PART I - ADMINISTRATIVE

Section 1. General administrative information

Title of project

Life History Of Spring Chinook Salmon And Summer Steelhead

BPA project number: 9202604
Contract renewal date (mm/yyyy): 10/1999 ☐ **Multiple actions?**

Business name of agency, institution or organization requesting funding
Oregon Department of Fish and Wildlife

Business acronym (if appropriate) ODFW

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NPPC Program Measure Number(s) which this project addresses
7.1C, 7.1D, 7.4L

FWS/NMFS Biological Opinion Number(s) which this project addresses
Information collected during this study relates to and will be useful for two actions described in the NMFS Hydrosystem Operations Biological Opinion. This study will provide data on multiple detections of wild PIT-tagged salmon at mainstem dams.

Other planning document references

Short description
Investigate the abundance, migration patterns, survival, and alternate life history strategies exhibited by spring chinook salmon and summer steelhead from distinct populations in the Grande Ronde and Imnaha River basins.

Target species
spring chinook salmon and summer steelhead

Section 2. Sorting and evaluation

Subbasin
Lower Snake /Grande Ronde

Evaluation Process Sort

CBFWA caucus	Special evaluation process	ISRP project type
Mark one or more caucus	If your project fits either of these processes, mark one or both	Mark one or more categories
☒ Anadromous fish ☐ Resident fish ☐ Wildlife	☒ Multi-year (milestone-based evaluation) ☐ Watershed project evaluation	☐ Watershed councils/model watersheds ☐ Information dissemination ☐ Operation & maintenance ☐ New construction ☒ Research & monitoring ☐ Implementation & management ☐ Wildlife habitat acquisitions

Section 3. Relationships to other Bonneville projects

Umbrella / sub-proposal relationships. List umbrella project first.

Project #	Project title/description
20512	ODFW Grande Ronde River Subbasin Umbrella

Other dependent or critically-related projects

Project #	Project title/description	Nature of relationship
9403300	Fish Passage Center's smolt monitoring program	Trap data will be exchanged with the Lower Grande Ronde study to provide in-river information on migration timing
8805305	Northeast Oregon Hatcheries Master Plan	Provide information on local populations that is crucial for planning, implementation, and evaluation of supplementation in the Grande Ronde basin.
9402700	Grande Ronde Model Watershed	Provide information on habitat utilization and juvenile production that is used to idnetify and prioritize habitat improvement projects.
9801001	Grande Ronde Basin Spring Chinook Captive Broodstock Program	Screw trap abundance will be used to monitor the success of the captive program when juveniles are released. Parr surveys will provide reconnaissance information for juvenile collection. Life history information will be used to evaluate captive program.
9600800	PATH: Plan for analyzing and testing hypotheses	Provide data for life cycle model
8805301	NEOH Grande Ronde (Nez Perce)	Provide information on local populations that is crucial for planning and implementation of supplementation in the Grande Ronde Basin. Provide monitoring for evaluating impacts of this project on naturally reproducing populations
8805302	NEOH Grande Ronde (CTUIR)	Provide information on local populations that is crucial for planning and implementation of supplementation in the Grande Ronde Basin. Provide monitoring

		for evaluating impacts of this project on naturally reproducing populations
8810804	STREAMNET	Provide information for use in database.
9405400	Bull Trout Studies in Central and Northeast Oregon	Collect bull trout for tagging and provide meristic and recapture data.

Section 4. Objectives, tasks and schedules

Past accomplishments

Year	Accomplishment	Met biological objectives?
1994	Deployed rotary screw traps at sites in the Grande Ronde River below upper rearing areas and below Grande Ronde valley.	Allowed us to estimate smolt production and describe fall and spring, in-basin migration patterns
	Pit tagged 1,500 juvenile salmon and obtained recapture data from mainstem dams	Compare detection rates between fish that migrate from rearing areas in the spring and fall.
	Completed annual progress report.	
	Presentation to Grande Ronde Model Watershed Board of Directors.	
1995	Maintained Grande Ronde traps and deployed screw trap in Catherine Creek.	Allowed us to estimate smolt production, describe fall and spring, in-basin migration patterns, and compare among tributary populations.
	Pit tagged 1,500 juvenile salmon in both Catherine Creek and the upper Grande Ronde River and obtained recapture data from mainstem dams	Compare detection rates between fish that migrate from rearing areas in the spring and fall and among tributary populations.
	Determined nighttime snorkeling to be the most effective method for locating juvenile salmon in winter.	Juvenile salmon were found in greatest abundance in pool habitats during both summer and winter surveys.
	Completed annual progress report.	
	Presentation at BPA review.	
1996	Maintained Grande Ronde River and Catherine Creek traps.	Allowed us to estimate smolt production, describe fall and spring, in-basin migration patterns,and compare among tributary populations.
	Pit tagged 1,500 juvenile salmon in both Catherine Creek and the upper Grande Ronde River and obtained recapture data from mainstem dams	Compare detection rates between fish that migrate from rearing areas in the spring and fall and among tributary populations.
	Conducted summer and winter habitat surveys for juvenile chinook salmon.	Juvenile salmon were found in greatest abundance in pool habitats during both summer and winter.
	Completed annual progress report.	
	Presentation to Northeast Oregon regional managers at ODFW Research Review.	
	Presentation at Oregon AFS.	
1997	Establish a field office for Wallowa River life history study.	
	Maintained Grande Ronde River and Catherine Creek traps. Deployed two traps in the Wallow River and one in the Lostine River.	Allowed us to estimate smolt production, describe fall and spring, in-basin migration patterns,and compare among tributary

		populations.
	Pit tagged 1,500 juvenile salmon in Catherine Creek, the upper Grande Ronde River, and the Lostine and obtained recapture data from mainstem dams.	Compare detection rates between fish that migrate from rearing areas in the spring and fall and among tributary populations.
	Conducted summer and winter habitat surveys for juvenile chinook salmon.	Juvenile salmon were found in greatest abundance in pool habitats during both summer and winter.
	Completed annual progress report.	
	Presentation at CBFWA Fish and Wildlife Program review.	

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Document the in-basin migration patterns for spring chinook salmon juveniles in the upper Grande Ronde River, Catherine Creek and the Lostine River tributary populations, including the abundance of migrants, migration timing and duration.	a	Collect juvenile spring chinook salmon migrants by operating five rotary screw traps at selected trapping sites. The traps will be operated year round if possible and will only be removed if low flows or ice prevent operations.
		b	Enumerate all spring chinook salmon collected in traps. Measure the length and weight for 80 migrants collected weekly at each trapping location. Calculate condition factor for these 80 salmon.
		c	Mark approximately 50 spring chinook salmon migrants collected weekly at each trap. Salmon will receive a mark of water soluble acrylic paint that is applied with a Panjet marking instrument.
		d	Determine trapping efficiencies for each trap throughout the trapping period using fish marked in Task 1.3.
		e	Estimate the number of juvenile chinook salmon migrating from rearing areas based on number of chinook salmon collected in the traps, trap efficiencies, and mortality estimates associated with the marking procedure.
		f	For each trap location, plot estimated number of migrants against time of the year to determine timing and duration of the juvenile migration periods.
		g	Continuously monitor water temperature using a thermograph and monitor river height daily from a river gage at each trap.

2	Estimate and compare smolt detection rates at mainstem Columbia and Snake River dams for fall and spring migrating spring chinook salmon from tributary populations in the upper Grande Ronde River, Catherine Creek, and the Lostine River.	a	Interrogate each chinook salmon collected in the screw traps for a previously implanted PIT tag. Record tag number and measure lengths and weights of all PIT-tagged recaptures.
		b	PIT-tag approximately 500 fall and spring migrating spring chinook salmon juveniles at rearing area traps that were not previously tagged and create a PIT tag data base for tagged fish. Tag 500 salmon from each tributary population.
		c	Collect and PIT tag approximately 500 winter resident parr from rearing areas above the upper screw traps. Tag 500 salmon from each tributary population. Create a PIT tag data base for these fish.
		d	Monitor PIT-tagged migrants at the lower Grande Ronde and Wallowa traps. Measure and record tag number, length and weight information for all PIT-tagged fish. Enter lower trap recovery data on PTAGIS database.
		e	Obtain detection information for PIT-tagged fish recovered at Lower Granite, Little Goose, Lower Monumental, McNary, John Day, and Bonneville dams.
		f	Determine mainstem dam detection rates for fall, winter and spring tagged fish from each tributary population.
		g	Compare detection rates between treatment groups. Estimate overwinter mortality, the success of fall migration strategy, and the relative success of the fall migrant and spring migrant life history strategies for each tributary population.
3	Determine seasonal habitat utilization and preference of juvenile spring chinook salmon in the Lostine River.	a	Identify the limits of the summer and winter rearing distribution of salmon juveniles. This task will be accomplished in conjunction with spawning ground surveys.
		b	Identify and select sites to be sampled within upper rearing areas. Select replicate sites that are representative of all available habitat types (i.e. plunge pool, glide, etc.).
		c	At each sampling site enumerate spring chinook salmon juveniles using snorkeling observations.
		d	Record the habitat classification and describe the habitat of each sampling site. The following measurements will be taken: temperature, water velocity, maximum river depth, width at three different points, length, substrate composition, instream

