2007 Okanogan Basin Monitoring & Evaluation Program Rotary Screw Trap Report

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2007 Okanogan Basin Monitoring & Evaluation Program Rotary Screw Trap Report

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ABSTRACT

The Okanogan Basin Monitoring and Evaluation Program (OBMEP) initiated smolt trapping operations on the Okanogan River in 2006 to close the data gap with regards to estimating anadromous salmonid production in the basin. Upon completion of all necessary permitting, fish collection began on 02 April, 2007, following standardized OBMEP rotary screw trapping protocols (Rayton and Wagner 2006). A total of 15,730 juvenile salmonids were captured in an 8-foot rotary trap, plus an additional 12,820 in a 5-foot trap, prior to the cessation of trapping on 24 June, 2007. Overall trap mortality in 2007 was reduced by 80% compared to rates experienced in 2006. The naturally-produced steelhead (*Oncorhynchus mykiss*) emigrant population estimate was 7,533 based upon a trap count of 113 at 1.5% trap efficiency. The population estimate for sub-yearling, summer Chinook (*O. tshawytscha*) was 1,126,545 fish based on a trap count of 11,873 at 0.9% trap efficiency. Caution must be used in interpreting population estimate data as these estimates are known to be consistently biased low; calculated capture efficiency rates were below 2% and highly variable, and estimates were not extrapolated to include time periods when the traps were not operational.

INTRODUCTION

The Colville Tribes are actively participating in a recovery program for naturally produced salmonids in the Okanogan River basin which includes recent inventories of habitat condition and water quality, fish migration barriers, habitat restoration projects, and the propagation of locally-adapted steelhead broodstock. Stock size and adult escapement of anadromous fish species in the basin have been estimated but little is known of juvenile salmonid production within the Okanogan River sub-basin or associated tributary streams.

In order to close the data gap with regards to anadromous salmonid production, the Okanogan Basin Monitoring and Evaluation Program (OBMEP) initiated smolt trapping operations on the Okanogan River in 2006. Data and recommendations from the 2006 monitoring season can be found in the 2006 screw trap report (Johnson and Rayton 2007). Smolt trap data will allow investigators to derive annual, emigrant population estimates for Okanogan River basin anadromous salmonids. Raw Okanogan River trap counts are posted on the Columbia River DART website:

http://www.cbr.washington.edu/dart/trap_com.html

The OBMEP smolt trapping operation is coordinated with other local and regional monitoring efforts. Funding for this project is provided by the Bonneville Power Administration (BPA) Project #200302200, and the Chelan County Public Utility District (Chelan PUD).

METHODS AND MATERIALS

Study site

The Okanogan River, originating at Okanagan Lake in Penticton, British Columbia, Canada, flows south through a chain of lakes before crossing the international border at Oroville, Washington. Okanogan River discharge is regulated by Zosel Dam at river mile 79.0 (Figure 1) to control water heights in Lake Osoyoos. Below Zosel Dam, the Okanogan River is joined by its largest tributary, the unregulated Similkameen River, before continuing to its confluence with the Columbia River near Brewster, Washington.

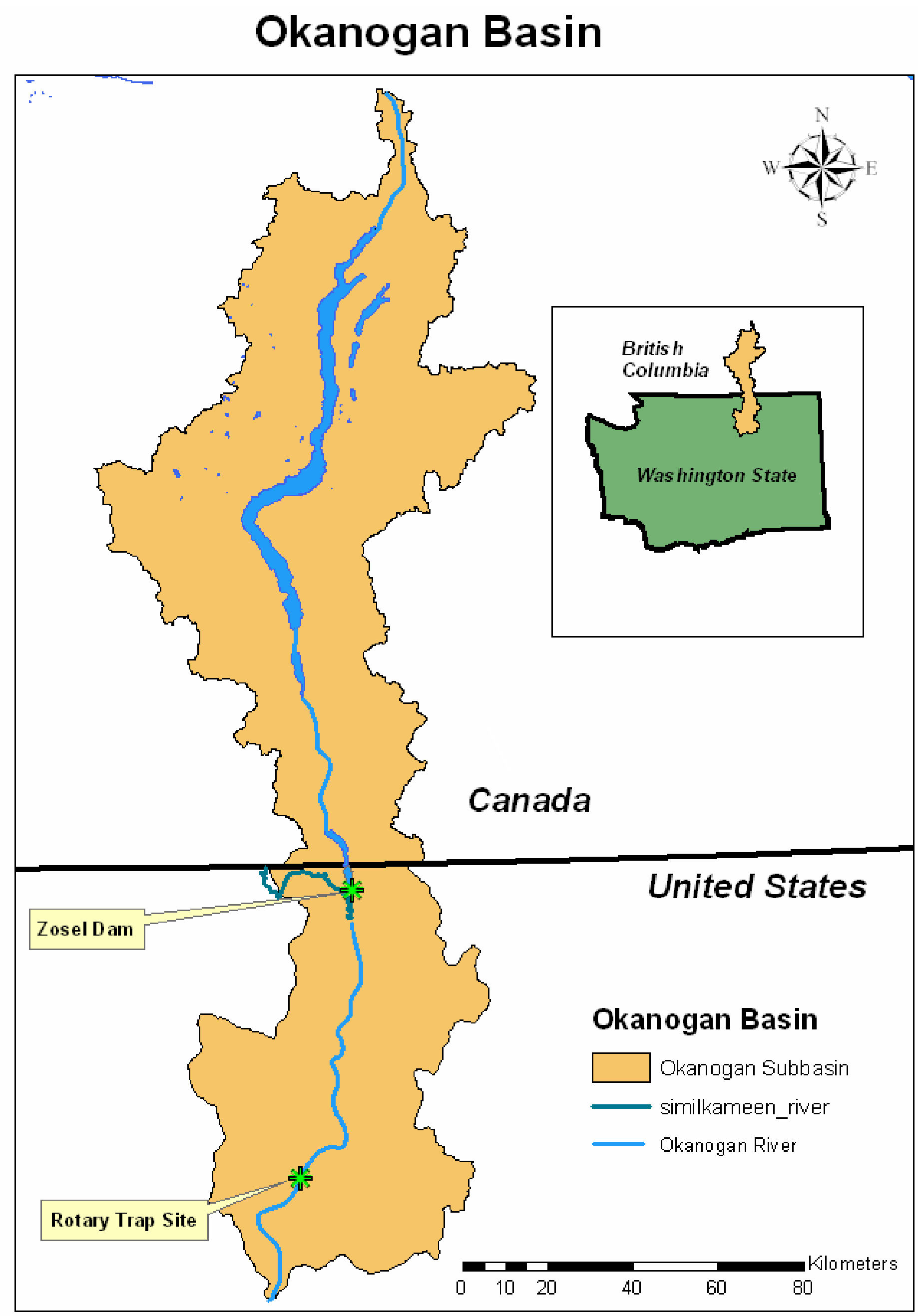

Figure 1. Map of the Okanogan River historically accessible to anadromous fish.

