

6 Inventory

6.1.1 Introduction

The inventory for the Lake Chelan subbasin summarizes fish and wildlife protection, restoration, and artificial production. Projects and programs focus on protection, restoration, and research. The inventory provides a baseline of activity from which future management decisions can be made and will have the greatest value when reviewed in conjunction with the limiting factors resulting from the assessment. A comparison of past actions with limiting factors should help assess the efficacy of current actions, indicate the areas of project gap and guide management decisions.

6.2 Terrestrial

Shrubsteppe Focal Habitat and Brewer's Sparrow and Mule Deer Focal Species

Table 18. Projects related to shrubsteppe habitat and/or representative focal species

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
CCPUD	CCPUD \$1,050.	Completed in 2003	Bitterbrush Planted for Mule Deer	Project Description: Bitterbrush seed collected and cleaned and/or purchased from local seed crops and planted within the Chelan basin Rationale & Results: To provide cover and winter forage for mule deer
CCPUD	CCPUD \$8,000	Completed in 2003	Deer Point Bitterbrush Propagation	Project Description: Propagated 10,000 bitterbrush plants to be planted in Deer Point fire area in 2004 (shrubsteppe & ponderosa pine habitat) Rationale & Results: To restore deer winter range
CCPUD	CCPUD, 33 man-days labor	Completed in 2003	Chelan Butte Habitat Management	Project Description: Enhanced and maintained deer and bird water and feeding structures

			Area	Rationale & Results: To improve wildlife habitat
CCPUD	CCPUD, 29 man-days labor	2002	Bitterbrush Seed Collection & Old Fence Removal	Project Description: Removed old, abandoned fence lines and collected bitterbrush seed for future plantings Rationale & Results: To improve mule deer winter range
CCPUD	CCPUD, 19 man-days labor	2000	Safety Harbor Creek Bitterbrush Pruning	Project Description: Pruned bitterbrush within one mile down-lake from Safety Harbor Creek Rationale & Results: Enhance forage on deer winter range
CCPUD & USFS	CCPUD, 49 man-days (1999) & 13 man-days (2000) labor	1999 & 2000	Water Guzzler Repair and Maintenance	Project Description: Repaired, rebuilt, and modified water guzzlers Rationale & Results: To provide water for big game, birds, and other wildlife
USFS	USFS	2002-Ongoing	Chelan Basin Cooperative Weed Control	Project Description: Treated noxious weeds along main roads Rationale & Results: To reduce weed infestation and degradation of shrubsteppe habitat and slow spread of Dalmatian toadflax to 25-Mile Creek and areas uplake of Mitchell Creek
USFS	CCPUD	1,740 acres completed April, 2004; Ongoing	Deer Point Fire Winter Range Rehabilitation	Project Description: Seeded 1,740 acres of shrubsteppe winter range habitat; future efforts will focus on cheatgrass infestations Rationale & Results: To slow spread of noxious weeds
USFS	Holden Mine Remediation	Negotiations are ongoing	Holden Mine Remediation	Project Description: North Shore Land Acquisition: Acquire 1-200 acres of shrubsteppe habitat; Remove LC Reclamation District pipeline (Antilon Lake to Safety Harbor) burned in 1970

