean weekly fork lengths increased little throughout the season until the final week of sampling at the I-5 and Kinsman trap sites (Figure 4, Figure 5, Figure 6, Figure 7, Figure 8, Appendix G, Appendix H, Appendix I, Appendix J, Appendix K). Low sample sizes precluded identifying any trend in mean weekly fork lengths at the Bogus and I-5 sites for age-1+ natural-origin steelhead. Mean weekly fork lengths of age-1+ natural-origin steelhead at the Kinsman site were variable but there was a noticeable increase after week 10. Length–weight data for steelhead are presented in Figure 9.

Other Species

Although sampling efforts were designed to target juvenile salmonids, a variety of fishes were captured in the frame nets and RSTs. The most common non-target fishes captured at the Bogus site were non-native Yellow Perch (*Perca flavescens*), Golden Shiner

(*Notemigonus crysoleucas*), and sunfish (*Lepomis* spp.), and native Klamath River Lamprey (*Entosphenus similis*) (Table 3). Notably, a single Miller Lake Lamprey (*Entosphenus minimus*) was also found at the Bogus site. This species is rarely observed downstream of Iron Gate Dam. The most common non-target fishes captured at the I-5 site were native Klamath River Lamprey (*E. similis*), Marbled Sculpin (*Cottus klamathensis*), Speckled Dace (*Rhinichthys osculus*), and suckers (*Catostomus* spp.), and non-native bullhead (*Ameiurus* spp.), Golden Shiner (*N. crysoleucas*), and Yellow Perch (*P. flavescens*) (Table 3). The most common non-target fishes captured at the Kinsman site were native Klamath River Lamprey (*E. similis*), lamprey ammocetes (*Entosphenus* spp.), Speckled Dace (*R. osculus*), suckers (*Catostomus* spp.), and Marbled Sculpin (*C. klamathensis*), and non-native bullhead (*Ameiurus* spp.) and Golden Shiner (*N. crysoleucas*) (Table 3).

Table 1. Mainstem Klamath River weekly age-0 juvenile Chinook Salmon outmigrant abundance estimates and mark-recapture information, 2015.

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	2/23/2015	1,235	0	--	0.2857	626,463	384,458	175,943	1,590,521
	10	3/2/2015	2,323	0	--	0.5714	558,402	298,481	195,195	1,234,635
	11	3/9/2015	6,962	0	--	0.5714	696,505	288,313	194,933	1,259,494
	12	3/16/2015	14,252	6,934	149	0.5714	1,141,447	93,743	974,356	1,343,175
	13	3/23/2015	7,671	0	--	0.5714	751,041	314,534	247,801	1,310,614
	14	3/30/2015	1,422	0	--	0.5714	598,013	245,668	216,808	1,138,176
	15	4/6/2015	2,920	0	--	0.5714	677,480	640,943	246,359	2,574,164
	16	4/13/2015	2,217	3,765	58	0.5714	267,775	36,343	205,468	346,645
	17	4/20/2015	320	0	--	0.5714	214,151	120,180	61,014	544,381
	18	4/27/2015	92	4,957	2	0.5714	183,919	115,330	66,961	492,549
	19	5/4/2015	47	0	--	0.5714	79,310	111,234	8,106	366,752
	Total						5,794,506	513,103	4,496,018	6,741,918
I-5	9	2/23/2015	1,376	0	--	0.3891	396,713	173,038	171,659	810,691
	10	3/2/2015	2,278	0	--	0.5714	479,263	195,026	225,421	980,882
	11	3/9/2015	2,591	0	--	0.5256	607,290	261,084	272,793	1,421,403
	12	3/16/2015	4,290	0	--	0.5174	762,556	254,851	410,606	1,400,348
	13	3/23/2015	5,318	4,108	47	0.5714	804,536	106,450	615,588	1,045,861
	14	3/30/2015	904	0	--	0.5714	351,981	167,822	124,336	748,252
	15	4/6/2015	3,428	4,813	130	0.5714	530,423	180,176	289,675	971,973
	16	4/13/2015	2,847	0	--	0.5714	425,804	141,116	234,184	772,393
	17	4/20/2015	1,534	1,805	40	0.5714	155,273	27,298	109,575	215,955
	18	4/27/2015	491	0	--	0.5567	155,342	75,156	70,518	323,595
	19	5/4/2015	731	4,421	25	0.5714	194,985	36,328	137,147	279,286
	20	5/11/2015	541	0	--	0.5600	121,678	61,844	50,897	273,245
	Total						4,985,844	917,871	3,597,168	7,434,523
Kinsman	9	2/23/2015	1,078	0	--	0.2857	679,343	337,180	266,808	1,556,949
	10	3/2/2015	1,686	0	--	0.5714	630,694	281,602	226,559	1,317,454
	11	3/9/2015	2,236	0	--	0.5714	518,008	193,294	252,205	1,025,003
	12	3/16/2015	1,518	4,963	68	0.4286	272,667	32,374	215,831	342,822
	13	3/23/2015	822	4,990	52	0.4286	186,748	25,472	143,747	243,194
	14	3/30/2015	223	4,941	38	0.5714	63,119	11,407	44,162	87,931
	15	4/6/2015	348	0	--	0.5714	86,864	34,352	41,624	172,555
	16	4/13/2015	152	0	--	0.4286	76,464	29,223	36,176	147,894
	17	4/20/2015	457	5,207	35	0.5714	118,995	19,026	87,324	161,586
	18	4/27/2015	478	4,991	21	0.5714	193,661	37,581	133,182	280,336
	19	5/4/2015	466	0	--	0.5714	258,465	115,348	101,315	535,586
	20	5/11/2015	320	0	--	0.5714	249,834	121,760	85,483	556,179
	21	5/18/2015	242	2,975	4	0.5714	187,795	60,621	102,551	334,562
	22	5/25/2015	141	0	--	0.4286	57,794	25,629	22,820	120,366
	23	6/1/2015	37	2,935	3	0.5714	6,654	4,132	1,086	16,938
	24	6/8/2015	1	0	--	0.1429	532	593	14	2,126
	Total						3,587,638	576,068	2,613,077	4,927,544

Table 2. Mainstem Klamath River weekly natural-origin age-0 Chinook Salmon health information, 2015. 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	**Week**	**Sample dates**	**Number examined**	**Number unhealthy**	**Percent unhealthy**	**Number examined**	**Number distended**	**Percent distended**
Bogus	9	2/26-2/27	0	0	--	30	0	0.0%
	10	3/3-3/6	0	0	--	90	0	0.0%
	11	3/10-3/13	0	0	--	90	0	0.0%
	12	3/17-3/20	0	0	--	87	0	0.0%
	13	3/24-3/27	1	0	0.0%	90	0	0.0%
	14	3/31-4/3	2	0	0.0%	90	0	0.0%
	15	4/7-4/10	28	0	0.0%	90	0	0.0%
	16	4/14-4/17	37	0	0.0%	90	0	0.0%
	17	4/21-4/24	39	0	0.0%	89	0	0.0%
	18	4/28-5/1	34	0	0.0%	72	0	0.0%
	19	5/5-5/8	14	1	7.1%	29	0	0.0%
	Total		155	1	0.6%	847	0	0.0%
I-5	9	2/25-2/27	0	0	--	90	0	0.0%
	10	3/3-3/6	0	0	--	180	0	0.0%
	11	3/10-3/13	1	0	0.0%	150	0	0.0%
	12	3/17-3/20	2	1	50.0%	180	0	0.0%
	13	3/24-3/27	0	0	--	180	0	0.0%
	14	3/31-4/3	11	0	0.0%	173	0	0.0%
	15	4/7-4/10	35	1	2.9%	180	0	0.0%
	16	4/14-4/17	41	0	0.0%	180	0	0.0%
	17	4/21-4/24	70	1	1.4%	169	0	0.0%
	18	4/28-5/1	76	1	1.3%	104	0	0.0%
	19	5/5-5/8	99	9	9.1%	110	0	0.0%
	20	5/12-5/15	86	1	1.2%	90	1	1.2%
	Total		421	14	3.3%	1,786	1	0.1%
Kinsman	9	2/26-2/27	0	0	--	30	0	0.0%
	10	3/3-3/6	6	0	0.0%	90	0	0.0%
	11	3/10-3/13	5	1	20.0%	90	0	0.0%
	12	3/18-3/20	8	0	0.0%	60	0	0.0%
	13	3/24-3/26	13	1	7.7%	90	0	0.0%
	14	3/31-4/3	45	0	0.0%	90	0	0.0%
	15	4/7-4/10	75	0	0.0%	90	0	0.0%
	16	4/15-4/17	66	1	1.5%	84	0	0.0%
	17	4/21-4/24	100	31	31.0%	112	7	6.3%
	18	4/28-5/1	107	69	64.5%	120	31	25.8%
	19	5/5-5/8	114	93	81.6%	120	86	71.7%
	20	5/12-5/15	118	54	45.8%	118	52	44.1%
	21	5/19-5/22	199	94	47.2%	201	84	41.8%
	22	5/27-5/29	152	72	47.4%	153	31	20.3%
	23	6/2-6/5	40	16	40.0%	40	10	25.0%
	Total		1,048	432	41.2%	1,488	301	20.2%

Table 3. Catch totals of non-target fish species captured in the mainstem Klamath River at the three trap sites (all traps within a site combined), 2015.