The rotary trap is anchored to the Highway 20 Bridge, at river mile 24.9, in Okanogan, Washington. This trap site was chosen for the following reasons:

- Near the downstream extent of the Okanogan River population segment;
- The presence of good hydraulic conditions suitable for rotary trapping;
- The proximity of the trap site to the Colville Tribe's Omak Fish & Wildlife office;
- The bridge was an ideal anchorage for rotary traps with easy access;
- Fenced storage area at the City of Okanogan Wastewater Treatment Plant;
- The presence of a nearby USGS gauging station.

Permitting

The necessary permits required for installation and operation of the rotary traps on the Okanogan River and their identification number and issuing agencies are listed below:

• Section 10 Incidental Take Permit	#1520	NOAA Fisheries
• Hydraulic Project Approval (HPA)	#104024-2	WDFW
• Scientific Collection Permit	#07-114	WDFW
• Bridge Attachment Permit	#7687A	WSDOT
• Shoreline Exemption	#1040	City of Okanogan

Each permit stipulated conditions for trap deployment, streambank protection or fish collection. Several contained language requiring periodic reporting of operations and data while others need only be kept appraised of continued trap efforts from year to year. This report is designed to fulfill all reporting requirements established by contracts associated with funding sources and applicable permits.

Environmental parameters

Discharge and water temperature data for the Okanogan River in 2007 were accessed via the Internet from the United States Geological Survey (USGS) gauge 12447200 - Okanogan River at Malott, WA, located at river mile 17.0. Data collection at this USGS site is partially funded by OBMEP.

Trapping protocols, hardware & rigging

Procedural details and protocols for the Colville Tribes rotary screw trap operations in the Okanogan River are presented in *Rotary Screw Trap Protocols* (Rayton and Wagner 2006). These protocols were adapted from Volkhardt and Seiler (2005) and Murdoch et al. (2000) as incorporated into a standardized basin-wide monitoring plan developed by the Upper Columbia Regional Technical Team for the Upper Columbia Salmon Recovery Board (Hillman 2004). Operations during the 2007 trapping season were consistent with procedures initiated in 2006. For safety reasons, two persons are always on site during active trapping.

The following actions were initiated in 2007 in response to the recommendations made in the 2006 report (Johnson and Rayton 2007);

- Purchasing a new, 8-foot rotary screw trap with a self-cleaning drum screen;
- Installation of a custom designed debris deflector (Figure 2);
- Addition of extra pontoons for added trap buoyancy (Figure 2); and
- Reflectors mounted on the cones to aid in determining trap rotation at night.

Significant changes to main line configuration and trap rigging also occurred, including;

- Changing the method for deploying and retrieving the 8-foot trap to improve efficiency and safety.
- Eliminating the anchor chain portion of the main line to allow the trap to be pulled closer to shore for safety at high discharge.
- Bridle cables were floated to prevent snagging on underwater obstacles.

Additional signs and reflectors were added to make both traps more conspicuous to boaters and other recreational river users. The 5-foot trap and rigging remained virtually unchanged from the 2006 season.

Figure 2. Photo of the 8-foot trap barge illustrating improvements made for the 2007 season. Note the retrofitted debris deflector and supplemental outriggers for extra floatation.

Fish collection

Two rotary screw traps (cone diameters of 8-foot and 5-foot) were deployed at the trap site and operated nightly between 01 April and 24 June (Figure 3). A single, 8-foot trap was used in the main channel, and was positioned at the edge of the main current to reduce exposure to potentially high RPMs and debris-impact damage. The crew checked the 8-foot trap for fish approximately once every two hours, or when the cone jammed due to debris loading.

A second trap, 5-foot diameter cone, was deployed near the shoreline above discharges of 4,800 cfs (Figure 3). The near-shore location enhances the catch of wild, sub-yearling salmonids along the west bank of the river. The 5-foot trap only required checking twice per day because debris loads were minimal at this location.

Figure 3. Photograph of the 8-foot rotary screw trap in the main channel (right) and the 5-foot rotary trap in the secondary channel (left) at 9,500 cfs.

All field staff involved with trapping procedures received training in the safe and efficient processing of captured fishes, accurate data collection, data recording techniques, and juvenile salmonid identification (Pollard et al 1997). Information collected during the 2007 season followed the methodology outlined in the OBMEP protocol document (Rayton and Wagner 2006). Adult fishes were counted, recorded and returned to the river immediately. Juvenile fishes were placed into multiple, six-gallon buckets without overcrowding. Species, life history stage, presence of tags or marks, total fishes released and number of mortalities were collected and recorded on all fish without anesthetic. Fork length was measured on 10 fish/species during every trap check. Fish measured or photographed were anesthetized in a Finquel® bath, (tricaine methane-sulfonate [MS-222]), processed and returned to the river after full recovery. Additionally, summer steelhead were checked for PIT tags and fin clips.

Trap efficiency

Data analysis requires calibrating the proportion of fish caught with the rotary screw traps as it relates to the population as a whole using mark/recapture techniques (Volkhardt et al 2007). A known number of salmonids collected at the trap site, or hatchery fish acquired at acclimation ponds, were dyed using Bismarck Brown "Y" dye (Figure 4) and released upstream at the Salmon Creek boat ramp. The rate of their recapture, or the trap efficiency, was used to estimate the total number of juvenile salmonids emigrating from the Okanogan River basin. Wild steelhead smolts collected at the trap site were not used for trap efficiency trials due to their low abundance and endangered population status.

Population estimates

Fish populations and associated 95% confidence intervals were estimated using methods outlined in the OBMEP rotary trapping protocol (Rayton and Wagner 2006). Approximately unbiased population values used a pooled Peterson estimator with a Chapman modification (Chapman 1954; Seber 1982). Estimates were not extrapolated to include periods when the traps were not operational.

Figure 4. Photo of a hatchery steelhead lightly marked with Bismarck Brown dye.

RESULTS & DISCUSSION

Environmental parameters

The Okanogan River exhibited an unusual discharge curve during the 2007 sampling season. The trap season began in April with above-normal flows exceeding 5,500 cfs (Figure 5). A subsequent decrease in flow occurred during the first week in April before rising to the first of three peaks (7,920 cfs) on 11 April. Discharge again decreased to near 5,000 cfs on 24 April, and then rose to a second peak (12,800 cfs) on 19 May. Discharge dropped to 8,530 cfs on 31 May and then rose to the highest discharge of the year on 07 June (13,500 cfs). Discharge exceeded 8,000 cfs between 01 April and 10 May, and again between 12 June and 24 June.

Mean daily water temperatures during the ascending limb of the hydrograph have an inverse relationship to daily discharge (Figure 5). In general, as discharge increases water temperature decreases and as discharge decreases water temperatures increase. Water temperatures during the trapping season steadily increased throughout the season reaching a high temperature of 17.8°C by the end of trapping season.

