YAKIMA RIVER SPECIES INTERACTIONS STUDIES

Annual Report FY 1990

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EXECUTIVE SUMMARY

Studies of species interactions were implemented to address concerns about the possible effects of supplementation (with anadromous species) on resident fish populations in the upper Yakima River basin. The current study objectives include collection of baseline information on the fish populations in the upper Yakima River and associated tributaries. As part of this baseline phase, spawning surveys of the upper Yakima River and thirteen selected tributaries between Roza and Keechelus dams were initiated during the spring of 1990. This report summarizes the results of field activities conducted from December, 1989 to June, 1990.

Data was collected primarily using electrofishing and snorkeling techniques. Backpack electrofishing was used to locate spawning rainbow trout in tributaries when flow conditions (< 3.0 cms) and channel morphology permitted. A jet boat electrofishing unit was used in the mainstem Yakima River below the confluence of the Teanaway River. Due primarily to high water velocities (>1.5 m/s) this system met with marginal success. Use of alternative methods will be explored in 1991.

Snorkeling techniques were used in some tributaries and in sections of the Yakima River where electrofishing was not practical and where channel shape and water clarity were suitable. Snorkeling provided a rapid assessment of the occurrence of adult salmonids but did not allow the collection of biological data from individual fish.

Biological data (e.g. species, length, weight) was collected from all salmonids captured with electrofishing techniques. Resident trout greater than 200 mm (fork length) were tagged with anchor tags and released. A total of 117 rainbow trout were collected from different locations throughout the study area for analysis of genetic (protein electrophoresis) structure, ancestry, and scale patterns.

As of June 30, 1990, spawning surveys had been conducted on 13 tributaries and seven mainstem Yakima River areas. The results indicate the greatest number of large spawning rainbow trout occurred in the lower mainstem and lower elevation tributaries such as Umtanum, Cherry, Wilson, and Naneum creeks. Higher elevation tributaries and mainstem areas contained fewer and smaller (though not necessarily younger) trout. It is in these higher elevation areas that most of the current anadromous fish (steelhead and spring chinook salmon) spawning is known to occur.

Preliminary analysis of the data collected thus far indicates that very few of the large resident rainbow trout that contribute to the recreational fishery in the Yakima Canyon area

utilize the upper elevation tributaries and mainstem areas for the purpose of spawning. It is possible that smaller fish in the upper reaches of the basin recruit to the Canyon area fishery at some point in their life cycle. More data will be collected to explore the relationship between mainstem and tributary fish. When a more complete set of age data is available, it will provide more information on size/age relationships throughout the upper basin.

More than 500 resident trout were tagged and released during the 1990 spawning surveys. Prior to the end of the spawning surveys nine recaptures were made. Continued tag return information from anglers, our own recaptures during sampling surveys, and from observations at downstream trapping facilities will clarify seasonal movement patterns and will be used to validate growth rates obtained by scale analysis.

High stream flows in April, May, and the first half of June severely limited the success of some electrofishing and snorkeling surveys.

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INTRODUCTION

In the Columbia Basin Fish and Wildlife Program (NPPC 1987), the Northwest Power Planning Council (NPPC) recognized the need and opportunity to improve natural runs of anadromous salmonids in the Yakima River basin (Section 800). A primary component of this restorative effort involves the planning, design, and implementation of a central outplanting facility, termed the Yakima/Klickitat Production Project (YKPP). The intent of production from this facility will be to increase the abundance of naturally reproducing anadromous salmonids (supplementation) and to provide fish for harvest purposes, while not adversely impacting the biological or genetic resources of affected stocks (Section 703(f)(3). The YKPP is also expected to provide a major opportunity for evaluation of supplementation success and for learning of its effects on coexisting supplemented and unsupplemented stocks.

The resident trout populations inhabiting the upper Yakima River presently provide one of the best resident trout stream fishing opportunities in Washington State. Thus the possibility exists that these resident trout populations will be negatively affected by competitive interactions with released or natural fish produced from the YKPP. The uncertainty and sensitivity of potential impacts of YKPP on resident fish in the upper Yakima River were identified in the Experimental Design Plan of the Yakima/Klickitat Production Project Preliminary Design Report

(BPA 1990a). Therefore, to address this uncertainty an investigation of species interactions was initiated by the Washington Department of Wildlife (WDW) in September of 1989, funded by the Bonneville Power Administration (BPA).

The overall goal of current species interactions research is to investigate possible impacts to resident salmonids resulting from YKPP activities in the upper Yakima River. Species of particular concern include rainbow trout (*Oncorhynchus mykiss*), steelhead trout (anadromous form of *O. mykiss*), and chinook salmon (*O. tshawytscha*). Study activities are expected to progress in three phases: baseline data collection, pre-facility experimentation, and post-facility monitoring. General objectives for each study phase include:

1. Baseline data collection

   Assess the population status and distribution of resident trout and other salmonids present in the upper Yakima drainage, and develop methods and sampling strategies to monitor resident trout populations once the YKPP is implemented.

2. Fre-facility experimentation

   Design and conduct experiments to investigate specific interactions between resident trout and anadromous salmonids, to assess potential impacts of supplementation prior to releases of juveniles and returning adults from the YKPP.

3. Post-facility monitoring

   Monitor and assess the status of resident trout populations after implementation of YKPP supplementation.

This report contains analyses of data collected from study activities conducted from February through June, 1990. Specific objectives for work conducted during this time were:

- Determine the timing and distribution of resident trout spawning activity in the mainstem Yakima River and in major tributaries.
- Collect biological data from a representative sample of the spawning population to determine age-composition, length-at-age characteristics, sex ratio, and growth rates.
- Investigate seasonal distribution and movement patterns of adult salmonids via observation of tagged individuals.
- Obtain samples to initiate a genetic assessment of resident trout population structure, ancestry, and distinctiveness from Yakima River steelhead trout.

STUDY AREA

The Yakima River originates in the Cascade Mountains of central Washington at an elevation of 2100 meters. As the river flows southeastward toward its confluence with the Columbia River it passes through climatic transitions ranging from cool and moist in the mountains to warm and dry in the valleys. Annual precipitation near the Cascade crest ranges from 200 to 350 cm, and in the lower elevations is no more than 25 cm (Fast et al. 1989).

The present study is being conducted on the Yakima River and associated tributaries in Kittitas County, Washington. The study area is located between Roza Dam at river kilometer (rkm) 180 and Keechelus Dam (rkm 305) and includes the major tributaries within this area (Fig. 1). The study is confined to stream reaches that are within the zone of anadromous salmonid activity, i.e. areas below obstructions that form barriers to upstream migrations by steelhead and salmon. Such obstructions occur on Cabin Creek at rkm 5.0, Manastash Creek at rkm 4.8, Wilson Creek at rkm 12.5, and Umtanum Creek at rkm 12.8 (BPA 1990b).

The upper reaches of the study area begin at Keechelus Dam, one of four large storage reservoirs in Kittitas County. These reservoirs (Keechelus, Kachess, Cle Elum, and Easton) are used to provide irrigation water for the Kittitas and Yakima Valleys and have a significant influence on water flows within the Yakima

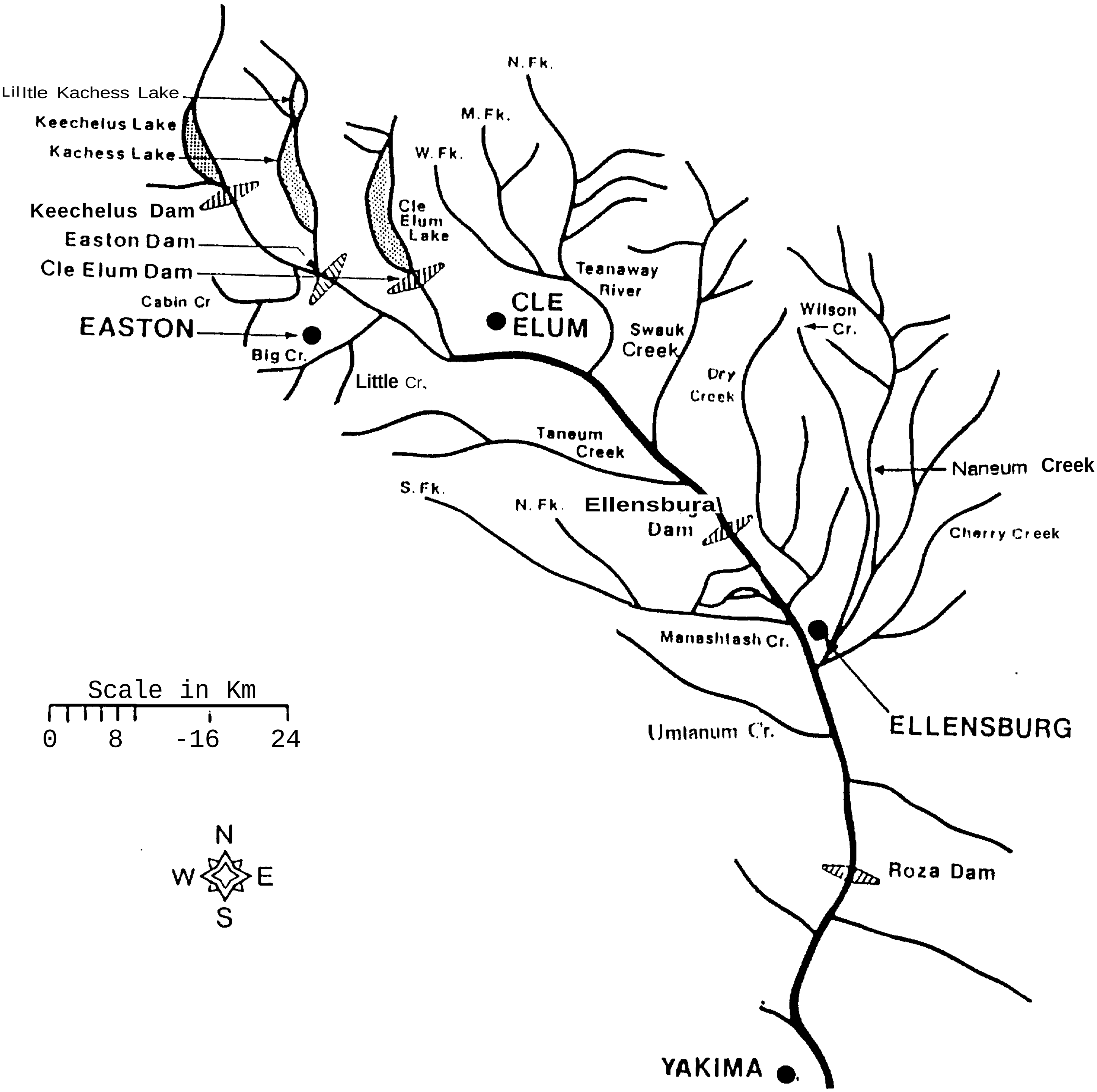

Figure 1. Map of Yakima River above the city of Yakima. Study area includes the Yakima River and its tributaries north of Roza Dam.

Basin. Major tributaries in this upper area include Cabin Creek, Big Creek, and the Kachess and Cle Elum rivers.

The intermediate reaches are characterized by warmer and drier conditions and reduced stream gradients. Important tributaries here include the Teanaway River and Swauk Creek. The Teanaway is the largest tributary within the study area, with a drainage area of approximately 512 square kilometers (BPA 1990b). The Teanaway River has 18.7 km of mainstem and three forks, the North (30.4 km), Middle (24 km), and West Forks (24 km).

Further downstream the Yakima River enters the agricultural land of Kittitas County west of the City of Ellensburg. A large diversion dam at rkm 233 (Ellensburg Dam), diverts water from the Yakima River for irrigation purposes. Improvements to the fish ladder and screen system at Ellensburg Dam were completed in 1989.

The Kittitas Valley is dominated by cattle grazing and hay production. The tributaries in this area are utilized primarily for irrigation, both as a source of water and as an irrigation return, with most streams having numerous diversion dams. During the irrigation season (mid-April through mid-October) the valley reaches of these tributaries can run high and turbid, or may be partially or totally dewatered. Important tributaries in this section include Taneum, Manastash, Wilson, Dry, Naneum, and Cherry creeks. Cherry Creek is the only outlet draining the southern part of the Kittitas Valley and in our spawning survey of Cherry Creek we have included the lower reaches of Cooke, Park, and Caribou creeks.

south of Ellensburg the river enters the Yakima Canyon. Here the river broadens and meanders southward toward Roza Dam. This area is heavily used by both recreational boaters and anglers, and is well known for its high-quality rainbow trout fishery (L. Brown, WDW, pers. comm.). Umtanum Creek, a small, relatively unaltered stream, enters the Yakima River in this area.

Roza Dam forms the lower boundary of the study area. A major re-construction phase of the dam and associated fish ladders and screens was completed in 1988 and more is scheduled to occur. Improvements to the right-bank fish ladder are currently underway. Prior to these improvements this fish ladder was often inoperable and the dam may have acted as a barrier (especially during low flows) to upstream passage of anadromous fish (J. Hubble, YIN, pers. comm.).

