4.0 Tucannon Subbasin Aquatic Assessment

4.1 Selection of Focal Species

Four aquatic species were chosen as focal for Tucannon Subbasin Planning: steelhead/rainbow trout *Oncorhynchus mykiss*; spring and fall Chinook *Onchorynchus tshawytcha*; bull trout *Salvelinus confluentus*. The criteria used to select focal species were the aspects of the Tucannon Subbasin ecosystem that the life histories represent; the Endangered Species Act (ESA) status; the cultural importance of the species and whether or not there was enough knowledge of the life history of the species to do an effective assessment. Those species of which too little was known to be included as focal at this time could be included as "species of interest" (see section 4.7). The WDFW suggested the above species as focal for the subbasin. These were then presented to the Nez Perce Tribe (NPT), the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), The Columbia County Conservation District Board, the citizens advisory group, subbasin planning team and other interested agencies and entities. Consensus was achieved on their selection. Tucannon summer steelhead, spring/fall chinook and bull trout life histories intersect a broad range of the aquatic ecosystem. Spatially, the life histories of these four species cover the entire subbasin from the mouth to the headwaters. These species also occupy all levels of the water column including slack water, swift water and the hyporheic zone. Not only are they present but also the ability of these species to thrive is dependent on being able to successfully occupy these areas. Temporally, these species are present (or were assumed to be present in the past) at one lifestage or another throughout much of the watershed in all seasons. The ability of these species to be present at a particular time in a particular area is also key to the success of these species. Given the wide range of both the spatial and temporal aspects of these life histories it can be assumed that having habitat conditions that are appropriate for these three species will also produce conditions that allow for the prosperity of other aquatic life in the Tucannon Subbasin.

The legal status of these species is important to the people of the Tucannon Subbasin. All three species are listed as threatened under the ESA (see sections 4.3.4.3; 4.4.4.3; 4.5.4.3; 4.6.4). Currently the citizens, governments, state and federal agencies and tribes are engaged in planning for the recovery of each of the salmonids through different processes. The intention of subbasin planning to address listed species within the subbasin supports the inclusion of the only four federally listed aquatic species within the subbasin as focal species.

4.2 Tucannon Subbasin Habitat Assessment Methods

The Tucannon Subbasin habitat was assessed using the Ecosystem Diagnosis and Treatment (EDT) method; EDT is an analytical model relating habitat features and biological performance to support conservation and recovery planning (Lichatowich et al. 1995; Lestelle et al. 1996; Mobrand et al. 1997; Mobrand et al. 1998). It acts as an analytical framework that brings together information from empirical observation, local experts, and other models and analyses.

The Information Structure and associated data categories are defined at three levels of organization. Together, these can be thought of as an information pyramid in which each level builds on information from the lower level (Figure 4-1). As we move up the through the three levels, we take an increasingly organism-centered view of the ecosystem. Levels 1 and 2 together characterize the environment, or ecosystem, as it can be described by different types of data. This provides the characterization of the environment needed to analyze biological performance for a species. The Level 3 category is a characterization of that same environment from a different perspective: "through the eyes of the focal species" (Mobrand et al. 1997). This category describes biological performance in relation to the state of the ecosystem described by the Level 2 ecological attributes.

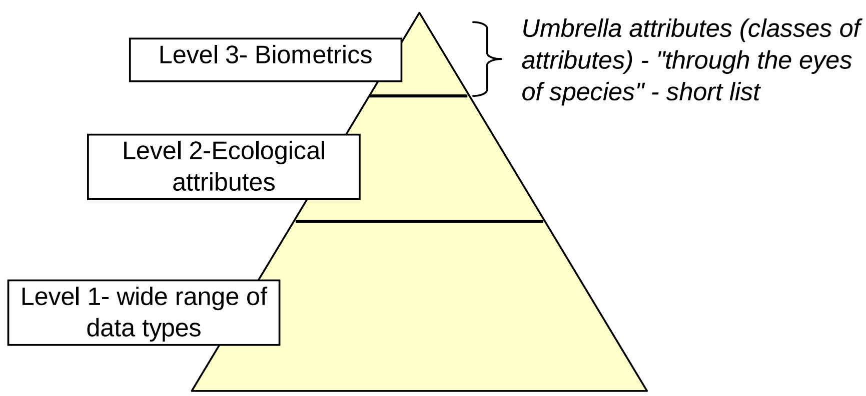

Figure 4-1. Data/information pyramid—information derived from supporting levels.

The organization and flow of information begins with a wide range of environmental data (Level 1 data) that describe a watershed, including all of the various types of empirically based data available. These data include reports and unpublished data. Level 1 data exist in a variety of forms and pedigrees. The Level 1 information is then summarized or synthesized into a standardized set of attributes (Level 2 ecological attributes, see Table 4-3) that refine the basic description of the watershed. The Level 2 attributes are descriptors that specify physical and biological characteristics about the environment relevant to the derivation of the survival and habitat capacity factors for the specific species in Level 3. Definitions for Level 2 and Level 3 attributes can be found at www.edthome.org , together with a matrix showing associations between the two levels and various life stages.

The Level 2 attributes represent conclusions that characterize conditions in the watershed at specific locations, during a particular time of year (season or month), and for an associated management scenario. Hence an attribute value is an assumed conclusion by site, time of year, and scenario. These assumptions become operating hypotheses for these attributes under specific scenarios. Where Level 1 data are sufficient, these Level 2 conclusions can be derived through simple rules. However, in many cases, experts are needed to provide knowledge about geographic areas and attributes where Level 1 data are incomplete. Regardless of the means whereby Level 2 information is derived, the characterization it provides can be ground-truthed and monitored over time through an adaptive process.

In the Tucannon Subbasin process, conclusions regarding Level 2 attribute conditions were derived using empirical data, where available, and data gaps were filled by a group of natural resource-related professionals with knowledge of the watersheds of interest. These individuals had expertise in such disciplines as fish habitat, hydrology, geomorphology, water quality, and civil engineering.

To perform the assessment we first structured the entirety of the relevant geographic areas, including marine waters, into distinct habitat reaches. The Tucannon drainage was subdivided into the 58 stream segments by an assembled technical workgroup (Table 4-1). We identified reaches on the basis of similarity of habitat features, drainage connectivity, and land use patterns. Such a detailed reach structure, however, is counterproductive for displaying results. Therefore the reaches were regrouped into the 20 larger “geographic areas” (Table 4-2). A set of standard habitat attributes and reach breaks developed by Mobrand Biometrics Incorporated (MBI) were used for the mainstem Columbia and Snake Rivers, estuarine, nearshore, and deepwater marine areas. We then assembled baseline information on habitat and human-use factors and fish life history patterns for the watersheds of interest. The task required that all reaches be completely characterized by rating the relevant environmental attributes.

Table 4-1. Stream reach codes, descriptions and river mile start/end points as defined in the Tucannon River for the Ecosystem Diagnosis and Treatment analysis method 2003. River miles are measured in Terrain Navigator®.

Reach code	Reach location/description	Start RM	End RM
Tuc1	Tucannon, mouth to end of backwater area	0	0.72
Tuc2	Tucannon, end of backwater area to Kellogg Cr	0.72	4.44
Kel1	Kellogg Cr, mouth to steelhead access limit at forks	0	1.29
Tuc3	Tucannon, Kellogg Cr to Starbuck Dam	4.44	5.47
Tuc4	Starbuck Dam (Obstruction)	OBSTRUCTION	
Tuc5	Tucannon, Starbuck Dam to Smith Hollow Cr	5.47	5.8
Smith	Smith Hollow Cr, mouth to forks	0	1.05
Tuc6	Tucannon R, Smith Hollow Cr to Pataha Cr	5.8	11.96
Pat1	Pataha Cr, mouth to Delaney (261) culvert	0	1.26
Pat2(Delaney culvert)	Delaney culvert (Obstruction)	OBSTRUCTION	
Pat3	Pataha, Delaney culvert to Dodge Bridge	1.26	10.83
Pat4	Dodge Bridge (Obstruction)	OBSTRUCTION	
Pat5	Pataha Cr, Dodge Br to Tatman Grade Road	10.83	20.02
Pat6	Pataha Cr, Tatman Rd to 3rd St Bridge in Pomeroy.	20.02	24.53
Pat7	Pataha Cr, 3rd St Br to 20th St Bridge	24.53	25.75
Pat8	20th St sewer line (obstruction)	OBSTRUCTION	
Pat9	Pataha Cr, 20th St Obstruction to Bihmaier Cr	25.75	27.6
Bih1	Bihmaier Gulch Cr, mouth to dam site	0	1.08
Bih2	Bihmaier dam	OBSTRUCTION	
Bih3	Bihmaier Gulch Cr, dam to Hutchin's Hill Cr	1.08	1.22
Hutch	Hutchin's Hill Cr, mouth to spring source	0	0.28
Bih4	Bihmaier Cr, Hutchin's Hill Cr to source at spring.	1.22	1.66
Pat10	Pataha Cr, Bihmaier Cr to Davis Bedrock shelf.	27.6	35.22
Pat11(Davis shelf)	Davis shelf (Obstruction)	OBSTRUCTION	
Pat12	Pataha Cr, Davis shelf to Dry Pataha Cr	35.22	42.66
DryPat1	Dry Pataha Cr, mouth to old dam	0	0.36
DryPat2(dam)	Dry Pataha Cr Dam	OBSTRUCTION	
DryPat3	Dry Pataha Dam to steelhead access limit	0.36	3.45
Pat13	Pataha Cr, Dry Pataha to Iron Springs CG Pond and outlet	42.66	48.39
IronSpr	Iron Springs Pond and outlet , mouth to	0	0.06

	pond's end.		
Pat14	Pataha Cr, Iron Springs Pond outlet to Stevens Ridge culvert	48.39	49.54
Tuc7	Tucannon R, Pataha Cr to Tucannon Falls	11.96	16.02
Tuc8(Tucannon Falls)	Tucannon Falls (Obstruction)	OBSTRUCTION	
Tuc8A	Tucannon R, Tucannon Falls to Hatchery Steelhead release site Einrich	16.02	18
Tuc8B(release site)	Hatchery Steelhead release site	HATCHERY REALEASE POINT	
Tuc9	Tucannon R, lower steelhead release site Einrich to King Grade	18	22.16
Tuc9A	Tucannon R, King Grade to Marengo steelhead release site	22.16	25.98
Tuc9B	Marengo steelhead release site	HATCHERY REALEASE POINT	
Tuc10	Tucannon R, Marengo steelhead release site to Tumalum Cr	25.98	34.35
Tumalum	Tumalum Cr, mouth to steelhead access limit	0	5.87
Tuc11	Tucannon R, Tumalum Cr to Cummings Cr	34.35	36.46
Cummmings	Cummings Cr, mouth to Unnamed Right Bank trib in Sec 13	0	6.78
Tuc12	Tucannon R, Cummings Cr to Fish Hatchery Diversion Dam	36.46	38.41
Tuc13(Hatchery Dam)	Hatchery Dam (Obstruction)	OBSTRUCTION	
Tuc14	Tucannon R, Hatchery Dam to Curl Lake spring chinook and edemic steelhead release site	38.41	42.9
Tuc14A	Curl Lake spring chinook and endemic steelhead release site	HATCHERY REALEASE POINT	
Tuc14B	Tucannon R, Curl Lake spring chinook endemic steelhead release site to Hixon Cr	42.9	43.9
Hix	Hixon Cr, mouth to impassibly steep section	0	0.93
Tuc15	Tucannon R, Hixon Cr to Little Tuc	43.9	46.26
Ltuc	Little Tucannon R, mouth to steelhead access limit	0	1.9
Tuc16	Tucannon R, Little Tucannon R to Panjab Cr	46.26	48.27
Pan1	Panjab Cr, mouth to Meadow Cr	0	2.2
Meadow	Meadow Cr, mouth to steelhead access limit	0	1.86
Pan2	Panjab Cr, Meadow Cr to steelhead access limit	2.2	3.63
Tuc17	Tucannon R, Panjab Cr to Sheep Cr	48.27	52.95
Tuc18	Tucannon R, Sheep Cr to Bear Cr	52.95	56.54

Table 4-2. Geographic Areas, locations, lengths and inclusive EDT reaches used for Tucannon River subbasin assessment 2003.

Geographic Area	Location	Length (Miles)	EDT Reaches included
Mouth Tucannon	Mouth to End of Backwater	.72	Tuc1
Lower Tucannon	Backwater to Pataha Cr	11.24	Tuc2, Tuc3, Tuc4, Tuc5, Tuc6
Kellogg Cr	Mouth to Steelhead Access Limit	1.29	Kel,
Smith Hollow	Mouth to Steelhead Access Limit	1.05	Smith
Lower Pataha	Mouth to Pomeroy	25.75	Pat1, Pat2, Pat3, Pat4, Pat5, Pat6, Pat7, Pat8
Bihmaier	Mouth to Steelhead Access Limit	1.94	Bih1, Bih2, Bih3, Bih4, Hutch
Upper Pataha	Pomeroy to Dry Pataha Cr	16.91	Pat9, Pat10, Pat11, Pat12
Dry Pataha	Dry Pataha Drainage	3.45	DryPat1, DryPat2, DryPat3
Mountain Pataha	Dry Pataha to Access Limit	6.88	Pat13, Pat14
Iron Springs	Iron Springs Cr Drainage	.06	IronSpr
Pataha-Marengo Tucannon	Pataha Cr to Marengo	14.02	Tuc7, Tuc8A, Tuc9, Tuc9A, Tuc9B
Marengo-Tumalum Tucannon	Marengo to Tumalum Cr	8.37	Tuc10
Tumalum	Mouth to Steelhead Access Limit	5.87	Tumalum
Tumalum-Hatchery Tucannon	Tumalum Cr to Hatchery Dam	4.06	Tuc11, Tuc12, Tuc13
Cummings	Mouth to Steelhead Access Limit	6.78	Cummings
Hatchery-Little Tucannon	Hatchery Dam to Little Tucannon	7.85	Tuc14, Tuc14A, Tuc14B, Tuc15
Hixon	Mouth to Steelhead Access Limit	.93	Hix
Little Tucannon	Mouth to Steelhead Access Limit	1.90	Ltuc
Panjab	Mouth to Steelhead Access Limit	5.49	Pan1, Pan2, Meadow
Mountain Tucannon	Little Tucannon Cr to Bear Cr	10.28	Tuc16, Tuc17, Tuc18

A technical work group was formed for the Tucannon subbasin for the purpose of rating the Level 2 habitat attributes for the freshwater stream reaches. Expert knowledge about habitat identification, habitat processes, hydrology, water quality, and fish biology was incorporated into the process. The work groups drew upon published and unpublished data and information for the basin to complete the task. Protocol for rating attributes was taken from “Attribute Ratings Guidelines (January 2003 revision) and “Attribute ratings Definitions” (January 2003); written and distributed by MBI (available at www.edthome.com). In addition MBI personnel were available for consultation and rated some attributes when local resources were not available. The WDFW watershed steward served as coordinator for the attribute rating process. As stated above, when available, published resources and/or empirical were utilized. If published resources for a particular attribute or set of attributes were not readily available the watershed steward met one on one with local technical personnel to rate the attributes for which they had empirical data or particular expert knowledge. When rating attributes for which no or only severely outdated data was available the watershed steward relied on the expert opinion of local biologists/other professionals or upon his own knowledge of the subbasin. The sources used for rating the individual attributes are outlined in Table 4-3. The patient (current) condition attribute ratings represent a variety of sources and levels of proof (see **Appendix X** for complete ratings, levels of proof and explanations of specific attribute rating methods). Levels of proof (or confidence levels) assigned to ratings are directly from developed rating methods by MBI specifically for the EDT process. The attributes assigned to each reach are assigned a numerical value from 1 to 5 where: 1 is empirical observation; 2 is expansion of empirical observation; 3 is derived information; 4 is expert opinion; 5 is hypothetical. The mean and standard deviation for confidence levels assigned to attributes are presented in Table 4-3. The template (historic) conditions were all considered to be the hypothetical or expert opinion of the resource professional that rated the attribute. The rating sources presented in Table 4-3 are by the agency or organization for which the individual is employed, represents or is affiliated; or the data/published source that was used.

Table 4-3. Attributes, attribute rating level of proof means/standard deviations and rating sources used for EDT analysis of the Tucannon River 2003. (All Template ratings considered hypothetical or expert opinion; EO= Expert Opinion)

Attribute	Level of Proof (patient ratings only)	Template Sources	Patient Sources
Alkalinity	Mean = 3 SD = 0	Mobrand Biometrics Incorporated (MBI).	Direct or derived from United States Geological Service (USGS) sample site and Environmental Protection Agency (EPA) STORET site and database.
Bed Scour	Mean = 4 SD =0	Mobrand Biometrics Incorporated (MBI) and WDFW Biologists.	Mobrand Biometrics Incorporated (MBI) and WDFW Biologists.

Benthic Community Richness	Mean = 3 SD = 0	Mobrand Biometrics Incorporated (MBI) and WDFW Biologists.	Mobrand Biometrics Incorporated (MBI) and WDFW Biologists.
Channel Length	Mean = 1 SD = 0	WDFW Biologist. Stream lengths increases proportionally with estimated decrease in gradients historically through Rosgen stream typing.	WDFW Biologist EO.
Channel Width Max	Mean = 3.0 SD =1.2	WDFW Biologist.	1992, 1997, 2000, 2001 United States Forest Service (USFS) Stream survey data; WDFW Biologist EO..
Channel Width Min	Mean = 3.11 SD = .99	WDFW Biologist.	WDFW Electrofishing data, habitat data and EO.
Confinement Hydromodifications	Mean = 3 SD = 0	N/A	Pomeroy Conservation District and WDFW Biologist EO.
Confinement Natural	Mean = 5 SD = 0	WDFW Biologist.	WDFW Biologist EO.
Dissolved Oxygen	Mean = 2 SD = 0	WDFW Biologist.	WDFW Biologist derived from temperature data.
Embeddedness	Mean = 2.71 SD = 1.38	WDFW Biologist	1992 and 1995-1999 USFS Stream Survey Data; Derived from 1980 Consultant Survey
Fine Sediment	Mean = 3.64 SD = .78	WDFW Biologist; MBI.	WDFW Biologist EO; some derived from 1986 survey.
Fish Community Richness	Mean = 1.21 SD = .79	WDFW Biologist.	From multiple year WDFW surveys.
Fish Pathogens	Mean = 1 SD = 0	N/A	From WDFW fish stocking records.
Fish Species Exotic	Mean = 1.11 SD = .57	N/A	From multiple WDFW surveys.

Flow High	Mean = 3.85 SD = .36	N/A	MBI and WDFW Biologist EO.
Flow Low	Mean = 3 SD = 0	N/A	MBI and WDFW Biologist EO.
Flow Diel Variation	Mean = 1 SD = 0	N/A	MBI and WDFW Biologist EO.
Flow Flashy	Mean = 4 SD = 0	N/A	MBI and WDFW Biologist EO.
Gradient	Mean = 3 SD = 0	WDFW biologist adjusted gradients for increase in stream length (sinuosity) historically. Gradients decreased by proportion of stream length increase; potential or historic sinuosity dervied from Rosgen stream typing.	WDFW Biologist estimations using Terrain Navigator.
Habitat Types (% of Backwater Pools, Glides, Beaver Ponds, Pools, Large Substrate Riffles, Small Substrate Riffles, Pool Tail-outs)	Mean = 3.36 SD = .49	WDFW Biologist	WDFW Habitat Alteration Evaluation 2000 and Biologist EO; 1992, 1997, 2001USFS Stream Survey Data
Habitat Off-Channel	Mean = 4 SD = 0	MBI	MBI
Harassment	Mean = 4 SD = 0	WDFW Biologist.	WDFW Biologist EO.
Hatchery Outplants	Mean = 1 SD = 0	N/A	WDFW fish stocking records.
Hydrologic Regime Natural	Mean = 3 SD = 0	MBI	MBI, Based on flow data from USGS station and MBI developed hydroregime categories.
Hydrologic Regime Regulated	N/A	N/A	N/A
Icing	Mean = 4 SD = 0	WDFW Biologist.	WDFW Biologist EO.
Metals in Water Column	Mean = 5 SD = 0	N/A	WDFW Biologist EO.
Metals in Soils and Sediment	Mean = 5 SD = 0	N/A	WDFW Biologist EO.
Misc Toxics	Mean = 4 SD = 0	N/A	WDFW Biologist EO.
Nutrients	Mean = 5 SD = 0	N/A	WDFW Biologist EO.
Obstructions	*Obstruction rated by percent passage of average adult. Obstruction ratings were the expert	N/A	Obstructions rated by WDFW Biologist EO.

	opinion of WDFW biologists.		
Predation Risk	Mean = 4 SD = 0	N/A	WDFW Biologist EO.
Riparian Function	Mean = 4 SD = 0	N/A	WDFW Biologist EO.
Salmon Carcasses	Mean = 2.61 SD = 1.52	WDFW Biologist.	From numerous WDFW surveys.
Temperature Max	Mean = 2.32 SD = 1.83	WDFW Biologist. Derived from, "Ecological Investigations of the Tucannon River Washington by DW Kelley and Associates for H. Esmaili and Associates for USDA.	From summary of water temperature data by WDFW Snake River Lab 2002. .1992, 2000, 2001 USFS Stream Survey Data.
Temperature Min	Mean = 3 SD = .98	WDFW Biologist.	From summary of water temperature data by WDFW Snake River Lab 2002 and WDFW Biologist EO.
Temperature Spatial Variation	Mean = 5 SD = 0	WDFW Biologist.	WDFW Biologist EO and consultation with Columbia Cons. District.
Turbidity	Mean = 4 SD = .0	WDFW Biologist.	WDFW Biologist EO.
Withdrawl	Mean = 1 SD = 0	N/A	WDFW Biologist in consultation with Columbia Conservation District.
Woody Debris	Mean = 2.68 SD = .47	WDFW Biologist.	WDFW Habitat Alteration Evaluation 2000 and Biologist EO; 1992, 1997, 2000, 2001USFS Stream Survey Data

The template or reference conditions for the watershed were estimated in order to rate attributes for the EDT analysis. Table 4-4 summarizes these conditions by geographic area. The lower elevations near the mouth of the subbasin were assumed to have moderate to heavy cottonwood galleries and a healthy beaver population. This would have created a somewhat complex habitat with long-lived large wood and many pools/backwater areas. Upstream of this area as you moved away from the Snake River there would have been sparser cottonwood growth with heavier brush near the riparian giving way to grassland/shrub-steppe as you moved upland. This character would have continued up the Pataha with brush growing thicker and woody growth becoming more common, grasslands replacing shrub-steppe and increased large wood in the stream as you approached the mountain areas. The mountainous areas surrounding the Pataha would have quickly changed from brushy/cottonwood riparian growth and grassland uplands to mixed conifer forest and woodlands. The stream would have been thick with wood as input to the stream would have been more common and featured larger pieces than below. Upstream form the mouth of the Pataha in the Pataha-Marengo Tucannon to Marengo-Tumalum Tucannon geographic areas the mixed conifer forestland would have inter-mingled with cottonwood galleries. Large wood in the stream would have been very common here due to low gradients and input from upstream as well as locally. Logjams and beaver ponds would have been very frequent. Off-channel habitat would have increased as over the years the river cut and re-cut across the valley. Lower Tumalum would have looked very much like the Marengo-Tumalum Tucannon area; while upper-Tumalum would likely be more heavily forested with occasional meadows. As elevation in the subbasin increased beaver would have decreased; riparian areas and side slopes change to heavier and heavier mixed conifer forest. Large wood would have been prevalent in the stream creating a pool/tail-out/riffle stream types with small cobble dominating giving way to more classic step-pool stream type as elevation increased. Sediment and embeddedness here, as throughout the watershed, would have been minimal due to heavy forested canopy and ground cover in the upland areas.