		Trap site		
Common name	**Scientific name**	**Bogus**	**I-5**	**Kinsman**
Ammocete (*Entosphenus*)	*Entosphenus* spp.	6	6	77
Bullhead[a]	*Ameiurus* spp.	4	59	281
Crappie[a]	*Pomoxis* spp.	13	7	1
Fathead Minnow[a]	*Pimphales promelas*	0	7	7
Golden Shiner[a]	*Notemigonus crysoleucas*	37	34	26
Klamath River Lamprey	*Entosphenus similis*	28	26	313
Marbled Sculpin	*Cottus klamathensis*	8	55	30
Miller Lake Lamprey	*Entosphenus minimus*	1	0	0
Pacific Lamprey	*Entosphenus tridentatus*	0	0	11
Prickly Sculpin	*Cottus asper*	0	1	5
Speckled Dace	*Rhinichthys osculus*	1	37	245
Sucker spp.	*Catostomus* spp.	7	33	120
Sunfish[a]	*Lepomis* spp.	22	7	2
Yellow Perch[a]	*Perca flavescens*	221	44	11

[a] non-native

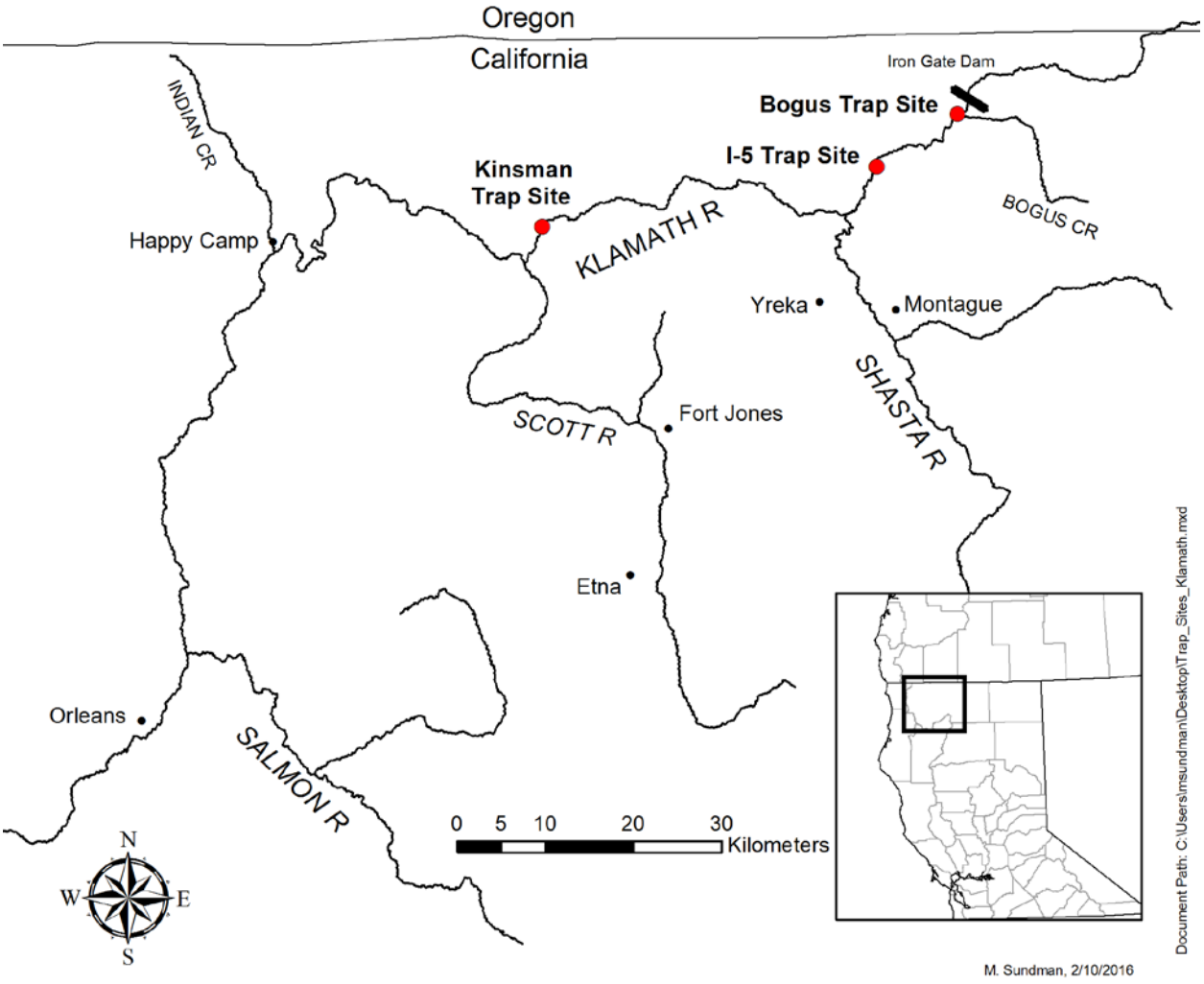

Figure 1. The Klamath River basin with trap sites identified.

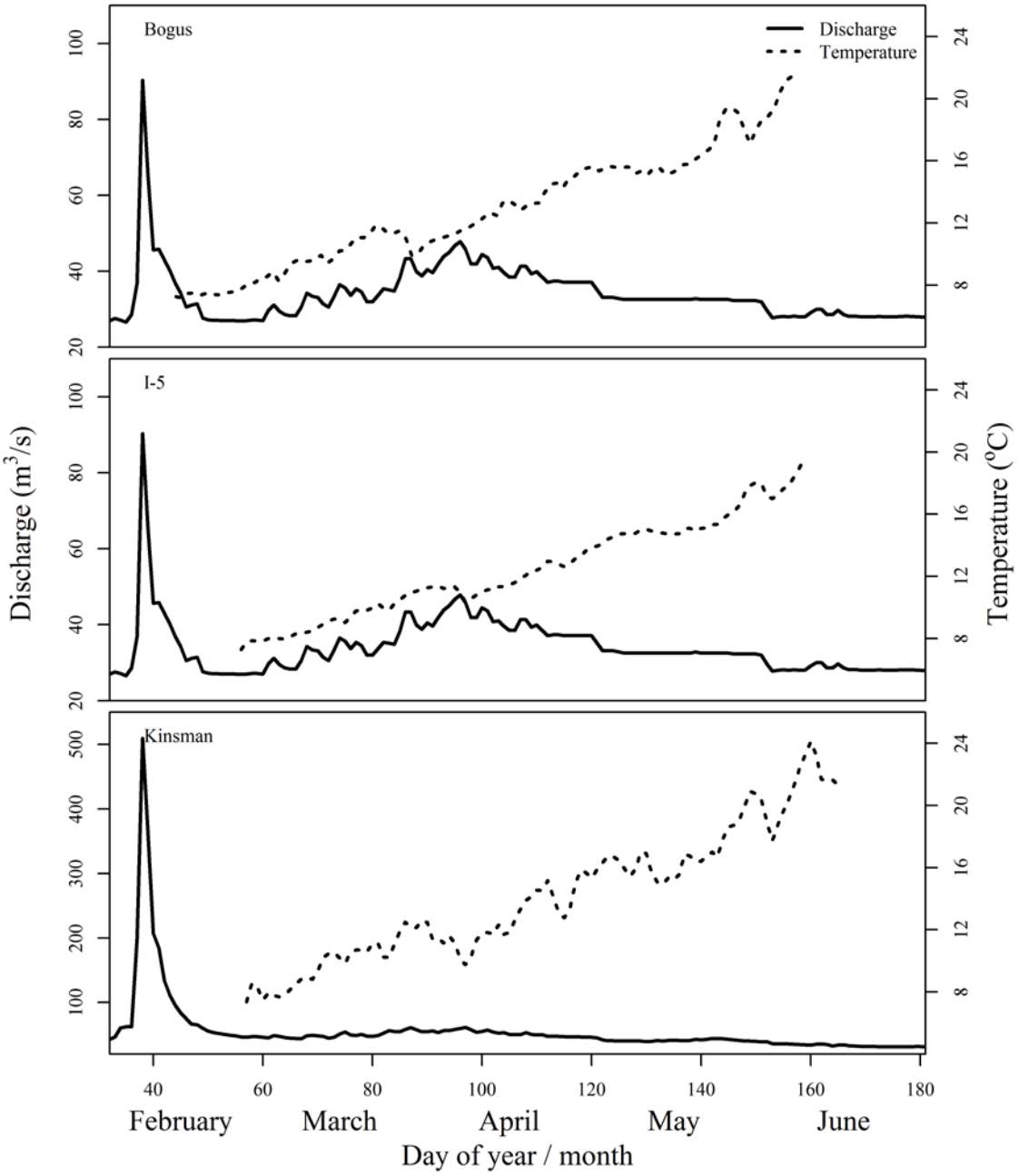

Figure 2. Klamath River mean daily discharge (m^3/s) and mean daily temperature (^oC) at the three trap sites for February through the end of June, 2015.

