7 Management Plan

7.1 Introduction

The information below will be used by subbasin planners and state salmon recovery personnel to aid in the conservation and restoration of the important habitat that will aid in the recovery of the focal species.

The management plan is made up of five components: the vision for the subbasin; biological objectives; strategies; research, monitoring and evaluation; and ESA and CWA requirements. Since the biological objectives are linked to the working hypotheses, we have inserted them here also for better clarity.

Aquatic and terrestrial portions of the management plan were completed independently.

7.2 Vision for the Plan

The vision for the Entiat subbasin plan iso voluntarily bring people together in a collaborative setting to improve communication, reduce conflicts, address problems, reach consensus and implement actions to improve coordinated natural resource management on private and public lands in the Entiat subbasin. The vision is to implement the locally developed, science based subbasin management plan using watershed specific information ultimately leading towards compliance with the federal Endangered Species Act (ESA) and Clean Water Act (CWA). End products will reflect a balance between existing natural resources and human uses and will capitalize on opportunities to improve these values.

Specific goals to move us forward towards this vision under the Watershed Planning Act are as follows:

- Optimize quantity and quality of water to achieve a balance between natural resources and human use both current and projected
- Provide for coexistence of people, fish and wildlife while sustaining lifestyles through planned community growth, and maintaining and/or improving habitats
- No avoidable human-caused mortality of state and federal threatened, endangered and candidate species

Develop and implement an adaptive action plan to address priority issues, emphasizing local customs, culture and economic stability in balance with natural resources. All actions will comply with existing laws and regulations. However, changes to existing laws and regulations will be recommended as needed to attain our common vision and avoid one-size-fits-all solutions.

Recognizing the significance of the roles of limiting factors outside of the watershed and natural events within the watershed, the long-term goal is to have the Entiat River's existing and future habitats contribute to the recovery of listed species and to eventually provide harvestable and sustainable populations of fishes and other aquatic resources.

Since 1993, landowner members of the CRMP Group/EWPU have always insisted that good science be applied to the collection and interpretation of information for all resource elements of concern. They hope that through the continued use of good science, the mission and goals of the group will be met, and with landowner cooperation during implementation, regulating agencies may not find it necessary to apply one-size-fits-all regulations to achieve their management objectives for the Entiat subbasin (CCCD 2004).

7.3 Purpose and Scope

The management plan integrates the vision for the Entiat subbasin with the assessment and inventory. The vision and goals were crafted by the Entiat Planning Unit and are incorporated into the Entiat subbasin plan. The vision and goals also drive for the selection of objectives and strategies for restoration of fish and wildlife habitat and populations, which form the bulk of the management plan.

The scope of the management plan is somewhat narrower than the scope of the assessment or the inventory. The assessment and inventory are designed to guide restoration and management actions by many parties under their own authorities in the course of ongoing efforts to protect and enhance the fish and wildlife populations and the aquatic and terrestrial ecosystems that exist within the Entiat subbasin. The management plan is based on the assessment and inventory, but is specifically designed to act as a draft amendment to the Columbia Basin Fish and Wildlife Program, and to be reviewed and approved by the Northwest Power and Conservation Council (NPCC).

The management plan describes the most effective ways that NPCC and Bonneville Power Administration (BPA) can use funding resources to meet obligations in the Entiat subbasin for protection and mitigation of resources that have been affected by the construction and operation of the Federal Columbia River Power System (FCRPS). As such, the management plan is non-regulatory in nature and contingent on BPA ratepayer funds to construct or improve existing infrastructure, acquire land or protective easements as a means of habitat protection, fund personnel to improve management of natural resources, monitor and research the relationships between management actions and the health of the resource, and fund other actions that protect or restore the health of natural resources that have been negatively impacted by the FCRPS.

7.3.1 Overarching Principles

The Entiat has a long history of citizen participation in resource management efforts. The Planning Unit recognizes the close connection between community well-being and watershed conditions, and as a result a set of basic principles regarding the past, present and future of Subbasin became clear during this planning process. The Planning Unit therefore acknowledges the following overarching principles:

Continued community participation and involvement with the Entiat Watershed Planning Unit is necessary to ensure its future success and achievement of the group's vision and goals

Future projects proposed in the subbasin need to be communicated to and coordinated with the Chelan County Conservation District and Entiat Watershed Planning Unit in order to reduce duplication of effort and assure compatibility with this strategic plan

Monitoring and continual feedback are key to the design of future projects and tracking progress to wards the achievement of desired results

Surface and ground water in the subbasin have a high degree of connectivity; therefore surface and ground water in the watershed should be treated as one source for all water quality, quantity, habitat and instream flow actions

7.4 Subbasin Planning Guidelines

The natural environment including its fish and wildlife resources is society's common cultural heritage. The underlying premise of the Entiat Planning Unit's *Mission* and *Goals* is to prepare and implement a balanced plan of action that plays a key role in the long-term sustainability of society's common cultural heritage within the Entiat subbasin.

The quality of water, a near natural timing, and quantity of water flow (normative hydrograph) are principle indicators of a healthy river ecosystem. These indicators must be improved and monitored to measure the progress of the subbasin plan.

The Entiat subbasin management plan enhances Native Americans' continued exercise of treaty reserved and aboriginal rights for religious, subsistence, commercial, and recreational use of cultural (natural) resources.

The Entiat subbasin management plan is based on voluntary incentives.

The processes of plan preparation, implementation, and amendment, must be open to the public and equitable to all stakeholders.

The costs of plan actions must be estimated in relation to benefits. Alternatives that achieve the highest benefit/cost ratio are preferred. Costs of habitat/species restoration should be mitigated and distributed equitably.

The science, strategies, and art of restoring ecosystems is evolving, hence programs and actions must be monitored and evaluated for effect, and may be altered as necessary.

Balanced sustainable resources management recognizes these basic precepts: a) that the physical and biological environments are functionally interdependent relative to productivity, b) that at any level of function, productivity is finite; c) without actions to restore degraded functions and to protect, avoid, and mitigate impacts to the physical and biological environment, the increasing demands of human population growth would reduce productivity to zero, with unacceptable costs to the cultures and economies of the subbasin.

7.5 Aquatic

7.5.1 Fisheries Biological Objectives

Recovery and maintenance of key populations must achieve two broad objectives:

1. Restore populations to a point where they no longer require the protection of the Endangered Species Act (ESA)

2. Maintain populations at a level that allows meaningful opportunity for tribal and non-tribal hunting and fishing rights.

Achievement of these objectives requires a healthy ecosystem and application of sound management principles. Four parameters form the key to evaluating and measuring the status of a population's health. They are: abundance (population size), population growth rate, population spatial structure and life history diversity. These parameters are reasonable predictors for extinction risks, they reflect general processes that are important to all populations of all species, and they are measurable.

Below is a brief synopsis of the biologic objectives underlying each of these four parameters. This information is derived from the NOAA Fisheries Technical Memorandum NMFS-NWFSC-42 (2000). Although many of the principles established in this work are technically sound, use of NOAA Fisheries concepts in this subbasin plan does not imply adoption of the referenced document. The subbasin plan recognizes the biologic objectives for cutthroat and bull trout contained in the USFWS Draft Bull Trout Recovery Plan, (2004) and incorporates by reference this document and biologic objectives.

Abundance

Populations are large enough to have a high probability of surviving environmental variation of the patterns and magnitudes observed in the past as well as those expected in the future.

Populations have sufficient abundance for compensatory processes to provide resilience to environmental and human caused disturbances.

Populations should be sufficiently large to maintain genetic diversity over a long term.

Populations should be sufficiently abundant to provide important ecological functions throughout its life cycle.

Population Growth Rate

Population natural productivity is sufficient to maintain its abundance above the viable level.

The population that includes naturally spawning hatchery fish exhibits sufficient productivity from naturally produced spawners to maintain population abundance above viability thresholds in the absence of supplemented hatchery production.

Populations exhibit sufficient productivity during fresh water life history stages to maintain abundance above thresholds, even during poor ocean (or other relevant environmental) conditions.

Populations do not exhibit sustained declines in abundance that span multiple generations and affect multiple broodyear cycles.

Populations do not exhibit trends or shifts in traits that portend declines in a population's growth rate.

Population Spatial Structure

Salmonid habitat should not be destroyed faster that is naturally created.

Natural rates of straying among subpopulations should not be substantially increased or decreased by human actions.

Some salmonid habitat should be maintained that appear suitable or marginally suitable, but currently contain no fish.

Key subpopulations (highly productive) should be maintained to support other subpopulations with lower productivity.

Life History Diversity

Human caused changes such as habitat changes, harvest pressures, artificial propagation, and exotic species introduction should not alter variation in traits such as migration timing, age structure, size, fecundity, morphology, behavior, and molecular genetic characteristics.

Natural processes of dispersal should be maintained. Human caused factors should not substantially alter the rate of gene flow among populations.

Natural processes that cause ecologic variation should be maintained.

7.6 Fisheries Habitat Objectives and Desired Future Conditions

7.6.1 Introduction

Habitat objectives are organized in a manner consistent with the information presented in the assessment of the Entiat subbasin plan. The intent is to provide specific and measurable objectives for habitat attributes important to maintain long term viability to native aquatic and riparian dependent species within the subbasin. Resource managers attaining these objectives will provide a baseline for long term environmental desired future conditions. (The following habitat objectives come primarily from "A Framework to Assist in Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Bull Trout Subpopulation watershed Scale" (US Fish and Wildlife Service 1999)).

It is understood that not all environments and habitat are inherently capable of achieving or maintaining these general standards. Human developments will also preclude attainment of these standards in some cases. However, to the extent feasible, the objective of the Entiat subbasin plan is to maintain and improve healthy ecosystems within the Entiat subbasin, via measurable habitat objectives that can be monitored.

7.6.2 Watershed Conditions

Disturbance Regime

Environmental disturbances (wildfire, etc.) are short lived with little or no long term change to the hydrograph. High quality habitats and watershed complexity continue to

provide refuge and rearing space for the expected assemblage of organisms, for all life stages and/or multiple life history forms. Natural processes are stable and resilient to significant changes over time.

Road Density/Location

At the watershed scale (6th field hydrologic unit code – HUC) road densities do not exceed one linear mile per square mile. Roads are maintained to provide adequate drainage and to minimize sediment transport. Valley bottom roads are relocated where feasible to minimize the affects to riparian and floodplain habitat, and functional attributes.

Refugia

Landscape scale habitats capable of supporting strong and significant populations are maintained and are well distributed and connected for the expected assemblage of organisms and for all life stages.

Water Quality

Temperature

Water temperatures will be at or near normative conditions throughout the year. Where possible the 7-day average maximum temperature in a stream reach will not exceed 2-5°C during incubation periods; 4-12°C during juvenile rearing periods and 4-9°C during spawning periods. Also, water temperatures do not exceed 15°C in areas usedby adults during migration thereby providing no thermal barriers to movement.

Sediment

Fine sediment (< 0.85mm) measured in spawning and incubation habitat is less than 12% of the total substrate composition. (If surface fines (< 0.6mm) are included, then total substrate composition should not exceed 20%.

Cobble and gravel substrate embedded by fine sediment/materials in juvenile rearing areas does not exceed 20%.

Contaminants and Nutrients

Low levels of chemical contaminants, waste materials (nutrients) from agricultural, industrial and other sources are measured in surface and ground water systems. There are no stream reaches designated as impaired (303d) under the CWA.

Water Quantity

The watershed hydrograph is at or near normative condition (peak flow, base flow and flow timing characteristics) compared to other watersheds of similar size, geology, and geography.

Riparian/Floodplain Condition

Riparian Condition

Riparian areas provide adequate shade, large woody debris (LWD) recruitment, and habitat protection and connectivity in sub watersheds. Riparian areas provide buffers and includes refugia for sensitive aquatic species (>80% intact). Riparian areas maintain at least 50% similarity of riparian vegetation to the potential natural community/composition.

Floodplain Connectivity

Off-channel and side channel areas are frequently (annually) hydrologically linked to main river. High flows that exceed the natural stream bank capacity are allowed to occur to reduce water velocity and energy within the stream channel and to maintain wetland functions, riparian vegetation, and succession.

In-Channel Conditions

A relatively high degree of in-channel structural diversity exists throughout stream reaches where expected. LWD occupies the channel at greater than 20 pieces per mile. LWD pieces must be >12 in. diameter at the small end and at least 35 ft. in length. Also, there is an adequate source of woody debris available within the riparian corridors for both long and short-term LWD recruitment into the stream channel.

Pool Quantity and Quality

In streams that are greater than 9.8 ft. in wetted width at base flow, large pools (those that occupy most of the channel width and are greater than one meter deep) are commonly found in reaches with adult holding, juvenile summer or overwintering rearing.

Pool frequency is known to be variable, typically depending upon the stream width. Pool frequency in a stream reach closely approximates:

Table 25. Pool frequency in the Entiat subbasin

Wetted width (ft)	#pools/mile
0-5	39
5-10	60
10-15	48
15-20	39
20-30	23
30-35	18
35-40	10
40-65	9
65-100	4

Pools have good cover and cool water, and only minor reduction of pool volume by fine sediment

Off-Channel Habitat

Watersheds have many ponds, oxbows, back waters, and other off-channel areas with adequate hiding cover. Side channels provide areas with low hydrologic energy that act as refuge for juvenile fish, especially during high flow events.

Channel Condition/Dynamics

Channel width to depth ratios, as measured for the stream reach, is at or near the expected normative value as described by Rosgen (1996).

Stream bank condition as measured for the stream reach is approximately 90% stable for approximately 80% of the linear stream channel.

Fish Passage

Man-made barriers present in watershed allow upstream and downstream fish passage at all flows. There are no barriers to fish passage within the subbasin.

Ecological

To the extent possible, non-native and non-desirable species are not present or do not have a significant affect through competition or predation on other native or desired species within the watershed.

7.6.3 Recommendations for Management

Strategies, Objectives, and Near-term Opportunities

The following pages summarize recommendations for management strategies, management objectives and near-term opportunities at both the subbasin scale and for each of the individual assessment units. For each assessment unit important information from the assessment and key findings are summarized. For each of the habitat attributes, recommended management strategies are provided that identify general direction for future management emphasis. For each management strategy, one or more management objectives are listed that imply certain types of actions that might be employed to successfully achieve the management strategy. Concluding the recommendations for each assessment unit, near-term opportunities are suggested.

Near term opportunities are a list of evaluations and potential restoration/enhancement projects that have been identified as having relatively high benefit to subbasin planning goals and objectives. This list is not intended to be comprehensive, nor is it intended to provide the basis for prioritization. Rather, these are projects that could be accomplished within a 10-year time frame and would significantly contribute towards achievement of long term objectives and desired future conditions related to salmon recovery. Due to the nature of the landscape and/or the project type, near-term opportunities are likely to be more easily implemented than many other actions. Many other activities should be considered, although development of these projects is expected to be more complex and requiring more time than available within the scope of this planning process.

Lower Entiat River Assessment Unit

Water Quality

Temperature

- Reduce impact of high temperature on incubation, rearing, and migrating adults so it does not exceed the 7 day average maximum within any reach by 2020

Sediment

- Reverse increasing trend and begin moving sediment loads to12% fines (0.85mm) in spawning gravels by 2020
- Decrease substrate embeddedness conditions throughout the Assessment Unit by 2020

Contaminants

- Maintain toxic pesticide and herbicides within regulatory standards and avoid contact of these materials with water
- Reduce or eliminate waste materials from surface and ground waters from failing septic systems and livestock by 2015
- Evaluate the effect of effluent from the Entiat National Fish Hatchery and maintain water quality at or below regulatory standards

Water Quantity

Flow

- Reduce impact, and increase efficiency of water withdrawal during August and September by 2020
- Decrease severity of high flow events by increasing in-channel structural diversity and restoring geofluvial processes by 2025

Riparian Floodplain

Riparian Condition

- Reestablish riparian vegetation corridors and associated stream canopies where they have been denuded to a minimum of 75% of the estimated historic condition, where feasible by 2025. Prioritize efforts in areas where other channel restoration projects occur.
- Increase the number of large trees (site potential tree height) and complex riparian communities that will eventually increase the natural recruitment of LWD by 2025.
- Reduce impacts to riparian areas from development and livestock management within the riparian area by 2015.
- Reduce road density in riparian areas throughout the Assessment Unit by 2025.