Mountain Tucannon, Little Tucannon and Panjab would have been forested with interspersed meadows. Fallen wood and understory growth would have been thick enough to make travel difficult. Snow and water retention in these areas would have been increased over current conditions. This would have increased summer flows throughout the Tucannon system. The stream at this elevation would have been very complex with lots of wood of all sizes. Step pool reaches would have been very common. Temperatures would have remained very cool even in the summer in most years. The watershed as a whole was considered to have been ecologically fit for the species of fish that were likely to have resided here (i.e. the focal species) to thrive. It was generally assumed that temperatures would have been lower and flow higher though not greatly so. Large wood was assumed to have been much more prevalent throughout the watershed as were the pools they help to create. Beaver was also thought to have been present in fair numbers, particularly in the lower elevations. Connection to the floodplain would have been complete (except natural confinement), increasing riparian function and particularly the complexity of the stream.

Table 4-4. Tucannon River geographic areas and description of assumed conditions used for rating EDT template attributes.

Geographic Area	Assumed Template Conditions
Mouth Tucannon	Heavy cottonwood galleries; many beaver ponds, low gradient = persistent LWD; well developed and accessible floodplain; some increase in flow due to better ability to retain water in the watershed; increased bank-full widths due to increased floodplain access..
Lower Tucannon	Cottonwood growth less in middle section increasing to mixed conifer/cottonwood; beaver ponds increasing toward top of area; low gradient = persistent LWD; well developed and accessible floodplain; some increase in flow due to better ability to retain water in the watershed; sediment load much reduced due to increased ground

	cover in upland/riparian areas (grassland/shrup-steppe), increased bank-full widths due to increased floodplain access.
Kellogg Cr	Spring fed stream; most likely cooler in summer and somewhat warmer in winter; brush and willows prevalent; some woody growth; off-channel prime beaver habitat, increased pools (beaver).
Smith Hollow	Spring fed stream; most likely cooler in summer and somewhat warmer in winter; brush and willows prevalent; some woody growth; off-channel prime beaver habitat, increased pools (beaver).
Lower Pataha	Mostly heavy brushed area with interspersed cottonwood galleries. Many beaver ponds, low gradient = persistent LWD; well developed and accessible floodplain; some increase in flow due to better ability to retain water in the watershed; increased bank-full widths due to increased floodplain access.
Bihmaier	Spring fed stream; most likely cooler in summer and somewhat warmer in winter; brush and willows prevalent; some woody growth; lower portion off-channel prime beaver habitat, decreasing upstream. Step-pool type stream due to few but persistent woody pieces.
Upper Pataha	well developed mixed conifer/cottonwood to woodland conifer as elevation increases; well-developed and accessible riparian areas; increased LWD; sediment and flashiness of stream much less due to well developed forest canopy cover and ground cover.
Dry Pataha	well developed mixed conifer/cottonwood riparian; increased LWD; increased pools; higher flows and cooler water in summer due to well developed riparian and increased canopy cover in sub-watershed; increased pools; increased LWD; sediment reduced mainly due to better upland ground cover (forest and grasslands) ; decreased bank-full widths due to better developed stream banks
Mountain Pataha	Well developed and occasionally very heavy forested area; large and long lived woody debris; complex stream make up with frequent pools; well developed and diverse riparian with almost complete canopy cover; snow retention and cool water into summer.
Iron Springs	Historically still small stream; probably very complex with large wood in lower part and small step-pool type stream higher up; probably heavy with LWD and probably frequently pooled in lower section.
Pataha-Marengo Tucannon	Some cottonwood growth changing to mixed conifer higher in area; LWD input locally and from above; increased pools; higher, higher flows and cooler water in summer due to well developed riparian locally and upstream; some beaver; sediment reduced mainly due to better upland ground cover (forest and grasslands); increased bank-full widths due to greater floodplain access (less confinement).
Marengo-Tumalum Tucannon	Well developed mixed conifer/cottonwood riparian; increased LWD; increased pools; higher flows and cooler water in summer due to well developed riparian and increased canopy cover in sub-watershed; increased pools; increased LWD; sediment reduced mainly due to better upland ground cover (forest and grasslands); increased bank-full widths due to greater floodplain access (less confinement).
Tumalum	well developed mixed conifer/cottonwood riparian giving way to heavier forestland as elevation inceases; increased LWD; increased pools; increased pools; increased LWD; sediment reduced mainly due

	to better upland ground cover (forest and grasslands).
Tumalum-Hatchery Tucannon	Well developed mixed conifer/cottonwood riparian giving way to more mixed conifer forestland; increased LWD; increased pools; higher flows and cooler water in summer due to well developed riparian and increased canopy cover in sub-watershed; increased pools; increased LWD; sediment reduced mainly due to better upland ground cover (forest and meadows) increased bank-full widths due to greater floodplain access (less confinement).
Cummings	Not considered greatly different than today; riparian more developed; increased LWD input with poll increase; pool increase is greatest change from present.
Hatchery-Little Tucannon	Mixed conifer forestland, quite heavy at times; increased floodplain; LWD very dense; pools much more frequent; complexity of habitat much greater; sediment reduced mainly due to better upland ground cover; some increase in flow due to better ability to retain water in the watershed; increased bank-full widths due to greater floodplain access (less confinement).
Hixon	Though always with flow probably served as off-channel area from mainstem; heavy with LWD causing pooled or even ponded conditions much of the time.
Little Tucannon	Increase riparian/canopy cover; increased LWD; increased pools; sediment reduced mainly due to better upland ground cover (forest and grasslands); some increase in flow due to better ability to retain water; complex mixed conifer forestland provided greater stability of flows.
Panjab	Probably much like today with the exception: Lower elevation had increased pools; increased LWD.
Mountain Tucannon	From the Little Tucannon to Panjab: improved riparian and coanopy cover; stream much more complex and woody. Probably much like today above Panjab with the exception: increased pools; increased LWD.

We characterized three baseline reference scenarios for the Tucannon Subbasin; predevelopment (historic or template as described above) conditions, current conditions, and properly functioning conditions (PFC). The comparison of these scenarios formed the basis for diagnostic conclusions about how the Tucannon and associated summer steelhead performance have been altered by human development. The historic reference scenario also served to define the natural limits to potential recovery actions within the basin. Properly functioning conditions were a set of standardized guidelines that NOAA Fisheries provided that were designed to facilitate and standardize determinations of the effect for Endangered Species Act (ESA) conferencing, consultations, and permits focusing on anadromous salmonids (Stelle 1996). The objective of the diagnosis then became identifying the relative contributions of environmental factors to the losses in summer steelhead performance. To accomplish this, we performed two types of analyses, each at a different scale of overall effect.

The first analysis considered conditions within *individual stream reaches* and identified the most important factors contributing to a loss in performance corresponding to each reach. This analysis, called the *Stream Reach Analysis* (**Appendix X),** identified the factors (classes of Level 2 attributes) that, if appropriately moderated or corrected, would produce the most significant improvements in overall fish population performance. It identified the factors that should be considered in planning habitat restoration projects.

The second analysis was done *across geographic areas* relevant to populations, where each geographic area typically encompasses many reaches. This analysis, called the *Geographic Area Analysis*, identified the relative importance of each area for either restoration or protection actions. In this case, we analyzed the effect of either restoring or further altering environmental conditions on population performance. These results will be discussed in the management plan. These results were available in two forms, scaled and unscaled. Briefly, scaled results take into account the length of the geographic area being analyzed. It does this by taking the original out put from EDT (i.e. percent productivity change, etc.) and dividing it by the length of stream in kilometers. This gives a value of the condition being measured per kilometer. The unmodified results are termed unscaled. Both results are presented here; though the scaled version was given more weight in the conclusions portion of the assessment.

A Reach Analysis identifies the life stages most severely impacted (relative to historical performance) on a reach-by-reach basis, as well as the environmental conditions most responsible for the impacts. This three-part diagnosis can then be used to develop a plan designed to protect areas critical to current production, and to implement effective restoration actions in reaches with the greatest production potential.

The first pair of charts in **Appendix X** describe this analysis in greater detail. The rest of the charts in **Appendix X** consist of the Reach Analysis for the Tucannon Subbasin. The Reach Analysis is intended to serve as a reference tool to be used in all types of watershed planning related to salmon conservation and recovery.

4.3 Focal Species Summer Steelhead/ Rainbow Trout (O. mykiss)

4.3.1 Life history

Tucannon summer steelhead are a typical Snake River "A"-run stock. A-run steelhead enter freshwater from June to August and generally pass Bonneville Dam before August 25. They begin passing Lower Monumental Dam in early June and can continue through the following spring (Glen Mendel, WDFW, personal communication). Adult summer steelhead appear to hold in the mainstem Snake River, rather than in the Tucannon, prior to spawning (Mark Schuck, WDW, personal communication, cited in WDF et al. 1990) possibly due to a lack of pools and cold water in the Tucannon during the summer and autumn. Entry into the Tucannon probably does not begin until September, when water temperatures drop (WDF et al. 1990). Spawning begins in late February or early March. Spawning peaks in early to mid-April and continues through mid-May.

Most wild Tucannon steelhead (60-65%) return to spawn after one year in saltwater, and 35-40% return to spawn after two years in saltwater (Bumgarner et al. 2000). Three-salt age fish are extremely rare. The frequency of repeat spawners is probably less than 5% (Bumgarner et al 2002).

Juveniles emerge from spawning gravels in late May or June (WDF et al. 1990). They typically rear in the Tucannon for one to two winters before migrating to the ocean. Smolt trapping conducted in the Tucannon River between 1998 and 2001 (Bumgarner et al. 2002) showed that emigrating steelhead were about 43% age 1, 52% age 2, and 5% age 3 or 4. Most outmigration occurs from December through June (WDF et al. 1990) with a peak in April (Glen Mendel, WDFW, personal communication).

4.3.2 Historical and Current Distribution

Information on historical summer steelhead distribution in the Tucannon is not available, but was assumed to be similar to the area covered by the EDT reaches previously outlined. Current and presumed steelhead distribution in the Tucannon is shown in Figure 4-2. Spawning occurs throughout the mainstem Tucannon and in many tributaries, especially in Cummings Creek. (WDFW 2003). Steelhead spawning in Pataha Creek is uncertain (Glen Mendel, WDFW, personal communication).

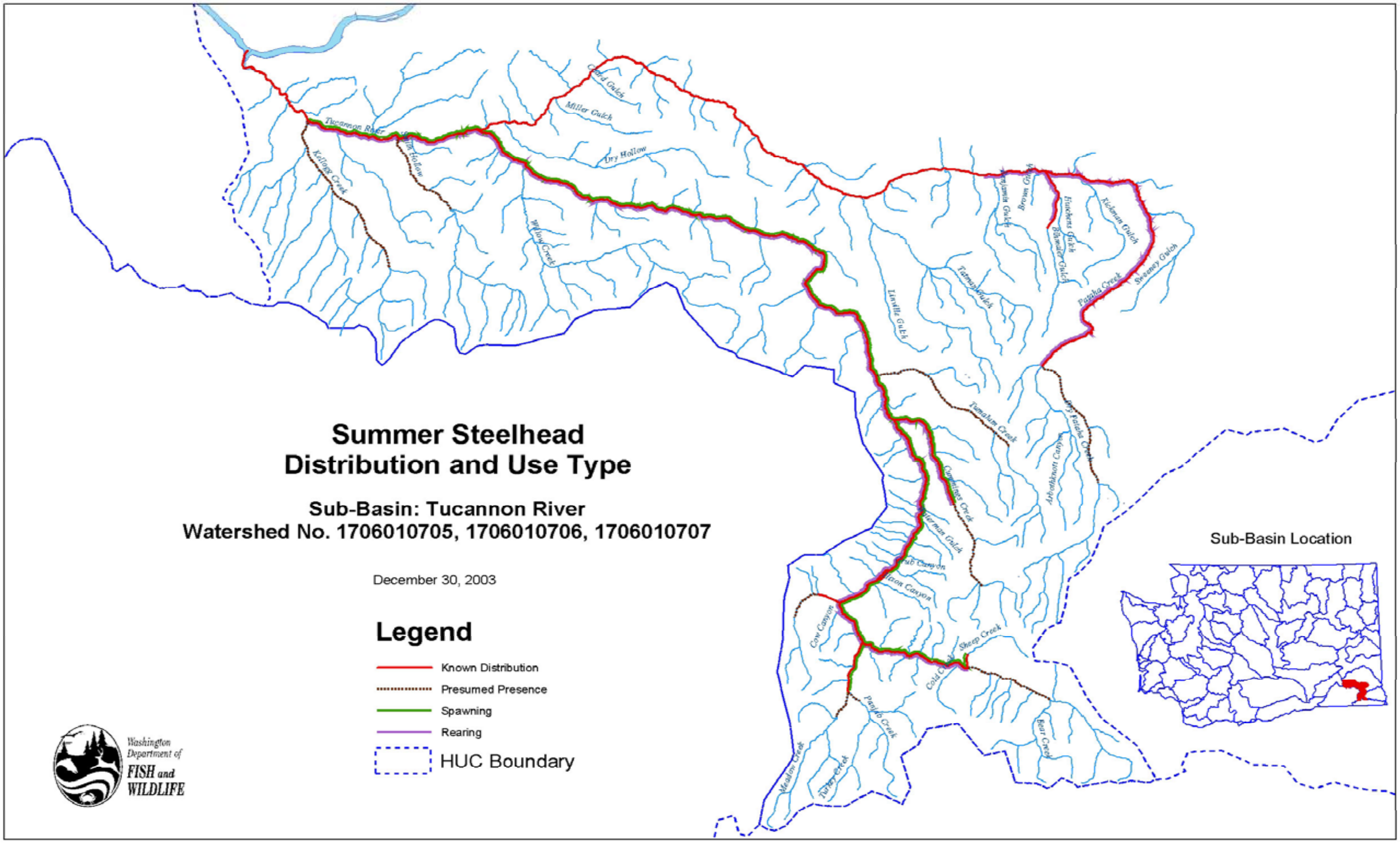

Figure 4-2. Current known and presumed distribution of summer steelhead in the Tucannon River. Data from the WDFW Washington Lakes and Rivers Information System (WLRIS) database.

4.3.3 Population Identification

Genetic characteristics of naturally produced Tucannon River summer steelhead have been assessed using several methods and have been analyzed by both WDFW and NMFS researchers. Allozyme genetic data were obtained from samples of parr or pre-smolts taken in 1989 and 1990 in the Hatchery-Little Tucannon and lower Tucannon areas. These samples were also used to collect data for microsatellite and other nuclear DNA loci (Winans et al. In press). Juveniles from the Tucannon River (no subdivision) were further sampled in 1991, 1992 and 1995, and these samples have been analyzed for variation at microsatellite DNA loci (Moran 2003). It has been assumed that sampled juveniles were produced by anadromous steelhead, and it is unknown if resident fish offspring were included in samples. Tucannon River wild adult steelhead sampled from 1998 through 2002 have been analyzed for microsatellite DNA variation and results from these analyses are pending (Maureen Small, WDFW, personal communication).

In general, the Tucannon River steelhead population has genetic characteristics that place it clearly in the Snake River Basin Evolutionarily Significant Unit (ESU; Busby et al. 1996; Winans et al. In press). Additionally, Tucannon steelhead were more similar to other Snake River A-run populations than to B-run populations. The Interior Columbia Technical Recovery Team (TRT), a work group organized by NMFS for ESU recovery planning, has preliminarily identified Tucannon River steelhead as an independent population in relation to all other Snake River Basin steelhead, considering genetic, geographic, phenotypic, environmental, and demographic data available (Interior Columbia Basin TRT, unpublished draft document July 2003).

Analyses and characterizations of steelhead populations using allozyme data by WDFW and NMFS staff have shown that Tucannon River steelhead were significantly differentiated from a variety of other Snake River Basin populations, including Asotin Creek (WDFW, unpublished data; NMFS, unpublished data). Recent analyses using microsatellite DNA data have compared populations from a large number of Snake Basin and Deschutes Basin steelhead populations (Moran 2003), and these results were utilized by the Interior Columbia TRT. Based on this data set, Tucannon River steelhead were not well-differentiated from Asotin Creek steelhead samples (Paul Moran, NMFS, personal communication). The relationship between Tucannon River and Asotin Creek steelhead needs to be explored to evaluate its implications in terms of population structure and gene flow. For example, it would be important to know if a common hatchery stock has been planted or occurs as strays in both drainages.

Lyons Ferry Hatchery steelhead, a non-local mixed-origin stock, have been released into the Tucannon River and the impact on the genetic integrity of the wild Tucannon population has been a concern. Preliminary comparative genetic results suggested that Tucannon steelhead samples were more similar to Lyons Ferry Hatchery steelhead samples than to Touchet River or Walla Walla River steelhead samples in the study, but that wild Tucannon steelhead still were genetically distinct from the hatchery stock (Maureen Small, WDFW, personal communication). Asotin Creek steelhead samples were not included in this study's data set.

4.3.4 Tucannon River Steelhead/Rainbow Trout Population

4.3.4.1 Population Characterization.

4.3.4.1.1 Empirical Data

Steelhead exist in the Pataha watershed, but relatively little is known about their distribution and abundance. Cursory sampling during summer has documented rainbow/steelhead juveniles in most of the watershed upstream of Pomeroy. Pataha is usually too turbid in spring for successful enumeration of steelhead redds or adult fish. Our sampling efforts to date have documented the existence of a few steelhead redds. The only juvenile sampling during summer was conducted in 1998. The results of that effort indicate there were more age 1+ and older fish than age 0+ fish. We also found relatively large numbers of brook trout *Salvelinus fontinalis* in the upper portion of the basin (above Dry Pataha Creek). This location is the only area in southeast Washington where brook trout have been documented.

Steelhead exist throughout most of the Tucannon subbasin (Table 4-5). WDFW has collected fish distribution and abundance data from various parts of the Tucannon subbasin for many years. Data are limited, or not available, for some stream reaches.

The empirical data (Table 4-5) indicates the highest spawning and rearing occurs in different geographic areas of the subbasin. Redd densities are highest in the mainstem Tucannon from Pataha to Marengo. The highest densities of age 1+ or older steelhead/redband trout have been found in Marengo to Tumalum and upstream of Tumalum Creek.

Empirical data were used to expand estimated average redd numbers (339) in index areas by 0.81 females/redd, and a 60/40 female/male ratio, to estimate average adult abundance at 458 adults in the Tucannon River. The average abundance derived from Bumgarner et al. 2002 (Table 29 in Bumgarner) is 438 adults with only 122 of those from naturally produced fish. No estimate was possible for Pataha Creek, but average escapement is not likely to be more than a 1-2 dozen adult steelhead. Capacity was not calculated here, but a 2001 WDFW Potential Parr Production (PPP) (WDFW, unpublished data) estimate of capacity for the Tucannon watershed was 1,210 adults, and for Pataha Creek was 89 adults. These estimates are similar to the EDT PFC estimate of 1,213 adult steelhead.

Tucannon River summer steelhead may have exceeded 3,000-4,000 adults in the past (Eldred 1960, cited in Gephart and Nordheim, 2001). The size of the population has decreased considerably since construction of mainstem dams on the Snake and Columbia rivers. Releases of hatchery reared steelhead has occurred for many years in the Tucannon River and returning hatchery-origin steelhead have contributed to the spawning population. The extent of these hatchery fish on the wild population is unknown. A Tucannon endemic steelhead stock is currently being tested for use in the Lyons Ferry Hatchery program.

The EDT estimate (636 adults) and empirical adult abundance estimate (438-458 adults) for the Tucannon River are similar, especially considering there are some stream reaches that were excluded from the empirical estimate. However, the number of naturally produced steelhead has been estimated to be only 122 adults when hatchery fish are excluded from fish spawning in the river (from Bumgarner et al. 2002). Therefore, the EDT estimate is higher than the empirical data for naturally produced fish. The EDT estimated abundance for the Tucannon subbasin at PFC is 1,213 and that estimate is similar to the WDFW parr production estimate of 1,210 for the basin. Current EDT abundance is estimated at 636 adult, naturally produced steelhead, with a current carrying capacity of 1,397 adults in the Tucannon Subbasin.

Table 4- 5. Tucannon subbasin steelhead empirical population data, 1998-2001 (PPP = Potential Parr Production Model estimates).
Steelhead/rainbow

	Reach length		Mean #	Estimated	Redds	Width	Total Density	Total Pop.	Age 1+	Age 1+	Age 1+
Tucannon	miles	meters	of redds/m	# of redds	per mile	meters	per/100 m	Estimate	density	Pop est	per/mile
Mouth to Pataha	11.24	18096.4				14.4	1.3	3,388	0	0	
Pataha to Marengo	14.02	22572.2	0.0083	188	5.2	12.2	26.8	73,802	2.92	8,041	574
Marengo to Tumalum	8.37	13475.7	0.0045	60	2.8	11.9	32.29	51,781	7.47	11,979	1,431
Tumalum to TFH dam	4.06	6536.6	0.0040	26	2.5	11.4	27.52	20,507	5.97	4,449	1,096
TFH dam to L. Tucannon	7.85	12638.5	0.0019	24	1.2	11	25.2	35,034	4.56	6,339	808
L.Tuc to Bear	10.28	16550.8	0.0005	8	0.3	7.5	22.6	28,054	9.56	11,867	1,154
Cummings Cr.	6.78	10915.8	0.0030	33	1.9	3.4	72.57	26,933	25.01	9,282	1,369
Kellogg Cr											
Smith Hollow											
Tumalum Cr.											
Hixon Cr.											
L. Tucannon	1.9	3059				3	37.43	3,435	12.82	1,176	619
Panjab Cr.	5.49	8838.9				3.6	44.18	14,058	39.8	12,664	2,307
Total				**339 redds**				**256,991**		**65,798**	
				X 0.81	Females/redd						
				= 275	Females /0.6					(proportion of females)	
Tucannon PPP = 1,210 adults				**= 458**	**Total average escapement 1999-2001**						
Pataha											
mouth to Pomeroy	25.75	41457.5				2.9	0	0	0	0	0
Pomeroy to Dry Pataha	16.91	27225.1				3.3	8.5	7,637	7.1	6,379	377
Dry Pataha	3.45	5554.5				1					
Dry Pataha to Upper limit	6.88	11076.8				3.2	37.7	13,363	18.9	6,699	974
Iron Springs	0.06	96.6				1					
Bihmaier	1.66	2672.6				1.1					
Total								**21,000**		**13,078**	
Pataha PPP = 89 adults											

4.3.4.1.2 EDT Analysis

Tucannon Summer Steelhead Baseline Population Performance.—Model results for Tucannon Subbasin summer steelhead are based on life history assumptions summarized in Table 4-6. The EDT model estimated the average spawning population size of the current Tucannon River summer steelhead to be 636 fish, with a carrying capacity of 1397 fish and a productivity of just 1.8 adult returns per spawner (Table 4-7). The life history diversity value indicates only 34 % of the historic life history pathways can be successfully used under current conditions. The analysis also suggests that the Tucannon Subbasin has a much greater production potential for summer steelhead than it now displays, as historical abundance was estimated at 12,953 spawners, with a productivity of 18.9 returning adults per spawner and a life history diversity of 100%.