			habitat
		e	Estimate surface area of each sampling site (S.A. = Length X mean width) and calculate the density of juvenile salmon per unit area of habitat.
		f	Determine habitat preference using preference/selectivity indices.
4	Characterize cold- and warm-water areas located in the Grande Ronde River basin and describe the patterns of use by juvenile spring chinook salmon.	a	Write report describing thermal refuge use of salmon and steelhead in the Grande Ronde River basin.
5	Estimate and compare smolt detection rates at mainstem Columbia and Snake River dams for migrants from four local, natural populations in the Grande Ronde and Imnaha River basins.	a	Collect 500 juvenile salmon from Catherine Creek and the Lostine River and 1,000 juveniles from the Minam and Imnaha rivers in August and September. Locate juveniles by snorkeling and collect fish with seines. Use sanctuary nets to transfer fish.
		b	PIT tag salmon 60mm FL or greater. Anesthetize salmon with MS222 and manually inject PIT tag with modified hypodermic syringes that are disinfected prior to each use. Fish will be allowed to recover after tagging and released near collection site.
		c	Incorporate data into ASCII files according to criteria developed by the PIT Tag Steering Committee and submit files to the PIT Tag Information System (PTAGIS) database.
		d	Import data from collection stations at Lower Granite, Little Goose, and McNary dams on the Snake and Columbia rivers. Files will be downloaded from PTAGIS and parr-to-smolt survival of the PIT tagged populations will be determined.
		e	Analyze the results and interpret the analysis.
6	Document the annual migration patterns for spring chinook salmon juveniles from four local, natural populations in the Grande Ronde and Imnaha River basins.	a	Plot the number of PIT tagged fish migrating over time for spring chinook from each population.
		b	Analyze the data using ANOVA of a distribution analysis and interpret the data.
7	Determine survival to parr stage for spring chinook salmon in two local, natural populations in the Grande Ronde River Basin.	a	Use snorkeling observation to determine the summer rearing distribution of parr and the relationship of parr distribution to redd distribution.
		b	Collect parr using snorkelers to herd the fish

			into a seine, anesthetize parr, determine length and weight and give appropriate mark. Release fish at or near collection site after they recover from anesthesia.
		c	Repeat collection survey two to three days later to enumerate recaptures.
		d	Use mark-recapture methodology to estimate the total abundance of parr in summer.
		e	Estimate survival by life stage using data collected in Task 9.2 combined with smolt abundance and adult escapement data from an ongoing related study.
8	Investigate the significance of alternative life history strategies of spring chinook salmon in two local populations in the Grande Ronde and Imnaha river basins.	a	Estimate the total abundance of precocious males in late summer and determine what portion of the population exhibits this alternate life history strategy.
		b	Estimate the abundance of juvenile salmon that remain in freshwater past their second spring and do not mature sexually and determine the portion of the total parr population that exhibits this alternate life history strategy.
		c	Estimate the number of two year old smolts that out migrate past the mainstem Snake and Columbia river dams.
9	Document patterns of movement for juvenile O.mykiss from tributary populations in Catherine Creek, the upper Grande Ronde, and the Lostine River. Include data on migration timing, duration, and smolt abundance.	a	Collect juvenile O. mykiss by operating five rotary screw traps at selected trapping sites. The traps will be operated year round if possible and will only be removed if low flows or ice prevent operations.
		b	Enumerate all O. mykiss collected in traps. Measure the length and weight of 100 fish weekly at each trapping location. Calculate the condition factor for these 100 fish. Idnetify smolts based on visual examination.
		c	Mark approximately 50 O. mykiss weekly at each trap. Fish will receive either a paint mark or a PIT tag for identification.
		d	Determine trap efficiencies for each trap throughout the trapping period.
		e	Estimate the number of O. mykiss migrating past the trap based on number of fish collected, trap efficiencies, recapture histories, and mortality associated with the marking procedures. Estimate annual smolt abundance for each tributary population.
		f	For each trap location, plot the estimated number of migrants against time of the year to determine timing and duration of juvenile migration periods.
10	Estimate and compare smolt detection rates at mainstem Columbia and Snake	a	Interrogate each O. mykiss juvenile collected in the traps for a previously

	River dams for summer steelhead from three tributary populations, Catherine Creek and the Lostine and upper Grande Ronde rivers.		implanted PIT tag. Record tag number and measure lengths and weights of all PIT-tagged recaptures.
		b	PIT tag approximately 500 migrating steelhead smolts that were not previously tagged and create a PIT tag data base for these fish.
		c	Monitor PIT-tagged migrants at the lower river traps. Measure and record tag number, length and weight information for all PIT-tagged fish. Enter lower trap recovery data on PTAGIS database.
		d	Obtain detection information for PIT-tagged fish recovered at Lower Granite, Little Goose. Lower Monumental, McNary, John Day and Bonneville dams.
		e	Determine mainstem dam detection rates for steelhead smolts from the three tributary populations.
11	Evaluate methods to estimate the proportion of O. mykiss captured during fall trapping that are migrating out of rearing areas and will undertake a smolt migration the following spring.	a	PIT tag up to 1,000 juvenile O. mykiss that are collected in each of the three rearing traps in the fall. Create a PIT tag database for these fish.
		b	Record recaptures of these fall-tagged fish both from in-basin sources and mainstem dam detections.
		c	Use recapture data and collection efficiences to estimate the minimum number of smolts leaving the tributary populations that miagrated out of upper rearing areas in the fall.
		d	Investigate the potential of altenative methods including but not limited to, radio tagging, tandem trapping, and genetic characterization of the juvenile O. mykiss population.
12	Begin to describe the population characteristics of the juvenile O. mykiss population in Catherine Creek.	a	Identify the limits and distribution of parr using field sampling in combination with recent ODFW survey data.
		b	Use passive seining techniques to collect parr throughout their distribution.
		c	Mark parr with a paint mark or similar benign technique. Collect scale samples from 100 fish in each size category collected.
		d	After several days collect a random sample of parr and use mark-recapture estimations to generate a parr population estimate.
		e	Read scales to determine parr age and to reconstruct the age structure of O. mykiss parr populaiton.

Objective schedules and costs

Obj #	Start date mm/yyyy	End date mm/yyyy	Measureable biological objective(s)	Milestone	FY2000 Cost %
1	10/1999	9/2000	Document the in-basin migration patterns for spring chinook salmon juveniles in the upper Grande Ronde River, Catherine Creek and the Lostine River tributary populations, including the abundance of migrants, migration timing and duration.		10.00%
2	10/1999	9/2000	Estimate and compare smolt detection rates at mainstem Columbia and Snake River dams for fall and spring migrating spring chinook salmon from tributary populations in the upper Grande Ronde River, Catherine Creek, and the Lostine River.		10.00%
3	10/1999	9/2000	Determine seasonal habitat utilization and preference of juvenile spring chinook salmon in the Lostine River.		10.00%
4	10/1999	9/2000	Characterize cold- and warm-water areas located in the Grande Ronde River basin and describe the patterns of use by juvenile spring chinook salmon.		5.00%
5	10/1999	9/2000	Estimate and compare smolt detection rates at mainstem Columbia and Snake River dams for migrants from four local, natural populations in the Grande Ronde and Imnaha River basins.		5.00%
6	10/1999	9/2000	Document the annual migration patterns for spring chinook salmon juveniles from four local, natural populations in the Grande Ronde and Imnaha River basins.		5.00%
7	10/1999	9/2000	Determine survival to parr stage for spring chinook salmon in two local, natural		10.00%

			populations in the Grande Ronde River Basin.		
8	10/1999	9/2000	Investigate the significance of alternative life history strategies of spring chinook salmon in two local populations in the Grande Ronde and Imnaha river basins.		10.00%
9	10/1999	9/2000	Document patterns of movement for juvenile O.mykiss from tributary populations in Catherine Creek, the upper Grande Ronde, and the Lostine River. Include data on migration timing, duration, and smolt abundance.		10.00%
10	10/1999	9/2000	Estimate and compare smolt detection rates at mainstem Columbia and Snake River dams for summer steelhead from three tributary populations, Catherine Creek and the Lostine and upper Grande Ronde rivers.		10.00%
11	10/1999	9/2000	Evaluate methods to estimate the proportion of O. mykiss captured during fall trapping that are migrating out of rearing areas and will undertake a smolt migration the following spring.		5.00%
12	10/1999	9/2000	Begin to describe the population characteristics of the juvenile O. mykiss population in Catherine Creek.		10.00%
				Total	100.00%

Schedule constraints
-Salmon and steelhead in the Grande Ronde River are listed under ESA and thus, this research is regulated by NMFS and is subject to annual permitting.
-Field activities on private land are subject to landowner permission.