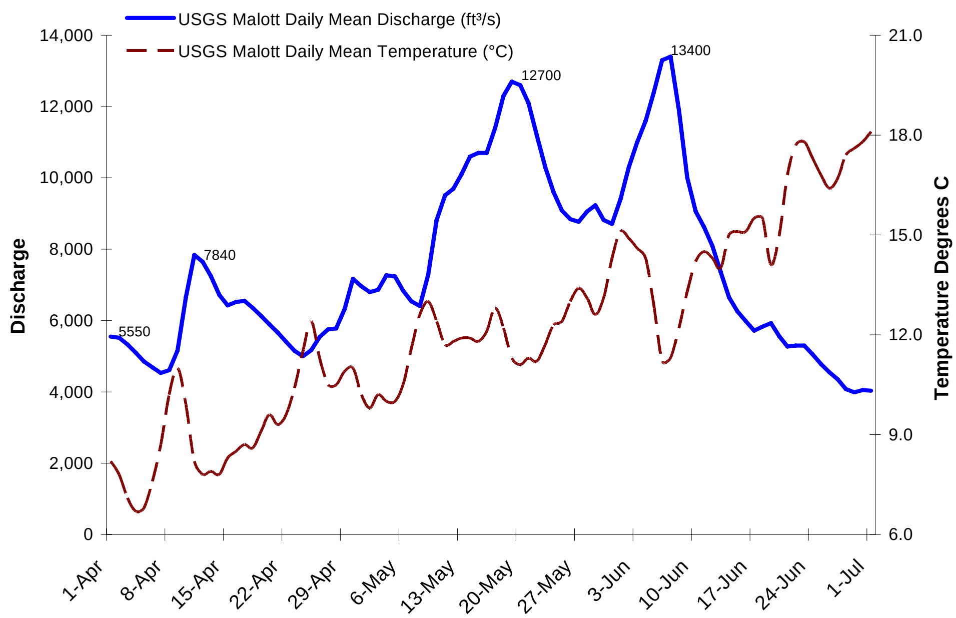

Figure 5. Daily mean discharge and water temperature in the Okanogan River (USGS Okanogan River at Malott) throughout the 2007 rotary screw trapping season.

Trap operations

Traps operated nightly between 20:00 and 04:00 hours, seven nights per week. The 8-foot trap ran from 02 April to 24 June, 2007 (Figure 6). No trapping occurred on 08 April due to personnel issues. Partial trapping occurred on trap dates 28 May (severe lightning event) and 07 June (rigging malfunction and trap breakaway). The 8-foot trap operated consistently in the main channel between 9 and 12 RPMs for a season total of 643.58 hours.

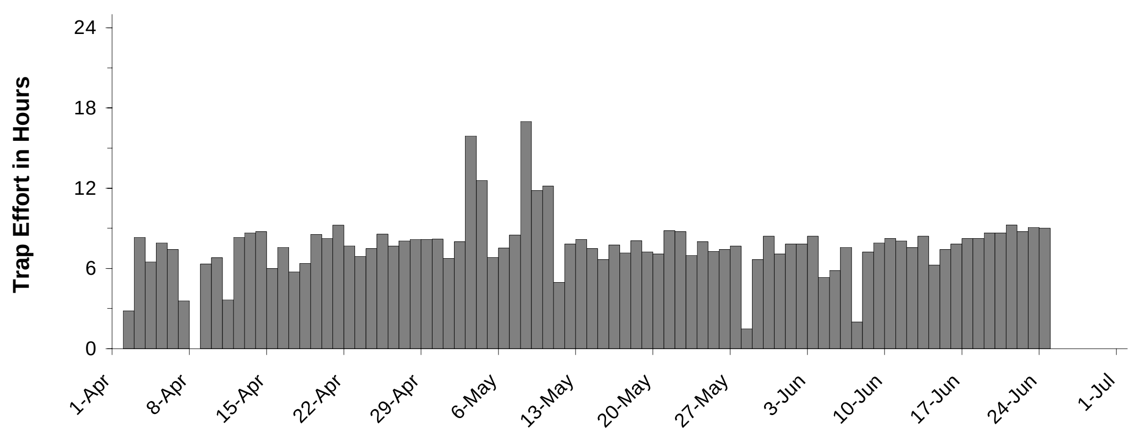

Figure 6. Daily operational time by trap date for the 8-foot screw trap in 2007.

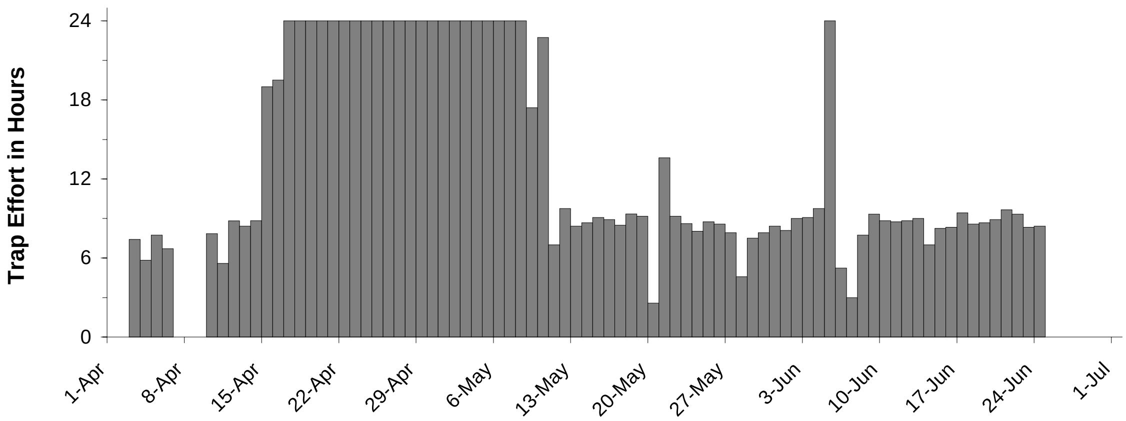

Figure 7. Daily operational time by trap date for the 5-foot screw trap in 2007.

During periods of discharges above 10,000 cfs (13-21, 23, 24 May, and 02-09 June), the 8-foot trap was moved away from the center of the channel and positioned at the edge of the main current to maintain consistent RPMs between trap sets.

The 8-foot trap experienced several minor difficulties during the trapping season; only one event interrupted data collection.

- On 07 June, several logs collected on the starboard side of the trap, exerted enough force on the bridle line to cause the wire rope clips to fail, the trap to float at an angle in the current, and break the welds holding the attachment plate to the port pontoon. The trap broke away and floated to the near bank, facing downstream, retained by the safety line. No trap hardware or rigging was lost or broken beyond repair; the trap was turned, recovered, repaired and ready for use the following night.
- The leading edge of the trap cone experienced moderate impact damage early in the season.
- An access door on the side of the trap cone was completely torn off on the night of 10 May. Surplus screen was used to patch the hole.
- The bicycle tire (16 x 1.75) used to power the self-cleaning drum screen was improperly located. Multiple tires and tubes were shredded on the cone's screen-edge before cone adjustments achieved proper rim positioning.
- The trap was observed to ride low in the main current at the end of the season; the debris deflector buoyancy cavity was filled with water. No impact damage or cracks were found; therefore the leak was attributed to water intrusion through the plug threads.