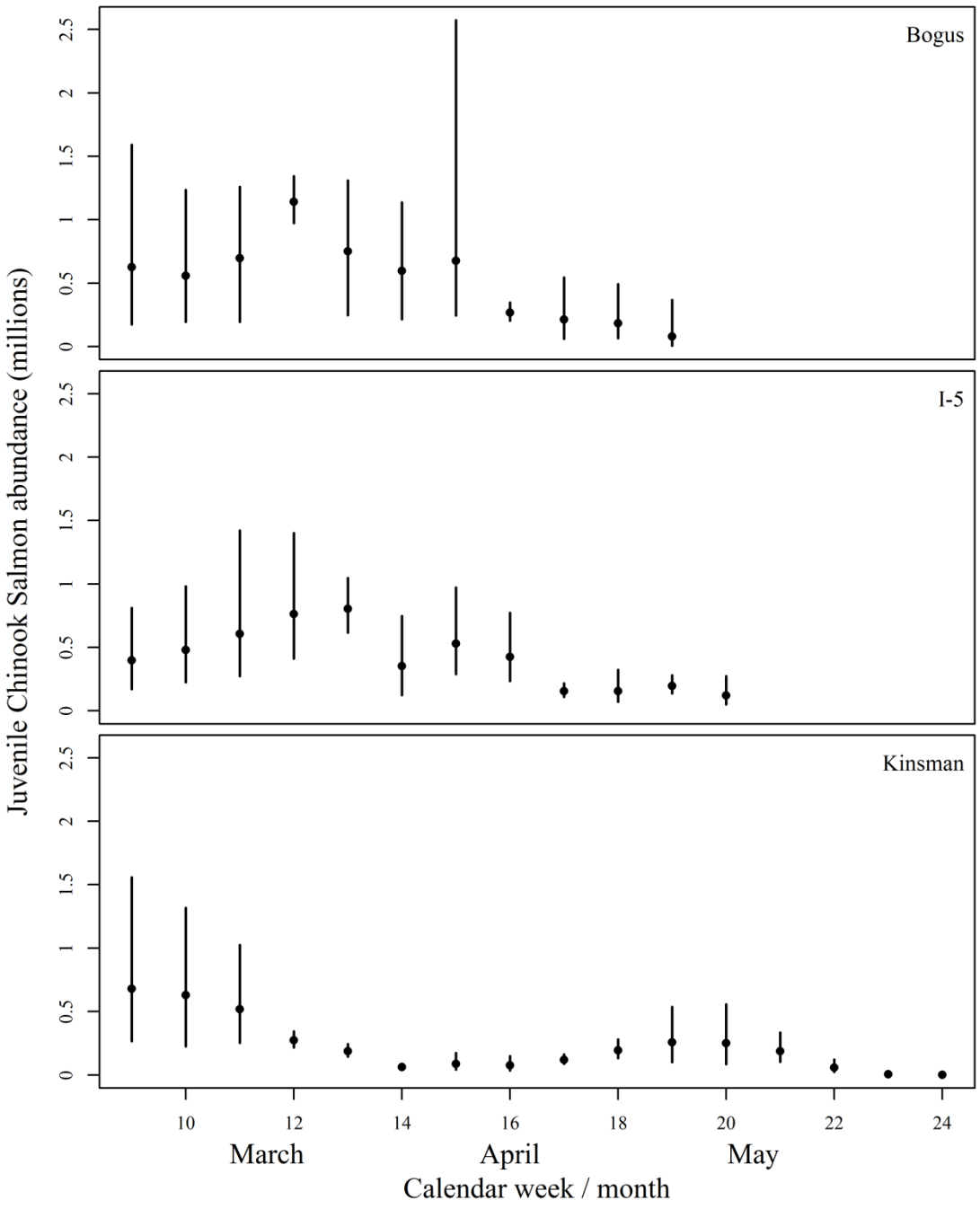

Figure 3. Weekly mean, lower (2.5% credible interval), and upper (97.5% credible interval) bound estimates for natural-origin, age-0 juvenile Chinook Salmon outmigrant abundance at the three trap sites, 2015. Trapping did not occur after weeks 19 and 20 at the Bogus and I-5 sites, respectively.

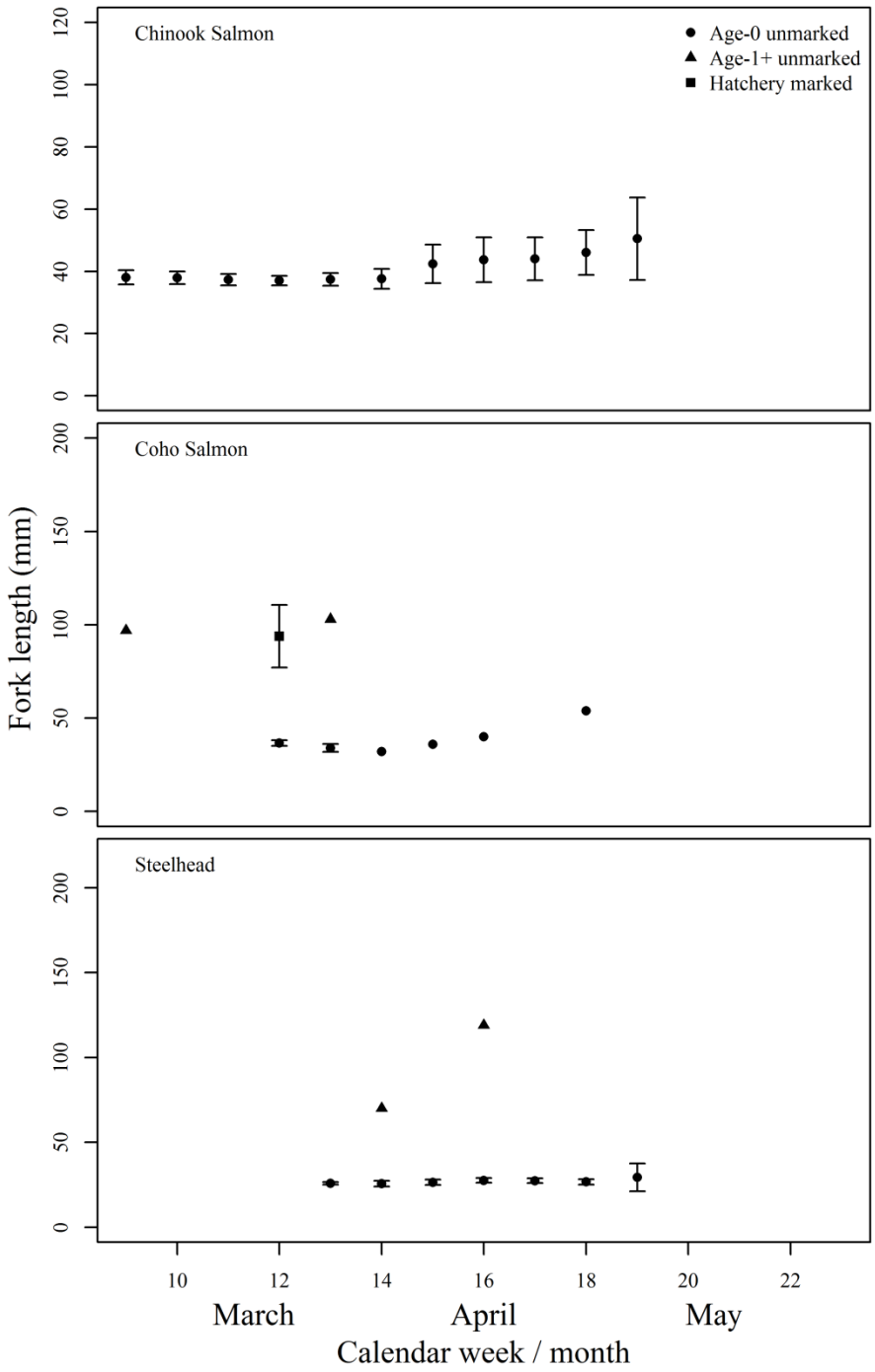

Figure 4. Weekly mean fork lengths (± one standard deviation) of unmarked age-0, unmarked age-1+, and hatchery-marked Chinook Salmon, Coho Salmon, and steelhead captured at the Klamath River Bogus frame net, 2015.