Floodplain Condition/Connectivity

- Minimize affects of development on channel migration zones within the riparian and floodplain, and increase stream sinuosity through active restoration when feasible by 2025.
- Increase, or reconnect floodplain (off-channel) habitats, where feasible, by 2025.
- Maintain and enhance wetland complexes, enhance ground water recharge by 2025.
- Remove bank armoring/dikes where applicable and appropriate by 2025.
- Protect/enhance geo-fluvial processes and floodplain function by 2025.

Road Density / Location

- Reduce road density to less than 1 miles/mi2 by 2030.
- Where feasible, relocate roads from the valley bottoms by 2030.

In-Channel

In-channel

- Increase in-stream structural diversity and complexity to provide refuge to juveniles during high flow events by 2020.
- Increase stream bank stability using active and passive restoration techniques, where feasible, by 2015.
- Increase/restore habitat diversity by increasing off-channel habitat, backwaters with cover and low energy refugia by 2025.
- Evaluate the use of irrigation ditches as a means to increase rearing habitat by 2010.

LWD

- Increase LWD to 20 pieces per mile (12”diameter > 35 ft length) and provide adequate sources for future woody debris recruitment in the riparian areas by 2025.

Pool Frequency and Quality:

- Increase quality pool (20 m2 by 1m deep) to an average of 9 pools per mile (Entiat Watershed Assessment) based on geomorphic type with a relatively high degree of structural diversity suitable for hiding cover by 2025.

Fish Passage Barriers

- Maintain and improve fish passage throughout the Assessment Unit by 2020.

Ecological

Reduce harassment to spawning and pre-spawning adult salmonids by 2010.

- Reduce poaching by 2010.

Predation

- Minimize piscivorous and avian predation on salmonids by 2015.

Food

- Improve nutrient base by 2010.

Hatchery

- Minimize hatchery contribution of pathogens by 2010.
- Minimize negative impacts of hatchery operations by 2010.

Middle Entiat River Assessment Unit

Water Quality

Sediment

- Decrease or maintain sediment loads to less than 12% fines (0.85mm) in spawning gravels throughout the Assessment Unit by 2020.
- Decrease substrate embeddedness conditions in the mainstem and tributaries by 2020.

Water Quantity

Flow

- Moderate severity of high flow events by enhancing floodplain conditions and in-channel complexity by 2025.

Riparian Floodplain

Riparian Condition:

- Improve riparian vegetation corridors and associated stream canopies where they have been degraded to a minimum of 75% of the estimated historic condition, where feasible by 2025
- Increase/maintain the number of large trees (site potential tree height) and complex riparian communities that will eventually increase the natural recruitment of LWD by 2025.
- Reduce impacts from development and livestock management within the riparian area by 2015.
- Reduce road density in riparian areas by 2025.

Floodplain Condition - Connectivity:

- Minimize affects of development on channel migration zones within the riparian and floodplain, and increase stream sinuosity in tributary streams through conservation or active restoration when feasible, by 2025.
- Increase, or reconnect floodplain (off-channel) habitats, where feasible, by 2025.

- Maintain and enhance wetland complexes, enhance ground water recharge by 2025.
- Remove bank armoring/dikes where applicable by 2025.
- Protect/enhance geo-fluvial processes and floodplain function from the moraine to the falls by 2025.

Road Density / Location

- Reduce road density to less than 1 miles/mi2 by 2030.
- Where feasible, relocate roads from the valley bottoms by 2030.

In-Channel

In Channel

- Maintain and enhance in-stream structural diversity and complexity to provide refuge to juveniles during high flow events by 2010.
- Protect and increase in-stream structures (complex log structures) by 2020.
- Increase stream bank stability using active and passive restoration techniques by 2015.
- Maintain and enhance habitat diversity by increasing off-channel habitat, backwaters with cover and low energy refugia by 2025.

LWD:

- Increase LWD to 20 pieces per mile (12"diameter > 35 ft length), restore large wood complexes and provide adequate sources for future woody debris recruitment in the riparian areas by 2025.

Pool Frequency and Quality:

- Increase quality pool (20 m2 by 1m deep) to an average of 9 pools per mile (Entiat Watershed Assessment) based on geomorphic type with a relatively high degree of structural diversity suitable for hiding cover by 2025.

Fish Passage Barriers

- Allow unimpeded access of fish passage throughout the tributaries by 2010.

Ecological

- Reduce or eliminate harassment to spawning and pre-spawning adult salmonids by 2010.
- Reduce or eliminate poaching by 2010.
- Eliminate or reduce impacts of eastern brook trout and hatchery rainbow trout by 2025.
- Maintain bull trout fishing closure and continue tracking bull trout populations.

Predation

- Minimize piscivorous and avian predation on salmonids by 2015.

Food

- Improve nutrient base by 2010.

Hatchery

- Minimize negative impacts of hatchery operations by 2010.
- Evaluate feasibility of coho reintroduction and begin implementation as appropriate.

Upper Entiat River Assessment Unit

Water Quality

Temperature:

- Maintain water temperatures

Sediment: Maintain sediment loads to 12% fines (0.85mm) in spawning gravels.

- Maintain unembedded conditions.

Water Quantity

Flow:

- Maintain the natural hydrograph.

Riparian Floodplain

Riparian Condition:

- Maintain riparian vegetation corridors and associated stream canopies and provide a minimum of 75% of the estimated historic condition, where feasible by 2025
- Maintain the number of large trees and complex riparian communities for natural recruitment of LWD.

In-Channel

In-Channel:

- Maintain in-stream structural diversity and complexity to provide refuge to juveniles during high flow events.

LWD:

- Maintain trend in LWD recruitment

Pool Frequency and Quality:

- Maintain quality pools (20 m2 by 1m deep) based on geomorphic type with a relatively high degree of structural diversity suitable for hiding cover.

Fish Passage Barriers

- Maintain unimpeded access of fish passage throughout the Assessment Unit.

Ecological

- Reduce or eliminate harassment to spawning and pre-spawning adult salmonids by 2010.
- Reduce or eliminate poaching by 2010.
- Eliminate or reduce impacts of eastern brook trout and hatchery rainbow trout by 2025.

Mad River Assessment Unit

Water Quality

Temperature:

- Maintain water temperatures

Sediment:

- Maintain or decrease sediment loads to, 12% fines (0.85mm) in spawning gravels.
- Maintain and/or improve road conditions to minimize or eliminate sediment delivery into the stream channel by 2020.
- Improve sediment (embeddedness) conditions in Tillicum Creek by 2020
- Maintain unembedded conditions in the mainstem.

Water Quantity

- Maintain the natural hydrograph.
- Decrease severity of high flow events by restoring geo-fluvial processes by 2025.
- Relocate roads from the valley bottoms where feasible by 2030.

Riparian Floodplain

Riparian Condition:

- Reestablish riparian vegetation corridors and associated stream canopies where they have been degraded to a minimum of 75% of the estimated historic condition, where feasible by 2025
- Reduce road density in tributaries by 2025
- Protect riparian vegetation and maintain trend in natural recruitment of LWD.

Floodplain Condition:

- Maintain and improve in lower Mad River and other localized areas by 2025.

- Protect fluvial processes and floodplain function by 2025.

Road Density / Location:

- Reduce road density to less than 1 miles/mi2 by 2030.
- Where feasible, relocate roads from the valley bottoms by 2030.

In-Channel

In-Channel:

- Maintain and enhance in-stream structural diversity and complexity in the lower Mad River by 2015.

LWD:

- Maintain trend in natural recruitment of LWD.

Pool Frequency and Quality:

- Maintain quality pools (20 m2 by 1m deep) at an average of 9 pools per mile (Entiat Watershed Assessment) based on geomorphic type with a relatively high degree of structural diversity suitable for hiding cover.

Fish Passage Barriers

- Maintain unimpeded access of fish passage throughout the Assessment Unit.

Ecological

- Reduce harassment to spawning and pre-spawning adult salmonids by 2010.
- Reduce poaching by 2010.

Predation

- Minimize piscivorous and avian predation on salmonids by 2015.

Food

- Improve nutrient base by 2010.

Hatchery

- Minimize negative impacts of hatchery operations by 2010.

7.6.4 Management Strategies

Strategies are set so factions to accomplish the biological goals. Strategies will serve as guidance on proposed projects in the future to achieve the objectives.

General Watershed

- Reduce or eliminate brook trout by removing harvest limit and encouraging public participation through education.

- Hold annual fishing derbies for brook trout.
- Electro-fish brook trout off spawning grounds.

Lower, Middle Entiat River, and Mad River Assessment Units

Water Quality

Temperature:

- Evaluate the effect of temperatures using FLIR, or other technology, on current and potential life histories and habitat use.
- Study egg/juvenile overwinter survival
- Evaluate effects of low temperatures on the productivity of native species.
- Initiate analysis and monitoring of anchor / frazil ice and its effects on macro-invertebrates and fish (spawning and over-winter rearing habitat) and the relationship, if any, to riparian vegetation and floodplain conditions.
- Evaluate effects of side channels and off channel habitat on instream summer temperatures
- Moderate summer water temperatures by improving riparian conditions.
- Use FLIR or other technology to identify winter and summer refugia.

Sediment

- Maintain and improve road conditions to minimize or eliminate sediment delivery into the stream channel.
- Continue monitoring sediment yield on an annual basis.
- Reduce localized streambank erosion.

Contaminants

- Continue upgrades of failing/old septic systems
- Prevent direct access of livestock to streams via fencing
- Reevaluate bioaccumulation of toxins and heavy metals in native fishes within the Entiat subbasin.
- Reduce pesticide and herbicide use near riparian zones by public education and incentive.

Water Quantity

- Investigate and implement programs designed to increase efficiency of water withdrawal.

- Decrease summer surface withdrawals by converting water withdrawals to ground water wells.
- Continue to improve irrigation efficiencies within the lower Entiat.
- Decrease summer surface withdrawals by converting water withdrawals to ground water wells.
- Explore the potential for water storage for late season use.

Riparian Floodplain

Riparian Condition:

- Increase nutrient recruitment of detritus from riparian vegetation by increasing riparian growth and floodplain connectivity.
- Protect and enhance riparian vegetation along unstable stream banks.
- Protect / enhance fluvial processes and floodplain function.
- Preserve high quality riparian patches as refuge habitats.
- Define hyporheic zone with natural flow regimes
- Evaluate fish use of off channel habitats.
- Prevent direct access of livestock to streams via fencing

Floodplain Condition – Connectivity:

- Reconnect and increase side-channel habitat to the main stream channel.
- Where appropriate, establish areas where natural channel migration can occur In-Channel

In-Channel:

- Where appropriate, provide in-stream structures (large wood, rock or other natural materials) that will enhance salmonid habitat diversity, habitat quality and quantity and channel -integrity.

LWD:

- Restore large wood complexes, passively and actively.

Pool frequency and Quality:

- Passively and actively restore in-stream structure that will increase juvenile rearing habitat and geo-fluvial processes that will encourage pool formation.

Ecologic

- Initiate/improve public outreach programs to eliminate harassment and poaching.

- Evaluate the feasibility and implement where appropriate, the introduction of beneficial species to the watershed or subbasin (noxious weed control)
- Evaluate carrying capacity for space and food resources to determine if elevated competition is occurring.

Predation:

- Evaluate piscivorous and avian predation on salmonids.

Pathogens:

- Study presence of pathogens in juveniles and adults.

Hatchery:

- Evaluate the use of artificial production (supplementation) to enhance recovery of target species.
- Continue to evaluate the composition of the Entiat spring Chinook and steelhead.
- Continue to evaluate ecologic interactions between coho and Chinook interactions.
- Continue evaluating spawning interaction between hatchery and wild fish.

Food:

- Evaluate nutrient cycling and carcass increases.
- Monitor and evaluate the productivity of macroinvertebrate production.

Upper Entiat River Assessment Unit

General Watershed

- Manage for cutthroat trout above Entiat Falls and remove brook trout.
- Evaluate bull trout populations above the falls.

Water Quality

Temperature:

- Evaluate the effect of temperatures on current and potential life histories and habitat use.

Sediment:

- Continue monitoring sediment yield on an annual basis.

Water Quantity

- Evaluate the potential for water storage within the subbasin.

Riparian Floodplain

- Restore natural hyporheic zone with natural flow regimes

Ecologic

- Initiate/improve public outreach programs to eliminate harassment and poaching.
- Evaluate the feasibility and implement where appropriate, the introduction of beneficial species to the watershed or subbasin (noxious weed control).

Food:

- Monitor and evaluate the productivity of macroinvertebrate production

7.7 Research, Monitoring, and Evaluation

Research within this plan is based on the objectives and strategies outlined in previous sections. The following compiles most of the recommended elements within the Technical Guide for Subbasin Planners, and also incorporates the hypothesis statements for each assessment unit. Key findings, objectives, and strategies that relate only to the hypothesis statements are also listed to show how they interrelate.

Within the Research section, data gaps are identified within the element of "additional informational needs." The Monitoring and Evaluation section lists various tables from which potential project proponents can determine various indicators to measure and how they relate to strategies.

7.7.1 Working hypotheses

Water Quality

Decreasing elevated summer water temperatures to a maximum of 16 °C throughout the Entiat subbasin will increase survival of spring Chinook, summer/fall Chinook, steelhead, and bull trout in the following life stages: spawning, incubation, emergence, and rearing.

Water Quantity

Maintaining the current flow regime throughout the Entiat Subbasin will support and maintain an increase in survival of spring Chinook, summer/fall Chinook, steelhead, and bull trout in the following life stages: spawning, incubation, emergence, rearing, and pre-spawn holding.

Key findings supporting hypothesis

- Water temperatures are believed to be elevated from historic levels.
- Conditions are exacerbated during low flow years.
- Water temperature typically exceeds state water quality standards from July through September, although exceedences are usually of short duration and diurnal in nature.
- Mainstem and tributary flows are highly variable and very responsive to local weather.
- Peak flow timing is assumed to be at or near historic conditions, with current peak flows showing signs of recovery from past fires.

- Low flows are a natural occurrence within the subbasin.
- Irrigation water use during the low summer flow period, coupled with increased channel width-to-depth ratio in the lower Entiat River, may exacerbate poor conditions.

Biological objectives

1. Reduce impact of temperature on incubation, rearing, and migrating adults so it does not exceed the 7 day average maximum within any reach by 2020.
2. Reduce impact, and increase efficiency of water withdrawal during August and September by 2020.
3. Decrease severity of high flow events by increasing in-channel structural diversity and restoring geo-fluvial processes by 2025.
4. Relocate roads from the valley bottoms where feasible by 2030.
5. Moderate severity of high flow events by enhancing floodplain conditions and in-channel complexity by 2025.

Strategies

1. Moderate summer water temperatures by improving riparian conditions.

Increasing riparian growth will increase shade and associated water cooling. Priority is moderate-high.

2. Use FLIR or other technology to identify winter and summer refugia.

The use of the FLIR or other technology will aid in the measurement and location of those areas that may need to be conserved, or protected. It may also identify areas that are potentially problematic. Priority is high.

3. Decrease summer surface withdrawals by converting water withdrawals to ground water wells.

Moderate increases in ground water use may aid in the reduction of withdrawal of surface water, increasing instream flow. Priority is moderate to high.

Continue to improve irrigation efficiencies within the lower Entiat.

Increased efficiency will aid in the reduction of withdrawal, thus increasing instream flow. Priority is high.

4. The priorities of the strategies are based on the potential impacts and feasibility of implementing programs that would occur under these strategies.

Research

Additional informational needs (data gaps)

1. Effect of temperatures on current and potential life histories and habitat use.

The effect of extreme high and low temperatures on current and potential life histories and habitat use is not well known.

2. Effects of side channels and off channel habitat on instream summer temperatures.

Side channels may incorporate ground water that is currently not available that may cool temperatures.

3. Evaluate the potential for water storage within the subbasin.

Water is available for storage during certain periods, however potential sites for water storage (off-channel, aquifer, other) have not been identified or evaluated.

4. Monitor actual water use.

Actual water use has not been documented.