The 5-foot trap operated nightly between 03 April and 24 June (Figure 7) with no trapping on 07-09 April due personnel issues. The 5-foot trap operated in the secondary flow tongue between 10 and 12 RPMs for a season total of 1,063.95 hours. No problems affected 5-foot trap operations during the 2007 season.

Trap mortality, trap counts & trap efficiency by species

Incidental trap mortality data were collected on targeted salmonid species. Total salmonid mortality for all traps during the 2007 trapping season was 2.02% which represents an 80% reduction from the 10.74% combined season mortality rate experienced in 2006. Mortality specific to the new, 8-foot trap was reduced to 3.67% in 2007 compared to 22.42% in 2006 (Table 1).

Table 1. Total number of fish, lifestage, mortalities and percent mortality for target salmonid species collected from the Okanogan River using an 8-foot rotary screw trap during 2007.

Fish Species	Lifestage	Marking	Catch	Mortality	Percent Mortality
Chinook	Fry/Alevin	n/a	4,210	68	1.62%
Chinook	Smolt	Ad Clip	4,221	187	4.43%
Sockeye	Smolt	n/a	6,020	292	4.85%
Steelhead	Smolt	Ad Clip	1,192	30	2.52%
Steelhead	Smolt	Unmarked	87	0	0.00%
2007 8-ft Trap Total			**15,730**	**577**	**3.67%**

Table 2. Total number of fish, lifestage, mortalities and percent mortality for target salmonid species collected from the Okanogan River using a 5-foot rotary screw trap during 2007.

Fish Species	Lifestage	Marking	Catch	Mortality	Percent Mortality
Chinook	Fry/Alevin	n/a	12,097	6	0.05%
Chinook	Smolt	Ad Clip	551	3	0.54%
Sockeye	Smolt	n/a	111	1	0.90%
Steelhead	Smolt	Ad Clip	35	0	0.00%
Steelhead	Smolt	Unmarked	26	0	0.00%
2007 5-ft Trap Total			**12,820**	**10**	**0.08%**

Improvement was also made with respect to mortality in the 5-foot trap. The 2007 mortality of 0.08% (Table 2) was down from the 1.61% experienced in 2006. This decrease can be attributed to the 5-foot trap fishing exclusively near the bank during 2007 whereas the 5-foot trap spent a portion of the 2006 season fishing in the main channel when the 8-foot trap was under repair. The hydraulic forces present in the main channel are more extreme and are believed to be responsible for higher mortality rates.

Flow is the dominant factor affecting downstream migrant trapping (Volkhardt et al. 2007). Trapping results uphold this assertion as most salmonids were collected during the ascending limb of the hydrograph (Figures 8 – 11). Hatchery Chinook and steelhead smolts out- migrated in a more focused group than wild fish of the same species.

Chinook

Chinook of three life stages were collected: naturally produced sub-yearling fry, naturally produced alevins, and hatchery smolts. In the Okanogan basin, naturally produced, ocean-type Chinook typically emigrate to the marine environment during the sub-yearling life stage. A total of 16,073 naturally produced, sub-yearling Chinook were collected in 2007; of which seventy-four percent were collected in the 5-foot trap. Only fish enumerated in the 5-foot trap were used for population computations. The peak daily trap counts for Chinook sub-yearlings occurred on 13 May, 17 May and 03 June when 954, 936 and 1,308 were caught, respectively. The sub-yearling migration was closely associated with periods of increasing discharge (Figure 8).

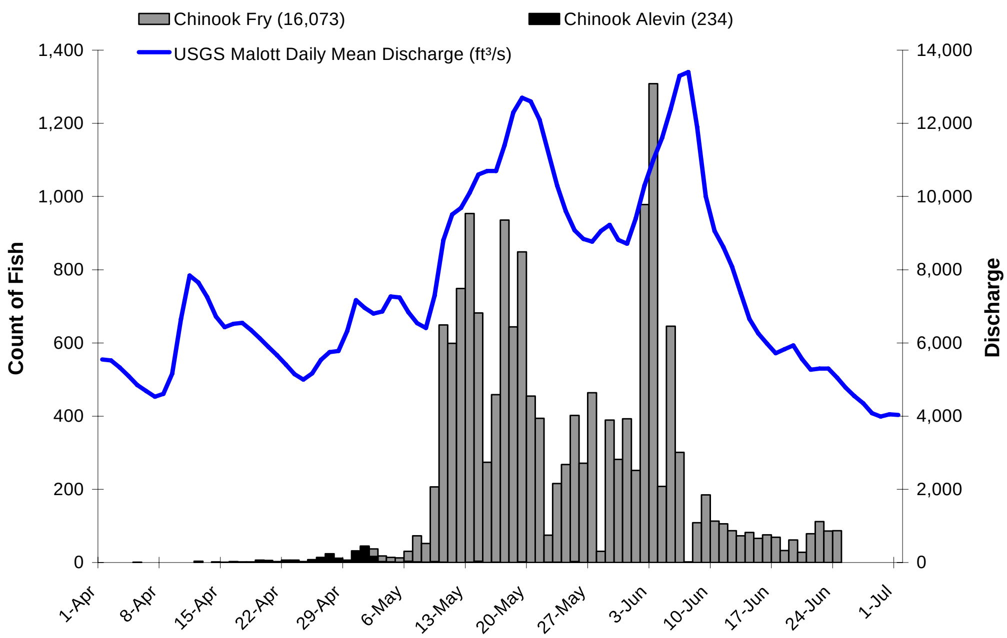

Figure 8. Mean daily discharge and counts of Chinook sub-yearlings caught in rotary screw traps on the Okanogan River in 2007. Discharge data from USGS gauge at Malott, WA.

Chinook alevins, which are newly hatched salmon with a visible yolk sac, were collected in the traps between 04 April and 25 May. The total catch was 234 alevins with the peak catch occurring on the night of 01 May when 42 alevins were collected. These fish are believed to have been washed out of their rearing areas by increasing discharges rather than actively emigrating downstream (Johnson et al. 2007).

A total of 758 wild Chinook sub-yearlings were marked and released across four release dates and only thirteen were recaptured. Recapture estimates ranged from 0.00% to 3.50%, and the pooled trap efficiency was estimated at 0.9% (Table 3). The discharge during the days in which dyed sub-yearlings were used for trap efficiency trials ranged between 10,600 and 12,400 cfs. Two of the four groups were released from the Salmon Creek boat launch after midnight allowing less than 4 hours for these fish to reach the trap site. Subsequently, no marked fish were recaptured on these occasions likely biasing trap efficiency estimates low. Artificially low trap efficiencies thus result in inflated population estimates. More frequent trap efficiency trials are needed to improve both trap efficiency and population estimates.