	Funds		Projects	and 2002 fires Rationale & Results: To prevent conversion of shrubsteppe habitat to residential uses; To prevent wildlife entanglement, collapse of buried pipeline and obstruction of migration corridors in shrubsteppe habitat
USFS	USFS	Ongoing	Natural Fuels Projects	Project Description: Mechanical treatments and prescribed burning in 25-Mile Creek and lower elevation north shore areas, and Slide Ridge and Forest Mountain areas on south shore Rationale & Results: To manage wildfires, protect wildlife habitat, and increase growth and availability of forage
USFS	CCPUD \$17,500.	Completed in 2004	Deer Point Fire Emergency Rehabilitation	Project Description: Planted 10,000 bitterbrush plants on 4000 acres of shrubsteppe, ponderosa pine, and lodgepole pine habitat burned in Deer Point fire Rationale & Results: To reduce post fire erosion and weed infestation and restore deer winter range
USFS	CCPUD \$7,500.	Completed in 2003	Deer Point Bitterbrush Inventory	Project Description: Conducted inventory of bitterbrush plant survival within 40,000 acres burned by Deer Point wildfire on north shore of Lake Chelan (shrubsteppe & ponderosa pine habitat) Rationale & Results: To determine where to restore bitterbrush for deer winter range
USFS	USFS	2001-2004	Rex Creek Fire Area: Crupina Weed Control	Project Description: Seeded 5000 acres of shrubsteppe and ponderosa pine habitat with native grass following 2001 Rex Creek fire; Crupina hand-pulled annually; herbicides will be used beginning in 2004 Rationale & Results: To control noxious weeds (e.g. Crupina)

				and prevent further degradation of mule deer and mountain goat winter range
USFS	CCPUD	2000	Grade & Camas Creeks Prescribed Burn	<p>Project Description: Conducted 946 acre prescribed burn on mule deer and big-horn sheep winter range along north shore of LC</p> <p>Rationale & Results: To increase growth and availability of bitterbrush and other forage</p>
USFS	CCPUD	1999	Bear Mtn. Native Grass Planting	<p>Project Description: Planted native grasses on south shore of LC in area burned by 1976 fire</p> <p>Rationale & Results: To provide forage for deer on winter deer range and control noxious weeds</p>
USFS	CCPUD	1999	Mitchell and Poison Creek Prescribed Burn	<p>Project Description: Conducted 1300 acre prescribed burn on mule deer and bighorn sheep winter range along north shore of LC</p> <p>Rationale & Results: To increase growth and availability of bitterbrush and other forage</p>
USFS	CCPUD	1998	30 Acre, So. Shore Forage Planting	<p>Project Description: Planted buckwheat, balsamroot, and bitterbrush on 30 acres on south shore of LC burned by Tye Fire</p> <p>Rationale & Results: To increase growth and availability of bitterbrush, grasses, and other forage for deer</p>
USFS	CCPUD	1998	25-Mile Creek and Box Canyon prescribed	<p>Project Description: Conducted 200 acre prescribed burn on mule deer winter range on south shore of LC</p> <p>Rationale & Results: To increase growth and availability of</p>

			burn	bitterbrush and other forage
USFS	CCPUD	1998	Seed Propagation	Project Description: Propagated bitterbrush and other forage seed for south shore of LC Rationale & Results: To rehabilitate deer winter range
WDFW	CCPUD \$17,500.	2002	Chelan Butte and Navarre Coulee Habitat Management Areas	Project Description: Purchased herbicides, fuels, seed, and fencing Rationale & Results: To improve deer winter range on south side of Lake Chelan
WDFW	CCPUD	2001	Mule Deer Habitat Use: GPS	Project Description: Purchased six GPS radio collars to place on adult mule deer does on winter range along north shore of LC Rationale & Results: To identify the habitat and areas used by deer to guide future habitat improvements
WDFW	CCPUD	2000	Bear Mountain Grass Seeding	Project Description: Seeded and re-seeded 25 acres of deer winter range and wildlife habitat with alfalfa, wild rye, and other grasses on south shore of LC Rationale & Results: To establish forage and control noxious weeds

Riparian Focal Habitat and Red-eyed Vireo and American Beaver Focal Species

Table 19. Projects related to riparian habitat and/or representative focal species