Completion date
2013

Section 5. Budget

FY99 project budget (BPA obligated): $715,000

FY2000 budget by line item

Item	Note	% of total	FY2000
Personnel	permanent = 189,865 seasonal = 132,228	%40	322,093
Fringe benefits	36% for permanents = 68,351 45% for seasonals = 59,503	%16	127,854
Supplies, materials, non-expendable property		%8	65,000
Operations & maintenance	NA	%0	0
Capital acquisitions or improvements (e.g. land, buildings, major equip.)	Computer printer = 2,500 Truck Canopy = 1,500	%1	4,000
NEPA costs	NA	%0	0
Construction-related support	NA	%0	0
PIT tags	# of tags: 13,000 @ 2.90 each	%5	37,700
Travel	100 d @ $90/d =9,000 8 Commercial flights@ 350 = 2,800	%1	11,800
Indirect costs	35.5% of PS and S&S (526,747)	%23	186,995
Subcontractor	Oregon State University	%5	42,174
Other		%0	0
		TOTAL BPA FY2000 BUDGET REQUEST	$797,616

Cost sharing

Organization	Item or service provided	% total project cost (incl. BPA)	Amount ($)
		%0	
		%0	
		%0	
		%0	
		Total project cost (including BPA portion)	$797,616

Outyear costs

	FY2001	FY02	FY03	FY04
Total budget	$821,545	$846,191	$871,577	$897,724

Section 6. References

Watershed?	Reference
☐	Achord, S., et al. 1992. Research related to transportation of juvenile salmonids on the Columbia and Snake Rivers, 1991. Report to the U.S. Army Corps of Engineers. #DACW68-84-H0034. NMFS, Seattle.
☐	Bisson, P. A., et al. 1982. A system of naming habitat types in small streams, with examples of habitat utilization by salmonids during low stream flow. p. 62-73. In N. B. Armantrout (ed.) Acquisition and utilization of aquatic habitat inventory info.
☐	Bryson, D. 1993. Northeast Oregon Hatchery Grande Ronde River Management Plan. Final Report. Bonneville Power Administration, Portland, OR.
☐	Burck, W. A. 1993. Life history of spring chinook salmon in Lookingglass Creek, Oregon.

	Oregon Department of Fish and Wildlife, Information Report (Fish) 94-1, Portland, OR.
☐	Keefe, M., D. J. Anderson, R. W. Carmichael, and B. C. Jonasson. 1995. Early life history study of Grande Ronde River basin chinook salmon. Annual Progress Report. Bonneville Power Administration, Portland, OR.
☐	Lofy, P. T. and M. L. McLean. 1995. Evaluation of reestablishing natural production of spring chinook salmon in Lookingglass Creek, Oregon, using a non-endemic hatchery stock. Lower Snake river Compensation Plan 1994 Annual Report. CTUIR, Pendleton.
☐	Matthews, G. M.et al. 1990. Evaluation of transportation of juvenile salmonids and related research on the Columbia and Snake rivers, 1989. Report to the U.S. Army Corps of Engineers, #DACW68-84-H0034, NMFS, Seattle.
☐	Matthews, G. M., et al. 1992. Evaluation of transportation of juvenile salmonids and related research on the Columbia and Snake rivers, 1990. Report to U.S. Army Corps of Engineers, # DACW68-84-H0034, NMFS, Seattle.
☐	Maule, A. G., J. W. Beeman, R. M. Schrock, and P. V. Harnes. 1994. Assessment of smolt condition for travel time analysis. Annual report. Bonneville Power Administration, Portland, OR.
☐	Nickelson, T. E., J. D. Rodgers, S. L. Johnson, and M. F. Solazzi. 1992. Seasonal changes in habitat use by juvenile coho salmon (Oncorhynchus kisutch) in Oregon coastal streams. Can. J. Fish. Aquat. Sci. 49:783-789.
☐	NWPPC (Northwest Power Planning Council). 1992. Strategy for salmon, Volume VII.
☐	Prentice, E. F., T. A. Flagg, C. S. McCutcheon, D. F. Brastow and D. C. Cross. 1990. Equipment, methods, and an automated data-entry station for PIT-tagging. American Fisheries Society Symposium 7:335-340, 1990.
☐	ODFW (Oregon Department of Fish and Wildlife). 1990. Grande Ronde River Subbasin Salmon and Steelhead Production Plan. Oregon Department of Fish and Wildlife, Portland, OR.
☐	Sankovich, P. M., et al. 1997. Smolt migration characteristics and mainstem Snake and Columbia river detection rates of PIT-tagged Grande Ronde and Imnaha river naturally-produced spring chinook salmon. Annual Report. BPA, Portland,OR.
☐	Snake River Recovery Team. 1993. Draft Snake River salmon recovery plan recommendations. National Marine Fisheries Service, Portland, OR.
☐	USACE (United States Army Corps of Engineers). 1975. Lower Snake River Fish and Wildlife Compensation Plan Special Report. U.S. Army Corps of Engineers, Walla Walla, WA.
☐	USFS (United States Forest Service) and six co-author agencies. 1992. Upper Grande Ronde River Anadromous Fish Habitat Restoration and Monitoring Plan. U. S. Forest Service, Wallowa-Whitman National Forest, Baker, OR.
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PART II - NARRATIVE

Section 7. Abstract

The goal of this project is to investigate the critical habitat, abundance, migration patterns, survival, and alternate life history strategies exhibited by spring chinook salmon and summer steelhead juveniles from distinct populations in the Grande Ronde and Imnaha River basins. Our methods include collecting juveniles with migrant traps and passive seining techniques.

This study will provide such information as directed under three separate measures of the Columbia River Fish and Wildlife Program. This study pertains to program measures 7.1C and D

in that it will provide information on abundance of parr and estimates for egg to parr and parr to smolt survival. This information is important in evaluating, critical life stages, population status, and sustainability of naturally spawning populations. This study will also provide a means for long term monitoring of juvenile salmonid production in the Grande Ronde and Imnaha River basins. Furthermore, program measure 7.4L funded the establishment of Northeast Oregon Hatcheries project (NEOH). Task 3.3.4, identified in the Northeast Oregon Hatchery Grande Ronde River Final Report is the completion of early life history studies in the upper Grande Ronde system.

Section 8. Project description

a. Technical and/or scientific background

The populations of spring chinook salmon and summer steelhead in the Grande Ronde basin are substantially depressed below estimates of historic levels. For example, it is estimated that prior to the construction of the Columbia and Snake River dams, more than 20,000 adult spring chinook salmon returned to spawn in the Grande Ronde River (ODFW 1990). A spawning escapement of 12,200 salmon was estimated for the Grande Ronde in 1957 (USACE 1975). Recent population estimates of both species have been variable year to year, yet remain a degree of magnitude lower than historic estimates (e.g., 248 adult salmon in 1995). In addition to a decline in population abundance, a constriction of spawning distribution is evident in the Grande Ronde basin. For example, 21 streams supported spawning chinook salmon historically, yet today the majority of production is limited to 8 tributary streams and the mainstem upper Grande Ronde River (ODFW 1990).

Numerous factors are thought to contribute to the decline of salmonids in the Snake River and its tributaries. These factors include passage problems and increased mortality of juvenile and adult migrants at mainstem Columbia and Snake river dams, overharvest, and habitat degradation associated with timber, agricultural and developmental practices. More than 80% of anadromous fish habitat in the Upper Grande Ronde River is considered to be degraded (USFS 1992). Habitat problems throughout the Grande Ronde River basin (reviewed by Bryson 1993) include poor water quality associated with high sedimentation and poor thermal buffering, moderately to severely degraded habitat, and a decline in abundance of large pool habitat.

Precipitous declines in Snake River spring chinook salmon and summer steelhead resulted in these stocks, including the Grande Ronde River stocks, being listed as threatened under the Endangered Species Act. Proposed recovery efforts for these salmonid stocks require knowledge of stock specific life history strategies and critical habitats for spawning, rearing, and downstream migration (Snake River Recovery Team 1993, NWPPC 1992, ODFW 1990). There is little information available on early life history and critical rearing habitats in the Grande Ronde River basin. Recent calls for information include: a description of the spatial differences in spawning and rearing habitat (Snake River Recovery Team 1993), development of a profile on genetic, life history, and morphometric characteristics of wild and naturally spawning populations (Snake River Recovery Team 1993; NWPPC 1992; ODFW 1990), evaluation of critical habitat needs and factors limiting production (NWPPC 1992; ODFW 1990) in the Grande Ronde Basin.