Table 4-6. Life history assumptions used to model summer steelhead in the Tucannon River, Washington.

Stock Name:	Tucannon River Summer Steelhead	
Geographic Area (spawning reaches):	Tucannon: All reaches except Tuc1 (Tucannon River, mouth to fishing access site); Tenmile: All reaches	
River Entry Timing (Columbia):	Bonneville Dam: mostly July-August, but as late as November	
River Entry Timing (Tucannon):	Early January through mid-April; mean entry date in mid-February	
Adult Holding:	Adults begin holding in Lower Monumental Pool and the lower Tucannon (between September and February)	
Spawn Timing:	Begins week of March 1, ends 20th of May, with a peak in mid-April	
Spawner Ages:	60% 1-Salt, 39% 2-Salt, <1% 3-Salt	
Emergence Timing (dates):	Lasts 2 weeks beginning as early as mid April and as late as early July, with an average period of May 25 – June 8.	
Smolt Ages:	35% Age 1, 60% Age 2, 5% Age 3, <0.5% Age 4	
Juvenile Overwintering:	Snake River:	10% (late October – March)
	Tucannon R.:	90% (late October – March)
***Stock Genetic Fitness:**	90% wild	
Harvest:	In-Basin: No Harvest	Out of basin: No Harvest

Table 4-7. Baseline spawner population performance parameters for summer steelhead in the Tucannon River, Washington as determined by EDT, 2003.

Scenario	Diversity Index	Productivity	Capacity	Adult Abundance
Patient (Current)	34 %	1.8	1,397	636
PFC (Properly Functioning Conditions)	79 %	2.7	1,941	1,213
Template (Reference)	100 %	18.9	13,677	12,953

4.3.4.2. Population characteristics consistent with VSP.

The NOAA Fisheries Technical Recovery Team (TRT) has identified Tucannon River summer steelhead as an independent population (TRT 2003). The NOAA Fisheries Viable Salmonid Population (VSP) document (McElhany 2000) identified four parameters that are key in determining the long-term viability of a population, those are: abundance, population growth rate, population spatial structure and diversity. Specific targets for these parameters have not yet been developed by the TRT for Tucannon salmonids. However, the interim spawner abundance target for steelhead in the Tucannon River is 1,300 adults (Lohn 2002). We discuss each of these parameters briefly.

Abundance

The EDT analysis for the Tucannon River summer steelhead estimated a current adult abundance of 636 steelhead and an abundance of 1213 fish with PFC. The difference between the interim TRT goal (1300 adults) and our abundance estimate at PFC (1213 adults) could easily be due to the unknown variance of our model estimates. Moreover, an examination of empirical data collected by the WDFW also shows that the subbasin may be capable of supporting 1,299 spawners in its current condition in any one year. Surveys conducted since the mid-1980s suggest the population is highly variable (see 4.3.4.3 below) and escapement averages well below the TRT's interim goal (Figure 4-3). Data quality for the basin (primarily gaps in spawning escapement estimates) makes it difficult to conclude with any confidence the true variability of abundance for steelhead. The worst years suggest that the population may have experienced a bottleneck because of critically low spawning numbers, but juvenile abundance throughout the main Tucannon above Pataha Creek remained moderately abundant (Figure 4-4). The relocation of hatchery steelhead plants (except for recent year endemic broodstock releases) to the lower basin decreased abundance in the upper basin but segregated hatchery fish from more productive wild fish. Also, replacement of a chinook salmon trapping weir at Tucannon hatchery with a new fishway/trap has resulted in better steelhead passage into upper reaches of the basin and commensurately more observed spawners in recent years as ocean conditions improved. Such a response is desirable, and as noted in the VSP guidelines, may be an indicator of sufficient abundance to support compensatory processes to ensure resilience of the population, prevent inbreeding depression, and function as an important part of the basin's ecological processes. The data for steelhead strongly suggest that current abundance fails to meet VSP goals. We conclude however, that the population persists and appears capable of responding to within and out-of-basin changes in productivity.

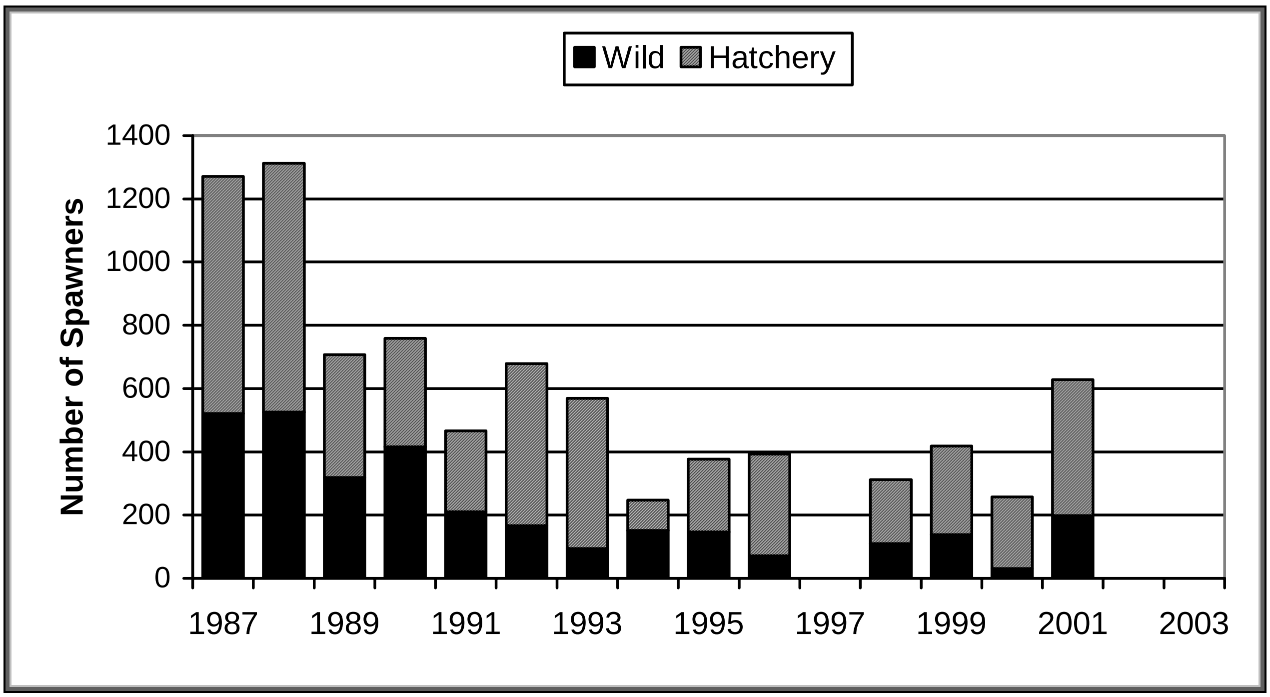

Figure 4-3. Estimated adult wild and hatchery summer steelhead escapement to the Tucannon River 1987 – 2003 (an estimate was not possible for some years).

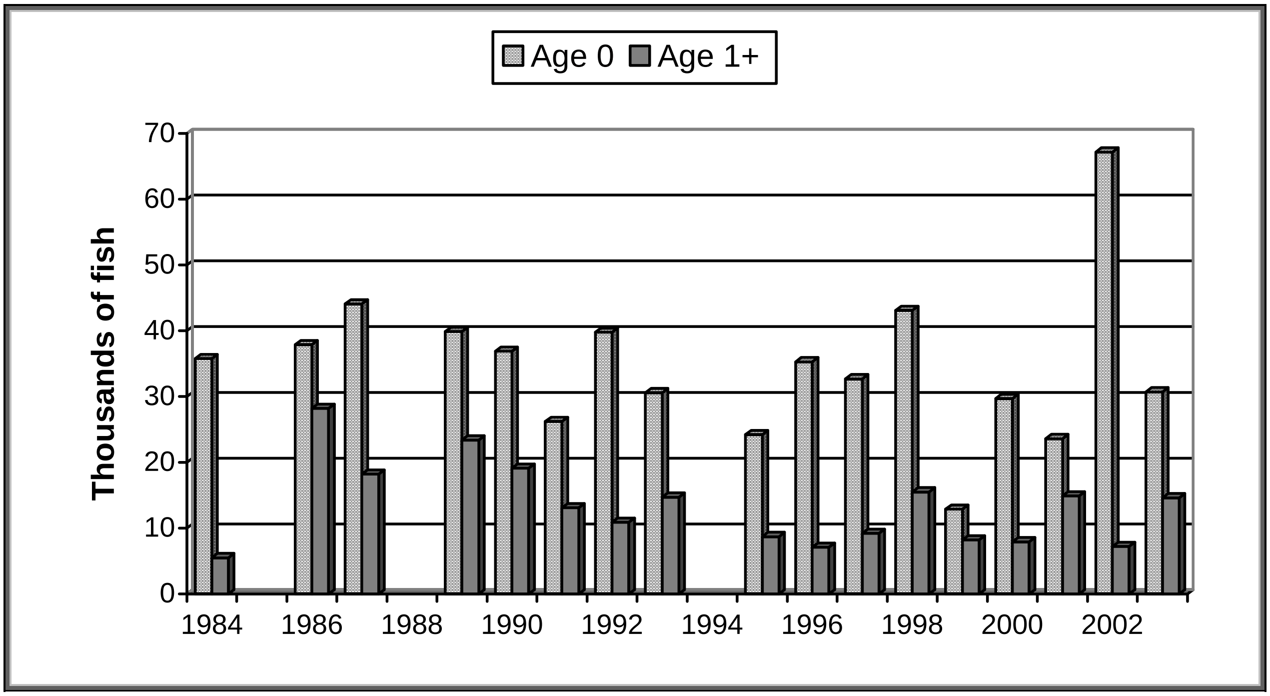

Figure 4-4. Juvenile steelhead abundance estimates in the Tucannon River from Campground 1 (rkm 55.4) upstream 19.1 rkm to Panjab Bridge for most years between 1984-2003.

Growth Rate (productivity)
EDT estimated that population productivity (1.8 returning adults / spawner) was less than the replacement value of 2.0, indicating a declining population trend. This only improved slightly with PFC (2.7) indicating that Out-of Subbasin-Effects (OOSE, **Appendix#)** were playing an important role in limiting the productivity of the Tucannon River steelhead population. An analysis of empirical data by WDFW using parr production as an indicator of trends over time concluded similarly: productivity fluctuated over time at or slightly above the replacement line (1.11). The effects of OOSE on a small population are critical and unless concurrent actions are taken with habitat initiatives in the subbasin, population response could be limited. Despite these concerns about adult replacement, juvenile population behavior over a short time still appears to retain the capacity for compensatory response at low adult escapement levels.

Spatial Structure
The Tucannon River basin is a comparatively small system. Historically the system was spatially complex, however the loss of Pataha as a major steelhead tributary limits steelhead spawning aggregates to the mainstem and Cummings Creek. Some additional loss of spatial structure may have occurred because of the Tucannon Hatchery weir, but the evidence suggests that the upper basin population segment is rebuilding. There is no current evidence that steelhead subpopulations exist within the subbasin. Except for Pataha Creek, there remains substantial connectivity within the system during the spring runoff that allows adult steelhead access to acceptable habitat throughout. Surveys of the subbasin by WDFW since the early 1980s, have documented spawning adults and juvenile steelhead throughout most of the basin. However, the number of redds observed

and juvenile densities in all sampled areas have been highly variable during this time frame. Such variability suggests that the spatial distribution of spawners, or of suitable spawning/rearing habitat, changed over time within the basin. Anthropogenic impacts, as mentioned above, have negatively affected fish habitat quality over time (e.g. road and levee construction, grazing, recreational use, Hatchery operations, elimination of riparian vegetation and stream channel connectivity). Likewise, stochastic environmental events (floods, log-jams, dewatered stream reaches) have affected habitat and fish distribution. Such population responses seems to fit an island-mainland population structure as defined in the NMFS Technical memorandum describing a VSP (McElhany 2000). During periods of low abundance, or habitat elimination, it may more closely resemble a panmictic population. Either way, the data suggest that sufficient spatial structure remains for the Tucannon *O. mykiss* population to persist during the short term. The VSP document cautions that salmonid habitat is dynamic, and for a population to persist, its “habitat patches should not be destroyed faster than they are naturally created” (McElhany 2000). It further cautions that VSP is defined for populations to persist over a 100 year period and that loss of spatial structure may eventually contribute to extirpation. Establishing a relationship between habitat loss and population collapse can be difficult, and may require monitoring over a longer time than is generally possible. There remains substantial concern by the managers that the steelhead population has lost significant spatial structure and needs to regain that structure to ensure its long-term health.

Diversity

The EDT model estimated that only 34 % of the life history diversity pathways are available to Tucannon River summer steelhead (*O. mykiss*) under current conditions, and that 79 % would be available under PFC. It is not known how the existing loss of pathways has affected population structure. Likewise, it is not known how close these PFC estimates will be to TRT requirements for a VSP. Anthropogenic impacts to populations can decrease their diversity and jeopardize their existence. The four H’s are capable of altering the population’s structure and its ability adapt to localized stochastic or human caused conditions. Habitat change has been substantial over the last 150 years in the Tucannon and Columbia Basins. These changes, combined with hatchery releases of trout and steelhead, and the ongoing effects of migration corridor impacts have undoubtedly stressed salmonid populations in the subbasin. Within the basin, whether resident *O. mykiss* populations (redband trout) exist that are reproductively separate from their anadromous counterparts is presently unknown. An identifiable resident phenotype does exist in the basin as resident trout spawners and redds have been documented in the Mountain Tucannon GA, and may be present in the upper reaches of Cummings, Panjab, Bear, and Pataha creeks. Resident spawners and a separate phenotype would suggest that some isolation occurs as a result of habitat accessibility, but there may also be a low level of spawning between resident and anadromous fish. Further, it is unknown whether the two were distinct in the past, or they have developed through a loss of diversity caused by human actions.

4.3.4.3 Population Status

Endangered Species Act Status

The Snake River Basin steelhead ESU, which includes Tucannon summer steelhead, was listed as threatened under the federal Endangered Species Act (ESA) by NOAA Fisheries in August, 1997 (NMFS 1997). Threatened status means that the listed group is likely to become endangered (in danger of extinction) within the foreseeable future throughout all or a significant portion of its range. The threatened determination for the ESU was made based on the following considerations:

- Severe declines in adult (escapement estimates) and juvenile abundance (parr densities) compared with historical levels, especially for B-run fish.
- The high proportion of hatchery-origin steelhead in the ESU (80% of steelhead passing Lower Granite Dam are hatchery fish) leading to concerns about straying and introgression with native steelhead, especially when the hatchery fish are from composite stocks that have been domesticated for several generations.

SaSI Status

In both 1992 and 2002, Tucannon summer steelhead were rated depressed because of chronically low escapement values (WDF, WDW and WWTIT 1993, WDFW 2003). The data on which these ratings are based are shown below in Table 4-8.

Table 4-8. Index area escapement estimates for Tucannon summer steelhead. Data from the WDFW SaSI database.

Year	Index Escapement
1986	143
1987	376
1988	418
1989	255
1990	333
1991	168
1992	133
1993	69
1994	103
1995	116
1996	63
1997	No data
1998	No data
1999	85
2000	31
2001	198
2002	Not available
2003	Not available

Data are escapement estimates based on spawner counts in the mainstem Tucannon from the mouth of Sheep Creek downstream to Highway 12 and in Cummings Creek.

The current escapement goal is 600 spawners annually, however the goal based on a 2001 run of the Potential Parr Production Model (Gibbons, Hahn and Johnson 1985) is 1,299 spawners (Glen Mendel, WDFW, personal communication). The NOAA Fisheries interim recovery goal is 1,300 spawners per year.

This stock is not meeting goals for naturally-produced fish. WDFW has initiated development and evaluation of endemic broodstock for hatchery supplementation to assist with increasing abundance of naturally produced steelhead in the basin.

Recent annual smolt estimates based on smolt trap located at RM 3.0 are shown in Table 4-9.

Table 4-9. Tucannon summer steelhead smolt estimates based on smolt trap located at RM 3 (Bumgarner et al 2000).

Migration Year	Smolt Estimate
1995/1996	14,667
1996/1997	15,944
1997/1998	29,096
1998/1999	24,229
1999/2000	43,282
2000/2001	26,612

Additional Information
The historic population size of Tucannon summer steelhead is unknown. Adult escapement prior to 1970 has been estimated at 3% of the total return to the Snake River basin or about 3,400 adults (Thompson et al. 1958, cited in WDF et al. 1990).

4.3.4.4 Harvest Assessment

Coded-wire tagged (CWT) hatchery steelhead have been released in the Tucannon subbasin for many years. The CWT release groups in the lower Tucannon River are used as a surrogate for wild unmarked steelhead for examination of harvest locations and harvest rates for net fisheries (Table 4-10). Columbia River net fisheries harvested an average 28.6% of the hatchery steelhead from the Tucannon River with CWTs for the 1992-1995 release years, but the average was reduced to 6.4% after ESA restrictions were imposed on the net fisheries for 1997-2000. Total exploitation rates cannot be determined because adult returns that escape to spawn are not accounted for in the table below. Sport harvest is restricted to adipose clipped steelhead in the Columbia, Snake and Tucannon rivers. Therefore, the sport harvest shown in the table below is not reflective of the sport harvest effects on unmarked wild steelhead.

Table 4-10. Percentages of expanded coded-wire tag recoveries, by location, for hatchery steelhead releases in the lower Tucannon River (1992-2000).

	Release Year						
Recovery Location	92	93	95	97	98	99*	00
Ocean Fisheries	0	0	0	0	0	0	0
Ocean Tributaries	0	2.5	0.4	0	0	0	0
Columbia R. sport	12.3	11.1	9.2	8.3	0	8.1	10.9
Columbia R. net	28.8	28.4	19.6	7.0	7.1	4.2	7.3
Columbia R. trib. trap	0	2.8	5.7	0	4.0	1.6	0
Columbia R. trib. sport	0	4.4	2.2	0	4.0	0.5	0
Deschutes R.	1.6	0	1.2	1.3	0	0.3	1.4
Snake R. sport	38.7	29.6	37.2	39.3	28.5	55.2	52.4
Snake R trap	18.6	28.4	25.2	36.2	64.3	24.1	25.8
Total expanded recoveries	424	81	250	229	56	569*	368

* includes a CWT release group at Marengo and a CWT release group at Enrich Br. All other release years include only the Marengo release recoveries.

Harvest rates in the Columbia basin have been reduced since the late 1980s and early 1990s to protect ESA listed salmon and steelhead. The Technical Advisory Committee, under US v OR, estimates harvest rates for naturally produced "A" run steelhead in the Columbia Basin. Harvest rates averaged about 18% in the 1980s, 15% in the early 1990s, and it was reduced to 4-6% in the 2001-2002 fisheries (Cindy LeFleur, WDFW, pers. Communication).

Juvenile steelhead may be harvested as trout in the Tucannon subbasin during June through October of each year. Resident trout fisheries are closed during the peak of the juvenile salmon and steelhead out-migration in the Snake River (April, May and early June). Daily limits in the Tucannon subbasin are 2 fish per day with an 8 in minimum size for trout. Selective gear restrictions (no bait, single barbless hook, etc.) are in place to minimize mortality on wild steelhead in the Tucannon River upstream of Marengo and in upper Pataha Creek (above Pomeroy). Selective gear rules are not in effect below Pomeroy or Marengo. Above Cow Camp Bridge in the upper Tucannon River, and all tributaries of the Tucannon River (except Pataha Creek), are closed to fishing. Up to 5 eastern brook trout can be harvested per day in Pataha Creek with no minimum size limit.

Descriptions of fisheries and their estimated effects on listed species of fish in the Snake River basin are discussed in the WDFW Fishery Management and Evaluation Plan (FMEP) for the incidental Take of listed species in the Snake River submitted under ESA Section 10/4d (submitted to NOAA-fisheries on Dec. 2, 2002).

4.3.4.5 Hatchery Assessment

Steelhead

Between 120,000 and 160,000 steelhead smolts were released annually from the Curl Lake acclimation pond from 1985 to 1997 primarily for adult steelhead harvest augmentation in the Snake and Tucannon rivers. Lyons Ferry and several hatchery stocks have been released into the Tucannon River in the past (**Appendix X**). Washington Department of Wildlife (WDW) (1993) identified problems with the hatchery steelhead stock used in the LSRCP program for Tucannon River releases and recommended development of a new endemic stock. Phelps (WDFW, per. com., 1994) concluded that wild steelhead remained genetically distinct from Lyons Ferry Hatchery stock steelhead. Phelps also concluded that the natural declining population was likely being suppressed through interbreeding with hatchery stock steelhead. The WDFW believes that the data supported this conclusion and it appeared to show that little introgression of the hatchery stock had occurred into the natural population, as would be expected if there was successful interbreeding. The WDFW believes that the continued use of hatchery fish could damage the population. However, the tribal co-managers have offered other interpretations of the data, most recently in the spring of 2000 on the issue of allowing hatchery steelhead to pass upstream of the weir. For this reason, trapping and spawning of endemic Tucannon River steelhead began in 1991 to develop a new broodstock. Poor survival success of the resulting smolts caused WDFW to discontinue stock development after three years. The program was restarted in 1999-2000 by trapping wild origin adult fish in the lower Tucannon River for development of a local broodstock, and will be evaluated over a five-year period to assess the stock's performance and WDFW's ability to successfully culture it. These fish will be used in the LSRCP program as the preferred stock for release into the Tucannon River and if successful, this stock should address ESA stock concerns over the use of Lyons Ferry and other out-of-basin hatchery stocks.