Approach (general experimental design)

- Installation of temperature recorders at strategic locations.
- Use of FLIR technology for all seasons.
- Evaluate potential ground water infusion sites.
- Implement a feasibility study to determine likely water storage sites

Statistical analyses

- Both descriptive statistics and graphing methods will be used to analyze data.

Spatial scale

- Temperature recorders will be installed in areas that do not have current temperature information throughout the lower and middle Assessment Units.
- Potential off-channel habitat sites should be identified throughout the lower and middle Assessment Units.
- Potential water storage would need to be upstream of current withdrawals, if it was the most cost effective strategy.

Temporal scale

- Temperature recordings should be on-going indefinitely.
- Potential off-channel habitat sites should be identified within two years
- Potential water storage sites should be located within two years.

Budget

- To be determined, although it is assumed that a consortium of agencies would take the lead in this effort.

Deliverable

- Draft annual report due December 15 of the year the research takes place
- Final annual progress reports due March 1 of the year following the research
- Final report due by July 1 after the final year of research

Data

- Data will be collected and entered in either spreadsheet or data base format, as agreed to by the lead agencies.
- Data will be stored by the lead agency, unless other collaboratively agreed upon arrangements are made.
- All data will be available upon request to other agencies or the public

7.7.2 Working hypotheses

Water Quality

Reducing point source and/or non-point source pollution in the Lower and Middle reaches will increase survival of spring Chinook, summer/fall Chinook, steelhead, and bull trout in the following life stages: spawning, incubation, emergence, rearing, and pre-spawn holding.

Riparian Floodplain

Increasing riparian shade will decrease instream temperatures thus increasing survival of spring Chinook, summer/fall Chinook, steelhead, and bull trout in the Lower and Middle Entiat for the following life stages: spawning, incubation, emergence, rearing, and pre-spawn holding.

Improving or restoring riparian floodplain will increase floodplain function and overall health within the Lower and Middle Entiat, and the Mad River.

Contaminants

Maintaining or lowering contaminant levels within the Lower and Middle Entiat to at or below Clean Water Act standards will prevent 303d listings and increase the health and survival of all focal species using the areas.

In-channel Habitat

Increased channel complexity and diversity will increase survival of spring Chinook, summer/fall Chinook, steelhead, and bull trout in the Lower and Middle Entiat for the following life stages: spawning, incubation, emergence, rearing, and pre-spawn holding.

Sediment

Maintaining or reducing sediment loads will increase survival of spring Chinook, summer/fall Chinook, steelhead, and bull trout in the Lower and Middle Entiat for the following life stages: spawning, incubation, emergence, rearing, and pre-spawn holding.

Nutrients

Increasing nutrient loads will increase survival of spring Chinook, summer/fall Chinook, steelhead, and bull trout in the Lower and Middle Entiat for the following life stages: spawning, incubation, emergence, rearing, and pre-spawn holding

Harassment

Reduction of harassment will increase survival of spring Chinook, summer/fall Chinook, steelhead, and bull trout in the Lower and Middle Entiat for the following life stages: spawning and pre-spawn holding.

Barriers

Providing passage to native salmonids will increase survival of spring Chinook, summer/fall Chinook, steelhead, and bull trout in the Lower and Middle Entiat for the following life stages: spawning, incubation, emergence, rearing, and pre-spawn holding.

Key findings supporting hypothesis

- Water temperatures are believed to be elevated from historic levels.
- Conditions are exacerbated during low flow years.
- Water temperature typically exceeds state water quality standards from July through September, although exceedences are usually of short duration and diurnal in nature.
- The use of herbicides and pesticides in lower Entiat may affect focal species health.
- The Lower Entiat lies within the depositional zone of the subbasin.
- Road densities, unstable banks, and natural/human caused disturbance events all contribute to fine sediment conditions.
- The 11-year trend of sediment deposition appears to be increasing in the lower AU and decreasing in the middle and Mad AUs.
- Irrigation water use during the low summer flow period, coupled with increased channel width-to-depth ratio in the lower Entiat River, may exacerbate naturally occurring poor conditions.
- Riparian conditions near confluence with the Columbia River show substantial vigor and contribute positively to stream channel diversity and properly functioning conditions.
- Channel straightening, clearing and diking/bank armoring have substantially changed riparian and floodplain conditions.
- Riparian cover is reduced (in various degrees) and LWD recruitment ranges from poor to fair. Filling and diking has eliminated floodplain connection in areas.

- In some reaches, loss of vigorous shrubs in the riparian zone has reduced instream organic input and shade, and contributed to unstable stream banks and associated erosion.
- Channel morphology has been significantly simplified as a result of mid-1900's channel straightening / widening, diking, and bank armoring.
- The lower Entiat has been changed in many reaches to a Rosgen F type channel, resulting in a high width-to-depth ratio, channelization, stream down-cutting, and a substantial lack of habitat diversity.
- Pool habitat has been reduced significantly from historic conditions.
- Quality and quantity of rearing and holding habitat, off-channel winter rearing habitat, and spawning habitat are considered to be fair to poor throughout most of the Lower Entiat River.
- There are no physical structures in the lower mainstem Entiat River.
- Food resources (macro invertebrate production) for juvenile salmonids have likely decreased since the historic reference condition as a result of increased water temperatures and decreased organic inputs and nutrient loads.
- Reduced salmonid carcasses, reduced riparian / leaf litter and reduced floodplain function may have contributed to a lowering of the nutrient content and benthic macro invertebrate production within the lower Entiat.
- Harassment of adult salmonids is largely a function of lack of hiding cover coupled with recreation use of the river.
- At this time there is no formal public outreach to educate people of the sensitivity of these fish to disturbance, especially during adult holding and spawning times.
- Riparian clearing and roading has likely resulted in bank erosion and increased sediment delivery in some areas.
- Riparian clearing and roading has resulted in a loss of side channel habitats, backwater pools and stream / riparian interface.
- General channel features, such as sinuosity, width/depth ratios exhibit near normal features. Localized bank erosion, and loss of habitat diversity and channel complexity is apparent due to stream channel clearing and development.
- In low-gradient areas, loss of side channel habitat has resulted in a loss of off-channel refugia during high flows.
- Passage in several tributary streams is hindered or blocked, primarily for juvenile life stages.
- The amount of habitat upstream of tributary culvert barriers is limited.

Biological objectives

1. Reduce toxic pesticide and herbicides in the riparian areas and water system so that stress, cumulative effects and/or direct mortality on all fish species for all life stages have been eliminated by 2025.
2. Reduce or eliminate waste materials from surface and ground waters from failing septic systems and livestock by 2015.
3. Reduce or maintain effluent for Entiat National Fish Hatchery at or below CWA standards by 2010.
4. Decrease sediment loads to 12% fines (0.85mm) in spawning gravels by 2020.
5. Improve substrate embeddedness conditions in tributaries by 2020.
6. Reestablish riparian vegetation corridors and associated stream canopies where they have been denuded to a minimum of 75% of the estimated historic condition, where feasible by 2025
7. Increase the number of large trees (site potential tree height) and complex riparian communities that will eventually increase the natural recruitment of LWD by 2025.
8. Restore (lower AU), maintain and enhance (middle AU and Mad AUs) in-stream structural diversity and complexity to provide refuge to juveniles during high flow events by 2020.
9. Increase stream bank stability using active and passive restoration techniques, where feasible, by 2015.
10. Protect and increase in-stream structures (complex log structures) by 2020.
11. Increase stream bank stability using active and passive restoration techniques by 2015.
12. Maintain and enhance habitat diversity by increasing off-channel habitat, backwaters with cover and low energy refugia by 2025.
13. Allow unimpeded access of fish to spawning and rearing areas by 2020.
14. Reduce harassment to spawning and pre-spawning adult salmonids by 2010.
15. Reduce poaching by 2010.
16. Improve nutrient base by 2010.

Strategies

1. Maintain and improve road conditions to minimize or eliminate sediment delivery into the stream channel.

Improving road conditions will reduce bank failure and subsequent sediment delivery. Priority mod-high.

2. Continue upgrades of failing/old septic systems.

This strategy will decrease non-point source contaminants. Priority mod-high.

3. Prevent direct access of livestock to streams via fencing

Removing livestock from riparian areas will increase riparian growth and reduce potential source of contaminants. Priority moderate.

4. Initiate/improve public outreach programs to eliminate harassment and poaching.

Improving public knowledge should decrease the likelihood of local people harming focal species. Priority moderate.

5. Evaluate effects of low temperatures on the productivity of native species.

Understanding egg and juvenile fish survival during winter will aid managers in setting realistic recovery levels. Priority moderate.

6. Initiate analysis and monitoring of anchor / frazil ice and its effects on macro-invertebrates and fish (spawning and over-winter rearing habitat) and the relationship, if any, to riparian vegetation and floodplain conditions.

Ice complexes may scour aquatic and terrestrial habitat when in movement. Priority mod-low.

7. Evaluate effects of side channels and off channel habitat on instream summer temperatures

Infusion of ground water may decrease high summer temperatures. Priority mod-high.

8. Evaluate nutrient cycling and carcass increases.

Understanding nutrient relationships will aid in our understanding of focal species productivity. Priority moderate.

9. Monitor and evaluate the productivity of macroinvertebrate production

    Macroinvertebrates are important food items for juvenile focal species. Priority moderate.

10. Evaluate the feasibility and implement where appropriate the introduction of beneficial species to the watershed or subbasin. (noxious weed control)

Removing noxious weeds will aid in the recovery of riparian areas. Priority mod-high.

11. Evaluate carrying capacity for space and food resources to determine if elevated competition is occurring.

Understanding carrying capacity will aid managers in setting realistic recovery levels. Priority moderate.

12. Restore large wood complexes

Restoration of large wood complexes will increase juvenile rearing and adult holding habitat, help create additional pools and general habitat diversity. Priority high.

13. Reconnect and increase side-channel habitat to the main stream channel

Reconnecting side channels will increase habitat diversity and increase juvenile productivity. Priority high.

14. Where appropriate, establish areas where natural channel migration can occur

Reconnecting side channels will increase off channel rearing and habitat diversity and increase juvenile productivity. Priority high.

15. Where appropriate, provide in-stream structures (large wood, rock or other natural materials) that will enhance salmonid habitat diversity, habitat quality and quantity and channel -integrity.

16. Restoration of large wood complexes will increase juvenile rearing and adult holding habitat, help create additional pools and general habitat diversity. Priority high.

The priorities of the strategies are based on the potential impacts and feasibility of implementing programs that would occur under these strategies.

Research

Additional informational needs (data gaps):

- Reevaluate bioaccumulation of toxins and heavy metals in native fishes within the Entiat subbasin. The level and extent of DDT/PCB contamination is unknown. Bioaccumulation of toxins and heavy metals in native fishes should be reevaluated.
- Define hyporheic zone with natural flow regimes. The extent of the hyporheic zone has not been delineated under natural flow regime.
- Fish use of off channel habitats. Fish use of off channel habitats has not been determined.
- Assess fish passage. The effects of potential thermal barriers on late-run Chinook are unknown. The extent to which some irrigation pumps / diversions and tributary culverts may not meet standards for fish passage and/or screening has not been assessed.
- Evaluate nutrient cycling, carcass increases, and productivity of macroinvertebrate production. Nutrient cycling, the effects of carcass supplementation, and the health/productivity of macroinvertebrate populations have not been evaluated.
- Continue monitoring sediment yield on an annual basis. Monitoring of fine sediment yield on an annual basis should continue.
- Document disparity between actual water use and the amount of water represented by rights and claims. This will increase water use efficiency.
- Determine areas of surface water-groundwater interchange and subsurface water movement. This will increase our ability to moderate temperatures.

- Determine the effects of cold water temperature and anchor ice on egg and fry survival. Understanding these processes will increase our ability to set realistic recovery goals.
- Assess extent to which some irrigation pumps / diversions and tributary culverts meet standards for fish passage and/or screening Rectifying these problems will increase juvenile survival and increase habitat availability.
- Determine areas for in-stream structure placement. Strategic sites need to be identified before structures can be placed in the stream channel.

Approach (general experimental design)

- Sample (bioassays) and monitor toxins in fish tissue.
- Monitor temperature

1. for ground water infusion (FLIR)
2. barrier for adults (temperature gauges)
3. over-winter survival of eggs and juveniles (temperature gauges, FLIR)

- Passive restoration of riparian areas (fencing only)
- Active restoration of riparian areas (fencing, plantings, etc.)
- Placement of in-stream structures, where appropriate (active).
- Encourage in-stream structure (passive).
- Remove or set back dikes where appropriate
- Water quality sampling

1. nutrient load (could be effectiveness monitoring)
2. toxins

- Snorkeling surveys to:

1. observe focal species within off channel habitats;
2. determine life history needs of focal species.
3. effectiveness monitoring of in-stream structures

- Electrofish:

To determine numbers and diversity of fish within a sample reach

- Monitor migration of adult summer/fall chinook in relationship to temperature.
- Sample nutrient load within sample reaches.
- Sample for sediment deposition on regular schedule.

Statistical analyses

- Both statistical and graphical methods will be used to analyze data. Statistical methods will include descriptive statistics, trend analysis (changes in trend before and after implementation of management actions), multiphase regression, and t-tests with before-after and before-after-control-impact designs. Depending on the characteristics of the data, nonparametric procedures like the randomization test, Wilcoxon rank sum test, or the Mann-Whitney test may be used.

Spatial scale

- Various sample reaches within all assessment units.

Temporal scale

- Some monitoring should occur on an annual basis.
- Most other work could be completed within five years.

Budget

- To be determined, although it is assumed that a consortium of agencies would take the lead in this effort.

Deliverable

- Draft annual report due December 15 of the year the research takes place
- Final annual progress reports due March 1 of the year following the research
- Final report due by July 1 after the final year of research

Data

- Data will be collected and entered in either spreadsheet or data base format, as agreed to by the lead agencies.
- Data will be stored by the lead agency, unless other collaboratively agreed upon arrangements are made.
- All data will be available upon request to other agencies or the public

Working hypotheses

Exotic Species

Reduction in exotic species will increase survival of steelhead, bull trout and westslope cutthroat trout in the Middle and Upper Entiat for the following life stages: spawning, incubation, emergence, rearing, and pre-spawn holding.

General Habitat

Maintaining current habitat conditions will increase the probability of success for programs initiated in other parts of the subbasin to increase productivity of focal species.

Key findings supporting hypothesis

- Brook trout have been introduced and remain in this assessment unit.
- Exogenous rainbow trout are also established.
- Water quality is at pristine condition.
- Flows are at or near the historic reference condition.
- Riparian and floodplain attributes are stable and considered to be in good to excellent condition and are at or near the historic reference condition.
- Some localized compaction and disturbance of riparian vegetation is noted due primarily to trails / recreation, although these are minor at the watershed scale.
- In-channel attributes are considered to be in good to excellent condition and near historic reference condition.
- There are no man-made barriers to fish passage in these Assessment Units.

Biological objectives

1. Eliminate or reduce impacts of eastern brook trout and hatchery rainbow trout by 2025.
2. Maintain water temperatures
3. Maintain sediment loads to 12% fines (0.85mm) in spawning gravels.
4. Maintain unembedded conditions.
5. Maintain the natural hydrograph.
6. Maintain riparian vegetation corridors and associated stream canopies and provide a minimum of 75% of the estimated historic condition, where feasible by 2025
7. Maintain the number of large trees and complex riparian communities for natural recruitment of LWD.
8. Maintain in-stream structural diversity and complexity to provide refuge to juveniles during high flow events.
9. Maintain trend in LWD recruitment
10. Maintain quality pools (20 m^2 by 1m deep) based on geomorphic type with a relatively high degree of structural diversity suitable for hiding cover.
11. Maintain unimpeded access of fish passage throughout the Assessment Units.
12. Reduce or eliminate harassment to spawning and pre-spawning adult salmonids by 2010.
13. Reduce or eliminate poaching by 2010.

Strategies

- Reduce or eliminate brook trout by removing harvest limit and encouraging public participation through education.

Educating the public to the negative effects of brook trout on focal species will increase the probability of public support and help for removal. Priority high.

- Hold annual fishing derbies for brook trout.