More specifically, we need to increase our knowledge of juvenile migration patterns, smolt production and survival, the importance of alternate life history strategies, and rearing habitat utilization for juvenile spring chinook salmon and summer steelhead in the Grande Ronde basin. Both historic and recent estimates of juvenile production in the basin are lacking. However, given the decrease in total number of adults returning to the basin and the extent of habitat degradation, it is reasonable to assume that juvenile production in the basin also has declined. Recent chinook salmon parr to smolt survival estimates for the Grande Ronde basin range from 7.3-22.1% (Achord et al. 1992, Sankovich et al. 1997).

Although, typically the chinook salmon and steelhead smolt migration occurs in the spring, data from Lookingglass Creek (Burck 1993, Lofy and McLean 1995), Catherine Creek and mainstem Grande Ronde River (Keefe et al. 1995) indicate that some salmon juveniles move out of summer rearing areas during the fall. We are learning about the patterns and success of this fall migration for chinook salmon but do not even know if it is exhibited by steelhead. Data from past migration years demonstrate that approximately 10% of the salmon juveniles migrated out of summer rearing areas in the upper Grande Ronde River; whereas 50 - 90% of juveniles move out of summer rearing areas in Catherine Creek. Recent data also indicates that not all chinook salmon parr transform into smolts and leave their rearing stream in their second spring. Some parr may choose to mature early and attempt to reproduce with adults during the summer of their first year, while others may simply delay the smolt transformation and migrate one year later (Sankovich et al. 1997), exhibiting a life history pattern more typical of steelhead.

We are also lacking information on where fall migrants overwinter. Data from Grande Ronde River trapping operations 1993-1997 indicated that salmon that leave upper rearing areas in the fall overwintered somewhere between the upper (RM 186) and lower (RM 102) traps. Much of the habitat in the mid-reaches of the Grande Ronde River is degraded. Stream habitat conditions in the section of the Grande Ronde River below La Grande consist of meandering and channelized stream section which run through agricultural land. Riparian vegetation in this area is sparse and provides little shade or instream cover. The river is heavily silted due to extensive erosion caused by agricultural and forest management practices and mining activities. The affect overwintering has in this habitat on subsequent survival is unclear. Availability of adequate winter habitat can be a major factor affecting salmonid production. Nickelson et al. (1992) demonstrated that the lack of alcove and beaver pond habitat during the winter was an important factor limiting coho salmon production in many coastal Oregon streams. If adequate overwinter rearing conditions do not exist in middle reaches of the Grande Ronde River, then we would expect reduced survival for juveniles exhibiting this life history strategy. We recently have seen similar patterns of movement in the Wallowa subbasin but do not yet know the extent of the fall and spring migrations nor the winter distribution of these fish. We do not know if summer steelhead juveniles undertake the same fall outmigration that we have seen in chinook salmon.

Current restoration efforts for salmonids include supplementation strategies. A promising supplementation strategy will utilize a donor stock with genetic and life history patterns that are comparable to the endemic stock being supplemented (Bryson 1993, Snake River Recovery Team 1993). We need to learn to recognize the importance of the diversified life history strategies of endemic salmonid populations so we can develop hatchery supplementation stocks that will mimic but not alter life history characteristics of the endemic fish.

The ultimate goal of this study is to describe the early life history strategies exhibited by spring chinook salmon and summer steelhead in the Grande Ronde basin. Initially, we will determine smolt production levels, juvenile migration patterns and smolt detection rates at the mainstem Columbia and Snake River dams for spring chinook salmon and summer steelhead in the upper Grande Ronde River, Catherine Creek, and the Lostine River. Once we have identified the rearing distributions of spring chinook slamon, we will evaluate habitat utilization and habitat preference. We will estimate juvenile survival by life stage and will begin to evaluate the significance of alternate life history strategies to the persistence of local spring chinook salmon populations. In addition, we will begin to evaulate the life history charactecrics exhibited by *O. mykiss* juveniles in Catherine Creek.

b. Rationale and significance to Regional Programs

The rationale behind the proposed project should be presented and project objectives and hypotheses related as specifically as possible to the FWP objectives and measures or to other plans. You should make a convincing case for how the proposed work will further goals of the FWP. Relevant projects in progress in the Columbia Basin and elsewhere should be listed and discussed in relation to the proposed project. Arrangements should be identified and documented for cooperation and synergistic relationships among the proposed project, *other project proposals*, and existing projects. Any particularly novel ideas or contributions offered by the proposed project should be highlighted and discussed.

Precipitous declines in Snake River spring chinook salmon and summer steelhead resulted in these stocks, including the Grande Ronde River stocks, being listed as threatened under the Endangered Species Act (October 1992). Proposed recovery efforts for these stocks require knowledge of stock specific life history strategies and critical habitats for spawning, rearing, and downstream migration (Snake River Recovery Team 1993, Northwest Power Planning Council 1992, Oregon Department of Fish and Wildlife 1990). There is little information available on the early life history and critical rearing habitats in the Grande Ronde River basin. Recent calls for information include: a description of the spatial differences in spawning and rearing habitat (Snake River Recovery Team 1993), development of a profile on genetic , life history, and morphometric characteristics of wild and naturally spawning populations (Snake River Recovery Team 1993; Northwest Power Planning Council 1992, Oregon Department of Fish and Wildlife 1990), and evaluation of critical habitat needs and factors limiting production (Northwest Power Planning Council 1992, Oregon Department of Fish and Wildlife 1990).

This study will provide information as directed under four measures of the Columbia River Basin Fish and Wildlife Program. Measure 7.7 B directs funding for model watershed projects in Idaho, Oregon, and Washington and directs the model watershed commission to identify actions that address key limiting factors for salmonids. At a board of director's meeting on March 11, 1994 the Grande Ronde Model Watershed Board approved a motion to support action item 5 "support application to BPA for funding salmonid life history study by ODFW (R. Carmichael)". This project is a direct result of that watershed board action.

This study also is relevant to program measures 7.1 C and D. The long term objective of the program is to collect information on sustainability of wild and naturally spawning, salmonid populations. This necessary information includes a description of the genetic, life history and morphological characteristics of wild and naturally spawning populations, identifying population limiting factors and carrying capacity of salmonid habitat. The proposed study will define critical early life history characteristics, provide estimates of juvenile production, and quantify juvenile habitat preference for naturally produced spring chinook salmon and summer steelhead in the upper Grande Ronde system. Furthermore, program measure 7.4 F directed the establishment of Northeast Oregon Hatcheries project (NEOH). Task 3.3.4, identified in the Northeast Oregon Hatchery Grand Ronde River Final Report is the completion of early life history studies in the upper Grande Ronde system.

c. Relationships to other projects

This Salmonid Life History study cooperates with numerous ongoing projects both within the Grande Ronde basin and in the Columbia River region. Information collected by our project has been and continues to be utilized by other projects including but not limited to Grande Ronde Basin Captive Broodstock Program and the PATH project (see above for integration with other projects). This data integration eliminates potential duplication of efforts, increases the efficiency of project operation, and enhances the data base of these other projects. The Salmonid Life History study also provides the opportunity to monitor changes in tributary smolt production and survival of wild smolts to Lower Granite Dam over time, thereby providing information for evaluating the Northeast Oregon Hatcheries and Grande Ronde Basin Spring Chinook Captive Broodstock programs, and other 'on the ground' restoration and enhancement activities. The Early Life History study has been approved by and is supported locally as an integral part of the Grande Ronde Model Watershed Program.

Three independent studies are ongoing in the Grande Ronde basin that provide a means for collaboration with the proposed Salmonid Life History Study. Collaboration will occur with a spring chinook spawning ground survey project conducted by our program under the Lower Snake River Compensation Plan. The spawning ground survey project is an ongoing study to monitor escapement to the Grande Ronde and Imnaha rivers. This spawning ground survey project will share redd count data and estimates of total escapement to the upper Grande Ronde River, Catherine Creek, and the Lostine River. Combining our salmon parr and smolt production estimates with escapement data will allow us to track the relationship between salmon spawning escapement and juvenile production in these drainages and estimate egg to parr and egg to smolt survival. We will also collaborate with the smolt monitoring study on the lower Grande Ronde River conducted under the Fish Passage Center's Smolt Monitoring Program. The smolt monitoring project's goal is to monitor and assess smolt travel time from the Grande Ronde Basin to Lower Granite Dam. Currently we provide the smolt monitoring project personnel with weekly trapping reports so that they have expectations of forthcoming trap catches. In addition, recoveries of PIT tagged fish at this trap will provide us with migration timing through lower reaches of the Grande Ronde River. We also collaborate with the Captive Brood project providing them with information of the distribution and specific locations of salmon juveniles and assisting them with collection of captive broodstock when out in the field conductign parr studies.

d. Project history (for ongoing projects)

History:

Recovery efforts for endangered stocks of Snake River salmon require life history and critical habitat information. The spring chinook early life history study was initiated in 1993 with NMFS, ESA funds. BPA funding for the project commenced in September of 1994. To date, we have collected data from five migration years on the upper Grande Ronde River, four migration years on Catherine Creek, and two migration year on the Lostine River. Past costs of the project have been as follows: FY 95 $553,939, FY 96 $525,050, FY 97 $520,897, FY 98 $650,697, FY 99 $688,250. These costs do not include costs of PIT tags that were purchased by BPA.