A total of seven study sections were selected in the mainstem Yakima River after dividing it into four general reaches based on physical geographic features and broad habitat types (Fig. 2). The upper reaches of the Yakima River (study sections 1, 2, and 3) are within the forested zone of the lower Cascade Mountains and are characteristically montane in nature (e.g. flow through conifers, meadows, and are fed by clear, cool mountain tributaries). Study section 4 is in the transition zone between the Cascade Mountains and the Kittitas Valley. In this section conifers are gradually replaced by shrub-steppe vegetation and precipitation levels decline. The Yakima River flows through a relatively steep canyon in section 4. Section 5 flows through

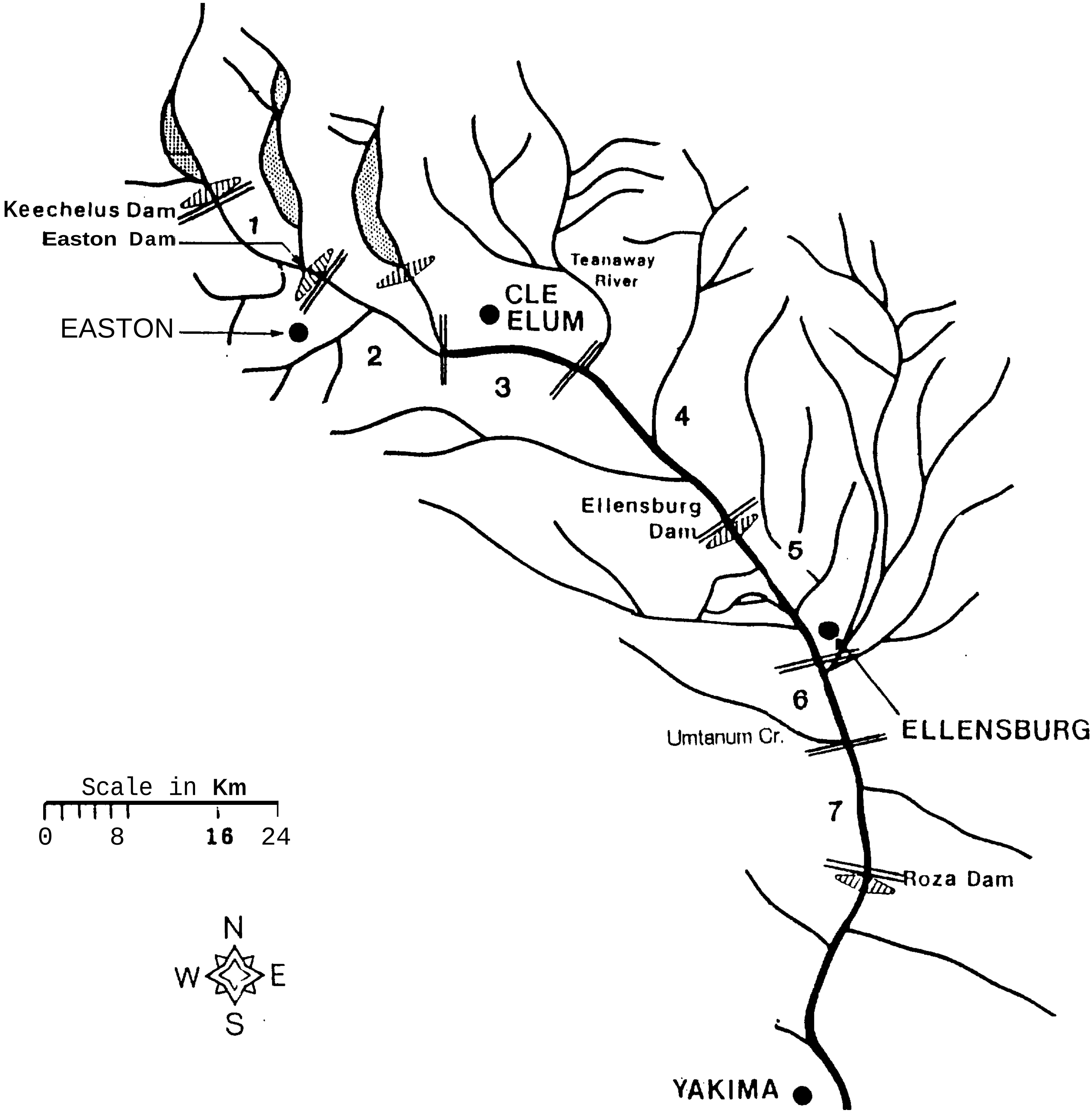

Figure 2. Map of the Yakima River above the city of Yakima. Mainstem sample sections (l-7) are identified in the study area above Roza Dam.

the Kittitas Valley and is characterized by increased channel braiding in the Ellensburg area, with a riparian corridor composed of willow, alder, and cottonwood. Sections 6 and 7, separated by the mouth of Umtanum Creek, are located in the Yakima Canyon and are the lowest (in elevation), and driest sections in the study area.

Descriptions of mainstem study sections are as follows: section 1 (Crystal) runs from Keechelus Dam to Easton Dam; section 2 (Nelson) from Easton Dam to the confluence of the Cle Elum River; section 3 (Cle Elum) from the Cle Elum River to the confluence of the Teanaway River; section 4 (Thorp) from the Teanaway River to Ellensburg Dam; section 5 (Ellensburg) from Ellensburg Dam to the Ringer Road access: section 6 (upper canyon) from Ringer Road access to Umtanum Creek; and section 7 (lower canyon) from Umtanum Creek to Roza Dam.

The trout fishery in the Yakima River above Roza Dam is presently managed for catch and release, which requires use of single barbless hooks and artificial lures only. The majority of anglers utilizing the river presently use fly-fishing gear, with only a small portion using lures (J. Cummins, WDW, pers. comm.). Typically, fishing pressure is heavy on weekends and holidays, and light at other times. The Yakima River is popular for guided fishing trips.

Fish species present in the upper Yakima River and associated tributaries include: rainbow trout, cutthroat trout (O. clarki) mountain whitefish (Prosopium williamsoni), spring chinook salmon (O. tshawytscha), suckers (Catostomus spp.), bull trout (Salvelinus confluentus), eastern brook trout (Salvelinus fontinalis), shiners (Richardsonius spp.), dace (Rhinichthys spp.), sculpins (Cottus spp.), northern squawfish (Ptychochelius oregonensis), chiselmouth (Acrocheilus alutaceus), three-spine stickleback (Gasterosteus aculeatus), and western brook lamprey (Lamptera richardsoni).

METHODS

Tributaries

Exploratory spawning surveys in selected tributaries of the Yakima River began on February 28, 1990 and were conducted by electrofishing sample sections. Electrofishing provides samplers the opportunity to sample individual fish in varied water conditions and to assess the relative sexual maturity of those fish. In our initial surveys we attempted to sample the entire lower portion of each tributary up to anadromous barriers. Time constraints in March forced us to change to a less intensive method in which selected short sections (0.4 to 0.8 km) were electrofished. Spawning surveys were first conducted in the lower elevation tributaries and progressed up the Yakima River drainage as road access (many forest roads in the higher elevations were snowed-in through late April), and stream flow conditions permitted.

Electrofishing spawning surveys were conducted by a three-person sampling team. A person equipped with a Smith-Root Model 12 backpack electrofisher (battery-powered) and a netter typically electrofished in an upstream direction while a third crew member followed, towing a canoe which contained sampling equipment and a live-box for captured fish. Netted salmonids were placed in the live-box in the canoe prior to collection of data at regular intervals. The fish were anesthetized with MS222 (tricaine methanesulfonate), identified by species, and fork lengths (FL) were measured to the nearest millimeter (see Table 1 for fork length/total length conversions). All trout were weighed to the nearest gram and scales were collected from a sub-sample of the trout captured. Each fish was examined for the presence of hook-scars (e.g. scars on soft-tissues around mouth, missing or damaged maxillary or mandible). All trout greater than 170 mm were tagged with serially numbered Hallprint T-bar anchor tags, examined for sexual maturity (spawning condition), and placed in a perforated holding bucket for recovery from the anesthetic. Once the fish had recovered from the anesthetic they were released into the stream. A few sexually mature fish from each section were retained for later genetic analysis. In addition, water temperature (C) for each sampled section was recorded. Water conductivity (mmhos/cm) was periodically measured using a LeMotte portable conductivity meter.

Several tributaries were too large to sample with backpack electrofishing equipment and were surveyed using snorkeling techniques similar to those described by Schill and Griffith (1984). Three crew members equipped with dry-suits, masks and snorkels positioned themselves across the width of the stream and floated downstream (usually a 2-5 km section) recording all trout observed and classifying the fish into two size groups, trout < 200 mm in length, and trout > 200 mm. We arbitrarily chose 200 mm to differentiate between the adult (potential spawner) and sub-adult segments of the population. This 200 mm criterion will be evaluated using results from this study. All snorkeling surveys were conducted during daylight hours. Water temperatures ranged from 7-10 C.

Obtaining exact lengths, weights, spawning condition, and genetic samples was not possible using snorkeling methods. However, this technique did allow for rapid assessment of the presence/absence of adult salmonids in areas where backpack electrofishing was ineffective. Relative abundance of non-salmonid species was also recorded.

Stream walking surveys to locate trout redds were not conducted in 1990. In future spawning surveys, index areas on three tributaries will be identified and redd habitat characteristics such as stream velocity, depth, substrate composition, distance to cover, and cover type will be quantified for each redd located.

Mainstem Yakima River

Several sections of the Yakima River were sampled using a jet boat equipped for electrofishing that was loaned by the Yakima Indian Nation (YIN). This boat was rigged with a gasoline-powered Honda generator, a Coffelt Mark XX rectifier, a stationary cathode (-), and either a stationary or mobile anode (+). Due primarily to low water conductivities, we experienced low capture efficiencies with the stationary anode system and re-equipped the boat with a mobile anode fabricated from plans provided by the Montana Department of Fish, Wildlife and Parks.

Typically the boat was held in position near one bank of the river by slowly "backing down" along the bank using the outboard motor. The mobile anode was thrown into probable trout habitat and then retrieved towards the boat where the stunned trout could be netted. Sampled fish were then placed in a live-box until data collection was performed (same as discussed for tributaries).

In areas of the Yakima River that were not accessible with the jet boat, and where channel shape and water clarity permitted, we used snorkeling techniques as previously mentioned. In a few instances hook and line sampling was also undertaken to capture fish for the spawning survey and to obtain trout for genetic analysis and tagging purposes.

Biological Profile of Spawning Populations

Spawning resident trout populations were sampled to determine age composition and length-at-age relationships using scales collected from trout in the field. At the time of this report a sub-sample of scales from 80 rainbow trout had been aged by project staff using a microfiche projector. Spawning checks were observed while aging the sub-sample but their occurrence was not quantified for this report. Scale samples obtained from rainbow trout were also aged by Washington Department of Fisheries (WDF) personnel as part of the genetic analysis (see below). These scales were used to compare and standardize aging results between analysts. The remainder of the scale samples obtained during the 1990 spawning survey will be aged during the next reporting period in order to more fully examine age composition, lengths-at-age, and growth rates.

Field data were also used to determine sex ratios, sexual maturity, and movement patterns of resident trout in the tributaries and the mainstem Yakima River. Movement patterns and seasonal distributions of resident trout will continue to be examined using tag recaptures made by WDW crews during the course of this study, by anglers, and by recaptures made at Roza and Prosser Dams by YIN personnel.

Genetic Profile of Spawning Populations

To obtain information on the genetic structure of spawning rainbow trout, it was intended that 33 adult rainbow trout would be collected from each of nine tributaries. An additional 100 rainbow trout were to be collected from Swauk Creek and the Teanaway River (combined) and a total of 200 rainbow trout were to be collected from the mainstem Yakima River. We chose to group the samples from the three forks of the Teanaway River and Swauk Creek based on their geographic proximity and on similarities in stream morphology.

Rainbow trout collected for genetic analysis were kept on ice in the field and then were stored in a freezer (-45 C) for up to 3 months until they could be transported (on dry ice) for laboratory analysis. Electrophoretic laboratory work, data analysis, and consultative support were provided by the WDF Genetics Stock Identification (GSI) lab. Results of this genetic analysis will be summarized in our next progress report.

RESULTS AND DISCUSSION

Exploratory Tributary Spawning Surveys

The tributaries sampled provided a wide array of water conditions, habitat types, fish species compositions, and trout size and abundance. As of June 30, 1990, exploratory electrofishing surveys had been conducted on Cherry, Wilson, Naneum, Dry, Umtanum, Manastash, Taneum, Swauk, Big, and Cabin creeks. Highest capture success occurred in lower elevation tributaries, notably Wilson, Cherry, Umtanum, Taneum, and Swauk creeks. Number of days surveyed, length of stream covered, and total number of salmonids for each tributary are summarized in Table 1. Note that in the electrofishing results we have arbitrarily chosen 150 mm FL as the break between potential spawners and non-spawners. While there were exceptions observed during the course of the surveys, fish less than 150 mm were generally not sexually mature.

Table 1. Summary of electrofishing spawning surveys in upper Yakima River tributaries, February-June 1990.[a]

Stream	No. of Days	Length (km)	Number: RB <150mm	RB >150mm	CT	BT	Adult SS	Juv CK
Cherry	6	4.8	73	275				14
Wilson	6	11.5	17	249	6	29		1
Naneum	3	4.0	13	34		3		35
Dry	1	1.6	13	12	1	1		20
Umtanum	5	3.7	82	88			1	38
Manastash	1	1.6	1	10				1
Taneum	4	4.9	199	50	15			1
Swauk	3	3.4	97	45	2			4
Big	1	3.3	12	6				
Cabin	2	2.4		2		1		
Total	32	41.2	507	771	24	34	1	114

[a] RB rainbow, CT cutthroat, BT eastern brook, SS summer steelhead, CK spring chinook salmon.

[b] Conversion factor for fork length to total length for RB 76-126 mm: TL=(FL X 1.0377) for RB 127-177 mm: TL=(FL X 1.0391) RB > 178 mm: TL=(FL X 1.145) (Carlander 1969).

Several study tributaries were too deep or had too much flow for backpack electrofishing surveys to be effective. Although flow data was not available for most upper Yakima River tributaries, Figure 3 shows how flows in the study area increased in March and were subsequently manipulated for irrigation purposes starting in mid-April. From April 6 to May 1 (26 days) no electrofishing surveys were conducted due to high flow conditions in the tributaries. In addition, low water conductivities were encountered which may have limited

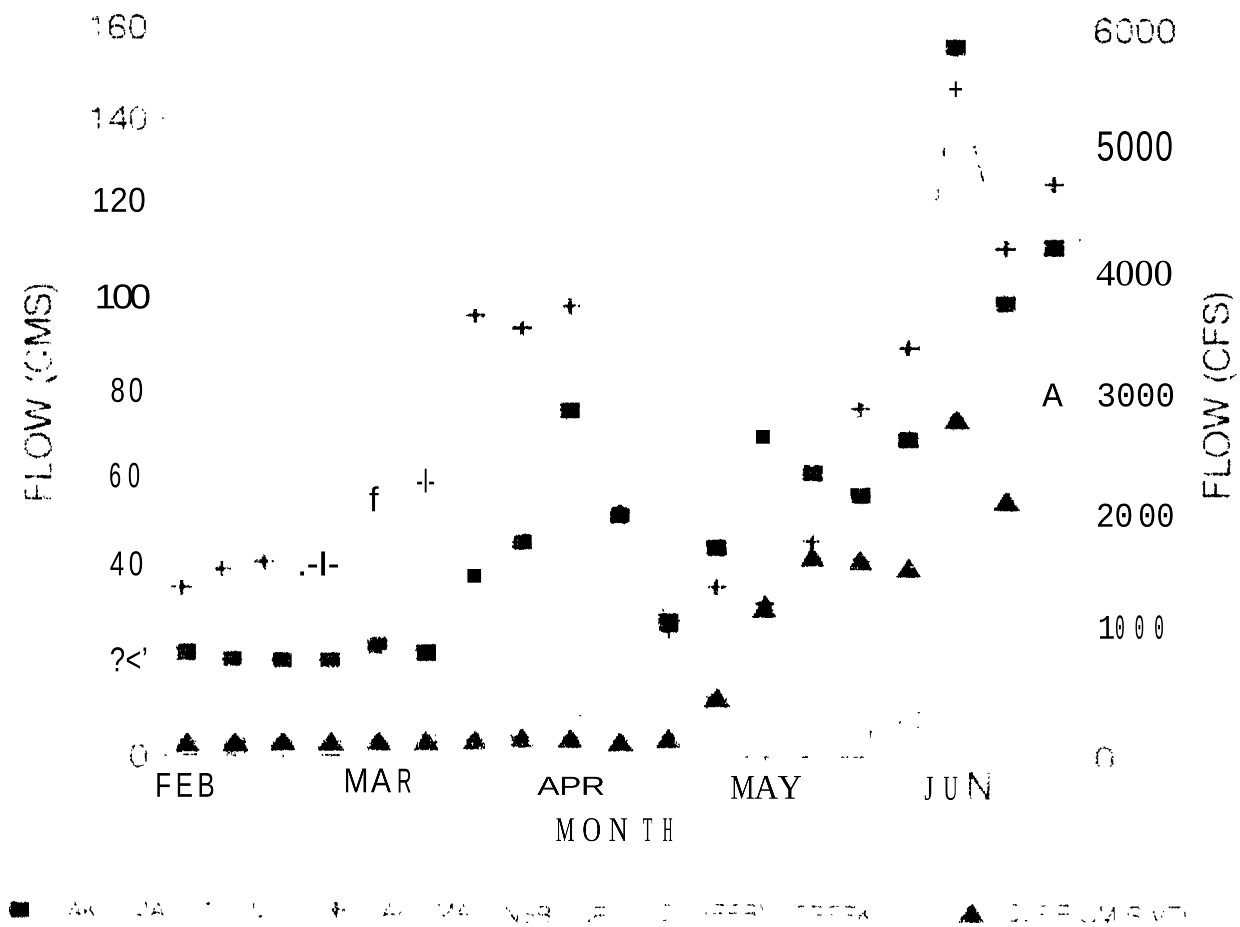

Figure 3. Mean weekly discharge at four stations in the upper Yakima Basin in cubic meters per second (cms) and cubic feet per second (cfs) (on Y2), February - June 1990 (USBR unpub. data).

electrofishing success throughout the study area during the course of the spawning season. In Montana streams low water conductivities have been associated with reduced electrofishing success (Vincent 1971). In surveys conducted in our higher elevation tributaries low conductivities (24-30 mmhos/cm), coupled with high water clarity (causing fish avoidance), may have hampered our efforts to collect fish.

