McGarvey Creek Salmonid Outmigration Monitoring

2012 Technical Memorandum

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In Partnership with:

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Introduction

McGarvey Creek enters the Klamath River 6.4 river miles (RM) upstream of the Pacific Ocean (Figure 1). The watershed supports runs of chinook, coho, steelhead and coastal cutthroat and provides critical rearing habitat for non-natal fish populations, especially coho salmon (YTFP 2009). The watershed has been subjected to intense logging and road building activities including the construction of the U.S. Highway 101 bypass through the headwaters in the mid-1980's (Gale and Randolph 2000). Historic logging resulted in the extraction of virtually all conifers from riparian corridors and large wood recruitment zones throughout the watershed, in addition to removal of a majority of instream wood and naturally formed jams. Past management activities have also resulted in excessive sediment delivery to fluvial habitats of McGarvey Creek. These conditions continue to limit both the quantity and quality of habitat available for juvenile and adult salmonids and reduce productivity of natal and non-natal salmonids utilizing the drainage.

The Lower Klamath River Sub-basin Restoration Plan identified McGarvey Creek as a high priority watershed for restoration based on the number of salmonid populations persisting in the system and the potential for providing high quality coho habitat once restored (Gale and Randolph 2000). Therefore, the Yurok Tribe's Fisheries (YTFP), Watershed Restoration (YTWRD), and Environmental (YTEP) programs have been conducting watershed and fisheries investigations and implementing restoration in the watershed for over a decade. YTWRD completed a road inventory in 1997 and has since treated all medium and high priority road segments in coordination with Green Diamond Resource Company (GDRC). In addition to upslope restoration activities, YTFP has modified several fish passage barriers to re-establish salmonid access to upstream habitats and constructed habitat structures to immediately improve spawning and rearing conditions in the watershed (Gale 2008; Gale 2009). YTFP has also implemented extensive planting of riparian habitats and associated floodplains with native conifers that (when recruited to fluvial habitats) will facilitate the formation of complex habitats and retain high quality spawning gravels. In addition to efforts by YTFP and YTWRD, YTEP has been monitoring water quality and quantity in the watershed since water year 2002.

In order for the Yurok Tribe to assess the effectiveness of watershed restoration projects in Lower Klamath tributaries, essential baseline data must continue to be collected to assess and quantify existing conditions, monitor trends over time, and gauge the success of ongoing and future restoration projects. YTFP has been monitoring salmonid populations in the McGarvey Creek watershed since 1997 and has gradually increased the effort and objectives over the past fourteen years. In 1997 YTFP initiated a long-term assessment and monitoring of McGarvey Creek salmonid populations and their associated habitat out of concerns over diminishing anadromous fish runs and a need to establish baseline data from which to monitor habitat and population trends over time. YTFP began annual outmigrant trapping in lower McGarvey Creek in 1997 and has been

conducting juvenile salmonid summer abundance estimates in McGarvey Creek since 2002 (YTFP 2009). Consistent, long-term monitoring of McGarvey Creek salmonid populations allows YTFP to: 1) quantify juvenile emigration, 2) collect species/age composition data, 3) document population trends, 4) describe life-history patterns of McGarvey Creek salmonid populations, and 5) describe non-natal use of McGarvey Creek by juvenile salmonids, specifically coho, originating from throughout the Klamath Basin. This information will also allow YTFP to obtain the necessary data to continue guiding Lower Klamath resource management, habitat restoration planning and implementation, restoration effectiveness monitoring, and ESA-related issues.

Study Area

McGarvey Creek is a small, low gradient coastal stream draining 8.9 square miles of moderately steep, forested lands in the Lower Klamath River (Figures 1 and 2). McGarvey Creek begins at an elevation of 75 feet at its confluence with the Klamath River and extends 4.9 miles to its headwaters, located at an elevation of 600 feet. The West Fork of McGarvey Creek, which is the principle tributary in the drainage, totals 2.2 miles in length. Virtually all of McGarvey Creek is owned by GDRC and is managed for commercial timber production.

The lower mainstem reach of McGarvey Creek is sinuous, flowing through a broad floodplain as it nears the Klamath River. Upper mainstem McGarvey Creek is moderately steep and confined by the valley side walls and contains natural and anthropogenic barriers to anadromous species. The West Fork of McGarvey is low gradient (≤3%) with the exception of one 2,235 ft. section (YTFP habitat mapping data 1996). Stream substrates within the drainage consist of highly embedded gravels with approximately 30% of the streambed consisting of silt or sand (YTFP habitat mapping data 1996).

The McGarvey Creek watershed receives high annual rainfall, averaging 100 inches per year. YTEP began operating a stream gage just downstream of the confluence of the mainstem and West Fork McGarvey in December 2001. Stream gage data collected in the watershed suggests that discharge is strongly related to rainfall, especially during winter when the groundwater table is elevated. The highest streamflow measurement taken by YTEP in McGarvey Creek was 292 cubic feet per second (cfs), although higher estimates have been made based on gage height and a rating curve generated by existing flow measurements.

McGarvey Creek affords fish access to and from the mainstem Klamath for much of the year with marginal or no access during periods of low flow in the summer months. In some years, streamflow in mainstem reaches can go subsurface for an indeterminate length during late summer (Beesley and Fiori 2007). In addition to native salmonids, McGarvey Creek also supports coastrange sculpin (*Cottus aleuticus)*, prickly sculpin (*Cottus asper*), Klamath smallscale sucker (*Catostomus rimiculus)*, speckled dace

(*Rhynichthys osculus)*, three spine stickleback (*Gasterosteus aculeatus)*, Pacific lamprey (*Lampetra tridentata)*, and brook lamprey (*Lampetra lethophaga*).

Vegetation of the McGarvey Creek watershed was historically comprised of old growth conifers, predominantly coastal redwood (*Sequoia sempervirens*), Sitka spruce (*Picea sitchensis*) and Douglas fir (*Pseudotsuga menziesii*) with cedar (*Cedrus* spp.) and western hemlock (*Tsuga heterophylla*). Presently, riparian habitats of McGarvey Creek are dominated by red alder (*Alnus rubra*). Big leaf maple *(Acer macrophyllum*), vine maple (*Acer circinatum*), tanoak (*Lithocarpus densiflorus*), Pacific madrone (*Arbutus menziesii*), California laurel (*Umbellularia californica*) and willow (*Salix* spp.) are also found within riparian habitats of the watershed.