Table 3. Chinook sub-yearling marked and recaptured release groups showing release date and time, calculated trap efficiency, and discharge at Malott for rotary screw trap efficiency trials on the Okanogan River in 2007.

Trap date Released	Time (24) Released	# Chinook YOY Marked	# Chinook YOY Recaptured	Trap Efficiency	Mean Daily Discharge @ Malott
15-May-07	:40	178	0	0.0%	10,800
17-May-07	2:30	209	0	0.0%	10,900
18-May-07	22:09	85	3	3.5%	11,700
6-Jun-07	19:40	286	4	1.4%	12,800
		758	**7**	**0.9%**	

Yearling Chinook found in the Okanogan basin are primarily artificially produced offspring of ocean type parents. These hatchery fish were classified as Chinook smolts for the purpose of this document. The primary source of Chinook smolts is the Washington Department of Fish and Wildlife's Similkameen acclimation pond located near the town of Oroville, WA. An estimated 276,000 hatchery Chinook smolts were released from this location between 18 April and 09 May, of which 4,750 were captured (Figure 9). This computes to a capture efficiency of 1.7%. A peak count of 733 Chinook smolts was recorded on 04 May. The 8-foot trap captured 88% of all Chinook smolts enumerated and these were the only fish included in population analysis. A total of 573 hatchery Chinook smolts were dyed and released at the Salmon Creek boat ramp on three release dates (Table 4) and 14 were recaptured. Trap efficiency was estimated to be 2.4% using this method during discharges ranging between 5,890 and 7,220 cfs.

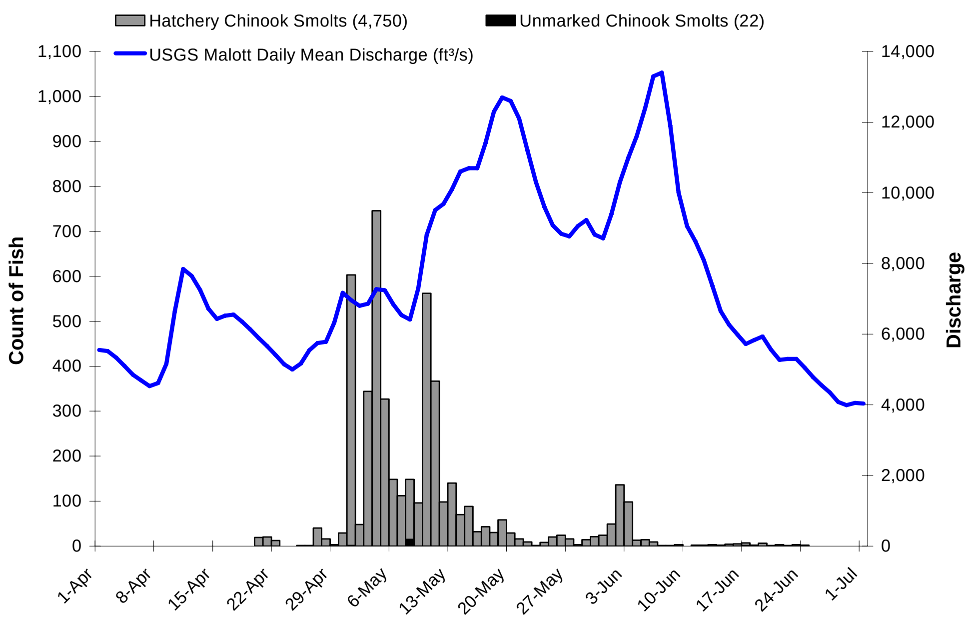

Figure 9. Mean daily discharge and counts of both marked and unmarked Chinook smolts caught in rotary screw traps on the Okanogan River in 2007. Discharge data from USGS gauge at Malott, WA.

Table 4. Marked Chinook smolt release groups showing release date and time, number of fish in release group, number marked fish recaptured in applicable trap, calculated trap efficiency and discharge at Malott for rotary screw trap efficiency trials on the Okanogan River in 2007.

Trap date Released	Time (24) Released	# Chinook Smolts Marked	# Chinook Smolts Recaptured	Trap Efficiency	Mean Daily Discharge @ Malott
21-Apr-07	19:00	45	0	0.0%	5,800
5-May-07	20:30	228	7	3.1%	7,400
7-May-07	19:45	300	7	2.3%	6,680
		573	**14**	**2.4%**	

Sockeye

Within the Okanogan River sockeye population, two distinct life history forms can be identified based upon the length of emigrating smolts. According to the Okanagan Nation Alliance, the longer sockeye smolts (mean fork length 113mm) are hatchery fish released as fry that overwinter in Skaha Lake before emigrating the following spring. The shorter, wild smolts (mean fork length 90mm) are naturally produced fish that originate from Osoyoos Lake (Howie Wright, ONA; Pers. Comm.). Hydroacoustic surveys in the spring of 2007 estimated 140,000 hatchery sockeye smolts in Skaha Lake and approximately 1.5 million wild sockeye smolts in Osoyoos Lake (Paul Rankin, Fisheries and Oceans Canada; Pers. Comm.). A total of 353 and 5,778 hatchery and wild sockeye, respectively, were caught in the rotary screw traps with hatchery smolts emigrating earlier than the wild smolts (Figure 10). The 8-foot trap caught >97% of all sockeye observed therefore only these data were used to estimate wild sockeye production. Wild sockeye smolts were collected primarily between 03 May and 02 June with the peak count of 1,035 occurring on 24 May.