Fishing derbies may assist fishery managers in the effort to reduce the impact of brook trout. Priority mod.-low.

- Electro-fish brook trout off spawning grounds.

Hook and line fisheries will most likely need to be supplemented to effectively reduce/remove brook trout populations within the basin. Priority mod.-high.

- Manage for cutthroat trout above Entiat Falls and remove brook trout.

Reduction of brook trout will reduce potential negative interactions with westslope cutthroat trout.

- Evaluate bull trout populations above the falls.

Distribution throughout the basin is poorly understood.

- Evaluate the effect of temperatures on current and potential life histories and habitat use.

Understanding life history requirements will aid in recovery of focal species.

- Evaluate the potential for water storage within the subbasin.

A water storage facility in the upper basin would moderate water withdrawal in the lower basin and potentially moderate naturally limiting water temperatures.

- Initiate/improve public outreach programs to eliminate harassment and poaching.

Without public buy-in for reduction of poaching and harassment, efforts will most likely be futile.

- Monitor and evaluate the productivity of macroinvertebrate production.

Macroinvertebrate populations are key for juvenile food.

The priorities of the strategies are based on the potential impacts and feasibility of implementing programs that would occur under these strategies.

Research

Additional informational needs (data gaps)

- Reevaluate bioaccumulation of toxins and heavy metals in native fishes within the Entiat subbasin.

- Evaluate the effect of temperatures on current and potential life histories and habitat use.
- Feasibility study for water storage within the subbasin.
- Surveys to determine presence of bull trout populations above Entiat Falls.
- Survey to determine bull trout abundance and distribution throughout the Entiat Watershed.
- Evaluate effects of hatchery stocking programs on current native populations of rainbow and cutthroat trout.
- Evaluate effects of brook trout on native species and extent of genetic alteration within the native fish populations
- The variability of stream channel sinuosity, width/depth ratio, and riparian coverage from fixed stations is not well understood in middle AU.
- The extent that the public harasses fish is not well understood, especially at high use areas, such as campgrounds.

Approach (general experimental design)

- Sample (bioassays) and monitor toxins in fish tissue.
- Monitor temperature

for ground water infusion (FLIR)

over-winter survival of eggs and juveniles (temperature gauges, FLIR)

- Water quality sampling

nutrient load (could be effectiveness monitoring)

toxins

- Snorkeling surveys to:
    1. determine life history needs of focal species.
    2. determine negative interactions between focal and exogenous species
- Electrofish:

to determine numbers and diversity of fish within a sample reach
Sample nutrient load within sample reaches.

Statistical analyses

- Both statistical and graphical methods will be used to analyze data. Statistical methods will include descriptive statistics, trend analysis (changes in trend before and after implementation of management actions), multiphase regression, and t-tests with before-after and before-after-control-impact designs. Depending on the characteristics

of the data, nonparametric procedures like the randomization test, Wilcoxon rank sum test, or the Mann-Whitney test may be used.

Spatial scale

- Various sample reaches within both assessment units.

Temporal scale

- Some monitoring should occur on an annual basis.
- Most other work will be completed within five years.

Budget

- To be determined, although it is assumed that a consortium of agencies would take the lead in this effort.

Deliverable

- Draft annual report due December 15 of the year the research takes place
- Final annual progress reports due March 1 of the year following the research
- Final report due by July 1 after the final year of research

Data

- Data will be collected and entered in either spreadsheet or data base format, as agreed to by the lead agencies.
- Data will be stored by the lead agency, unless other collaboratively agreed upon arrangements are made.
- All data will be available upon request to other agencies or the public

Monitoring and Evaluation

The monitoring and evaluation (M&E) section of this plan incorporates the general approach outlined within the Technical Guide for Subbasin Planners. Within this plan, a potential framework and steps are identified to help design the M&E plan, however this information is still considered very preliminary. This potential framework has been broken down into tables to incorporate the information easily for potential project planners. One additional step is included; a table showing "commonality" between the monitoring needs. This was developed to show that many of the methods employed or indicators measured, will be able to be used over more than one strategy.

This framework is consistent with the Moniotoring Stategy for the Upper Columbia Basin (February 2004) incorporated in this document as Appendix B.

Table 26. Monitoring and evaluation indicators for all assessment units.

General characteristics	Specific indicators	Main Strategies									
Biological		***Reduce or eliminate brook trout***	***Moderate summer and winter temperature***	***Identify summer and winter refugia***	***Reduce sediment***	***Determine contaminant levels***	***Reduce impacts of water withdrawal***	***Increase riparian area and function***	***Increase off-channel habitat***	***Increase in-channel diversity and structure***	***Reduce poaching and harassment***
Adults	Escapement/ Number	X		X							X
	Age structure										
	Size										
	Sex ratio										
	Run timing	X	X								X
	Origin (hatchery/ wild)										
	Fecundity										
Redds	Number	X					X				
	Distribution	X	X				X				
	Egg survival				X						
	Timing		X				X				
Parr/	Abundance	X	X	X			X	X	X	X	

General characteristics	Specific indicators	Main Strategies									
Biological		***Reduce or eliminate brook trout***	***Moderate summer and winter temperature***	***Identify summer and winter refugia***	***Reduce sediment***	***Determine contaminant levels***	***Reduce impacts of water withdrawal***	***Increase riparian area and function***	***Increase off - channel habitat***	***Increase in-channel diversity and structure***	***Reduce poaching and harassment***
Juveniles	Distribution/ Habitat use	X	X	X			X	X	X	X	
	Size	X	X	X			X	X	X	X	
Interactions	Predator/ prey	X						X	X	X	
	Displacement	X	X	X				X		X	
	Interbreed	X									
Habitat											
Water Quality	MWMT and MDMT		X	X			X	X		X	
	Turbidity				X						
	Conductivity					X					
	pH					X					
	Dissolved oxygen		X	X		X	X				
	Nitrogen					X					
	Phosphorus					X					

General characteristics	Specific indicators	Main Strategies									
Biological		***Reduce or eliminate brook trout***	***Moderate summer and winter temperature***	***Identify summer and winter refugia***	***Reduce sediment***	***Determine contaminant levels***	***Reduce impacts of water withdrawal***	***Increase riparian area and function***	***Increase off - channel habitat***	***Increase in-channel diversity and structure***	***Reduce poaching and harassment***
Habitat Access	Road crossings			X				X	X		
	Diversion dams			X			X		X		
	Timing		X	X					X		
	Barriers			X			X		X		
Habitat Quality	Dominant substrate			X	X	X		X		X	
	Embeddedness			X	X			X		X	
	Depth fines				X			X		X	
	LWD (pieces/km)			X				X	X	X	
	Pools (pools/km)			X			X			X	
	Residual pool depth			X			X			X	
	Fish cover			X			X	X	X	X	
	Side channels and backwaters			X	X		X	X	X	X	

General characteristics	Specific indicators	Main Strategies									
Biological		***Reduce or eliminate brook trout***	***Moderate summer and winter temperature***	***Identify summer and winter refugia***	***Reduce sediment***	***Determine contaminant levels***	***Reduce impacts of water withdrawal***	***Increase riparian area and function***	***Increase off-channel habitat***	***Increase in-channel diversity and structure***	***Reduce poaching and harassment***
Channel condition	Stream gradient			X	X	X			X	X	
	Width/depth ratio		X	X	X		X	X	X	X	
	Wetted width			X	X		X	X	X	X	
	Bankfull width			X	X		X	X	X	X	
	Bank stability				X			X	X	X	
Riparian Condition	Riparian structure		X	X	X			X	X	X	
	Riparian disturbance				X			X	X	X	X
	Canopy cover		X		X			X			X
Flows and Hydrology	Streamflow		X	X	X		X	X	X	X	
Watershed Condition	Watershed road density				X			X	X	X	
	Riparian-road index				X			X	X	X	

General characteristics	Specific indicators	Main Strategies									
Biological		***Reduce or eliminate brook trout***	***Moderate summer and winter temperature***	***Identify summer and winter refugia***	***Reduce sediment***	***Determine contaminant levels***	***Reduce impacts of water withdrawal***	***Increase riparian area and function***	***Increase off - channel habitat***	***Increase in-channel diversity and structure***	***Reduce poaching and harassment***
	Land ownership				X	X	X	X	X	X	X
	Land use			X	X	X	X	X	X	X	X

Table 27. Commonality between monitoring needs for the Enitat subbasin

Category	Metric or method	*Reduce or eliminate brook trout*	*Moderate summer and winter tempera-ture*	*Identify summer and winter refugia*	*Reduce sed-iment*	*Determine contamin-ant levels*	*Reduce impacts of water withdrawal*	*Increase riparian area and function*	*Increase off - channel habitat*	*Increase in-channel diversity and structure*	*Reduce poaching and harass-ment*
Adults	Spawning ground surveys	X	X				X	X			X
	Estimate of abundance	X					X	X			X
	Interactions with native species	X	X	X			X			X	
	Interaction with exogenous species	X	X	X			X			X	
	Bioassay					X					
	Movement	X	X	X			X	X		X	
	Run timing		X	X			X				
Egg Juveniles	Emergence timing	X	X	X	X						
	Egg survival		X		X						
	Distribution	X	X	X			X	X	X	X	
	Interactions with native species	X	X	X			X		X	X	

Category	Metric or method	*Reduce or eliminate brook trout*	*Moderate summer and winter tempera-ture*	*Identify summer and winter refugia*	*Reduce sed-iment*	*Determine contamin-ant levels*	*Reduce impacts of water withdrawal*	*Increase riparian area and function*	*Increase off - channel habitat*	*Increase in-channel diversity and structure*	*Reduce poaching and harass-ment*
	Interaction with exogenous species	X	X	X			X		X	X	
	Bioassays					X					
	Abundance	X	X	X			X	X	X	X	
Methods-fish	Snorkel	X	X	X			X	X	X	X	
	Electro-fish	X	X				X	X	X	X	
	Active tag & track	X	X	X			X		X	X	
	Hook & line	X									
	Creel survey	X									
Methods-habitat	Passive restoration		X		X			X	X	X	X
	Active restoration		X		X			X	X	X	X
	Instream structures				X				X	X	X
	FLIR		X	X							
	Temperature recorders		X	X				X			
	McNeil core sampling				X						

Category	Metric or method	*Reduce or eliminate brook trout*	*Moderate summer and winter tempera-ture*	*Identify summer and winter refugia*	*Reduce sed-iment*	*Determine contamin-ant levels*	*Reduce impacts of water withdrawal*	*Increase riparian area and function*	*Increase off - channel habitat*	*Increase in-channel diversity and structure*	*Reduce poaching and harass-ment*
	Increase ground water use						X				
	Storage reservoir						X				
	Remove or set back dikes		X					X	X		

Table 28. Planning, design, and standards for the Entiat subbasin

Category	Metric/ responsibility	Reduce or eliminate brook trout	Moderate summer and winter temperature	Identify summer and winter refugia	Reduce sediment	Determine contaminant levels	Reduce impacts of water withdrawal	Increase riparian area and function	Increase off -channel habitat	Increase in-channel diversity and structure	Reduce poaching and harassment
Evaluation planning	Evaluation responsibility	WDFW, USFS, USFWS, YN	EPU, USFS, DOE, YN	EPU, USFWS, USFS, WDFW, YN	EPU, USFS, DOE, YN	DOE, WDFW, USFWS, YN	EPU, DOE, USFWS, USFS, YN	EPU, DOE, USFWS, USFS, YN	EPU, DOE, USFWS, USFS, YN	EPU, DOE, USFWS, USFS, YN	WDFW, YN
	Decision responsibility	USFWS, WDFW, YN	DOE, YN	USFWS, WDFW, YN	USFS, YN	DOE, YN	DOE, YN	EPU, YN	WDFW, YN	WDFW, YN	WDFW, YN
	Public feedback	2x/yr	4x /yr	2 x/yr	4 x /yr	2 x/yr	4 x /yr	4 x /yr	4 x /yr	4 x /yr	4 x /yr
	Potential cost share (mostly personnel)	USFWS, USFS, WDFW, YN	USFS, DOE, USFWS, YN	USFWS, USFS, WDFW, YN	USFS, DOE, USFWS, YN	DOE, WDFW, USFWS, YN	USFS, DOE, USFWS, YN	USFS, DOE, USFW, YNS	USFS, DOE, USFWS, YN	USFS, DOE, USFWS, YN	WDFW, EPU, YN
Sampling design*	Monitoring	S/T & E	S/T	S/T	S/T	S/T	S/T	S/T & E	S/T & E	S/T	S/T
	Frequency	3 x/yr	Continuously	4 x in summer and then again in winter	Quarterly, plus after major events	2 x/yr	Low flow during late summer	3 x/yr	3 x/yr	3 x/yr	Contin-uously
	Methods	Snorkel, electro-shocking	FLIR (winter), and gauges	Snorkel	McNeil core samples	Bioassay	Increased use of ground water, storage reservoir	Active and passive restoration	Remove or set back dikes, use of irrigation cannels for rearing,	Instream structure, more LWD recruitment	Public education, outreach, public "enforce-ment"
Statistical	Significance level	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Category	Metric/ responsibility	Reduce or eliminate brook trout	Moderate summer and winter temperature	Identify summer and winter refugia	Reduce sediment	Determine contaminant levels	Reduce impacts of water withdrawal	Increase riparian area and function	Increase off-channel habitat	Increase in-channel diversity and structure	Reduce poaching and harassment
ns	Hypothesis	Middle and Upper AUs	Lower AU	Lower Entiat and Mad AUs	Lower AU	Lower, Middle, Mad AUs	Lower AU	Lower AU	Lower AU	Lower and middle Aus	All AUs
Performance standards	Reference	Presumed effects	Current conditions	Current conditions	Current rats of deposition	Current levels	Current levels	Current area	Current condition	Current condition	Current level
	Desired effect	Low or no numbers of brook trout left	Lower summer and higher winter temperatures	Increase in the area that juvenile fish hold in critical periods	Long term trend of reduced rates of deposition	Reduce (or no increase) in current levels	More instream flow	More riparian area	More fish habitat	Increased cover and resting areas	Reduced or none

E = Effectiveness; S/T = status/trend monitoring

Table 29. Data information and archive

		Reduce or eliminate brook trout	***Moderate summer and winter temperature***	***Identify summer and winter refugia***	***Reduce sediment***	***Determine contaminant levels***	***Reduce impacts of water withdrawal***	***Increase riparian area and function***	***Increase off - channel habitat***	***Increase in-channel diversity and structure***	***Reduce poaching and harassment***
Quality Assurance/ control	Agency responsible for developing QA/QC	USFWS, WDFW, YN	DOE, YN	USFWS, WDFW, YN	USFS, YN	DOE, YN	DOE, YN	EPU, YN	WDFW, YN	WDFW, YN	WDFW, YN
Data management	Format	PDA in field	PDA in field	PDA in field	PDA in field	PDA in field	PDA in field	PDA in field	PDA in field	PDA in field	n.a.
	Stored	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	n.a.
	Updated	2 x/yr	2 x/yr	2 x/yr	2 x/yr	2 x/yr	2 x/yr	2 x/yr	2 x/yr	2 x/yr	2 x/yr
	Access	Updates, Drafts, website	Updates, Drafts, website	Updates, Drafts, website	Updates, Drafts, website	Updates, Drafts, website	Updates, Drafts, website	Updates, Drafts, website	Updates, Drafts, website	Updates, Drafts, website	n.a.
Report preparation	Format	Technical memo.	Formal report	Formal report	Formal report	Formal report	Formal report	Formal report	Formal report	Formal report	Update memo.
	Presentation	Updates, final	Updates, final	Updates, final	Updates, final	Updates, final	Updates, final	Updates, final	Updates, final	Updates, final	Updates
	Incorporation of comments	After sent to regional biologists for input	After sent to regional biologists for input	After sent to regional biologists for input	After sent to regional biologists for input	After sent to regional biologists for input	After sent to regional biologists for input	After sent to regional biologists for input	After sent to regional biologists for input	After sent to regional biologists for input	Continuously

Table 30. Evaluation

		Reduce or eliminate brook trout	***Moderate summer and winter temperature***	***Identify summer and winter refugia***	***Reduce sediment***	***Determine contaminant levels***	***Reduce impacts of water withdrawal***	***Increase riparian area and function***	***Increase off - channel habitat***	***Increase in-channel diversity and structure***	***Reduce poaching and harassment***
Scientific	Strength	If successful, can increase productivity of focal species	Modifying temperatures may increase survival of focal species through various life stages	Identifying summer ad winter refugia will increase managers' knowledge on habitat features that should be developed or preserved.	Many of the habitat conditions that need to be restored or fixed will do more than just reduce sediment depositional rate.	Toxin levels within fish will be an indicator of pesticide and herbicide movement through the environ-ment	Increased efficiency of water use will have many benefits for fish and wildlife species, and potentially for irrigators.	Increases in riparian area can have immediate impacts on fish and wildlife, and long term impacts on habitat improvement.	Increased off channel habitat will have immediate benefits for focal species, especially late-run Chinook.	Increase in-channel habitat will have long term benefits to fish through all life stages.	Reduced poaching should increase the number of spawning adults of the various focal species.
	Weaknesss	Brook trout are established in many areas within the subbasin and eliminating them will be difficult	Temperature is naturally limiting within the subbasin. Attempts may be futile.	Data may be highly variable between years.	The outcome of the proposed actions may take years and years before any benefit is seen (and it may be difficult to show cause and effect).	Factors regulating the use of pesticides and herbicides may not decrease the uptake of toxins by fish for many years	Water use is complicated and increases in efficiency may be costly.	Restoring riparian areas is difficult because of current land use practices and natural events that might decrease the project's success.	Finding appropriate sites in areas that it is needed is difficult because of current land use practices.	Historically, man made in-channel projects have a high rate of failure.	Unless enforce-ment is increased, or "watchdog groups" are formed, tracking and reducing poaching is futile.
Decision-making	Determine if alternatives should be needed	If the removal program proves to be ineffective	After monitoring suggests that there is nothing that can be done	If evaluations suggests that refugia cannot be found	If proposed actions are not feasible.	If no toxins are found within a representati ve sample	After feasibility studies and other efforts do not identify mutually agreed upon alternatives.	If proposed actions are not feasible.	If proposed actions are not feasible.	If proposed actions are not feasible.	If local groups are not involved.