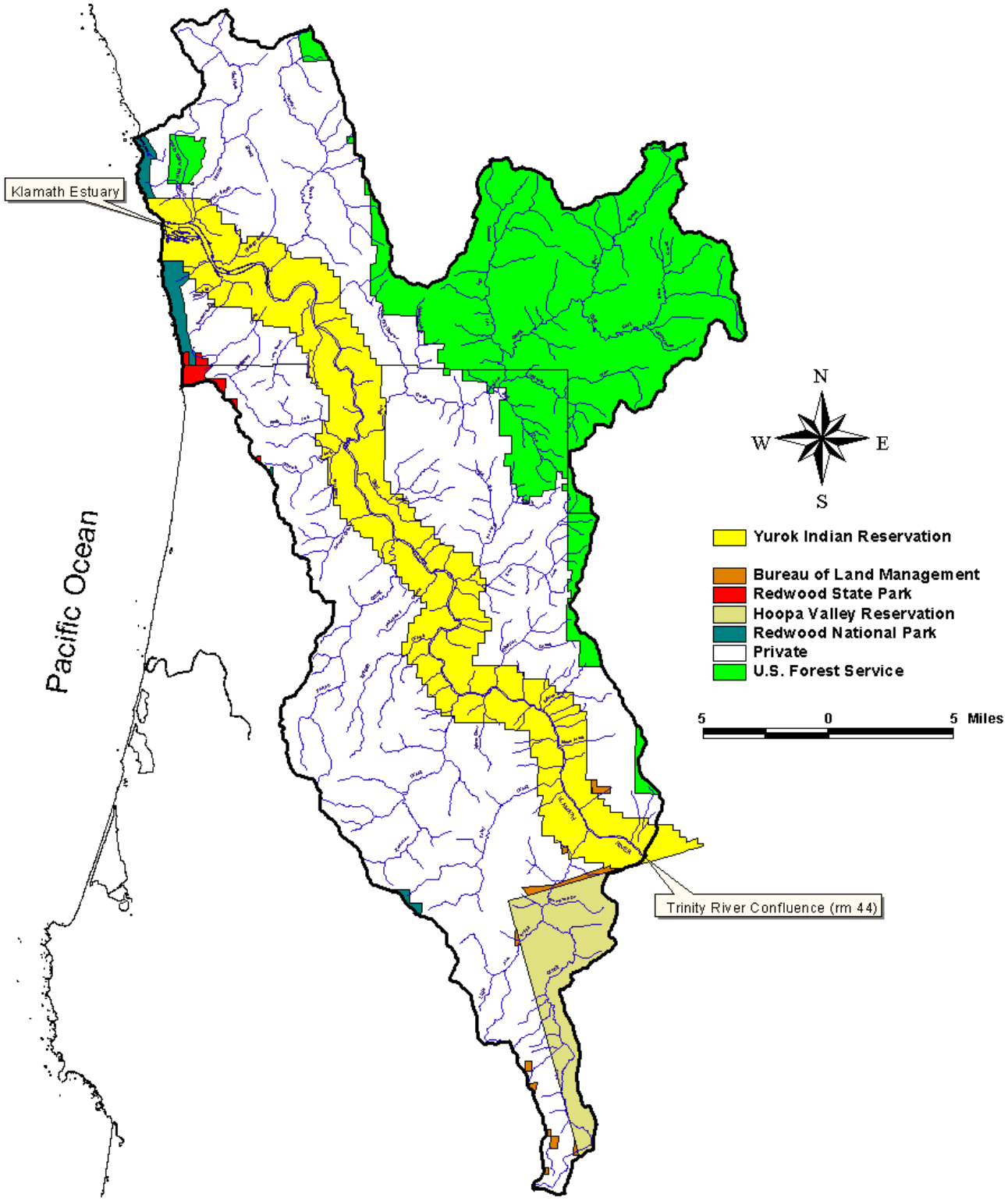

Figure 1. Lower Klamath River Sub-basin, California, with McGarvey Creek identified.

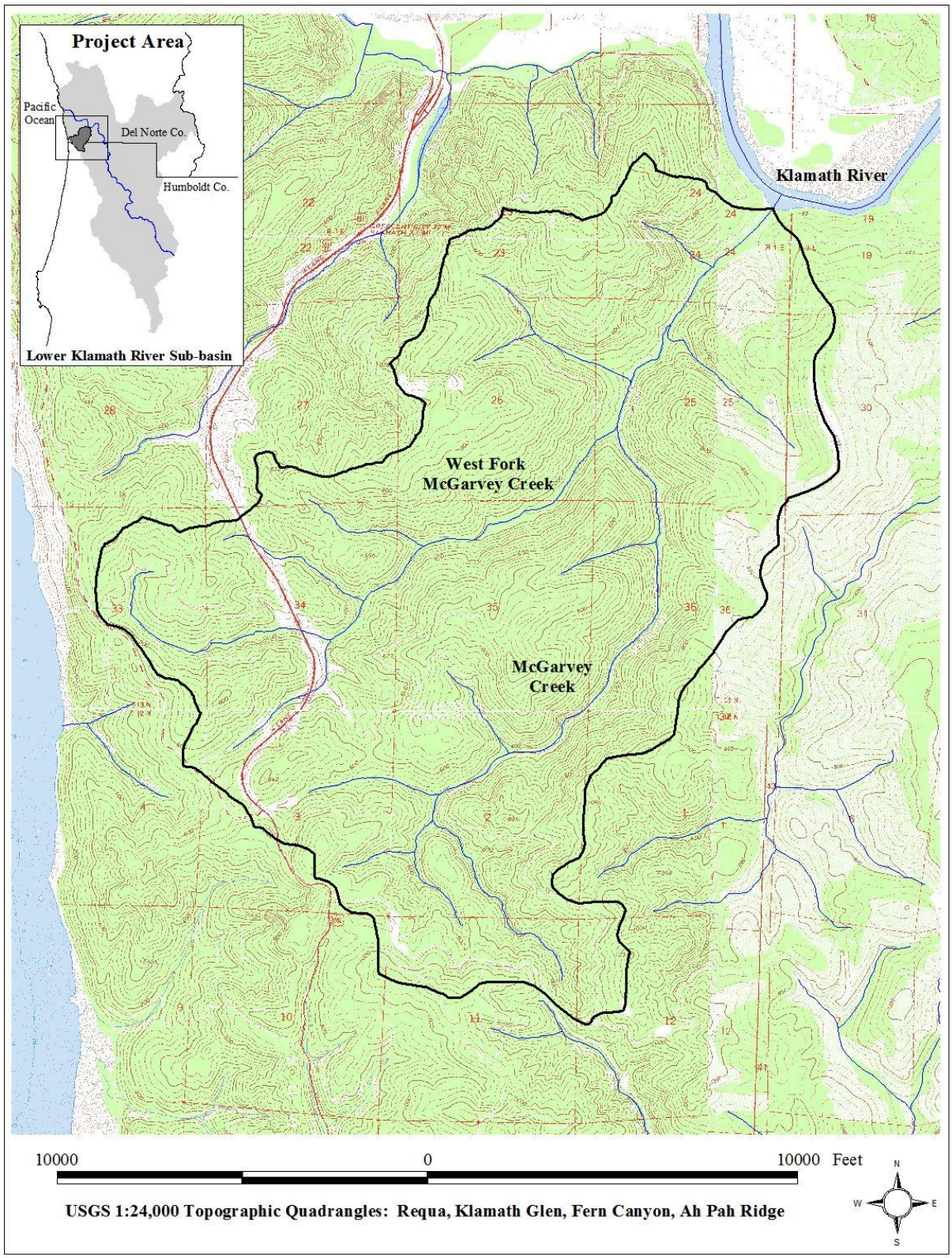

Figure 2. Map of the McGarvey Creek watershed, Lower Klamath River, California. Blue Creek Outmigrant Screw Trap

