Summary of Biological Monitoring and Sampling Activities Conducted at the Coleman National Fish Hatchery (NFH) by the Hatchery Evaluation Program during the 2002-2003 Spawning Season

U.S. Fish & Wildlife Service

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Introduction

This report documents the biological monitoring and sampling activities conducted at the Coleman National Fish Hatchery (NFH) by the Red Bluff Fish and Wildlife Office's (RBFWO) Hatchery Evaluation Program during the 2002-2003 spawning season. These activities, which are generally referred as "bio-sampling", include recovery of coded-wire tags and collection of biological samples and data from adult salmonids collected at the Coleman NFH. This report summarizes the bio-sampling activities for return year (RY) 2002 fall Chinook and RY 2003 late-fall Chinook and steelhead.

Operation of the Upstream Fish Ladder

The upstream fish ladder at the Coleman NFH Barrier Weir was closed on 30 August 2002 to congregate broodstock and preclude fall Chinook from migrating upstream of the Coleman NFH. The upstream ladder remained closed through the late-fall Chinook and steelhead trout spawning seasons. The upstream fish ladder was opened on 3 March 2003 to allow fish passage upstream of the Coleman NFH Barrier Weir. From 3 March through 29 August 2003, a combination of trapping and video monitoring in the upstream fish ladder was conducted by the Battle Creek Tributary Monitoring Program and details on these activities can be found in the corresponding U.S. Fish and Wildlife Service report.

Fall Chinook

Broodstock Collection

The fish ladder leading from Battle Creek into the hatchery's broodstock collection pond was opened on 30 September 2002; eight days before the first hatchery spawn of fall Chinook salmon. Collection of fall Chinook broodstock at the Coleman NFH continued through 26 November 2002. The fish ladder was opened intermittently to allow fish to enter the Coleman NFH broodstock collection pond while preventing overcrowding. A total of 66,060 Chinook salmon was collected during this period, including 5,196 marked (clipped adipose fin) and 60,864 unmarked (intact adipose fin) fish (Tables 1 through 4). Unmarked Chinook salmon returning to Coleman NFH were likely a mixture of hatchery and natural origin fish, however, it was not possible to differentiate between them because not all hatchery juveniles receive an adipose fin clip (Appendix A).

Spawning and Sorting

Hatchery spawning of fall Chinook occurred from 8 October through 21 November 2002. Hatchery personnel processed fish for up to twelve hours per day, five days a week. Four hundred twenty eight marked and 12,159 unmarked fall Chinook salmon were used as hatchery broodstock (Tables 1 and 2). To alleviate congestion in Battle Creek below the Coleman NFH barrier weir, fall Chinook salmon entering the hatchery's broodstock collection ponds in excess of broodstock needs were sacrificed (excessed). During the fall Chinook spawning season, 50,646 Chinook were excessed (4,625 marked and 46,021 unmarked; Tables 1 and 3) with an additional 2,827 Chinook (143 marked, 2,684 unmarked) expiring in the hatchery holding ponds (Died in Ponds [DIP]; Tables 1 and 4). To guard against mating fall Chinook (which were marked at a relatively low rate) with late-fall Chinook (which were marked at a 100% rate), no marked Chinook were spawned between 6 November and 21 November 2002.

Table 1. Total numbers of adipose-fin clipped (marked) and unmarked Chinook salmon entering Coleman NFH from 30 September through 26 November 2002. These fish are categorized by gender as spawned, excessed, or found dead in the hatchery holding ponds (DIP). Males were classified as Adults (≥Age 3) or Jacks (Age 2) based on fork length measurements, where fish ≥65 cm were considered to be Adults.

	Adipose-Fin Clipped			Unmarked			
	Male			Male			
	Adult	Jack	Female	Adult	Jack	Female	**Total**
Spawned	142	3	283	6,515	320	5,324	**12,587**
Excessed	3,043	460	1,122	31,694	3,230	11,107	**50,646**
DIP	66	6	71	1,410	94	1,180	**2,827**
Total	**3,250**	**469**	**1,476**	**39,619**	**3,643**	**17,611**	**66,060**

Table 2. Numbers of adipose-fin clipped (marked) and unmarked Chinook salmon spawned at Coleman NFH, by spawn date and gender, from 30 September through 26 November 2002. Males were classified as Adults (≥Age 3) or Jacks (Age 2) based on fork length measurements, where fish ≥65 cm were considered to be Adults.

	Adipose-Fin Clipped			Unmarked			
	Male			Male			**Total**
Date	Adult	Jack	Female	Adult	Jack	Female	**Spawned**
10/8/2002	1	0	5	212	8	97	**323**
10/9/2002	0	0	4	185	10	73	**272**
10/10/2002	5	0	23	550	16	236	**830**
10/15/2002	4	0	26	520	5	303	**858**
10/16/2002	10	0	19	554	12	280	**875**
10/17/2002	36	0	25	395	17	370	**843**
10/19/2002	13	0	29	464	14	420	**940**
10/22/2002	9	1	34	457	18	412	**931**
10/23/2002	17	1	24	441	17	394	**894**
10/24/2002	15	0	29	405	14	407	**870**
10/29/2002	26	0	34	401	31	401	**893**
10/31/2002	6	1	30	447	27	420	**931**
11/5/2002	0	0	1	318	25	284	**628**
11/7/2002	0	0	0	245	29	317	**591**
11/12/2002	0	0	0	372	27	342	**741**
11/14/2002	0	0	0	311	26	327	**664**
11/19/2002	0	0	0	117	14	122	**253**
11/21/2002	0	0	0	121	10	119	**250**
Total	**142**	**3**	**283**	**6,515**	**320**	**5,324**	**12,587**

Table 3. Numbers of adipose-fin clipped (marked) and unmarked Chinook salmon excessed at Coleman NFH, by date and gender, from 30 September through 26 November 2002. Males were classified as Adults (≥Age 3) or Jacks (Age 2) based on fork length measurements, where fish ≥65 cm were considered to be Adults.

	Adipose-Fin Clipped			Unmarked			
	Male			Male			**Total**
Date	Adult	Jack	Female	Adult	Jack	Female	**Excessed**
9/30/2002	90	4	27	1,278	29	349	**1,777**
10/1/2002	118	3	60	1,592	30	635	**2,438**
10/2/2002	94	2	36	1,249	18	489	**1,888**
10/3/2002	117	2	38	1,476	28	584	**2,245**
10/4/2002	90	1	32	1,279	23	413	**1,838**
10/7/2002	135	6	56	1,695	42	820	**2,754**
10/8/2002	83	6	18	969	22	220	**1,318**
10/9/2002	97	4	35	1,153	39	405	**1,733**
10/10/2002	68	7	15	550	16	147	**803**
10/11/2002	124	1	27	1,411	39	382	**1,984**
10/15/2002	82	7	15	599	12	160	**875**
10/16/2002	149	5	13	1,545	77	115	**1,904**
10/17/2002	106	7	42	1,437	80	430	**2,102**
10/18/2002	108	12	55	1,360	93	628	**2,256**
10/19/2002	37	2	6	208	28	124	**405**
10/21/2002	159	18	43	1,883	125	619	**2847**
10/22/2002	109	22	9	1,093	84	176	**1,493**
10/23/2002	83	4	13	717	55	120	**992**
10/24/2002	149	22	39	1,153	137	470	**1,970**
10/25/2002	185	29	97	2,043	207	1,268	**3,829**
10/26/2002	33	2	12	345	57	276	**725**
10/27/2002	116	28	76	1,415	231	834	**2,700**
10/28/2002	68	7	32	741	55	275	**1,178**
10/29/2002	110	38	26	1,085	316	364	**1,939**
10/30/2002	93	24	9	940	165	110	**1,341**
10/31/2002	49	7	13	136	123	15	**343**
11/5/2002	71	20	39	530	89	31	**780**
11/6/2002	99	28	50	926	248	350	**1,701**
11/7/2002	69	11	48	373	536	56	**1,093**
11/12/2002	50	27	45	249	170	60	**601**
11/14/2002	47	13	34	158	30	105	**387**
11/19/2002	19	6	26	3	19	0	**73**
11/21/2002	18	24	18	35	7	31	**133**
11/26/2002	18	61	18	58	0	46	**201**
Total	**3,043**	**460**	**1,122**	**31,684**	**3,230**	**11,107**	**50,646**

Table 4. Numbers of adipose-fin clipped (marked) and unmarked Chinook salmon that died in the hatchery holding ponds [DIP] at Coleman NFH, by date and gender, from 30 September through 26 November 2002. Males were classified as Adults (≥Age 3) or Jacks (Age 2) based on fork length measurements, where fish ≥65 cm were considered to be Adults.

	Adipose-Fin Clipped			Unmarked			
	Male			Male			**Total**
Date	Adult	Jack	Female	Adult	Jack	Female	**DIP**
10/2/2002	1	1	0	12	0	5	**19**
10/4/2002	0	0	1	9	0	4	**14**
10/7/2002	1	0	1	38	0	13	**53**
10/8/2002	0	0	1	21	0	11	**33**
10/9/2002	0	0	0	15	0	9	**24**
10/10/2002	2	0	0	29	0	10	**41**
10/11/2002	1	0	0	22	0	9	**32**
10/15/2002	14	0	14	213	0	167	**408**
10/16/2002	1	0	1	29	0	23	**54**
10/17/2002	0	0	0	51	2	34	**87**
10/18/2002	1	0	1	27	0	11	**40**
10/19/2002	3	1	0	23	0	34	**61**
10/21/2002	1	0	2	62	0	25	**90**
10/22/2002	6	0	4	51	1	33	**95**
10/23/2002	0	0	2	18	0	42	**62**
10/24/2002	3	0	4	40	0	40	**87**
10/25/2002	5	1	0	45	0	16	**67**
10/26/2002	0	0	1	0	0	0	**1**
10/27/2002	0	0	0	40	0	21	**61**
10/28/2002	1	0	0	35	1	8	**45**
10/29/2002	0	0	1	9	1	12	**23**
10/30/2002	1	0	1	14	0	6	**22**
10/31/2002	1	0	1	22	5	27	**56**
11/4/2002	0	0	0	123	14	97	**234**
11/5/2002	1	1	6	20	0	35	**63**
11/6/2002	3	0	4	34	1	34	**76**
11/7/2002	1	0	0	53	5	34	**93**
11/12/2002	9	0	9	168	30	196	**412**
11/14/2002	2	0	6	136	30	157	**331**
11/19/2002	6	1	6	13	2	22	**50**
11/21/2002	1	0	2	14	0	22	**39**
11/26/2002	1	1	3	24	2	23	**54**
Total	**66**	**6**	**71**	**1,410**	**94**	**1,180**	**2,827**

Sampling Marked Fish for Coded-Wire Tags (CWT's)

The head was removed from each marked Chinook encountered at the Coleman NFH during the fall Chinook spawning season. The head was severed, behind the eyes, on a cutting table. Heads were placed into plastic bags pre-labeled with a unique identification number. From 30 September through 26 November 2002, 5,195 heads were collected; including 428 from spawned fish, 4,625 from excessed fish, and 142 from fish that died in the hatchery's broodstock collection pond (one additional marked fish died in the broodstock collection pond, but the head was never recovered). Heads were transferred to the Red Bluff Fish and Wildlife Office where they were frozen until the CWTs could be extracted. Data collected from all marked Chinook salmon include gender, fork length (cm), and disposition (e.g., spawned, excessed, or dead in pond [DIP]).