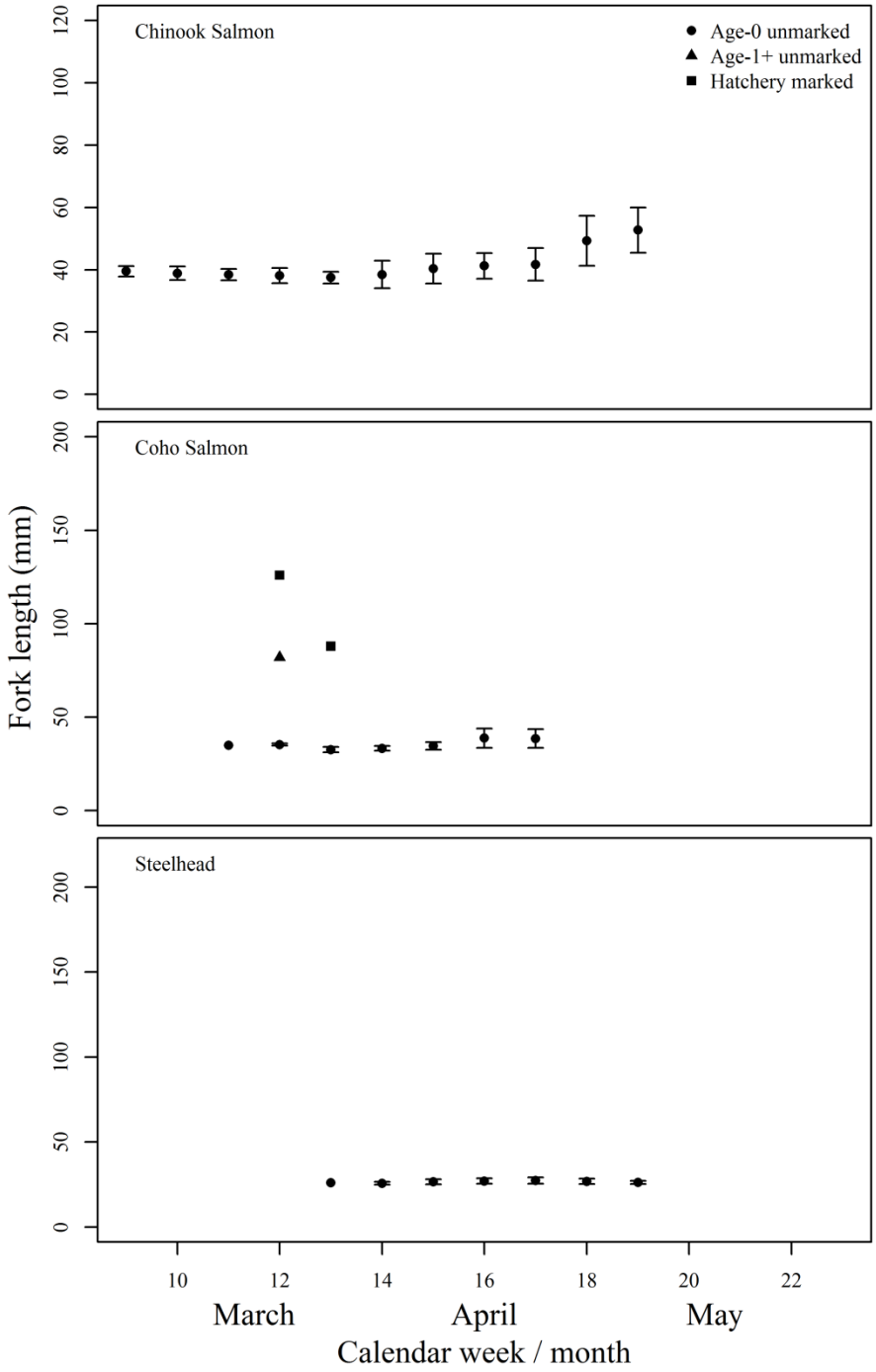

Figure 5. Weekly mean fork lengths (± one standard deviation) of unmarked age-0, unmarked age-1+, and hatchery-marked Chinook Salmon, Coho Salmon, and steelhead captured at the Klamath River I-5 frame net, 2015.

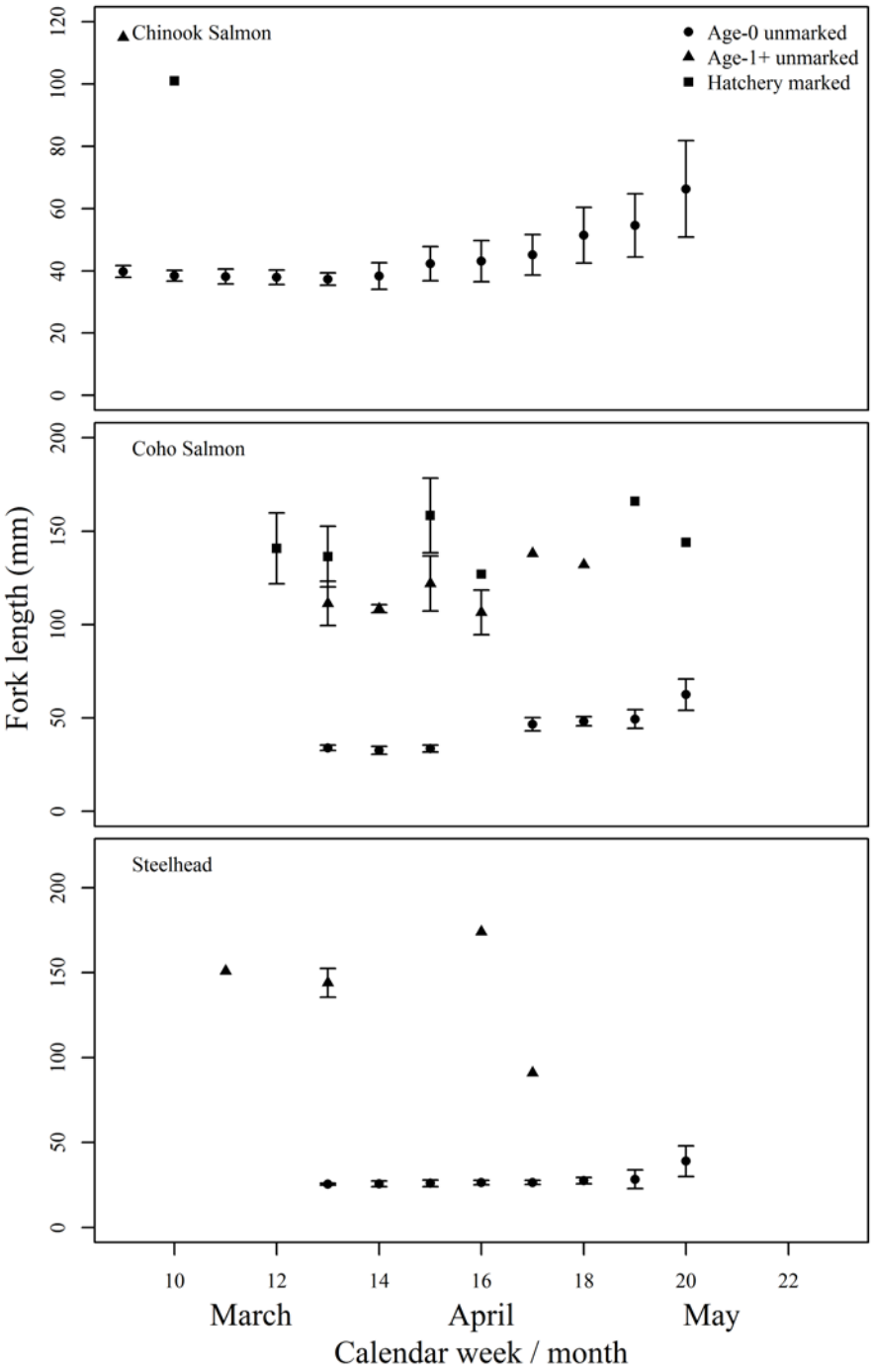

Figure 6. Weekly mean fork lengths (± one standard deviation) of unmarked age-0, unmarked age-1+, and hatchery-marked Chinook Salmon, Coho Salmon, and steelhead captured at the Klamath River I-5 RSTs, 2015.