We attempted to increase stream conductivity in Swauk Creek and Big Creek by placing a 23 kg salt block in the stream prior to electrofishing. Conductivity readings above and below the salt block were virtually the same and there was no apparent increase in electrofishing efficiency.

Piper et al. (1983) reported that optimum rainbow trout spawning temperatures are between l0-13 C. Water temperatures in the mainstem Yakima River appeared ideal for rainbow trout spawning in May and June (Fig. 4). It is interesting, however, that a sexually mature female rainbow trout was captured in the upper canyon area of the Yakima River on February 21 when water temperature was only 4 C.

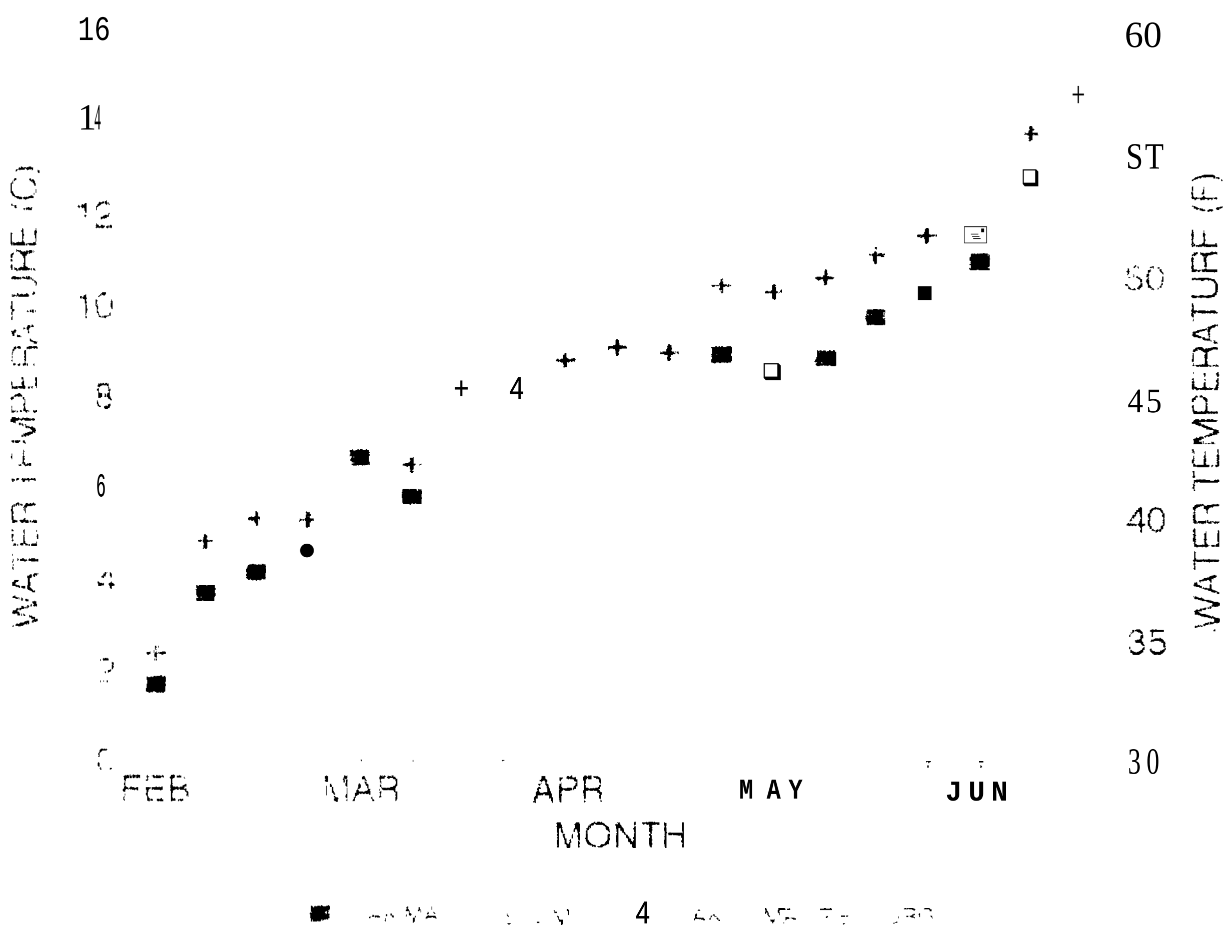

Figure 4. **Mean weekly water temperatures at two stations** on the upper Yakima River, February - June 1990 (USBR unpub. data).

In tributaries where backpack electrofishing was ineffective we conducted snorkeling surveys in order to determine the presence or absence of spawning trout. Snorkeling surveys were conducted on the Cle Elum River, the West Fork Teanaway River, and Cabin Creek (Table 2). Very few trout were observed in the Cle Elum River and Cabin Creek.

Table 2. Summary of snorkeling surveys conducted in upper Yakima River tributaries, February - June 1990.

Stream	Date	Length (km)	Number RB <200mm	Number RB >200mm	BT	Juv CK
W.F.Teanaway	6/7	2.8	40	10		
Cle Elum R.	4/26	4.8				12
Cle Elum R.	4/30	0.2		4		5
Cabin Cr.	6/27	1.2		4	1	
Total		9.0	40	18	1	17

Exploratory Mainstem Surveys

Spawning surveys were initiated in the mainstem Yakima River on February 21, 1990 with the assistance of YIN Fisheries personnel and their electrofishing jet-boat, configured with a stationary 'boom' anode. In February and March three survey trips were conducted with YIN personnel.

In early May a mobile electrode was installed on the YIN boat in an attempt to increase electrofishing efficiency. Subsequent mainstem surveys were conducted and pooled survey results are summarized in Table 3. Electrofishing results from the mainstem Yakima River were disappointing (with both electrode systems) and we suspect the number of trout collected reflects a low capture efficiency rather than low population densities. This hypothesis is based on visual observations of trout evading and/or escaping the electric field created by the electrofishing equipment.

Table 3. Summary of electrofishing and angling surveys in the mainstem Yakima River, February - June 1990.

Area (Section)	Length (km)	Number RB <150mm	RB >150mm	CT	BT	Adult SS	Juv CK
Lower Canyon (7)	8.0	7	54				
Upper Canyon (6)	9.6	2	46				
Ellensburg (5)	11.0	1	8	1		1	
Thorp (4)	13.0	1	7	2			2
Cle Elum (3)[a]	7.0	4	1				
Nelson Rd. (2)[a]	0.0						
Crystal Spr. (1)[a]	0.8						
Total	49.4	15	116	3		1	2

[a] Electrofishing surveys not possible with jet boat, the fish captured in the Cle Elum section were obtained in side-channels using a backpack electrofisher.

Sections of the Yakima River above Thorp (section 4 on Figure 2) were too shallow for the jet boat and were too large for the backpack electrofisher to be effective. In these sections we used the snorkeling methods previously described to determine the presence/absence of adult salmonids. Results of these snorkeling surveys are shown in Table 4.

Table 4. Summary of snorkeling surveys conducted in the mainstem Yakima River, February - June 1990.

Area (Section)	Date	Length (km)	Number RB <200mm	RB >200mm	BT	Juv CK
Cle Elum (3)	4/30	4.8	2	13		
Nelson (2)	5/25	5.6	1	41		80
Crystal (1)	5/30	4.5		1		
Crystal (1)	6/27	2.0		1		
Nelson (2)	6/28	6.4	113	90	4	143
Total		23.3	116	146	4	223

Biological Profile of Spawning Populations

As of June 30, 1990 a total of 1,410 rainbow trout had been captured and examined in the Yakima River and its tributaries. The largest resident trout were collected in the mainstem Yakima River and in Wilson and Cherry creeks (Table 5).

Table 5. Mean fork lengths (± SD), weights (± SD), and condition factors (k) of rainbow trout collected in electrofishing spawning surveys, February - June 1990.

Stream	N	Fork Length (mm) Mean	Fork Length (mm) ±SD	Weight (g) Mean	Weight (g) ±SD	k[a]	%>150 mm
Cherry	348	213	68	145	129	0.88	79
Wilson	267	259	84	306	293	0.94	94
Naneum	47	211	68	156	142	1.13	72
Dry	25	197	93	171	164	0.92	48
Umtanum	170	197	112	196	198	0.84	52
Manastash	11	188	35	100	60	1.02	91
Taneum	249	129	32	34	31	1.04	20
Swauk	142	142	31	39	28	1.02	32
Cabin[b]	2	135	47	41	44	1.05	67
Big[b]	18	133	57	46	89	1.04	33
Yakima R.	131	264	80	257	178	0.83	89
Total	1410						

[a] Condition factor ($k = w (100,000)/l^3$ where w=weight in grams, l=length in mm). Standard condition'factor for RB is k = 1.12 (Piper et al. 1983). Fork lengths were converted to total lengths using correction factors from Carlander (1969).

[b] Condition factors are probably misleading due to small sample sizes and small mean lengths.

As of this writing, relatively few of the scale samples collected in the spawning surveys had been aged (N=80). Length-at-age data for fish collected from tributaries are shown in Table 6. Presence of spawning checks was noted in some instances but was not quantified for inclusion in this report.

Table 6. Length-at-age characteristics for rainbow trout collected in three Yakima River tributaries, February - June 1990.

Stream	Age	N	Fork Length (mm) Mean	Min.	Max.	SD
Cherry Cr.						
	1+	5	121	92	160	36
	2+	28	240	153	321	43
	3+	13	304	256	364	31
	4+	3	372	318	403	47
	5+	0				
Wilson Cr.						
	1+	0		-	-	-
	2+	1	235	-	-	-
	3+	10	315	279	387	34
	4+	3	380	302	422	68
	5+	1	391	-	-	-
Umtanum Cr.						
	1+	0		-	-	-
	2+	0				
	3+	8	306	210	355	48
	4+	4	339	328	359	14
	5+	4	354	336	367	14

A relatively high percentage of the larger trout sampled in the tributaries were observed with hook-scars (especially those collected in lower elevation tributaries: Umtanum, Cherry, Wilson, and Taneum creeks). Percentages of trout greater than 200 mm that were scarred are listed in Table 7. The presence of hook-scars on tributary spawners may indicate that these fish spend at least some portion of their life exposed to the fishery in the mainstem Yakima River. Recaptures of tagged fish while conducting future spawning and rearing surveys, coupled with angler tag returns, should help clarify the migratory patterns of tributary spawners.

Table 7. Summary of hook-scarring, sexual maturity, sex ratio and tagging data collected for rainbow trout > 200 mm FL during spawning surveys in the upper Yakima River tributaries and mainstem in the spring, 1990.

Stream	N	% HS[a]	% SM[b]	Sex Ratio[c]	(N)	No. Tagged	No. Kept[d]
Cherry Cr.	185	NA[e]	14.6	1.3:1	(45)	175	10
Wilson Cr.	193	6.0	11.4	0.5:1	(79)	175	18
Naneum Cr.	24	4.0	4.0	0.0:l	(7)	21	2
Umtanum Cr.	71	33.8	88.7	2.3:1	(66)	54	16
Dry Cr.	10	0.0	20.0	0.8:1	(9)	9	1
Manastash Cr.	3	0.0	0.0	NA	(0)	1	2
Taneum Cr.	12	8.0	25.0	0.0:l	(3)	7	4
Swauk Cr.	9	0.0	22.0	NA	(2)	7	2
Big Cr.	1	0.0	100.0	0.0:l	(1)	0	1
Cabin Cr.	0						
Yakima R.	96[f]	28.1	3.1	l.0:l	(8)	78	14
Total	604				(220)	527	70
Mean		15.4	20.1	0.9:1			

[a] HS = hook-scarred fish.

[b] SM = sexually mature.

[c] Male:female ratio. Not all fish were sexed. Sample sizes for estimation of sex ratios are shown in parentheses.

[d] Number of RB $\geq$ 200 mm kept for genetic analysis.

[e] NA = data not available.

[f] 92% captured in sections 6 and 7 (upper and lower canyon areas).

Tributaries

Cherry Creek

The lower 4.8 km of Cherry Creek was sampled February 28, March 1, 2, and 5, 1990. At the time of these surveys a total of only 15% of the trout sampled were sexually mature (Table 7) and the larger trout did not appear spent. We thus suspect that spawning activity had not yet peaked. Water temperatures recorded at random times on survey dates were from 7 to 10 C. This was slightly cooler than optimum spawning temperatures for rainbow trout (l0-13 C) described by Piper et al. (1983). Nearly 80% of the trout were larger than 150 mm in length (Fig. 5, Table 1).

Although hook-scar data were not recorded for Cherry Creek, observations of fish with scarred or missing maxillaries (suggesting they had been hooked by anglers) were noted in the lower 1.5 km of the creek. This observation suggests that many of the fish using Cherry Creek as a spawning stream may reside in the mainstem Yakima River during at least part of the sport angling season. The systematic examination of all trout for hook-scars has since become standard practice on all electrofishing surveys and will continue in future surveys.

Four of the trout tagged in Cherry Creek in March spawning surveys were subsequently recaptured in June. All four recaptures were made within 500 meters of the initial tagging location.