Coded-Wire Tag Recovery

Coded-wire tags were extracted from salmon heads at the RBFWO. Coded-wire tags were located by passing partially-thawed heads through a V-detector (Northwest Marine Technology, Inc.). Heads were divided into successively smaller pieces with individual pieces being passed through a V-detector, until the tag was isolated in a piece of tissue small enough that it could be seen. If a CWT could not be located using the V-detector, tissue pieces were placed in a plastic bag and passed through a R9500 tunnel-type tag detector (Northwest Marine Technology, Inc.). The R9500 detector is more accurate than the V-detector at identifying the presence of a CWT. If the tunnel detector indicated that a tag was present, tissue pieces were reexamined for a CWT. If no tag was detected by the R9500 detector, the head was discarded. Coded-wire tags were placed into bags pre-labeled with the head identification number.

Coded-Wire Tag Decoding and Verification

Recovered CWTs, consisting of binary and decimal formats, were decoded (read) by two independent readers. When CWT codes did not match for the first and second reader, a third, independent read was performed. The average error rate of readers ranged from 2.4%-2.6% for all fall and late-fall Chinook and steelhead tags recovered at the Coleman NFH during the 2002-2003 spawning season. All CWT codes were validated using the Regional Mark Processing Center website (http://www.rmpc.org). Numbers of CWT's recovered from Chinook collected during the Return Year (RY) 2002 fall Chinook salmon spawning season at the Coleman NFH are shown in Table 5.

Table 5. Results of coded-wire tag extractions from heads collected 30 September through 26 November 2002. Tag extractions were categorized as "read and verified", "unreadable", "lost" (a tag that was initially observed and/or recovered from a salmon head but was lost before it could be read and verified), or was not detected or observed in the head during the tag recovery process (NTD). "DIP" indicates a fish that died in the hatchery holding ponds

	Excessed	Spawned	DIP	**Total**
Read and Verified	4,156	388	121	**4,665**
Unreadable	14	1	0	**15**
Lost	91	11	3	**105**
NTD	364	28	18	**410**
Total	**4,625**	**428**	**142**	**5,195**

Coded-Wire Tag Expansions

A total of 149 different coded-wire tag codes was collected at the Coleman NFH during fall Chinook broodstock collection activities. Each tag code generally represents a different juvenile release group that was marked and tagged at inconsistent rates. We performed a simple expansion to estimate the number of untagged fish returning from each release group. Expansions were conducted in two steps: 1.) lost and unreadable tags were apportioned among each tag code, based on the rate those codes were recovered and 2.) recovered tags were expanded to account for unmarked fish in the release group. Individual coded-wire tag recoveries and expansions are presented in Appendix A.

Lost and unreadable tags were apportioned among each different tag code according to the proportion of tags observed for that code:

$$CWT_{Total\ i} = CWT_i + (CWT_{lost} \times CWT_i / CWT_{\sum i}) \quad (1)$$

where,

$CWT_{Total\ I}$ = the total number of coded-wire tags recovered for each tag code

CWT_i = the number of read and verified coded-wire tags for a tag code *i*,

CWT_{lost} = the number of lost and unreadable tags, and

$CWT_{\sum i}$ = the total number of all coded-wire tags recovered.

The total number of coded-wire tags recovered from each code was then expanded to account for the untagged fish in each release group. This expansion is based on the mark and tag retention rates that are measured for each group prior to their release. These data can be found at the Regional Mark Processing Center website (http://www.rmpc.org).

$$R_i = CWT_{Total\ i} / (Rel_{Mark} / Rel_{Total}) \quad (2)$$

where,

R_i = the total number of fish recovered from each release group

$Rel_{Mark\ i}$ = the estimated number of juveniles released with a clipped adipose fin and a coded-wire tag for release group *i* and

$Rel_{Total\ i}$ = the total number of juveniles in release group *i*.

Origin of Coded-Wire Tagged Fish Collected at the Coleman NFH During the Fall Chinook Spawning Season

A total of 4,665 CWTs were read and verified from Chinook salmon collected at the Coleman NFH during the fall Chinook spawning season. Most of the recovered tags were from fall Chinook salmon propagated at the Coleman NFH (Table 6). Coded-wire tags were also recovered from Coleman NFH origin late-fall Chinook, Feather River Hatchery fall and spring Chinook, Tiburon Net Pen fall Chinook (Feather River fall Chinook), Merced River Fish Facility fall Chinook and Mokelumne River Fish Installation fall Chinook.

Table 6. Numbers of coded-wire tagged Chinook salmon returning to the Coleman NFH from 30 September through 26 November 2002. Acronyms for the various salmon production facilities are as follows: Feather River Hatchery (FRH), Tiburon Net Pens (TNP), Merced River Fish Facility (MRFF), and Mokelumne River Fish Installation (MRFI).

	Coleman NFH		FRH				
	Fall	Late-Fall	Fall	Spring	TNP	MRFF	MRFI
Excessed	3,925	133	68	8	13	5	4
Spawned	385	1	2	0	0	0	0
DIP	117	3	1	0	0	0	0
Total	**4,427**	**137**	**71**	**8**	**13**	**5**	**4**

Age and Gender of Coded-Wire Tagged Fall Chinook Originating at the Coleman NFH

The age composition of fish collected at the Coleman NFH and the numbers of males and females at each age class were estimated by apportioning the expanded CWT recoveries based on the ratio of males to females observed for each tag code. In 2002, Coleman NFH origin fall Chinook returned predominantly at age-3 (82.0%); followed by age-4 (9.9%), age-2 (8.0%), and age-5 (0.1%) fish. Overall, more male fall Chinook (70.4%) entered the hatchery (Table 7). Males were predominant in age-2, age-3, and age-4 fish; with females more abundant among age-5 fish. A very large percentage of the age-2 fish were males (94.0%).

The large percentage of male fall Chinook collected at the Coleman NFH is noteworthy, particularly the large number of age-3 males (69.0%). We speculate that, on average, males may be larger, stronger, and more aggressive than females. Therefore, when abundance of fall Chinook salmon in Battle Creek is very large, as was true in 2002, males may out-compete females to enter the hatchery's holding ponds. In 2002, the estimate of fall Chinook salmon abundance in Battle Creek was the largest since surveying began in 1952 (Colleen Harvey-Arrison, California Dept. of Fish and Game, pers. comm.).

Table 7. Expanded numbers of Coleman NFH origin male and female fall Chinook salmon, by age, returning to Coleman NFH from 30 September through 26 November 2002. Expansions, based on recoveries of coded-wire tags, were made to account for the different mark and tag rates for each release group.

	Age 2	Age 3	Age 4	Age 5	**Total**
Males	3,976	29,871	3,314	17	**37,178**
Females	254	13,389	1,931	33	**15,607**
Total	**4,,230**	**43,260**	**5,245**	**50**	**52,785**

Size at Age of Coded-Wire Tagged fall Chinook Originating at the Coleman NFH

Coded-wire tagged fall Chinook salmon originating at the Coleman NFH and subsequently collected at the Coleman NFH between 30 September and 26 November 2002 ranged in size from 46 cm to 116 cm fork length. The mean fork lengths of Coleman NFH origin fall Chinook males were 64.0 cm at age-2 (SD=61.9), 85.4 cm at age-3 (SD=78.9), and 99.2 cm at age-4 (SD=78.6). One age-5 male was measured at 97 cm. The mean fork lengths of Coleman NFH origin fall Chinook females were 65.7 cm at age-2 (SD=44.4), 81.3 cm at age-3 (SD=52.5), and 92.3 cm at age-4 (SD=51.2). Two age-5 females were measured, with fork lengths of 94 cm and 102 cm. Length frequency distributions are presented in Figure 1 (males) and Figure 2 (females).

Biological Sample Collections

Samples of fin tissue were collected from 150 Chinook spawned during the 2002 spawning season. Fin tissues were collected, in replicates of three, from the caudal fin of the first five male and first five female unmarked Chinook spawned each day. These tissue samples are archived at the Red Bluff Fish and Wildlife Office and are intended to serve as a historical representation of hatchery broodstock for future genetic analyses. Samples were stored in 2 ml pre-labeled vials containing TEN buffer (Tris, EDTA, NaCl). Gender and fork length (cm) were recorded for all sampled fish. Scales were collected from each fish that was sampled for fin tissue. Scales were collected posterior to the dorsal fin and above the lateral line, placed on filter paper, and stored in a paper envelope labeled with the corresponding tissue sample identification number.