	Management response to changes in indicators	Pursue comments, collaborate, and determine other approaches	Focus on other limiting factors	Pursue comments, collaborate, and determine other approaches	Pursue comments, collaborate, and determine other approaches	Pursue comments, collaborate, and determine other approaches	Pursue comments, collaborate, and determine other approaches	Pursue comments, collaborate, and determine other approaches	Pursue comments, collaborate, and determine other approaches	Pursue comments, collaborate, and determine other approaches	Pursue comments, collaborate, and determine other approaches
Public	Review format	Advertise web page where draft info is available then presentation	Advertise web page where draft info is available then presentation	Advertise web page where draft info is available then presentation	Advertise web page where draft info is available then present-ation	Advertise web page where draft info is available then present-ation	Advertise web page where draft info is available then presentation	Advertise web page where draft info is available then presentation	Advertise web page where draft info is available then present-ation	Advertise web page where draft info is available then present-ation	Advertise web page where draft info is available then present-ation
	Comment format	Written, verbal @ presentation	Written, verbal @ presentation	Written, verbal @ presentation	Written, verbal @ presentation	Written, verbal @ presentation	Written, verbal @ presentation	Written, verbal @ presentation	Written, verbal @ present-ation	Written, verbal @ present-ation	Written, verbal @ present-ation
	Incorporate comments	Lead agency	Lead agency	Lead agency	Lead agency	Lead agency	Lead agency	Lead agency	Lead agency	Lead agency	Lead agency

7.8 Terrestrial

7.8.1 Introduction

The process used to develop wildlife assessments and management plan objectives and strategies is based on the need for a landscape level holistic approach to protecting the full range of biological diversity at the Ecoregion scale with attention to size and condition of core areas (subbasin scale), physical connections between core areas, and buffer zones surrounding core areas to ameliorate impacts from incompatible land uses. As most wildlife populations extend beyond subbasin or other political boundaries, this "conservation network" must contain habitat of sufficient extent, quality, and connectivity to ensure long-term viability of obligate/focal wildlife species. Subbasin planners recognized the need for large-scale planning that would lead to effective and efficient conservation of wildlife resources.

In response to this need, Ecoregion planners approached subbasin planning at two scales. The landscape scale emphasizes focal habitats and associated species assemblages that are important to Ecoregion wildlife managers while specific focal habitat and/or species needs are identified at the subbasin level.

Ecoregion and subbasin planners agreed with Lambeck (1997) who proposed that species requirements (umbrella species concept) could be used to guide ecosystem management. The main premise is that the requirements of a demanding species assemblage encapsulate those of many co-occurring less demanding species. By directing management efforts toward the requirements of the most exigent species, the requirements of many cohabitants that use the same habitat type are met. Therefore, managing habitat conditions for a species assemblage should provide life requisite needs for most other focal habitat obligate species.

Ecoregion/subbasin planners also assumed that by focusing resources primarily on riparian wetland, ponderosa pine, and shrub-steppe habitats, the needs of most listed and managed terrestrial species dependent on these habitats would be addressed during this planning period. While other listed and managed species occur within the subbasin, primarily forested habitat obligates, needs of these species are addressed primarily through the existing land management frameworks of the federal agencies within whose jurisdiction the overwhelming majority of these habitats occur within the Entiat subbasin (primarily, Entiat National Forest).

Ecoprovince/subbasin planners identified a focal species assemblage for each focal habitat type and combined life requisite habitat attributes for each species assemblage to form a "recommended range of management conditions", that, when achieved, should result in functional habitats. The rationale for using focal species assemblages is to draw immediate attention to habitat features and conditions most in need of conservation or most important in a functioning ecosystem. The corollary is that factors that affect habitat quality and integrity within the Ecoregion and subbasins also impact wildlife species. As a result, identifying and addressing "factors that affect focal habitats" should support the needs of obligate wildlife populations as well. Planners recognize, however, that addressing factors that limit habitat does not necessarily address some anthropogenic induced limiting factors such as affects of human presence on wildlife species.

Emphasis in this management plan is placed on the selected focal habitats and wildlife species described in the inventory and assessment. It is clear from the inventory and assessment that reliable quantification of most subbasin level impacts is lacking, however, many anthropogenic changes have occurred and clearly impact the focal habitats: riparian wetlands, shrub-steppe and ponderosa pine forest habitats. While all habitats are important, focal habitats were selected in part because they are disproportionately vulnerable to anthropogenic impacts, and likely have received the greatest degree of existing impacts within the subbasin. In particular, the majority of shrub-steppe and ponderosa pine habitats fall within the low or no protection status categories defined above. Some of the identified impacts are, for all practical purposes, irreversible (conversion to urban and residential development, primary transportation systems); others are already being mitigated through ongoing management (i.e., USFS adjustments to grazing management).

It is impractical to address goals for future conditions within the subbasin without consideration of existing conditions; not all impacts are reversible. The context within which this plan was drafted recognizes that human uses do occur, and will continue into the future. Recommendations are made within this presumptive framework.

7.8.2 Vision

Natural habitats exist with sufficient quantity, quality and linkages to perpetuate existing native wildlife populations into the foreseeable future. Where sufficient habitat exists, through a combination of protection and restoration, extirpated wildlife species are restored within the subbasin.

7.8.3 Biological Goals, Objectives, and Strategies

The overall goal is for natural habitats to exist with sufficient quantity, quality and linkages to perpetuate existing native wildlife populations into the foreseeable future. Where sufficient habitat exists, through a combination of protection and restoration, extirpated wildlife species will be restored within the subbasin.

Shrubsteppe

Goal

Provide sufficient quantity and quality shrubsteppe habitat to support the diversity of wildlife as represented by sustainable focal species populations. Emphasis should be placed on managing sagebrush-dominated shrub-steppe toward conditions 1 and 2 identified in 3.1.7.2.3.1 (Inventory and Assessment).

Habitat Objective 1

Determine the necessary amount, quality, and juxtaposition of shrubsteppe by the year 2008.

- Strategy: Select and implement methodology, alternative to IBIS or GAP, to accurately characterize shrubsteppe habitat in the Entiat subbasin.

Habitat Objective 2

Based on findings of Objective 1, identify and provide biological and social conservation measures to sustain focal species populations and habitats by 2010.

- Strategy: Utilize federal, state, tribal, and local government programs, such as USDA "Farm Bill" programs, to conserve shrubsteppe habitat.
- Strategy: Achieve permanent protection of shrubsteppe through acquisition, conservation easement, cooperative agreements, etc.
- Strategy: Emphasize conservation of large blocks and connectivity of high quality shrubsteppe habitat.
- Strategy: Promote local planning and zoning to maintain or enhance large blocks of habitat.

Habitat Objective 3

Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving agricultural practices, fire management, weed control, livestock grazing practices, and road management on existing shrubsteppe.

- Strategy: Implement habitat stewardship projects with private landowners.
- Strategy: Develop fire management protocols (protection and prescribed burning) to produce desired shrubsteppe habitat conditions.
- Strategy: Entiat National Forest plan, Chelan County Watershed Mgt Plan, WDFW Wildlife Area Management Plan, Yakama Nation Tribal Restoration Plan, Colville Tribes Integrated Resource Management Plan.
- Strategy: Develop and implement a coordinated, cross-jurisdictional comprehensive weed control management plan.
- Strategy: Develop and implement a coordinated, cross-jurisdictional road management plan.

Biological Objective 1

Determine population status of Brewer's sparrow by 2008.

Strategy: Select survey protocol and measure abundance of focal species.

Strategy: Select survey protocol and measure diversity and richness of species assemblages within shrub-steppe.

Biological Objective 2

Within the framework of the Brewer's sparrow population status determination, inventory other shrub-steppe obligate populations to test assumption of the umbrella species concept for conservation of other shrub-steppe obligates.

Strategy: Implement federal, state, tribal management and recovery plans.

Biological Objective 3:

Maintain and enhance mule deer populations consistent with state/tribal herd management objectives.

Strategy: Implement state and tribal management plans.

Strategy: Ensure mule deer habitat needs are met on federal, state, and tribal managed lands during land use planning.

Strategy: Maintain mule deer populations within private landowner tolerances.

Ponderosa Pine

Goal

Provide sufficient quantity and quality ponderosa pine habitats to support the diversity of wildlife as represented by sustainable focal species populations. Emphasis should be placed on managing ponderosa pine toward conditions 1a, 1b, 2 and 3 identified in 3.1.7.1.3 (Inventory and Assessment).

Habitat Objective 1

Determine the necessary amount, quality, and juxtaposition of ponderosa pine habitats by the year 2008.

- Strategy: Select and implement methodology, alternative to IBIS or GAP, to accurately characterize ponderosa pine habitat in the Entiat subbasin.

Habitat Objective 2

Based on findings of Objective 1, provide biological and social conservation measures to sustain focal species populations and habitats by 2010.

- Strategy: Utilize federal, state, tribal, and local government programs to conserve ponderosa pine habitat.
- Strategy: Achieve permanent protection of ponderosa pine through acquisition, conservation easement, cooperative agreements, etc.
- Strategy: Emphasize conservation of large blocks and connectivity of high quality ponderosa pine habitat.
- Strategy: Promote local planning and zoning to maintain or enhance large blocks of habitat.

Habitat Objective 3

Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving silvicultural practices, fire management, weed control, livestock grazing practices, and road management in existing and restored ponderosa pine habitat.

Strategy: Implement habitat stewardship projects with private landowners.

Strategy: Develop fire management protocols (protection and prescribed burning) to produce desired ponderosa pine habitat conditions.

Strategy: Entiat National Forest plan, Chelan County Watershed Mgt Plan, WDFW Wildlife Area Management Plan, Yakama Nation Tribal Restoration Plan, Colville Tribes Integrated Resource Management Plan.

- Strategy: Develop and implement a coordinated, cross-jurisdictional comprehensive weed control management plan.
- Strategy: Develop and implement a coordinated, cross-jurisdictional road management plan.

Biological Objective 1:

Determine population status of white-headed woodpecker, flammulated owl, and pygmy nuthatch by 2008.

- Strategy: Select survey protocol and measure abundance of focal species.
- Strategy: Select survey protocol and measure diversity and richness of species assemblages within ponderosa pine.

Biological Objective 2

Within the framework of the focal species population status determinations, inventory other ponderosa pine obligate populations to test assumption of the umbrella species concept for conservation of other ponderosa pine obligates.

- Strategy: Implement federal, state, tribal management and recovery plans.

Riparian Wetlands

Goal

Provide sufficient quantity and quality riparian wetlands to support the diversity of wildlife as represented by sustainable focal species populations. Emphasis should be placed on managing riparian wetland habitats toward conditions 1a, 1b, and 2 identified in 3.1.7.3.3 (Inventory and Assessment).

Habitat Objective 1

Determine the necessary amount, quality, and connectivity of riparian wetlands by the year 2008.

- Strategy: Select and implement methodology, alternative to IBIS or GAP, to accurately characterize riparian wetlands habitats in the Entiat subbasin.

Habitat Objective 2

Based on findings of Habitat Objective 1, provide biological and social conservation measures to sustain focal species populations and habitats by 2010.

- Strategy: Utilize federal, state, tribal, and local government programs, to conserve riparian wetlands habitat.

- Strategy: Achieve permanent protection of riparian wetlands through acquisition, conservation easement, cooperative agreements, etc.
- Strategy: Emphasize conservation connectivity of high quality riparian wetlands habitat.
- Strategy: Promote local planning and zoning to maintain or enhance riparian wetlands habitat.

Habitat Objective 3

Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving silviculture, agricultural practices, fire management, weed control, livestock grazing practices, and road construction and maintenance on and adjacent to existing riparian wetlands.

- Strategy: Implement habitat stewardship projects with private landowners.
- Strategy: Develop fire management protocols (protection and prescribed burning) to produce desired riparian wetlands habitat conditions.
- Strategy: Entiat National Forest plan, Chelan County Watershed Mgt Plan, WDFW Wildlife Area Management Plan, Yakama Nation Tribal Restoration Plan, Colville Tribes Integrated Resource Management Plan.
- Strategy: Develop and implement a coordinated, cross-jurisdictional comprehensive weed control management plan.
- Strategy: Develop and implement a coordinated, cross-jurisdictional road management plan.

Biological Objective 1

Determine population status of beaver, red-eyed vireo, and yellow-breasted chat by 2008.

- Strategy: Select survey protocol and measure abundance of focal species.
- Strategy: Select survey protocol and measure diversity and richness of species assemblages within riparian wetland habitats.

Biological Objective 2

Within the framework of the focal species population status determinations, inventory other riparian wetlands obligate populations to test assumption of the umbrella species concept for conservation of other riparian wetlands obligates.

- Strategy: Implement federal, state, tribal management and recovery plans.

Biological Objective 3

Based on findings of Biological Objective 1 and Habitat Objective 2, maintain and enhance beaver populations where appropriate and consistent with state/tribal management objectives.

- Strategy: Protect, and where necessary restore, habitat to support beaver.
- Strategy: Reintroduce beaver into suitable habitat where natural recolonization may not occur.
- Strategy: Through state harvest restrictions, protect beaver populations at a level sufficient to allow natural and reintroduced beaver populations to perpetuate at levels that will meet Habitat Objective 2.

7.8.4 Research, Monitoring, and Evaluation Plan

The Research, Monitoring, and Evaluation (RME) plan for the subbasin is intended as a tool that will allow managers to evaluate the efficacy of employed strategies in achieving corresponding focal habitat objectives for the subbasin. If implemented, elements of the plan will also facilitate coordination and tracking of management activities within the subbasin, periodic review of progress, and a basis for recommended adjustments to management direction over time (adaptive management).

The RME plan, as presented, consists of a variety of quantitative elements, ranging from scientific wildlife and vegetation surveys, spatial analyses of project location and acreage, to simple enumeration of land use projects/regulations commented upon by cooperating agencies.