Methods

YTFP conducted outmigrant trapping between March 2012 – July 2012 in mainstem McGarvey Creek just downstream of the lower bridge on GDRC Road # M-10 at RM 1.25 (Figure 3). This site was selected based on channel characteristics, accessibility, and previous monitoring conducted at this site. The trapping site was not located further downstream because the Klamath River routinely backfloods into lower McGarvey Creek during higher flow events. Therefore, the trap site was situated upstream of the typical inundation zone.

The outmigrant trap was installed on March 7, 2012 and operated 24 hours a day, seven days a week through July 9, 2012 (99 sample days). The trap was dismantled during high flows that occurred between March 14, 2012 and April 9, 2012.

The outmigrant trap was constructed of weir panels, sand bags, T-posts, and 20 ft. sections of eight inch diameter PVC pipe leading from a frame net to the live boxes (Figure 3). Weir panels were made from one ft. by four ft. wood frames with ¼ inch hardware cloth. T-posts were used to position weir panels in a V-shaped configuration and the pipe was positioned at the vertex of this V-shape. The panels were positioned so that 95% of the stream channel was funneled to the pipe inlet. A two ft. wide passage was maintained in the weir to allow upstream fish migration. A 15 ft. long frame net with a four ft. by six ft. opening was inserted between the weir and the pipe during high flow periods to aid in dissipating streamflow. This allowed the trap to be operated over a wider range of discharge levels and minimized downtime associated with high flow events.

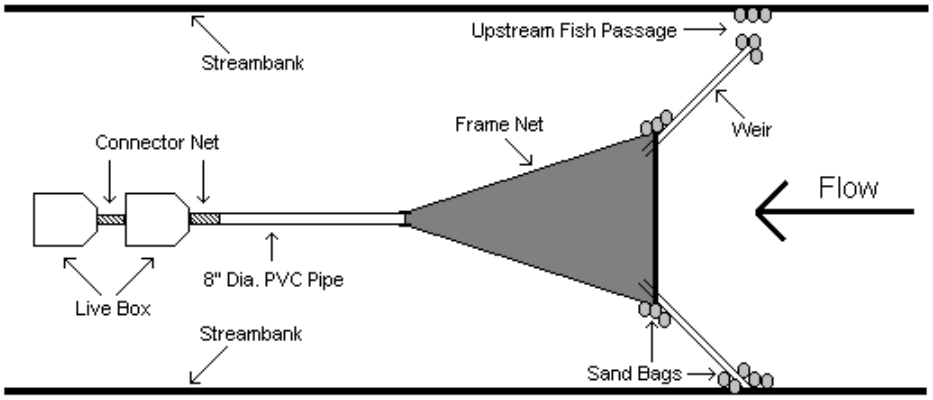

Figure 3. Schematic diagram of outmigrant trap deployed in McGarvey Creek, 1997-2012.

YTFP checked the trap daily in the morning hours to reduce holding times and temperature-induced stress. Captured fish were removed from live boxes in small groups of 20 - 30 fish and placed in five-gallon buckets. Holding water was replenished regularly to maintain water quality. All salmonids were anaesthetized using FINQUEL® MS-222 (tricaine methanesulfonate) and identified to species and age class. YTFP measured fork lengths from a random sample of up to 30 fish of each salmonid species, as well as inspected all captured salmonids for physical marks and passive integrated transponder (PIT) tags. Each captured salmonid was given a smolt condition factor as follows: parr (distinct parr marks), intermediate smolt (fading parr marks with some silvering), or smolt (no parr marks, distinct silver coloration and black pigment on fin margins). All non-salmonid species were enumerated and released downstream of the trap site and any invasive species captured were euthanized.

Efficiency and Emigration Estimates

Annual emigration estimates were calculated for all salmonid species. Mark-recapture methods were utilized to estimate species-specific trapping efficiencies throughout each trapping season. These efficiencies enabled expansion of captured fish numbers to estimate the total number of emigrants by species during each season. Kennan et al. (1994) and Polos (1997) noted the following assumptions are made when conducting such a mark-recapture experiment:

(1) Marked fish continue their migration downstream after release
(2) Handling and marking fish will not affect their behavior
(3) Marked and unmarked fish are evenly distributed when they migrate past the trapping site and exhibit similar behavior (equal capture probability)
(4) Fish do not lose their marks prior to passing through trap site
(5) All marks are observed and recorded
(6) Mortality of marked fish prior to recapture is minimal

Anesthetized salmonids were marked with a partial fin clip (only the tips of selected fins were removed) using surgical scissors. To increase reliability of trap efficiency estimates, several different clips were used to enable tracking of marked fish from discrete weekly marking periods. After all marked fish recovered from the anesthesia, they were transported 500 feet upstream of the trap in buckets and released into the creek.

All marked and recaptured fish from the outmigrant trap were categorized by mark type and assigned discrete marking time-periods (weekly intervals). Trap efficiency estimates for each marking period were calculated using the following formula:

$E = R/M * 100$

where

M = number of fish marked from a given marking period

R = number of fish recaptured from a given marking period

Estimates from each marking period were calculated using Darroch Analysis with Rank Reduction (DARR 2.0.2) software (Bjorkstedt 2005, Bjorkstedt 2010).

Summary

YTFP operated the outmigrant frame-net pipe trap for a total of 99 days in 2012. During this period the outmigrant trap captured a total of 293 coho young-of-the-year and 531 coho yearlings. The trap also captured 1,119 age 1+ and older steelhead, 1,003 age 1+ and older cutthroat trout, 861 chinook YOY, and 28 trout YOY (Table 1).

Table 1. Total number of juvenile salmonids captured by week in the outmigrant trap, McGarvey Creek, 2012.