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
USFS	Holden Mine Remediation Funds	Negotiations are ongoing	Holden Mine Remediation Projects	<p>Project Description: 100 acres of riparian, stream, and forested habitat would be treated to reduce or remove environmental contaminants associated with mine.. Other projects: Domke Lake Milfoil control, 60-70 acres of wetland/lacustrine habitat; Stehekin Delta, 50 acres of channels and islands created; Antilon Lake, stabilize lake level and limit recreation to designated sites; Dry Lake/Stink Creek, restore and diversify 10 acres wetland; Coyote Creek, plant cedars and stabilize roads on 50 acre wetland</p> <p>Rationale & Results: To provide, diversify, and restore riparian, wetland, and fisheries habitat, structure, and function</p>
CCPUD	CCPUD, 33 man-days labor	Completed in 2003	Chelan Butte Habitat Management Area	<p>Project Description: Created check dams in creek bottoms to slow erosion and enhance riparian habitat</p> <p>Rationale & Results: Improved fish and wildlife habitat</p>
CCPUD	CCPUD, 11 man-days labor	2000	Riparian Plantings	<p>Project Description: Planted cuttings (e.g., cottonwood, willow, and red-osier dogwood) in riparian bottom lands scoured by fires.</p> <p>Rationale & Results: To Restore riparian habitat</p>

Ponderosa Pine Forest Focal Habitat and Pygmy Nuthatch, White-headed Woodpecker, and Flammulated Owl

Table 20. Projects related to ponderosa pine habitat and/or representative focal species

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
USFS	Holden Mine Remediation Funds	Negotiations are ongoing	Holden Mine Remediation Projects	<p>Project Description: 100 acres of riparian, stream, and forested habitat would be treated to reduce or remove environmental contaminants associated with mine. Other projects: Remove LC Reclamation District pipeline (Antilon Lake to Safety Harbor) burned in 1970 and 2002 fires.</p> <p>Rationale & Results: To prevent wildlife entanglement, collapse of buried pipeline and obstruction of migration corridors in ponderosa pine habitat</p>
USFS	USFS	To be implemented over next 5 yrs.	Pot Peak Fuel Reduction	<p>Project Description: Will thin 565 acres of ponderosa pine</p> <p>Rationale & Results: To restore old-growth habitat and reduce risk of stand replacement in treated areas</p>
USFS	USFS	Began in 2004	Antilon Lake and Alta Coulee Fuels Reduction	<p>Project Description: Thinned 6,300 acres and conducted 12,500 acre prescribed burn on ponderosa pine habitat in area between Antilon Lake and Alta coulee</p> <p>Rationale & Results: To reduce fuels, establish a more frequent low intensity fire cycle, and restore ponderosa pine woodland, especially large fire resistant trees</p>
USFS	USFS	Ongoing	Natural Fuels Projects	<p>Project Description: Mechanical treatments and prescribed burning in 25-Mile Creek and lower elevation north shore areas, and Slide Ridge and Forest Mountain areas on south shore</p>

				Rationale & Results: To manage wildlife, protect wildlife habitat, and increase growth and availability of forage
USFS	USFS	2001-2004	Rex Creek Fire Area: Crupina Weed Control	Project Description: Seeded 5000 acres of shrubsteppe and ponderosa pine habitat with native grass following 2001 Rex Creek fire; Crupina hand-pulled annually; herbicides will be used beginning in 2004 Rationale & Results: To control noxious weeds (e.g. Crupina) and prevent further degradation of mule deer and mountain goat winter range
USFS	CCPUD \$17,500.	Completed in 2004	Deer Point Fire Emergency Rehabilitation	Project Description: Planted 10,000 bitterbrush plants on 4000 acres of shrubsteppe, ponderosa pine, and lodgepole pine habitat burned in Deer Point fire Rationale & Results: To reduce post fire erosion and weed infestation and restore deer winter range
CCPUD	CCPUD \$8,000	Completed in 2003	Deer Point Bitterbrush Propagation	Project Description: Propagated 10,000 bitterbrush plants to be planted in Deer Point fire area in 2004 (ponderosa pine & shrubsteppe habitat) Rationale & Results: To restore deer winter range
USFS	CCPUD \$7,500.	Completed in 2003	Deer Point Bitterbrush Inventory	Project Description: Conducted inventory of bitterbrush plant survival within 40,000 acres burned by Deer Point wildfire on north shore of LC (ponderosa pine & shrubsteppe habitat) Rationale & Results: To determine where to restore bitterbrush for deer winter range