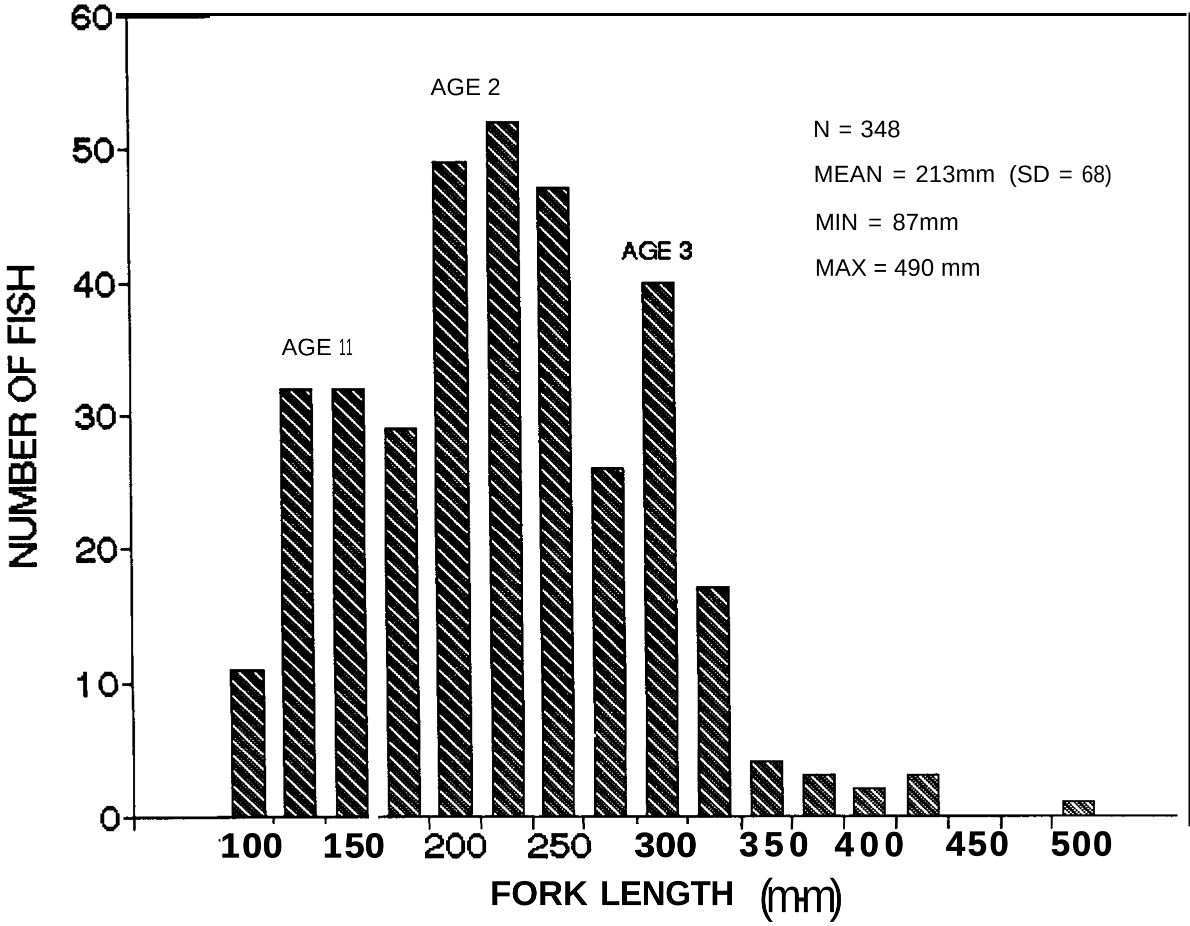

Figure 5. Length frequency histogram of rainbow trout captured in Cherry Creek spawning surveys, February 28 - June 5, 1990.

Preliminary scale analysis and length frequency distributions of Cherry Creek rainbow trout show at least four age classes were present during spawning surveys (Fig. 5, Table 6). Growth rates appear to be rather rapid in this creek in comparison to growth rates for rainbow trout in other areas. Brown (1971) reported approximate lengths at each year of life for rainbow trout in Montana waters as follows: age 1 = 76 mm; age 2 = 203 mm: age 3 = 279 nun; age 4 = 330 mm. In comparison, mean length-at-age for Cherry Creek rainbow was: age 1 = 121 mm: age 2 = 240 mm: age 3 = 304 mm; age 4 = 372 mm.

Juvenile spring chinook salmon (N=14) were captured in the lower 2 km of the creek. It is suspected that these fish migrated up into Cherry Creek to rear and were not actually progeny of adults that spawned there (J. Hubble, YIN, pers. comm.). Dace, sculpins, and shiners were abundant in this creek while brook trout, suckers, squawfish, and mountain whitefish were observed in lesser abundance.

Based on these data and our preliminary observations, it appears that the large number of diversion dams and their un-screened diversions on Cherry Creek, as well as the virtual absence of unsedimented substrate, may reduce this creek's potential as a spawning stream for steelhead and salmon.

Wilson Creek

Spawning surveys were conducted in Wilson Creek on March 6, 8, 13, 16, and 19, 1990. Because a low percentage of the adults handled were in spawning condition, and most large trout still retained large numbers of eggs, we suspect that the majority of the spawning activity had not yet taken place (Table 7). Water temperatures recorded at random times during these surveys were from 6 to 11 C. Many large resident trout were collected in Wilson Creek, including a few between 500 and 600 mm (Table 7, Fig. 6). Wilson Creek trout had the highest mean weight (306 g) and the highest proportion (94%) of trout longer than 150 mm of all areas sampled (Table 1).

As in Cherry Creek, many of the larger fish in the lower portion of Wilson Creek showed evidence of hook-scars, suggesting they may have spent at least a portion of their life cycle in the mainstem Yakima River where angling pressure is high. From these hook-scars it appeared that many of the trout collected in the lower 1.6 km (below the first diversion dam) of this creek were fish that entered this tributary from the Yakima River for the purpose of spawning, while the majority of the fish upstream of this area were suspected of being tributary residents. Two trout tagged in March surveys were recaptured in June within 400 meters of the tagging location.

Johnston (1980) sampled several areas of Wilson Creek in April, 1980 and captured several large rainbow trout (310-486 mm) that were in or approaching spawning condition.

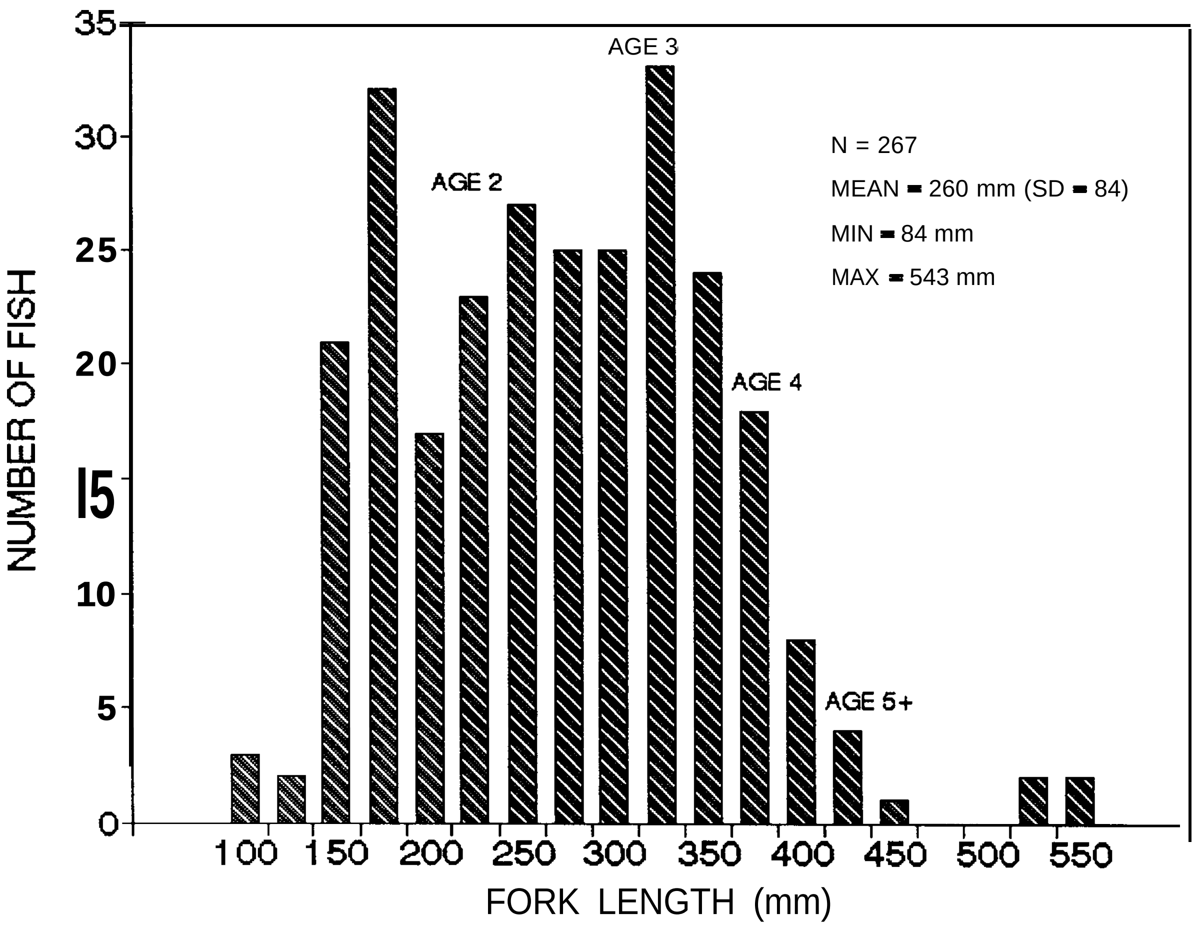

Figure 6. Length frequency histogram of rainbow trout captured in Wilson Creek spawning surveys, March 6 - 19, 1990.

Scale analysis and length frequency distributions indicate that there were at least five age classes of rainbow trout present in Wilson Creek at the time of our survey (Table 6). Growth rates in the sampled sections of this creek, as in Cherry Creek, appear to be slightly higher than the average growth rates for this species in other areas, such as Montana waters (Brown 1971).

In general, trout abundance declined as sampling progressed upstream. Relatively few trout were captured between Canyon Road (rkm 5.6) and Damman Road (rkm 8.0).

A total of 22 brook trout and one cutthroat trout were sampled in the lower 11.5 km of Wilson Creek. Dace, sculpins, squawfish, suckers, and mountain whitefish were also present in the creek. One juvenile spring chinook salmon was captured below the diversion dam at rkm 1.6.

As in the Cherry Creek system, the large number of unscreened diversions and the general lack of unsedimented substrate in lower Wilson Creek may reduce the potential of this stream as a spawning tributary for anadromous salmonids. Preliminary observations and analyses of data collected thus far suggest that Wilson Creek (that area above rkm 1.6) may be of limited importance as a spawning tributary for mainstem Yakima River trout.

Naneum Creek

The lower 4.0 km of Naneum Creek was sampled March 26 and 27, 1990. Very few sexually mature rainbow trout were sampled in this creek (Table 7) and the total number of trout sampled was relatively low in comparison to streams in the same general area (Cherry and Wilson Creeks). The length frequency distribution of rainbow trout captured in Naneum Creek suggests that at least three year classes were present, however, this has not yet been verified through scale analyses (Fig. 7). From the length frequency distribution it appears that trout in Naneum are generally smaller than trout captured in nearby Cherry and Wilson creeks. Johnston (1980) did not capture any spawning rainbow trout in Naneum Creek when he sampled it in April of 1980.

A concentration of yearling spring chinook salmon was located approximately 3.2 km upstream from the mouth (near Road 6) (Table 1) which suggests that adult chinook salmon spawned in that area in the fall of 1988. A few brook trout, mountain whitefish, dace, sculpin and suckers were also observed.

The lack of un-screened diversions and the presence of relatively clean substrate in the area adjacent to Fio Rito Lakes (rkm 0.5 to 1.0) suggests that this small reach has more potential for anadromous salmonid production than either Cherry or Wilson creeks, however, no spawning rainbow trout were captured in that area.

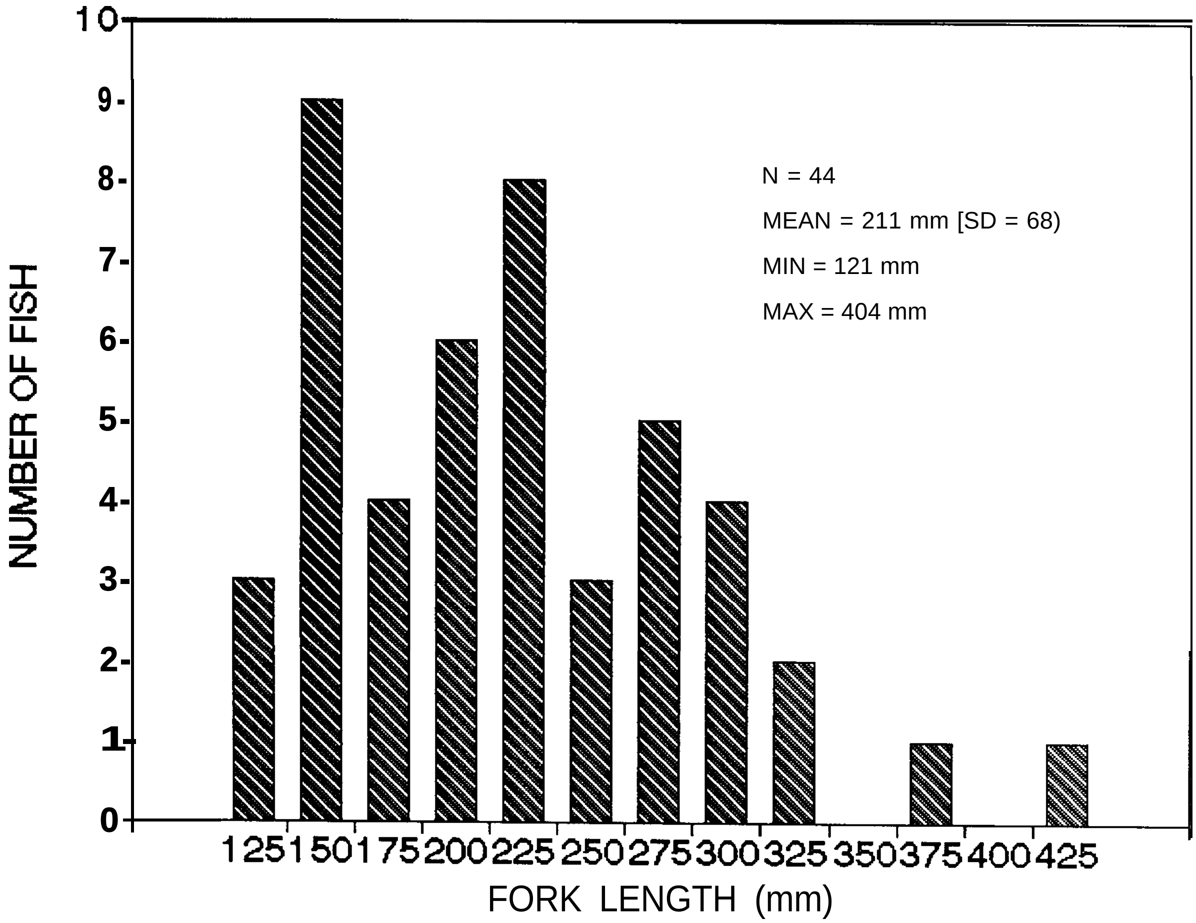

Figure 7. Length frequency histogram of rainbow trout captured in Naneum Creek spawning surveys, March 6 - June 26, 1990.