Until the endemic stock evaluation study is complete and a decision made by the co-managers, releases of LFH stock steelhead will continue at a reduced level. A study in 1991 showed that up to 17 percent of the hatchery stock smolt releases did not migrate from the river, and some were shown to prey on juvenile salmonids (Schuck *et al.* 1994). A decision was implemented in 1998 that all LFH hatchery stock smolt releases occurred at or below RM 24.8 (Marengo) to minimize their potential interaction with wild adult steelhead and spring chinook; that is expected to continue. The WDFW intends to manage the Tucannon River above Marengo for wild or endemic supplemented wild salmonid production and will not release LFH hatchery steelhead into that area of the subbasin.

Rainbow Trout

Hatchery rainbow trout (primarily Spokane stock) have been released into the Tucannon River as part of the LSRCP program for over 15 years. Releases since 1990 are summarized in **Appendix X**. These fish were intended to mitigate for lost fisheries in the mainstem Snake River caused by construction and operation of the four lower Snake River dams. Initially, the fish were released primarily within state owned lands with public access near the Tucannon Hatchery (RM 25 – 40).

A summer trout fishery (June-October) occurred throughout the river that was supported by hatchery reared rainbow trout. The majority of areas planted were in state ownership.

Schuck and Mendel (1987) conducted a creel survey of anglers on the Tucannon River within State ownership. They estimated over 17,000 angler days of effort and that anglers harvested about 78% of planted hatchery trout during a 3-month period. Schuck and Mendel (1987) also estimated that wild fish contributed only 0.6% of the trout harvest during that season. They believed that most of the wild fish were juvenile steelhead, and that significant hook-and-release of wild salmonids occurred. They could not estimate the total impact of the fishery on natural populations but warned of the potential negative effect. However, during the last several years the fish were released in the lower portion of the Tucannon River to minimize adverse effects on listed steelhead and spring chinook. In 2000, all trout releases into the Tucannon River were terminated. The long-term effects of trout plants on the wild population are unknown.

4.3.4.6 Steelhead Habitat EDT Assessment Summary

Restoration and Protection Potential

Using EDT, we assessed habitat priorities for Tucannon River summer steelhead in three basic ways. Two of these ways emphasized the "where" of a fish management plan while the third emphasizes the "what". Places where a strategic plan should be focused were determined by identifying areas critical to preserving current production (viz., by identifying areas with high "Protection Value"), and by identifying areas with the greatest potential for restoring a significant measure of historical production (viz., by identifying areas with high "Restoration Potential"). The kinds of actions a management plan should include were determined by performing a "Reach Analysis" (Section 4.2).

The restoration potential, as derived by the EDT model, for steelhead within the Tucannon watershed was 75% for life history diversity, 64% for productivity, and 46% for abundance (Figure 4-5). This suggests that 25-54 % of the potential for improving performance of Tucannon summer steelhead is tied to actions in the mainstem Columbia and Snake Rivers.

Within the watershed, the Pataha-Marengo Tucannon geographic area ranked first (69%) for restoration potential, followed closely by the Marengo-Tumalum Tucannon (67%) and Lower Pataha (63%) (Table 4-11). When scaling the potential for restoration benefit on a per kilometer basis the Tumalum-Hatchery Tucannon ranked first (5.6% / km), followed by the Marengo-Tumalum Tucannon (5.0% / km), and Hatchery-Little Tucannon (4.1% / km) (Table 4-11). The largest potential for restoration of abundance (33%) and productivity (30%) was in the Marengo-Tumalum Tucannon (from Marengo to Tumalum Creek), whereas Lower Pataha ranked highest for potential change in life history diversity (Table 4-11).

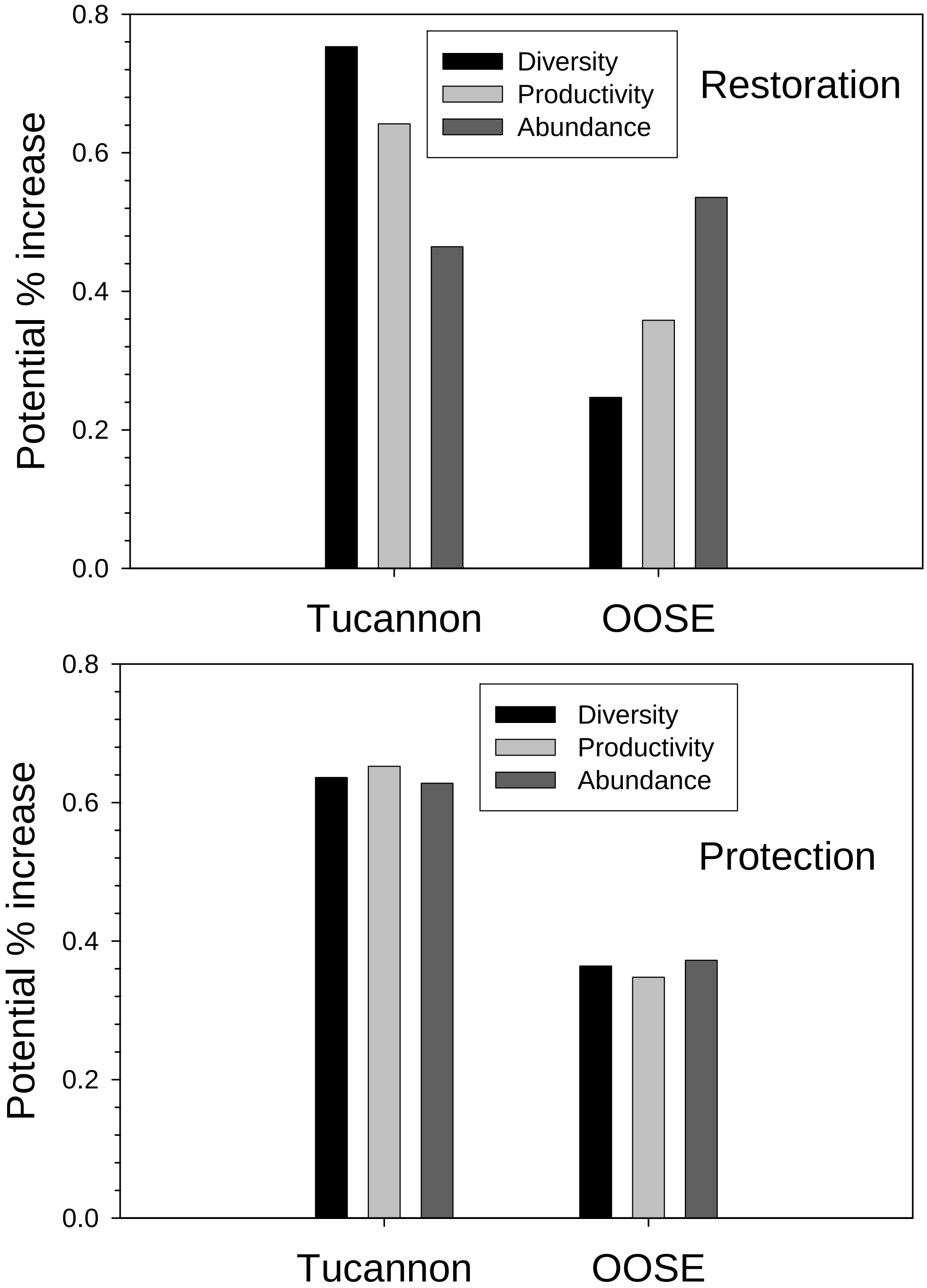

Figure 4-5. Contribution of reaches inside the Tucannon Subbasin and outside the Tucannon Subbasin to the total restoration and protection potential of Tucannon River, Washington summer steelhead. Out Of Subbasin Effects (OOSE) include the Snake River.

Table 4-11. Ecosystem Diagnosis and Treatment Model predictions of restoration potential for summer steelhead in Geographic Areas of the Tucannon River watershed, Washington. The scaled rank adjusted the unscaled rank by dividing by the length of stream

				Unscaled		Scaled (% / km)	
Geographic Area	Diversity Index	Productivity	N(eq)	Sum	Rank	Sum	Rank
Columbia River	25%	76%	180%	282%	1	0.3%	20
Pataha-Marengo Tucannon	8%	29%	31%	69%	2	3.0%	4
Marengo-Tumalum Tucannon	5%	30%	33%	67%	3	5.0%	2
Lower Pataha	36%	9%	18%	63%	4	1.5%	10
Hatchery-Little Tucannon	4%	24%	24%	52%	5	4.1%	3
Snake River	12%	10%	29%	52%	6	0.1%	22
Tumalum-Hatchery Tucannon	1%	17%	18%	36%	7	5.6%	1
Upper Pataha	20%	4%	8%	31%	8	1.2%	14
Mountain Tucannon	2%	15%	14%	30%	9	1.8%	7
Lower Tucannon	11%	6%	11%	28%	10	2.3%	5
Tumalum	3%	7%	7%	16%	11	1.7%	8
Mountain Pataha	12%	1%	3%	16%	12	1.2%	13
Mouth Tucannon	6%	1%	4%	12%	13	1.6%	9
Panjab	1%	5%	4%	10%	14	1.1%	15
Cummings	0%	3%	3%	6%	15	0.5%	19
Bihmaier	2%	1%	2%	5%	16	1.5%	11
Dry Pataha	4%	0%	0%	4%	17	0.7%	18
Little Tucannon	2%	0%	1%	3%	18	0.9%	17
Hixon	0%	1%	1%	2%	19	1.4%	12
Smith Hollow	1%	0%	1%	2%	20	1.0%	16
Kellog	0%	0%	0%	0%	21	0.2%	21
Iron Springs	0%	0%	0%	0%	22	2.0%	6

Reaches within the Tucannon watershed accounted for 65 % of the total protection value for productivity, 63% of the total protection value for abundance and 64% for life history diversity (Figure 4-5). This suggests that approximately one third of the potential for improving performance of Tucannon summer steelhead is tied to actions in the mainstem Columbia and Snake Rivers.

Within the Tucannon watershed, the Mountain Tucannon ranked first overall for protection value with a cumulative potential of -80% [sum of degradation values for life history diversity (-21%), productivity (-24%), and abundance (-35%)](Table 4-12). The Marengo-Tumalum Tucannon ranked second (-75%) for protection potential, and the Marengo-Tumalum Tucannon was third (-69%). When scaling the potential for restoration benefit on a per kilometer basis the Tumalum-Hatchery Tucannon ranked first (-6.4% / km), followed by the Marengo-Tumalum Tucannon (-5.6% / km), and Mountain Tucannon (-4.9% / km). The largest potential for protection of abundance (-35%) and productivity (-24 %) was in the Mountain Tucannon, whereas the Mountain Tucannon, Marengo-Tumalum Tucannon, and Pataha-Marengo Tucannon tied (-21%) for the highest for potential change in life history diversity with degradation (Table 4-12).

Table 4-12. Ecosystem Diagnosis and Treatment Model predictions of degradation potential (protection benefit) for summer steelhead in Geographic Areas of the Tucannon River watershed, Washington. The scaled rank adjusted the unscaled rank by dividing by

				Unscaled		Scaled (% / km)	
Geographic Area	Diversity Index	Productivity	N(eq)	Sum	Rank	Sum	Rank
Snake River	-50%	-40%	-75%	-165%	1	-0.4%	15
Columbia River	-23%	-21%	-39%	-83%	2	-0.1%	18
Mountain Tucannon	-21%	-24%	-35%	-80%	3	-4.9%	3
Marengo-Tumalum Tucannon	-21%	-20%	-34%	-75%	4	-5.6%	2
Pataha-Marengo Tucannon	-21%	-17%	-31%	-69%	5	-3.0%	7
Hatchery-Little Tucannon	-17%	-15%	-24%	-55%	6	-4.4%	4
Tumalum-Hatchery Tucannon	-12%	-11%	-19%	-42%	7	-6.4%	1
Cummings	-9%	-10%	-14%	-34%	8	-3.1%	6
Panjab	-10%	-9%	-12%	-31%	9	-3.5%	5
Tumalum	-7%	-4%	-7%	-19%	10	-2.0%	9
Lower Tucannon	-1%	0%	-5%	-6%	11	-0.5%	13
Little Tucannon	-3%	0%	-1%	-5%	12	-1.6%	10
Hixon	-2%	-1%	-1%	-5%	13	-3.0%	8
Mouth Tucannon	-1%	-1%	-2%	-4%	14	-0.6%	12
Upper Pataha	0%	0%	-3%	-3%	15	-0.1%	16
Bihmaier	-1%	0%	-1%	-2%	16	-0.7%	11
Mountain Pataha	0%	0%	-1%	-1%	17	-0.1%	17
Lower Pataha	0%	0%	-1%	-1%	18	0.0%	22
Dry Pataha	0%	0%	0%	0%	19	-0.1%	19
Smith Hollow	0%	0%	0%	0%	20	-0.1%	20
Kellog	0%	0%	0%	0%	21	0.0%	21
Iron Springs	0%	0%	0%	0%	22	-0.5%	14

Limiting Habitat Attributes

The below is a discussion of the limiting habitat attribute as determined by the EDT model. These are in no particular order of importance.

Marengo-Tumalum Tucannon, Tumalum-Hatchery Tucannon, and Hatchery-Little Tucannon.—Habitat diversity and key habitat quantity were the primary limiting factors for summer steelhead in the Marengo-Tumalum Tucannon, Tumalum-Hatchery Tucannon, and Hatchery-Little Tucannon geographic areas. Flow and channel stability were secondary limiting factors (**Appendix X**). Moderate losses in habitat diversity were apparent across most life stages with high losses to fry colonization in reach Tuc12. Major contributing factors to this poor riparian condition and lack of stream complexity (poor LWD densities). Moderate losses in key habitat quantity were apparent across most life stages with high to extreme losses of key habitat for prespawn holding adults in most reaches. This may be affected by reduced sinuosity and few pools or large woody debris.

Pataha-Marengo Tucannon.—Key habitat quantity was the primary limiting factor for summer steelhead in the Pataha-Marengo Tucannon geographic area. Habitat diversity, flow, channel stability, sediment and temperature were secondary limiting factors. High losses of key habitat types were apparent for fry colonization, migrating smolts, and prespawn adults. Increased peak flows and decreased low flows were a moderate problem for rearing juveniles and loss of habitat diversity was a problem across most life stages. Warm early-summer temperatures were a problem for incubating eggs in reaches Tuc 8a, 9 and 9a, and sediment load was a problem for incubating eggs in reach Tuc 7.

Lower Tucannon.—Key habitat quantity and sediment load were the primary limiting factors for summer steelhead in the Lower Tucannon geographic area (**Appendix X**). Habitat diversity, flow, channel stability, predation, obstructions (Starbuck Dam), and temperature were secondary limiting factors. Sediment load was a high to extreme impact on all life stages during spring runoff. High losses of key habitat types were apparent for fry colonization, migrating smolts, and prespawn adults. Increased peak flows and decreased low flows were a moderate problem for rearing juveniles and loss of habitat diversity was a moderate to small problem across most life stages. Warm early-summer temperatures were a problem for incubating eggs and rearing juveniles, particularly in reach Tuc 2. Predation was also a problem in Tuc 2 due to exotic species present in close proximity to the Snake River.

Iron Springs—Sediment load and habitat diversity were the primary limiting factors for summer steelhead in the Iron Springs geographic area (**Appendix X**). Although this geographic area is small (0.7 mi), it came up relatively high (6 out of 22) on the scaled EDT ranking due to a high potential for increase to steelhead abundance (per kilometer of restoration effort).

Mountain Tucannon.— Habitat diversity was the primary limiting factor for summer steelhead in the Mountain Tucannon geographic area. Flow, key habitat quantity and channel stability were secondary limiting factors (**Appendix x**). The biggest impacts were to fry colonization for habitat diversity and loss of key habitat for prespawn holding in Tuc 16.

Tumalum.—Tumalum Creek did not have one or two dominant limiting factors, rather, it was moderately limited by several survival factors. Channel stability, key habitat quantity, flow, habitat diversity, and sediment load had moderate to small losses across most life stages. Additionally, high losses to egg incubation were predicted due to loss of channel stability and prespawn holding due to loss of key habitat quantity.

Mouth Tucannon.—Sediment load and habitat diversity were the primary limiting factors for summer steelhead in the Mouth Tucannon geographic area (**Appendix x**). Temperature, predation, flow, pathogens, and key habitat quantity were secondary factors.

Lower and Upper Pataha.—Obstructions, habitat diversity, key habitat quantity, and sediment load were the primary limiting factors for summer steelhead in the Lower and Upper Pataha geographic areas (**Appendix x**). The Delaney culvert, Dodge bridge, and 20th Street sewer line were all obstructions to fish passage in Lower Pataha. The Davis shelf was a barrier to fish passage in Upper Pataha. Flow and channel stability were secondary limiting factors. Sediment load was a moderate to extreme impact on all life stages throughout the year. High losses of key habitat types and habitat diversity were apparent for all life stages and increased peak flows and decreased low flows were a moderate problem for rearing juveniles.

Other geographic areas in the Tucannon watershed.—The remaining geographic areas will not be discussed due to their low priority ranking; however, EDT model output with detailed evaluations of habitat in each reach can be seen in **Appendix x**.

4.4 Focal Species Spring Chinook

4.4.1 Life history

Spring Chinook spawners enter the Tucannon from late April or early May to late June or early July (WDFW 2003). Spawning generally occurs from late August to late September. The peak of spawning generally occurs from the last week of August to mid-September.

Most Tucannon spring Chinook spawn at age 4 (72%) or age 5 (26%), but a small percentage (3%) may spawn at age 3 (Glen Mendel and Mark Schuck, WDFW, personal communication).

Juvenile spring Chinook rear in the Tucannon system for 12 to 15 months prior to migrating to the ocean. Smolt age composition has not been summarized, however there appear to be more subyearling smolts than yearlings (c.f. Gallinat et al. 2001). Migration takes place from October to July and peaks from April to late May.

4.4.2 Historical and Current Distribution

Information on historical spring Chinook distribution in the Tucannon is not available. Current spring Chinook distribution is shown in Figure 4-6. Spawning takes place in the mainstem Tucannon from the mouth of Sheep Creek (RM) 52) downstream to King Grade (RM 21) (WDFW 2003). Spawning has not been observed in Tucannon tributaries.

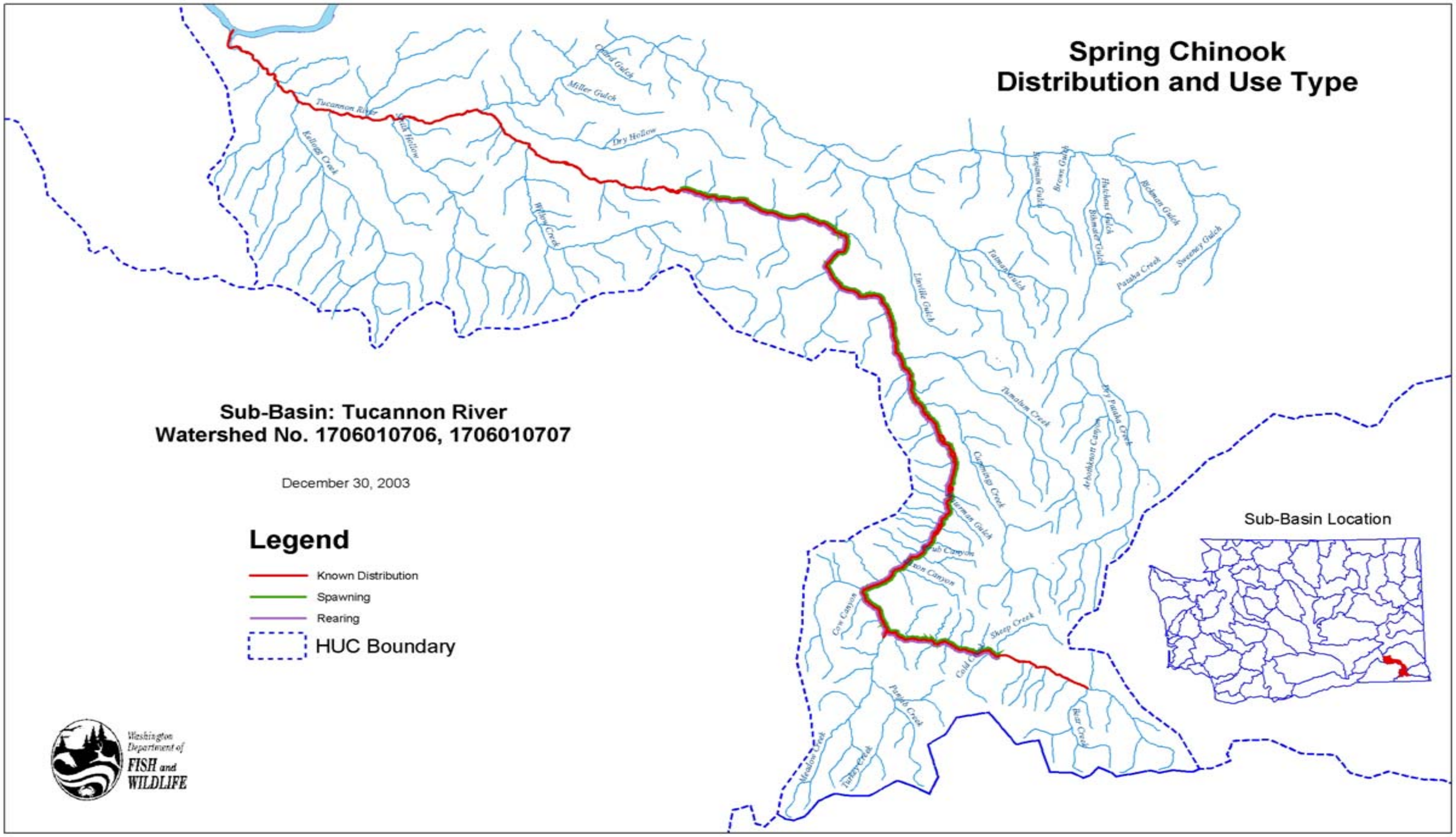

Figure 4-6. Presumed current distribution of spring Chinook in Tucannon River. Data from the WDFW Washington Lakes and Rivers Information System (WLRIS) database.

4.4.3 Population Identification

Genetic data (allozyme loci) for Tucannon River spring chinook have been collected over an extensive period (1986 to 1995), primarily to evaluate the Tucannon Hatchery spring chinook supplementation program. These data have been used to characterize the population relative to other chinook populations by WDFW and NMFS (Marshall et al. 1995; Myers et al. 1998). Tucannon River spring chinook are a genetically distinct population, well-differentiated from all other Snake River Basin and Columbia Basin chinook populations. The Interior Columbia Technical Recovery Team (TRT) has preliminarily identified Tucannon River spring chinook as an independent population relative to all other populations in the Snake River spring/summer chinook ESU on the basis of genetics, sufficient habitat to sustain a viable population, and sufficient geographic separation from other populations to provide substantial reproductive isolation (Interior Columbia Basin TRT, unpublished draft document July 2003).