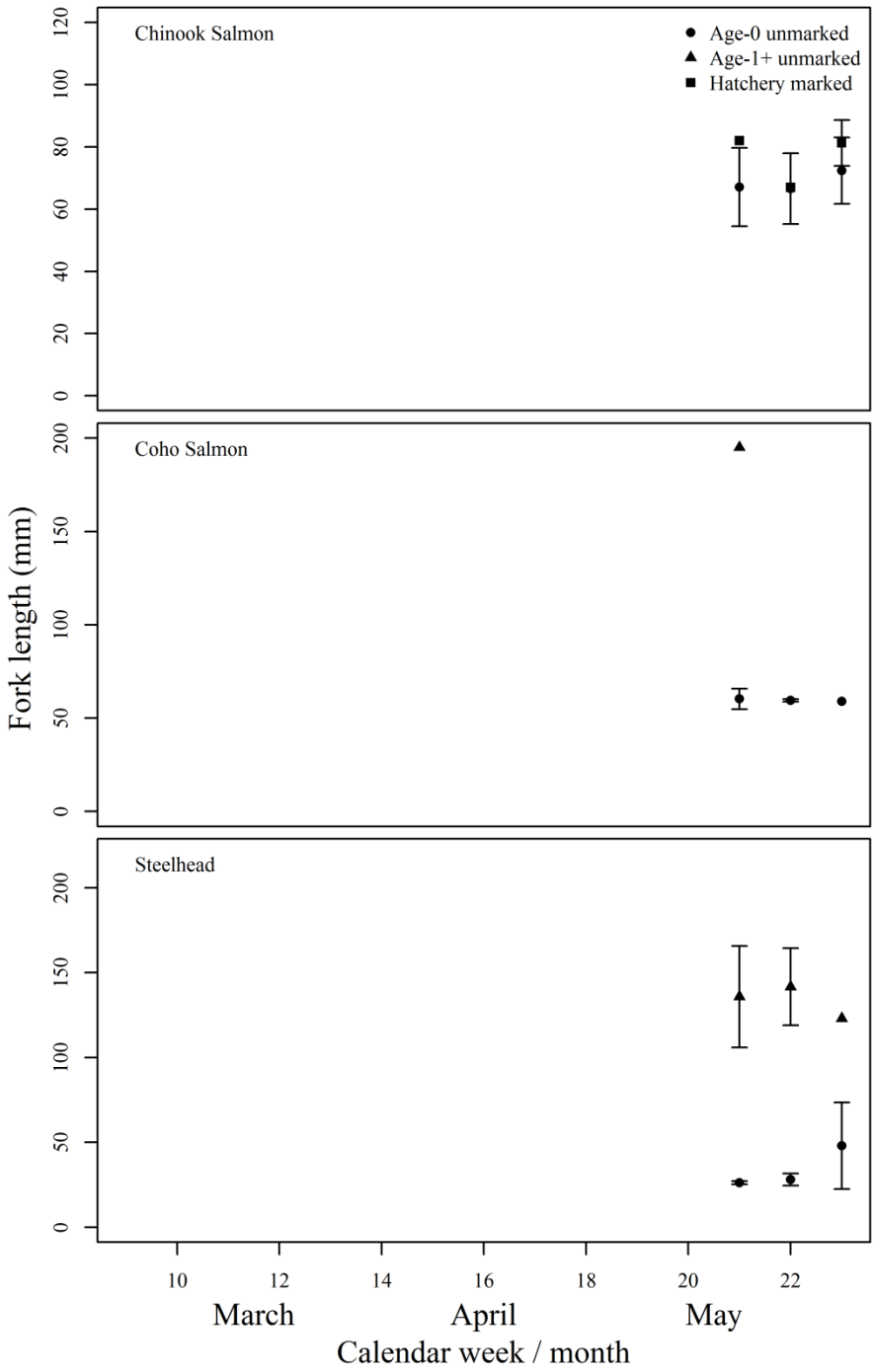

Figure 7. Weekly mean fork lengths (± one standard deviation) of unmarked age-0, unmarked age-1+, and hatchery-marked Chinook Salmon, Coho Salmon, and steelhead captured at the Klamath River Kinsman frame nets, 2015. Note: the Kinsman frame nets were only operated during calendar weeks 21–24 in 2015.

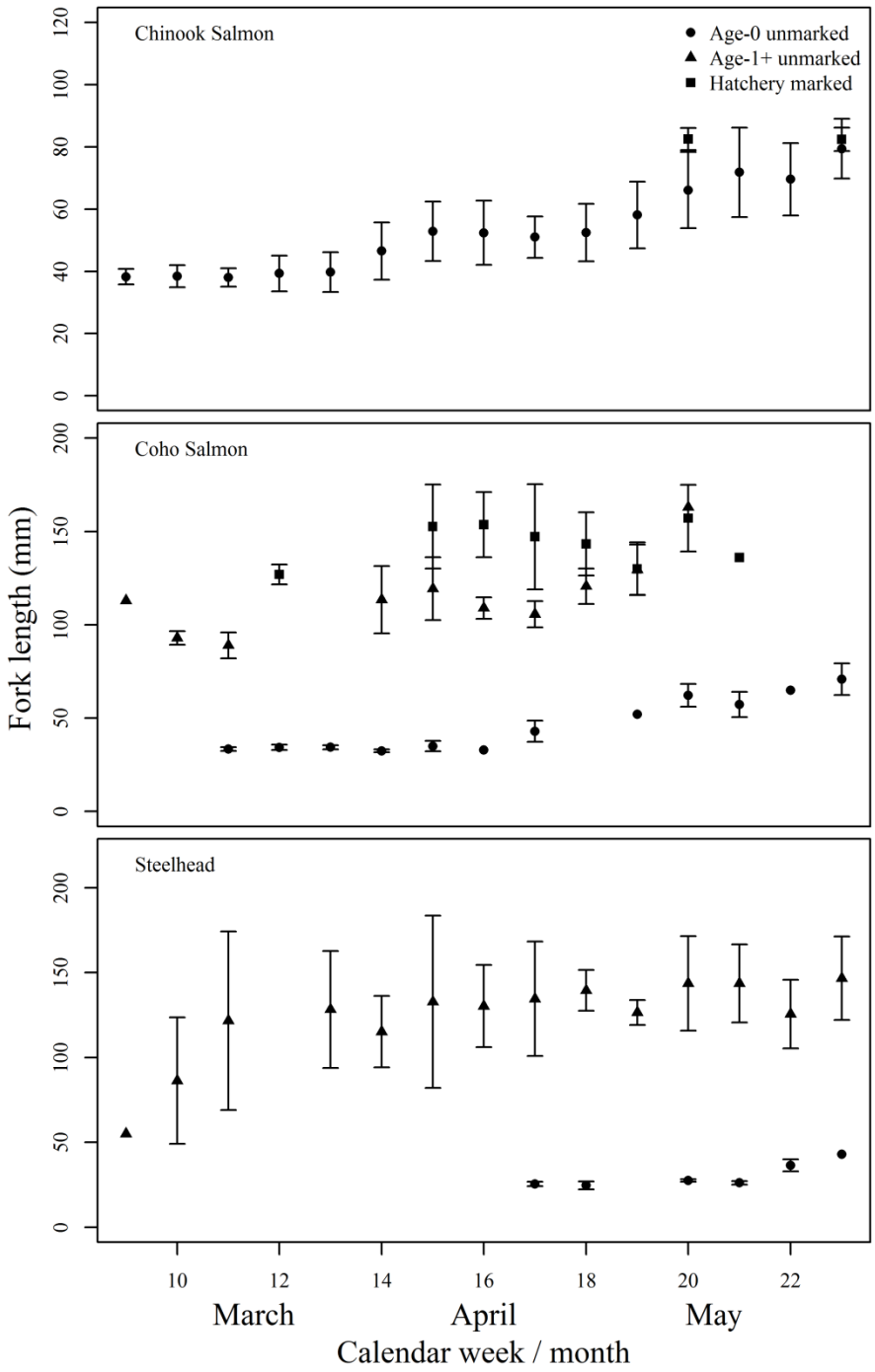

Figure 8. Weekly mean fork lengths (± one standard deviation) of unmarked age-0, unmarked age-1+, and hatchery-marked Chinook Salmon, Coho Salmon, and steelhead captured at the Klamath River Kinsman RST, 2015.