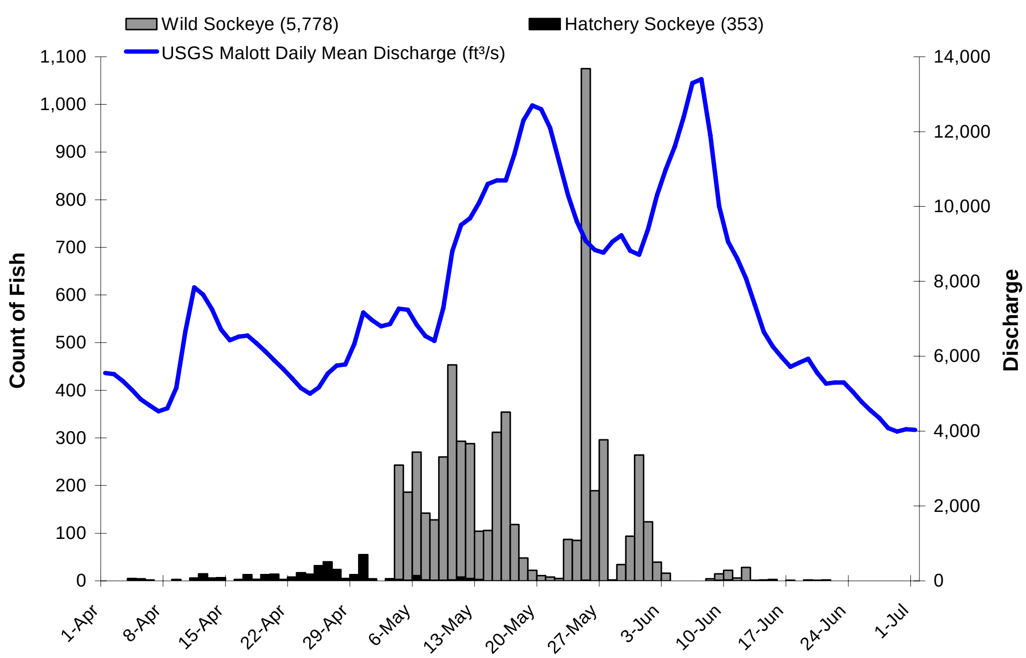

Figure 10. Mean daily discharge and counts of sockeye smolts caught in rotary screw traps on the Okanogan River in 2007. Discharge data from USGS gauge at Malott, WA.

To estimate trap efficiency, 1,135 wild sockeye smolts were marked and released in nine separate groups ranging from 20 to 285 individuals (Table 5); only 28 sockeye smolts were recaptured. Marked sockeye were recaptured from every group except from the smallest release group. Trap efficiency estimates for sockeye smolts ranged between 0.00% and 4.35% over discharges ranging from 6,350 to 10,900 cfs. Five of the 9 marked releases occurred after midnight potentially leading to biased low trap efficiencies.

Table 5. Marked and recaptured sockeye smolts by release date and time, applicable trap, calculated trap efficiency and discharge for rotary screw trap efficiency trials on the Okanogan River in 2007.

Trap date Released	Time (24) Released	# Sockeye Marked	# Sockeye Recaptured	Trap Efficiency	Mean Daily Discharge @ Malott
5-May-07	0:17	93	1	1.1%	7,130
7-May-07	2:30	115	5	4.3%	6,500
13-May-07	22:45	20	0	0.0%	9,820
17-May-07	2:35	285	3	1.1%	10,600
23-May-07	1:25	63	1	1.6%	10,900
24-May-07	1:15	69	2	2.9%	10,100
25-May-07	23:00	200	1	0.5%	9,540
27-May-07	22:49	136	2	1.5%	8,730
31-May-07	23:25	154	4	2.6%	8,710
		1,135	**19**	**1.7%**	

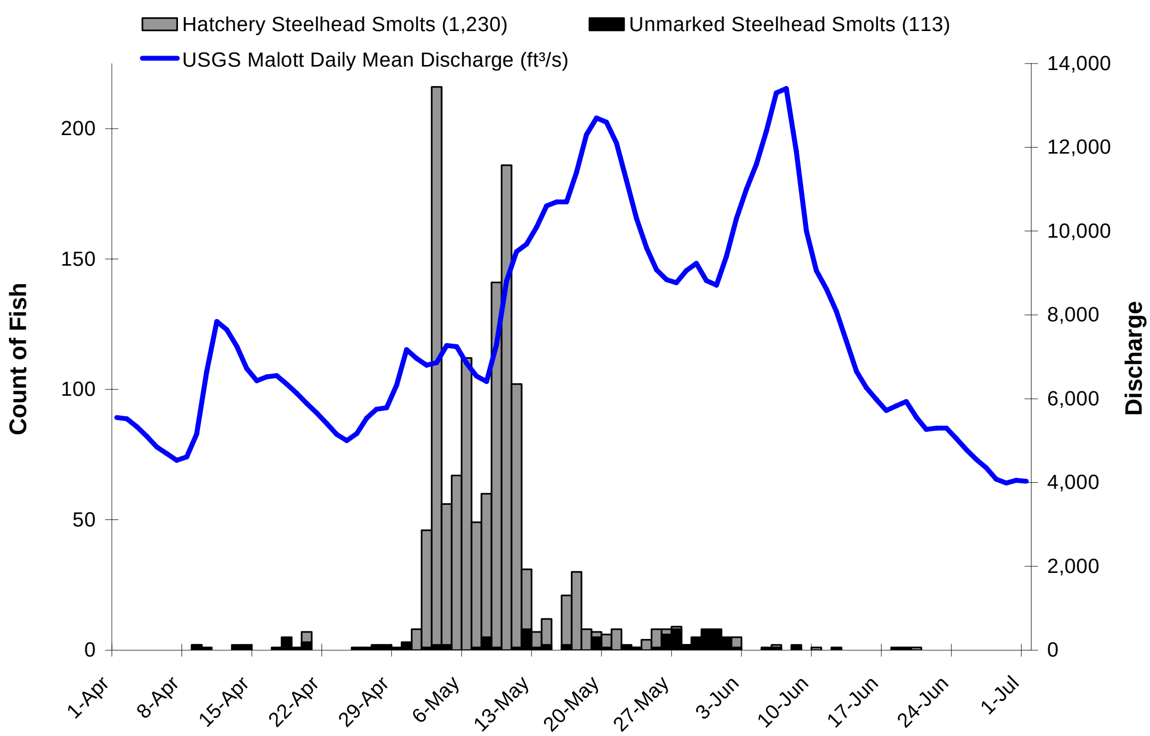

Figure 11. Mean daily discharge and counts of steelhead smolts caught in rotary screw traps on the Okanogan River in 2007. Discharge data from USGS gauge at Malott, WA.

Steelhead

A total of 113 naturally-produced and 1,343 hatchery steelhead smolts were captured in 2007 (Figure 11). Most wild steelhead were collected after 27 May. Of the hatchery fish, 87% were captured in the 8-foot trap and were the only fish used for population estimation. Hatchery smolts were counted between 08 April and 20 June with a peak catch of 281 occurring on 09 May. Peak counts corresponded with the release of 20,260 hatchery steelhead smolts into Salmon Creek between 08 May and 11 May. Eighteen hatchery steelhead smolts with PIT tags were detected between 09 April and 03 May. Three marked-fish release-groups yielded 5.8% trap efficiency (Table 6).

Table 6. Marked and recaptured steelhead smolts for given release dates and times, applicable trap, calculated trap efficiency, and discharge at Malott for rotary screw trap efficiency trials on the Okanogan River in 2007.

Trap date Released	Time (24) Released	# Steelhead Marked	# Steelhead Recaptured	Trap Efficiency	Mean Daily Discharge @ Malott
3-May-07	5:45	104	0	0.0%	6,810
11-May-07	19:45	200	5	2.5%	9,370
12-May-07	20:15	200	24	12.0%	9,500
		504	**29**	**5.8%**	

The Salmon Creek fish releases provided an additional opportunity to measure trap efficiency using a very large release group. The background catch ratio at the rotary screw trap was assumed to be stable. The number of steelhead smolts captured in the traps that could be attributed to the Salmon Creek release was calculated using a linear regression analysis (Figure 12). The predicted number of summer steelhead was summed for the days of 09-15 May. Assuming a one day travel lag from the Salmon Creek release site to the trap site, the predicted number or recaptures was divided by the total number of fish released in order to derive a trap efficiency of 1.5%.