Other Lake Chelan Subbasin Habitat Types

Table 21. Projects related to other Lake Chelan subbasin habitat types

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
CCPUD	CCPUD, 3 man-days labor	2002	Chelan Butte & Navarre Coulee HMAs: Kestrel Nest Boxes	<p>Project Description: Built kestrel nest boxes</p> <p>Rationale & Results: Provided nesting sites for kestrels</p>
CCPUD & USFS	CCPUD, 13 man-days labor	2000	Water Guzzler Repair and Maintenance	<p>Project Description: Repaired, rebuilt, and modified water guzzlers</p> <p>Rationale & Results: To provide water for big game, birds, and other wildlife</p>

6.3 Aquatic

Projects and programs listed in the aquatic assessment focus on conservation, restoration, and research.

Lake Chelan Assessment Unit

Table 22. Projects in Lake Chelan assessment unit

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
CCPUD		2003	Lake Chelan Hydroelectric Project (FERC #637): Offer of Settlement	<p>Project Description: Enhances fish & wildlife habitat, revises lake level regime, stocks fish, replaces survey monuments, and protects resources.</p> <p>Rationale & Results: Provides protection, mitigation, & enhancement measures for resources affected by Lake Chelan Project.</p>
DNR	ID#AL-41, Aquatic Lands Enhancement Account \$12,887	4/2/04 emailed DNR for date	Willow Point Waterfront Park	<p>Project Description: Enhanced recreation via picnic area, toilets, landscaping and enlargement of parking area.</p> <p>Rationale & Results: Developed public access site on Lake Chelan.</p>
Ecology	Environmental Assessment	1984	Basic Water Monitoring Program: Fish Tissue and Sediment Samples	<p>Project Description: Collected and analyzed fish (organic pesticides, PCBs, heavy metals) and sediment (priority pollutants excluding volatile organics) samples at ten locations in Washington, including Lake Chelan.</p> <p>Rationale & Results: Distinctive array of pollutants, usually at low concentrations. Elevated levels of DDT</p>

				in the central region of the state.
Ecology	Environmental Assessment	1994	Washington State Pesticide Monitoring Program: Fish Tissue and Sediment	<p>Project Description: Fourteen fish tissue samples and five sediment samples were collected from six sites, including Lake Chelan, and tested for pesticides, PCBs and other compounds.</p> <p>Rationale & Results: See Report at Ecology website.</p>
NPS		1968	Lake Chelan National Recreational Area	<p>Project Description: Established the Lake Chelan NRA.</p> <p>Rationale & Results: Provides public outdoor recreation; conserves resources; minimizes conflicts.</p>
USFS		1995-2000	Watershed Analyses	<p>Project Description: Completed watershed analyses North Shore, Middle, and Upper Chelan.</p> <p>Rationale & Results: To develop goals and priorities for ecosystem restoration projects and meet requirements of NWFP.</p>
WDFW	WDFW (including partnerships & cost-sharing)	1974-78, 1990-Ongoing[?]	WDFW landlocked chinook stocking	<p>Project Description: Introduced landlocked chinook salmon to provide a trophy fishery for Lake Chelan.</p> <p>Rationale & Results: Landlocked chinook population has remained at low levels in recent years but has been a very popular sport fishery.</p>
WDFW (formerly WDG)	Chelan PUD	1985-86, 1993-94	Lake Chelan Fishery Investigations	<p>Project Description: Creel Censuses (Kokanee and Rainbow Trout) and plankton surveys.</p> <p>Rationale & Results: Low population densities of</p>

				plankton in Lake Chelan, Kokanee: Low catch per unit of effort.
WDFW & Chelan Ranger District	Lake Chelan Sportsman's Association	1996	Large Woody Debris Removal	<p>Project Description: Over 700 tons of LWD (flood debris) removed from Lake Chelan.</p> <p>Rationale & Results: Some of the LWD used to enhance fish habitat in Prince and Safety Harbor creeks.</p>