Summary of Major Results Achieved:

Preliminary analysis of the data indicates differences in migration patterns and survival both between populations and between groups exhibiting different life history strategies within a population. Data demonstrated that the upper Grande Ronde River, Lostine River, and Catherine Creek populations exhibit a fall movement out of summer rearing areas in addition to the typical spring smolt migration. In the Lostine River and Catherine Creek it appears that 50% or more of the juvenile population leave summer rearing areas in the fall, whereas only approximately 10% leave the upper Grande Ronde River in the fall. In addition, we found that the fish migrating out of the upper Grande Ronde River in the fall are larger than fish that remain in the rearing areas and that fish continue to move out of rearing areas at extremely low water temperatures. We also have collected habitat utilization data for the upper Grande Ronde River, Lostine River, and Catherine Creek populations which indicate that juvenile chinook are most abundant in pool habitats. We have substantial data that indicates that the Grande Ronde River valley habitat is utilized by a substantial number of overwintering spring chinook salmon from both the Catherine Creek and upper Grande Ronde population. These salmon leave upper rearing areas in the fall, overwinter in the Grande Ronde valley and leave the valley as smolts in the spring.

Project Reports:

Monthly and quarterly progress reports.

Annual Reports:

- 1994. Investigations into the life history of spring chinook salmon in the Grande Ronde River basin.
- 1995. Early life history study of Grande Ronde River basin chinook salmon.
- 1996. Investigations into the early life history of naturally produced spring chinook salmon in the Grande Ronde River basin.
- 1997. Investigations into the early life history of naturally produced spring chinook salmon in the Grande Ronde River basin.

Presentations of results have been made to Grande Ronde Model Watershed Board, Technical Committee; and other Grande Ronde organizations; Columbia Basin Fish and Wildlife Review, Lower Sanke Compensation Plan Review, and Oregon Chapter American Fisheries Society.

Adaptive Management Implications:
Results of this study have been used to make recommendations for protection and enhancement of Grande Ronde basin spring chinook populations and their critical rearing habitats. Data from the early years of this study demonstrated reduced survival among spring chinook salmon that overwinter in the upper Grande Ronde River as compared with those salmon that migrate out of the upper Grande Ronde in the fall. Thus, we recommended to local managers that the upper Grande Ronde habitat be considered critical for overwintering salmon and that immediate habitat restoration efforts should be directed there. Grande Ronde valley habitat also has been shown to be important to overwintering salmon and we have recommended it as a high priority for protection and restoration. In addition, this Early Life History study provides population status information (Fish and Wildlife Program Measure 6.2.A) in the form of estimates of smolt production out of Grande Ronde River tributaries. Data collected as a part of this project can also be used by the Grande Ronde Model Watershed Program (Fish and Wildlife Program Measure 6.5B) and local managers to monitor changes in juvenile production as restoration and monitoring activities are implemented.

e. Proposal objectives

Objective 1: Document the in-basin migration patterns for spring chinook salmon juveniles in Catherine Creek and the upper Grande Ronde and Lostine rivers, including the abundance of migrants, migration timing and duration. This objective is descriptive and does not conform to hypothesis testing.

Objective 2: Estimate and compare smolt detection rates at mainstem Columbia and Snake River dams for fall and spring migrating spring chinook salmon from the tributary populations in Catherine Creek and the upper Grande Ronde and Lostine rivers.

H_o2: Dam detection rates for tag groups that exhibit different life history strategies are similar.
H_a2: Dam detection rates for tag groups that exhibit different life history strategies are different.

H_o2a: Dam detection rates of fall-tagged salmon are similar to dam detection rates of spring-tagged salmon.
H_a2a: Dam detection rates of fall-tagged salmon are different from dam detection rates of spring-tagged salmon.

Objective 3: Determine seasonal habitat utilization and preference of juvenile spring chinook salmon in the Lostine River.

H_o3: Juvenile spring chinook salmon utilize available habitats equally during summer and winter.
H_a3: Juvenile spring chinook salmon do not utilize available habitats equally during summer and winter.

Objective 4: Characterize cold- and warm-water areas located in the Grande Ronde River basin and describe the patterns of use by juvenile spring chinook salmon. This objective is descriptive and does not conform to hypothesis testing.

Objective 5: Estimate and compare smolt detection rates at mainstem Columbia and Snake River dams for migrants from four local, natural populations in the Grande Ronde and Imnaha River basins.

H_o5: Dam detection rates for spring chinook salmon from local populations are similar.

H_a5: Dam detection rates for spring chinook salmon from local populations are different.

Objective 6: Document the annual migration patterns for spring chinook salmon juveniles from four local, natural populations in the Grande Ronde and Imnaha River basins.

H_o6: Migration timing to Lower Granite Dam is similar among local populations of spring chinook salmon.
H_a6: Migration timing to Lower Granite Dam is different among local populations of spring chinook salmon.

Objective 7: Determine survival to parr stage for spring chinook salmon in two local, natural populations in the Grande Ronde River Basin. This objective is descriptive and does not conform to hypothesis testing.

Objective 8: Investigate the significance of alternative life history strategies of spring chinook salmon in two local populations in the Grande Ronde and Imnaha river basins. This objective is descriptive and does not conform to hypothesis testing.

Objective 9: Document patterns of movement for juvenile *O. mykiss* from tributary populations in catherine Creek, the upper Grande Ronde, and the Lostine River. Include data on migration timing, duration, and smolt abundance. This objective is descriptive and does not conform to hypothesis testing.

Objective 10: Estimate and compare smolt detection rates at mainstem Columbia and Snake River dams for summer steelhead from three tributary populations, Catherine Creek and the upper Grande Ronde and Lostine rivers.

H_o2a: Dam detection rates of fall-tagged salmon are similar to dam detection rates of steelhead smolts.
H_a2a: Dam detection rates of fall-tagged salmon are different from dam detection rates of steelhead smolts.

Objective 11: Evaluate methods to estimate the proportion of *O. mykiss* captured during fall trapping that are migrating out of rearing areas and will undertake a smolt migration the following spring. This objective is descriptive and does not conform to hypothesis testing.

Objective 12: Begin to describe the population characteristics of the juvenile *O. mykiss* population in Catherine Creek. This objective is descriptive and does not conform to hypothesis testing.

f. Methods

Obj. 1 Methods: Rotary screw traps will be used to collect juvenile spring chinook salmon during their migration from the rearing areas. The traps will be equipped with live boxes which can safely hold the numbers of chinook salmon expected to be trapped during the trapping time intervals. The traps will be checked at time intervals varying from several times a day to every third day dependent upon river conditions and the number of fish being captured. All juvenile spring chinook salmon will be removed from the traps for enumeration, sampling, or interrogation of PIT tags. Prior to sampling, juvenile chinook salmon will be anesthetized with MS-222. Fish will be sampled as quickly as possible and allowed to recover fully before release into the river. Trap efficiencies will be conducted as needed corresponding with changes in river conditions, or at a minimum of once per week. Trap efficiency will be determined by releasing known numbers of paint marked juveniles above the traps and determining the number of recaptures within a defined period of time.

Task 1.1: Collect juvenile spring chinook salmon migrants by operating five screw traps at selected trapping sites. The traps will be operated year round if possible and will only be removed if low flows or ice prevents operation.

Task 1.2: Enumerate all spring chinook salmon collected in traps. Measure the length and weight for 80 migrants collected weekly at each trapping location. Calculate condition factor for these 80 salmon

Task 1.3: Mark approximately 50 spring chinook salmon migrants collected weekly at each trap. Salmon will receive a mark of water soluble acrylic paint that is applied with a Panjet marking instrument.

Task 1.4: Determine trapping efficiencies for each trap throughout the trapping period using fish marked in Task 1.3.

Task 1.5: Estimate the number of juvenile chinook salmon migrating from rearing areas based on number of chinook salmon collected in the traps, trap efficiencies, and mortality estimates associated with the marking procedure. Use Bootstrap estimation to calculate confidence intervals for the estimate of juvenile chinook migrating from rearing areas.

Task 1.6: For each trap location, plot estimated number of migrants against time of the year to determine timing and duration of the juvenile migration periods.

Task 1.7: Continuously monitor water temperature using a thermograph and monitor river height daily from a river gage at each trap.