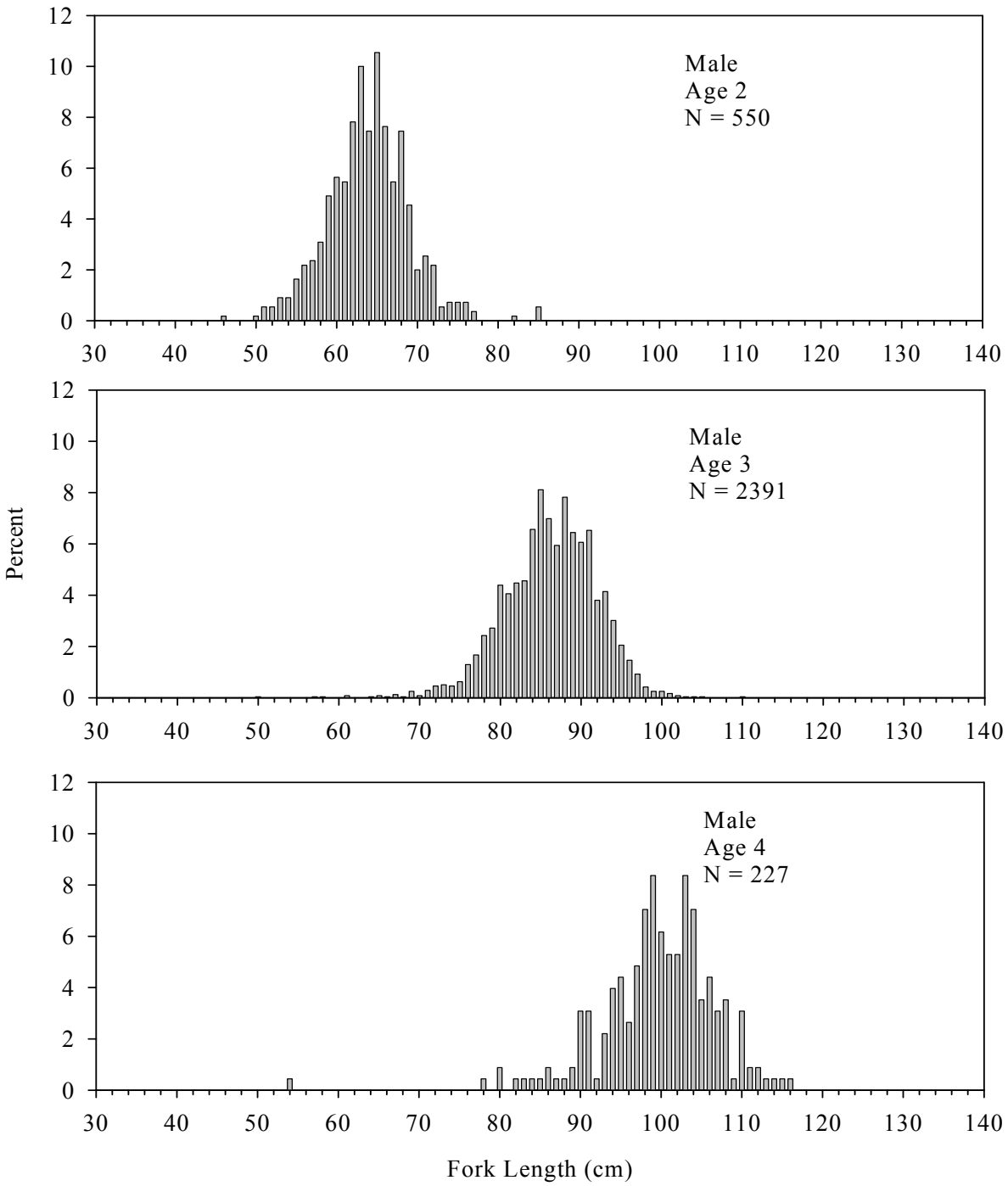

Figure 1. Frequency distribution for Coleman NFH origin male fall Chinook salmon returning to Coleman NFH in 2002-2003. Age and hatchery origin were determined based on coded-wire tag data. Age five males were not included due to the small number of recoveries. Mark rates were not consistent among years and only marked fish were measured (i.e. measured fish are not representative of the fish entering the hatchery).

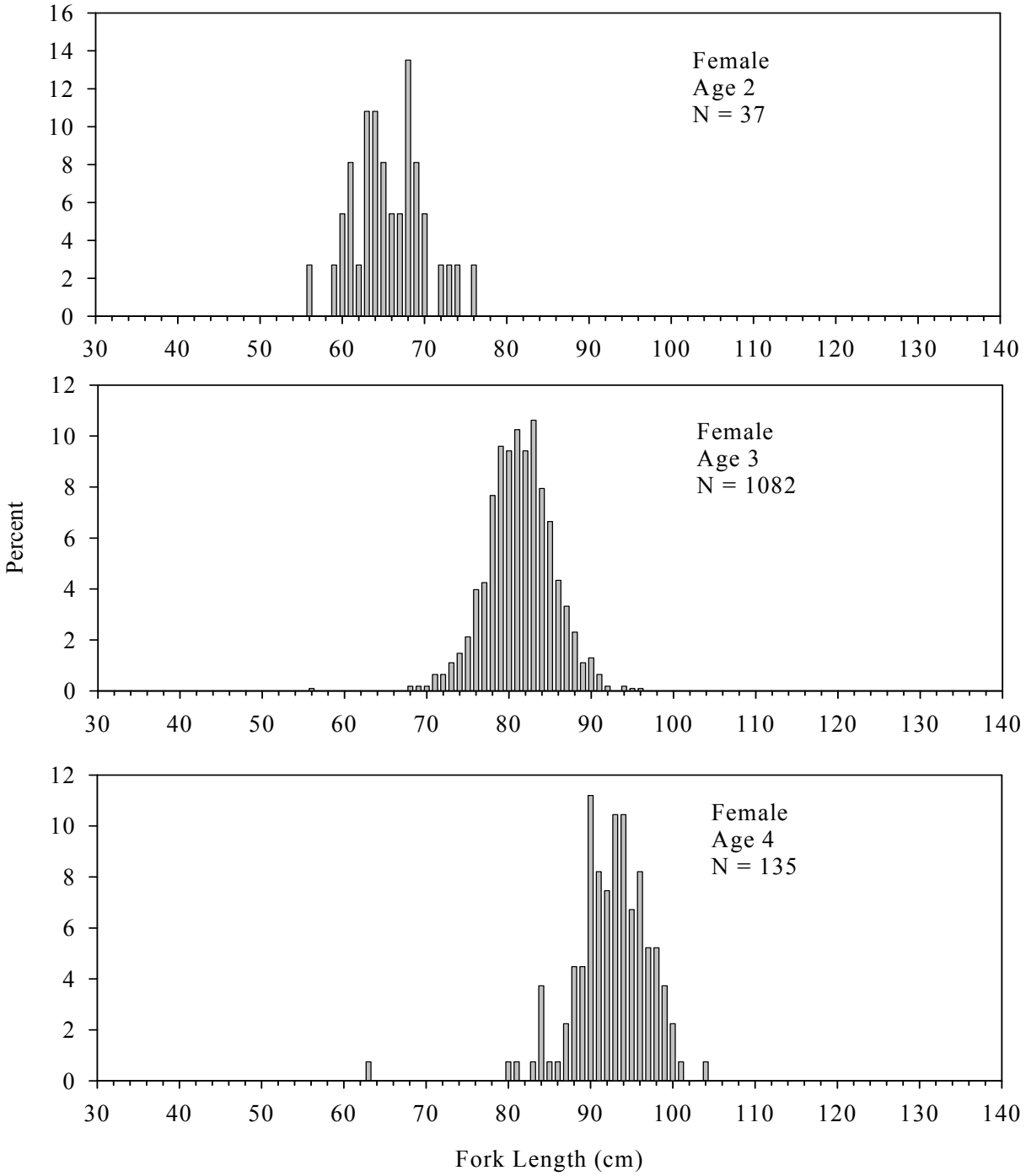

Figure 2. Frequency distribution for Coleman NFH origin female fall Chinook salmon returning to Coleman NFH in 2002-2003. Age and hatchery origin were determined based on coded-wire tag data. Age five males were not included due to the small number of recoveries. Mark rates were not consistent among years and only marked fish were measured (i.e. measured fish are not representative of the fish entering the hatchery).

Broodstock Management between the Fall and Late-fall Spawning Periods

After the final hatchery spawning of fall Chinook on 21 November 2002, the fish ladder into the hatchery was closed. Chinook salmon were then confined below the Coleman NFH barrier weir in Battle Creek until 9 December 2002 when the fish ladder into the hatchery was opened for one day. All marked Chinook salmon entering the hatchery at that time were culled (excessed). This practice is intended to promote divergence in spawn timing between hatchery fall and late-fall Chinook, and is believed to reduce the risk of hatchery hybridization of these distinct runs. On 10 December 2002, 157 marked Chinook were excessed. Of these, 149 were Coleman NFH late-fall Chinook, one fish was a Coleman NFH fall Chinook, one fish was a fall Chinook from the Mokelumne River Fish Installation, and six tags were not recovered (3 NTD's and 3 lost tags). No unmarked Chinook entered the Coleman NFH on 10 December 2002.

Late-fall Chinook

Collection of Late-Fall Chinook Broodstock at Coleman NFH

The fish ladder leading from Battle Creek to the broodstock collection pond at the Coleman NFH was opened on 10 December 2002 and remained open until 27 February 2003 to collect late-fall Chinook broodstock. A total of 2,797 Chinook salmon were collected at the Coleman NFH during this period, including 2,740 marked and 57 unmarked fish (Table 8).

Table 8. Total numbers of adipose-fin clipped (marked) and unmarked Chinook salmon entering Coleman NFH from 10 December 2002 through 27 February 2003. These fish are categorized by gender as spawned, excessed, released, or found dead in the hatchery holding ponds (DIP). Males were classified as Adults (≥Age 3) or Jacks (Age 2) based on fork length measurements, where fish ≥65 cm were considered to be Adults. Released fish were returned to Battle Creek above the Coleman NFH barrier weir.

	Adipose-Fin Clipped			Unmarked			
	Male			Male			
	Adult	Jack	Female	Adult	Jack	Female	**Total**
Spawned[1]	476	62	564	0	0	0	**1,102**
Excessed	226	171	274	0	0	0	**671**
DIP[1]	361	169	437	0	0	0	**967**
Released	0	0	0	27	15	15	**57**
Total	**1,063**	**402**	**1,275**	**27**	**15**	**15**	**2,797**

[1] An additional 31 natural origin Chinook salmon were collected at the Keswick Dam fish trap; including 16 males and 15 females. These 31 fish were mated with a marked fish that returned to the Coleman NFH. These fish were not included in Table 8.

Collection of Late-Fall Chinook Broodstock at the Keswick Dam Fish Trap

To promote genetic diversity and reduce the potential for genetic divergence between hatchery and natural late-fall Chinook, late-fall Chinook salmon from the mainstem Sacramento River were collected at the Keswick Dam Fish Trap and transferred to the Coleman NFH for spawning. The 2002-2003 spawning season was the first time since 1997 that natural origin late-fall Chinook were collected at the Keswick Dam Fish Trap and used as hatchery broodstock. Collection of late-fall Chinook at the Keswick Dam Fish Trap occurred concurrently with the collection of winter Chinook broodstock. The natural origin salmon captured at the Keswick Dam Fish Trap were mated with a marked fish that returned to the Coleman NFH.