Dry Creek

The lower 1.6 km of Dry Creek was sampled when water temperatures reached 16 C on April 4, 1990. This temperature is warmer than that typically associated with rainbow trout spawning (Piper et al. 1983). Only two of the ten rainbow trout over 200 mm were still sexually mature at the time of sampling (Table 7). The remaining 8 trout over 200 mm that were handled in this creek did not appear to be in spawning condition and thus we suspect that the majority of trout spawning activity might have occurred in late winter or early spring when water temperatures would have been more favorable (l0-13 C) for spawning.

Over half of the rainbow trout sampled in Dry Creek were less than 150 mm, suggesting that the cohort of age 1 trout was strong (Table 1). Scales collected from fish sampled in this creek have yet to be analyzed so this determination is based solely on examination of the length frequency distribution (Fig. 8).

A few concentrations of age 0+ spring chinook salmon (25-35 mm) were located in the lower 1 km of the creek suggesting that adult spring chinook salmon may have spawned there in the fall of 1989. Dace, shiners, and sculpins were abundant while cutthroat trout, brook trout, and suckers were present in smaller numbers. The creek was typical of spring-fed streams, with well developed riparian habitat, areas of clean substrate, and stable flows. These features give the lower 2.0 km of Dry Creek fair potential for anadromous fish spawning and rearing.

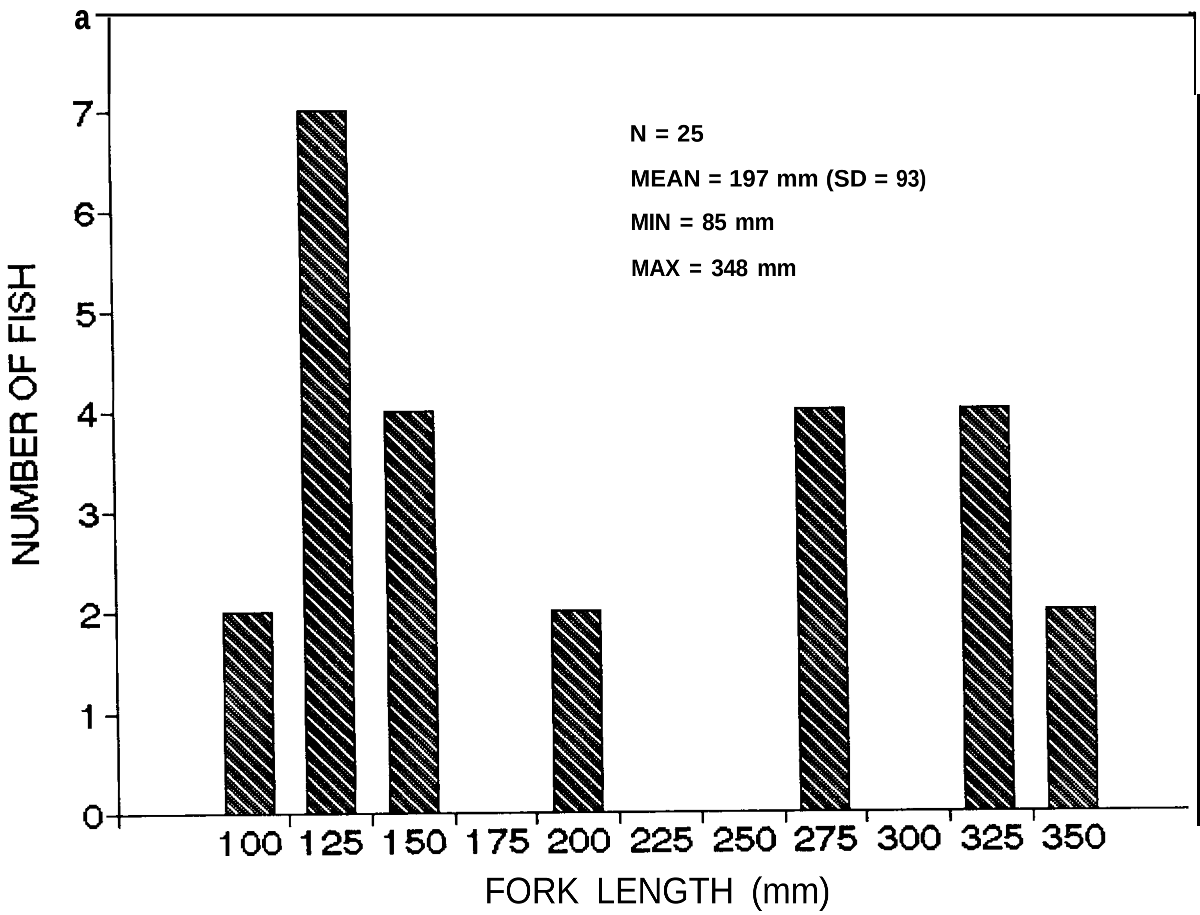

Figure 8. Length frequency histogram of rainbow trout captured in Dry Creek spawning survey, April 2, 1990.

Umtanum Creek

Umtanum Creek was surveyed March 21, 22, and June 5, 1990. Spawning rainbow trout were observed and the timing of the first two surveys coincided with widespread spawning activity. Over 88% of the trout examined on the initial survey dates were sexually mature (Table 7). Water temperatures recorded were from 8 to 10 C, water was not turbid, and flow was moderate (< 1.0 cms).

On March 21 we surveyed the lower 2.4 km of Umtanum Creek below the first of several beaver dams. Rainbow trout, juvenile spring chinook salmon, and one steelhead kelt were collected. The steelhead was tagged and released in Umtanum Creek, and subsequently recaptured in the Prosser Dam outmigrant trapping facility on April 3, 1990 (M. Kohn, YIN, pers. comm).

On March 22 we surveyed 1.3 km above the beaver dams in lower Umtanum Creek and an additional section near Durr Road (rkm 7.8). Rainbow trout collected in the section below the beaver dams were markedly larger than fish collected above the dams. Trout from the lower section averaged 220 mm in length while trout collected above the dams averaged 135 mm (Fig. 9). The former also exhibited a high degree of hook-scarring (34%) while no hook-scars were observed on trout collected above the beaver dams (Table 7). Sexually mature rainbow trout in Umtanum Creek below the beaver dams averaged 322 mm in length while sexually mature trout collected above the obstructions averaged only 139 mm.

Both the large mean length and the high percentage of hook-scarring suggest that rainbow trout spawning in the lower section of Umtanum Creek spend some portion of their life cycle in the mainstem Yakima River and enter the creek during the spawning period.

These preliminary results also suggest that the beaver dams at rkm 2.4 act as partial or complete barriers to upstream movement by trout from the Yakima River. The possibility exists that Umtanum Creek contains two distinct populations of rainbow trout: a lower riverine group, and an upper resident group. A genetic analysis of upper and lower Umtanum rainbow trout has been initiated, and the results from 32 samples will be available in the fall of 1990. This genetic analysis, coupled with scale analysis and tag return information, will be used to determine if distinct spawning populations occur in Umtanum Creek.

Length-at-age statistics for 16 fish collected for genetic analysis from Umtanum Creek below the beaver dams are shown in Table 6. It is important to note that only potential spawners were selected, and that these fish do not represent the spectrum of ages that were present in Umtanum Creek during the spawning survey.

On June 5 we returned to the lower section of Umtanum Creek and collected 36 rainbow trout and two age 0+ spring chinook salmon. The trout collected were much smaller than those collected in our initial survey (maximum size = 133 mm), and 12 were considered to be young-of-the-year (age 0+) (<50 mm). Because it is virtually impossible to visually differentiate

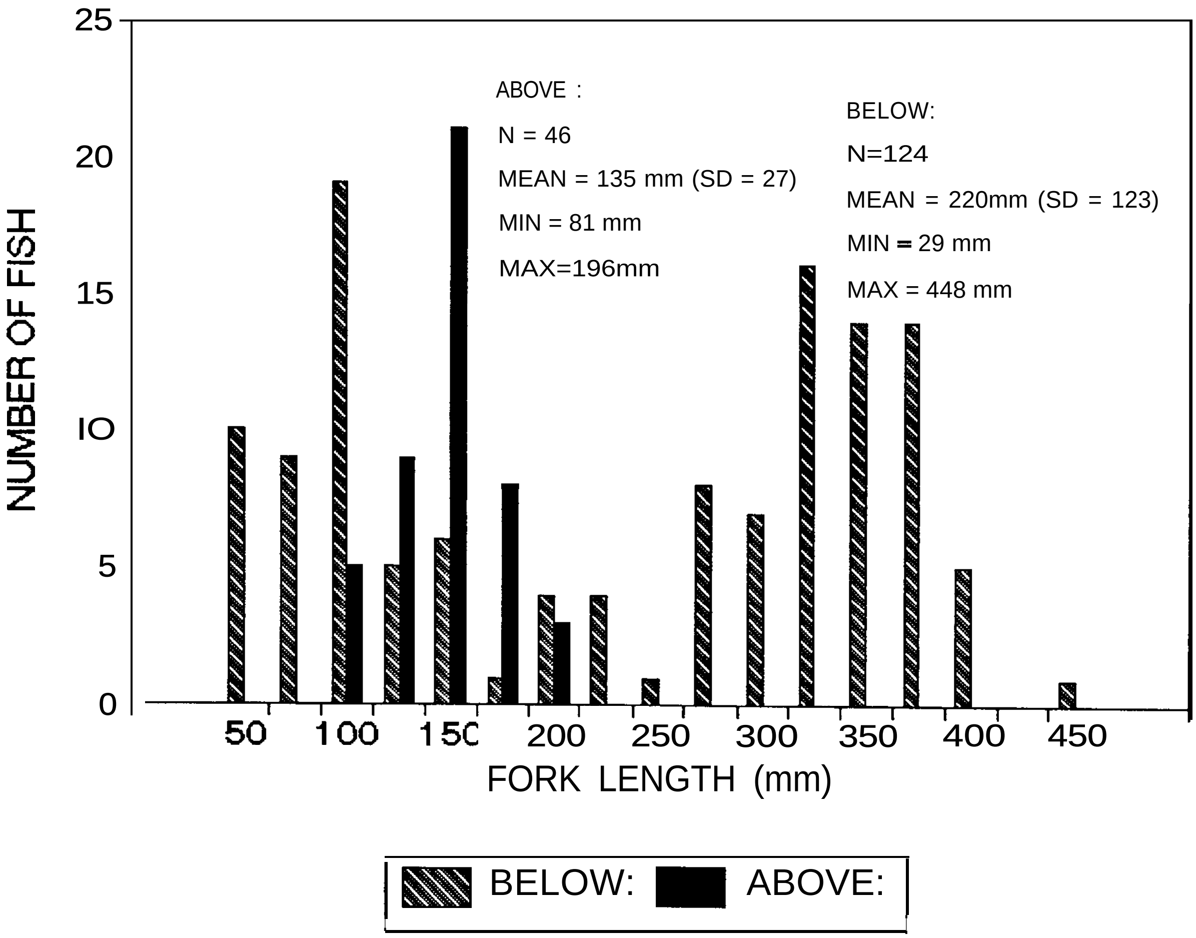

Figure 9. Length frequency histograms of rainbow trout captured in two areas of Umtanum Creek during spawning surveys, March 21 - June 5, 1990.

between age 0+ resident rainbow trout and age 0+ steelhead trout, we classified all age 0+ trout captured as resident rainbows. It is entirely possible that some of these 0+ fish were in fact juvenile steelhead. Dace and sculpin were present in the creek and adult suckers in spawning coloration were observed in the creek in mid-May, approximately six weeks after we had observed rainbow trout spawning activity.

Umtanum Creek is relatively undisturbed, with good spawning and rearing habitat present. Low summer flows (< 0.03 cms) have been reported in the lower 1.3 km, with some stretches having intermittent flow (BPA 1990b). Low summer flows may be a factor stimulating trout to move downstream to the river. The clean substrate and undisturbed nature of this drainage may increase its potential as a spawning and/or rearing stream for anadromous steelhead.

Manastash Creek

High stream flows and poor water clarity prevented initiation of spawning surveys in lower Manastash Creek until June 15, 1990. A total of 11 rainbow trout were captured in a 1.6 km section and none of the fish examined were sexually mature. Due to the late date of the survey, and to high water temperatures (14-15 C), we suspect that peak spawning occurred prior to June 15. Only one spawning survey was conducted in 1990.

Because of the small sample size, the length frequency distribution for Manastash Creek is of limited statistical value (Fig. 10). It suggests however, that age 1, age 2, and possibly age 3 trout were present.

We experienced extremely low capture efficiency while conducting this survey. Numerous trout were observed escaping the electric field created by the backpack electrofisher. Low water conductivity and high water temperature may have contributed to this low capture efficiency. One juvenile spring chinook salmon, many dace, and several sculpins were also captured in lower Manastash Creek.

Our sampling efforts on Manastash Creek were confined to the lower 4.8 km of the stream (below the upper Anderson Diversion). This diversion acts as a barrier to upstream migrants in all flows. It has been reported that irrigation diversions cause Manastash Creek to go dry between rkm 2.4 and rkm 4.8 (BPA 1990b).

Taneum Creek

For our spawning surveys we divided Taneum Creek into three different study sections (Section l- lower, Section 2- middle, Section 3- upper). These study sections were meant to represent the three major habitat "types" found as the stream progresses from the lower valley reach (Section 1) up to the colder, montane reaches (Section 3). The lowermost reach (Section 1, 2.4 km

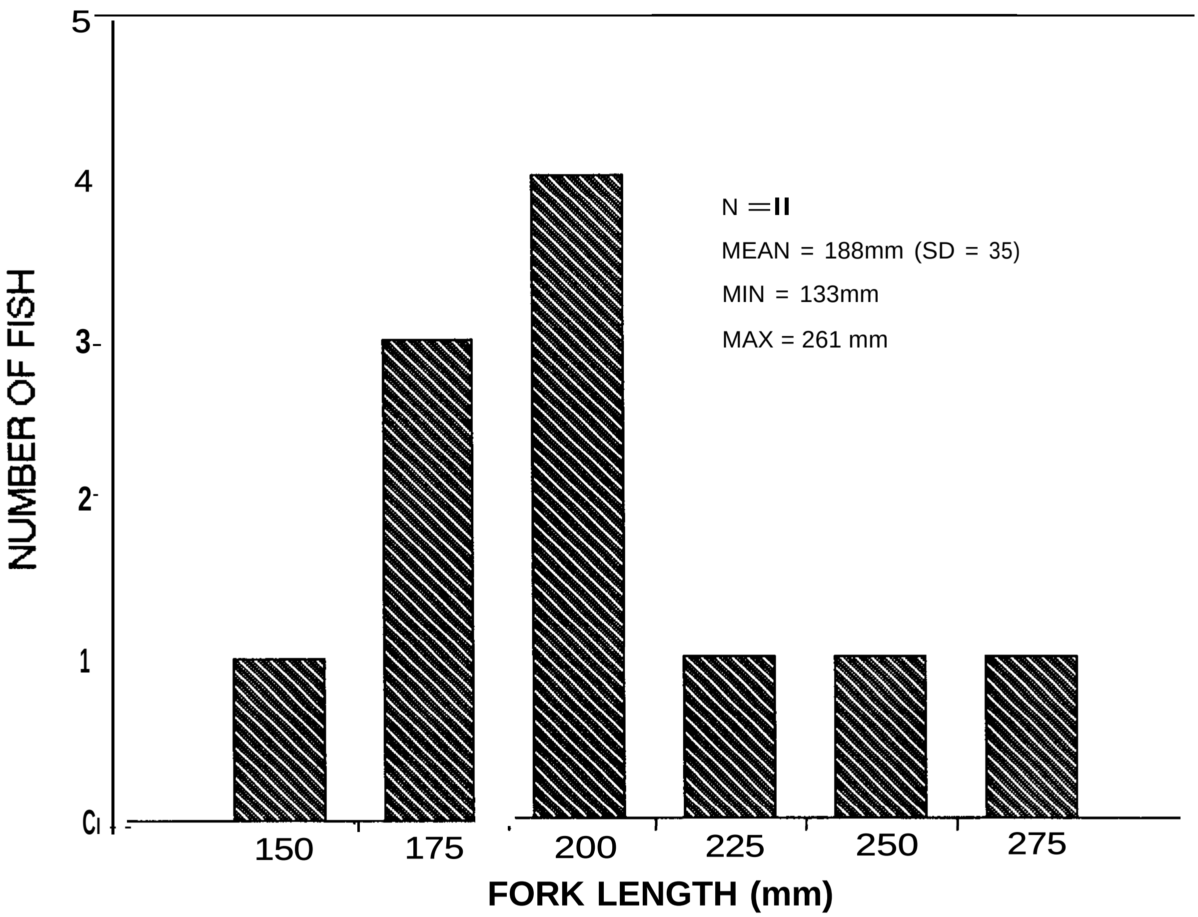

Figure 10. Length frequency histogram of rainbow trout captured in Manastash Creek spawning survey, June 15, 1990.

long) of Taneum Creek was initially surveyed on May 2, 1990. Stream conditions were marginal for backpack electrofishing, water temperature was 9 C, and electrofishing success was considered to be poor (N=37). Most of the rainbow trout collected were small (< 200 mm), and we were unable to identify the sex of any of the trout examined with the exception of one small immature female.