4.4.4 Tucannon Spring Chinook Population

4.4.4.1 Population Characterization.

4.4.4.1.1 Empirical Data

Spring Chinook in the Tucannon subbasin are restricted to portions of the mainstem Tucannon River, with little or no use of the tributaries.

WDFW has intensively monitored the spring Chinook population in the Tucannon River since 1985 (see Gallinat et al. 2003). A spawning index area in the upper Tucannon River (near Panjab Creek) has been surveyed since 1954. That index area shows a long-term decline in spring Chinook redds. Some of that decline has been caused partly by hatchery broodstock collection activities in recent years.

Tucannon spring Chinook experienced a precipitous decline in 1994 and 1995 that reduced the population to only 54 adult fish (Table 4-13). Most of the run was collected in 1995 for hatchery production in an attempt to maximize survival and maintain this population. Parent-to-progeny ratios have generally been below one returning adult for every parent spawner in the river for naturally produced spring Chinook (Gallinat et al. 2003). Average adult returns over the past 7 years have been about 466 fish (241 were naturally produced, Table 4-13, from Gallinat et al. 2003). The EDT model estimates adult abundance for naturally produced spring Chinook in the Tucannon River at 235 fish when using 90% genetic fitness, and 362 adults when using 100% genetic fitness. The EDT estimate for 90% fitness squares quite well with Gallinat’s estimate for naturally produced fish.

The average numbers of juvenile spring Chinook by geographic area for 2000-2003 are shown in Table 4-15. Highest densities of juvenile spring Chinook exist between Marengo and the Little Tucannon River. On a per mile basis, the highest production was from the Tucannon Fish Hatchery Dam to the Little Tucannon River (3,250 juveniles/mile) and from Tumalum to the Hatchery Dam (2,188 fish/mile).

Table 4-13. Estimated spring chinook salmon run to the Tucannon River, 1985-2002. (from Gallinat et al. 2003).

Year[a]	Total Redds	Fish/Redd Ratio[b]	Spawning fish In the river	Broodstock Collected	Pre-spawning Mortalities[c]	Total Run-Size	Percent Natural
1985	219	2.60	569	22	0	591	100
1986	200	2.60	520	116	0	636	100
1987	185	2.60	481	101	0	582	100
1988	117	2.60	304	125	0	429	96
1989	106	2.60	276	169	0	445	76
1990	180	3.39	611	135	8	754	66
1991	90	4.33	390	130	8	528	49
1992	200	2.82	564	97	92	753	56
1993	192	2.27	436	97	56	589	54
1994	44	1.59	70	70	0	140	70
1995	5	2.20	11	43	0	54	39
1996	68	2.00	136	80	16	232	63
1997	73	2.00	146	97	45	288	47
1998	26	1.94	51	89	4	144	59
1999	41	2.60	107	136	2	245	1
2000	92	2.60	239	81	19	339	24
2001	298	3.00	894	106	12	1,012	71
2002	299	3.00	897	107	1	1,005	35

[a] In 1994, 1995, 1998 and 1999, fish were not passed upstream, and in 1996 and 1997, high pre-spawning mortality occurred in fish passed above the trap, therefore; fish/redd ratio was based on the sex ratio of broodstock collected.
[b] From 1985-1989 the TFH trap was temporary, thereby underestimating total fish passed upstream of the trap. The 1985-1989 fish/redd ratios were calculated from the 1990-1993 average, excluding 1991 because of a large jack run.
[c] Effort in looking for pre-spawn mortalities has varied from year to year with more effort expended during years with poor conditions.

The empirical data (Tables 4-14 and 4-15) indicate the highest spawning and rearing occurs in the Tumalum to Little Tucannon Geographic units and then the Marengo to Tumalum area during the past 3-5 years. Spring Chinook use of the area above Panjab Creek has decreased substantially since the mid 1980s (Gallinat et al. 2003).

Excluding 1995 and 1996, when natural production was radically reduced due to low escapement throughout the Columbia Basin, the data in Table 4-16 indicate mean spring chinook smolt production has been 32,381 since 1985. This figure is also quite similar to the EDT estimate of 39,190.

Historically, Tucannon spring chinook runs probably numbered in the thousands. The size of the population has decreased considerably since the 1950s and is likely related to construction and operation of main-stem dams on the Snake and Columbia rivers. Releases of hatchery reared spring Chinook have occurred since the early 1980s in the Tucannon River and returning hatchery-origin spring chinook have contributed to the spawning population in the river. This Chinook population is likely maintained by hatchery production (Bumgarner 1998). Estimates of number of fish by life stage are shown in Table 4-16.

Table 4-14. Spring chinook average redd counts from 1999 through 2003 and estimated adults in Tucannon River during same period (SRL = Snake River Labs, WDFW).

	Redds/mi	miles avail.	avg. redds	
Enrich to Marengo	0.37	9.96	3.7	
Marengo - Tumalum	3.7	8.37	31.0	
Tumalum - L. Tucannon	10.3	11.91	122.7	
L. Tuc to Sheep Cr	3.1	6.69	20.7	
			178.1	
Total redds range =	41-299 redds		(169.6)	from 5 yr avg. SRL data

178	redds average
x	2.8 fish per redd (1999-2002) average
498	adults in the river (excluding fish taken into the hatchery broodstock)
(532)	average from WDFW estimates (range 245-1012 adults for 1999-2002 from Gallinat et al. 2003)

Table 4-15. Tucannon River juvenile spring chinook average population (2000-2003).

	Reach length		Width	Total Density	Total Pop.
	miles	meters	meters	per/100 m	Estimate
Pataha to Marengo	14.02	22,572.2	12.2	3.2	8,895
Marengo to Tumalum	8.37	13,475.7	11.9	8.5	13,593
Tumalum to TFH dam	4.06	6,536.6	11.4	11.9	8,882
TFH dam to L. Tucannon	7.85	12,638.5	11.0	9.0	12,517
L.Tuc to Bear	6.69	10,770.9	7.5	3.3	2,677
Panjab Cr.	2.2	3,542.0	3.6	0.0	0
					46,564

Table 4-16. Estimates of natural Tucannon spring chinook salmon abundance by life stage for 1985-2002 broods (from Gallinat et al. 2003).

Brood Year	Females in river natural	Females in river hatchery	Mean[a] fecundity natural	Mean[a] fecundity hatchery	Estimated Number of eggs	Estimated Number[b] of fry	Estimated Number of smolts	Progeny[c] (returning adults)
1985	219	-	3,883	-	850,377	90,200	42,000	392
1986	200	-	3,916	-	783,200	102,600	58,200	468
1987	185	-	4,096	-	757,760	79,100	44,000	238
1988	117	-	3,882	-	454,194	69,100	37,500	527
1989	103	3	3,883	2,606	407,767	58,600	30,000	158
1990	128	52	3,993	2,697	651,348	86,259	49,500	94
1991	51	39	3,741	2,517	288,954	54,800	30,000	7
1992	119	81	3,854	3,295	725,521	103,292	50,800	194
1993	112	80	3,701	3,237	673,472	86,755	49,560	204
1994	39	5	4,187	3,314	179,863	12,720	7,000	12
1995	5	0	5,224	0	26,120	0	75	6
1996	53	16	3,516	2,843	231,836	2,845	1,612	69
1997	39	33	3,609	3,315	250,146	32,913	21,057	803
1998	19	7	4,023	3,035	97,682	8,453	5,508	266
1999	1	40	3,965	3,142	129,645	15,944	8,157	9
2000	26	66	3,969	3,345	323,964	44,618	20,045	
2001	219	79	3,612	3,252	1,047,936	63,412		
2002	104	195	3,981	3,368	1,070,784			

A 1985 and 1989 mean fecundity of natural females is average of 1986-88 and 1990-93.
b Number of fry estimated from electrofishing (1985-1989), Line transect snorkel surveys (1990-1992), and Total Count snorkel surveys (1993-1999).
C Numbers do not include down river harvest estimates or out-of-basin recoveries.

4.4.4.1.2 EDT Assessment

Tucannon River Spring Chinook Baseline Population Performance.—Model results for Tucannon Spring Chinook are based on life history assumptions summarized in Table 4-17. Assuming a 10% loss of fitness due to past and ongoing hatchery practices and a 7% out-of-basin harvest rate, the EDT model estimated the average spawning population size of the current naturally-produced spring Chinook population to be 235 fish, with a carrying capacity of 712 and a productivity of 1.49 adult returns per spawner (Table 4-18). The life history diversity value indicates 69% of the historic life history pathways can be successfully used under current conditions. The analysis also suggests that the Tucannon Subbasin had a very much greater production potential for spring Chinook than it now displays, as historical abundance was estimated at 12,215 spawners, with a productivity of 26.9 returning adults per spawner and a life history diversity of 100%. Under Properly Functioning Conditions (PFC) and with the 90% fitness assumption, the EDT model predicted an abundance of 1,769 spawners with a capacity of 2,412 spawners, a productivity of 3.8 returning adults per spawner, and a life history diversity of 95% (Table 4-18).

Table 4-17. Life history assumptions used to model spring Chinook in Tucannon River, Washington.

Stock Name:	Tucannon River Spring Chinook	
Geographic Area (spawning reaches):	Tucannon: From Tuc 9 (Tucannon River, lower steelhead release site to King Grade) to Tuc 18 (Tucannon River, Sheep Cr to Bear Cr).	
River Entry Timing (Columbia):	Bonneville Dam: late March – late May	
River Entry Timing (Tucannon):	Late April – late June	
Adult Holding:	Tucannon: all in Tucannon above Einrich steelhead release site (between early May & mid September)	
Spawn Timing:	Between August 27 & October 7	
Spawner Ages:	2% jacks, 72% age-4, 26% age-5	
Emergence Timing (dates):	Late March – mid May	
Smolt Ages:	All age-1	
Juvenile Overwintering:	Snake River:	27% (late October – early March)
	Tucannon R.:	73% (late October – early March)
***Stock Genetic Fitness:**	90% of wild fitness	
Harvest:	In-Basin: No Harvest	Out of Basin: 7% rate

Table 4-18. Baseline spawner population performance parameters for Tucannon River spring chinook as determined by EDT, 2003 (Assumes 7% harvest out of subbasin).

Scenario	Diversity Index	Productivity	Capacity	Adult Abundance
Patient (Current) (90 % genetic fitness)	69%	1.49	712	235
PFC (90% genetic fitness)	95%	3.8	2,412	1,769
Template (Reference)	100%	26.9	12,688	12,215
Patient (Current) (100% genetic fitness)	77%	1.8	829	362
PFC(Current) (100 % genetic fitness)	95%	3.8	2,412	1,769

4.4.4.2. Population characteristics consistent with VSP.

The NOAA Fisheries Technical Recovery Team (TRT) has identified Tucannon River spring Chinook as an independent population (TRT 2003). The interim goal for Tucannon River spring Chinook is 1000 adults (Lohn 2002). Although specific targets for population growth rate, spatial structure, and diversity have not yet been developed by the TRT. We discuss each of these parameters briefly. A brief discussion of each, based on empirical data, is provided below.

Abundance

The EDT analysis for the Tucannon River summer steelhead estimated a current adult abundance of 235 spring chinook and an abundance of 1,769 fish with PFC. The difference between the interim TRT goal (1,000 adults) and our abundance estimate at PFC could be due to the unknown variance of our model estimates, or be density or nutrient dependent. An examination of empirical data collected by the WDFW in the 1990s showed that the subbasin might be capable of supporting about 1,300 spawners in its current condition in any one year. Juvenile production from large escapements in 2001 and 2002, when factored into production, indicate the strong possibility of density dependence. Under present conditions the capacity of the Tucannon may be between 800 – 1200 adult spawners. Surveys conducted since the mid-1980s suggest the population is highly variable and escapement averages well below the TRT's interim goal except in 2001 and 2002 (Figure 4-7). The worst years, as for steelhead, suggest that the population may have experienced a bottleneck because of critically low spawning numbers. In three years the number of spawning chinook above the hatchery weir was very low, and near zero in one year. Replacement of the chinook salmon trapping weir at Tucannon hatchery with a new fishway/trap has resulted in better passage into upper reaches of the basin, and commensurately more observed spawners in recent years as ocean conditions improved. Moreover, a captive broodstock program undertaken by WDFW with joint funding by BPA and the LSRCP program is striving to increase annual spawning abundance. Poor abundance is likely to result from low escapement years (1994-2000) and managers hope to prevent another critical abundance bottleneck. The data strongly suggest that current average abundance fails to meet VSP goals. We conclude however, that the population persists and may be capable of responding to within and out-of-basin changes in productivity if overall abundance is not allowed to consistently fall too low.

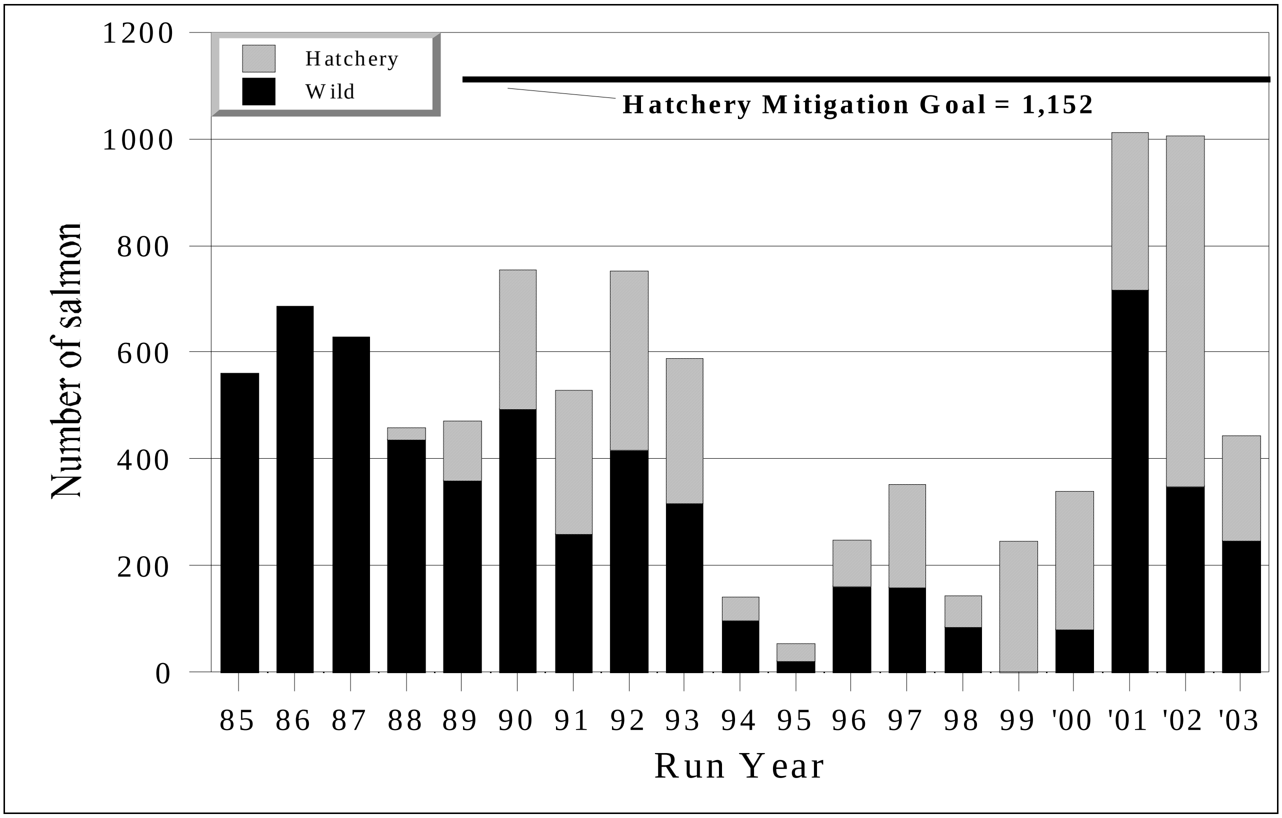

Figure 4-7. Estimated adult wild and hatchery spring chinook escapement to the Tucannon River 1985 – 2003 .

Growth Rate (productivity)
EDT estimated that population productivity (1.49 returning adults / spawner); less than the replacement value of 2.0, indicating an unstable population that could be prone to long-term extirpation. This improved remarkably with PFC (3.8) indicating that while Out-of Subbasin-Effects (OOSE) were playing an important role in limiting the productivity of the population, substantial benefits could accrue from within basin recovery efforts. An analysis of empirical data by WDFW using smolt production as an indicator of trends concluded similarly: productivity for the full hatchery + wild population fluctuated over time at or slightly above the replacement line. However the direct parent: progeny ratio was only 0.59 for wild chinook while it was 1.74 for the hatchery fish. Without the current abundance support of the hatchery program, it appears that current natural productivity is not capable of supporting the spring chinook population.

Spatial Structure
The Tucannon River basin is a comparatively small system. Historically the system was spatially complex, however it is unlikely that chinook used much of the system other than the mainstem for spawning, and only some of the tributaries for juvenile rearing. Some additional loss of spatial structure may have occurred because of the Tucannon Hatchery weir, but the evidence suggests that the upper basin population segment is rebuilding.

There is no current evidence that spring chinook subpopulations exist within the subbasin other than those taken into the hatchery. Surveys of an index area of the subbasin by WDFW since the 1970s, have documented a shift of chinook densities to lower in the basin. Anthropogenic impacts, specifically the hatchery weir as mentioned above, have negatively affected fish habitat quality over time (e.g. road and levee construction, grazing, recreational use, elimination of riparian vegetation and stream channel connectivity). Elevated summer water temperatures limit the downstream extent of river available for pre-spawn holding. Without improvements in in-stream habitat, the population may suffer from habitat limitations that could prevent its recovery. The VSP document cautions that salmonid habitat is dynamic, and for a population to persist, its "habitat patches should not be destroyed faster than they are naturally created" (McElhany 2000). It further cautions that VSP is defined for populations to persist over a 100 year period and that loss of spatial structure may eventually contribute to extirpation. Establishing a relationship between habitat loss and population collapse can be difficult, and may require monitoring over a longer time than is generally possible. There remains substantial concern by the managers that the spring chinook population has lost significant spatial structure and needs to regain that structure to ensure its long-term health.

Diversity

The EDT model estimated that only 69% of the life history diversity pathways are available to spring chinook in the Tucannon River under current conditions, and that 95% would be available under PFC. It is not known how the existing loss of pathways has affected population structure. Likewise, it is not known how close these PFC estimates will be to TRT requirements for a VSP. Anthropogenic impacts to populations can decrease their diversity and jeopardize their existence. The four H's are capable of altering the population's structure and its ability adapt to localized stochastic or human caused conditions. Habitat change has been substantial over the last 150 years in the Tucannon and Columbia Basins. These changes, combined with hatchery releases of spring chinook, as well as trout and steelhead in the Tucannon R., and the ongoing effects of migration corridor impacts have undoubtedly stressed salmonid populations in the subbasin.

4.4.4.3 Population Status

Endangered Species Act Status

The Snake River spring/summer Chinook evolutionarily significant unit (ESU), which includes Tucannon spring Chinook, was listed as threatened under the federal Endangered Species Act in 1992 (NMFS 1992).[1] Threatened status means that the listed group is likely to become endangered (in danger of extinction) within the foreseeable future throughout all or a significant portion of its range. The threatened determination for the ESU was made based on the following considerations (NMFS 1999):

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[1] In 1994 the status of the ESU was temporarily reclassified as endangered (Federal Register v1ol. 59, no. 248, pp. 66784-66787, Dec, 28, 1994).

- The 1992-1996 geometric mean abundance of 3,820 natural spawners (Meyers et al. 1998) was significantly lower than historical levels, which may have been as high as 1.5 million adults in the 1800s.
- Long- and short-term trends in abundance have generally been negative.
- Sixty-one percent of the total escapement is hatchery derived.
- Access to historic spawning/rearing habitat has been blocked; remaining accessible habitat has been degraded.

SaSI Status

In 1992 the status of Tucannon spring Chinook was rated Depressed based on a long-term negative trend in escapements and chronically low escapements (WDF, WDW and WWTIT 1993). The stock was again rated depressed in 2002 (WDFW and WTIT 2003) for the same reasons. This rating means that production levels are lower than expected but not so low that permanent genetic damage to the stock is likely to have occurred. The spawner abundance data on which the SaSI ratings are based are shown below in Table 4-19. The data are natural escapement estimates expanded from redd counts in the mainstem Tucannon from the mouth of Sheep Creek (RM 52) to King Grade (RM 21) and numbers of broodstock collected at the Tucannon Hatchery.

Table 4-19. Natural and hatchery escapement estimates for Tucannon spring Chinook. Data from Gallinat et al. (2003) (hatchery).

Year	Natural Escapement	Hatchery Escapement
1986	686	0
1987	628	0
1988	440	19
1989	363	109
1990	497	260
1991	259	268
1992	414	335
1993	318	272
1994	98	42
1995	21	33
1996	163	85
1997	161	154
1998	85	59
1999	3	242
2000	81	257
2001	*716*	*294*
2002	350	655
2003	248	196

The NOAA Fisheries interim recovery goal for this stock is 1,000 natural spawners. The Lower Snake River Compensation Plan mitigation goals are 1,152 adult hatchery returns to the Snake River (mostly to the Tucannon) and 1,248 naturally-produced spawners (USACE 1975, USFWS 1998).

This population has not met hatchery or natural production goals. Naturally-produced spring Chinook seldom produce spawner-recruit rates that meet or exceed the replacement rate of one spawner returning at least one recruit (Gallinat et al. 2003). This population has experienced a serious abundance bottlenecks in 1994, 1995. WDFW initiated a captive broodstock program in an attempt to boost the abundance of adult spring Chinook. The captive broodstock program is expected to be discontinued after 2008.

Annual estimates of the numbers of naturally-produced spring chinook smolts in the Tucannon beginning with the 1985 brood year are shown in Table 4-20 below. Estimates are based on smolt captures in a rotary screw trap operated by WDFW at Rkm 3.

Table 4-20. Numbers of naturally-produced Tucannon spring smolts annually beginning with the 1985 brood. Data from Gallinat et al. (2003).

Brood Year	Naturally-produced smolts
1985	42,000
1986	58,200
1987	44,000
1988	37,500
1989	30,000
1990	49,500
1991	30,000
1992	50,800
1993	49,560
1994	7,000
1995	75
1996	1,612
1997	21,057
1998	5,508
1999	8,157
2000	20,045

Additional Information

The spring Chinook run to the Snake River may have exceeded 1.5 million spawners annually (SRSRT 1993) during the late 1800s. Prior to 1916, the spring Chinook run size entering the Tucannon may have been about 30,000 spawners and by 1935 the stock probably numbered about 3,000 adults (Parkhurst 1950). In 1939, no spring Chinook spawners were observed (Gephart and Nordheim 2001). Prior to 1954, numbers of spring chinook spawners entering the Tucannon were estimated to range from 100 to 3,000 (Edson 1960).