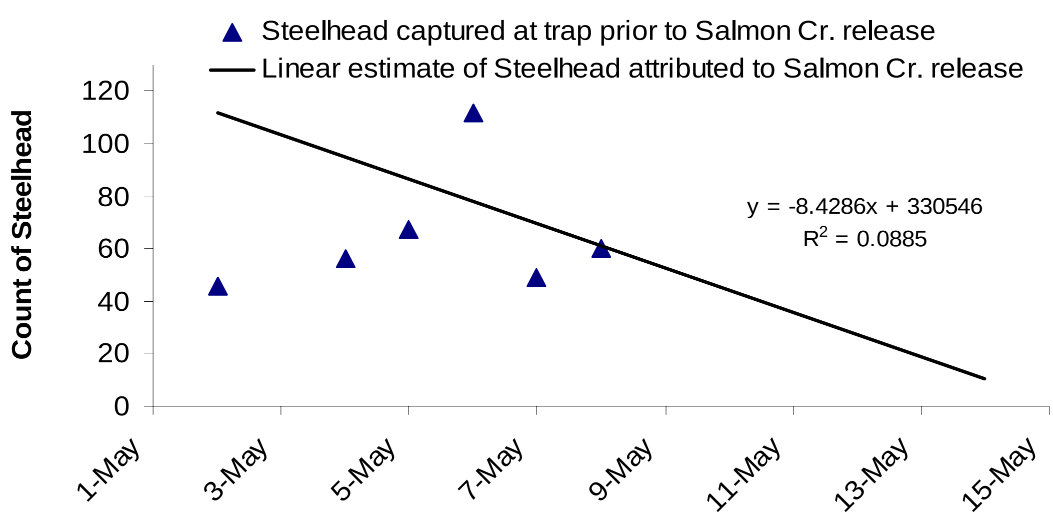

Figure 12. Linear regression analysis estimating the number of steelhead trapped at the study site that can be attributed to the Salmon Creek hatchery steelhead releases in May, 2007.

Table 7. Non-target fish species and numbers of fish caught in the Okanogan River rotary screw traps in 2007.

Species	Count	Species	Count
Yellow Perch	585	Largemouth Bass	20
Mountain Whitefish	322	Carp	18
Smallmouth Bass	101	Peamouth Chub	16
Sucker spp	76	White Crappie	15
Three-spine stickleback	76	Northern Pikeminnow	9
Bullhead spp	40	Sculpin spp	2
Bluegill	27	Dace spp	1
Pacific Lamprey	24		

Non-Target Fish

A total of 1,332 non-target fish of 15 different species were captured in 2007 (Table 7). Yellow perch (585), mountain whitefish (322) and smallmouth bass (101) were the most abundant species. Immature pacific lamprey (24) were collected for the second consecutive year but in lower numbers than 2006 (Figure 13). Confirmation on lamprey identification was provided by Bao Le (Douglas County PUD) and Molly Hallock (WDFW).

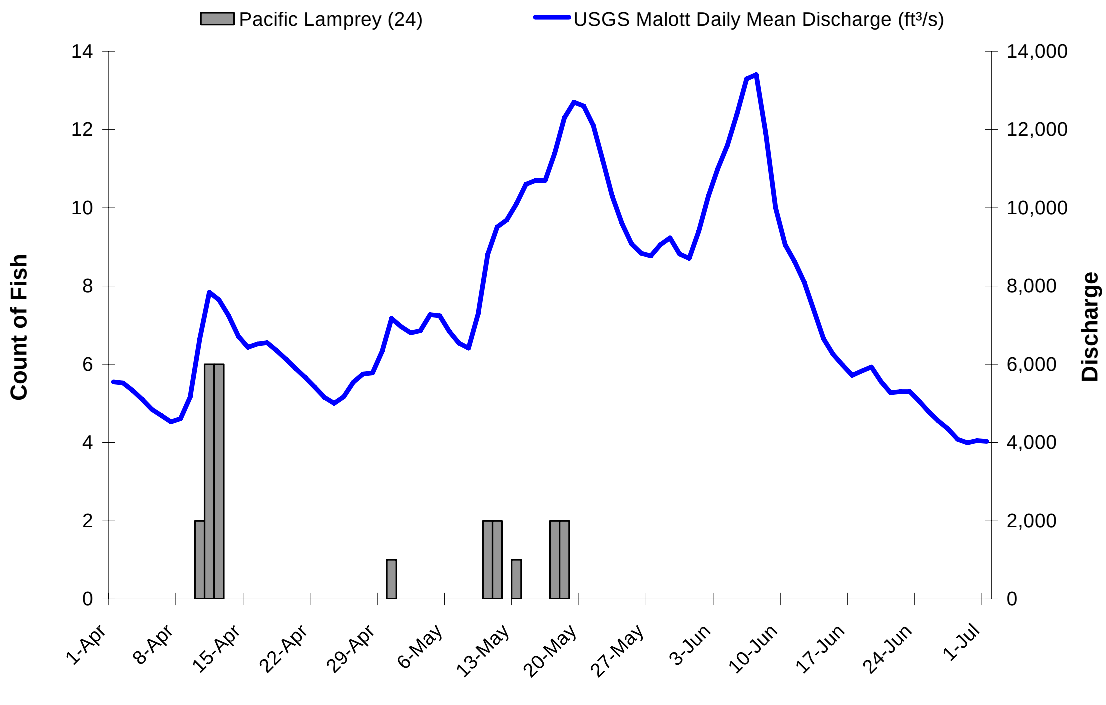

Figure 13. Mean daily discharge and counts of juvenile Pacific lamprey caught in rotary screw traps on the Okanogan River in 2007. Discharge data from USGS gauge at Malott, WA.

Relative abundance and population estimates

Relative abundance estimates are an index of population density and are widely used in fisheries management (Hubert 1996). Relative abundance is used to evaluate the proportional stock density when the true population density is unknown. Indicators from catch per unit effort (CPUE) assume that as the population size increases the higher the number of fish will be collected during a discrete time period. Relative abundance for each species of emigrating salmonids collected at the OBMEP rotary screw trap was calculated per hour (Table 8). The CPUE analysis for 2007 indicates that of the 6 groups compared, the most abundant species in the Okanogan River were wild, sub-yearling Chinook and wild sockeye smolts; wild summer steelhead were the least abundant.

Table 8. Catch per Unit Effort of target salmonids by species, lifestage, natal origin, selected trap size and trapping effort. Trap representing the majority of detections for each species and lifestage during the trap season is shown.