Organization of the RME plan is as follows:

Research

- Research needs, with justification, are also listed. Detailed research project design is not presented, however, being beyond the scope of the current planning effort
- Existing Data Gaps, as identified through the subbasin planning process, are listed in this section, because many will require effort above routine monitoring and evaluation to address

Monitoring and Evaluation

- Focal habitat monitoring methodology, and Management Plan strategies addressed
- Focal species monitoring methodology, and Management Plan strategies addressed

7.8.5 Existing Data Gaps and Research Needs

In the course of subbasin plan development, a number of data gaps were identified. Some of these gaps will be filled as data is collected via the monitoring and evaluation process as the plan is implemented. Others will require formal research efforts to address. Data gaps and research needs identified during development of the subbasin plan are listed in Table 31.

As part of the adaptive management philosophy of subbasin planning, managers believe that additional research needs not yet identified will become apparent over time. These needs should be addressed in future subbasin plan iterations.

Table 31. Data gaps and research needs, Entiat subbasin, as identified during subbasin planning

RESEARCH NEEDS AND DATA GAPS	STRATEGY TO ADDRESS	AGENCY/ PERSONNEL
GENERAL		
Testing of assumption that focal habitats are functional if a focal species assemblage's recommended management conditions are achieved		Coordinated government & NGO effort
Testing of assumption that selected species assemblages adequately represent focal habitats		Coordinated government & NGO effort
Current, broad-scale habitat data	Spatial data collection and GIS analysis	Coordinated government & NGO effort
RIPARIAN WETLANDS		
Research Needs, recommended priority order		
Refinement of recommended management conditions for Riparian Wetlands	Research need; use for update to future subbasin plan iterations	Coordinated government & NGO effort.
Data are needed on all aspects of red-eyed vireo, yellow-breasted chat and beaver ecology in the subbasin.		Coordinated government & NGO effort
Data Gaps		
Accurate habitat type maps are needed to improve assessment quality and support management strategies and actions, including, updated and fine resolution historic/current riparian wetland data and GIS products e.g., structural conditions and KEC ground-truthed maps	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
Riparian habitat quality data. Assessment data do not address habitat quality.	Monitoring activities	Subbasin managers
Refined habitat type maps	Spatial data collection and GIS analysis	Subbasin managers
GIS soils products including wetland delineations	Spatial data collection and GIS analysis	Subbasin managers
Local population/distribution data for red-eyed vireo, yellow-breasted chat, and beaver	Species Monitoring, Spatial data collection, and GIS analysis	WDFW, Subbasin managers
PONDEROSA PINE		
Research Needs, recommended priority order		
Data are needed on all aspects of white-headed woodpecker nesting ecology and habitat use within the Entiat subbasin		Coordinated government & NGO effort
Data are needed on all aspects of pygmy nuthatch nesting ecology and habitat use within the Entiat subbasin		Coordinated government & NGO effort
Data are needed on all aspects of flammulated owl nesting		Coordinated government

RESEARCH NEEDS AND DATA GAPS	STRATEGY TO ADDRESS	AGENCY/ PERSONNEL
ecology and habitat use, specifically related to the size, configuration, and abundance of grassy openings for foraging and clumped thickets of sapling/pole trees for roosting		& NGO effort
Research to determine if restored sites attract white-headed woodpeckers and provide viable habitat, to include recommendations on effective treatment conditions		Coordinated government & NGO effort
Research to determine if restored sites attract pygmy nuthatches and provide viable habitat, to include recommendations on effective treatment conditions		Coordinated government & NGO effort
Research to determine whether an intensively harvested landscape that meets snag and large tree objectives support viable white-headed woodpecker populations		Coordinated government & NGO effort
Research to determine whether a managed site attracts flammulated owls and provides viable habitat. Identification of the most effective treatment processes and conditions most effective.		Coordinated government & NGO effort
Data Gaps		
Refinement of recommended management conditions for Ponderosa pine: collect current ponderosa pine structural condition/habitat variable data	Management Objective for Ponderosa pine	Subbasin managers
Accurate habitat type maps are needed to improve assessment quality and support management strategies and actions, including, updated and fine resolution historic/current ponderosa pine data and GIS products e.g., structural conditions and KEC ground-truthed maps	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
Habitat quality data. Assessment data do not address habitat quality.	Coordinated, standardized monitoring efforts); Spatial data collection and GIS analysis	Subbasin managers
Finer resolution GIS habitat type maps that include structural component and KEC data.	Coordinated, standardized monitoring efforts); Spatial data collection and GIS analysis	Subbasin managers
GIS soils products	Spatial data collection and GIS analysis	Subbasin managers
Identify current distribution and population levels of white-headed woodpeckers, pygmy nuthatches and flammulated owls	Species Monitoring, Spatial data collection, and GIS analysis	WDFW, Subbasin managers
Identify current and potential areas of high quality flammulated owl habitat (short-term strategy i.e., <2 years).	Habitat Monitoring, Spatial data collection, and GIS analysis	WDFW, Subbasin managers
Monitor white-headed woodpecker, pygmy nuthatch and flammulated owl distributions within the Entiat subbasin, to determine current distributions, population levels and population	Species Monitoring, Spatial data collection, and GIS analysis	WDFW, Subbasin managers

RESEARCH NEEDS AND DATA GAPS	STRATEGY TO ADDRESS	AGENCY/ PERSONNEL
trends		
SHRUBSTEPPE		
Research Needs, recommended priority order		
Data are needed on all aspects of Brewer's sparrow nesting ecology, especially area requirements to maintain populations		WDFW, Subbasin managers
Data are needed on all aspects of Brewer's sparrow nesting ecology, particularly relationship to livestock grazing and pesticide use		WDFW, Subbasin managers
An assessment of the viability of small populations of Brewer's sparrow in fragments of habitat versus those in large contiguous blocks		WDFW, Subbasin managers
Data Gaps		
Accurate habitat type maps are needed to improve assessment quality and support management strategies and actions, including, updated and fine resolution historic/current shrubsteppe data and GIS products e.g., structural conditions and KEC ground-truthed maps	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
Habitat quality data. Assessment data bases do not address habitat quality	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
Refined habitat type maps	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
GIS soils products, including wetland delineations	Spatial data collection and GIS analysis	Subbasin managers
Local population/distribution distribution for Brewer's sparrow	Species Monitoring, Spatial data collection, and GIS analysis	WDFW, Subbasin managers
Monitor Brewer's sparrow distribution within the Entiat subbasin, to determine current distribution, population level and population trends	Species Monitoring, Spatial data collection, and GIS analysis	WDFW, Subbasin managers
Evaluate the role of fire, mowing, and other management treatments to maintain/improve shrupsteppe habitat quality	Coordinated, standardized monitoring efforts	Subbasin managers

7.8.6 Monitoring and Evaluation

Focal Habitat and Species monitoring methodology

Recommended monitoring and evaluation strategies contained below for each focal habitat type, including sampling and data analysis and storage, are derived from national standards established by Partners in Flight for avian species (Ralph et al, 1993, 1995) and

habitat monitoring (Nott et al, 2003). Deer sampling methodology follow standard protocols established by the Washington Department of Fish and Wildlife. In addition, protocols for specific vegetation monitoring/sampling methodologies are drawn from USDA Habitat Evaluation Procedure standards (USFWS 1980a and 1980b). A common thread in the monitoring strategies which follow is the establishment of permanent census stations to monitor bird population and habitat changes.

Wildlife managers will include statically rigorous sampling methods to establish links between habitat enhancement prescriptions, changes in habitat conditions and target wildlife population responses.

Specific methodology for selection of Monitoring and Evaluation sites within all focal habitat types follows a probabilistic (statistical) sampling procedure, allowing for statistical inferences to be made within the area of interest. The following protocols describe how M&E sites will be selected (from WDFW response to ISRP http://www.cbfwa.org/files/province/cascade/projects/199609400resp.pdf):

- Vegetation/HEP monitoring and evaluation sites are selected by combining stratified random sampling elements with systematic sampling. Project sites are stratified by cover types (strata) to provide homogeneity within strata, which tends to reduce the standard error, allows for use of different sampling techniques between strata, improves precision, and allows for optimal allocation of sampling effort resulting in possible cost savings (Block et al. 2001). Macro cover types such as shrub-steppe and forest are further sub-cover typed based on dominant vegetation features i.e., percent shrub cover, percent tree cover, and/or deciduous versus evergreen shrubs and conifer versus deciduous forest. Cover type designations and maps are validated prior to conducting surveys in order to reduce sampling inaccuracies.

- Pilot studies are conducted to estimate the sample size needed for a 95% confidence level with a 10% tolerable error level (Avery 1975) and to determine the most appropriate sampling unit for the habitat variable of interest (BLM 1998). In addition, a power analysis is conducted on pilot study data (and periodically throughout data collection) to ensure that sample sizes are sufficient to identify a minimal detectable change of 20% in the variable of interest with a Type I error rate of not more than 0.10 and P = 0.9 (BLM 1998, Hintze 1999, Block et al. 2001). M&E includes habitat trend condition monitoring on the landscape scale (Tier 1-HEP) and plant community monitoring (Tier 2) i.e., measuring changes in vegetative communities on specific sites.

- For HEP surveys, specific transect locations within strata are determined by placing a Universal Transverse Mercator (UTM) grid over the study area (strata) and randomly selecting “X” and “Y” coordinates to designate transect start points. Random transect azimuths are chosen from a computer generated random number program, or from a standard random number table. Data points and micro plots are systematically placed along the line intercept transect at assigned intervals as described in Part 2 – monitoring section of the proposal. Sample sizes for statistical inferences are determined by replication and systematic placement of lines of intercept within the

strata with sufficient distance between the lines to assume independence and to provide uniform coverage over the study site.

- Permanent vegetation monitoring transect locations are determined by placing a UTM grid over the strata and randomly selecting "X" and "Y" coordinates to designate plot locations as described for HEP surveys. One hundred meter baseline transect azimuths are randomly selected from a random numbers table. Ten perpendicular 30 meter transects are established at 10 meter intervals along the baseline transect to form a 100m x 30m rectangle (sample unit). Micro plot and shrub intercept data are collected at systematic intervals on the perpendicular transects.

By systematically collecting and analyzing plant species frequency, abundance, density, height, and percent cover data, vegetative trends through time can be described. Likewise, the effectiveness of exotic weed control methods can be evaluated and weed control plans can be adjusted accordingly.

Presence of all exotic weeds i.e., knapweeds, yellow starthistle, etc. will be mapped in GIS using Global Positioning System (GPS) equipment. This information will be used to develop an annual exotic vegetation control plan.

Causes of seeding or planting failure will be identified and planting methods/site preparation will be modified as necessary. Data will be collected and analyzed, and, where necessary, changes in the management plan (adaptive management) will be identified and implemented.

General and site specific M&E protocols, outlining monitoring goals and objectives and specific sampling designs are included in the following monitoring section.

In addition to defining habitat and species population trends, monitoring will also be used to determine if management actions have been carried out as planned (implementation monitoring). In addition to monitoring plan implementation, monitoring results will be evaluated to determine if management actions are achieving desired goals and objectives (effectiveness monitoring) and to provide evidence supporting the continuation of proposed management actions. Areas planted to native shrubs/trees and/or seeded to herbaceous cover will be monitored twice a year to determine shrub/seeding survival, and causes of shrub mortality and seeding failure i.e. depredation, climatic impacts, poor site conditions, poor seed/shrub sources.

Monitoring of habitat attributes and focal species in this manner will provide a standardized means of tracking progress towards conservation, not only within the Entiat subbasin, but within a national context as well. Monitoring will provide essential feedback for demonstrating adequacy of conservation efforts on the ground, and guide the adaptive management component that is inherent in the subbasin planning process.

7.8.7 Riparian Wetlands

Focal Species

Red-eyed vireo (*Vireo olivaceous*), yellow-breasted chat (*Icteria virens*), and American Beaver (*Castor canadensis*)

Overall Habitat and Species Monitoring Strategy: Establish monitoring program for protected and managed Riparian Wetland sites to monitor focal species population and habitat changes and evaluate success of efforts.

Overall Habitat and Species Monitoring Strategy: Establish permanent censusing stations to monitor bird population and habitat changes.

Focal Habitat Monitoring

Factors affecting habitat: 1.) Direct loss of riparian deciduous and shrub understory, 2.) Fragmentation of wetland habitat, 3.) agricultural and sub-urban development and disturbance, 4.) reduction in water quality, 5.) organochlorines such as dieldrin or DDE may cause thinning in egg shells which results in reproductive failure (Graber et al. 1978; Ohlendorf et. al. 1980; Konermann et. al. 1978) (Sec. 5.2.3.3.6).

Riparian Wetlands Working Hypothesis Statement

The proximate or major factors affecting this focal habitat type are direct loss of habitat due primarily to urban/agricultural development, reduction of habitat diversity and function resulting from exotic vegetation, livestock overgrazing, fragmentation and recreational activities. The principal habitat diversity stressor is the spread and proliferation of invasive exotics. This coupled with poor habitat quality of existing vegetation have resulted in extirpation and or significant reductions in riparian habitat obligate wildlife species.

Recommended Range of Management Conditions

1. Well-distributed range of 20 to 100 percent tree canopy closure (cottonwood and other hardwood species), with a mature cottonwood component including trees at least 160 feet tall
2. Multi-structure/age tree canopy (includes trees less than 6 inches in diameter and mature/decadent trees)
3. Forty to 80 percent native shrub cover (greater than 50 percent comprised of hydrophytic shrubs), with scattered herbaceous openings
4. Multi-structured shrub canopy greater than 3 feet in height, at least 10% of which are comprised of young cottonwoods

Focal Habitat Monitoring Strategies: Establish an inventory and long-term monitoring program for protected and restored riparian wetlands to determine success of efforts.

1. Identify riparian wetland sites within the subbasin that support populations of focal species for this habitat.
2. Evaluate habitat site potential on existing public lands and adjacent private lands for protection. (short-term strategy i.e., < 2 years).
3. Enhance habitat on public lands and adjacent private lands.
4. Identify high quality/functional privately owned riparian wetlands sites that are not adjacent to public lands (long-term strategy 2 to 15 years).

5. Establish permanent censusing stations to monitor bird population and habitat changes

Sampling Design

HEP is a standardized habitat-analysis strategy developed by the U.S. Fish and Wildlife Service. It uses a variety of Habitat Suitability Indices (HSI) for select wildlife species to evaluate the plant community as a whole (Anderson and Gutzwiller 1996). Sites are stratified by cover type, and starting points are established using a random number grid. Minimum length of a HEP transect is 600 ft, and patches of cover must be large enough to contain a minimum transect without extending past a 100 foot buffer inside the edge of the cover type. (Riparian zone width within portions of the subbasin will require modification of this 100 foot buffer requirement.)

In addition, at any permanently established avian species monitoring site established within the Riparian Wetland habitat, structural habitat conditions will be monitored every 5 years as per Habitat Structure Assessment protocol (Nott et al 2003).

Sampling Methods (USFWS 1980a and 1980b):

1. Herbaceous measurements are taken every 20 ft. on the right side of the tape (the right is always determined by standing at 0 ft and facing the line of travel). The sampling quadrant is a rectangular 0.5m2 microplot, placed with the long axis perpendicular to the tape, and the lower right corner on the sampling interval.

2. Shrub canopy cover is measured using a point intercept method and is visually estimated before starting each transect. If the total shrub cover is anticipated to be >20%, shrub data are collected every 5 ft (20 possible “hits” per 100 ft segment). If shrub canopy cover is anticipated to be <20%, data are collected every 2 ft (50 possible “hits” per 100 ft segment).

Shrub height measurements are collected on the tallest part of a shrub that crosses directly above each sampling intercept mark. For shorter shrub classifications (i.e. all shrubs less than 3 feet), the tallest shrub is measured that falls within that category.

3. Tree canopy cover measurements are taken every ten feet along a transect. Basal and snag measurements are taken within a tenth-acre circular plot at the end of each 100 ft segment. The center point of the circular plot is the 100 ft mark of the transect tape, and the radius of the circle is 37.2 ft.

In addition, at any permanently established avian species monitoring site established within the Riverine Wetland habitat, structural habitat conditions will be monitored every 5 years as per Habitat Structure Assessment protocol (Nott et al 2003) (http://www.birdpop.org/DownloadDocuments/manual/HSAManual03.PDF).