The collection goal for natural origin late-fall Chinook salmon was 135; equivalent to 25% of the broodstock required to achieve the hatchery's production target for late-fall Chinook salmon. Only mature fish ready to spawn ("ripe") at the time of collection were retained for use as broodstock. Thirty-two natural origin Chinook salmon phenotypically identified as late-fall (seventeen adult males and fifteen females) were collected from the Keswick Dam fish trap on the Sacramento River and transported to the Coleman NFH. One male died prior to being spawned and 31 fish were mated with a marked fish that returned to the Coleman NFH. The hatchery target for spawning natural origin late-fall Chinook was not achieved because too few "ripe" fish were captured at the Keswick Dam fish trap.

Disposition of Unmarked Chinook

Late-fall Chinook salmon originating at the Coleman NFH have been marked with an adipose fin-clip and a CWT since 1992[2]. Unmarked Chinook entering the Coleman NFH after mid-December were presumed to be naturally-produced in Battle Creek and were released upstream of the Coleman NFH barrier weir immediately after sorting. Fifty-seven unmarked Chinook salmon were collected at the Coleman NFH from 20 December 2002 through 20 February 2003 (Table 12). Fifteen of the unmarked Chinook were females (all adults) and forty-two were males (twenty-seven adults and fifteen grilse).

Spawning and Sorting

Spawning of late-fall Chinook began on 31 December 2002 and continued through 20 February 2003. A total of 1,133 fish was spawned; including 1,102 marked fish collected from Battle Creek (Table 8 and 9) and 31 unmarked fish collected at the Keswick Dam Fish Trap (Table 9). Between 10 December 2002 and 27 February 2003, 671 marked Chinook collected at the Coleman NFH were excessed and 967 Chinook died in the hatchery holding ponds prior to being processed (Tables 8, 10, and 11).

[2] In 1998, approximately 125,000 unmarked late-fall Chinook juveniles were placed in the hatchery's pollution abatement pond. Evidence suggests that substantial numbers of these fish (estimated 50,000) may have exited the pond through a spillway and entered Battle Creek.

Table 9. Numbers of adipose-fin clipped (marked) and unmarked Chinook salmon spawned at Coleman NFH, by spawn date and gender, from 31 December 2002 through 20 February 2003. Males were classified as Adults (≥Age 3) or Jacks (Age 2) based on fork length measurements, where fish ≥65 cm were considered to be Adults. All spawned unmarked fish were collected at the Keswick Dam Fish Trap.

	Adipose-Fin Clipped			Unmarked			
	Male			Male			**Total**
Date	Adult	Jack	Female	Adult	Jack	Female	**Spawned**
12/31/2002	64	11	75	0	0	0	**150**
1/3/2003	134	24	148	0	0	0	**306**
1/9/2003	34	7	46	0	0	0	**87**
1/14/2003	70	10	72	6	0	3	**161**
1/23/2003	64	3	67	4	0	4	**142**
1/29/2003	43	4	56	0	0	1	**104**
2/7/2003	26	2	47	2	0	0	**77**
2/13/2003	39	1	49	1	0	5	**95**
2/20/2003	2	0	4	3	0	2	**11**
Total	**476**	**62**	**564**	**16**	**0**	**15**	**1,133**

Table 10. Numbers of adipose-fin clipped (marked) Chinook salmon excessed at Coleman NFH, by date and gender, from 10 December 2002 through 27 February 2003. Males were classified as Adults (≥Age 3) or Jacks (Age 2) based on fork length measurements, where fish ≥65 cm were considered to be Adults.

	Adipose-Fin Clipped			
	Male			**Total**
Date	Adult	Jack	Female	**Excessed**
12/10/2002	70	47	40	**157**
12/20/2002	2	1	3	**6**
12/31/2002	14	21	12	**47**
1/3/2003	14	80	11	**105**
1/9/2003	4	4	6	**14**
1/14/2003	18	10	12	**40**
1/23/2003	5	3	5	**13**
1/29/2003	0	0	6	**6**
2/7/2003	0	0	2	**2**
2/13/2003	0	0	1	**1**
2/20/2003	43	4	93	**140**
2/27/2003	56	1	83	**140**
Total	**226**	**171**	**274**	**671**

Table 11. Numbers of adipose-fin clipped (marked) and unmarked Chinook salmon that died in the hatchery holding ponds [DIP] at Coleman NFH, by date and gender, from 10 December 2002 through 27 February 2003. Males were classified as Adults (≥Age 3) or Jacks (Age 2) based on fork length measurements, where fish ≥65 cm were considered to be Adults.

	Adipose-Fin Clipped			Unmarked			
	Male			Male			**Total**
Date	Adult	Jack	Female	Adult	Jack	Female	**DIPS**
12/10/2002	3	7	3	0	0	0	**13**
12/20/2002	9	3	8	0	0	0	**20**
12/31/2002	25	14	24	0	0	0	**63**
1/3/2003	53	67	45	0	0	0	**165**
1/7/2003	37	36	21	0	0	0	**94**
1/9/2003	15	6	26	0	0	0	**47**
1/14/2003	20	8	25	0	0	0	**53**
1/17/2003	47	12	82	0	0	0	**141**
1/21/2003	58	8	74	0	0	0	**140**
1/23/2003	31	2	26	0	0	0	**59**
1/29/2003	43	5	73	0	0	0	**121**
1/31/2003	1	0	7	0	0	0	**8**
2/4/2003	4	0	8	0	0	0	**12**
2/7/2003	7	1	10	0	0	0	**18**
2/13/2003	4	0	2	0	0	0	**6**
2/20/2003	4	0	3	0	0	0	**7**
2/27/2003	0	0	0	0	0	0	**0**
Total	**361**	**169**	**437**	**0**	**0**	**0**	**967**

Table 12. Numbers of unmarked Chinook salmon that entered Coleman NFH and were passed above the Coleman NFH barrier weir, by date and gender, from 10 December 2002 through 27 February 2003. Males were classified as Adults (≥Age 3) or Jacks (Age 2) based on fork length measurements, where fish ≥65 cm were considered to be Adults.

	Unmarked			
	Male			
Date	Adult	Jack	Female	**Total**
12/20/2002	16	13	7	**36**
12/31/2002	5	2	2	**9**
1/3/2003	1	0	1	**2**
1/23/2003	0	0	1	**1**
1/29/2003	2	0	1	**3**
2/13/2003	1	0	1	**2**
2/20/2003	2	0	2	**4**
Total	**27**	**15**	**15**	**57**

Sampling Marked Fish for Coded-wire Tags

The head was removed from each marked salmon encountered at the Coleman NFH during the late-fall Chinook spawning season. A total of 2,740 heads was collected from 10 December 2002 through 27 February 2003 (Table 13). Sampling procedures and methods for CWT recovery, reading, and verification were identical to those previously described for fall Chinook.

Table 13. Results of coded-wire tag extractions from heads collected 10 December 2002 through 27 February 2003; categorized as "read and verified", "unreadable", "lost", and "no tag detected" (NTD. Tag extractions were categorized as "read and verified", "unreadable", "lost" (a tag that was initially observed and/or recovered from a salmon head but was lost before it could be read and verified), or was not detected or observed in the head during the tag recovery process (NTD). "DIP" indicates a fish that died in the hatchery holding ponds .

	Excessed	Spawned	DIP	**Totals**
Read and Verified	629	1,033	905	**2,567**
Unreadable	0	3	2	**5**
Lost	18	36	23	**77**
NTD	24	30	37	**91**
Totals	**671**	**1,102**	**967**	**2,740**

Origin of Coded-Wire Tagged fish Collected at the Coleman NFH During the Late-Fall Chinook Spawning Season

A total of 2,567 CWTs was read and verified from Chinook salmon collected at the Coleman NFH from 10 December 2002 through 27 February 2003. Two fish were identified as fall Chinook originally released at the Coleman NFH, and one fish was identified as a fall Chinook

from Mokelumne River Fish Installation (MRFI). One of the Coleman NFH origin fall Chinook was a DIP and the other was excessed. The MRFI origin fall Chinook was excessed. All other Chinook salmon collected during this period (n = 2,564) were late-fall Chinook released from the Coleman NFH.

Age of Coded-Wire Tagged Late-Fall Chinook Originating at the Coleman NFH

Coleman NFH origin late-fall Chinook returned predominantly at age-3 (42.7%) and age-4 (41.3%); with fewer age-2 (14.5%) and age-5 (1.5%) fish (Table 14). Overall, more male (55.1%) late-fall Chinook entered the hatchery (Table 14). Males were predominant in fish returning at a younger age (age-2 and 3) with 98.7% of the age-2 fish being males. Females were more abundant in the older age classes, representing 63% and 70% of age-4 and age-5 fish, respectively.

Table 14. Numbers of Coleman NFH origin male and female late-fall Chinook salmon, by age, returning to Coleman NFH from 5 November 2002 through 27 February 2003 based on recoveries of coded-wire tags.

	Age 2	Age 3	Age 4	Age 5	**Total**
Males	386	677	414	12	**1,489**
Females	5	476	701	29	**1,211**
Total	**391**	**1,153**	**1,115**	**41**	**2,700**

Size at Age of Coded-Wire Tagged Late-Fall Chinook Originating at the Coleman NFH

Coleman NFH origin late-fall Chinook salmon ranged in size from 32 cm to 119 cm fork length. The mean fork lengths of Coleman NFH origin late-fall Chinook males were 49.1 cm at age-2 (SD=95.0), 72.2 cm at age-3 (SD=100.7), 87.7 cm at age-4 (SD=99.3), and 98.3 cm at age-5 (n = 12, SD=82.6)). The mean fork lengths of Coleman NFH origin late-fall Chinook females were 71.0 cm at age-3 (SD=63.9), 82.5 cm at age-4 (SD=76.7), and 87.8 cm at age-5 (n = 29, SD=104.1)). Average fork lengths are not provided for age-2 females due to the small sample size (n = 5). Length frequency distributions for male and female late-fall Chinook are presented in Figure 3.

Biological Sample Collections

Samples of fin tissue were collected from 150 marked Chinook spawned during the 2002-2003 late-fall Chinook spawning season. Fin tissues were collected, in replicates of three, from the caudal fin of the first twelve male and first thirteen female unmarked Chinook spawned each day. These tissue samples are archived at the Red Bluff Fish and Wildlife Office and are intended to serve as a historical representation of hatchery broodstock for future genetic analyses. Samples were stored in 2 ml pre-labeled vials containing TEN buffer (Tris, EDTA, NaCl). Gender and fork length (cm) was recorded for all sampled fish. Scales were also collected from each fish that was sampled for fin tissue. Methods of scale sampling were similar to those previously described for fall Chinook.