Tributaries Assessment Unit

Table 23. Projects in the tributaries assessment unit

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
CCPUD		2003	Lake Chelan Hydroelectric Project (FERC #637): Offer of Settlement	<p>Project Description: Enhances fish & wildlife habitat, removes tributary barriers, stocks fish, and protects resources.</p> <p>Rationale & Results: Provides protection, mitigation, & enhancement measures for resources affected by Lake Chelan Project.</p>
CCPUD	CCPUD	1984 – Ongoing	Kokanee and Chinook Spawning Surveys	<p>Project Description: Conduct annual spawning surveys (First, Twentyfive Mile, Safety Harbor, Company & Blackberry creeks).</p> <p>Rationale & Results: To determine tributaries used by kokanee and chinook for spawning. Annual reports summarize results.</p>
Ecology	Environmental Assessment	1996	Effects of Holden Mine on Railroad Creek	<p>Project Description: Studied effects of Holden Mine on water sediments and benthic invertebrates of Railroad Creek.</p> <p>Rationale & Results:</p>
USFS		1995-2000	Watershed Analyses	<p>Project Description: Completed watershed analyses for First/Twenty-five Mile Creek, & Antoine creeks.</p> <p>Rationale & Results: To develop goals and priorities for ecosystem restoration projects and meet</p>

				requirements of NWFP.
USFS	WSDOT/USFS	1999-2000	First Creek Project	<p>Project Description: Replaced 2 highway culverts with bridges, applied longterm revegetation measures to stabilize streambanks and restore ecosystem function, and installed rock/log channel structures to modify in-channel passage problems and provide resting and spawning habitat</p> <p>Rationale & Results: Physical channel connectivity restored between Lake Chelan and National Forest waters in First Creek. Post-project spawning surveys reported 1215 kokanee, a 123% increase in a 17-year average of 544 spawners. Use of the restored habitat is taken as evidence of immediate success of the project.</p>
USFS, Wenatchee National Forest		1992-94	Mitchell Creek Watershed Restoration	<p>Project Description: Constructed several fish habitat enhancement structures in Mitchell Creek.</p> <p>Rationale & Results: May account for an increase in trout population in this creek.</p>
WDFW (formerly WA. Dept. of Game)	CCPUD	1984	Lake Chelan Fishery Investigation Report	<p>Project Description: Identified tributaries that support adfluvial trout and kokanee, and estimated standing crop and linear meters of stream accessible to rainbow trout and kokanee (BROWN 1984).</p> <p>Rationale & Results: Twenty-three tributaries support adfluvial trout and kokanee populations. Accessible stream: 10,002 linear m (rainbow trout) & 6,044 (kokanee). Standing Crop: 18,104 (rainbow trout) & 658 (cutthroat trout).</p>

WDFW (formerly WA. Dept. of Game)	CCPUD	2000	Population Study: Electrofishing	Project Description: Assessed salmonid population by electrofishing in eight study streams(DES 2000a). Rationale & Results: Determined efficacy of the kokanee, cutthroat and rainbow trout stocking/hatchery programs.
WDFW (formerly WA. Dept. of Game)	CCPUD	1999-2000	Snorkeling Surveys: Adult Adfluvial Trout and Rainbow Trout	Project Description: Conducted snorkeling surveys of eight tributaries in 1999 & nine in 2000. Rationale & Results: Determined fish presence and use at creek mouths and in lower reaches of the streams, for staging upstream migration.
WDFW(formerly WDG)		1965 & 1991	Twenty-five Mile Creek Spawning Channel	Project Description: Replaced spawning gravel in the Stehekin River and constructed spawning channel on Twenty five Mile Creek Rationale & Results: Restored kokanee spawning habitat after the floods of 1948 / 49.
WDFW, DOT, WSP, USFS (Chelan Ranger District), CCCD, WCC, LCSA, Save Chelan Alliance, and three private landowners		1999	First Creek Culvert Removal and Bridge Construction	Project Description: Removed two state highway culverts and replaced them with bridges. Rationale & Results: Restored kokanee and rainbow trout access to and production from several miles of First Creek. 1,215 Kokanee Spawners in First Creek during 1999, a 123% increase over 17-yr. avg. of 544.