4.4.4.4 Harvest Assessment

Coded-wire tagged (CWT) hatchery spring Chinook have been released in the Tucannon subbasin for many years. The CWT release groups in the Hatchery-Little Tucannon River (at the hatchery or from Curl Lake or higher) are used as a surrogate for wild unmarked spring chinook for examination of harvest locations and harvest rates for net fisheries (Table 4-21).

Sport harvest of hatchery fish outside the Tucannon subbasin increased in the past few years, but unmarked naturally produced Chinook would not experience similar harvest as sport fisheries restrict harvest to only marked fish. No Tucannon Hatchery spring Chinook are expected to be harvested in the lower Columbia River sport fisheries after the 2000 release year. WDFW no longer adipose clips hatchery spring Chinook released in the Tucannon River in an effort to exclude them from selective fisheries (harvest of adipose clipped fish) in the lower Columbia River. Out of basin harvest of hatchery fish has ranged from 0-1.6% of recoveries per year for ocean fisheries, 0-6.0% for Columbia River net fisheries, 0-18.9% for sport fishing and 0-18.9% for tribal ceremonial fishing.

From 76.8-100% of CWT recoveries per year occur at the hatchery or on spawning grounds in the Tucannon River. Wild fish should have higher survival rate to the Tucannon River as they would generally be excluded from sport fisheries out-side the Tucannon subbasin. No fisheries in the Snake or Tucannon rivers occur for spring Chinook downstream, or near, the mouth of the Tucannon River. Tribal fisheries may be initiated in the Tucannon River within the next year or two. WDFW, the Nez Perce Tribe, and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) have begun development of a harvest framework based on adult salmon abundance that will be used to determine the extent of fisheries at various abundance levels.

Table 4-21. Percentages of expanded coded-wire tag recoveries, by location, for hatchery spring chinook releases in the lower Tucannon River (1987-2000).

			Release Year											
Recovery Location	87	88	89	90	91	92	93	94	95	96	97	98	99	00
Ocean sport									1.0					
Columbia R. net	1.6	0.3		0.6	0.8								6.0	
Columbia R. trib. trap								8.8	0.3					
Columbia R sport		1.2		0.8				2.0					6.6	18.9
Snake R trap				0.2										
Tucannon R	98.4	95.4	99.1	94.9	95.3	100.0	80.0	81.4	96.2	100.0	98.9	98.7	86.7	76.8
Treaty ceremonial		1.2	0.9	3.5	3.1		10.0	1.0	1.0					
Treaty troll		0.6			0.8									
Non-treaty ocean troll		1.2									1.1			
Oregon Hatchery								3.0	0.3		0.5	0.8	0.6	
Oregon FW spawn							10.0	3.9	1.0		0.5			3.2
Total expanded recoveries	61	323	233	489	258	25	30	102	287	32	187	241	151	185

4.4.4.5 Hatchery Assessment

In 1962, two spring-fed rearing ponds were excavated at Russell Springs, two miles downstream of Cummings Creek, and planted with non-native spring chinook fry. The first release of 16,000 Klickitat River stock occurred in August 1962. In June 1964, 10,500 Willamette River stock were out planted. The large flood of 1964-65 destroyed these ponds and the program was discontinued (Phinney and Kral 1965). These were the only introduced non-native chinook that have been documented in the Tucannon River.

The LSRCP hatchery program began by collecting native spring chinook adults, trapped near the Tucannon Hatchery in 1985, on their way to upriver spawning areas. Each year since then the returning hatchery and wild adults have been trapped near the Tucannon Hatchery for hatchery broodstock collection (egg take) or they have been enumerated and released upstream to spawn naturally. In recent years both hatchery and wild (unmarked) spring chinook have been collected for hatchery broodstock. The fish are taken to the Lyons Ferry Hatchery to remain in cold well water until they are ready to spawn in the fall. They are spawned and reared at Lyons Ferry Hatchery until they are marked and transferred to the Tucannon Hatchery in October. All hatchery smolts are tagged with coded-wires and fin-clips so they can be recognized as hatchery progeny when they return as adults. They rear at the Tucannon Hatchery until they are transferred in late winter to the Curl Lake acclimation pond about 5 miles upstream of the hatchery. They acclimate in the pond until March or April when they are volitionally released into the Tucannon River at about 15 fish per pound. The targeted release number is 132,000 smolts per year (Bumgarner 1998) but releases have often been well below that level (Table X). Yearling smolt releases have increased to an average of 127,000 each year, resulting in annual hatchery returns of 300-400 adults each year until 1993 (Figure 4-7) (Gallinat *et al.* 2003). Bugert (1989) initiated a long-term sampling protocol for Tucannon spring chinook. The sampling documented some of the potential effects and has attempted to determine the degree to which spring chinook in the river are affected.

Although there is no evidence of serious negative interactions between hatchery and wild spring chinook, smolt to adult returns (SAR) for hatchery reared fish are significantly less than for their wild counterparts (Bumgarner et al. 1998). This survival difference suggests a negative effect associated with the hatchery. Despite these concerns, the WDFW has initiated intensive fish culture by means of a captive broodstock project, in which smolts are produced and released from fish kept in cultivation for their entire lifecycle. This is an effort to quickly rebuild population numbers and stave off loss of the genetic resource present in wild spring chinook. The captive broodstock effort is in addition to a conventional hatchery spring chinook supplementation program that releases yearling smolts into the river from adults returning to the river annually. (WDFW 2000d-Master Plan to NPPC).

4.4.4.6 Spring Chinook Habitat EDT Assessment Summary

Restoration and Protection Potential

We assessed strategic priorities for Tucannon River spring Chinook in three basic ways. Two of these ways emphasized the "where" of a fish habitat management plan while the third emphasizes the "what". Places where a strategic plan should be focused were determined by identifying areas critical to preserving current production (viz., by identifying areas with high "Protection Value"), and by identifying areas with the greatest potential for restoring a significant measure of historical production (viz., by identifying areas with high "Restoration Potential"). The kinds of actions a management plan should include were determined by performing a "Reach Analysis" (Section 4.2).

The restoration potential for spring chinook within the Tucannon watershed was 57% for life history diversity, 72% for productivity, and 64% for abundance (Figure 4-8). This suggests that 28-43% of the potential for improving performance of Tucannon spring Chinook was tied to actions in the mainstem Columbia and Snake Rivers.

Within the watershed, the Pataha-Marengo Tucannon geographic area ranked first (256%) when summing the restoration potential for life history diversity (6%), productivity (124%), and abundance (126%)(Table 4-22). The Marengo-Tumalum Tucannon (131%) ranked second Hatchery-Little Tucannon (96%) and Tumalum-Hatchery Tucannon (88%) were third and fourth, respectively. When scaling the potential for restoration benefit on a per kilometer basis the Tumalum-Hatchery Tucannon ranked first (13.5% / km), followed by the Pataha-Marengo Tucannon (11.4% / km), and Marengo-Tumalum Tucannon (9.8% / km) (Table 4-22).

Reaches within the Tucannon watershed accounted for 84% of the total protection value for life history diversity, 69% of the total protection value for productivity, and 67% for abundance (Figure 4-8). This suggests that 16-33% of the potential for improving the performance of Tucannon summer steelhead is tied to actions in the mainstem Columbia and Snake Rivers.

Within the Tucannon watershed, the Pataha-Marengo Tucannon ranked first overall for protection value with a cumulative potential of -202% [sum of degradation values for life history diversity (-35%), productivity (-67%), and abundance (-100%)](Table 4-23). The Marengo-Tumalum Tucannon ranked second (-58%) for protection potential, and the Mountain Tucannon was third (-52%). When scaling the potential for restoration benefit on a per kilometer basis the Pataha-Marengo Tucannon still ranked first (-9.0% / km), followed by the Marengo-Tumalum Tucannon (-4.3% / km), and the Tumalum-Hatchery Tucannon (-4.1% / km) (Table 4-23).

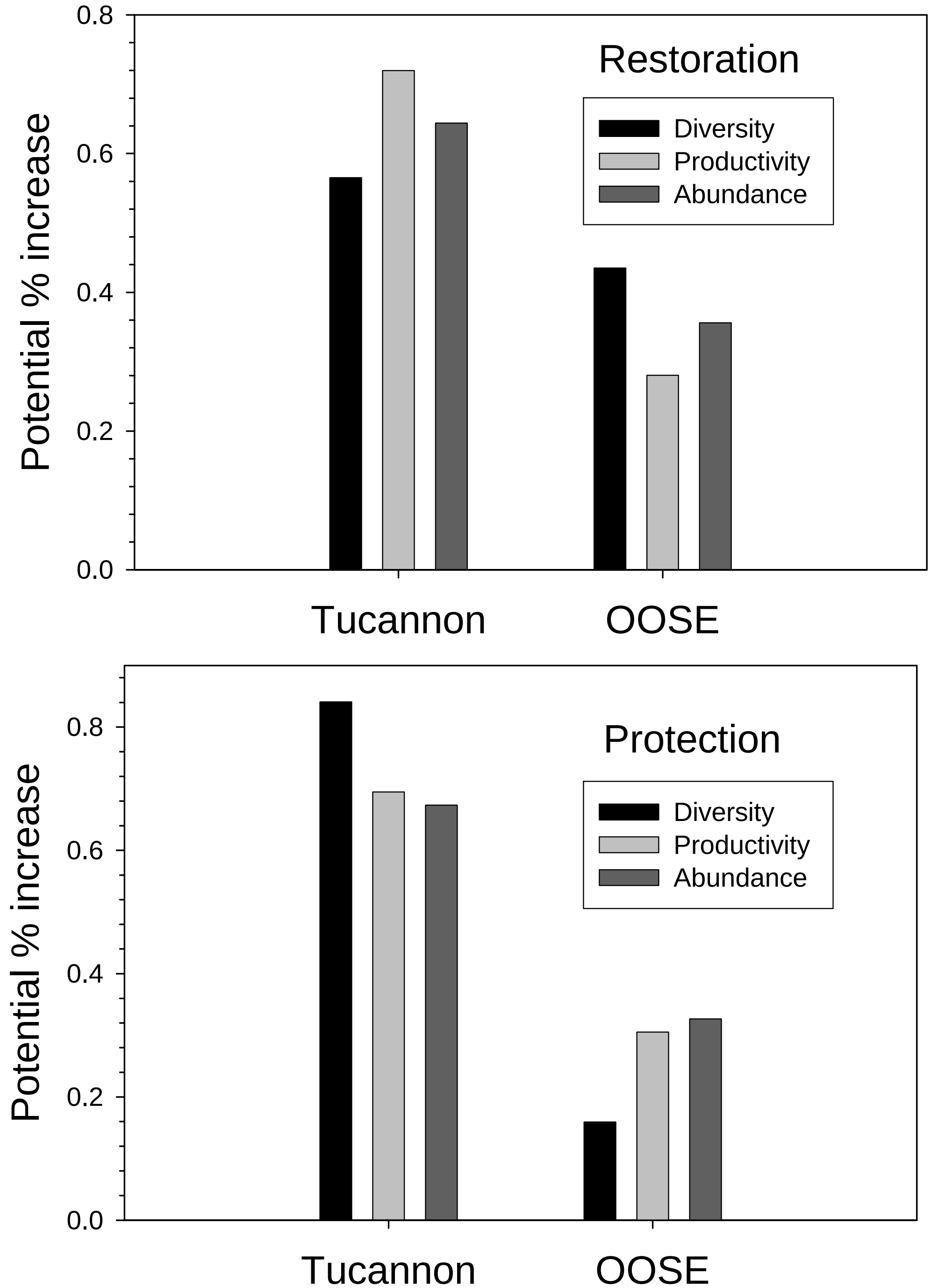

Figure 4-8. Contribution of reaches inside the Tucannon Subbasin and outside the Tucannon Subbasin (OOSE) to the total restoration and protection potential of Tucannon River, Washington spring Chinook. Out Of Subbasin Effects (OOSE) include the Snake

Table 4-22. Ecosystem Diagnosis and Treatment Model predictions of restoration potential for spring Chinook in Geographic Areas of the Tucannon River watershed, Washington. The scaled rank adjusted the unscaled rank by dividing by the length of stream in the geographic area to evaluate restoration potential on a per kilometer basis. N(eq) is the equilibrium abundance of returning adult spawners.

				Unscaled		Scaled (% / km)	
Geographic Area	Diversity Index	Productivity	N(eq)	Sum	Rank	Sum	Rank
Columbia River	10%	122%	195%	327%	1	0.4%	9
Pataha-Marengo Tucannon	6%	124%	126%	256%	2	11.4%	2
Marengo-Tumalum Tucannon	0%	68%	63%	131%	3	9.8%	3
Hatchery-Little Tucannon	1%	50%	45%	96%	4	7.6%	5
Tumalum-Hatchery Tucannon	0%	48%	40%	88%	5	13.5%	1
Lower Tucannon	3%	15%	51%	69%	6	5.7%	6
Mouth Tucannon	4%	16%	41%	62%	7	8.6%	4
Mountain Tucannon	3%	20%	19%	42%	8	2.5%	7
Snake River	4%	12%	19%	34%	9	0.1%	10
Panjab	0%	2%	1%	3%	10	0.4%	8

Table 4-23. Table TUC8. Ecosystem Diagnosis and Treatment Model predictions of degradation potential (protection benefit) for spring Chinook in Geographic Areas of the Tucannon River watershed, Washington. The unscaled rank adjusted the unscaled rank by dividing by the length of stream in the geographic area to evaluate restoration potential on a per kilometer basis. N(eq) is the equilibrium abundance of returning adult spawners.

				Unscaled		Scaled (% / km)	
Geographic Area	Diversity Index	Productivity	N(eq)	Sum	Rank	Sum	Rank
Pataha-Marengo Tucannon	-35%	-67%	-100%	-202%	1	-9.0%	1
Snake River	-9%	-30%	-61%	-100%	2	-0.2%	9
Columbia River	-12%	-26%	-50%	-87%	3	-0.1%	10
Marengo-Tumalum Tucannon	-17%	-14%	-28%	-58%	4	-4.3%	2
Mountain Tucannon	-21%	-12%	-20%	-52%	5	-3.2%	6
Hatchery-Little Tucannon	-17%	-12%	-22%	-51%	6	-4.0%	4
Lower Tucannon	-4%	-9%	-32%	-45%	7	-3.7%	5
Tumalum-Hatchery Tucannon	-11%	-6%	-10%	-27%	8	-4.1%	3
Mouth Tucannon	-1%	-4%	-14%	-19%	9	-2.7%	7
Panjab	-5%	-3%	-3%	-11%	10	-1.2%	8

Limiting Habitat Attributes

Tucannon mainstem.—Habitat diversity and key habitat quantity were the primary limiting factors for spring Chinook throughout the Tucannon mainstem geographic areas. Flow, channel stability, and temperature were secondary limiting factors (**Appendix x**). Small to moderate losses in habitat diversity were apparent across most life stages with high losses to fry colonization in reach Tuc8A. Small to moderate losses in key habitat quantity were apparent across most life stages with high to extreme losses of key habitat for prespawn holding and migrant adults in many reaches. Both the loss of habitat diversity and key habitat quantity is most likely due to channel straightening, lack of LWD and disconnect form the floodplain (loss of riparian function). Warm summer temperatures were only a major factor for prespawn holding adults in reach Tuc8A. Food (reduced benthic productivity) was not a major limiting factor in any one reach, but the cumulative effect of small losses for juvenile life history stages throughout the watershed could make it an important factor.

4.5 Focal Species Fall Chinook

4.5.1 Life history

Fall Chinook in the Snake River, including the Tucannon are "bright" fall chinook, meaning that they enter freshwater with chrome bright skin and are not ready to spawn for several weeks to months after entering their spawning streams. Adult fall Chinook enter the Columbia River in July and August and the Snake River from mid-August through October (Waples et al. 1991). They enter the Tucannon River from early October to early December. Spawning generally occurs from mid-October to mid-December (WDFW 2003). The peak of spawning is from late October to mid-November.

Spawning takes place in the lower Tucannon mainstem, generally below the mouth of Pataha Creek, but a few redds have been observed upstream of Pataha Creek to near Enrich Bridge.

Most Tucannon fall chinook females are thought to at age four or five (Glen Mendel, WDFW, personal communication).

Juvenile fall Chinook in the Tucannon and in the Snake basin outmigrate as subyearlings. Summer water temperatures in the lower Snake and Tucannon may be too high for juvenile Chinook rearing to yearling stage (Waples et al.1991, Gallinat et al. 2001). Smolt migration occurs in the Tucannon River from mid-April to July. The peak of migration is at the end of May. Juvenile migrants are from the mid-50 to upper 60 mm size range.

4.5.2 Historical and Current Distribution

No information on historical fall Chinook distribution in the Tucannon is available. Spawning and juvenile rearing take place from just above slack water at the confluence with the Snake River up to about river mile 17.

4.5.3 Population Identification

Need language here.

4.5.4 Tucannon Fall Chinook Population

4.5.4.1 Population Characterization.

4.5.4.1.1 Empirical Data

Fall Chinook in the Tucannon subbasin are limited to the lower Tucannon, primarily below Pataha Creek. A few fish spawn upstream to above Highway 12.

WDFW has monitored fall Chinook spawning since 1985. Smolt production has been monitored since 1997 or 1998 (see section 4.5.4.3)

The estimated adult fall Chinook return includes hatchery and naturally produced fish. The average adult return, based on redd counts since 1995, has been 160 fish.

The EDT estimate of 52 adult, naturally produced fish seems reasonable given the empirical data. Excluding the large run in 2002 reduces the estimated average adult return since 1995 from 160 to 105 fish. This estimate includes hatchery fish that spawn naturally in the Tucannon River and therefore is expected to exceed the EDT estimate.

The general distribution of fall Chinook spawning and rearing is shown in Table 4-24. Spawning densities are highest from the mouth to the dam (Fletcher's or Starbuck Dam) above the town of Starbuck. Generally, few fish spawn upstream of the dam.

Table 4-24. Tucannon River survey section descriptions and numbers of redds by location (from Milks et al. 2003).

River section description	Rkm	Number of redds		Redds/rkm	
	Surveyed	2001	2002	2001	2002
Mouth of Tucannon R. to highway 261 Bridge	1.4	17	40	12.1	28.6
Highway 261 Bridge to smolt trap	0.3	3	3	10.0	10.0
Smolt trap to Powers Bridge	0.7	6	17	8.6	24.3
Powers Bridge to upper hog barns	0.3	7	26	23.3	86.7
Hog barns to boundary fence above Starbuck	3.3	11	41	3.3	12.4
Upper boundary fence to Fletchers Dam	1.2	10	29	8.3	24.2
Fletchers Dam to Smith Hollow	3.1	6	9	1.9	2.9
Smith Hollow to Sheep Ranch Bridge	5.0	5	14	1.0	2.8
Sheep Ranch Bridge to Highway 12[a]	4.3	-	4	-	0.9
Highway 12 to Enrich Bridge[a]	6.0	-	0	-	0.0
Totals	**25.6**	**65**	**183**		

[a] Section not surveyed in 2001

4.5.4.1.2 EDT Assessment

Tucannon River Fall Chinook Baseline Population Performance.—Model results for Tucannon Fall Chinook are based on life history assumptions summarized in Table 4-25 The EDT model estimated the average spawning population size of the fall Chinook population to be 52 fish, after impacts of reduced genetic fitness and harvest. The model predicted a carrying capacity 931 fish and productivity of 1.1 adult returns per spawner (Table 4-26). The life history diversity value indicates 21% of the historic life history pathways can be successfully used under current conditions. The analysis also suggests that the Tucannon Subbasin had a much greater production potential for fall Chinook than it now displays, as historical abundance was estimated at 7,882 spawners, with a productivity of 19.9 returning adults per spawner and a life history diversity of 100%. Under Properly Functioning Conditions (PFC), the EDT model predicted an abundance of 1,745 spawners with a capacity of 2,263 spawners, a productivity of 4.4 returning adults per spawner, and a life history diversity of 78% (Table 4-26).

Table 4-25. Life history assumptions used to model fall Chinook in Tucannon River, Washington.

Stock Name:	Tucannon River Fall Chinook	
Geographic Area (spawning reaches):	Tucannon mainstem, mouth to Pataha confluence.	
River Entry Timing (Columbia specify pool?):	At Bonneville Dam, early September – late October, mean September 22.	
River Entry Timing (Tucannon):	Late September – late November, mean October 24.	
Adult Holding:	Lower Tucannon mainstem, mid-October – early December	
Spawn Timing:	Mid-October – early December, mean November 13.	
Spawner Ages:	51% ocean age 2, 35% ocean age 3, 14% ocean age 4.	
Emergence Timing (dates):	Late March – late April, mean April 8.	
Smolt Ages:	All subyearling.	
Juvenile Overwintering:	Columbia River:	N.A.
	Tucannon R.:	N.A.
***Stock Genetic Fitness:**		85%
Harvest :	No harvest inside Tucannon	30% Harvest Rate out of subbasin

Table 4-26. Baseline spawner population performance parameters for Tucannon River fall Chinook as determined by EDT, 2003.

Scenario	Diversity Index	Productivity	Capacity	Adult Abundance
Current	21%	1.1	931	52
PFC	78%	4.4	2,263	1,745
Template (Reference)	100%	19.9	8,299	7,882

4.5.4.2. Population characteristics consistent with VSP.

The NOAA Fisheries Technical Recovery Team (TRT) has not identified Tucannon River fall Chinook as an independent population (TRT 2003). Rather, the TRT has identified tributary populations as part of the Lower Snake River mainstem population; therefore, fall Chinook salmon spawning in the Tucannon River are not recognized as a viable, distinct salmonid population. Spawning abundance is highly variable among years and is probably primarily dependent upon Snake River fall chinook abundance (see section 4.5.4.3 below). Likewise smolt production from the Tucannon is variable, and highly dependent on late fall and winter stream flows and water quality. Tucannon fall Chinook spawn in the lowest reaches of the river, which receive heavy sediment deposition from surrounding agricultural lands. This has a strong negative affect on egg-to-fry survival. The interim recovery goal for the Lower Snake River population is 2500 adults (Lohn 2002).