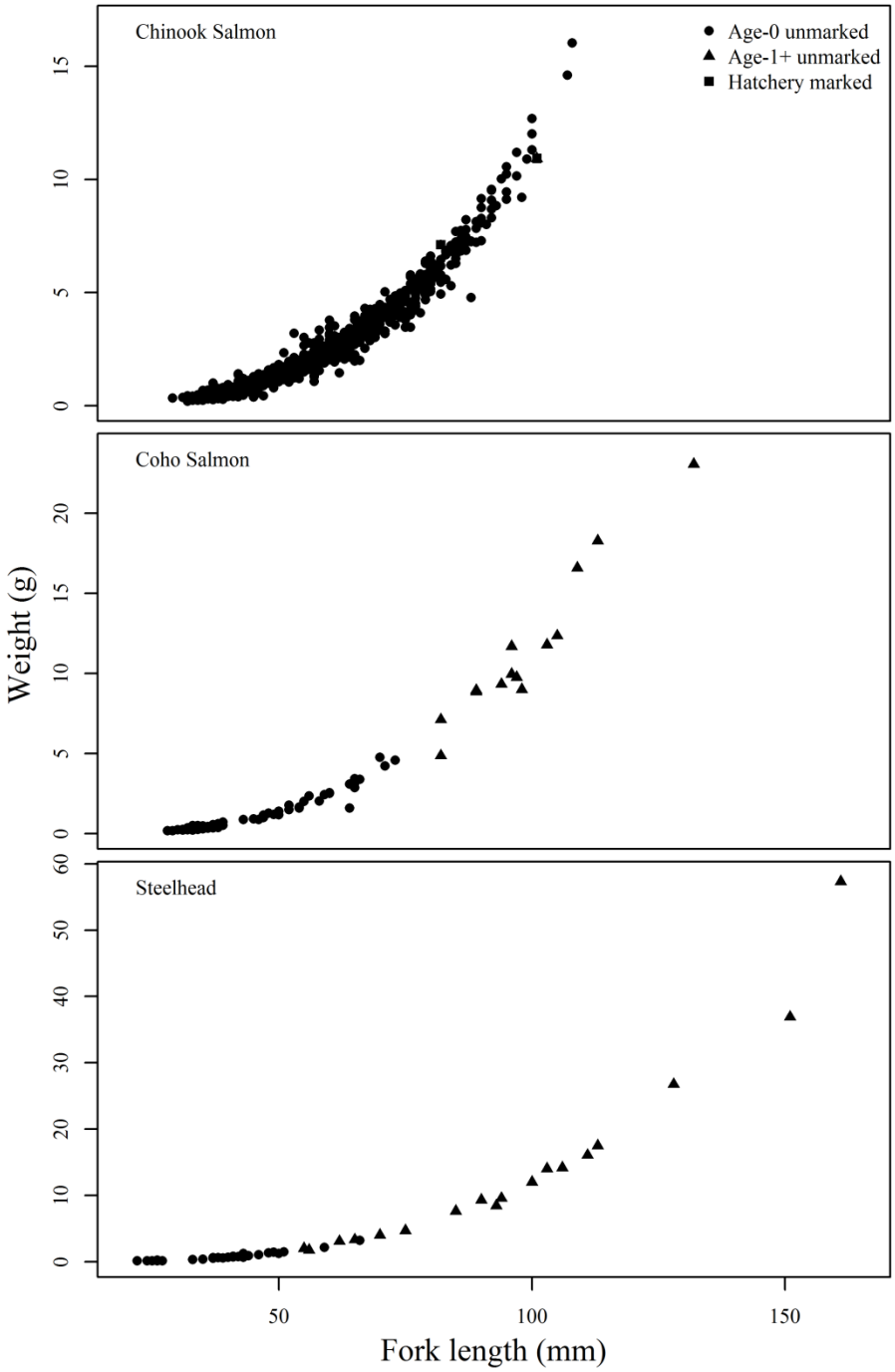

Figure 9. Weight plotted against fork length for individual juvenile Chinook Salmon, Coho Salmon, and steelhead, all trap sites combined, 2015.

Acknowledgements

We particularly thank the Karuk Tribe for their annual participation in this project. Data were collected by AFWO personnel: Michael Sundman, Nick Van Vleet, Matt Drummond, and Aaron David. Data were collected by Karuk Tribe personnel: Kenneth "Binks" Brink and Jerry "Rabbit" Brink. We thank Savannah Bell for helpful 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, Arcata, California.

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, Arcata, California.

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, Arcata, California.

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, 2015. (appendix continued on following page)

								Chinook Salmon				Coho Salmon			Steelhead	
					Water temp (C)			Age-0		Age-1+		Age-0	Age-1+		Age-0	Age-1+
Trap	Calendar week	Sample dates	Trap days	Mean Q (m^3/s)	Min	Max	Mean	No clip	AD clip	No clip	AD clip	No clip	No clip	LM clip	No clip	No clip
Bogus Frame	9	2/26-2/27	2	27.0	6.4	9.5	7.7	1,235	0	0	0	0	1	0	0	0
	10	3/3-3/6	4	28.9	6.6	9.9	7.8	2,323	0	0	0	0	0	0	0	0
	11	3/10-3/13	4	32.4	7.2	11.4	8.9	6,962	0	0	0	0	0	0	0	0
	12	3/17-3/20	4	34.3	7.3	12.5	9.8	14,252	0	0	0	10	0	13	0	0
	13	3/24-3/27	4	37.7	8.9	13.4	10.6	7,671	0	0	0	72	1	0	56	0
	14	3/31-4/3	4	41.4	10.4	13.5	11.5	1,422	0	0	0	1	0	0	46	1
	15	4/7-4/10	4	44.6	7.5	12.6	10.8	2,920	0	0	0	2	0	0	61	0
	16	4/14-4/17	4	40.2	10.7	14.8	11.9	2,217	0	0	0	2	0	0	230	1
	17	4/21-4/24	4	38.1	11.7	16.7	13.2	320	0	0	0	0	0	0	204	0
	18	4/28-5/1	4	36.2	12.2	18.2	14.3	92	0	0	0	1	0	0	59	0
	19	5/5-5/8	4	32.8	14.0	19.0	15.5	47	0	0	0	0	0	0	14	0
I-5 Frame	9	2/26-2/27	2	27.0	6.4	9.5	7.7	279	0	0	0	0	0	0	0	0
	10	3/3-3/6	4	28.9	6.6	9.9	7.8	533	0	0	0	0	0	0	0	0
	11	3/11-3/13	3	32.4	7.2	11.4	8.9	677	0	0	0	1	0	0	0	0
	12	3/17-3/20	3	34.3	7.3	12.5	9.8	1,344	0	0	0	6	1	1	0	0
	13	3/24-3/27	4	37.7	8.9	13.4	10.6	1,370	0	0	0	60	0	1	10	0
	14	3/31-4/3	4	41.4	10.4	13.5	11.5	155	0	0	0	11	0	8	23	0
	15	4/7-4/10	4	44.6	7.5	12.6	10.8	701	0	0	0	18	0	0	28	0
	16	4/14-4/17	4	40.2	10.7	14.8	11.9	384	0	0	0	15	0	0	45	0
	17	4/21-4/24	4	38.1	11.7	16.7	13.2	135	0	0	0	8	0	0	70	0
	18	4/28-5/1	2	36.2	12.2	18.2	14.3	13	0	0	0	0	0	0	12	0
	19	5/5-5/8	4	32.8	14.0	19.0	15.5	32	0	0	0	1	0	0	13	0
I-5 RST	9	2/25-2/27	6	27.0	6.4	9.5	7.7	1,097	0	1	0	0	1	0	0	1
	10	3/3-3/6	8	28.9	6.6	9.9	7.8	1,745	0	0	1	0	1	0	0	1
	11	3/10-3/13	8	32.4	7.2	11.4	8.9	1,914	0	0	0	0	1	0	0	1
	12	3/17-3/20	8	34.3	7.3	12.5	9.8	2,946	0	0	0	0	2	111	0	0
	13	3/24-3/27	8	37.7	8.9	13.4	10.6	3,948	0	0	0	12	3	11	15	4
	14	3/31-4/3	8	41.4	10.4	13.5	11.5	749	0	0	0	3	4	0	23	1
	15	4/7-4/10	8	44.6	7.5	12.6	10.8	2,727	0	0	0	7	5	7	20	1
	16	4/14-4/17	8	40.2	10.7	14.8	11.9	2,463	0	0	0	2	2	2	71	1
	17	4/21-4/24	8	38.1	11.7	16.7	13.2	1,399	0	0	0	4	2	0	162	1
	18	4/28-5/1	8	36.2	12.2	18.2	14.3	478	0	0	0	4	1	0	38	0
	19	5/5-5/8	8	32.8	14.0	19.0	15.5	699	0	0	0	6	0	1	29	1
	20	5/12-5/15	8	32.6	13.9	18.2	15.3	541	0	0	0	5	0	2	40	0