Obj. 2. Methods: PIT tag technology allows fish to be individually marked and subsequent observations made on marked fish without sacrificing the fish. Presently, PIT tag monitors are used at six mainstem Columbia and Snake River dams to monitor PIT-tagged fish passage. Detection rates at the dams only allow us to estimate relative survival from the time of tagging to time of detection and do not allow us to separate parr and smolt mortality. In addition, fish that migrate at different times of the year and overwinter in different habitat types are subject to different environmental conditions which can result in variable survival. In addition to the typical spring smolt migration, there is a fall migration from summer rearing areas in the upper Grande Ronde River. To determine if juveniles migrating at different times of the year exhibit differential detection rates at mainstem dams we will PIT tag approximately 500 juvenile spring chinook salmon during both the fall and spring migration. We will define the fall migration as any downstream movement evident between September and December and the spring migration as any downstream movement evident between February and June. These times encompass the majority of spring and fall migrants. After the fall migration has passed we will also collect and PIT tag approximately 500 juveniles from rearing areas upstream of our traps. We will classify these fish as winter residents. Thus, there are three separate groups for comparisons of detection rates at mainstem dams. Comparing detection rates of smolts tagged during the spring migration with detection rates of smolts tagged in winter will allow us to estimate overwinter mortality. Comparing detection rates of smolts tagged during the fall migration with detection rates of smolts tagged as winter residents will allow us to evaluate the relative success of fall migrant and spring migrant life history types. For statistical comparisons between treatment groups we will use a contingency table designed for the analysis of frequencies. Parametric T-tests and ANOVA tests will be used to compare dam detection rates among groups. Appropriate nonparametric will be substituted if the data are found not to conform to parametric assumptions.

Task 2.1: Interrogate each chinook salmon collected in the screw traps for a previously implanted PIT tag. Record tag number and measure lengths and weights of all PIT-tagged recaptures.

Task 2.2: PIT-tag approximately 500 fall and spring migrating spring chinook salmon juveniles at rearing area traps that were not previously tagged and create a PIT tag data base for tagged fish. Tag 500 salmon from each tributary population.

Task 2.3: Collect and PIT tag approximately 500 winter resident parr from rearing areas above the upper screw traps. Tag 500 salmon from each tributary population. Create a PIT tag data base for these fish.

Task 2.4: Monitor PIT-tagged migrants at the lower traps. Measure and record tag number, length and weight information for all PIT-tagged fish. Enter lower trap recovery data on PTAGIS database.

Task 2.5: Obtain detection information for PIT-tagged fish recovered at Lower Granite, Little Goose, Lower Monumental, McNary, John Day, and Bonneville dams.

Task 2.6: Determine mainstem dam detection rates for fall, winter and spring tagged fish.

Task 2.7: Compare detection rates between treatment groups. Derive estimates of overwinter mortality, the success of fall migration strategy, and the relative success of the fall migrant and spring migrant life history strategies for each tributaary population.

Obj. 3 Methods: We will determine the summer and winter rearing distribution of spring chinook salmon in the Lostine River. Summer and winter were chosen for examining rearing distributions because during these seasons river flow is low and rearing habitat may be limited. Rearing distribution in the upper Grande Ronde and upper Wallowa Rivers is thought to be limited by warm water temperatures in late summer and by ice build up in the winter. Understanding what habitat is utilized and preferred will allow us to make knowledgeable recommendations for habitat protection and enhancement projects. Data from 1997 fall migrations indicate that spring chinook juveniles moved onto the valley reaches of the Wallowa River and maybe beyond into the Grande Ronde. We do not yet know what habitat the fish are using in these river sections. After defining the habitat used by wintering fish we will return to these locations in the summer to assess habitat characteristics. In addition, we will estimate fish abundance and density and will determine habitat preferences of juvenile salmon in upper rearing areas. We will use the habitat classification system described in Bisson et al. (1982) with modifications for backwater pools (Nickelson et al 1992). Preferred habitat will be identified using preference/selectivity indices. The habitat and fish abundance surveys began in the summer of 1995 and will continue through the winter of 1999.

Task 3.1: Identify the limits of the summer and winter rearing distribution of salmon juveniles. This task will be accomplished in conjunction with spawning ground surveys.

Task 3.2: Identify and select sites to be sampled within upper rearing areas. Select replicate sites that are representative of all available habitat types (i.e. plunge pool, glide, etc.).

Task 3.3: At each sampling site enumerate spring chinook salmon juveniles using snorkeling observations.

Task 3.4: Record the habitat classification and describe the habitat of each sampling site. The following measurements will be taken: temperature, water velocity, maximum river depth, width at three different points, length, substrate composition, instream habitat, cover, and shade.

Task 3.5: Estimate surface area of each sampling site (S.A. = Length X mean width) and calculate the density of juvenile salmon per unit area of habitat.

Task 3.6: Determine habitat preference using preference/selectivity indices.

Obj. 4 Methods: Stream temperature can be a limiting factor in the behavior, ecology, and survival of salmonids. Recent data indicates that both adult and juvenile salmonids may utilize thermally moderated temperature zones to escape nonpreferred or even lethal temperatures. We propose to locate and characterize both cold- and warm-water zones in critical rearing habitat of juvenile chinook salmon in the Grande Ronde River. Based on the geomorphology of the river channel and basin we will attempt to predict where thermal zones may occur. The presence of a temperature moderated refuge will then be confirmed by conducting stream surveys. After the thermal refugia are mapped for the upper Grande Ronde River will attempt to determine how juvenile spring chinook salmon utilize these systems.

Task 4.1: Complete analysis of three years data and write a report describing thermal refuge use by spring chinook salmon and summer steelhead in the Grande ronde baisn.

Obj. 5 Methods: We will collect and PIT tag naturally produced spring chinook parr from Catherine Creek, the Lostine, Minam and Imnaha rivers in the late summer of 1999. Sites and techniques providing the least harmful collection of parr will be used. Relative parr-to-smolt survival of each tagged population will be indexed from recovery rates of PIT-tagged smolts collected at mainstem Snake and Columbia river dams. This data will provide information on interpopulational variation in the parr-to-smolt survival of naturally-produced spring chinook salmon.

Task 5.1: Collect 500 juvenile salmon from Catherine Creek and the Lostine River and 1,000 juveniles from the Minam and Imnaha rivers in August and September 1998. We will locate juveniles using snorkel observations and will collect the fish with seines. Sanctuary dip nets will be used to minimize out of water transfers.

Task 5.2: Once collected, we will implant passive-integrated- transponder tags in the fish. Tags will be implanted as described in Prentice et al. (1990) and Mathews et al. (1990,1992). We will proceed with collection at temperatures up to 17°C and will tag at temperatures up to 15°C. We will tag fish that are 60 mm in fork length or longer and appear to be in good health. Fish will be anesthetized with 40-50 ppm MS-222. PIT tags will be injected manually with modified hypodermic syringes. The syringes will be disinfected for 10 minutes in 70% ethanol prior to tagging. Fish will be allowed to recover after tagging and will be released as near to the collection site as possible.

Task 5.3: Incorporate data into ASCII files according to criteria developed by the PIT Tag Steering Committee and submit files to the PIT Tag Information System (PTAGIS) database.

Task 5.4: Import data from collection stations at Lower Granite, Little Goose, and McNary dams on the Snake and Columbia rivers. Files will be downloaded from PTAGIS and parr-to-smolt survival of the PIT tagged populations will be determined.

Task 5.5: Analyze the results and interpret the analysis.

Obj. 6 Methods: As migrating smolts pass through the collection stations at Lower Granite, Little Goose, and McNary dams, PIT tagged fish will be detected, tags will be decoded, and the date recorded. We will plot and compare this migration timing data for the four populations of spring chinook salmon tagged. This data will provide information on the interpopulational variation in migration timing of naturally produced spring chinook salmon smolts.

Task 6.1: Plot the number of PIT tagged fish migrating over time for spring chinook from each population.

Task 6.2: Analyze the data using ANOVA of a distribution analysis and interpret the data.

Obj. 7 Methods: We will use habitat and spawning survey data to determine all potential summer rearing habitat and then will snorkel to locate spring chinook parr in Catherine Creek and the Lostine River. We will collect and mark up to 1,500 summer parr with either a PIT tag (including 500 from Objective 10) or a paint mark. Approximately three days after marking we will conduct a second snorkel survey to enumerate recaptures. Handling upon recapture will be minimized to allow only identification of PIT tag code or paint mark. Sampling recaptures two to three days after marking allows time for the fish to recover from handling and redistribute themselves and at the same time minimizes the potential for immigration and emigration in the collection area. All fish will be released as near to the collection site as possible.

Task 7.1: Use snorkeling observation to determine the summer rearing distribution of parr and the relationship of parr distribution to redd distribution.

Task 7.2: Collect parr using snorkelers to herd the fish into a seine, anesthetize parr, determine length and weight and give appropriate mark. Release fish at or near collection site after they recover from anesthesia.

Task 7.3: Repeat collection survey two to three days later to enumerate recaptures.