4.5.4.3 Population Status

Endangered Species Act Status
The Snake River fall Chinook evolutionarily significant unit (ESU), which includes fall chinook in the Tucannon River, was listed as threatened under the federal Endangered Species Act (ESA) in 1992 (NMFS 1992).[2] Threatened status means that the listed group is likely to become endangered (in danger of extinction) within the foreseeable future throughout all or a significant portion of its range. The threatened determination for the ESU was made based on the following considerations (Waples et al. 1991, NMFS 1992, and NMFS 1999):

- There has been a decline in the Snake River fall Chinook population from 72,000 in 1940 to a 1992-1996 geometric mean of about 500 natural spawners.
- Fall Chinook populations that spawned in the Snake River above the Hells Canyon Dam Complex are now extinct as are other fall Chinook populations in parts

[2] In 1994 the status of the ESU was temporarily reclassified as endangered (Federal Register vol. 59, no. 248, pp. 66784-66787, Dec, 28, 1994).

of the mainstem Columbia River and in the John Day, Umatilla and Walla Walla rivers.

- There has been a long-term negative trend in Snake River fall chinook abundance, though the recent trend has been positive.
- Approximately 47 percent of the Snake River fall Chinook escapement at the time of the listing was hatchery-produced, although no hatchery fall Chinook were released into the Tucannon.
- There has been significant inundation and degradation of spawning and rearing habitats, and much historic spawning/rearing habitat is no longer accessible to fall Chinook.
- The system of dams on the Snake and Columbia rivers has resulted in migration delays, injury and increased predation for fall Chinook.

SaSI Status

Snake River fall Chinook, including those spawning and rearing in the Tucannon, were rated as depressed in both 1992 and 2002 based on chronically low spawner counts (WDF, WDW and WWTIT 1993 and WDFW 2003). This rating means that production levels are lower than expected but not so low that permanent genetic damage to the stock is likely to have occurred. The data for Snake River fall Chinook on which the ratings were based are shown in Table 4-27.

Table 4-27. Adult spawner abundance data for Snake River fall Chinook, at Lower Monumental Dam. Data from the WDFW SaSI database (Derived from USACE dam counts).

Year	Dam Counts
1986	5,783
1987	8,412
1988	5,882
1989	5,990
1990	5,317
1991	6,026
1992	5,530
1993	3,137
1994	3,102
1995	5,202
1996	4,662
1997	4,621
1998	7,776
1999	10,112
2000	16,456
2001	23,826
2002	15,193
2003	Not yet available

Data are video and visual counts of adult Chinook at Lower Monumental Dam. They include fall Chinook returning to the WDFW Lyons Ferry Hatchery as well as naturally-produced fish. We believe that the trend for the basin would be similar to the trend in the Tucannon.

In 1985 the Washington Department of Fisheries began fall chinook surveys in the Tucannon below Starbuck Dam (RM 5.5). In 1990 surveys were extended above the dam up to the Enrich Bridge at about RM 17. Table 4-28 shows fall Chinook redd counts from these surveys. Estimates of fall Chinook smolt numbers from the smolt trap above the Highway 261 bridge are shown in Table 4-29 (Mendel, Pers. Comm).

Table 4-28. Fall Chinook redd counts and redds per mile surveyed below Starbuck Dam in the Tucannon River, Washington 1985-2003 ([2] indicates redds counted above Starbuck Dam).

Year	Redds	Estimated Escapement
1985	0	0
1986	0	0
1987	16	48
1988	26	78
1989	48	144
1990	61	183
1991	50	150
1992	21+2[2]	69
1993	21+7[2]	84
1994	25	75
1995	28+1[2]	87
1996	31+12[2]	129
1997	24+3[2]	81
1998	38+2[2]	120
1999	18+3[2]	63
2000	15+4[2]	57
2001	65	195
2002	183	549
2003	146	438

Table 4-29. Tucannon River, Washington fall Chinook smolt estimates 1998-2003.

Year	Number of Smolts
1998	17,800
1999	500
2000	11,800
2001	6,000
2002	16,100
2003	14,300

There are no Chinook production goals specifically for the Tucannon River. We have confirmed spawning and variable smolt production. This population includes hatchery fish from Lyons Ferry and the Umatilla River, as well as naturally-produced spawners.

The interim NOAA Fisheries recovery goal for Snake River basin fall Chinook is 2,500 natural-origin spawners above Lower Granite Dam annually. The Lower Snake River Compensation Plan (USACE 1975, USFWS 1998) annual goal for Snake River fall Chinook is 18,300 hatchery-origin fish. The LSRCP goal was based on the assumption that hatchery fish and 14,300 natural-origin fish would return annually to the basin.

4.5.4.4 Harvest Assessment

Coded-wire tagged (CWT) hatchery fall Chinook have not been released in the Tucannon subbasin. However, they have been released in the Snake River from Lyons Ferry Hatchery since 1985. The subyearling CWT release groups from Lyons Ferry Hatchery (BY 85 through 90) are used as a surrogate for wild unmarked fall chinook for examination of harvest locations and relative harvest rates. Mendel (1998) summarized the recovery of CWTs through 1997 (Table 4-30) and found that harvest outside the Snake River basin accounted for 72% of the recoveries of CWTs. Recent fall agreements under US v OR have reduced the harvest of naturally produced upriver bright fall Chinook in the Columbia River to at least a 30% reduction in the harvest rate relative to the 1988-93 base period. The Technical Advisory Committee under US v OR has estimated that a harvest rate of 31.29 represents a 30% reduction in the base period harvest rate in the Columbia River. The current harvest target (2003 fall season) is for the non-tribal harvest rate not to exceed 8.25% of the upriver bright fall Chinook, and tribal fisheries are not to exceed a 23.04% harvest rate in the Columbia Basin. The current escapement objective for upriver bright fall Chinook (which includes Snake River fall Chinook and all other fall Chinook above McNary Dam) has been established under US v OR at 43,500 at McNary Dam. Ocean fisheries have also been reduced to reflect a 30% reduction in harvest compared to the base period. Fisheries for adult fall Chinook have not occurred in the Snake River since 1976, except for a limited fishery for adult Chinook in 1988.

Table 4-30. Percent recovery locations old sub-yearling coded-wire tagged fall Chinook released from Lyons Ferry Hatchery in the Snake River (5,336 CWT recoveries from brood years 1985 through 1990; from Mendel 1998).

	Percentage	Total Percentage
Ocean Harvest total		44
Washington	7	
Oregon	6	
California	1	
British Columbia	26	
Alaska	4	
Columbia River Harvest		28
Columbia River escapement		1
Snake River escapement		26

Fall Chinook adults and jacks are occasionally caught during the fall and winter steelhead fisheries in the Snake and lower Tucannon rivers (September through early December).

Juvenile fall Chinook migrate to the ocean at a relatively small size so few of these fish are likely to be caught by trout or warmwater anglers in the Snake River Basin.

Resident trout fisheries are closed during the peak of the juvenile salmon and steelhead out-migration in the Snake River (April, May and early June). Daily limits in the Tucannon subbasin are 2 fish per day with an 8 in minimum size for trout. Selective gear restrictions (no bait, single barbless hook, etc.) are in place to minimize mortality on wild steelhead in the Tucannon River upstream of Marengo and in upper Pataha Creek (above Pomeroy). Selective gear rules are not in effect below Pomeroy or Marengo. Above Cow Camp Bridge in the Hatchery-Little Tucannon River, and all tributaries of the Tucannon River (except Pataha Creek), are closed to fishing. Up to 5 eastern brook trout can be harvested per day in Pataha Creek with no minimum size limit.

Descriptions of fisheries and their estimated effects on listed species of fish in the Snake River basin are discussed in the WDFW Fishery Management and Evaluation Plan (FMEP) for the incidental Take of listed species in the Snake River submitted under ESA Section 10/4d (submitted to NOAA-fisheries on Dec. 2, 2002).

4.5.4.5 Hatchery Assessment

There is presently no hatchery smolt release of fall chinook into the Tucannon River. Lyons Ferry Hatchery reared Snake River Stock fall chinook adults have been documented spawning in the Tucannon through collection of coded wire tags from fall chinook carcasses. Tribal managers have proposed hatchery plants of fall chinook into the river, but current production at LFH is insufficient to support such plants.

4.5.4.6 Fall Chinook Habitat EDT Assessment Summary

Restoration and Protection Potential

We assessed strategic priorities for Tucannon River fall Chinook in three basic ways. Two of these ways emphasized the “where” of a fish management plan while the third emphasizes the “what”. Places where a strategic plan should be focused were determined by identifying areas critical to preserving current production (viz., by identifying areas with high “Protection Value”), and by identifying areas with the greatest potential for restoring a significant measure of historical production (viz., by identifying areas with high “Restoration Potential”). The kinds of actions a management plan should include were determined by performing a “Reach Analysis” (Section 4.2).

The Tucannon watershed only had two Geographic Areas for fall Chinook, the Mouth Tucannon and Lower Tucannon. It was not valid to compare in basin versus out of basin effects for fall Chinook because the population is not independent, and is strongly dependent on the parent population in the Snake River mainstem. Therefore, performance cannot be tied to actions in the basin. However, within the watershed, the Mouth Tucannon geographic area ranked first (276%) when summing the restoration potential for life history diversity (20%), productivity (155%), and abundance (101%)(Table 4-31). The Lower Tucannon ranked second, with a potential increase of 177% (Table 4-31). When scaling the potential for restoration benefit on a per kilometer basis, the Mouth Tucannon ranked first (38.6% / km), followed by the Lower Tucannon (14.6% / km) (Table 4-31).

Within the Tucannon watershed, the Mouth Tucannon ranked first overall for protection value with a cumulative potential of -177% [sum of degradation values for life history diversity (-49%), productivity (-51%), and abundance (-77%)](Table 4-32). The Lower Tucannon ranked second for protection potential (-82%). When scaling the potential for restoration benefit on a per kilometer basis, the Mouth Tucannon still ranked first (-14.3 % / km), followed by the Lower Tucannon (-6.1% / km)(Table 4-32).

Table 4-31. Ecosystem Diagnosis and Treatment Model predictions of restoration potential for fall Chinook in Geographic Areas of the Tucannon River watershed, Washington. The scaled rank adjusted the unscaled rank by dividing by the length of stream in the geographic area to evaluate restoration potential on a per kilometer basis. N(eq) is the equilibrium abundance of returning adult spawners.

				Unscaled		Scaled (% / km)	
Geographic Area	Diversity Index	Productivity	N(eq)	Sum	Rank	Sum	Rank
Mouth Tucannon	20%	155%	101%	276%	1	38.6%	1
Columbia River	43%	87%	124%	253%	2	0.3%	3
Lower Tucannon	24%	89%	64%	177%	3	14.6%	2
Snake River	13%	33%	50%	96%	4	0.2%	4

Table 4-32. Ecosystem Diagnosis and Treatment Model predictions of degradation potential (protection benefit) for fall Chinook in Geographic Areas of the Tucannon River watershed, Washington. The unscaled rank adjusted the unscaled rank by dividing by the length of stream in the geographic area to evaluate restoration potential on a per kilometer basis. N(eq) is the equilibrium abundance of returning adult spawners.

				Unscaled		Scaled (% / km)	
Geographic Area	Diversity Index	Productivity	N(eq)	Sum	Rank	Sum	Rank
Mouth Tucannon	-49%	-51%	-77%	-177%	1	-14.3%	1
Columbia River	-14%	-29%	-59%	-102%	2	-0.2%	4
Lower Tucannon	-11%	-23%	-48%	-82%	3	-6.1%	2
Snake River	-28%	-20%	-26%	-74%	4	-0.2%	3

Limiting Habitat Attributes

*Tucannon mainstem.—*Sediment load and key habitat quantity were the primary limiting factors for fall Chinook in the Tucannon River mainstem geographic areas. Habitat diversity and channel stability were secondary limiting factors (**Appendix x**). Sediment load was a moderate to high impact to egg incubation and fry colonization in most reaches. Small to moderate losses in key habitat quantity were apparent across most life stages with high losses to in some reaches during fry colonization and age-0 active rearing.

4.6 Focal Species Bull Trout

4.6.1 Life History

Bull trout are relatively common in the Tucannon River and are not known to exist in the Pataha watershed.

Bull trout are known to spawn in Hatchery-Little Tucannon River (Panjab Creek to the headwaters), Bear Creek, lower Cold and lower Sheep creeks (Table 4-33), Panjab Creek, Meadow Creek, Turkey Creek and Little Turkey Tail Creek (Table 4-34). The lower 6.5 miles of Cummings Creek was surveyed by WDFW for spawning bull trout in October 2003 but no redds or fish were observed. Therefore, spawning in Cummings Creek has not been confirmed, although juveniles have been documented there. Spawning occurs from late August through October (USFWS 2002). Juvenile rearing is generally in the spawning areas, but subadult and adult bull trout may wander or migrate to other areas of the drainage during winter, spring and summer.

Table 4-33. Bull trout spawning survey summary, redd count (number of times surveyed), for the Tucannon River and 3 tribs, 1990-2003 (Mendel, G., personal communication).

	Reach Surveyed[a]														
	Tucannon			Bear Ck.		Tucannon				Sheep	Cold	Tucannon			
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	
Year	**RM 58.0-56.4**	**RM 56.4-54.7**	**RM 54.7-54.2**	**RM 0.0-1.0**	**RM 1.0-1.9**	**RM 54.2-53.5**	**RM 53.5-52.8**	**RM 52.8-52.1**	**RM 52.1-50.7**	**RM 0.0-0.6**	**RM 0.0-0.8**	**RM 50.7-48.2**	**RM 48.2-46.1**	**RM 46.1-44.6**	**Total Redds**
1990						21(1)	0(1)	32(6)	9(6)			1(6)			63
1991			11(4			21(4)	5(5)	10(5)	11(5)						58
1992			9(4)			41(4)		12(4)	4(4)						66
1993[b]															0
1994				10(3)		99(3)[c]						22(3)			131
1995				5(1)		63(1)[c]						37(1)			105
1996		31(1)	21(3)	25(3)		78(2)						15(2)			170
1997		11(1)	2(1)	23(1)		25(1)						13(3)			74
1998				4(1)		78(2)[c]						10(2)	16(2)	0(1)	108
1999		36(1)	6(3)	26(1)		57(3)				2(1)	2(1)	24(1)	12(1)		165
2000	26(1)			49(2)		52(2)						11(1)	3(1)	3(1)	144
2001						68(2)									68
2002	11(1)		3(1)	32(2)		20(1)						10(1)	3(1)		79
2003	59(3)			49(3)		37(5)						26(2)			171

[a] A: Headwaters to Buckley Ck.
B: Buckley Ck. to Jelly Spring.
C: Jelly Spring to Bear Ck.
D: Mouth to RM 1.0.
E: RM 1.0 to forks.
F: Bear Ck. to 3/4 mi. below Bear Ck.
G: 3/4 mi. below Bear Ck. to Tinman Camp.
H: Tinman Camp to Rucherts Camp.
I: Rucherts Camp to Sheep Ck.
J: Mouth to falls.
K: Mouth to first large spring.
L: Sheep Ck. to Ladybug Flat Campground.
M: Ladybug Flat Campground to Panjab Br.
N: Panjab Br. to Cowcamp Br.

[b] No survey done.

[c] includes redds from section **C**.

grey cells are all part of the same survey

Table 4-34. Bull trout spawning survey summary, redd count (number of times surveyed), for the Panjab and Meadow Ck. Basins, 1995-2002 (Mendel, G, personal communication).

<table>
<tr><th rowspan="4">Year</th><th colspan="12">Reach Surveyed[a]</th><th rowspan="4">Total Redds</th></tr>
<tr><th colspan="4">Panjab Ck.</th><th colspan="5">Meadow Ck.</th><th>Turkey</th><th colspan="2">Turkey Tail</th></tr>
<tr><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th><th>G</th><th>H</th><th>I</th><th>J</th><th>K</th><th>L</th></tr>
<tr><th>RM 3.8-3.5</th><th>RM 3.5-3.2</th><th>RM 3.2-2.1</th><th>RM 2.1-0.0</th><th>RM 4.9-4.0</th><th>RM 4.0-2.2</th><th>RM 2.2-1.2</th><th>RM 1.2-1.0</th><th>RM 1.0-0.0</th><th>RM 2.1-0.0</th><th>RM 3.4-2.8</th><th>RM 2.8-0.0</th></tr>
<tr><td>1995</td><td></td><td></td><td></td><td>7(1)</td><td></td><td></td><td></td><td></td><td>2(1)</td><td></td><td></td><td></td><td>9</td></tr>
<tr><td>1996</td><td></td><td></td><td></td><td>9(1)</td><td></td><td></td><td></td><td></td><td>5(1)</td><td></td><td></td><td></td><td>14</td></tr>
<tr><td>1997</td><td></td><td></td><td>2(2)</td><td>2(1)</td><td></td><td colspan="4">0(2)</td><td></td><td></td><td></td><td>4</td></tr>
<tr><td>1998</td><td></td><td></td><td></td><td>0(1)</td><td></td><td></td><td></td><td></td><td>0(1)</td><td></td><td></td><td></td><td>0</td></tr>
<tr><td>1999</td><td colspan="2">9(1)</td><td>6(1)</td><td>1(1)</td><td colspan="3">25(1)</td><td colspan="2">0(1)</td><td>8(1)</td><td colspan="2">8(1)</td><td>57</td></tr>
<tr><td>2000</td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="3">7(1)</td><td></td><td></td><td></td><td>7</td></tr>
<tr><td>2001[b]</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td></tr>
<tr><td>2002</td><td></td><td colspan="2">3(2)</td><td>0(2)</td><td></td><td></td><td>8(2)</td><td colspan="2">0(2)</td><td></td><td></td><td></td><td>11</td></tr>
<tr><td>2003</td><td></td><td colspan="2">6(3)</td><td>5(3)</td><td colspan="3">3(3)</td><td colspan="2">0(3)</td><td>3(1)</td><td></td><td>0(1)</td><td>17</td></tr>
</table>

[a] A: RM 3.8 to mouth of Turkey Ck.
B: Mouth of Turkey Ck. to trail crossing.
C: Trail crossing to mouth of Meadow Ck.
D: Mouth of Meadow Ck. to mouth.
E: Forks to RM 4.0.
F: RM 4.0 to RM 2.2.
G: RM 2.2 to Meadow Ck. Campground.
H: Meadow Ck. Campground to RM 1.0.
I: RM 1.0 to mouth.
J: Forks to mouth.
K: RM 3.4 to RM 2.8.
L: RM 2.8 to mouth.

[b] No survey done.

Migratory and resident bull trout are known to exist in the Tucannon subbasin. Migratory forms include fluvial fish that overwinter in the mainstem Tucannon River and fish that overwinter in the Snake River (USFWS 2002). Over two hundred migratory bull trout have been captured during their upstream migration in the spring and early summer at the Tucannon Hatchery trap (Faler et al. 2003).

4.6.2 Historical and Current Distribution

Current distribution is limited to the upper portion of the subbasin in summer and early fall. They are not known to exist in the Pataha watershed. Bull trout use of the Little Tucannon is questionable. Historic distribution of bull trout is unknown.

4.6.3 Population Identification

Bull Trout in the Tucannon subbasin were grouped into a Tucannon Core Area in the Draft Bull Trout Recovery Plan (Chapter 24, USFWS 2002). A decision on whether there is only one population of Tucannon subbasin is pending as part of the finalization of the Bull Trout Recovery Plan.

4.6.4 Population Status

The status of bull trout in the Tucannon subbasin is classified as “healthy” by the WDFW(1998). WDFW considers bull trout “category 1, 2 and 3” species on the priority habitat and species list, and lists the Tucannon River population as “low risk ” of extinction (WDFW 1998). The Bull Trout Recovery Team considers bull trout in the Tucannon subbasin to be at “intermediate” risk of extinction. Bull Trout in the Columbia Basin (including the Tucannon River) were listed as threatened under the Endangered Species Act in 1998.

4.6.5 Integrated Assessment

Bull trout in the Tucannon subbasin are at “intermediate risk” of extinction (USFWS 2002). They spawn and rear in the headwaters of the Tucannon River and most of its tributaries but some fish migrate downstream as far as the Snake River. Barrier removal, reduction of instream sediment, and reducing or maintaining stream temperatures are some of the primary habitat recommendations in the draft bull trout recovery plan. This is consistent with the EDT analyses for steelhead and spring Chinook, and with the results of the Snake River Limiting Factors Report for the Tucannon River.

4.7 Integrated Assessment Analysis

<u>Spring Chinook, Fall Chinook and Summer Steelhead EDT analysis limiting attributes</u>

Within the Tucannon Subbasin, the EDT analysis identified key habitat quantity and habitat diversity were the most common limiting habitat attributes for both steelhead and spring Chinook. Additionally, sediment load was a primary limiting factor for steelhead and fall Chinook. Channel stability, flow, temperature, and obstructions were common secondary limiting factors, with obstructions more commonly affecting steelhead and warm summer temperatures having a bigger impact on spring Chinook.

Sediment load and channel stability were common limiting factors for egg incubation and early life history stages of summer steelhead throughout much of the Tucannon watershed. Restoration efforts for reaches upstream of steelhead distribution should also be evaluated and considered for restoration, if they are determined to be major contributors of sediment to the system. These efforts will also directly benefit bull trout, which could not be evaluated using EDT. Food (reduced benthic productivity) was not a major limiting factor in any one reach, but the cumulative effect of small losses for juvenile life history stages throughout the watershed could make it an important factor for all salmonids.

Warm summer temperatures were a common problem for spawning (pre-spawn holding) and egg incubation for spring Chinook, but appeared to have little effect on steelhead probably due to differences in spawn timing. However, other assessments have indicated that marginal summer temperatures would likely adversely affect juvenile rearing for spring Chinook and steelhead. Increased peak flows, reduced low flows, and food (salmon carcasses and benthic productivity) were consistently low to moderate limiting factors for fry colonization and juvenile rearing life stages. The cumulative impact of these low-level limiting attributes could be important to the overall reduced productivity in the Tucannon River Subbasin.

EDT analyses indicate that restoration efforts should focus on restoring riparian function (connection to the floodplain, riparian vegetation and possibly offchannel habitat), minimizing man-made confinement (roads and dikes), increasing LWD density, decreasing summer temperatures and reducing sediment load throughout the watershed. Addressing these habitat attributes will benefit steelhead and spring Chinook, as well as bull trout and possibly fall Chinook.

Priority Areas for Protection from EDT Analysis

EDT analysis recommended geographic areas for protection in the Tucannon for both steelhead and spring Chinook (Table 4-35). Protection here is defined as “protection of these areas in such a way as to prevent further degradation of the habitat attributes that are important to the focal species” (MBI products refer to this as “preservation”; for the purposes of this assessment the terms are synonymous). EDT predicted some overlap of priority geographic areas for protection of steelhead, fall Chinook and spring Chinook in the Tucannon River Subbasin. Merengo-Tumalum Tucannon, Tumalum-Hatchery Tucannon and Hatchery-Little Tucannon all ranked in the top five for protection for steelhead and spring Chinook. Pataha-Marengo Tucannon was the top ranked area for protection for spring Chinook but was only seventh for steelhead.