<p>WDFW & and Chelan Ranger District</p>	<p>LCSA</p>	<p>1996</p>	<p>LWD Placement: Prince and Safety Harbor Creeks</p>	<p>Project Description: LWD (flood debris from Lake Chelan) placed in Prince and Safety Harbor creeks to enhance fish habitat enhancement would be beneficial to cutthroat trout, rainbow trout, and kokanee.</p> <p>Rationale & Results: Several of the LWD pieces captured bedload creating vertical drops & passage barriers at low flow.</p>
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Chelan River, Bypassed Reach, and Lake Chelan Project Tailrace Assessment Unit

Table 24. Projects in the Chelan River, Bypassed Reach, and Lake Chelan Project Tailrace assessment unit

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
CCPUD		2003	Lake Chelan Hydroelectric Project (FERC #637): Offer of Settlement	<p>Project Description: Restores flow to bypassed reach, enhances salmon & steelhead spawning habitat, and protects resources.</p> <p>Rationale & Results: Provides protection, mitigation, & enhancement measures for resources affected by Lake Chelan Project.</p>

7 Interpretation and Synthesis

7.1 Terrestrial-

7.1.1 Introduction

The terrestrial interpretation and synthesis for the Lake Chelan subbasin plan summarizes information in terms of key findings and advances hypotheses for existing conditions. The section reviews each of the focal species in spatial and linear contexts, comparing current and historic conditions. For further information related to wildlife, see Appendix A.

7.1.2 Key findings and hypothesis

Shrubsteppe

Focal species: Brewer's sparrow, mule deer

Key findings

- Degradation of habitat from intensive grazing and invasion of exotic plant species.
- Fire management, either suppression or over-use, and wildfires.
- Invasion and seeding of crested wheatgrass and other introduced plant species which reduces wildlife habitat quality and/or availability.
- Loss and reduction of cryptogamic crusts, which help maintain the ecological integrity of shrubsteppe/grassland communities.
- Human disturbance during breeding/nesting season, parasitism.

Working hypothesis

1. Reduction of habitat diversity/function has occurred from invasion of exotic vegetation, wildfires, and grazing.
2. Habitat loss and fragmentation, coupled with poor quality of existing habitat has resulted in the extirpation or reduction of shrubsteppe obligate species.

Eastside (Interior) Riparian Wetlands

Focal species: beaver, red-eyed vireo

Key findings

- Habitat degradation from livestock overgrazing which can widen channels, raise water temperatures, reduce understory cover, etc.
- Hostile landscapes, particularly those in proximity to agricultural and residential areas, may have high density of nest parasites (brown-headed cowbird), exotic nest competitors (European starling), and domestic predators (cats), and be subject to high levels of human disturbance.

Working hypothesis

3. Loss of habitat diversity/function has resulted from invasion of exotic vegetation and grazing.
4. Habitat loss and fragmentation, coupled with poor quality of existing habitat has resulted in the extirpation or reduction of riparian obligate species.

Ponderosa pine

Focal species: white-headed woodpecker, flammulated owl, pygmy nuthatch

Key findings

- Timber harvesting has reduced the amount of old growth forest and associated large diameter trees and snags.
- Urban and residential development has contributed to loss and degradation of properly functioning ecosystems.
- Fire suppression/exclusion has contributed towards habitat degradation, particularly declines in characteristic herbaceous and shrub understory from increased density of small shade-tolerant trees. High risk of loss of remaining ponderosa pine overstories from stand-replacing fires due to high fuel loads in densely stocked understories.
- Overgrazing has resulted in lack of recruitment of sapling trees, particularly pines.
- Invasion of exotic plants has altered understory conditions and increased fuel loads.
- Fragmentation of remaining tracts has negatively impacted species with large area requirements.
- Hostile landscapes, particularly those in proximity to agricultural and residential areas, may have high density of nest parasites (brown-headed cowbird), exotic nest competitors (European starling), and domestic predators (cats), and may be subject to high levels of human disturbance.