Task 7.4: Use mark-recapture methodology to estimate the total abundance of parr in summer.

Task 7.5: Estimate survival by life stage using data collected in Task 9.2 combined with smolt abundance and adult escapement data from an ongoing related study.

Obj. 8 Methods: During initial collection (Objective 11) all fish will be examined for evidence of precocious maturation and we will collect scales from them to determine age structure of the parr population. Precocious parr will receive a unique mark so that they may be treated as a separate group and the data collected on them can be analyzed independently from immature parr.

Task 8.1: Estimate the total abundance of precocious males in late summer and determine what portion of the population exhibits this alternate life history strategy.

Task 8.2: Estimate the abundance of juvenile salmon that remain in freshwater past their second spring and do not mature sexually and determine the portion of the total parr population that exhibits this alternate life history strategy.

Task 8.3: Estimate the number of two year old smolts that out migrate past the mainstem Snake and Columbia river dams.

Obj. 9 Methods: Rotary screw traps will be used to collect juvenile *O. mykiss*. One difficulty when trapping *O. mykiss* is that traps are useful for estimating the abundance of migrants but not residents and only steelhead smolts can be differentiated from resident rainbow trout. Thus, information obtained for this objective will be limited to a description of the smolt migration and smolt abundance. Details of trap operation can be found under Obj. 1.

Task 9.1: Collect juvenile *O. mykiss* by operating five rotary screw traps at selected trapping sites. The traps will be operated year round if possible and will only be removed if low flows or ice prevent operations.

Task 9.2: Enumerate all *O. mykiss* collected in traps. Measure the length and weight of 100 fish weekly at each trapping location. Calculate the condition factor for these 100 fish. Idnetify smolts based on visual examination.

Task 9.3: Mark approximately 50 *O. mykiss* weekly at each trap. Fish will receive either a paint mark or a PIT tag for identification.

Task 9.4: Determine trap efficiencies for each trap throughout the trapping period.

Task 9.5: Estimate the number of *O. mykiss* migrating past the trap based on number of fish collected, trap efficiencies, recapture histories, and mortality associated with the marking procedures. Estimate annual smolt abundance for each tributary population.

Task 9.6: For each trap location, plot the estimated number of migrants against time of the year to determine timing and duration of juvenile migration periods.

Obj. 10 Methods: PIT tag technology allows fish to be individually marked and subsequent observations made on marked fish without sacrificing the fish. PIT tag monitors at mainstem dams monitor the passage of tagged fish and provide us with recapture data that we can expand to estimate smolt survival.

Task 10.1: Interrogate each *O. mykiss* juvenile collected in the traps for a previously implanted PIT tag. Record tag number and measure lengths and weights of all PIT-tagged recaptures.

Task 10.2: PIT tag approximately 500 migrating steelhead smolts that were not previously tagged and create a PIT tag data base for these fish.

Task 10.3: Monitor PIT-tagged migrants at the lower river traps. Measure and record tag number, length and weight information for all PIT-tagged fish. Enter lower trap recovery data on PTAGIS database.

Task 10.4: Obtain detection information for PIT-tagged fish recovered at Lower Granite, Little Goose. Lower Monumental, McNary, John Day and Bonneville dams.

Task 10.5: Determine mainstem dam detection rates for steelhead smolts from the three tributary populations.

Obj. 11 Methods: It is uncertain if the *O. mykiss* collected in the upper rearing trpas during the fall represent fish migrating out of rearing areas or simply fish undergoing local movements. For sprign chinook salmon, we see a distinct fall outmigration. We will evaluate methods to allow us to determine what portion, if any, of the fall collected fish are migrating from rearing areas. By PIT tagging individuals and recording all recaptures we should begin to see if patterns of recapture are evident for individuals or if the pass the trap only once. In addition, we will explore alternate methods to determine where these fish are going and if the movement is unidirectional.

Task 11.1: PIT tag up to 1,000 juvenile *O. mykiss* that are collected in each of the three rearing traps in the fall. Create a PIT tag database for these fish.

Task 11.2: Record recaptures of these fall-tagged fish both from in-basin sources and mainstem dam detections.

Task 11.3: Use recapture data and collection efficiences to estimate the minimum number of smolts leaving the tributary populations that migrated out of upper rearing areas in the fall.

Task 11.4: Investigate the potential of alternative methods including but not limited to radio-tagging and tandem trapping.

Obj. 12 Methods: In the Grande Ronde basin most of our steelhead populations are sympatric with populations of rainbow trout. The genetic relationship of the steelhead and trout remains uncertain; are steelhead (rainbow trout) simply a form of rainbow trout (steelhead) that exhibit a different life history. The uncertainty of this relationshop necessitate us treating juvenile *O. mykiss* as one population. To better understand the population dynamics of these fish, we will begin to describe the characteristic of one such population of *O. mykiss* in Catherine Creek.

Task 12.1: Identify the limits and distribution of parr using field sampling in combination with recent ODFW survey data.

Task 12.2: Use passive seining techniques to collect parr throughout their distribution.

Task 12.3: Mark parr with a paint mark or similar technique. Collect scale samples from 100 fish in each size category collected.

Task 12.4: After several days collect a random sample of parr and use mark-recapture estimation to generate a parr population estimate.

Task 12.5: Read scales to determine parr age structure of *O. mykiss* parr population.

g. Facilities and equipment

All necessary field equipement has been obtained. A truck canopy is requested to increase efficiency of sampling and tagging during winter and inclement weather. The addition of one computer printer is requested to supplement the small printer we have and facilitate report writing.

h. Budget

This project is heavily field oriented. We operate five juvenile traps in in two subbasins and conduct parr work in 6 tributary streams in four subbasins. The large personnel component reflects the operation of two field offices for year round trapping and simultaneous summer parr research. The supplies component reflects maintaining five screw traps, fish collection and tagging suppplies, the need for three vehicles to access field locations, and operations of one field office plus assistance at the main research office. The travel budget is to provide transportation and per diem for field crews working in remote areas. The request for capital is justified above in the equipement section. The indirect rate is based on an agreement between ODFW and the U.S. Government.

Section 9. Key personnel

Richard W. Carmichael, Program Leader, 0.1 FTE

Education

B.S., Fisheries Science, Oregon State University, 1979
M.S., Fisheries Science, Oregon State University, 1984

Current employment

Oregon Dept. Fish and Wildlife, Fish Research and Development, La Grande, OR. July 1990 - present. Program Leader - Executive Manager for NE Oregon Scientific Investigations Program. Primary responsibilities are to develop and direct implementation of a complex research program to evaluate success of protecting, reestablishing, and restoring ESA listed and non-listed stocks in eastern Oregon, oversee the work of 14 full-time fisheries biologists and up to 8 projects, and represent ODFW on regional and national scientific committees.

Past employment

Fisheries Research Biologist (Project Leader), Oregon Department of Fish and Wildlife, LaGrande, OR. December 1983 to July 1990.
Fisheries Research Biologist (Assistant Project Leader), Oregon Department of Fish and Wildlife, LaGrande, OR. March 1983 to December 1983.
Project Assistant (Experimental Biology Aid), Oregon Department of Fish and Wildlife, LaGrande, OR. Oct. 1982 to March 1983.

Expertise

Expertise in fisheries research project development and implementation, personnel management, budget development and tracking, technical report writing, natural production and supplementation research, hatchery effectiveness, hatchery and wild interactions, life history, harvest assessment, stock assessment, passage evaluation, straying, captive broodstock, statistical analysis, coded-wire tag implementation and assessment, bass and trout ecology, creel censusing.

Recent publications

1998. Status review of the spring chinook salmon hatchery program in the Grande Ronde River basin, Oregon. Lower Snake River Compensation Plan Status Review Symposium, USFWS, Boise, ID.

1998. Status review of the spring chinook salmon hatchery program in the Imnaha River basin, Oregon. Lower Snake River Compensation Plan Status Review Symposium, USFWS, Boise, ID.

1997. Straying of Umatilla River hatchery origin fall chinook salmon into the Snake River. (R. W. Carmichael). *In* Genetic effects of straying of non-native hatchery fish into natural populations (R. S. Waples, convenor). National Oceanic and Atmospheric Administration, Seattle, WA.

1995. Status of supplementing chinook salmon natural production in the Imnaha River basin. *In* Uses and effects of cultured fishes in aquatic ecosystems (H.L. Shramm, Jr., and R.G. Piper, eds.)

1994. A comparison of the performance of acclimated and direct stream released , hatchery-reared steelhead smolts in Northeast Oregon. (Whitesel, T.A., P.T. Lofy, R.W. Carmichael, R.T. Messmer, M.W. Flesher, and D.W. Rondorf) Pages 87-92 *in* High performance fish (D.D. MacKinlay, ed.); Fish Physiology Section, American Fisheries Society, Fish Physiology Association, Vancouver, British Columbia, Canada.