Otoliths, scales, and three fin tissue samples were collected from each unmarked late-fall Chinook collected at the Keswick Dam Fish Trap and spawned at the Coleman NFH. The number of the floy tag that was applied during the broodstock collection process was recorded at the time of spawning, and was used to reference biological data recorded during the initial collection process.

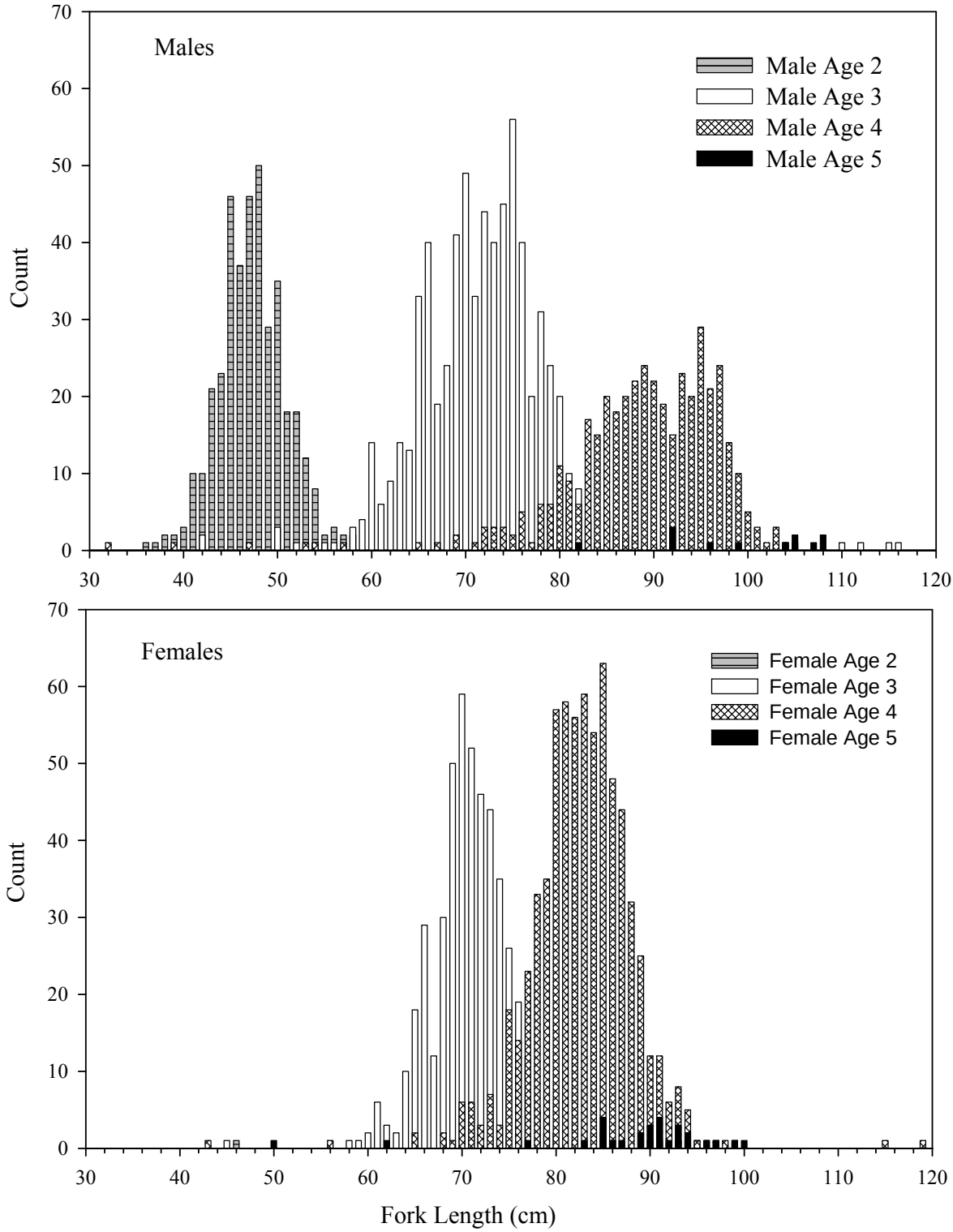

Figure 3.--Frequency distribution for Coleman NFH origin late-fall Chinook salmon returning to Coleman NFH in 2002-2003. Age and hatchery origin were determined based on coded-wire tag codes.

Steelhead

Broodstock Collection

Steelhead enter Coleman NFH concurrently with fall and late-fall Chinook salmon. Broodstock were collected at the hatchery from 30 September 2002 through 27 February 2003. All steelhead originating at the Coleman NFH have been marked with an adipose fin-clip since 1998. Unmarked steelhead encountered during the 2003 spawning season were presumed to be of natural origin. A total of 2,688 steelhead entered the hatchery during this period, including 2,263 marked and 425 unmarked fish (Table 15). Steelhead returning to the Coleman NFH were either used for broodstock or released upstream of the Coleman NFH barrier weir; however, marked and unmarked steelhead were handled differently as described below.

Table 15. Total numbers of adipose-fin clipped (marked) and unmarked steelhead entering the Coleman NFH from 30 September 2002 through 27 February 2003. These fish are categorized by gender as spawned, excessed, released, or found dead in the hatchery holding ponds (DIP). Coleman NFH staff have conventionally categorized steelhead as "longs" or "shorts" based on fork length measurements and this classification was retained throughout this report. Steelhead ≥56 cm were classified as "longs". Released fish were returned to Battle Creek above the Coleman NFH barrier weir.

	Adipose-Fin Clipped				Unmarked				
	Male		Female		Male		Female		
	Long	Short	Long	Short	Long	Short	Long	Short	**Total**
Spawned	90	186	89	237	1	8	2	1	**614**
Excessed	40	178	68	230	0	0	0	0	**516**
Released	58	270	88	350	69	86	117	144	**1,182**[3]
DIP	N/A	N/A	N/A	N/A	0	0	0	0	**376**[4]
Total									**2,688**

Handling and Disposition of Unmarked Steelhead Collected at the Coleman NFH

Natural origin steelhead were incorporated into the hatchery broodstock to maintain genetic diversity and reduce the potential for genetic divergence from naturally spawned steelhead. The hatchery target for spawning natural origin steelhead was forty fish, equivalent to 10% of the number of broodstock required to meet the hatchery's production goal. To reduce the potential for pre-spawn mortality of natural origin steelhead, unmarked steelhead were retained for spawning only if they were fully mature, or "ripe", at the time of collection (i.e "green" fish were not retained in hatchery ponds until ready to spawn). Steelhead that appeared to be

[3] Three marked males (all short) were initially released above the Coleman NFH barrier weir and subsequently returned to the hatchery and were spawned. Also, two marked female steelhead (one short and one long) were spawned then released above the Coleman NFH barrier weir. These fish are accounted for in the "Spawned" category and are not included in the "Released" category.

[4] All fish that died in the Coleman NFH's holding ponds were adipose-fin clipped; however, only the total number of fish was recorded.

"ripe" were transferred to an aerated holding tank for spawning later that day. Otherwise, unmarked steelhead were sampled and immediately returned to Battle Creek to spawn naturally. Unmarked steelhead were anesthetized with carbon dioxide until they could be easily handled for gender identification, fork length measurement (cm), and sampling of fin tissue and scales (as described previously for fall Chinook). The fin tissue sample was collected from the upper lobe of the caudal fin using a circular punch; this mark also indicated if a fish had been previously sampled. Steelhead were then transferred to an aerated holding tank where they were allowed to recover before being placed head first into a tube that carried them to an inlet to Battle Creek located upstream of the Coleman NFH barrier weir.

A total of 425 unmarked steelhead was collected and released upstream of the Coleman NFH barrier weir during the hatchery broodstock collection period (Table 15). Prior to being released, seven unmarked steelhead (5 males and 2 females) were spawned with a marked steelhead, and two unmarked steelhead were spawned together (Tables 15 and 16). Three unmarked steelhead that were initially released upstream were recaptured steelhead and used as broodstock. The hatchery target for spawning natural origin steelhead (n = 40) was not achieved because too few "ripe" fish were encountered at the hatchery.

Table 16. Total numbers of adipose-fin clipped (marked) and unmarked steelhead spawned at Coleman NFH from 30 September 2002 through 27 February 2003. Coleman NFH staff have conventionally categorized steelhead as "longs" or "shorts" based on fork length measurements and this classification was retained throughout this report. Steelhead ≥56 cm were classified as longs.

	Adipose-Fin Clipped				Unmarked				
	Male		Female		Male		Female		**Total Spawned**
Date	Long	Short	Long	Short	Long	Short	Long	Short	
1/7/2003	18	21	14	24	0	0	0	0	**77**
1/14/2003	0	1	2	1	0	3	1	0	**8**[5]
1/17/2003	25	20	20	26	0	0	0	0	**91**
1/21/2003	19	29	21	26	0	0	0	0	**95**
1/23/2003	0	0	0	0	0	1	1	0	**2**
1/29/2003	1	0	0	4	1	3	0	1	**10**[6]
1/31/2003	16	36	25	33	0	0	0	0	**110**
2/4/2003	10	64	6	85	0	0	0	0	**165**
2/13/2003	1	11	1	22	0	0	0	0	**35**
2/20/2003	0	2	0	8	0	0	0	0	**10**
2/27/2003	0	2	0	8	0	1	0	0	**11**[7]
Total	**90**	**186**	**89**	**237**	**1**	**8**	**2**	**1**	**614**

[5] Two adipose fin-clipped female steelhead (one short and one long) were spawned then released above the Coleman NFH barrier weir.
[6] Includes two short males (unmarked) that were initially released above the Coleman NFH barrier weir returned to the hatchery and were spawned.
[7] Includes one short male (unmarked) that was initially released above the Coleman NFH barrier weir returned to the hatchery and was spawned.

Handling and Disposition of Marked Steelhead

Many marked steelhead entered the Coleman NFH before they were "ripe" and some were held inside the spawning building, in concrete ponds (ponds 4 and 5), until they were ready to spawn. Spawning schedules at the Coleman NFH are designed to collect broodstock across the range of run timing to help ensure a representative sample of the steelhead population is incorporated as broodstock. Marked steelhead that were retained for spawning were separated into two groups based on the date that they entered the hatchery; steelhead entering the hatchery from 30 September through 21 December 2002 were held in Pond 5 and those entering after that time were held in Pond 4. Approximately 50% of the spawned steelhead were from each pond. Marked steelhead returning in excess of broodstock needs were released upstream of the Coleman NFH barrier weir to supplement the naturally spawning population.