Analysis: Transects are divided into 100 ft. segments, and total transect length is determined using a “running mean” to estimate variance (95% probability of being within 10% of the true mean).

Sample size equation: n = t2 x s2

E2

Where: t = value at 95 percent confidence interval with suitable degrees of freedom

s = standard deviation

E = desired level of precision, or bounds

Focal Species Monitoring

Beaver, yellow-breasted chat and red-eyed vireo

Rationale: Maintaining and enhancing beaver, yellow-breasted chat and red-eyed vireo populations within the subbasin will assure the maintenance and rehabilitation of riparian wetlands.

Limiting Factors

1) Loss of deciduous tree cover and sub-canopy/shrub habitat in riparian zones. 2.) Conversion of riparian habitat due to channelization, agriculture, and development, 3) flooding of habitat resulting from hydropower facilities, 4) habitat fragmentation, 5) degradation of existing habitats from overgrazing and introduced weedy vegetation, and 6) tree/shrub removal in riparian areas. Proximity to agriculture, suburban development creates a hostile landscape where a high density of nest parasites, such as, brown cowbird and predation by domestic cats may occur. Disturbance from agriculture, silviculture, road management and recreational activities can also cause nest abandonment.

Assumptions: 1) Addressing factors that affect riparian wetlands, will also address red-eyed vireo, beaver and other wetland obligate species limiting factors. 2) If riparian wetland habitat is of sufficient quality, extent, and distribution to support viable yellow-breasted chat, red-eyed vireo and beaver populations, the needs of most other riparian wetland obligate species will also be addressed and habitat functionality could be inferred. 3) If habitat is present sufficient to support avian focal species, suitable habitat will be present to support beaver. 4) Beaver will persist in these habitats if appropriate protection measures to preclude overharvest are implemented.

Sampling Strategy: Survey points will be placed among habitat types of interest using a stratified random design. Number of survey points in each habitat type will be determined using power analysis with the goal of being able to detect a 25% increase in abundance of yellow warbler with a power of 0.8 or greater. This protocol is based on the point count survey (Ralph et al. 1993, Ralph et al. 1995), with each survey station referred to as a "point count station." In addition to these bird survey data, information about the distance at which individual birds are detected will also be collected, allowing absolute density estimated to be made using distance-sampling methodology (e.g., the program DISTANCE).

Methods: We will survey birds on randomly selected (stratified) points along the riparian corridor. Each site will have 4 100-m fixed-radius point counts (Ralph et al. 1993) established along a transect and spaced 200m apart (Fig 4). Each point will be marked with a permanent fiberglass stake (1m electric fence post) and colored flagging will be placed on shrubs at 50 and 100m from the point in each of the 4 cardinal directions to aid in determining distance. Counts at each point will be 5 minutes in duration during which all birds seen or heard will be noted, along with their sex (if known), distance from the

point (within 50m, >50 but <100m, or beyond 100m), and behavior (singing, calling, silent, or flying over the site). Surveys will be conducted once each in May and June and within prescribed weather parameters (e.g., no rain and low wind).

Analysis: Analysis is described by Nur et al. (1999). Absolute density estimation (see Buckland et al. 1993) can be estimated using the program DISTANCE, a free program available on the World-Wide Web (http://www.ruwpa.st-and.ac.uk/distance); an example is given in Nur et al. (1997). In brief: for species richness and species diversity, these can be analyzed as total species richness or as species richness for a subset of species; the same is true for species diversity. Species diversity can be measured using the Shannon index (Nur et al. 1999), also called the Shannon-Weiner or Shannon-Weaver index. Statistical analysis can be carried out using linear models (regression, ANOVA, etc.), after appropriate transformations (examples in Nur et al. 1999).

7.8.8 Ponderosa Pine

Focal Species

Flammulated owl (Otus flammeolus), white-headed woodpecker (Picoides albolarvatus), pygmy nuthatch (Sitta pygmaea)

Overall Habitat and Species Monitoring Strategy: Establish monitoring program for protected and managed Ponderosa pine sites to monitor focal species population and habitat changes and evaluate success of efforts.

Focal Habitat Monitoring

Factors affecting habitat

1. Direct loss old growth forest and associated large diameter trees and snags
2. Fragmentation of remaining Ponderosa pine habitat
3. Agricultural and sub-urban development and disturbance
4. Hostile landscapes which may have high densities of nest parasites, exotic nest competitors, and domestic predators
5. Fire suppression/wildfire
6. Overgrazing
7. Noxious weeds
8. Silvicultural practices
9. Insecticide use

Ponderosa Pine Working Hypothesis Statement: The near term or major factors affecting this focal habitat type are direct loss of habitat due primarily to timber harvesting, fire reduction/wildfires, mixed forest encroachment, development, recreational activities, reduction of habitat diversity and function resulting from invasion by exotic species and vegetation and overgrazing. The principal habitat diversity stressors are the spread and proliferation of mixed forest conifer species within ponderosa pine communities due

primarily to fire reduction and intense, stand-replacing wildfires, and invasive exotic weeds. Habitat loss and fragmentation (including fragmentation resulting from extensive areas of undesirable vegetation) coupled with poor habitat quality of existing vegetation (i.e., lack of old growth forest and associated large diameter trees and snags) have resulted in significant reductions in ponderosa pine habitat obligate wildlife species.

Recommended Range of Management Conditions

Recognizing that extant ponderosa pine habitat within the subbasin currently covers a wide range of seral conditions, wildlife habitat managers have identified three general ecological / management conditions that, if met, will provide suitable habitat for multiple wildlife species at the subbasin scale within the ponderosa pine habitat type. These ecological conditions correspond to life requisites represented by a species' assemblage that includes white-headed woodpecker (Picoides albolarvatus), flammulated owl (Otus flammeolus), and pygmy nuthatch (Sitta pygmaea)

1. Mature ponderosa pine forest: The white-headed woodpecker represents species that require/prefer large patches (greater than 350 acres) of open mature/old growth ponderosa pine stands with canopy closures between 10 - 50 percent and snags (a partially collapsed, dead tree) and stumps for nesting (nesting stumps and snags greater than 31 inches DBH).

2. Multiple canopy ponderosa pine mosaic: Flammulated owls represent wildlife species that occupy ponderosa pine sites that are comprised of multiple canopy, mature ponderosa pine stands or mixed ponderosa pine/Douglas-fir forest interspersed with grassy openings and dense thickets. Flammulated owls nest in habitat types with low to intermediate canopy closure (Zeiner et al. 1990), two layered canopies, tree density of 508 trees/acre (9 foot spacing), basal area of 250 feet2/acre (McCallum 1994b), and snags greater than 20 inches DBH 3-39 feet tall (Zeiner et al. 1990). Food requirements are met by the presence of at least one snag greater than 12 inches DBH/10 acres and 8 trees/acre greater than 21 inches DBH.

3. Heterogeneous stands of ponderosa pine with a mixture of well-spaced, old pines and vigorous trees of intermediate age: pygmy nuthatches represent those species that depend on snags for nesting and roosting, high canopy density, and large diameter (greater than 18 inches DBH) trees characteristic of mature undisturbed forests. Connectivity between suitable habitats is important for species, such as pygmy nuthatch, whose movement and dispersal patterns are limited to their natal territories.

Focal Habitat Monitoring Strategies:

Establish an inventory and long-term monitoring program for protected and managed Ponderosa pine habitats to determine success of efforts. Subbasin managers recognize that restoration of late-successional forest is a long-term process, but these short-term (i.e., up to 15 years) strategies reflect the commitment and initiation of the process of management.

1. Identify Ponderosa pine habitat sites within the subbasin that support populations of focal species for this habitat.

2. Evaluate habitat site potential on existing public lands and adjacent private lands for protection of focal species habitat (short-term strategy i.e., < 2 years).
3. Enhance habitat on public lands and adjacent private lands (intermediate strategy; 2 to 10 years)
4. Identify high quality/functional privately owned Ponderosa pine sites that are not adjacent to public lands (long-term strategy 2 to 15 years).
5. Establish permanent censusing stations to monitor bird population and habitat changes.

Sampling Design: Permanent survey transects will be located within Ponderosa pine habitats using HEP protocols. HEP is a standardized habitat-analysis strategy developed by the U.S. Fish and Wildlife Service. It uses a variety of Habitat Suitability Indices (HSI) for select wildlife species to evaluate the plant community as a whole (Anderson and Gutzwiller 1996). Sites are stratified by cover type, and starting points are established using a random number grid. Minimum length of a HEP transect is 600 ft, and patches of cover must be large enough to contain a minimum transect without extending past a 100 foot buffer inside the edge of the cover type.

In addition, at any permanently established avian species monitoring site established within the Riverine Wetland habitat, structural habitat conditions will be monitored every 5 years as per Habitat Structure Assessment protocol (Nott et al 2003).

Sampling Methods (USFWS 1980a and 1980b):

1. Herbaceous measurements are taken every 20 ft. on the right side of the tape (the right is always determined by standing at 0 ft and facing the line of travel). The sampling quadrant is a rectangular 0.5m2 microplot, placed with the long axis perpendicular to the tape, and the lower right corner on the sampling interval.
2. Shrub canopy cover is measured using a point intercept method and is visually estimated before starting each transect. If the total shrub cover is anticipated to be >20%, shrub data are collected every 5 ft (20 possible “hits” per 100 ft segment). If shrub canopy cover is anticipated to be <20%, data are collected every 2 ft (50 possible “hits” per 100 ft segment).

Shrub height measurements are collected on the tallest part of a shrub that crosses directly above each sampling intercept mark. For shorter shrub classifications (i.e. all shrubs less than 3 feet), the tallest shrub is measured that falls within that category.

3. Tree canopy cover measurements are taken every ten feet along a transect. Basal and snag measurements are taken within a tenth-acre circular plot at the end of each 100 ft segment. The center point of the circular plot is the 100 ft mark of the transect tape, and the radius of the circle is 37.2 ft.

Measurement of Attributes (Habitat Conditions):

>10 snags/40 ha (>30cm DBH and 1.8m tall)

Method: A direct count in the 1/10 acre circle plot at the end of each 100

ft segment of the transect. DBH (measured with a loggers tape) and condition is noted for each snag. Snag condition scale follows Parks et al. (1997).

>20 trees /ha (>21" DBH)

Method: A direct count in the 1/10 acre circle plot. DBH measured with a logger's tape.

Ponderosa Pine – old growth: >10 trees/ac (>21" DBH w/ >2 trees >31" DBH)

Method: A direct count in the 1/10 acre circle plot. DBH measured with a logger's tape.

10-50% canopy closure

Method: A line intercept 'hit' or 'miss' measurement. Ten direct measurements along each 100 foot section of the transect (one every 10 feet) taken with a moosehorn densitometer.

> 1.4 snags/ac (>8" DBH w/ >50% >25")

Method: A direct count in the 1/10 acre circle plot at the end of each 100 ft segment of the transect. DBH (measured with a loggers tape) and condition is noted for each snag. Snag condition scale follows Parks et al. (1997).

In addition, at any permanently established avian species monitoring site established within the ponderosa pine habitat, structural habitat conditions will be monitored every 5 years as per Habitat Structure Assessment protocol (Nott et al 2003).

Analysis: Transects are divided into 100 ft. segments, and total transect length is determined using a "running mean" to estimate variance (95% probability of being within 10% of the true mean).

Sample size equation: $n = t2 \times s2$

E2

Where: t = value at 95 percent confidence interval with suitable degrees of freedom

s = standard deviation

E = desired level of precision, or bounds

Focal Species Monitoring

Flammulated Owl

Rationale: The Flammulated owl is listed as candidates for inclusion on the WDFW endangered species list and is considered a species-at-risk by the Washington GAP Analysis and Audubon-Washington. Flammulated owls are highly structurally dependent on the Ponderosa Pine habitat. Therefore, it is important to maintain and enhance the structure and function of ponderosa pine habitats for flammulated owls.

Limiting Factors: 1) Silvicultural practices that reduce habitat quality; 2) pesticide use; 3) predation/competitors; 4) exotics.

Assumptions: 1) Addressing factors that affect ponderosa pine, will also address flammulated owl and other ponderosa pine obligate species limiting factors. 2) If ponderosa pine habitat is of sufficient quality, extent, and distribution to support viable flammulated owl and white-headed woodpecker populations, the needs of most other ponderosa pine obligate species will also be addressed and ponderosa pine functionality could be inferred.

Sampling Strategy: The following methods are designed to, 1.) facilitate delineation of current distribution and population levels of flammulated owls, and; 2) identify current and potential areas of high quality flammulated owl habitat (short-term strategy i.e., <2 years).

Methods: Nighttime surveys will be conducted throughout potentially suitable Flammulated Owl breeding habitat, which will be determined according to habitat use reported in the literature, other reports, GIS habitat mapping, and other reported sightings the species.

Routes will be randomly selected from within the potential habitat area using a stratified sampling scheme. Each route should have between 10-12 stations, distributed along the route at equal intervals of .5 km, a standard methodology based on the distance owls can be heard on a calm night (at least 1.0 km) and the average size of territories (<500 m across) (Reynolds and Linkhart 1984, Howle and Ritchie 1987, Van Woudenberg and Christie 1997). The location of the starting point of the route, and of each station along the route, should be recorded as precisely as possible using a GPS (Global Positioning System). Each route should be surveyed three times per year during May-July – the time of year when vocal activity of the majority of species is greatest. Conduct surveys between 2200 and 0100 hours (Howle and Ritcey 1987, Groves et al. 1997). An attempt should be made to conduct the survey at the same time of night each year. At the beginning of the breeding season the greatest calling intensity for the Flammulated Owl is during much of the evening, and then after nestling hatching singing is "later at night" (Reynolds and Linkhart 1987).

Surveys should only be conducted under favorable conditions: wind speeds <20 km per hour, a wind speed of Beaufort 3 or less and no precipitation (including rain and/or snow). Temperatures should be close to the average for the season and efforts should be made to avoid extremely cold temperatures because of evidence that owls may be less vocal in very cold weather (Takats 1998a).

Surveys will consist of visiting a point for two minutes to listen for Flammulated Owls calling, and if no owls are heard then a male territorial call will be imitated or played from tape for one minute. After listening for an additional two minutes, the observer will then walk to the next point while still listening for calling owls. (Two minutes appears to be adequate for most spontaneously calling owls to be detected, at least during the period of peak calling activity. In Alberta, relatively few additional owls were detected during a third minute of listening (Takats, pers. comm.). In Ontario, more than 70% of 5 species of owls that were detected over a 5 minute period (included playback) were detected in the first two minutes (Takats 1997, 1998b)

Playback recordings should be as clear and loud as possible without distortion. Digital technology is recommended (CD-ROM, solid state, or digital tape) as the sound quality can be better controlled and is less likely to deteriorate over time. The audio equipment should be of sufficient quality that it will not distort the sound at loud volumes. We suggest the volume be such that the recording can be heard at 400m, but not at 800m (to minimize bias at the next survey station due to owls hearing the recording from the previous station). If possible, the volume should be measured at a standard distance (e.g., 1m from the speakers) using a decibel meter.

The recording should include both the silent listening periods as well as the playback sequence time period. A soft 'beep' or other sound can be used to indicate the start of the first silent listening period, and another beep to indicate the end of the final listening period. This will ensure that the time is fully standardized at each station, and reduce the need for participants to keep checking their watches.

Surveyors should be asked to estimate the approximate direction and distance to the first position where they detect each owl and plot location on a map. This data can help to determine whether the same owls are being detected at different stations along the route, to adjust for some of the variation in detection rates, and to aid in daytime nest searches.

Male presence is not adequate to determine habitat suitability as many males may remain unmated (Reynolds and Linkart 1987a, McCallum 1994a). The nests should be monitored so that success can be determined. Parallel transects 50 m apart through areas where owls were detected were surveyed in June and early July to try and find nest site locations. Since most of the calls heard in the field are from territorial reproductive males, nests can be located by systematic nest searches during the day (Bull et al. 1990). Once territory boundaries are delineated, all suitable nesting cavities (tree cavities with entrance diameters >4 cm) within territories will be checked for nesting owls (Linkart and Reynolds 1997).