We returned on May 16 and sampled Taneum Creek between the lower diversion dam at Brunton Ditch and the upper diversion dam at Taneum Ditch (Section 2, 1.3 km long). The diversion at Taneum Ditch was in operation and flows below the dam were low. A total of 25 trout were collected (24 rainbow and one cutthroat), of which three (rainbow) were sexually mature females.

On May 17, we surveyed short sections on the North and South Forks of Taneum Creek (Section 3, 0.6 km long on each fork). The North and South forks are a significant distance above the previously sampled sections (approximately 16 km) and represent a much different habitat type. Water temperatures measured were from 6 to 8 C. A total of 16 trout were collected, including two rainbow and 14 cutthroat trout. Two of the fish sampled had external characteristics intermediate to those of rainbow and cutthroat trout (these were classified as cutthroat trout). Only two of the cutthroat examined were sexually mature at the time of the survey.

We re-surveyed Section 1 on May 24, after flows had substantially decreased, and collected 185 rainbow trout.

Nineteen of these fish were sexually mature males and no sexually mature females were observed. Water temperature was 13 C. The length frequency distribution for rainbow trout collected from all three sections suggests that the majority of the trout sampled were age 1, with some age 2 and possibly age 3 fish also present (Fig. 11). Rainbow trout are capable of spawning at ages 1 through 5, but most reach sexual maturity at age 3 (Wydoski and Whitney 1979).

It is difficult to determine when peak spawning activity occurred in the lower reaches of Taneum Creek. High flows precluded successful surveys from taking place until water was diverted for irrigation purposes in mid-May. Our initial survey of Section 1 (May 2) was only marginally successful; fast-flowing water prevented us from capturing many of the trout that were electrofished and no sexually mature trout were captured.

On our second survey of Section 1 (May 24), we observed 19 sexually mature males but no sexually mature females. It is possible that peak spawning activity occurred after May 24 but the high water temperature (13 C), and the lack of maturing females, suggests that peak spawning occurred prior to that time.

Our results are similar to those reported in Johnston (1980) (below Brunton Diversion), who found the majority of rainbow collected were juveniles, with only two sexually maturing trout observed. One juvenile spring chinook salmon, along with numerous dace, sculpins, and suckers were also captured during Taneum Creek surveys.

Low summer flows (0.03-0.06 cms) and high temperatures

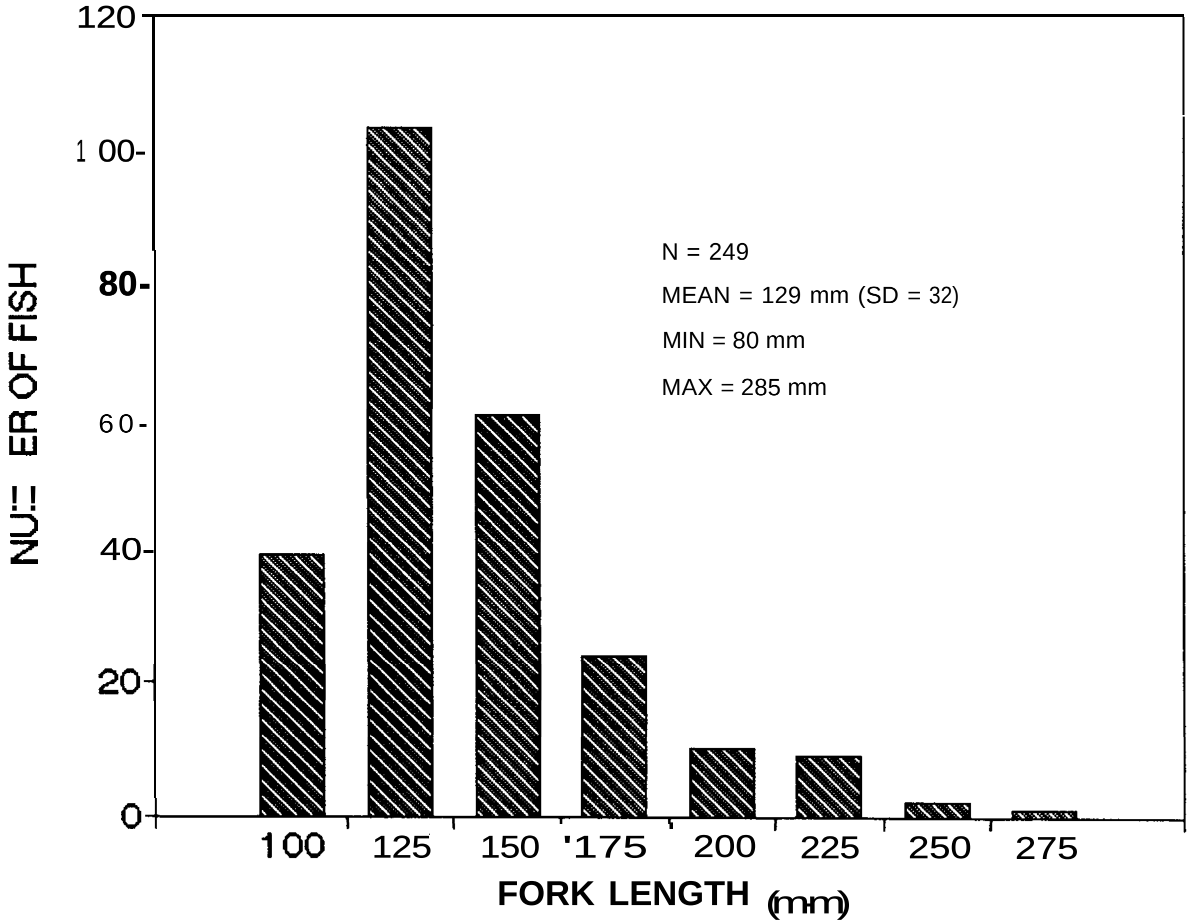

Figure 11. Length frequency histogram for rainbow trout captured in Taneum Creek spawning surveys, May 2 - 24, 1990.

20 C) have been reported in the lower 5.3 km of Taneum Creek (BPA 1990b). The seasonal de-watering of the stream below the Brunton Diversion may cause juvenile salmonids to move downstream to the Yakima River. Until recently no upstream passage was possible at either the Brunton Diversion or the Taneum Ditch Diversion. Recent improvements (fish ladders) have been installed at both diversions which will make a substantial amount of good spawning and rearing habitat available to anadromous salmonids. This may have the effect of increasing the potential for spatial overlap between resident rainbow trout and anadromous steelhead.

Swauk Creek

Swauk Creek was sampled on June 13, 14, and 21, 1990. Very few of the rainbow trout sampled were in spawning condition (Table 7). Nearly 70% of the trout sampled in this creek were less than 150 mm (Table 1). Low stream flow and high water temperature in the lower portion of this drainage may have had a negative effect on the trout populations present (either by direct mortality or by causing trout to migrate out of this section). The length frequency distribution for Swauk Creek suggests there was one predominant year class (probably age 2, scale analysis was not completed prior to the preparation of this report) of rainbow trout in Swauk Creek (Fig. 12). Dace and sculpins were also abundant in Swauk Creek, while cutthroat

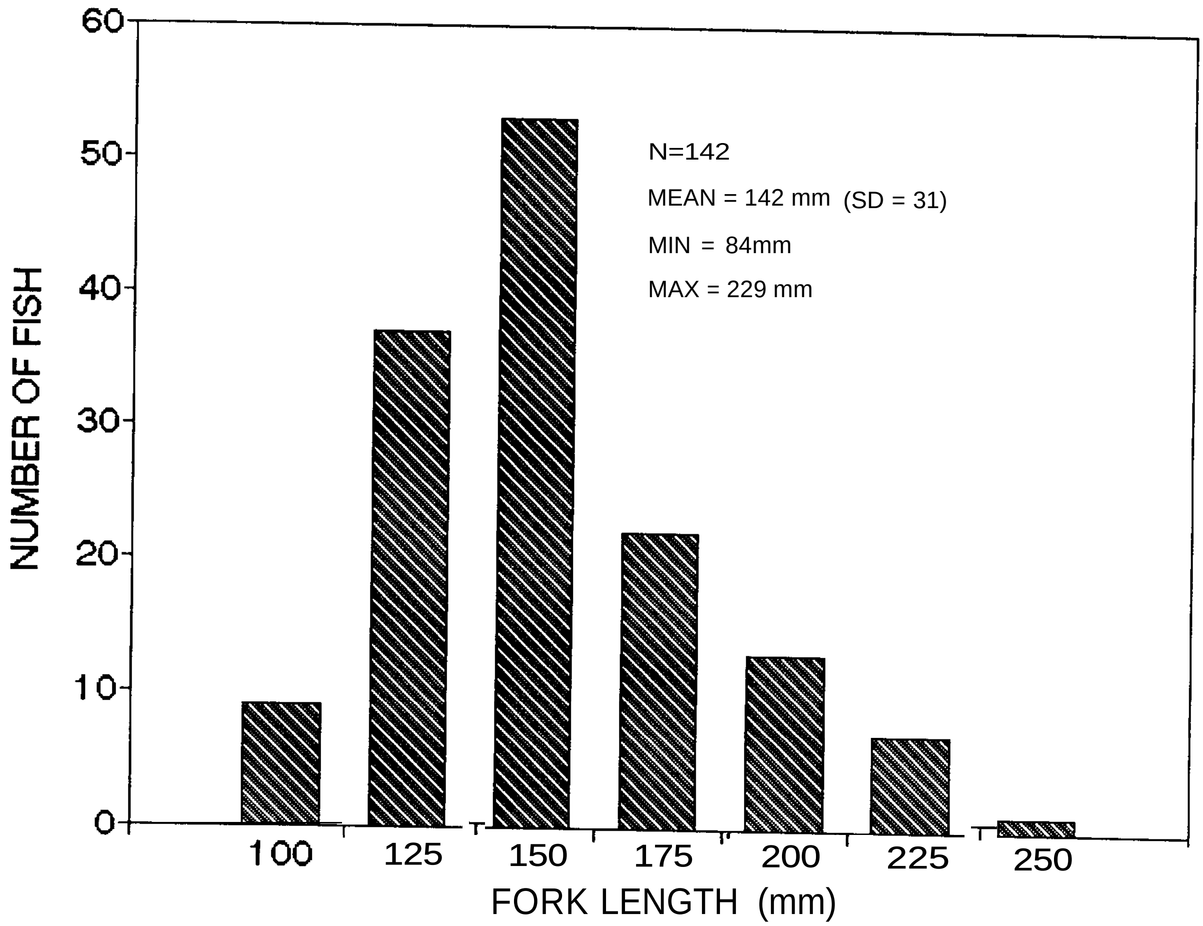

Figure 12. Length frequency histogram of rainbow trout captured in Swauk Creek spawning surveys, June 13 - 21, 1990.

trout, mountain whitefish, juvenile spring chinook salmon, and northern squawfish were captured in lower numbers. The lower 4 to 8 km of Swauk Creek may become totally dewatered in years of low precipitation (BPA 1990b), which may limit anadromous production potential.

Lower Teanaway River

Sampling equipment available to survey the mainstem Teanaway River was insufficient given the rigorous hydraulic conditions present in the spring of 1990. Therefore, small tributaries to the mainstem of the river were sampled in an attempt to gather at least some useful information from this part of the basin.

Mason Creek, a tributary to the mainstem Teanaway River, was electrofished on June 12. Mason Creek enters the Teanaway River at rkm 8.0. This stream is a relatively small tributary which may exhibit extremely low flows in the summer. During our spawning survey relatively high quality rearing habitat was present. Five rainbow trout (< 140 mm), one spring chinook salmon fry, numerous dace, shiners, suckers, and one western brook lamprey were captured.

The Teanaway system as a whole is considered to have great potential for natural production by anadromous fish. High quality spawning and rearing habitat is present in all three forks of the Teanaway system, which historically produced steelhead, chinook, and coho salmon (BPA 1990c). Current constraints to salmonid production include naturally low summer and fall flows which are exacerbated by irrigation diversions in the main Teanaway below the confluence of the North and Middle Forks. In the summer of 1990, flows in the lowermost Teanaway River ranged from 2.1 cms to 0.2 cms.

Low summer flows in the mainstem Teanaway may negatively impact juvenile salmonid production by increasing the water temperature, increasing the exposure to terrestrial predators, and by concentrating fish into pools. High water temperatures and low flows may also interfere with the movements of anadromous fish into and out of the system. Adult spring chinook migrate into spawning streams from April through July and peak spawning occurs in September (BPA 1990c). In the Teanaway system this period coincides with the period of lowest flows which may impede the movements of spring chinook into the upper river.

West Fork Teanaway

The lower 2.8 km of the West Fork of the Teanaway River was sampled on June 7, 1990 using snorkeling and electrofishing techniques. One crew member snorkeled while two crew members followed with the backpack electrofisher and associated sampling equipment. Trout were located by the snorkeler, who would point them out to the electrofishing crew. The snorkeler would then move away from the site as the electrofishing crew attempted to capture the target fish. These collection efforts were unsuccessful, most probably due to low water conductivities and high visibility. The majority of the trout were observed in large pools, where they were able to scatter and evade the electrical field. Numerous rainbow trout (N=50) were located by the snorkeler while only one was collected with the electrofishing equipment.