Since 1998, all steelhead that have been released from the Coleman NFH have been marked (adipose-fin clipped); however, only a portion of these fish were coded-wire tagged. Fish received coded-wire tags for specific studies or evaluations (i.e. short vs. long cross evaluation, natural rearing, and underwater feed study). All marked steelhead collected at the Coleman NFH were passed through a R9500 tunnel-type tag detector to scan for a CWT. We assumed that a CWT was present in all fish that triggered the detector. Handling and sampling of marked steelhead with a CWT was different than handling and sampling of marked steelhead without a CWT, as described below.

Marked steelhead with a CWT:

During the initial screening of steelhead, half of the marked steelhead with a CWT were retained for spawning and half were sacrificed for tag recovery. After spawning, all marked steelhead containing a CWT were sacrificed for tag recovery. After approximately the third week of November the procedure for handling marked steelhead with a CWT changed; thereafter, steelhead with a CWT were not spawned.

Marked steelhead without a CWT:

Approximately half of the marked steelhead entering the hatchery without a CWT were released upstream of the Coleman NFH barrier weir during the initial sorting process and the other half were retained for spawning. The protocol used to sample marked steelhead prior to release above the Coleman NFH Barrier Weir was similar to that previously described for unmarked steelhead; however, due to the large numbers of fish being processed, scales were only collected from the first ten hatchery fish released each day.

Tissue and Scale Samples Collected

Samples of fin tissue were collected from a total of 150 marked steelhead spawned during the 2003 spawning season at the Coleman NFH. Fin tissues were collected, in replicates of three, from the caudal fin of the first twelve male and first thirteen female marked steelhead with a CWT spawned each day. Tissue and scales were collected using methods previously described for fall Chinook. Fin tissue samples were collected from 1,194 steelhead released above the barrier weir; including 769 marked and 425 unmarked fish (nine unmarked fish spawned then released). Scales were collected from 275 marked steelhead and all 425 unmarked steelhead.

Spawning and Sorting

Spawning of steelhead at the Coleman NFH occurred from 7 January to 27 February 2003. A total of 614 steelhead was spawned; including 602 marked and 12 unmarked fish (Tables 15 and 16). Seven hundred and sixty nine marked and 416 unmarked steelhead were released above the Coleman NFH barrier weir from 30 September 2002 through 27 February 2003 (Tables 15 and 17). Five hundred sixteen marked steelhead were excessed for CWT recovery (Tables 15 and 18) and 376 marked steelhead died in the holding ponds prior to processing (Table 15).

Table 17. Total numbers of adipose-fin clipped (marked) and unmarked steelhead released above the Coleman NFH barrier weir from 30 September 2002 through 27 February 2003. Coleman NFH staff have conventionally categorized steelhead as "longs" or "shorts" based on fork length measurements and this classification was retained throughout this report. Steelhead ≥56 cm were classified as longs.

	Adipose-Fin Clipped				Unmarked				
	Male		Female		Male		Female		
Date	Long	Short	Long	Short	Long	Short	Long	Short	**Total Released**
10/1/2002	1	1	1	1	1	0	2	1	**8**
10/2/2002	0	1	1	0	0	0	2	0	**4**
10/3/2002	0	1	0	3	2	0	0	0	**6**
10/4/2002	0	3	0	0	0	0	0	0	**3**
10/7/2002	1	1	0	2	1	0	1	0	**6**
10/8/2002	0	2	0	0	0	0	1	0	**3**
10/9/2002	0	0	1	0	0	0	0	0	**1**
10/11/2002	1	1	0	0	0	0	0	0	**2**
10/15/2002	0	1	0	0	1	0	1	0	**3**
10/16/2002	0	0	2	0	0	0	0	0	**2**
10/17/2002	1	1	0	1	0	0	1	0	**4**
10/18/2002	1	0	0	0	1	0	2	0	**4**
10/19/2002	0	1	0	0	0	0	0	0	**1**
10/21/2002	0	0	1	0	2	0	1	1	**5**
10/22/2002	1	1	1	0	0	0	0	0	**2**
10/23/2002	1	0	1	0	0	0	1	0	**3**
10/24/2002	0	1	0	1	1	0	1	0	**4**
10/25/2002	2	1	1	0	1	0	0	0	**5**
10/26/2002	1	0	0	1	0	0	0	0	**2**
10/27/2002	0	0	2	0	4	0	1	0	**7**
10/28/2002	0	1	2	1	0	0	3	0	**7**
10/29/2002	1	6	1	0	0	0	0	0	**8**
10/31/2002	0	0	2	0	0	0	0	0	**2**
11/5/2002	1	1	0	0	0	0	2	0	**4**
11/6/2002	0	2	2	4	1	1	2	0	**12**
11/7/2002	3	3	1	0	0	0	2	0	**9**
11/12/2002	5	16	3	7	4	6	9	5	**55**

Table 17. (Continued) Total numbers of adipose-fin clipped (marked) and unmarked steelhead released above the Coleman NFH barrier weir from 30 September 2002 through 27 February 2003. Fish were classified as longs or shorts based on fork length measurements, where fish ≥56 cm were considered to be longs.

	Adipose-Fin Clipped				Unmarked				
	Male		Female		Male		Female		**Total**
Date	Long	Short	Long	Short	Long	Short	Long	Short	**Released**
11/14/2002	2	28	16	17	8	4	13	8	**96**
11/19/2002	0	0	0	0	2	0	2	1	**5**
11/21/2002	13	25	12	18	5	1	17	4	**95**
11/26/2002	9	45	14	51	8	2	15	13	**157**
12/10/2002	6	49	5	58	6	7	11	15	**157**
12/20/2002	7	52	14	55	8	15	18	15	**184**
12/31/2002	0	0	0	0	1	6	2	11	**20**
1/3/2003	0	0	0	0	2	12	1	6	**21**
1/7/2003	0	0	0	0	0	1	0	0	**1**
1/9/2003	2	5	0	11	0	2	0	2	**22**
1/14/2003	0	12	1	31	1	6	2	10	**63**
1/23/2003	0	3	1	16	0	3	0	5	**28**
1/29/2003	0	0	0	0	0	3	2	14	**19**
1/31/2003	0	4	2	49	1	2	0	0	**58**
2/4/2003	0	0	0	0	0	0	0	2	**2**
2/7/2003	0	0	0	0	0	1	0	5	**6**
2/13/2003	0	0	0	0	2	3	0	3	**8**
2/20/2003	0	0	0	0	3	7	1	9	**20**
2/27/2003	0	5	1	23	3	4	1	14	**51**
Total	**58**	**273**	**88**	**350**	**69**	**86**	**117**	**144**	**1,185**

Table 18. Total numbers of adipose-fin clipped (marked) steelhead excessed at the Coleman NFH from 30 September 2002 through 27 February 2003. Coleman NFH staff have conventionally categorized steelhead as "longs" or "shorts" based on fork length measurements and this classification was retained throughout this report. Steelhead ≥56 cm were considered to be longs.

	Adipose-Fin Clipped				Unmarked				
	Male		Female		Male		Female		**Total**
Date	Long	Short	Long	Short	Long	Short	Long	Short	**Excessed**
11/19/2002	5	7	5	3	0	0	0	0	**20**
11/21/2002	12	33	26	33	0	0	0	0	**104**
11/26/2002	10	42	14	42	0	0	0	0	**108**
12/10/2002	7	59	11	38	0	0	0	0	**115**
12/20/2002	3	25	3	19	0	0	0	0	**50**
1/3/2003	0	1	0	0	0	0	0	0	**1**
1/9/2003	1	2	1	6	0	0	0	0	**10**
1/14/2003	0	5	0	13	0	0	0	0	**18**
1/21/2003	0	0	3	2	0	0	0	0	**5**
1/23/2003	0	1	1	8	0	0	0	0	**10**
1/29/2003	0	1	0	15	0	0	0	0	**16**
1/31/2003	1	2	3	14	0	0	0	0	**20**
2/4/2003	0	0	0	18	0	0	0	0	**18**
2/13/2003	0	0	0	1	0	0	0	0	**1**
2/20/2003	0	0	0	5	0	0	0	0	**5**
2/27/2003	1	0	1	13	0	0	0	0	**15**
Total	**40**	**178**	**68**	**230**	**0**	**0**	**0**	**0**	**516**

Recapture of Steelhead Rreleased Above the Coleman NFH Barrier Weir

All steelhead released upstream of the Coleman NFH barrier weir were tissue sampled with a circular punch through the upper lobe of the caudal fin, enabling them to be identified if they reentered the hatchery. One-hundred seventy-two of these fish returned to the Coleman NFH; 166 were marked and 6 were unmarked (these were not recounted in the total release numbers).

Table 19.-- Total numbers of adipose-fin clipped (marked) and unmarked steelhead recaptured at the Coleman NFH from 30 September 2002 through 27 February 2003. Coleman NFH staff have conventionally categorized steelhead as "longs" or "shorts" based on fork length measurements and this classification was retained throughout this report. Steelhead ≥56 cm were considered to be longs.

	Adipose-Fin Clipped				Unmarked				
	Male		Female		Male		Female		**Total**
Date	Long	Short	Long	Short	Long	Short	Long	Short	**Recaptured**
11/26/2002	0	1	0	0	0	0	0	0	**1**
12/10/2002	1	1	0	0	0	0	0	0	**2**
12/20/2002	5	15	3	14	0	2	0	0	**39**
12/31/2002	1	5	0	8	0	0	0	1	**15**
1/3/2003	4	19	2	13	0	0	0	0	**38**
1/9/2003	2	4	2	7	0	0	0	0	**15**
1/14/2003	0	16	2	16	0	1	0	0	**35**
1/23/2003	0	6	0	4	0	0	0	0	**10**
1/29/2003	1	10	0	3	0	0	0	0	**14**
1/31/2003	0	0	0	0	0	0	0	1	**1**
2/20/2003	0	0	0	0	0	0	0	1	**1**
2/27/2003	0	1	0	0	0	0	0	0	**1**
Totals	**14**	**78**	**9**	**65**	**0**	**3**	**0**	**3**	**172**

Sampling Marked Steelhead for Coded-Wire Tags

As described above, all marked steelhead collected at the Coleman NFH during the 2002-2003 spawning season were electronically scanned for a CWT. Heads were collected from 851 steelhead that were indicated by the R9500 tunnel-type detector as containing a CWT; including 148 spawned fish, 486 excessed fish, and 217 fish that expired in the ponds (DIP) prior to being processed at the hatchery (Table 20).