Nest sites will be searched for using a pinhole camera system attached to a telescoping pole that reaches approximately 11 m high (Proudfoot 1996). This is an effective nest finding technique, but is limited to cavities within reach. Tree scratching (with a stick) can also used, which imitates a predator climbing the nest tree and often stimulates incubating or brooding females to look out of the nest cavity entrance (Bull et al. 1990). Observation of a female Flammulated Owl at a cavity entrance will document a nest site.

Analysis: Data from the surveys described here are similar to those of the Breeding Bird Survey, though some modifications may be required in the future. A wide variety of methods have been developed for analysis of BBS data (James et al. 1996, Link and Sauer 1994, 1998), but there is still some disagreement as to which methods are best (James et al. 1996, Link and Sauer 1994a, Link and Sauer 1994b, Thomas 1996). There are two main methods currently being used by the coordinators of the BBS. One involves route regression using estimating equations (Link and Sauer 1994), which assumes that trends may differ among routes, and calculates a weighted mean of the trends within routes. The selection of weighting factors is strongly dependent upon the sampling scheme used to select routes. An alternate approach involves a generalized linear model assuming over-dispersed Poisson residuals and a log-link function (Link and Sauer 1998). This approach assumes that trends are similar within a broader region, and allows more

robust modeling of nonlinear population changes (e.g., year to year fluctuations). A simplified version of this latter approach has been used for analysis of population trends in Ontario (Lepage et al 1999, Francis and Whittam 2000), but it is not yet known whether this is the most appropriate analysis method.

The power of the survey technique will be investigated after its first three years in its present design to determine the actual variance. This will allow us to determine the number of routes required to detect our objective of a 35% change by 2020.

Finally, we recommend that relevant data be made publicly available, preferably over the Internet. This will encourage further research into analysis methods, thus ensuring that maximum use is made of the data for conservation purposes. However, care should be taken to protect sensitive information, such as precise nesting locations of rare species.

White-headed woodpecker

Rationale: Suitable white-headed woodpecker habitat includes large patches (greater than 350 acres) of open mature/old growth ponderosa pine stands with canopy closures between 10 - 50 percent and snags (a partially collapsed, dead tree) and stumps for nesting (nesting stumps and snags greater than 31 inches DBH). Maintaining white-headed woodpecker populations will require that this mature/old growth component of ponderosa pine habitat is maintained or enhanced within the subbasin.

Limiting Factors: 1) Silvicultural practices that reduce habitat quality; 2) pesticide use; 3) predation/competitors; 4) exotics.

Assumptions: If ponderosa pine habitat is of sufficient quality, extent, and distribution to support viable white-headed woodpecker populations, the needs of most other ponderosa pine obligate species will also be addressed and ponderosa pine functionality could be inferred.

Sampling Strategy: Survey points will be placed among habitat types of interest using a stratified random design. Number of survey points in each habitat type will be determined using power analysis with the goal of being able to detect a 25% increase in abundance of white-headed woodpecker with a power of 0.8 or greater.

Methods: The method used, point counts, is derived from Dixon (1998)

POINT COUNTS

Each observer will conduct one transect per day individually. Survey low-elevation transects first to assure accessibility. The protocol for point counts will follow standardized methods for variable circular plots (Reynolds et al. 1980, Ralph et al.1995, Hutto and Hoffland 1996), but modified to better census White-headed Woodpeckers.

WHEN TO SURVEY: Point counts should be conducted between April 1 and May 15 when the detectability of White-headed Woodpeckers is highest and most stable. After this period the woodpeckers typically excavate from within the nest cavity and become less visible and less vocal. Counts should begin at official sunrise and end no later than 1030 and 1100. Each transect will be visited once.

POINT COUNTS: Counts will begin as soon as the observer arrives at the station and will be comprised of a 5-minute listening period without the use of tape playbacks followed by a 6-minute sequence of tape playbacks of White-headed Woodpecker calls and drums for a total count of 11 minutes. Data from the two types of counts will be recorded separately-with a code-on a the bird data sheet.

TAPE PLAYBACK PROCEDURE: Tape playback procedures will essentially follow the Payette National Forest Protocol for Broadcast Vocalizations (Payette National Forest 1993). The tape playback sequence should begin immediately after the 5-min unsolicited point count-be ready to start the tape at exactly 5 min. A total of four 30-second tape-playbacks of White-headed Woodpecker drums and calls will be projected at 1-min intervals (e.g. using a Johnny Stewart™ game caller); that is, begin the first sequence of vocalizations to the north. During the one minute pause after the first sequence, rotate 90° for the second sequence, pause, then rotate another 90° for the third sequence of vocalizations after the second one minute break. When the third sequence is complete, rotate 90° for the fourth and final sequence for a total of 6 minutes of tape-playbacks.

WHEN NOT TO SURVEY: Surveys will not be conducted during heavy rain, fog, or when wind interferes with an observer's ability to detect calls (greater than 20 mph). If the weather appears prohibitive, wait 1 to 1.5 hours, or until you cannot reasonably complete the transect by 1100 hours. If the weather puts you in danger, STOP-your safety comes first.

WHAT TO RECORD: Record all species detected, visual or auditory. At the bottom of the data sheet, record any birds you might have detected either before or after a point count, or between stations.

Pygmy nuthatch

Rationale: Suitable pygmy nuthatch habitat contains heterogeneous stands of ponderosa pine with a mixture of well-spaced, old pines and vigorous trees of intermediate age. Pygmy nuthatch represents those species that depend on snags for nesting and roosting, high canopy density, and large diameter (greater than 18 inches DBH) trees characteristic of mature undisturbed forests. Connectivity between suitable habitats is important for species, such as pygmy nuthatch, whose movement and dispersal patterns are limited to their natal territories.

Limiting Factors: 1) Silvicultural practices that reduce habitat quality; 2) fragmentation; 3) predation/competitors; 4) exotics.

Assumptions: If ponderosa pine habitat is of sufficient quality, extent, and distribution to support viable pygmy nuthatch populations, the needs of most other ponderosa pine obligate species will also be addressed and ponderosa pine functionality could be inferred.

Sampling Strategy: This is a survey development need.

7.8.9 Shrubsteppe

Focal Species

Brewer's sparrow (Spizella breweri), mule deer (Odocoileus hemionus hemionus)

Overall Habitat and Species Monitoring Strategy: Establish monitoring program for protected and managed shrubsteppe sites to monitor focal species population and habitat changes and evaluate success of efforts.

Focal Habitat Monitoring

Factors affecting habitat:

1. Direct loss shrubsteppe due to conversion to agriculture, residential, urban and recreation developments
2. Fragmentation of remaining shrubsteppe habitat, with resultant increase in nest parasites
3. Fire Management, either suppression or over-use, and wildfires
4. Invasion of exotic vegetation
5. Habitat degradation due to overgrazing, and invasion of exotic plant species
6. Loss and reduction of cryptogamic crusts, which help maintain the ecological integrity of shrubsteppe/grassland communities.

Shrub-steppe Working Hypothesis Statement: The near term or major factors affecting this focal habitat type are direct loss of habitat due primarily to conversion to agriculture, reduction of habitat diversity and function resulting from invasion of exotic vegetation and wildfires, and livestock grazing. The principal habitat diversity stressor is the spread and proliferation of annual grasses and noxious weeds such as cheatgrass and knapweeds that either supplant and/or radically alter entire native bunchgrass communities significantly reducing wildlife habitat quality. Habitat loss and fragmentation (including fragmentation resulting from extensive areas of undesirable vegetation) coupled with poor habitat quality of extant vegetation have resulted in extirpation and/or significant reductions in shrub-steppe obligate wildlife species.

Recommended Range of Management Conditions

Condition 1: Sagebrush dominated shrubsteppe: The Brewer's sparrow was selected to represent wildlife species that require sagebrush dominated sites, but prefer a patchy distribution of sagebrush clumps 10-30 percent cover, lower sagebrush height (between 20 and 28 inches), native grass cover 10 to 20 percent (Dobler 1994), non-native herbaceous cover less than 10 percent, and bare ground greater than 20 percent (Altman and Holmes 2000).

Condition 2 - Diverse shrubsteppe habitat: Mule deer were selected to represent species that require/prefer diverse, dense (30 to 60 percent shrub cover less than 5 feet tall) shrubsteppe habitats comprised of bitterbrush, big sagebrush, rabbitbrush, and other shrub species (Leckenby 1969; Kufeld et al. 1973; Sheehy 1975; Jackson 1990; Ashley et

al. 1999) with a palatable herbaceous understory exceeding 30 percent cover (Ashley et al. 1999).

Focal Habitat Monitoring Strategies

Establish an inventory and long-term monitoring program for protected and managed shrubsteppe habitats to determine success of management strategies. Subbasin managers recognize that restoration of shrubsteppe is still very much a fledgling field, and complete restoration of degraded or converted shrubsteppe may not be feasible. These monitoring strategies reflect the commitment to and initiation of the process of longterm management.

1. Identify shrubsteppe habitat sites within the subbasin that support populations of Brewer's sparrow
2. Evaluate habitat site potential on existing public lands and adjacent private lands for protection of focal species habitat (short-term strategy i.e., < 2 years).
3. Enhance habitat on public lands and adjacent private lands (intermediate strategy; 2 to 10 years)
4. Identify high quality/functional privately owned shrubsteppe sites that are not adjacent to public lands (long-term strategy 2 to 15 years).
5. Establish permanent censusing stations to monitor bird population and habitat changes.

Sampling Design: Permanent survey transects will be located within shrubsteppe habitats using HEP protocols. HEP is a standardized habitat-analysis strategy developed by the U.S. Fish and Wildlife Service. It uses a variety of Habitat Suitability Indices (HSI) for select wildlife species to evaluate the plant community as a whole (Anderson and Gutzwiller 1996). Sites are stratified by cover type, and starting points are established using a random number grid. Minimum length of a HEP transect is 600 ft, and patches of cover must be large enough to contain a minimum transect without extending past a 100 foot buffer inside the edge of the cover type.

In addition, at any permanently established avian species monitoring site established within the Shrubsteppe habitat, structural habitat conditions will be monitored every 5 years as per Habitat Structure Assessment protocol (Nott et al 2003).

Sampling Methods (USFWS 1980a and 1980b):

1. Bare ground or cryptogram crust measurements are taken every 20 ft. on the right side of the tape (the right is always determined by standing at 0 ft and facing the line of travel). The sampling quadrant is a rectangular 0.5m2 microplot, placed with the long axis perpendicular to the tape, and the lower right corner on the sampling interval.

The percentage of the microplot consisting of either bare ground or cryptogram crust is estimated via ocular estimate.

2. Herbaceous measurements are taken every 20 ft. on the right side of the tape (the right is always determined by standing at 0 ft and facing the line of travel). The sampling quadrant is a rectangular 0.5m2 microplot, placed with the long axis perpendicular to the tape, and the lower right corner on the sampling interval.

Herbaceous cover % is measured via an ocular estimate of the percentage of the microplot shaded by any grass or forb species.

3. Shrub canopy cover is measured using a point intercept method and is visually estimated before starting each transect. If the total shrub cover is anticipated to be >20%, shrub data are collected every 5 ft (20 possible "hits" per 100 ft segment). If shrub canopy cover is anticipated to be <20%, data are collected every 2 ft (50 possible "hits" per 100 ft segment).

Shrub canopy cover is measured on a line intercept 'hit' or 'miss'. Measurements are taken every 2 or 5 feet, depending upon shrub density.

Shrub height measurements are collected on the tallest part of a shrub that crosses directly above each sampling intercept mark. For shorter shrub classifications (i.e. all shrubs less than 3 feet), the tallest shrub is measured that falls within that category.

4. Tree canopy cover measurements are taken every ten feet along a transect. Basal and snag measurements are taken within a tenth-acre circular plot at the end of each 100 ft segment. The center point of the circular plot is the 100 ft mark of the transect tape, and the radius of the circle is 37.2 ft.

Analysis: Transects are divided into 100 ft. segments, and total transect length is determined using a "running mean" to estimate variance (95% probability of being within 10% of the true mean).

Sample size equation: $n = t2 \times s2$

$E2$

Where: t = value at 95 percent confidence interval with suitable degrees of

freedom

s = standard deviation

E = desired level of precision, or bounds

Focal Species Monitoring

Brewer's Sparrow

Rationale: The main premise for focal species selection is that the requirements of a demanding species assemblage such as Brewer's sparrow encapsulate those of many co-occurring less demanding species. By directing management efforts toward the requirements of the most exigent species, the requirements of many cohabitants that use the same habitat type are met. Therefore, managing habitat conditions for a species assemblage comprised of these three species should provide life requisite needs for most other shrubsteppe obligate species.

Limiting Factors: 1) Conversion of native shrub-steppe habitat for agricultural purposes, 2) habitat fragmentation; 3) degradation of existing habitats from overgrazing and introduced weedy vegetation, 4) brush removal, 5.) wildfire

Assumptions: 1) Addressing factors that affect shrub steppe habitat will address Brewer's sparrow; 2) If shrub steppe habitat is of sufficient quality, extent, and distribution to support Brewer's sparrow populations, the needs of most other shrub steppe obligate species will also be addressed and shrub steppe functionality could be inferred.

Sampling Strategy: Survey points will be placed among habitat types of interest using a stratified random design. Number of survey points in each habitat type will be determined using power analysis with the goal of being able to detect a 35% increase in abundance of key species with a power of 0.8 or greater.

Methods: We will survey birds on 64 sites in different vegetation types and levels of fragmentation. Each site will have 4 100-m fixed-radius point counts (Ralph et al. 1993) established along a transect and spaced 200m apart (Fig 4). The outer points of the point-count circles will describe a rectangular plot of 16ha that will be the focus of all survey work in Objectives 2-4. Each point will be marked with a permanent fiberglass stake (1m electric fence post) and colored flagging will be placed on shrubs at 50 and 100m from the point in each of the 4 cardinal directions to aid in determining distance. Counts at each point will be 5 minutes in duration during which all birds seen or heard will be noted, along with their sex (if known), distance from the point (within 50m, >50 but <100m, or beyond 100m), and behavior (singing, calling, silent, or flying over the site). Surveys will be conducted once each in May and June and within prescribed weather parameters (e.g., no rain and low wind).

Mule Deer

Rationale: Mule deer inhabit all habitats within the subbasin. The largest concentration of mule deer is found in the lower Entiat basin during winter. Shrub-steppe habitat quality determines the size and persistence of mule deer populations within the subbasin, as they are both critical winter habitat and the limiting factor for this species in the subbasin. Mule deer have been selected as a focal species due to the significant economic, recreational, and cultural values this species provides.

Limiting Factors: 1) flooding of habitat resulting from hydropower facilities, 2) loss of habitat due to urban and suburban development, 3) road and highway construction, 4) degradation of existing habitats from overgrazing and introduced weedy vegetation, 5) alteration of historic fire regimes, 6) past silvicultural practices, 7) deer control efforts necessitated by agricultural damage, 8) natural predation and over-harvest by hunters, 9) disease and parasites

Assumptions: Addressing factors that affect shrubsteppe habitats, will also address mule deer and other shrubsteppe obligate species limiting factors.

Management Objective: The population management objective for mule deer will be to increase or maintain populations within the limitations of available mule deer habitat and landowner tolerance (agricultural damage). Population monitoring variables and objectives are established in the Washington Department of Fish and Wildlife Game

Management Plan (WDFW 2003). In areas with periodically high mule deer populations and significant agricultural damage complaints, WDFW will regulate populations as appropriate through hunter harvest.

Monitoring Methods: Mule deer populations will be monitored using a combination of post hunting surveys, spring surveys and harvest data. Current surveys allow the monitoring of age/sex ratios to determine if management objectives established in the Game Management Plan (WDFW 2003) are being met for post-season buck survival (> 15 bucks/100 does) and fawn production and recruitment. Harvest data is used as an indicator of population trend.

Evaluation Strategies:

1. Use winter aerial and ground surveys to classify mule deer to determine post-hunt buck/fawn to doe ratios, spring fawn to adult ratios, and population size trends.
2. Monitor harvest level of bucks and antlerless deer using mandatory hunter report system.
3. Model the Chelan PMU mule deer population (which extends beyond the subbasin border).