Working hypothesis

5. Habitat has been lost due to timber harvest, fire reduction (and subsequent intensive wildfires), mixed forest encroachment, and development.
6. Habitat diversity and function has been lost from invasion of exotic vegetation and grazing.
7. Loss of habitat and habitat diversity/function has resulted in extirpation or reduction of ponderosa pine obligate species.

7.1.3 Reference Conditions

Shrubsteppe

Abundance and productivity

Table 25. Abundance and productivity currently, historically and projected

	Current	Historic	Potential	Future w/no action
Brewer's sparrow	Low	Moderate	Low-Moderate	Potentially Extinct
Mule deer	Moderate	Moderate-High	Moderate	Low-Moderate

Near term opportunities

- Preserve existing high quality and restorable shrubsteppe habitat, with emphasis placed on adjacency to protected ownerships (public land, conservation easements), prioritize by size and connectivity of existing habitat patches.
- Control undesirable exotic vegetation using integrated pest management principals to control both existing weeds and addressing factors that contribute to weed establishment and dominance.
- Re-plant desired natives in conjunction with weed control activities.
- Integrate shrubsteppe habitat composition objectives with fire management planning.

Eastside (Interior) Riparian Wetlands

Abundance and productivity

Table 26. Abundance and productivity currently, historically and projected

	Current	Historic	Potential	Future w/no action
Red-eyed vireo	Low-Moderate	Moderate	Low-Moderate	Low-Moderate
Beaver	Low	Moderate	Low-Moderate	Low-Moderate

Near term opportunities

- Preserve and restore existing high quality and restorable riparian wetlands habitat, with emphasis placed on restoration of protected ownerships (public land, conservation easements), prioritize by size of potential riparian habitats.
- Establish riparian buffer zones to reduce negative effects of livestock, recreation, and vegetation manipulations.

- Control undesirable exotic vegetation using integrated pest management principals to control both existing weeds and addressing factors that contribute to weed establishment and dominance.
- Re-planting desired natives in conjunction with weed control and establishment of protective buffers.

Ponderosa pine

Abundance and productivity

Table 27. Abundance and productivity currently, historically and projected

	Current	Historic	Potential	Future w/no action
Pygmy nuthatch	Low	Moderate	Low-Moderate	Potentially Extinct
White-headed woodpecker	Low	Moderate	Low-Moderate	Potentially Extinct
Flammulated owl	Low	Moderate	Low-Moderate	Potentially Extinct

Near term opportunities

- Protect remnant large diameter ponderosa pines, and retain all snags and large diameter downed logs where feasible.
- Plan fire management activities to re-establish native pine savannah characteristics.

Summary of abundance and productivity

Table 28. Summary of abundance and productivity

	Current	Historic	Potential	Future w/no action
Terrestrial				
<i>Shrubsteppe</i>				
Brewer’s sparrow	Low	Moderate	Low-Moderate	Potentially Extinct
Mule deer	Moderate	Moderate-High	Moderate	Low-Moderate
<i>Riparian</i>				
Red-eyed vireo	Low-Moderate	Moderate	Low-	Low-Moderate

			Moderate	
Beaver	Low	Moderate	Low-Moderate	Low-Moderate
<i>Ponderosa pine</i>				
Pygmy nuthatch	Low	Moderate	Low-Moderate	Potentially Extinct
White-headed woodpecker	Low	Moderate	Low-Moderate	Potentially Extinct
Flammulated owl	Low	Moderate	Low-Moderate	Potentially Extinct

7.2 Aquatic

7.2.1 Introduction

This synthesis and interpretation of information presented in the assessment section of this plan, focuses on three fish species; westslope cutthroat trout (WSCT), bull trout, and kokanee salmon. WSCT currently appear to be reduced from historic abundance. Bull trout have not been observed since the 1950s, and kokanee, introduced to Lake Chelan in 1917, have shown extreme fluctuations in abundance. The key findings, hypotheses statements and assumptions are by focal species and assessment units.