Table 20.—Results of coded-wire tag extractions from steelhead collected 10 December 2002 through 27 February 2003. Tag extractions were categorized as "read and verified", "unreadable", "lost" (a tag that was initially observed and/or recovered from a salmon head but was lost before it could be read and verified), or was not detected or observed in the dead during the tag recovery process (NTD). "DIP" indicates a fish that died in the hatchery holding ponds

	Excessed	Spawned	DIP	**Totals**
Read and Verified	456	138	149	**743**
Unreadable	1	0	2	**3**
Lost	8	4	9	**21**
NTD	21	6	57	**84**
Totals	**486**	**148**	**217**	**851**

Tag Recovery and Verification

Methods for CWT recovery, reading, and verification were the same as those previously described for fall Chinook. Of the 851 steelhead heads collected at the hatchery, 743 (87.3%) contained a readable tag with a verified code, Three heads (0.3%) contained a CWT that was unreadable, 21 (2.4%) contained a CWT that was initially observed and/or recovered but was lost before it could be read and verified. A CWT was neither observed nor detected in 84 (9.9%) collected heads (Table 20). In cases where no tag was detected, it is possible that there was a false-positive detection when the fish were previously screened at the hatchery (e.g. a fish hook, etc. could have triggered the R9500 tunnel-type tag detector).

Origin of Coded-Wire Tagged Steelhead Collected at the Coleman NFH During the 2002-2003 Broodstock Collection Season

Seven hundred and forty-three CWTs were successfully extracted and read. Seven hundred and forty-two CWT's were identified as tags from steelhead originating at the Coleman NFH and one was identified as a tag from a brood year 2000 (age-3) Feather River Hatchery steelhead.

Age and Size-at-Age of Coded-Wire Tagged Steelhead Originating at the Coleman NFH

As described above, all steelhead originating at the Coleman NFH have been marked with an adipose fin-clip since 1998. However, coded-wire tags were applied only to specific groups of study fish. Therefore, age and size-at-age information based on steelhead recovered with a coded-wire tag may not be representative of the general production steelhead releases and; therefore, that data is not included in this report. Evaluation of these specific study groups will be included in corresponding investigation reports.

Acknowledgments

We would like to thank the Hatchery Evaluation program staff at the Red Bluff Fish and Wildlife Office for assisting in all aspects of this data collection: Curtis Brownfield, Karie Hiam, Laura Mahoney, William McKinney, Tyler Miranda, Kevin Niemela, Robert Null, Kevin Offill, Rochelle Phillips, Randy Rickert, and Greg True. In addition, we appreciate the assistance provided by the staff of the Coleman NFH: Julia Chittenden, Jason Fookes, Jeff Fruend, Scott Hamelberg, J.B. Hooper, Jeff Laurie, John Rueth, John Scott, John Silva, and Ralph Winstead.

Appendix A. Actual (CWTi) and expanded (Ri) coded-write tag recoveries by hatchery, release location, tag code, run, brood year, and age-at return. Expansions are based on the number of marked (clipped and tagged) and unmarked fish initially released in that tag group. Acronyms for the various salmon production facilities are as follows: Coleman NFH (CNFH), Feather River Hatchery (FRH), Merced River Fish Facility (MRFF), and Mokelumne River Hatchery (MRH).

Hatchery Stock	Release Location	CWT Code	Run	Brood Year	Age	Clipped and Tagged	Not Marked	Recoveries (CWTi)	Expanded Recoveries (Ri)
CNFH	Battle Creek	0501020512	Fall	1997	5	27,628	421,622	1	17
CNFH	Battle Creek	0501020607	Fall	1997	5	33,520	410,702	1	14
CNFH	Battle Creek	0501020705	Fall	1997	5	34,735	616,962	1	19
CNFH	Battle Creek	0501021007	Fall	1998	4	24,239	429,737	11	211
CNFH	Battle Creek	0501021008	Fall	1998	4	22,091	446,296	13	283
CNFH	Battle Creek	0501021009	Fall	1998	4	28,376	417,780	12	194
CNFH	Battle Creek	0501021010	Fall	1998	4	28,507	417,649	13	209
CNFH	Battle Creek	0501021011	Fall	1998	4	31,306	461,603	16	258
CNFH	Battle Creek	0501021012	Fall	1998	4	31,228	461,681	13	210
CNFH	Battle Creek	0501021013	Fall	1998	4	34,037	461,420	17	254
CNFH	Battle Creek	0501021014	Fall	1998	4	34,171	461,286	16	238
CNFH	Battle Creek	0501021015	Fall	1998	4	29,997	896,021	7	222
CNFH	Battle Creek	0501021101	Fall	1998	4	32,136	411,911	21	298
CNFH	Battle Creek	0501021102	Fall	1998	4	32,721	411,327	15	209
CNFH	Battle Creek	0501021103	Fall	1998	4	33,101	441,082	14	206
CNFH	Battle Creek	0501021104	Fall	1998	4	32,280	441,903	11	166
CNFH	Battle Creek	0501021105	Fall	1998	4	30,240	442,756	9	144
CNFH	Battle Creek	0501021106	Fall	1998	4	32,241	440,756	8	120
CNFH	Battle Creek	0501021107	Fall	1998	4	34,328	443,321	15	214
CNFH	Battle Creek	0501021108	Fall	1998	4	37,763	200,903	13	84
CNFH	Battle Creek	0501021109	Fall	1998	4	37,875	200,791	14	90
CNFH	Battle Creek	0501021110	Fall	1998	4	34,689	441,746	21	296
CNFH	Battle Creek	0501021111	Fall	1998	4	36,099	441,569	15	204
CNFH	Battle Creek	0501021112	Fall	1998	4	35,099	445,164	21	295
CNFH	Battle Creek	0501021113	Fall	1998	4	36,166	444,097	13	177
CNFH	Battle Creek	0501021114	Fall	1998	4	36,245	406,709	12	150

Appendix A. (Continued) Actual (CWTi) and expanded (Ri) coded-write tag recoveries by hatchery, release location, tag code, run, brood year, and age-at return. Expansions are based on the number of marked (clipped and tagged) and unmarked fish initially released in that tag group. Acronyms for the various salmon production facilities are as follows: Coleman NFH (CNFH), Feather River Hatchery (FRH), Merced River Fish Facility (MRFF), and Mokelumne River Hatchery (MRH).

Hatchery Stock	Release Location	CWT Code	Run	Brood Year	Age	Clipped and Tagged	Not Marked	Recoveries (CWTi)	Expanded Recoveries (Ri)
CNFH	Battle Creek	0501021115	Fall	1998	4	35,530	447,845	18	251
CNFH	Battle Creek	0501021201	Fall	1998	4	36,332	416,259	12	153
CNFH	Battle Creek	0501021202	Fall	1998	4	36,487	286,339	12	109
CNFH	Below RBDD	0501011514	Fall	1999	3	48,798	492	93	96
CNFH	Clarksburg	0501011515	Fall	1999	3	46,216	2,690	2	2
CNFH	Below RBDD	0501020101	Fall	1999	3	47,098	1,708	56	60
CNFH	Clarksburg	0501020102	Fall	1999	3	47,168	963	2	2
CNFH	Below RBDD	0501021310	Fall	1999	3	11,072	833	1	1
CNFH	Battle Creek	0501021313	Fall	1999	3	33,820	439,847	115	1652
CNFH	Battle Creek	0501021314	Fall	1999	3	34,092	460,944	80	1192
CNFH	Battle Creek	0501021315	Fall	1999	3	32,817	417,081	114	1603
CNFH	Battle Creek	0501021401	Fall	1999	3	32,504	504,650	122	2068
CNFH	Battle Creek	0501021402	Fall	1999	3	34,176	415,377	139	1875
CNFH	Battle Creek	0501021403	Fall	1999	3	34,264	429,459	142	1971
CNFH	Battle Creek	0501021404	Fall	1999	3	34,628	415,175	122	1625
CNFH	Battle Creek	0501021405	Fall	1999	3	33,380	417,372	136	1884
CNFH	Battle Creek	0501021406	Fall	1999	3	33,366	413,660	128	1759
CNFH	Battle Creek	0501021407	Fall	1999	3	34,789	414,959	164	2175
CNFH	Battle Creek	0501021408	Fall	1999	3	33,500	427,852	151	2133
CNFH	Battle Creek	0501021409	Fall	1999	3	34,381	417,417	157	2116
CNFH	Battle Creek	0501021410	Fall	1999	3	32,814	427,232	129	1855
CNFH	Battle Creek	0501021411	Fall	1999	3	34,306	351,225	151	1741
CNFH	Battle Creek	0501021412	Fall	1999	3	35,099	414,271	142	1865
CNFH	Battle Creek	0501021413	Fall	1999	3	34,002	414,515	133	1800
CNFH	Battle Creek	0501021414	Fall	1999	3	35,047	182,119	186	1182
CNFH	Battle Creek	0501021415	Fall	1999	3	32,609	454,628	107	1640

Appendix A. (Continued) Actual (CWTi) and expanded (Ri) coded-write tag recoveries by hatchery, release location, tag code, run, brood year, and age-at return. Expansions are based on the number of marked (clipped and tagged) and unmarked fish initially released in that tag group. Acronyms for the various salmon production facilities are as follows: Coleman NFH (CNFH), Feather River Hatchery (FRH), Merced River Fish Facility (MRFF), and Mokelumne River Hatchery (MRH).