Approximately 100 large suckers in spawning coloration were also observed in this section of the West Fork Teanaway. In Umtanum Creek, we observed an influx of suckers in spawning condition six weeks after the majority of the rainbow trout had spawned and moved back downstream to the mainstem. If this temporal relationship was similar throughout the upper basin, the presence of large numbers of suckers in spawning condition in this area of the West Fork Teanaway may indicate that rainbow trout spawning had already occurred at the time of our survey.

Middle Fork Teanaway

Due to high runoff conditions throughout the spring of 1990 no electrofishing surveys were conducted in the Middle Fork of the Teanaway River. We considered conducting snorkeling surveys but the steep gradient and high turbulence of the stream prohibited us from doing so.

In future years we will attempt to conduct snorkeling and electrofishing surveys prior to peak spring runoff in all three forks of the Teanaway.

North Fork Teanaway

The North Fork of the Teanaway River system is the longest (30.4 km) and the largest of the three forks (flow data not available). High spring flows made the North Fork totally inaccessible for electrofishing with our equipment during the spawning season.

On June 8, 1990 five tributaries to the North Fork (Dickey, Jack, Jungle, Standup, and Beverly creeks) were sampled. Estimated flows in the streams varied from approximately 0.3 cms in Dickey Creek to approximately 2.8 cms in Beverly Creek. Small rainbow trout (< 200 mm) were collected in all five streams with 71% (17 of 24) being less than 100 mm. None of the trout collected were in spawning condition. A total of five cutthroat trout (< 200 mm) were captured in Dickey (N=l), Standup (N=3), and Beverly (N=l) creeks.

Big Creek

Big Creek was sampled on June 20, 1990 from an irrigation diversion dam at rkm 3.3, downstream to the confluence with the Yakima River. The dam, with a head of 1.5 m, has been identified as a barrier to upstream movements by resident trout and anadromous fish (BPA 1990b). However, based on our own observations at the site, we suspect that adult steelhead may be able to ascend the dam during moderate to high flow conditions.

A sample of 18 rainbow trout was collected from Big Creek (Table 1), of which all but one were less than 170 mm (Fig. 13). The majority of the fish sampled were either sexually immature or spent. One large (327 mm) female and two smaller males were in spawning condition, suggesting that some spawning activity was still taking place in Big Creek. Water temperatures warmed to 13 C by mid-afternoon. Based on the late date of the survey, and on water temperature, we feel that the majority of the spawning activity took place sometime prior to June 20.

The upstream 1.1 km reach of the sampled section was moderately steep and consisted of a series of cascades. The middle 1.1 km reach was channelized while the final 1.1 km nearest the mainstem was heavily overgrown with vegetation. The stream here had deep pools with areas of long riffles and apparently suitable rearing habitat.

The number of trout captured increased as the sampling team progressed downstream. The length frequency distribution for rainbow trout in Big Creek (Fig. 13) shows that there were possibly two year classes less than 200 mm in length. The relative absence of larger fish could be due to sampling conditions and/or small sample size.

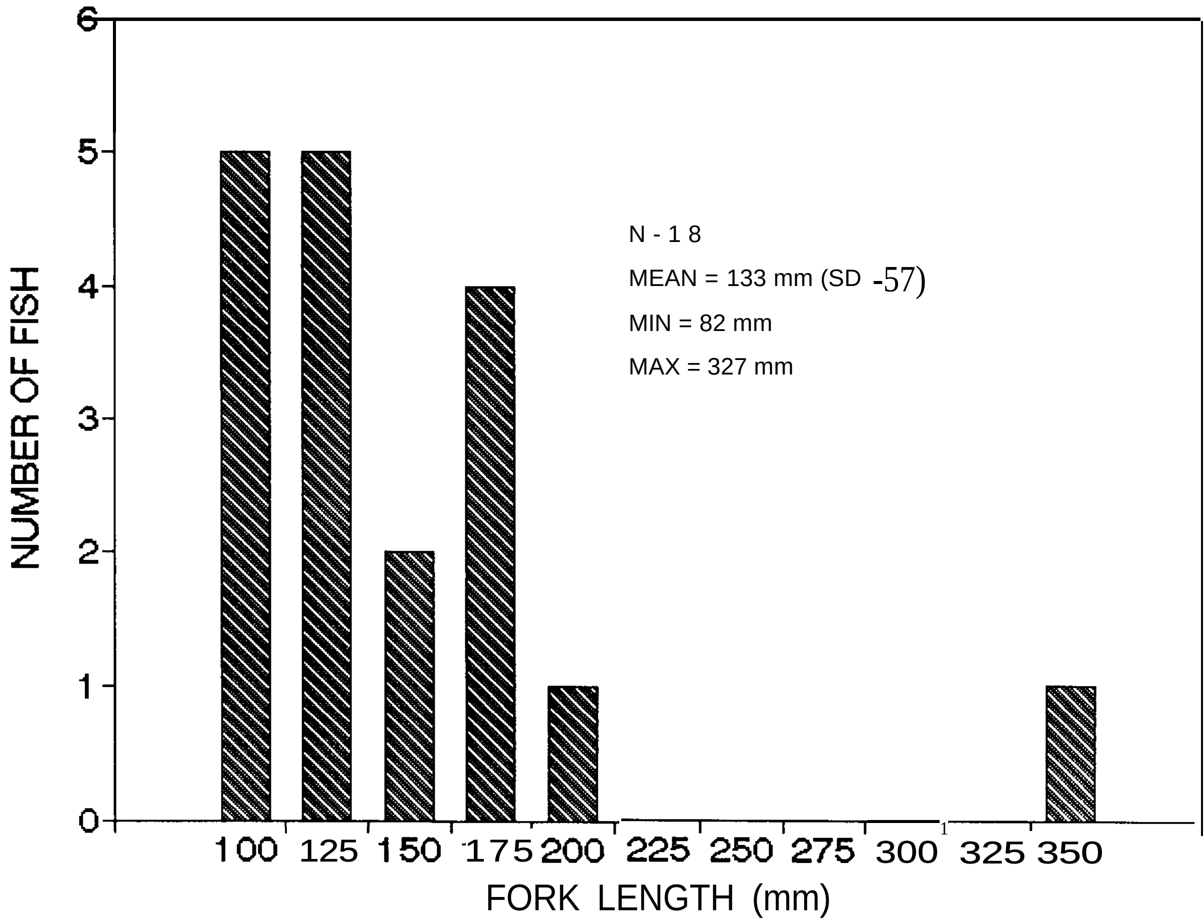

Figure 13. Length frequency histogram of rainbow trout captured in Big Creek spawning survey, June 20, 1990.

Cabin Creek

A series of cascades and small waterfalls in Cabin Creek canyon at rkm 5.0 to 6.1 form a complete barrier to upstream migration. The creek was electrofished on June 25, 1990 from the falls downstream for approximately 2.4 km. Only two rainbow trout were captured in this section. High water velocities and low water conductivities may have again played a role in our low capture efficiency. One of the trout collected was a sexually mature female. A few sculpins were also captured during this survey. Water temperature at mid-day was 14 C.

A second sampling run on the lower 2.4 km of Cabin Creek was conducted on June 27 using combined snorkeling and electrofishing techniques. Four rainbow trout (~200 mm FL) and one brook trout were observed by a snorkeler but only the brook trout was collected with the electrofishing gear. The snorkeler was unable to assess the sexual state (maturing, ripe, spent) of the rainbow trout.

Cabin Creek has been affected by severe flooding in the recent past. Streambed and bank damage are especially apparent in the lower 4.8 km below the canyon.

The potential for anadromous fish utilization of this creek has been enhanced by the recent improvements in the fish passage facility at Easton Dam. Though our capture efficiencies for this survey were low, it does not appear that resident trout populations in Cabin Creek were fully utilizing the available habitat.

Cle Elum River

Because flows were too high for effective electrofishing, snorkeling surveys were conducted on the Cle Elum River. The first snorkeling survey was conducted on April 26, 1990 from the base of Cle Elum Dam downstream 3.2 km; no trout were observed. On the same day a 1.6 km section was surveyed near the confluence of the Cle Elum River with the Yakima River. Only 12 rainbow trout adults (300-400 mm), one whitefish, and 12 spring chinook salmon fry were counted in this section. No spawning activity was observed and snorkelers were unable to assess the sexual state of the rainbow trout. Water temperature at noon was 7 C.

A second snorkeling survey was conducted on April 30 covering the lower 200 meters of the Cle Elum River. Observations in this section included four adult rainbow trout (300-400 mm) and five spring chinook salmon fry. Water temperature was 9 C, and no spawning activity was observed.

Flows in the Cle Elum River fluctuate greatly as water is released from the reservoir for irrigation needs. Flows ranged from 2.9 cms at the start of the spawning survey (late February) to 84.4 cms at the conclusion of the survey (late June) (Fig. 3). A large increase occurred during the week of May 9 to 16 from a flow of 13.7 cms to 34.6 cms. Also, from the week of June 6 to 13, flow increased from 44.2 cms to 78.7 cms.

Mongillo and Faulconer (1980) reported that the trout fishery may have been influenced more by fluctuations in flows in the Cle Elum River than by low flows themselves. The low numbers of resident trout observed and the relative abundance of loose clean substrate suggests the potential for steelhead spawning in this river would be quite good. However, the fact that few trout were observed during the spawning surveys does not preclude the possibility that there is significant use of the Cle Elum River by resident trout at other times of the year. Spring chinook salmon use the Cle Elum River for spawning during the fall of each year (Fast et al. 1988).

Tributary Summary

Results from tributary electrofishing surveys indicated that a greater number of larger and older resident trout were present in the lower elevation tributaries than were present in the upper elevation tributaries. Trout collected in Cherry, Wilson, and Umtanum Creeks ranged in length from 84 to 543 mm (ages 1 through 5), with a fair representation of fish 3, 4, and 5 years old (Table 6). Upper elevation tributaries (notably Taneum, Swauk, and Big Creeks) contained very few trout greater than 200 mm, with the majority averaging less than 150 mm (Table 5). At the time of this report we had not aged the scale samples collected from upper tributary trout but an examination of the length frequencies in these tributaries indicated that very few of the fish collected were age 3 or older (Figures 11, 12, and 13). A sub-sample of the scales collected from upper tributary trout will be analyzed in order to determine the age structure of the spawning populations, and will be presented in the next progress report.

Several factors prevented the 1990 spawning surveys from providing conclusive information on spawn timing. Limited personnel and equipment, coupled with adverse environmental conditions, limited our success in the field. This was particularly evident in the upper elevation tributaries. In January, February, and March greater-than-average snowfall in the upper elevations of our study area closed forest roads and restricted access to several of our study streams. The resulting spring runoff in April, May, and the first half of June limited the success of both electrofishing and snorkeling surveys.

Based on the limited information obtained in the 1990 spawning survey, we estimate that peak spawning activities in Wilson, Cherry, Naneum, and Umtanum Creeks occurred between mid-March and mid-April. It is more difficult to determine when peak spawning occurred in Manastash, Taneum, and Swauk Creeks but it appears to be between mid-April and the beginning of June. Too few trout were collected in Big Creek, Cabin Creek, the Cle Elum River, and the Teanaway system for us to speculate on the time of peak spawning.

Our results are similar to those reported by Johnston (1980) who conducted spawning surveys in mid-April in several Yakima River tributaries. He also encountered difficulties in obtaining sexually mature rainbow trout from upper elevation tributaries and concluded that more spawning-condition trout would be present in late April/early May when flows and turbidities were highest.

Mainstem Yakima River

Crystal Springs (Section 1)

An attempt was made on May 4, 1990 to survey the Yakima River at Crystal Springs Campground using the backpack electrofisher. Due to high flows only 0.5 km of the river was electrofished before we terminated the survey. Shocking efficiency was poor and no fish were collected. A snorkeling survey was conducted on May 30 to determine the incidence of adult trout from Crystal Springs Campground to the power-line crossing (4.5 km). The Yakima River in this area is heavily braided and extensive log jams are common. Numerous pools and clean gravel give this section good spawning and rearing potential. At the time of the survey the flows were relatively low (4.2 cms) and water clarity was excellent. There appeared to be excellent trout habitat although signs of flooding were evident. At the time of the survey the study section appeared to be virtually devoid of fish life as only one rainbow trout and one whitefish were observed at the lower end of the section. This stretch of the Yakima River is subjected to extreme flow fluctuations from irrigation releases made at Keechelus Dam. Flows in the Yakima River below Keechelus Dam tripled from 10.5 cms to 30.3 cms in a 24 hour period on June 5 (USBR, unpub. data). This type of flow fluctuation occurs several times each year and may be a major factor responsible for the low abundance of fish observed on this survey.

Spawning areas appeared to be underutilized and thus might be available for spawning steelhead and spring chinook salmon. The recent improvements to the fish passage facility at Easton Dam will allow easier access to this area for anadromous fish. Low numbers of trout observed during the spawning season suggest that the potential for overlap between resident trout and anadromous steelhead during spawning season would initially be minimal in this section.

Nelson Siding (Section 2)

The Nelson section of the Yakima River was surveyed by snorkeling on two occasions. On May 25, 1990 a section was snorkeled from Easton Dam 5.6 km downstream. Moderate flows and good visibility resulted in a count of 42 rainbow trout and 80 spring chinook salmon fry (Table 4). All but one of the rainbow trout were estimated to be over 200 mm in length.

A second snorkeling survey was conducted on June 28 from the WDW access ramp in the Nelson Siding area, downstream 6.4 km to the crossing with Interstate 90. A team of three snorkelers counted 203 rainbow trout, four brook trout, and 143 spring chinook salmon fry (Table 4).

The occurrence of relatively abundant adult resident rainbow trout combined with areas of good spawning habitat in this section during the spawning season suggest that some resident trout spawning activity may have taken place here. Spring chinook salmon have been observed spawning in this section during the fall for the past several years (Fast et al. 1988). The limited amount of data collected suggests that the potential for interactions between resident trout and anadromous salmonids in this section may be as high as in any area sampled thus far.

Cle Elum (Section 3)

The Cle Elum section of the Yakima River was sampled on April 30, 1990. Snorkeling a 4.8 km section from the Cle Elum River to South Cle Elum yielded a total count of 15 rainbow trout. The majority (13) were estimated to be larger than 300 mm in length. Numerous whitefish and suckers were also present. No spawning activity was observed and snorkelers were unable to determine the sexual stage of the rainbow trout.

On May 4, electrofishing was conducted in the side-channels of the river between South Cle Elum and the Teanaway River confluence. Five rainbow trout were collected (86-212 mm) and one tagged trout was released (212 mm). None of the fish collected were sexually mature.

Depressions in the substrate suspected of being steelhead redds were located in two of these side-channels by YIN personnel in April, 1990 (J. Hubble, YIN, pers. comm.). Very few trout were captured in these areas and those that were captured were small. At the time of our surveys it did not appear that these side-channels were being used for spawning by resident trout. However, the temporal and spatial spawning patterns of resident trout and steelhead in this section remain undefined.