Week Ending	# Days Sampled	Coho		Chinook	Steelhead	Cutthroat	Trout YOY
		YOY	Yearling				
11-Mar-12	4	2	4	0	57	33	0
18-Mar-12	3	12	13	0	35	52	0
25-Mar-12	0						
1-Apr-12	0	*Trap not fishing due to high flows*					
8-Apr-12	0						
15-Apr-12	7	156	38	65	441	311	21
22-Apr-12	7	61	125	38	165	248	0
29-Apr-12	7	63	108	23	102	136	0
6-May-12	7	3	72	15	62	94	0
13-May-12	7	10	87	46	127	71	0
20-May-12	7	2	66	76	72	26	0
27-May-12	7	2	10	38	22	9	0
3-Jun-12	7	0	4	75	11	1	0
10-Jun-12	7	4	1	114	2	1	0
17-Jun-12	7	1	2	240	13	6	2
24-Jun-12	7	4	0	82	8	10	2
1-Jul-12	7	3	1	39	0	5	3
8-Jul-12	7	0	0	9	2	0	0
9-Jul-12	1	0	0	1	0	0	0
		- Trap Pulled on 9-Jul-12 Due to Low Fish Numbers -					
Season Totals:	99	293	531	861	1,119	1,003	28

Coho

A total of 531 coho salmon yearlings were captured during 99 days of sampling between March and July of 2012 (Table 1). Coho salmon yearlings were captured immediately following trap installation on March 7, 2012, indicating that juveniles likely began emigrating prior to trap installation. Peak weekly capture of 125 individuals occurred during the week ending April 22, 2012.

Trap efficiency for coho salmon yearlings during the 2012 trapping season varied between 27 – 85% and was calculated weekly based on trap recaptures (Table 2). Based on these efficiencies, an estimated 1,586 (+/- 146) coho salmon yearlings emigrated past the outmigrant trap site during the sample period.

Table 2. Mark-recapture summary for coho salmon yearlings captured in the outmigrant trap, McGarvey Creek, Spring 2012.

Week Ending	Mark Period	Days Sampled	# Captured	# Marked	# Recaptured	Trap Efficiency (%)	Estimated # of Outmigrants	Variance	Standard Deviation
11-Mar-12	1	4	4	4	1	27.9% [1]	14	5143 [P]	5
18-Mar-12	2	3	13	12	1	27.9% [1]	47		17
25-Mar-12	3								
1-Apr-12	4			*Trap not fishing due to high flow*					
8-Apr-12	5								
15-Apr-12	6	7	38	38	13	27.9% [1]	136		50
22-Apr-12	7	7	125	124	34	29.5%	424	38,012	195
29-Apr-12	8	7	108	107	29	21.5%	501	10,823	104
6-May-12	9	7	72	72	40	49.9%	144	820	29
13-May-12	10	7	87	86	48	72.6%	120	1,127	34
20-May-12	11	7	66	66	27	38.5%	172	849	29
27-May-12	12	7	10	10	6	52.2%	19	38	6
3-Jun-12	13	7	4	4	5	85.7% [2]	5	0.7 [P]	0.4
10-Jun-12	14	7	1	1	0	85.7% [2]	1		0.1
17-Jun-12	15	7	2	1	0	85.7% [2]	2		0.2
24-Jun-12	16	7	0	0	1	85.7% [2]	0		
1-Jul-12	17	7	1	1	0	85.7% [2]	1		0.1
8-Jul-12	18	7	0	0	0	85.7% [2]	0		
9-Jul-12	19	1	0	0	0	85.7% [2]	0		
				Trap Pulled on 9-Jul-12 Due to Low Fish Numbers					
Totals:		99	531	526	205	3	1,586		146

- Estimated trap efficiency for pooled marking periods

[P] - Estimated variance for pooled marking periods

Mean weekly fork lengths of coho salmon yearlings ranged from 97.8 mm (week ending March 11, 2012) to 127 mm (week ending June 10, 2012) (Table 3). Coho size increased gradually throughout the trapping season until mid-June, at which time the average size of capture fish leveled off for the remainder of the spring trapping season.

A total of 491 coho yearlings were marked with full duplex (FDX) Passive Integrated Transponder (PIT) tags at the outmigrant trap beginning March 10, 2012 through June 30, 2012. Fork length range from 82 to 150 for coho yearlings. The propose for the PIT tag marking is to assess how juvenile coho utilize the range of habitats that exist within the mainstem Klamath River corridor prior to seaward smolt migration.

Coho salmon fry were first captured during the week ending March 11, 2012 (Table 1). The peak weekly capture of coho fry occurred during week ending April 15, 2012 (n=156). Coho fry continued to be captured in small numbers through the end of the trapping season. The mean fork length of capture young-of the-year (YOY) coho salmon remained relatively stable from when they were initially observed in early March through mid-April, with lengths from 34.4 to 37.0 mm (Table 4). A steady increase in fish length of captured YOY coho was observed throughout the remainder of the trapping season. Mean fork length was largest for YOY coho captured early June (~55.3 mm) (Table 4).

The estimated number of coho salmon yearlings emigrating during the spring trapping period has varied substantially over the 16 year period of record (Figure 4). Peak spring emigration was documented during the 2009 with an estimated 3,660 (+/- 145) coho, and the lowest annual emigration estimate was observed in 1999 with 146 (+/- 47) age 1+ coho emigrating past the trap site. The 2012 estimate of 1,586 (+/- 146) coho yearling emigrants was above the estimated 16 year average of 1,139 (Figure 4).

Table 3. Weekly mean fork length, fork length range, +/- 95% confidence interval, and sample size of coho salmon yearlings captured in the outmigrant trap, McGarvey Creek, 2012.

Week #	Week Ending	Mean Fork Length (mm)	Range FL (mm)	+/- 95% CI	# Sampled
1	11-Mar-12	97.8	90 - 101	5.08	4
2	18-Mar-12	98.5	82 - 117	6.06	13
3	25-Mar-12				
4	1-Apr-12		*Trap not fishing due to high flows*		
5	8-Apr-12				
6	15-Apr-12	107.7	90 - 128	2.88	38
7	22-Apr-12	109.6	93 - 128	1.42	125
8	29-Apr-12	112.2	90 - 131	1.50	108
9	6-May-12	116.2	88 - 150	1.92	72
10	13-May-12	116.3	100 - 136	1.72	87
11	20-May-12	114.3	90 - 132	1.90	66
12	27-May-12	110.7	93 - 131	5.99	12
13	3-Jun-12	116.3	113 - 122	3.87	4
14	10-Jun-12	127.0	127	-	1
15	17-Jun-12	112.0	112	-	1
16	24-Jun-12	90.0	90	-	1
17	1-Jul-12	89.0	89	-	1
18	8-Jul-12	-	-	-	0
19	9-Jul-12	-	-	-	0

- Trap Pulled on 09-Aug-09 Due to Low Fish Numbers -

Table 4. Weekly mean fork length, fork length range, +/- 95% confidence interval, and sample size of coho salmon YOY captured in the outmigrant trap, McGarvey Creek, 2012.