Trap	Calendar week	Sample dates	Trap days	Mean Q (m^3/s)	Water temp (C)			Chinook Salmon				Coho Salmon			Steelhead	
								Age-0		Age-1+		Age-0	Age-1+		Age-0	Age-1+
					Min	Max	Mean	No clip	AD clip	No clip	AD clip	No clip	No clip	LM clip	No clip	No clip
Kinsman Frame	21	5/20-5/22	6	42.5	14.5	18.6	15.8	145	1	0	0	3	1	0	33	9
	22	5/27-5/29	6	41.4	15.3	22.5	18.1	113	1	0	0	2	0	0	7	9
	23	6/3-6/5	6	36.7	15.2	23.5	18.6	65	14	0	0	1	0	0	8	3
	24	6/10-6/10	2	34.5	18.7	25.4	21.7	8	5	0	0	5	0	0	31	5
Kinsman RST	9	2/26-2/27	2	47.9	6.4	9.5	7.7	1,078	0	0	0	0	2	0	0	4
	10	3/3-3/6	4	46.1	6.6	9.9	7.8	1,686	0	0	0	0	3	0	0	4
	11	3/10-3/13	4	46.8	7.2	11.4	8.9	2,236	0	0	0	23	4	0	0	4
	12	3/18-3/20	3	50.0	7.3	12.5	9.8	1,518	0	0	0	48	0	10	0	0
	13	3/24-3/26	3	55.2	8.9	13.4	10.6	822	0	0	0	19	0	0	0	3
	14	3/31-4/3	4	55.7	10.4	13.5	11.5	223	0	0	0	2	7	0	0	5
	15	4/7-4/10	4	57.7	7.5	12.6	10.8	348	0	0	0	5	7	9	0	6
	16	4/15-4/17	3	52.1	10.7	14.8	11.9	152	0	0	0	1	8	10	1	6
	17	4/21-4/24	4	48.5	11.7	16.7	13.2	457	0	0	0	2	4	8	4	12
	18	4/28-5/1	4	45.6	12.2	18.2	14.3	478	0	0	0	0	4	10	3	5
	19	5/5-5/8	4	40.4	14.0	19.0	15.5	466	0	0	0	1	4	4	0	11
	20	5/12-5/15	4	40.5	13.9	18.2	15.3	320	2*	0	0	4	1	7	2	17
	21	5/19-5/22	4	42.5	14.5	18.6	15.8	242	0	0	0	3	0	1	17	21
	22	5/27-5/29	3	41.4	15.3	22.5	18.1	141	1	0	0	1	0	0	2	9
	23	6/2-6/5	4	36.7	15.2	23.5	18.6	37	11	0	0	5	0	0	1	6
	24	6/10-6/10	1	34.5	18.7	25.4	21.7	1	1	0	0	1	0	0	4	5

*Two ad-clipped Chinook were captured at Kinsman prior to the IGH release. We assumed these fish were from an earlier efficiency test and excluded them from our population estimates.

Appendix B. Klamath River at Bogus site (frame net) weekly unmarked and hatchery-marked Chinook and Coho salmon fork lengths (mm), 2015.

Calendar week	Sample dates	Unmarked Chinook Salmon										Unmarked Coho Salmon										Marked Coho Salmon				
		Age-0					Age-1+					Age-0					Age-1+					Age-1+				
		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	2/26-2/27	30	38.1	33	42	2.3	0	--	--	--	--	0	--	--	--	--	1	97.0	97	97	0.0	0	--	--	--	--
10	3/3-3/6	90	37.9	31	42	2.0	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
11	3/10-3/13	90	37.3	33	42	1.9	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
12	3/17-3/20	90	37.0	32	40	1.5	0	--	--	--	--	5	36.6	34	38	1.5	0	--	--	--	--	12	93.9	72	133	16.8
13	3/24-3/27	90	37.4	33	48	2.0	0	--	--	--	--	48	34.0	28	38	2.1	1	103.0	103	103	0.0	0	--	--	--	--
14	3/31-4/3	90	37.6	32	49	3.2	0	--	--	--	--	1	32.0	32	32	0.0	0	--	--	--	--	0	--	--	--	--
15	4/7-4/10	90	42.4	35	63	6.2	0	--	--	--	--	1	36.0	36	36	0.0	0	--	--	--	--	0	--	--	--	--
16	4/14-4/17	90	43.7	34	64	7.2	0	--	--	--	--	1	40.0	40	40	0.0	0	--	--	--	--	0	--	--	--	--
17	4/21-4/24	90	44.0	33	65	7.0	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
18	4/28-5/1	72	46.1	35	67	7.2	0	--	--	--	--	1	54.0	54	54	0.0	0	--	--	--	--	0	--	--	--	--
19	5/5-5/8	31	50.5	37	89	13.3	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--

Appendix C. Klamath River at I-5 site (frame net) weekly unmarked and hatchery-marked Chinook and Coho salmon fork lengths (mm), 2015.

		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	2/26-2/27	30	39.5	35	42	1.7	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
10	3/3-3/6	90	38.9	33	48	2.2	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
11	3/11-3/13	60	38.4	34	43	1.8	0	--	--	--	--	1	35.0	35	35	0.0	0	--	--	--	--	0	--	--	--	--
12	3/17-3/20	90	38.1	32	51	2.4	0	--	--	--	--	3	35.3	35	36	0.6	1	82.0	82	82	0.0	1	126.0	126	126	0.0
13	3/24-3/27	90	37.5	34	42	1.9	0	--	--	--	--	47	32.7	29	36	1.4	0	--	--	--	--	1	88.0	88	88	0.0
14	3/31-4/3	83	38.5	32	59	4.4	0	--	--	--	--	11	33.3	32	36	1.3	0	--	--	--	--	0	--	--	--	--
15	4/7-4/10	90	40.4	35	65	4.8	0	--	--	--	--	14	34.6	32	39	2.1	0	--	--	--	--	0	--	--	--	--
16	4/14-4/17	90	41.2	35	52	4.2	0	--	--	--	--	10	38.8	33	50	5.2	0	--	--	--	--	0	--	--	--	--
17	4/21-4/24	79	41.7	33	58	5.2	0	--	--	--	--	5	38.6	34	47	4.9	0	--	--	--	--	0	--	--	--	--
18	4/28-5/1	14	49.3	38	59	8.0	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
19	5/5-5/8	24	52.7	38	70	7.2	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), 2015.

		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	2/25-2/27	60	39.8	36	44	1.9	1	115.0	115	115	0.0	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
10	3/3-3/6	90	38.4	32	42	1.7	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
11	3/10-3/13	90	38.2	33	53	2.4	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
12	3/17-3/20	90	38.0	33	46	2.3	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	61	140.8	90	179	19.0
13	3/24-3/27	90	37.4	33	43	1.9	0	--	--	--	--	8	34.0	33	37	1.4	3	111.3	104	125	11.9	10	136.4	106	168	16.2
14	3/31-4/3	90	38.3	33	62	4.2	0	--	--	--	--	3	32.7	31	35	2.1	2	108.5	107	110	2.1	0	--	--	--	--
15	4/7-4/10	90	42.3	34	60	5.5	0	--	--	--	--	6	33.7	32	37	1.9	4	122.0	102	134	14.7	7	158.4	136	190	20.0
16	4/14-4/17	90	43.1	33	63	6.6	0	--	--	--	--	0	--	--	--	--	2	106.5	98	115	12.0	1	127.0	127	127	0.0
17	4/21-4/24	90	45.1	34	66	6.5	0	--	--	--	--	3	46.7	43	50	3.5	1	138.0	138	138	0.0	0	--	--	--	--
18	4/28-5/1	90	51.4	37	79	8.9	0	--	--	--	--	4	48.3	47	52	2.5	1	132.0	132	132	0.0	0	--	--	--	--
19	5/5-5/8	90	54.6	37	94	10.1	0	--	--	--	--	5	49.4	45	58	5.0	0	--	--	--	--	1	166.0	166	166	0.0
20	5/12-5/15	90	66.3	42	107	15.5	0	--	--	--	--	4	62.5	54	73	8.4	0	--	--	--	--	1	144.0	144	144	0.0

Appendix E. Klamath River at Kinsman site (frame net) weekly unmarked and hatchery-marked Chinook and Coho salmon fork lengths (mm), 2015.