1992. Straying of hatchery origin spring chinook salmon and hatchery:wild composition of naturally spawning adults in the Grande Ronde River basin. (Carmichael, R.W., L.A. Borgerson, and P.A.

Lofy) *In* Salmon management in the 21st century: Recovering stocks in decline. Proceedings of the 1992 Northeast Pacific chinook and coho workshop. American fisheries Society, Bethesda, MD

MaryLouise Keefe, Project Leader, 0.7 FTE

Education

Ph.D., Biological Sciences, University of Rhode Island, August 1990. Dissertation topic: Chemical Ecology of brook trout, Salvelinus fontinalis.

Graduate courses, Oceanography, University of South Florida, 1984.

B.A., Biology, Smith College, May 1983.

Current employment

Oregon Dept. Fish and Wildlife, Fish Research and Development, La Grande, OR. Jan. 6, 1992 - present. Fish and Wildlife Biologist. Project leader for spring chinook salmon early life history, smolt migration, and natural escapement monitoring studies. Oversees and coordinates data collection and necessary project operations. Responsible for coordinating ESA and other research activities in the Grande Ronde basin. Prepares manuscripts, study plans, budgets, reports, permits, detailed sampling plans, and schedules. Assists supervisor in personnel activities. Presents project findings at professional fisheries meetings and to public interest groups.

Past employment

Post-doctoral Research Associate. Rutgers University Marine Field Station, Tuckerton, NJ. Jan. 1, 1991 - Dec. 30, 1991.

Instructor of General Animal Biology. College of Continuing Education, University of Rhode Island, Providence, RI. Sept. 11, 1990 - Jan. 1, 1991.

Instructor of Introductory Biology. Bristol Community College. Fall River, MA. Aug. 27, 1990 - Jan. 1, 1991.

Expertise

Early life history of fishes, salmonid ecology, fish migration, natural escapement monitoring, chemical signals, effects of electrofishing, population dynamics, habitat utilization and preference, and hatchery effectiveness studies.

Recent publications

1997. Accuracy of fork length estimates for chinook salmon and steelhead in compartmented and standard hatchery raceways. (M.C. Hayes, R.C. Carmichael, M. Keefe, and T.A. Whitesel). Prog. Fish Cult.

1996. Investigations into the early life history of spring chinook salmon in the Grande Ronde Basin. (M. Keefe, D.J. Anderson, R.C. Carmichael, B.C. Jonasson) Oregon Dept. of Fish and Wildlife Annual Progress Report.

1995. Smolt migration characteristics and mainstem Snake and Columbia River Detection Rates of PIT-tagged Grande Ronde and Imnaha River naturally produced spring chinook salmon. (Sankovich, P., M. Keefe, and R.W. Carmichael). Annual Progress Report to the Bonneville Power Administration, Portland, OR.

Brian C. Jonasson, Assistant Project Leader, 1.0 FTE

Education

B.S., Fisheries Science, Oregon State University, 1979
M.S., Fisheries Science, Oregon State University, 1984

Current employment

Oregon Department of Fish and Wildlife, Fish Research and Development, La Grande, OR. , October 1982 - present. Assistant Project Leader for spring chinook salmon early life history study. Duties include planning and coordination of field activities; collection, summary, and analysis of field data; writing manuscripts and reports

Past employment

Graduate Research Assistant, Oregon State University, September 1979 - September 1982
Biological Technician, US Forest Service, June 1979 - September 1979
Biological Intern, Weyerhaeuser Company, June 1978 - September 1978

Expertise

Life history studies of fishes, population estimation of salmonids in streams, sampling of stream fish populations, PIT-tagging of salmonids, estimation of stream habitat quantity and quality, fish culture, hatchery effectiveness.

Recent publications

1996. Investigations into the early life history of naturally produced spring chinook salmon in the Grande Ronde River basin. (Jonasson, B. C., R. W. Carmichael, and M. Keefe) Annual Progress Report. Bonneville Power Administration, Portland, OR

1996. Residual hatchery steelhead: characteristics and potential interactions with spring chinook salmon in northeast Oregon. (Jonasson, B. C., R. W. Carmichael, and T. A. Whitesel) Oregon Department of Fish and Wildlife, Fish Research Project, Annual Project Report, Portland.

1995. Early life history study of Grande Ronde River basin chinook salmon. (Keefe, M., D. J. Anderson, R. W. Carmichael, and B. C. Jonasson) Annual Progress Report. Bonneville Power Administration, Portland, OR.

1994. Investigations into the life history of spring chinook salmon in the Grande Ronde River basin. (Keefe, M., R. W. Carmichael, B. C. Jonasson, R. T. Messmer, and T. A. Whitesel) Annual Progress Report. Bonneville Power Administration, Portland, OR.

Paul M. Sankovich, Assistant Project Leader, 1.0 FTE

Education

B.S. in Biology, University of Nevada, May 1987
M.S. in Fishery Resources, University of Idaho, June 1995

Current employment

Oregon Department of Fish and Wildlife, Fish Research and Development, LaGrande OR since August 1995. Assistant Project Leader, spring chinook salmon early life history study in the Grande Ronde River basin. Duties include planning and coordination of field activities, collection and analysis of data, and preparation of manuscripts and reports.

Previous employment

Temporary fishery research technician and fishery research biologist, Hatchery Evaluation Studies and Idaho Supplementation Studies, Idaho Department of Fish and Game, October 1992 - July 1995;
Graduate assistant, University of Idaho, August 1989 - June 1992.

Expertise

Spawning behavior of chinook salmon, migratory behavior of juvenile chinook salmon, hatchery effectiveness and influence of hatchery fish on wild populations, juvenile and adult capture techniques, PIT-tagging methods.

Recent reports

1997. Smolt migration characteristics and mainstem Snake and Columbia River detection rates of Grande Ronde and Imnaha River naturally produced spring chinook salmon. (Sankovich P., R.W. Carmichael, and M. Keefe) Oregon Department of Fish and Wildlife, Fish Research Project 97-56, Annual Progress Report, Portland.

1996. Smolt migration characteristics and mainstem Snake and Columbia River detection rates of Grande Ronde and Imnaha River naturally produced spring chinook salmon. (Sankovich P., R.W. Carmichael, and M. Keefe) Oregon Department of Fish and Wildlife, Fish Research Project 96-28, Annual Progress Report, Portland.

1995. Smolt migration characteristics and mainstem Snake and Columbia River detection rates of Grande Ronde and Imnaha River naturally produced spring chinook salmon. (Sankovich P., R.W. Carmichael, and M. Keefe) Oregon Department of Fish and Wildlife, Fish Research Project 95-37, Annual Progress Report, Portland.

1992. Distribution and spawning behavior of hatchery and natural adult chinook salmon released upstream of weirs in two Idaho rivers. (Sankovich P., and T.C. Bjornn) Idaho Cooperative Fish and Wildlife Research Unit, Technical Report 92-8, University of Idaho, Moscow, Idaho.

J. Vincent Tranquilli, Assistant Project Leader 1.0 FTE

Education

B.S., Zoology, Southern Illinois University at Carbondale, IL. May 1994

M.S., Natural Resource Ecology and Conservation Biology, University of Illinois at Urbana-Champaign, IL. August 1996

Current employment

Oregon Department of Fish and Wildlife, Fish Research and Development. Enterprise, OR. Assistant Project Leader for spring chinook salmon early life history study in the Grande Ronde River Basin. Duties include planning and coordination of field activities, collection and analysis of data, writing manuscripts and reports.

Previous employment

Experimental Biological Aide, Oregon Department of Fish and Wildlife, Fish Research, LaGrande, OR.

Graduate Research Assistant, Illinois Natural History Survey, Center for Aquatic Ecology, Champaign, IL.

Expertise

Conservation genetics, genetic analysis (protein electrophoresis, polymerase chain reaction (PCR), PCR based RFLP analysis, RAPD analysis, Southern blotting, DNA isolation). Salmonidae early life history strategies, collection and tagging methods, population estimation, and habitat utilization and preference.

Recent publications

1996. Molecular Ecology of Bluegill in the Upper Midwest. (J. V. Tranquilli) Masters Thesis, University of Illinois at Urbana-Champaign, IL.

Section 10. Information/technology transfer

Information and recommendations are distributed to local fisheries managers through meetings and monthly and annual reports. Results are presented to the Grande Ronde Model Watershed Board Technical Committee, other Grande Ronde area organizations, and the Oregon Chapter of the American Fisheries Society. Data are provided electronically and by written reports to other projects including, but not limited to, Northeast Oregon Hatcheries (NEOH) Master Plan, Grande Ronde Basin Spring Chinook Captive Broodstock Program, PATH: Plan for Analyzing and Testing Hypotheses, NEOH Grande Ronde (Nez Perce), NEOH Grande Ronde (CTUIR), and STREAMNET.

Congratulations!