Week #	Week Ending	Mean Fork Length (mm)	Range FL (mm)	+/- 95% CI	# Sampled
1	11-Mar-12	34.5	34 - 35	0.98	2
2	18-Mar-12	34.4	31 - 37	1.19	12
3	25-Mar-12				
4	1-Apr-12	*Trap not fishing due to high flows*			
5	8-Apr-12				
6	15-Apr-12	37.0	32 - 49	0.44	126
7	22-Apr-12	35.6	32 - 50	0.67	61
8	29-Apr-12	36.7	30 - 51	0.98	63
9	6-May-12	38.3	35 - 41	3.46	3
10	13-May-12	46.1	35 - 54	4.19	10
11	20-May-12	54.5	44 - 65	20.58	2
12	27-May-12	51.0	48 - 54	5.88	2
13	3-Jun-12	-	-	-	0
14	10-Jun-12	50.8	47 - 55	3.43	4
15	17-Jun-12	49.0	49	-	1
16	24-Jun-12	54.5	50 - 59	3.62	4
17	1-Jul-12	55.3	48 - 63	8.49	3
18	8-Jul-12	-	-	-	0
19	9-Jul-12	-	-	-	0

- Trap Pulled on 09-Aug-09 Due to Low Fish Numbers -

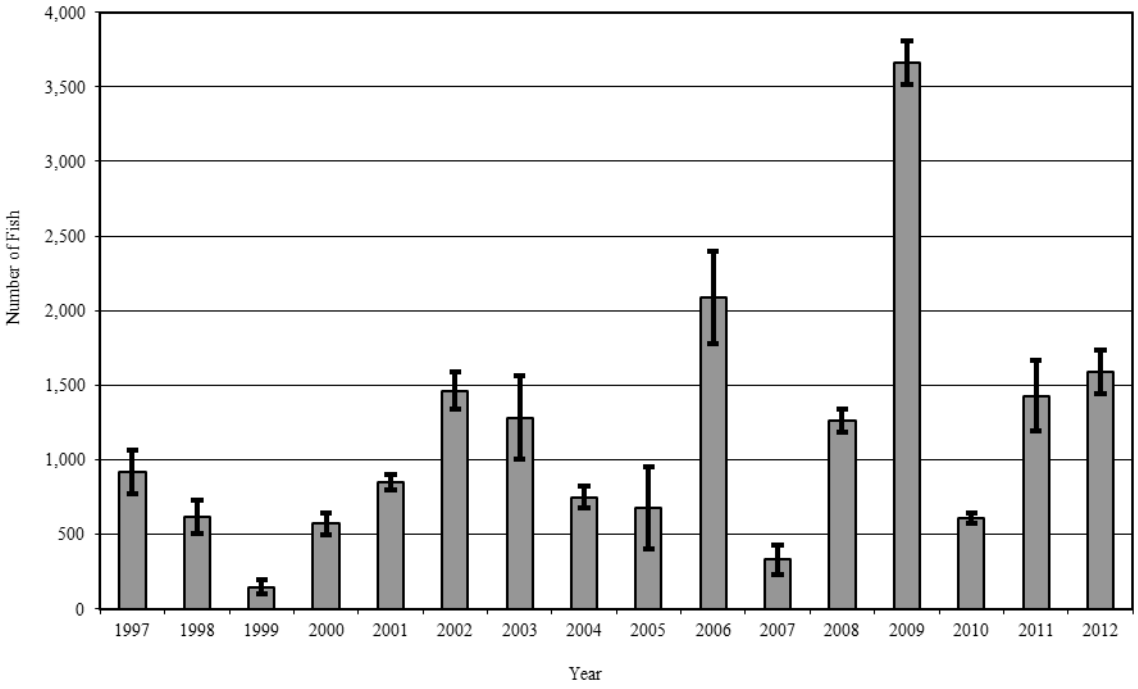

Figure 4. Estimated number (+/- S.D.) of coho salmon yearling emigrating past the outmigrant trap, McGarvey Creek, 1997 – 2012.

Steelhead Trout

YTFP captured 1,119 age 1+ steelhead emigrating during 99 days of outmigrant sampling during spring 2011 (Table 1). The peak capture of 441 age 1+ steelhead emigrants occurred during the week ending April 14, 2012. Only 28 trout fry were capture during the sample period with the peak of 21 occurring during the week ending April 15, 2012 (Table 1).

Trapping efficiency for age 1+ and older steelhead fluctuated from 24% to 79% during the trapping season (Table5). Based on these efficiencies, an estimated 2,255 (+/- 81) age 1+ steelhead past the McGarvey Creek trap site between March and July of 2012.

Table 5. Mark-recapture summary for age 1+ and older steelhead trout captured in the outmigrant trap, McGarvey Creek, Spring 2012.

Week Ending	Mark Period	Days Sampled	# Captured	# Marked	# Recaptured	Trap Efficiency (%)	Estimated # of Outmigrants	Variance	Standard Deviation
11-Mar-12	1	4	57	56	14	24.0%	237	3,141	56
18-Mar-12	2	3	35	27	0	52.5% [1]	67	1328 [P]	3
25-Mar-12	3								
1-Apr-12	4			*Trap not fishing due to high flow*					
8-Apr-12	5								
15-Apr-12	6	7	441	435	244	52.5% [1]	840		34
22-Apr-12	7	7	165	160	97	78.5%	210	1,555	39
29-Apr-12	8	7	102	97	40	36.8%	277	2,191	47
6-May-12	9	7	62	61	32	51.9%	119	180	13
13-May-12	10	7	127	126	77	62.9%	202	200	14
20-May-12	11	7	72	70	34	48.6%	148	343	19
27-May-12	12	7	22	22	14	69.9%	31	39	6
3-Jun-12	13	7	11	11	4	29.4% [2]	37	971 [P]	10
10-Jun-12	14	7	2	2	1	29.4% [2]	7		2
17-Jun-12	15	7	13	13	4	29.4% [2]	44		11
24-Jun-12	16	7	8	8	1	29.4% [2]	27		7
1-Jul-12	17	7	0	0	0	29.4% [2]	0		
8-Jul-12	18	7	2	0	0	29.4% [2]	7		2
9-Jul-12	19	1	0	0	0	0	0		
				Trap Pulled on 9-Jul-12 Due to Low Fish Numbers					
Totals:		99	1,119	1,088	562	4	2,255		81

- Estimated trap efficiency for pooled marking periods

[P] - Estimated variance for pooled marking periods

Mean weekly fork length of age 1+ and older steelhead peaked at 137 mm during the first week of trapping and gradually decreased through the trapping season (Table 6). Larger smolts (>170mm) captured during the first half of the trapping season were presumed to be almost exclusively non-natal fish that had immigrated into the system earlier in the fall or early winter. YTFP has routinely observed large numbers of steelhead smolts suddenly present in the creek following fall and early winter freshets.