Thorp (Section 4)

The Thorp section of the Yakima River was sampled on three occasions. On June 29, 1990 the river was electrofished using the jet boat system configured with a mobile electrode. Although whitefish and suckers were netted, no trout were collected. The low capture efficiency for rainbow trout is assumed to be due to high water velocities, low conductivity, and the stimulation of a fright response prior to their exposure to the electrical field. This section was also sampled on May 18 and 31 using hook and line sampling. A total of eight rainbow trout, two cutthroat trout and two spring chinook salmon yearlings were collected (Table 3). The larger rainbow trout (N=6) were tagged and released. None of the trout captured were in spawning condition. The mean length of the rainbow trout collected in this section was 216 mm (range 120-300 mm), which was less than the average length of rainbow trout measured in the lower Yakima River sections (264 mm).

The limited data collected to date suggest that salmonid species composition in this section was diverse. Spawning habitat was present in lower proportions in this section than in areas both upstream and downstream. A limited amount of resident trout spawning may have occurred in this section, however, low capture efficiencies prevented a conclusive assessment. The extremely limited data available suggest that potential for spawning interactions between resident trout and anadromous steelhead appears low in this area.

Ellensburg (Section 5)

The Ellensburg section of the Yakima River was sampled March 28, May 15, and May 31, 1990. Water temperatures were fairly stable, between 8 and 10 C. Capture efficiencies were very low in this section regardless of methods used (jet boat with stationary anode, jet boat with mobile anode, or hook and line). A total of nine rainbow trout, one cutthroat, and one adult steelhead were captured here (Table 3). Mean length of the trout (excluding one 660 mm steelhead) collected here was 249 mm (range 144-335 mm). Only one of the fish examined was in spawning condition (male rainbow captured May 15).

Spawning habitat appears to be good in this section, in the form of extensive braiding and side-channels with relatively loose clean gravel. Our spawning survey results did not indicate that these areas were being widely used by spawning resident rainbow trout. However, we feel that low electrofishing efficiency and/or inopportune time of sampling may have caused us to miss potential spawning activity. If spawning by resident trout did occur in this section, the extensive spawning habitat in the side-channels may be areas of potential overlap between resident trout and anadromous steelhead.

Upper Canyon (Section 6)

The upper canyon area of the Yakima River was sampled on February 21, May 14, and May 20, 1990. Water temperatures measured during sampling were from 6 to 8 C. A large (480 mm) female rainbow trout in spawning condition (expelling ova) was captured on a gravel bar in this area on the first survey, indicating that mainstem spawning does occur and that it can take place early in the spring. Low capture efficiencies resulted in a small sample size in this area, similar to other mainstem areas. In the future we hope to sample mainstem areas prior to the irrigation season (mid-April) to reduce flow-related sampling problems.

A total of 48 rainbow trout were captured in this section. On February 21 only one of the 13 (7%) trout captured was sexually mature. None of the 18 fish captured on May 14 were classified as sexually mature while 2 of these fish (11%) were considered to have already spawned. On the final sample date, May 20, one of the 17 fish captured (6%) was sexually mature. The rainbow trout collected in this section were quite large, most were greater than 150 mm in length (Table 3), and had a mean length of 297 mm (range 110-480 mm). Though scales collected from trout in this section have not yet been analyzed, it appears from the length frequency histogram of mainstem Yakima River rainbow trout (Fig. 14), that most of the fish sampled in this upper canyon section were between age 1 and age 3. Juvenile spring chinook salmon were captured periodically while sampling with hook and line in this section.

The extent of mainstem spawning by resident trout has not yet been determined, but resident trout do spawn in the mainstem Yakima River in this section. Based on the limited amount of data collected thus far, it appears that the potential for competitive overlap could be high in this section if steelhead select spawning areas currently being utilized by resident trout, and if trout use is sufficient to approach the limits of that habitat available for spawning.

Lower Canyon (Section 7)

Portions of the lower canyon section of the Yakima River were sampled May 9, 11, and 20, 1990. As previously mentioned, electrofishing efficiency was poor. We suspect that most spawning of rainbow trout had occurred prior to these efforts based on the capture of a sexually mature fish in the upper canyon section on February 21. Water temperatures in this section were from 9 to 10 C during sampling.

A total of 61 rainbow trout were collected in the lower canyon area. None of the six trout captured on May 9 were classified as being sexually mature. Similarly, none of the 35 fish collected on May 11 nor of the 20 captured on May 20 were sexually mature. Nearly 90% of the trout captured exceeded 150 mm in length (Table 3). Mean length of rainbow trout in this section was 257 mm (range 109-376 mm). Again, in the absence of analyzed scale aging data, it appeared from the length frequency histogram that most of the fish captured in this lower canyon section were between age 1 and age 3. Juvenile spring chinook salmon were captured in this section along the margins of the river.

Preliminary analysis of the data collected thus far suggests that densities of resident trout were relatively high in this section (density was not quantified), however the relative lack of quality spawning habitat and the absence of sexually mature rainbow trout in our samples in this area may reduce the potential for resident trout/anadromous steelhead spawning interactions here.

One major tributary, Umtanum Creek, enters the lower canyon section at its upper boundary. As mentioned in a previous section of this report, Umtanum Creek is a very productive spawning tributary.

Mainstem Summary

Due to the small sample sizes in the separate study sections of the mainstem Yakima River, data were pooled to form the length frequency distribution shown in Figure 14. Scale analysis has not yet been completed on Yakima River trout but it appears that there are three strong year classes of trout (age 1, 2, and 3) and one weak year class (4+). The distinction between age 3 and age 4+ trout seems to occur at approximately 380 mm, which coincides with the 1986-1989 minimum size limit of 15 inches (381 mm). Thus it appears that at the times of our sampling the larger fish were either: 1) in the tributaries or other mainstem spawning areas: or 2) harvested from the population prior to the spring of 1990.

Of all areas we sampled in the Yakima River basin in 1990, rainbow trout from mainstem areas were the largest. However, trout in these areas had relatively low condition factors in comparison to many of the trout captured in tributaries (Table 5). As expected in an area with high angling pressure and restrictive regulations, many of the fish handled in the mainstem showed evidence of hook-scars (Table 7).

Though capture efficiencies were generally low, it appears that trout densities are higher in the lower reaches (closer to Roza Dam) than in the upper areas. Also, it appears that the majority of the angling pressure is concentrated in the lower three sections, from Ellensburg to Roza Dam. Spawning survey data indicates some spawning does occur in the Yakima River.

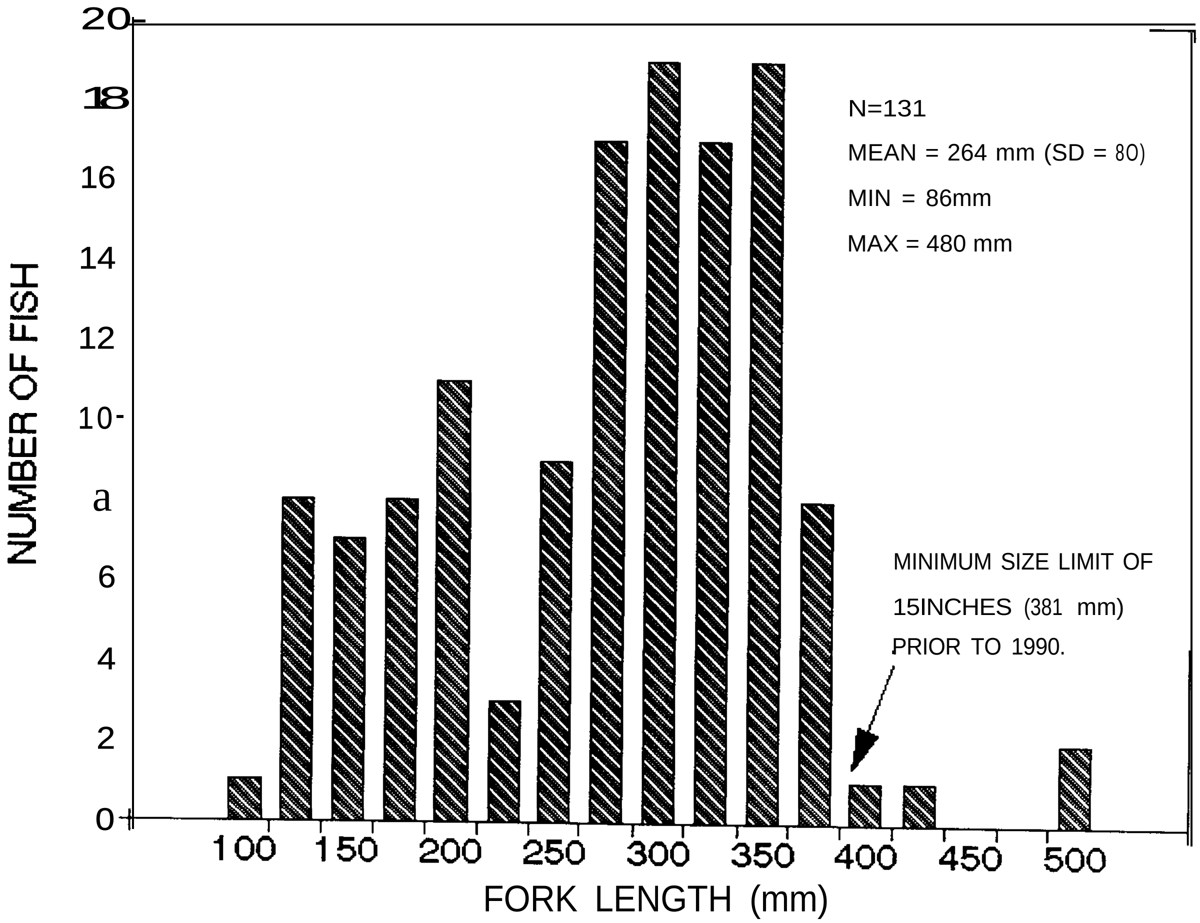

Figure 14. Length frequency histogram of rainbow trout captured in Yakima River mainstem spawning surveys (sections pooled), February 21 - May 31, 1990.

Basinwide Summary

Extensive spawning activity was found in a few of the lower elevation tributaries of the Yakima River (e.g. Umtanum, Cherry, and Wilson creeks). High runoff conditions in middle and upper elevation tributaries most likely caused us to miss the majority of spawning activity taking place. Spawning-condition trout were observed in the mainstem Yakima River, however, sampling problems prohibited us from capturing adequate sample sizes in most study sections.

Future efforts to gather spawning information in the mainstem sections will rely heavily on the use of an electrofishing drift boat system that will be capable of operating under most flow conditions. In addition, sampling will begin earlier in the spawning season (February-April) prior to irrigation water releases into the mainstem.

The National Marine Fisheries Service is currently conducting radiotelemetry studies to define the spatial and temporal distribution of steelhead spawning throughout the Yakima River Basin. This research, coupled with our spawning surveys, will help identify the temporal and spatial overlap between spawning steelhead and resident trout. Once the spawning areas are identified it will be possible to estimate the probability of interactions.

Population estimates are scheduled to be conducted in tributaries and mainstem sections for the first time in the summer and fall of 1990 using electrofishing multiple removal methods (tributaries) and mark-recapture methods (mainstem). The presence of age 0+ trout during these efforts may provide further information on the distribution of trout spawning. These population estimates will also provide baseline data on salmonid distribution and abundance that will be used, over time, to identify and assess changes to salmonid populations due to the implementation of YKPP supplementation activities.

The total number of rainbow trout collected for genetic analyses from tributaries and mainstem sections combined was 117. The actual number of fish collected per tributary and mainstem section fell far short of the targeted number due to sampling inefficiencies and the non-availability of adult trout in spawning condition at the time of most surveys. In only one tributary, Umtanum Creek, were a sufficient number of adults collected to achieve the genetic sampling target.

The collected samples will be analyzed by the WDF Genetic Stock Identification Laboratory and results will be discussed in a future report. Stock structure and origin will be identified and a baseline genetic database will be established. It is also anticipated that electrophoretic techniques will identify specific genetic markers for experimentation purposes. Finally, electrophoretic methods will be used in an attempt to differentiate juvenile rainbow trout from juvenile steelhead, which is a persistent problem with experimental and management implications.

With the exception of fish kept for genetic analysis, all trout greater than **200** mm **long were tagged and released (Table 7)** to obtain information on temporal and spatial aspects of adult trout movements. Of the 527 total trout tagged and released, 78 were placed in the mainstem Yakima River fish, while 449 were placed in tributary fish. This disparity in numbers was due primarily to low capture efficiencies in the Yakima River and a greater expenditure of effort in tributary areas. Several tributaries had very few trout over 200 mm (e.g. Taneum, Swauk, and Big creeks) and in such cases tags were placed in slightly smaller trout ($\geq$ 170 mm). Trout will continue to be tagged as a routine part of our research activities (e.g. rearing area surveys).

Over the course of the study tag return information from various sources (anglers, WDW surveys, Roza and Prosser Dams) will be used to help determine growth rates, seasonal movements, and distribution patterns of resident trout. During the reporting period, only 9 of the fish tagged in the **1990** spawning survey had been recaptured (Table 8). Efforts are being made to increase recapture sample sizes by improving angler participation.

The majority of the recaptures (N=7) occurred in the same reaches where the fish were tagged, indicating that some percentage of the trout remain in given stream segments through the end of spawning season. A steelhead kelt tagged in Umtanum Creek on March 21 was recaptured at Prosser Dam on April 3 (having moved 125 km). The remaining recapture, a 270 mm fish (presumed to be a resident rainbow trout) was tagged on April 2 in Dry Creek and was subsequently recaptured at the Prosser

Table 8. Summary of tag recapture data collected from rainbow trout tagged during spawning surveys in the upper Yakima River and major tributaries, February - June 1990.

Tag Number	Date Tagged	Location Tagged	Date of Recap.	Location of Recap.	Dist. Moved[a] (km)	Net Growth (mm)
MAO010	02/21	Yakima R.	05/14	Yakima R.	0.2	-1
TA1123	03/02	Cherry Cr.	06/01	Cherry Cr.	0.5	NA[b]
TA1135	03/02	Cherry Cr.	06/03	Cherry Cr.	0.5	NA
TA1155	03/02	Cherry Cr.	05/02	Cherry Cr.	0.2	NA
TA1169	03/05	Cherry Cr.	06/17	Cherry Cr.	0.5	NA
TA1306	03/13	Wilson Cr.	06/01	Wilson Cr.	0.4	NA
TA1308	03/13	Wilson Cr.	06/06	Wilson Cr.	0.4	NA
TA1412[c]	03/21	Umtanum Cr.	04/03	Prosser Dam	125	NA
TA1498	04/02	Dry Cr.	05/13	Prosser Dam	150	NA

[a] Approximate distance moved as determined by using field data.

[b] Size at recapture not available (angler return data).

[c] Adult female wild steelhead 660 mm in length.

juvenile collection facility on May 13. It is unclear whether this fish was a misidentified steelhead smolt or whether it was indeed a resident fish that simply moved downstream a great distance (over 150 km).

At present it is not possible to assess the contribution of tributary spawning rainbow trout to the mainstem Yakima River population. Our limited tag recapture data, and the high incidence of hook-scars on tributary spawners, suggests that some portion of the tributary spawners move into the Yakima River after the spawning season.

We anticipate that future spawning surveys will clarify where and when the majority of the trout spawning activities take place and that continued tagging efforts will help identify the recruitment of tributary fish to the mainstem Yakima River and vice-versa.

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