		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
21	5/20-5/22	96	67.1	44	108	12.6	0	--	--	--	--	3	60.3	55	66	5.5	1	195.0	195	195	0.0	0	--	--	--	--
22	5/27-5/29	112	66.6	40	105	11.4	0	--	--	--	--	2	59.5	59	60	0.7	0	--	--	--	--	0	--	--	--	--
23	6/3-6/5	18	72.3	53	94	10.7	0	--	--	--	--	1	59.0	59	59	0.0	0	--	--	--	--	0	--	--	--	--

Appendix F. Klamath River at Kinsman site (RST) weekly unmarked and hatchery-marked Chinook and Coho salmon fork lengths (mm), 2015.

		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	2/26-2/27	30	38.3	32	43	2.5	0	--	--	--	--	0	--	--	--	--	1	113.0	113	113	0.0	0	--	--	--	--
10	3/3-3/6	90	38.4	29	53	3.5	0	--	--	--	--	0	--	--	--	--	3	93.0	89	96	3.6	0	--	--	--	--
11	3/10-3/13	90	38.0	32	48	2.9	0	--	--	--	--	12	33.4	32	36	1.1	3	89.0	82	96	7.0	0	--	--	--	--
12	3/18-3/20	60	39.3	32	58	5.8	0	--	--	--	--	30	34.3	32	37	1.5	0	--	--	--	--	9	127.0	120	135	5.3
13	3/24-3/26	90	39.8	32	67	6.4	0	--	--	--	--	19	34.4	32	37	1.2	0	--	--	--	--	0	--	--	--	--
14	3/31-4/3	90	46.5	34	75	9.2	0	--	--	--	--	2	32.5	32	33	0.7	4	113.5	100	140	18.1	0	--	--	--	--
15	4/7-4/10	90	52.8	35	76	9.5	0	--	--	--	--	5	35.0	32	38	2.8	6	119.3	101	150	16.9	3	152.7	128	172	22.5
16	4/15-4/17	84	52.4	35	74	10.3	0	--	--	--	--	1	33.0	33	33	0.0	5	109.0	101	115	5.8	13	153.6	123	177	17.5
17	4/21-4/24	90	51.0	38	70	6.6	0	--	--	--	--	2	43.0	39	47	5.7	3	105.7	98	112	7.1	5	147.2	120	180	28.2
18	4/28-5/1	90	52.4	38	92	9.2	0	--	--	--	--	0	--	--	--	--	3	120.7	111	130	9.5	9	143.3	121	175	17.0
19	5/5-5/8	90	58.1	42	100	10.7	0	--	--	--	--	1	52.0	52	52	0.0	2	129.5	120	139	13.4	2	130.0	120	140	14.1
20	5/12-5/15	117	66.1	44	98	12.3	0	--	--	--	--	4	62.3	56	70	6.1	1	163.0	163	163	0.0	7	157.1	133	177	17.8
21	5/19-5/22	120	71.8	43	111	14.4	0	--	--	--	--	3	57.3	52	65	6.8	0	--	--	--	--	1	136.0	136	136	0.0
22	5/27-5/29	90	69.6	45	104	11.7	0	--	--	--	--	1	65.0	65	65	0.0	0	--	--	--	--	0	--	--	--	--
23	6/2-6/5	23	79.4	61	98	9.6	0	--	--	--	--	5	70.8	64	85	8.4	0	--	--	--	--	0	--	--	--	--

Appendix G. Klamath River at Bogus site (frame net) weekly unmarked steelhead fork lengths (mm), 2015.

		Unmarked steelhead									
Calendar	Sample	Age-0					Age-1+				
week	dates	n	mean	min	max	sd	n	mean	min	max	sd
13	3/24-3/27	51	25.8	24	28	0.7	0	--	--	--	--
14	3/31-4/3	27	25.7	23	30	1.7	1	70.0	70	70	0.0
15	4/7-4/10	49	26.5	23	30	1.5	0	--	--	--	--
16	4/14-4/17	89	27.5	24	30	1.4	1	119.0	119	119	0.0
17	4/21-4/24	90	27.4	25	35	1.4	0	--	--	--	--
18	4/28-5/1	55	26.7	24	33	1.6	0	--	--	--	--
19	5/5-5/8	10	29.4	25	45	8.2	0	--	--	--	--

Appendix H. Klamath River at I-5 site (frame net) weekly unmarked steelhead fork lengths (mm), 2015.

		Unmarked steelhead									
Calendar	Sample	Age-0					Age-1+				
week	dates	n	mean	min	max	sd	n	mean	min	max	sd
13	3/24-3/27	1	26.0	26	26	0.0	0	--	--	--	--
14	3/31-4/3	22	25.7	25	27	0.8	0	--	--	--	--
15	4/7-4/10	18	26.6	24	30	1.5	0	--	--	--	--
16	4/14-4/17	25	27.0	25	30	1.6	0	--	--	--	--
17	4/21-4/24	64	27.3	24	37	1.9	0	--	--	--	--
18	4/28-5/1	13	26.9	23	30	1.6	0	--	--	--	--
19	5/5-5/8	9	26.1	24	27	0.9	0	--	--	--	--

Appendix I. Klamath River at I-5 site (RST) weekly unmarked steelhead fork lengths (mm), 2015.

		Unmarked steelhead									
Calendar	Sample	Age-0					Age-1+				
week	dates	n	mean	min	max	sd	n	mean	min	max	sd
11	3/10-3/13	0	--	--	--	--	1	151.0	151	151	0.0
12	3/17-3/20	0	--	--	--	--	0	--	--	--	--
13	3/24-3/27	4	25.5	25	26	0.6	2	144.0	138	150	8.5
14	3/31-4/3	15	25.7	21	28	1.6	0	--	--	--	--
15	4/7-4/10	12	25.9	23	29	1.9	0	--	--	--	--
16	4/14-4/17	44	26.4	24	29	1.3	1	174.0	174	174	0.0
17	4/21-4/24	89	26.5	24	32	1.3	1	91.0	91	91	0.0
18	4/28-5/1	32	27.5	24	33	1.9	0	--	--	--	--
19	5/5-5/8	16	28.3	24	42	5.4	0	--	--	--	--
20	5/12-5/15	32	39.0	22	59	9.0	0	--	--	--	--

Appendix J. Klamath River at Kinsman site (frame net) weekly unmarked steelhead fork lengths (mm), 2015.

		Unmarked steelhead									
Calendar	Sample	Age-0					Age-1+				
week	dates	n	mean	min	max	sd	n	mean	min	max	sd
21	5/20-5/22	26	26.2	24	28	1.0	9	135.9	93	184	29.9
22	5/27-5/29	7	28.1	24	33	3.5	9	141.7	108	185	22.7
23	6/3-6/5	2	48.0	30	66	25.5	1	123.0	123	123	0.0

Appendix K. Klamath River at Kinsman site (RST) weekly unmarked steelhead fork lengths (mm), 2015.

		Unmarked steelhead									
Calendar	Sample	Age-0					Age-1+				
week	dates	n	mean	min	max	sd	n	mean	min	max	sd
9	2/26-2/27	0	--	--	--	--	1	55.0	55	55	0.0
10	3/3-3/6	0	--	--	--	--	3	86.3	56	128	37.3
11	3/10-3/13	0	--	--	--	--	3	121.7	62	161	52.5
12	3/18-3/20	0	--	--	--	--	0	--	--	--	--
13	3/24-3/26	0	--	--	--	--	3	128.3	106	168	34.4
14	3/31-4/3	0	--	--	--	--	5	115.2	85	136	21.1
15	4/7-4/10	0	--	--	--	--	5	132.8	65	178	50.7
16	4/15-4/17	0	--	--	--	--	3	130.3	113	158	24.2
17	4/21-4/24	4	25.5	24	27	1.3	10	134.6	94	215	33.7
18	4/28-5/1	3	24.7	22	26	2.3	2	139.5	131	148	12.0
19	5/5-5/8	0	--	--	--	--	6	126.5	118	140	7.3
20	5/12-5/15	2	27.5	27	28	0.7	12	143.7	90	199	27.9
21	5/19-5/22	13	26.2	24	28	1.1	20	143.7	100	209	23.0
22	5/27-5/29	2	36.5	34	39	3.5	9	125.6	94	162	20.2
23	6/2-6/5	1	43.0	43	43	0.0	3	146.7	121	170	24.6