Table 6. Weekly mean fork length, fork length range, +/- 95% confidence interval, and sample size age 1+ and older steelhead captured in the outmigrant trap, McGarvey Creek, 2012.

Week #	Week Ending	Mean Fork Length (mm)	Range FL (mm)	+/- 95% CI	# Sampled
1	11-Mar-12	137.3	79 - 215	13.99	47
2	18-Mar-12	134.7	80 - 228	15.83	35
3	25-Mar-12				
4	1-Apr-12		*Trap not fishing due to high flows*		
5	8-Apr-12				
6	15-Apr-12	106.8	50 - 272	2.19	441
7	22-Apr-12	104.2	72 - 199	2.68	165
8	29-Apr-12	103.3	74 - 179	3.36	102
9	6-May-12	105.7	80 - 146	3.50	62
10	13-May-12	102.4	76 - 143	2.40	127
11	20-May-12	103.3	78 - 155	3.40	72
12	27-May-12	106.5	87 - 137	5.79	22
13	3-Jun-12	110.6	84 - 132	9.91	11
14	10-Jun-12	99.0	90 - 108	17.64	2
15	17-Jun-12	116.0	94 - 137	8.08	13
16	24-Jun-12	118.4	83 - 142	14.11	8
17	1-Jul-12				
18	8-Jul-12	63.5	63 - 64	0.98	2
19	9-Jul-12	-	-	-	0
- Trap Pulled on 09-Aug-09 Due to Low Fish Numbers -					

The estimated number of age 1+ and older steelhead emigrating past the McGarvey outmigrant trap during the spring trapping period showed a gradual increase from 1997 through 2009 (Figure 5). Peak spring emigration of 5,716 (+/- 148) steelhead was documented during 2007, while the lowest annual emigration estimate of 1,488 fish (+/-

92) occurred in 2010. The estimated number of 1+ steelhead emigrants for 2012 was 2,255 (+/- 81), which was below the 16 year average of 3,445 over the period of record (Figure 5).

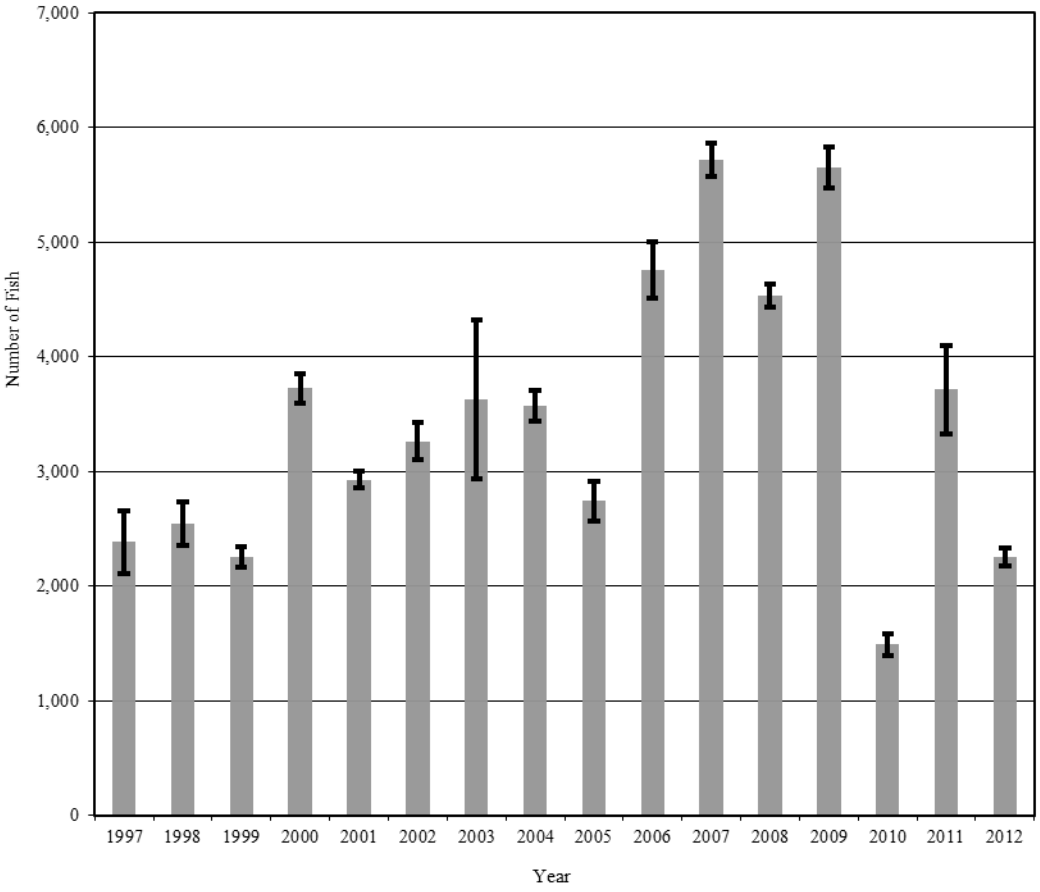

Figure 5. Estimated number (+/- S.D.) of age 1+ and older steelhead emigrating past the outmigrant trap site, McGarvey Creek, 1997 – 2012.

Coastal Cutthroat Trout

A total of 1,003 age 1+ older coastal cutthroat trout were captured during the 2012 outmigrant sampling period (Table 1). The peak weekly capture of age 1+ and older cutthroat emigrants occurred during the week ending April 15, 2012 (n=311).

Trapping efficiency for age 1+ and older cutthroat fluctuated between 43% and 77% during the trapping season (Table 7). Based on these efficiencies, and estimated 1,529 (+/- 31) age 1+ cutthroat migrated past the McGarvey Creek trap site during spring 2012.

Mean weekly fork length of age 1+ and older cutthroat remained relative consisted throughout the trapping season with peaks occurring the week ending during March 18th, May 27th, and June 17th, 2012 (Table 8).

Table 5. Mark-recapture summary for age 1+ and older coastal cutthroat trout captured in the outmigrant trap, McGarvey Creek, Spring 2012.