	Chinook		**Sockeye**		**Steelhead**	
Description	Hatchery smolts (8 foot)	Wild sub-yearling (5 foot)	Hatchery smolts (8 foot)	Wild smolts (8 foot)	Hatchery smolts (8 foot)	Wild smolts (8 foot)
Catch	4,215	11,873	341	5,679	1,195	87
Effort (hrs)	643.58	1,063.95	643.58	643.58	643.58	643.58
2007 CPUE	**6.55**	**11.16**	**0.53**	**8.82**	**1.86**	**0.14**

Table 9. Peterson population estimates and 95% confidence limits for several species, life stages, and origins of target salmonids collected at rotary screw traps on the Okanogan River in 2007.

Species	**Life History Stage**	**Origin**	**Trap Efficiency**	**Population Mean**	**Lower 95% CI**	**Upper 95% CI**
Steelhead	Smolt	Hatchery	1.5%**	83,808	75,723	91,892
Steelhead	Smolt	Wild	1.5%*	7,533	N/D	N/D
Chinook	Sub-yearling	Wild	0.9%	1,126,545	394,671	1,858,419
Chinook	Smolt	Wild	2.4%*	917	N/D	N/D
Chinook	Smolt	Hatchery	2.4%	161,331	83,457	239,205
Sockeye	Smolt	Wild	1.7%	341,992	197,253	486,730
Sockeye	Smolt	Hatchery	1.7%*	19,372	N/D	N/D

N/D-Insufficient data collected for calculation of 95%CI.
*-Trap efficiencies borrowed from most appropriate surrogate.
**- Trap efficiency calculated from Salmon Creek linear regression analysis.

Population estimates are popular indicators for planning goals, recovery targets, and decision thresholds. However, noisy data often results in very broad confidence intervals that are difficult to properly interpret. These data are no exception, especially when trap efficiencies below 2% are prevalent (Tussing 2008). Great caution should be taken when interpreting these population estimates derived from rotary screw traps because of wide confidence intervals and difficulty meeting the basic assumptions for conducting population estimates (Table 9).

Calculated population estimates were compared with known hatchery releases. For example, 97,000 summer steelhead smolts were known to have been released into the Okanogan River system during 2007. Using the previously discussed a priori mark/recapture methodology resulted in a calculated population mean of 20,721 and an upper bound of 27,709; both these numbers are well below what was already known to be true. An alternate method was developed that reduced the trap efficiencies from 5.9% to 1.5% thus providing a believable population estimate. Approximately 276,000 yearling Chinook smolts were known to have been released into the Okanogan River in 2007. Calculated population estimates for hatchery Chinook smolts resemble these values and validate this methodology (Table 9). Although other population estimates existed for sockeye salmon that might allow validation of the current methodology, the accuracy and precision of sockeye estimates are difficult to determine.

An estimated 7,533 wild summer steelhead emigrated from the Okanogan River Basin in 2007 (Table 9). Using the estimated Wells Hatchery smolt-to-adult return rate of 1.1%, a predicted 83 wild adult summer steelhead will return to the Okanogan River to spawn over the next 1-3 years. The calculated sub-yearling Chinook population estimates have the largest confidence intervals of any group analyzed, but these are the first data to ever be collected from this life history form in the Okanogan basin. It is hypothesized that smolt-to-adult returns for the sub-yearling life history form are very low and highly variable as these small fish are susceptible to mortality from many sources. Therefore from these data it is nearly impossible to predict what adult escapement might be in the Okanogan River over the next 3-5 years.

RECOMMENDATIONS

Building upon the lessons learned from the pilot year of the project (2006), the 2007 rotary screw trap operations were vastly improved and resulted in improved data quality. Methodologies for trap deployment and operation were refined, overall rates of trap mortality were significantly reduced, mark/recapture efforts were increased, and population estimates could be calculated. The following recommendations are made with a focus on repeatability and simplicity:

1. *Establish Consistent Trap Operations*
    - Establish the trap location based upon a trap rotational speed of between 10 and 12 revolutions per minute;
    - Define consistent trap operation and fish release times; and
    - Determine a discharge threshold for trap operations during the ascending limb of the hydrograph.

2. *Improve trap efficiency trials:*
    - Begin mark-recapture efforts for key species at the earliest possible date within the migration period;
    - Investigate the minimum elapsed time for subjects traveling between the release point and the trap site;
    - Conduct mark-recapture trials more frequently;
    - Release mark groups of more than 100 by retaining fish trapped over multiple nights;
    - Focus mark recapture efforts on wild, sub-yearling Chinook and summer steelhead smolts; and
    - Attempt to ensure that marked fish are being captured in an equal proportion to the rest of the population in order to produce unbiased population estimates.

3. *Extrapolate population estimates to include the entire trapping season and not based solely upon operational time periods;*

4. *Determine if additional equipment is necessary to meet a minimum goal of 2% trap efficiency and make recommendations in 2008.*

Future reporting over the next 5 to 10 years should combine data from multiple sources and attempt to establish smolt to adult return rates for wild sub-yearling Chinook, wild summer steelhead, and wild sockeye salmon. Additional years of data collection will be needed to do this along with appropriate age data, or age at length relationships and length data. Since adult return data have been collected over many years generalized smolt production estimates can be used in the interim. Continued funding for this work will make future run reconstructions and return predictions possible but will require that data be collected over the next 10-12 years at a minimum.

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APPENDICES

Appendix A. Daily rotary screw trap data sheet (obverse) used on the Okanogan River in 2007.

Colville Tribes Fish & Wildlife	Collectors:			Date	24h Time	Trap RPM		Trap Size & Position		
			Start				Start	8 foot		
2007			End				End	5 foot		
OKANRT	Weather:		Redeploy				Redeploy		Pos 1	Pos 2
RKM 858.040	Number Dyed	Recaps	TRAP NOTES:						USGS Malott	
									Temp	Discharge
	Species:									

	CHINOOK		SOCKEYE		STEELHEAD		OTHER				
	Unmarked	AD Clip	Skaha(Yr2)	Osoyoos(Yr1)	Unmarked	AD Clip					
Smolts											
Number measured											
Morts											

	CHINOOK		WHITEFISH		STEELHEAD		OTHER				
YOY											
Number measured											
Morts											6/4/2007

Date Entered:	Sample ID:

Appendix B. Daily rotary screw trap data sheet (reverse) used on the Okanogan River in 2007.

Individual fish measurements by species **(in millimeters)**

fish species		fish species		fish species		fish species				
	Fork Length		Fork Length		Fork Length		Fork Length		Fork Length	PIT tag
1		1		1		1		1		
2		2		2		2		2		
3		3		3		3		3		
4		4		4		4		4		
5		5		5		5		5		
6		6		6		6		6		
7		7		7		7		7		
8		8		8		8		8		
9		9		9		9		9		
10		10		10		10		10		
11		11		11		11		11		
12		12		12		12		12		
13		13		13		13		13		
14		14		14		14		14		
15		15		15		15		15		
16		16		16		16		16		
17		17		17		17		17		
18		18		18		18		18		
19		19		19		19		19		
20		20		20		20		20		

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