Table 4-35. Priority geographic areas for habitat protection for spring Chinook (Spr Chk), summer steelhead (Stlhd), and fall Chinook (Fal Chk) in the Tucannon River Subbasin, Washington. Potential performance decrease was the sum of the model predicted degradation in life history diversity, productivity, and abundance for the scaled (% benefit/ km) EDT output. Results are sorted by steelhead ranking and do not represent an integrated priority list for all species.

	EDT Protection Priority Rank			Potential Performance Increase (% / km)		
Geographic Area	**Stlhd**	**Spr Chk**	**Fal Chk**	**Stlhd**	**Spr Chk**	**Fal Chk**
Tumalum-Hatchery Tucannon	1	3		-6.4%	-4.1%	
Marengo-Tumalum Tucannon	2	2		-5.6%	-4.3%	
Mountain Tucannon	3	6		-4.9%	-3.2%	
Hatchery-Little Tucannon	4	4		-4.4%	-4.0%	
Panjab	5	8		-3.5%	-1.2%	
Cummings	6			-3.1%		
Pataha-Marengo Tucannon	7	1		-3.0%	-9.0%	
Hixon	8			-3.0%		
Tumalum	9			-2.0%		
Little Tucannon	10			-1.6%		
Bihmaier	11			-0.7%		
Mouth Tucannon	12	7	1	-0.6%	-2.7%	-14.3%
Lower Tucannon	13	5	2	-0.5%	-3.7%	-6.1%
Iron Springs	14			-0.5%		
Snake River	15	9	3	-0.4%	-0.2%	0.20%
Upper Pataha	16			-0.1%		
Mountain Pataha	17			-0.1%		
Columbia River	18	10	4	-0.1%	-0.1%	0.20%
Dry Pataha	19			-0.1%		
Smith Hollow	20			-0.1%		
Kellog	21			0.0%		
Lower Pataha	22			0.0%		

Restoration Priority Areas from EDT Analysis

EDT predicted substantial overlap of priority geographic areas for restoration for steelhead and spring Chinook in the Tucannon River Subbasin (Table 4-36). One exception was that the fourth priority for spring Chinook (Mouth Tucannon) and first priority for fall Chinook was the ninth priority for steelhead. Potential benefits of restoration work were 2-4 fold greater for spring Chinook (5.7-13.5% / km) than for steelhead (2.3-5.6 % / km).

Table 4-36. Priority geographic areas for restoration of spring Chinook (Spr Chk), summer steelhead (Stlhd), and fall Chinook (Fal Chk) in the Tucannon River Subbasin, Washington. Potential performance increase was the sum of the model predicted increases in life history diversity, productivity, and abundance for the scaled (% benefit/ km) EDT output. Results are sorted by steelhead ranking and do not represent an integrated priority list for all species.

	EDT Restoration Priority Rank			Potential Performance Increase (% / km)		
Geographic Area	Stlhd	Spr Chk	Fal Chk	Stlhd	Spr Chk	Fal Chk
Tumalum-Hatchery Tucannon	1	1		5.6%	13.5%	
Marengo-Tumalum Tucannon	2	3		5.0%	9.8%	
Hatchery-Little Tucannon	3	5		4.1%	7.6%	
Pataha-Marengo Tucannon	4	2		3.0%	11.4%	
Lower Tucannon	5	6	2	2.3%	5.7%	14.6%
Iron Springs	6			2.0%		
Mountain Tucannon	7	7		1.8%	2.5%	
Tumalum	8			1.7%		
Mouth Tucannon	9	4	1	1.6%	8.6%	38.6%
Lower Pataha	10			1.5%		
Bihmaier	11			1.5%		
Hixon	12			1.4%		
Mountain Pataha	13			1.2%		
Upper Pataha	14			1.2%		
Panjab	15	8		1.1%	0.4%	
Smith Hollow	16			1.0%		
Little Tucannon	17			0.9%		
Dry Pataha	18			0.7%		
Cummings	19			0.5%		
Columbia River	20	9	3	0.3%	0.4%	0.30%
Kellogg	21			0.2%		
Snake River	22	10	4	0.1%	0.1%	0.20%

Analysis Discussion

The subbasin assessment has many findings that are comparable to other recent assessments and planning efforts. Riparian Function, LWD, Pools, Confinement; Sediment and Temperature were the most common limiting attribute identified with the assessment. These same habitat attributes were identified by virtually all the assessments performed on the Tucannon in the last seven years (Table 4-37). Particularly pronounced in these assessments is the mention of attributes having to do with floodplain connectivity, riparian health (both of which are related to the EDT attribute Riparian Function) and LWD. These limiting factors are mentioned in all the assessments reviewed and figure prominently in nearly every reach in the Tucannon analyzed with EDT.

Table 4-37. Assessments performed in the Tucannon Subbasin and the key limiting factors identified.

Assessment	Key Limiting Factors Identified
EDT	Habitat Diversity (Includes: riparian Function, confinement, gradient, LWD density for most life stages); Key Habitat (pools, pool tail-outs and small cobble riffles); Temperature; Low-Flows; Sediment; Channel Stability (); hatchery competition
LFA	LWD; pools (quality & frequency); embeddedness (Pataha); floodplain connectivity; temperature; streambank condition; riparian condition; reduced salmon carcasses
Subbasin Summary	temperature; geomorphic instability (pools, floodplain access); riparian function; sedimentation; instream habitat (inc. pools and LWD); passage; hatchery effects; exotic species; harvest; ecologic productivity; flows
Model Watershed Plan	temperature; turbidity, sediment, lack of pools; streambank and geomorphic stability (stream complexity and floodplain accessability)
Bull Trout Recovery Plan (draft)	LWD; temperatures; sediment; bank stability; loss of riparian, barrier removal

The Limiting Factors Analysis (LFA) performed for WRIA 35 (Kuttle, 2002) identified many of the same habitat problems as EDT or the other documents (such as sediment; confinement; lack of primary pools and temperature). In addition to these limiting habitat attributes the LFA identified the “upper” Tucannon, particularly state and federal land, as areas to protect from further degradation. This was in addition to land already protected within the Wenaha-Tucannon Wilderness.

The Subbasin Summary (Gephart and Nordheim 2001) identified many of the same habitat issues as the EDT or Limiting factors reports, but it was not reach specific. The Summary identified key factors that occur at the local and regional level limiting fish production. These included water quality, geomorphic instability, riparian function, sedimentation, insufficient instream habitat, out-of-basin effects, the introduction and proliferation of non-native species, and ecological productivity.

The draft Bull Trout Recovery Plan (Chaper 24, USFWS 2002) lists many of the same habitat issues, but as with the Summary it is not reach specific. Because bull trout are remaining in the headwater areas, the report tends to emphasize those areas. Proposed Critical habitat included the Tucannon River mainstem, Cummings Creek, Hixon Canyon, Cold Creek, Sheep Creek, Turkey Creek, Little Turkey Creek, Bear Creek, Panjab and Meadow Creek. Pataha Creek and the Little Tucannon River were included in the draft critical areas, but WDFW recommended deleting these areas in their response to the draft critical habitat designations. Grub Creek was not included in the original draft critical areas but has been recommended for inclusion by USFS. Results from EDT and the above works appear to generally compliment the results of the Recovery Plan when complete.

The Model Watershed Plan (CCD 1997) identified major watershed problems. These included: sediment deposition in spawning gravels; lack of resting and rearing pools; lack of large woody debris; high stream temperatures and diminished riparian vegetation.

In short, if we examine EDT in light of other planning reports and our empirical data results we find a very similar story with a few slight differences. Most age 1 and older steelhead production overlaps with primary spring Chinook spawning and rearing areas in the mainstem Tucannon River. Bull trout spawn and rear in areas in the upper reaches of the mainstem Tucannon River and upper tributaries that are important for steelhead production (Cummings Creek) or for protection (mostly in Wilderness designation). Bull trout migration and overwintering uses the geographic areas of the mainstem Tucannon that are important for spring Chinook, steelhead and even the lower river that is the primary area for fall Chinook. Other than the bull trout overwintering and fall Chinook production areas, the areas of highest value for steelhead and spring Chinook rearing, as well as the bull trout spawning or rearing areas in, or near the Wilderness are consistent among all the planning documents and most of the EDT results.

Assessment Conclusions

Restoration Priority Geographic Areas

The following geographic areas have the highest restoration value in Tucannon River according to the EDT analysis of steelhead and spring chinook and taking into account other factors, such as previous planning efforts and empirical data:

a. Pataha-Marengo Tucannon
b. Marengo-Tumalum Tucannon
c. Tumalum-Hatchery Tucannon
d. Hatchery-Little Tucannon
e. Mountain Tucannon

These are not in ranked order. These five areas are, as a group, considered a priority for restoration. The assessment team did not believe that the information available was at a fine enough detail to rank the areas beyond the top five. The priority geographic areas were identified by considering first their rankings by the EDT analysis for restoration for steelhead, fall Chinook and spring Chinook from tables 22 and 23. Then these were considered in the light of past planning efforts and empirical data within the subbasin.

Divergence from EDT – Lower Tucannon and Iron Springs ranked higher than Mountain Tucannon in EDT restoration value. Iron Springs was eliminated from consideration because of its small size (0.6 mile) and correspondingly low potential to contribute to the overall abundance of the only focal species to spawn there, steelhead. Lower Tucannon and Mountain Tucannon were very close in scaled potential performance increase. This assessment placed the Mountain Tucannon in the priority restoration area based on the amount and varied use of the area by the three focal species that are currently having the most resources put to there recovery. The empirical evidence indicates that that steelhead, bull trout and spring chinook use all or part of this geographic area during all life stages that occur within the subbasin. For this reason restoration projects here (especially from the Little Tucannon to Panjab Creek) will have the greater benefit to salmonids in the near term than activities in the Lower Tucannon. The Lower Tucannon currently supports only adult/smolt passage of steelhead and spring chinook, possibly bull trout passage and over-wintering of these three species to a limited degree. Spawning does not occur in this area for any of these three focal species and current summer temperatures preclude summer rearing. The assessment team does recognize the importance of the area for fall Chinook, passage and over-wintering of the other three focal species and as a winter rearing area. Though this area is also not listed as a priority for protection it does deserve attention given that all four focal species do use it at one stage or another in the life histories.

Impacted Life Stages

Within the priority restoration geographic areas above the following life stages are the most impacted according to the EDT analysis (STS = steelhead; CHS = spring Chinook):

a) Pataha-Marengo Tucannon
    i. Incubation (STS)
    ii. Fry (STS & CHS)
    iii. Subyearling rearing (STS & CHS)
    iv. Overwintering (CHS)
    v. Yearling rearing (STS)
    vi. Pre spawning (CHS)
b) Marengo-Tumalum Tucannon
    i. Fry (STS & CHS)
    ii. Subyearling rearing (STS & CHS)
    iii. Overwintering (STS & CHS)
    iv. Yearling Rearing (STS)
    v. Pre spawning (CHS)
c) Tumalum-Hatchery Tucannon
    i. Fry (STS & CHS)
    ii. Subyearling rearing (STS & CHS)

iii. Overwintering (STS & CHS)
iv. Yearling Rearing (STS)
v. Pre Spawning (CHS)

d) Hatchery-Little Tucannon
  i. Fry (STS & CHS)
  ii. Subyearling rearing (STS & CHS)
  iii. Overwintering (STS & CHS)
  iv. Yearling (STS)
  v. Pre Spawning (CHS)
e) Mountain Tucannon
  i. Fry (STS & CHS)
  ii. Sub-yearling rearing (STS & CHS)
  iii. Overwintering (STS & CHS)
  iv. Yearling (STS)
  v. Pre Spawning (CHS)

The impacted life stages are strictly from the EDT analysis. These represent the top four by life stage rank for the geographic areas as determined from the reach analysis. Life stage ranks are determined through EDT for each reach by considering all three EDT population performance measures (life history diversity, abundance and production). The individual reach analysis that make up the geographic areas were then considered in determining the top four life stages. Those life stages that were ranked in the top four within the reaches most often by the EDT reach analysis were determined to be the four most impacted life stages for the geographic areas. It should be noted that in order to develop a well targeted subbasin plan we determined to make this distinction in life stage impacts. However, throughout the system the habitat factors that were identified as most limiting to these life stages actually impact all life stages of salmonids to one degree or another. The previous assessment and planning documents did not usually go into this fine of detail, in that limited life stages were not clearly defined within specific reaches. These results are not inconsistent with previous assessments given that there appears to be general agreement on the limiting factors for the Tucannon Subbasin and that the affected life stages are determined for the EDT analysis using the latest literature.

Limiting Habitat Attributes
The following habitat attributes are considered to have the most impact within the above Tucannon River geographic areas and key life stages listed above (LWD = Large Woody Debris):

a) Pataha-Marengo Tucannon
  i. LWD
  ii. Confinement
  iii. Riparian Function
  iv. Sediment (embeddedness, turbidity and % fines)
  v. Key Habitat (pools)
  vi. Temperature

vii. Flow

b) Marengo –Tumalum Tucannon
   i. LWD
   ii. Confinement
   iii. Riparian Function
   iv. Key Habitat (pools)
   v. Temperature
   vi. Flow

c) Tumalum-Hatchery Tucannon
   i. LWD
   ii. Confinement
   iii. Riparian Function
   iv. Key Habitat (pools)
   v. Temperature
   vi. Flow

d) Hatchery-Little Tucannon
   i. LWD
   ii. Confinement
   iii. Riparian Function
   iv. Key Habitat (pools)

e) Mountain Tucannon
   i. LWD
   ii. Confinement
   iii. Riparian Function
   iv. Key Habitat (pools & glides)

These habitat attributes were taken from the EDT analysis. The limiting attributes identified appeared to be consistent with what is known about the subbasin..

Divergence from EDT- Competition with Hatchery Fish

The output from EDT identified impacts from hatchery fish on subyearling and yearling steelhead and spring chinook. While this assessment recognizes that there are likely still impacts from hatchery fish within the subbasin; the recent reductions in fish stocking and the changes in the way steelhead are managed (endemic stock development see section 4.3.4.5) has addressed this limiting factor. The spring chinook broodstock and hatchery program uses both hatchery origin and wild (unmarked) fish in its supplementation program (see section 4.4.4.5); there is no evidence of negative interaction between hatchery and wild spring chinook.

Flow

Flow showed up as a limiting factor within the priority geographic areas. It is not well understood by the assessment team how the interaction between the ratings we gave for flow and the EDT model run gave us poor ratings for flow. Lack of time and resources did not allow us to re-examine this attribute and re-run the model. What is generally understood is that summer flows within the Tucannon are likely reduced from historical levels and that all previous planning documents mentioned flow as being limiting for salmonid production. This probably has to do with a lessened ability of the watershed to retain water in the system into the summer months. Reduced upland canopy and ground cover and compromised riparian areas are a couple reasons why this may be happening. Since flow affects many attributes; amount of rearing space, temperature and stream hydraulics to name a few, any opportunities to lease or purchase water that is now being diverted from the Tucannon should be a high priority. In addition to low flow conditions, the rate at which water comes out of the watershed also has impacts to salmonids according to the analysis. This was reflected in the EDT analysis for the flow attributes: where flow-flashy and flow high actually had a greater affect on production than flow low. The causes of this condition are likely the same as for low flow: upland canopy removal, poor riparian conditions and loss of ground cover in uplands.

Protection Priority Geographic Areas

The following geographic areas have the highest protection value in the Tucannon River according to the EDT analysis, empirical data and taking into account other assessment work and empirical data:

a. Pataha-Marengo Tucannon
b. Marengo-Tumalum Tucannon
c. Tumalum-Hatchery Tucannon
d. Hatchery-Little Tucannon
e. Mountain Tucannon
f. Panjab
g. Cummings
h. Lower Tucannon
i. Headwaters*

*Headwaters is a assemblage of reaches covering the Bull Trout bearing (present or potential) waters upstream of the present reaches designated through the EDT process (see discussion in below).

As can be seen the five areas high for restoration also show up here as priorities for protection. This emphasizes the importance of these areas to the focal species identified for this plan. This is not a contradiction but spells out here clearly the importance of protecting these areas from degradation while doing restorative work.

Divergence from EDT - The priority areas above are consistent with the EDT output priorities for steelhead and to a lesser degree for spring Chinook. Hixon Cr was removed from the list of Priority Protection areas due to its small size and limited ability to contribute to the steelhead population as a whole. Lower Tucannon was included as an area that is priority for protection despite the fact that it ranked 13th when evaluated for steelhead. It did, however rank in the top five for protection in terms of spring chinook even though spawning and summer rearing do not occur there, and is one of only two geographic areas that support fall Chinook. Bull trout also overwinter here. For these reasons the focal species as a whole will benefit more from protecting this area than

Tumalum and Little Tucannon which ranked higher, but support only steelhead (and possibly bull trout in the Little Tucannon). Protecting the Lower Tucannon from further degradation may require more effort than areas higher in the watershed and should be addressed in the Management Plan section.

Bull Trout

The assessment of Bull Trout and its habitat presented some difficulty in the Tucannon Subbasin. Rules for Bull Trout in EDT had not been developed in time for this assessment. This coupled with a lack of knowledge of even the basic life history of Bull Trout in the Tucannon River put the fish at a distinct disadvantage when it came to naming priority habitats for protection and restoration. EDT reaches and the geographic areas described thus far in the document were developed based on the distribution of steelhead, fall chinook and spring chinook, not Bull Trout. Given that, and to be consistent with other assessments such as the list of priority streams from the Bull Trout Recovery Plan, the following reaches are to be considered as priority for protection under the geographic area named “Headwaters”:

- Tucannon above Bear Cr (which is above current EDT reaches)
- Panjab above EDT reaches (Including Turkey, Little Turkey and Meadow Creeks)
- Bear Cr
- Sheep Cr
- Cold Cr
- Hixon Cr (above EDT reaches)
- Cummings Cr (above EDT reaches)

These reaches do not reflect the extent of Bull Trout habitat. Many of the reaches defined for EDT should also take into account Bull Trout needs when formulating management plans. In addition it is assumed by this assessment team that actions within those reaches that benefit the other focal species will also benefit Bull Trout.

EDT Analysis

The EDT analysis used in this assessment has proved to be a valuable tool. While conducting this assessment we have tried to use this tool in a responsible manner. We believe that the most value from EDT is in the future. The time frame that we operated under and the shortage of data available for some key attributes (see below) encouraged us to use caution with the results. It is our determination that the current data set used for this EDT run should be re-examined and revised between each rolling provincial review. This should also occur before it is used for other planning efforts. We believe that its use in its present state for this Subbasin Plan was necessary, however, with more time and better data the model results can certainly be improved upon.

Habitat Data

While conducting this assessment and particularly while performing the attribute ratings for EDT, it became quite clear that in many cases we were lacking even the most basic habitat information. This made the assessment work quite difficult, particularly outside of the Forest Service lands where at least some basic surveys had been conducted. In order to properly assess the subbasin and provide better information for the management strategy process it is vital that additional habitat and life history surveys be conducted.

There were some reaches for which we had no empirical data on habitat types (pools:riffles:glides, etc.), embeddedness, LWD density, winter temperature or percent fines. The entire subbasin is lacking in, bedscour, bankfull widths, flow and riparian function data. Gradient measurements for individual reaches was also a concern. Gradients were measured using Terrain Navigator; the accuracy of these gradients is unknown and needs to be ground-truthed.

4.7 Species of Interest

4.7.1 Introduction

Species of Interest (SOI) was included within the plan to provide a venue to present species that may have ecological and/or cultural significance but for which there is not enough known about the species to include them in the focal species category for planning purposes. SOI were submitted to the subbasin planning team for approval to be included within the plan. SOI that are submitted have an unknown quantity of ecological significance; in order to determine whether or not these species should be considered as focal for the subbasin more must be learned about subbasin specific life histories and conditions that may be limiting there productivity. Each SOI has a corresponding section within the research, monitoring and evaluation section that includes either a research plan for the SOI or a place holder with the intention of inserting a plan in a later iteration of the subbasin plan. Species of Interest were not to be submitted without either a research plan or the intention of developing one.

4.7.2 Species of Interest

Mountain Whitefish (submitted by WDFW)
Mountain Whitefish (Prosopium williamsoni) are often a forgotten member of the salmonidae family in southeast Washington. A popular winter fishery used to exist for whitefish in parts of southeast Washington. Few anglers target whitefish now days.

Extensive sampling for salmon and steelhead by WDFW in the Tucannon River during the past two decades suggests that whitefish are not very common or well distributed in the Tucannon subbasin. When whitefish are found, WDFW tends to observe occasional clusters of adult whitefish in pools, and occasional juveniles scattered in the Tucannon River. The age classes between adult whitefish and subyearlings are uncommonly captured or observed.

WDFW has concerns that mountain whitefish in southeast Washington are not maintaining themselves and may vanish in the next decade or two. WDFW intends to propose a project to compile the literature about whitefish life history and habitat use and compare that with a compilation of WDFW sampling efforts and observations of whitefish for southeast Washington. The compilation of information would form the basis to help determine what additional sampling efforts and methods are needed to develop a more complete understanding of whitefish ecology, distribution and abundance in the Tucannon River and other southeast Washington streams.

Lamprey (this section submitted by the Nez Perce Tribe and is still under development)
Pacific lamprey (Lampetra tridentata) numbers have been in great decline since the installation of numerous dams and habitat degradation in the Columbia Basin. The Nez Perce Tribe regards Pacific lamprey as a highly valued resource harvested to this day as a subsistence food and is highly regarded for its cultural value.

It is believed that Pacific lamprey plays an important role in the food web, it may have acted as a buffer for salmon from predators, and may have been an important source of marine nutrients to oligotrophic watersheds.

The Nez Perce Tribe's goal relating to lamprey is to create a sustainable annual subsistence harvest and re-establish the lamprey's role in the Asotin and Tucannon subbasins.

What is Known: Inventory and Assessment by Subbasin Planning Team (SPT)

RM & E:

Proposed Research: *Assess population status, limiting factors, and rehabilitation potential for Pacific lamprey in the Asotin and Tucannon subbasins*

Goal: To define population status and rehabilitation potential of Pacific lamprey in the Asotin and Tucannon subbasins

Proposed M&E: Environmental and population status M&E. M&E sampling will include collection of life history, distribution, abundance by life stage, and genetic and homing behavior attributes of Pacific lamprey ammocoetes and macrothalmia in the Asotin and Tucannon subbasins. Genetic analysis of ammocoetes will be coordinated through ongoing programs (i.e. USGS lab at Cook WA). Homing behavior will include tagging of individuals (using methods consistent with ongoing programs) and subsequent evaluation upon recapture. Use data collected through habitat assessments and population surveys to identify potential restoration opportunities

Coordination Potential: Coordinate with ongoing lamprey evaluation programs, if any, and potential program cooperators (i.e. WDFW, CRITFC, CTUIR, NPT). Ensure that smolt traps are adequately equipped to collect lamprey and that trap operators are informed as to data collection procedures

Geographic Scope: Accessible anadromous waters in Asotin and Tucannon subbasins

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