Week Ending	Mark Period	Days Sampled	# Captured	# Marked	# Recaptured	Trap Efficiency (%)	Estimated # of Outmigrants	Variance	Standard Deviation
11-Mar-12	1	4	33	30	23	76.8%	43	11	3
18-Mar-12	2	3	52	43	0	73.9% [1]	70	319 [P]	3
25-Mar-12	3	0							
1-Apr-12	4	0	*Trap not fishing due to high flow*						
8-Apr-12	5	0							
15-Apr-12	6	7	311	308	249	73.9% [1]	421	-	15
22-Apr-12	7	7	248	246	141	53.6%	462	769	28
29-Apr-12	8	7	136	133	120	77.1% [2]	176	113.7 [P]	6
6-May-12	9	7	94	94	51	77.1% [2]	122	-	1
13-May-12	10	7	71	71	42	60.3%	118	129	11
20-May-12	11	7	26	25	14	58.9%	44	94	10
27-May-12	12	7	9	8	3	43.1% [3]	21	240 [P]	8
3-Jun-12	13	7	1	1	1	43.1% [3]	2		1
10-Jun-12	14	7	1	1	0	43.1% [3]	2		1
17-Jun-12	15	7	6	6	3	43.1% [3]	14		5
24-Jun-12	16	7	10	8	5	45.5% [4]	22	100 [P]	7
1-Jul-12	17	7	5	3	0	45.5% [4]	11		3
8-Jul-12	18	7	0	0	0	45.5% [4]	0		
9-Jul-12	19	1	0	0	0	45.5% [4]	0		
			Trap Pulled on 9-Jul-12 Due to Low Fish Numbers						
Totals:		99	1,003	977	652	2	1,529		31

- Estimated trap efficiency for pooled marking periods

[P] - Estimated variance for pooled marking periods

Table 6. Weekly mean fork length, fork length range, +/- 95% confidence interval, and sample size age 1+ and older cutthroat trout captured in the outmigrant trap, McGarvey Creek, 2012.

Week #	Week Ending	Mean Fork Length (mm)	Range FL (mm)	+/- 95% CI	# Sampled
1	11-Mar-12	138.2	90 - 300	23.69	26
2	18-Mar-12	141.9	77 - 365	18.18	52
3	25-Mar-12				
4	1-Apr-12		*Trap not fishing due to high flows*		
5	8-Apr-12				
6	15-Apr-12	131.5	86 - 306	2.88	311
7	22-Apr-12	126.6	78 - 198	2.48	248
8	29-Apr-12	125.7	86 - 292	4.89	136
9	6-May-12	126.0	90 - 299	6.97	94
10	13-May-12	124.6	97 - 173	3.54	71
11	20-May-12	126.3	103 - 184	8.14	26
12	27-May-12	140.4	106 - 304	40.50	9
13	3-Jun-12	120.0	110 - 130	19.60	2
14	10-Jun-12	116.0	116	-	1
15	17-Jun-12	143.3	120 - 160	12.80	6
16	24-Jun-12	118.8	65 - 144	17.55	8
17	1-Jul-12	119.3	112 - 131	11.56	3
18	8-Jul-12	-	-	-	0
19	9-Jul-12	-	-	-	0

- Trap Pulled on 09-Aug-09 Due to Low Fish Numbers -

The estimated number of age 1+ and older cutthroat emigrating during the spring trapping period has fluctuated over the 16 year period of record (Figure 6). Prior to 2012 trapping season, peak annual migration estimated of 4,460 (+/-301) was documented during 2011. This season was the lowest annual emigration estimate of 1,529 (+/-31) age 1+ and older cutthroat emigrated from McGarvey during 2012 outmigrant trapping period.

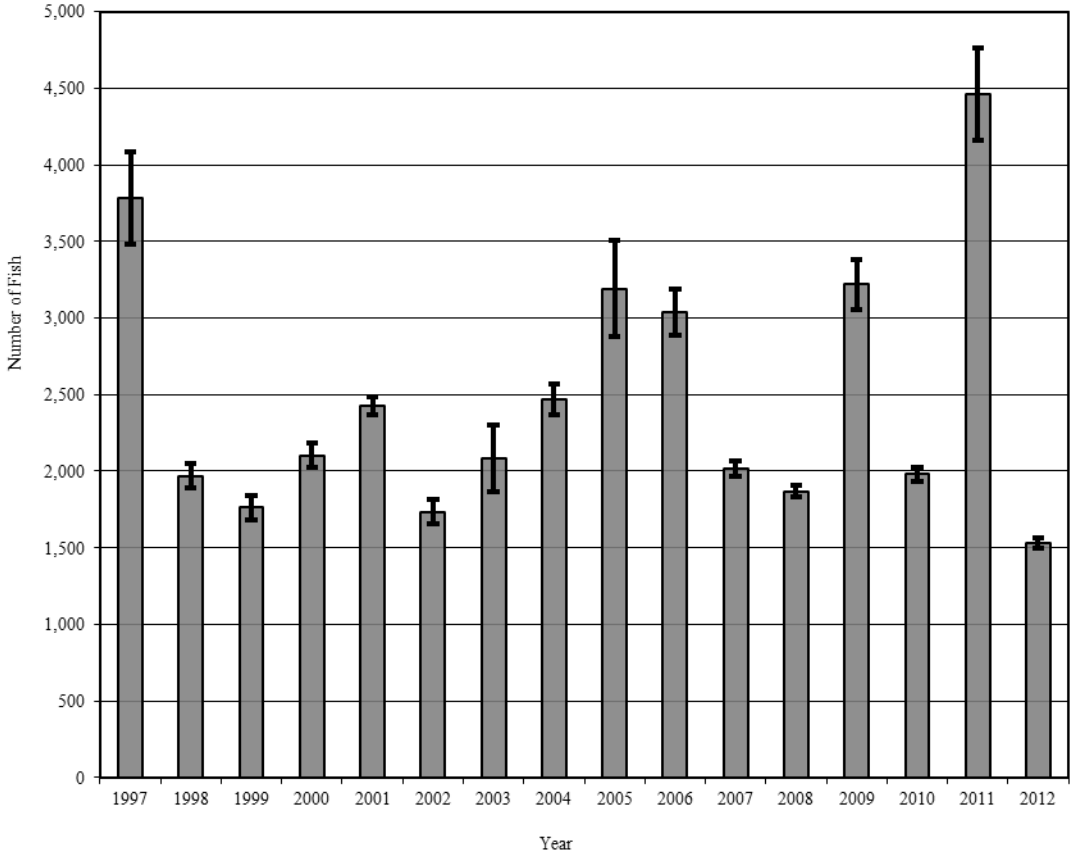

Figure 6. Estimated number (+/- S.D.) of age 1+ and older cutthroat trout emigrating past the outmigrant trap site, McGarvey Creek, 1997 – 2012.