Hatchery Stock	Release Location	CWT Code	Run	Brood Year	Age	Clipped and Tagged	Not Marked	Recoveries (CWTi)	Expanded Recoveries (Ri)
CNFH	Battle Creek	0501021501	Fall	1999	3	33,860	438,526	113	1617
CNFH	Battle Creek	0501021502	Fall	1999	3	34,076	420,149	102	1395
CNFH	Battle Creek	0501021503	Fall	1999	3	34,616	414,663	88	1172
CNFH	Battle Creek	0501021504	Fall	1999	3	34,174	385,738	108	1361
CNFH	Battle Creek	0501021505	Fall	1999	3	34,195	386,798	114	1440
CNFH	Battle Creek	0501021506	Fall	1999	3	34,703	321,762	113	1191
CNFH	Battle Creek	0501021507	Fall	1999	3	34,553	410,962	75	992
CNFH	Battle Creek	0501021508	Fall	1999	3	36,126	404,913	99	1240
CNFH	Battle Creek	0501021509	Fall	1999	3	35,908	178,288	91	557
CNFH	Battle Creek	050497	Fall	2000	2	65,275	296,599	16	91
CNFH	Battle Creek	050498	Fall	2000	2	65,412	412,836	19	142
CNFH	Battle Creek	050499	Fall	2000	2	62,110	319,589	28	177
CNFH	Battle Creek	050564	Fall	2000	2	58,822	377,443	26	198
CNFH	Battle Creek	050565	Fall	2000	2	64,185	382,042	10	71
CNFH	Battle Creek	050566	Fall	2000	2	64,479	363,207	24	163
CNFH	Battle Creek	050567	Fall	2000	2	62,403	365,585	33	232
CNFH	Battle Creek	050568	Fall	2000	2	65,645	381,961	9	63
CNFH	Battle Creek	050569	Fall	2000	2	65,355	347,310	32	207
CNFH	Battle Creek	050570	Fall	2000	2	64,981	373,224	33	228
CNFH	Battle Creek	050571	Fall	2000	2	65,463	404,974	27	199
CNFH	Battle Creek	050572	Fall	2000	2	65,502	366,053	28	189
CNFH	Battle Creek	050573	Fall	2000	2	64,110	395,945	12	88
CNFH	Clarksburg	0501021515	Fall	2000	2	46,944	3,533	1	1
CNFH	Below RBDD	0501030501	Fall	2000	2	46,413	4,036	2	2
CNFH	Below RBDD	0501030502	Fall	2000	2	44,594	4,955	4	5
CNFH	Battle Creek	0501030503	Fall	2000	2	57,896	378,614	7	54

Appendix A. (Continued) Actual (CWTi) and expanded (Ri) coded-write tag recoveries by hatchery, release location, tag code, run, brood year, and age-at return. Expansions are based on the number of marked (clipped and tagged) and unmarked fish initially released in that tag group. Acronyms for the various salmon production facilities are as follows: Coleman NFH (CNFH), Feather River Hatchery (FRH), Merced River Fish Facility (MRFF), and Mokelumne River Hatchery (MRH).

Hatchery Stock	Release Location	CWT Code	Run	Brood Year	Age	Clipped and Tagged	Not Marked	Recoveries (CWTi)	Expanded Recoveries (Ri)
CNFH	Battle Creek	0501030504	Fall	2000	2	62,298	384,332	28	206
CNFH	Battle Creek	0501030505	Fall	2000	2	61,379	367,205	27	193
CNFH	Battle Creek	0501030506	Fall	2000	2	62,634	463,709	28	241
CNFH	Battle Creek	0501030507	Fall	2000	2	59,109	374,695	20	151
CNFH	Battle Creek	0501030508	Fall	2000	2	59,872	369,207	35	257
CNFH	Battle Creek	0501030509	Fall	2000	2	58,197	421,279	15	127
CNFH	Battle Creek	0501030601	Fall	2000	2	58,049	421,945	10	85
CNFH	Battle Creek	0501030602	Fall	2000	2	61,071	363,482	18	128
CNFH	Battle Creek	0501030603	Fall	2000	2	61,754	379,333	28	205
CNFH	Battle Creek	0501030604	Fall	2000	2	62,325	463,840	21	182
CNFH	Battle Creek	0501030605	Fall	2000	2	61,099	366,257	17	122
CNFH	Battle Creek	0501030606	Fall	2000	2	63,265	383,190	8	58
CNFH	Battle Creek	0501030607	Fall	2000	2	60,878	396,277	8	62
CNFH	Battle Creek	0501030608	Fall	2000	2	60,792	399,417	13	101
FRH	Crockett	062637	Fall	1998	4	49,140	1,003	1	1
FRH	Georgianna Slough	0501020713	Fall	1998	4	26,248	244	1	1
FRH	Ryde-Koket	0501020715	Fall	1998	4	25,133	126	1	1
FRH	Isleton	0501020809	Fall	1999	3	26,837	135	1	1
FRH	Yolo Bypass	0601061104	Fall	1999	3	100,901	4,810	1	1
FRH	Wickland Oil Net Pen	062664	Fall	2000	2	202,096	719,407	27	126
FRH	Wickland Oil Net Pen	062665	Fall	2000	2	142,204	719,713	20	124
FRH	Rodeo Minor Port	062669	Fall	2000	2	32,082	2,194	1	1
FRH	Rodeo Minor Port	062671	Fall	2000	2	31,575	2,159	3	3
FRH	Rodeo Minor Port	062672	Fall	2000	2	42,003	2,872	3	3
FRH	Rodeo Minor Port	062673	Fall	2000	2	46,642	3,189	2	2
FRH	Rodeo Minor Port	062674	Fall	2000	2	47,369	3,239	3	3

Appendix A. (Continued) Actual (CWTi) and expanded (Ri) coded-write tag recoveries by hatchery, release location, tag code, run, brood year, and age-at return. Expansions are based on the number of marked (clipped and tagged) and unmarked fish initially released in that tag group. Acronyms for the various salmon production facilities are as follows: Coleman NFH (CNFH), Feather River Hatchery (FRH), Merced River Fish Facility (MRFF), and Mokelumne River Hatchery (MRH).

Hatchery Stock	Release Location	CWT Code	Run	Brood Year	Age	Clipped and Tagged	Not Marked	Recoveries (CWTi)	Expanded Recoveries (Ri)
FRH	Rodeo Minor Port	062675	Fall	2000	2	42,704	2,920	2	2
FRH	Rodeo Minor Port	062676	Fall	2000	2	44,021	3,010	3	3
FRH	Feather River	062712	Fall	2000	2	19,810	100	1	1
FRH	Feather River	062713	Fall	2000	2	20,129	101	1	1
MRFF	Jersey Pt, San Joaquin	064403	Fall	1999	3	25,527	776	1	1
MRFF	Jersey Pt, San Joaquin	0601061001	Fall	1999	3	25,572	488	1	1
MRFF	Jersey Pt, San Joaquin	064434	Fall	2000	2	24,444	1,287	1	1
MRFF	Jersey Pt, San Joaquin	064441	Fall	2000	2	25,910	130	1	1
MRFF	Jersey Pt, San Joaquin	064442	Fall	2000	2	25,466	257	1	1
MRH	Wickland Oil Net Pen	060251	Fall	1999	3	51,765	438,256	2	19
MRH	New Hope Landing	060252	Fall	1999	3	51,134	1,222	1	1
MRH	SF Mokelumne River	060266	Fall	2000	2	50,964	199	1	1
Tiburon Net Pens	Tiburon Net Pens	062940	Fall	1999	3	28,888	500	3	3
Tiburon Net Pens	Tiburon Net Pens	062941	Fall	2000	2	41,819	12	10	10
CNFH	Georgianna Slough	052308	Late-fall	1998	5	69,180	2,140	1	1
CNFH	Battle Creek	055140	Late-fall	1999	4	70,129	4,082	1	1
CNFH	Battle Creek	055141	Late-fall	1999	4	75,948	4,848	5	5
CNFH	Battle Creek	055207	Late-fall	1999	4	79,469	399	11	11
CNFH	Battle Creek	055208	Late-fall	1999	4	84,024	1,280	10	10
CNFH	Battle Creek	055210	Late-fall	1999	4	93,088	468	2	2
CNFH	Battle Creek	055211	Late-fall	1999	4	81,228	820	3	3
CNFH	Battle Creek	055213	Late-fall	1999	4	81,263	2,084	1	1
CNFH	Battle Creek	050398	Late-fall	2000	3	54,568	1,979	4	4
CNFH	Battle Creek	050399	Late-fall	2000	3	65,285	2,020	8	8
CNFH	Battle Creek	050465	Late-fall	2000	3	56,146	568	3	3
CNFH	Battle Creek	050466	Late-fall	2000	3	70,032	1,066	3	3

Appendix A. (Continued) Actual (CWTi) and expanded (Ri) coded-write tag recoveries by hatchery, release location, tag code, run, brood year, and age-at return. Expansions are based on the number of marked (clipped and tagged) and unmarked fish initially released in that tag group. Acronyms for the various salmon production facilities are as follows: Coleman NFH (CNFH), Feather River Hatchery (FRH), Merced River Fish Facility (MRFF), and Mokelumne River Hatchery (MRH).

Hatchery Stock	Release Location	CWT Code	Run	Brood Year	Age	Clipped and Tagged	Not Marked	Recoveries (CWTi)	Expanded Recoveries (Ri)
CNFH	Battle Creek	050467	Late-fall	2000	3	62,127	312	3	3
CNFH	Battle Creek	050468	Late-fall	2000	3	62,578	314	4	4
CNFH	Walnut Grove	050479	Late-fall	2000	3	27,106	1,032	1	1
CNFH	Battle Creek	050699	Late-fall	2001	2	88,039	0	2	2
CNFH	Battle Creek	050764	Late-fall	2001	2	73,856	746	7	7
CNFH	Ryde-Koket	050767	Late-fall	2001	2	52,327	1,342	1	1
CNFH	Port Chicago	050768	Late-fall	2001	2	47,876	0	1	1
CNFH	Battle Creek	050769	Late-fall	2001	2	77,418	0	13	13
CNFH	Battle Creek	050770	Late-fall	2001	2	74,770	0	12	12
CNFH	Battle Creek	050771	Late-fall	2001	2	71,621	1,091	19	20
CNFH	Battle Creek	050772	Late-fall	2001	2	78,216	0	14	14
CNFH	Battle Creek	050773	Late-fall	2001	2	66,305	333	2	2
CNFH	Battle Creek	050774	Late-fall	2001	2	74,780	376	1	1
CNFH	Battle Creek	055135	Late-fall	2001	2	68,226	343	5	5
FRH	Rodeo Minor Port	062678	Spring	2000	2	46,052	2,732	3	3
FRH	Rodeo Minor Port	062679	Spring	2000	2	46,052	2,732	1	1
FRH	Rodeo Minor Port	062680	Spring	2000	2	47,742	2,832	1	1
FRH	Rodeo Minor Port	062681	Spring	2000	2	47,742	2,832	1	1
FRH	Rodeo Minor Port	062682	Spring	2000	2	47,742	2,832	2	2