Chinook

The estimated number of Chinook salmon YOY emigrating during the spring trapping period varied widely over the 16 year period of record (1997 – 2012). Estimates have varied from relatively high abundance to years with extremely low or no abundance observed throughout the study period (Figure 7). The peak emigration estimate occurred in 2003, with 15.433 outmigrants, and very few or no outmigrants observed in 1997, 1998, 2001, 2005, and 2007 – 2010. Emigrant abundance of juvenile Chinook in McGarvey Creek appears directly correlated with adult spawner presence the previous fall.

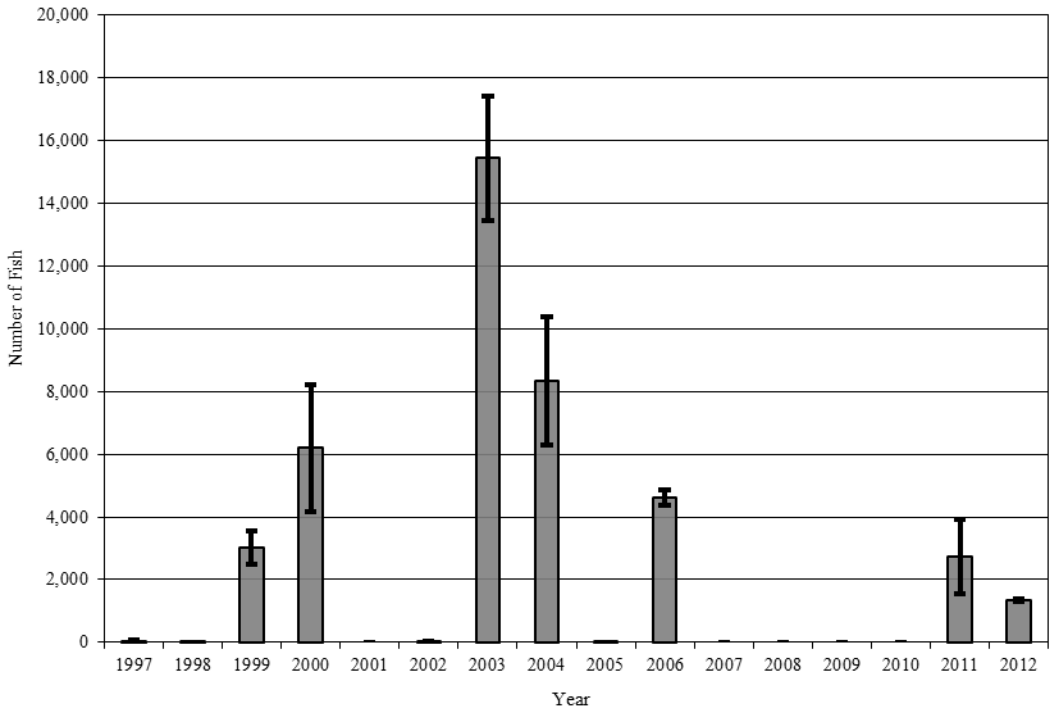

Figure 7. Estimated number (+/- S.D.) of YOY Chinook salmon emigrating past the outmigrant trap site, McGarvey Creek, 1997 – 2012.

YTFP captured a total of 861 chinook YOY during the 2012 outmigrant sampling period. The estimated number of chinook YOY emigrating through spring 2012 was 1,349 (+/- 50). The peak weekly estimate of emigrating chinook YOY was 453 and occurred during the week ending June 17th (Table 7).

Table 7. Mark-recapture summary for chinook salmon YOY captured in the outmigrant trap, McGarvey Creek, Spring 2012.

Week Ending	Mark Period	Days Sampled	# Captured	# Marked	# Recaptured	Trap Efficiency (%)	Estimated # of Outmigrants	Variance	Standard Deviation
11-Mar-12	1	4	0	0					
18-Mar-12	2	3	0	0					
25-Mar-12	3	0							
1-Apr-12	4	0	*Trap not fishing due to high flow*						
8-Apr-12	5	0							
15-Apr-12	6	7	65	0	0	93.8% [1]	69	1371 [P]	13
22-Apr-12	7	7	38	0	0	93.8% [1]	41		8
29-Apr-12	8	7	23	0	0	93.8% [1]	25		5
6-May-12	9	7	15	0	0	93.8% [1]	16		3
13-May-12	10	7	46	8	7	93.8% [1]	49		9
20-May-12	11	7	76	48	30	62.4%	122	152	12
27-May-12	12	7	38	35	23	65.5%	58	50	7
3-Jun-12	13	7	75	71	45	67.1%	112	628	25
10-Jun-12	14	7	114	96	58	60.4%	189	168	13
17-Jun-12	15	7	240	237	127	52.9%	453	617	25
24-Jun-12	16	7	82	65	43	68.2%	120	118	11
1-Jul-12	17	7	39	38	23	51.1% [2]	76	141 [P]	10
8-Jul-12	18	7	9	9	1	51.1% [2]	18		2
9-Jul-12	19	1	1	0	0	51.1% [2]	2		0.3
			Trap Pulled on 9-Jul-12 Due to Low Fish Numbers						
Totals:		99	861	607	357		1,349		50

- Estimated trap efficiency for pooled marking periods

[P] - Estimated variance for pooled marking periods

Mean fork length of captured YOY Chinook salmon remained relatively stable through April, ranging from 40.7 to 43 mm (Table 8). A steady increase in length of capture YOY chinook was observed throughout the remainder of the trapping season, Mean fork length of YOY chinook was greatest for fish captured in early July at 79 mm (Table 8).

Table 8. Weekly mean fork length, fork length range, +/- 95% confidence interval, and sample size of chinook salmon captured in the outmigrant trap, McGarvey Creek, 2012.

Week #	Week Ending	Mean Fork Length (mm)	Range FL (mm)	+/- 95% CI	# Sampled
1	11-Mar-12				
2	18-Mar-12				
3	25-Mar-12				
4	1-Apr-12		*Trap not fishing due to high flows*		
5	8-Apr-12				
6	15-Apr-12	41.5	37 - 46	0.43	65
7	22-Apr-12	40.7	38 - 45	0.51	38
8	29-Apr-12	43.0	36 - 50	1.36	23
9	6-May-12	46.9	41 - 55	2.26	14
10	13-May-12	47.7	40 - 55	1.00	46
11	20-May-12	49.5	39 - 58	0.93	76
12	27-May-12	53.3	44 - 61	1.32	38
13	3-Jun-12	56.4	43 - 70	1.10	92
14	10-Jun-12	59.6	49 - 72	0.89	114
15	17-Jun-12	63.7	48 - 80	0.96	240
16	24-Jun-12	63.9	49 - 79	1.51	82
17	1-Jul-12	67.8	54 - 97	2.73	39
18	8-Jul-12	72.2	62 - 83	4.7	9
19	9-Jul-12	79.0	79	-	1
- Trap Pulled on 09-Aug-09 Due to Low Fish Numbers -					

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