Information that supports the hypothesis and assumptions used above can be found in: Brown, L.G. 1984; Chelan PUD. 1998; FERC 2001; Hagen 1995; Hillman and Giorgi 2000; Viola and Foster 2002; DES 2000; Kanda, N. 1998; Leary, R.F., F.W. Allendorf, and S.H. Forbes. 1993. (Full citation in References.)

7.2.2 Key findings, hypothesis statements and assumptions

Westslope cutthroat trout (WSCT)

Key Findings Tributaries Assessment Unit:

- Spawning habitat is naturally limited (except in the Stehekin River Basin), but rearing and other features are essentially in tact.
- Spawning and rearing competition occurs with native bridgelip suckers and introduced rainbow trout and brook trout. Rainbow trout may also breed with WSCT, further affecting genetic integrity.
- Most spawning streams (excluding First, Twenty-five Mile Creek and the Stehekin River) are currently difficult to reach at historic spawning times because of the barriers that have been created at their mouths.
- Key factors limiting production are most likely caused by interactions with exogenous species, and maladaptive spawning times in smaller spawning streams.
- Railroad Creek, downstream of Holden mine, has been lost to production because of mining activities.

Key Findings Tributaries and Lake Assessment Units:

- Westslope cutthroat trout are found throughout the Chelan Basin, but are most abundant in Lucerne Basin. Exact status has not been determined.
- Historic populations were reduced by over harvest, hatchery practices, and introduction of exogenous species.
- With the exception of Twenty-five Mile Creek, First Creek, and the Stehekin River, barriers (velocity, deposition, and depth) have formed at spawning tributary mouths. Most other habitat features remain (except for LWD in the lake which is removed for navigation purposes).

- Based on anecdotal information on early catch rates of WSCT in newspapers and other sources, the current population of WSCT appears to be much reduced from historic times. High catch rates in the 19th century and historic and current hatchery practices have most probably lead to their decline.

Working hypotheses

Lake Chelan Assessment Unit

8. Development of barriers at tributary mouths has negatively affected spawning and subsequent fry survival of WSCT.

Lake Chelan and Tributary Assessment Units

9. Interactions with non-native species have negatively affected WSCT spawning and rearing.
10. Harvest regulations and hatchery practices have reduced adult abundance.

Key assumptions

- Interactions with rainbow trout and suckers limit spawning success.
- Interactions with rainbow trout, lake trout, brook trout, and Chinook salmon may limit initial rearing, both within natal streams and the lake.
- Predation by Chinook salmon and lake trout may decrease spawner recruits. WSCT are spawning later than they did historically in the smaller tributaries.
- Delayed spawning access to spawning habitat may decrease initial rearing success after emergence.
- WSCT and Chinook salmon or lake trout inhabit the same areas at certain life stages
- WSCT early rearing takes place in natal tributaries

Bull trout

Key findings (all assessment units)

Bull trout have not been documented within the Chelan Basin since the 1950s.

- It is not clear why they may be extinct, but potential reasons are: over harvest, loss of spawning grounds due to high floods in 1948 and 1949; or a catastrophic disease outbreak, or a combination of above factors.
- Introduced rainbow trout, lake trout, and brook trout (and kokanee salmon) may inhibit re-introduction of bull trout through competition during rearing, foraging, or spawning phases.
- Brook trout are known to reduce genetic integrity of bull trout when they interbreed (and are sterile)¹

¹ Hybridization results in offspring that are frequently sterile (Leary et al. 1993), although recent genetics work has shown that reproduction by hybrid fish is occurring at a higher level than previously suspected (Kanda 1998).

- Current spawning and rearing areas within the Stehekin, and other tributaries are functioning near pristine levels
- Railroad Creek has been lost to production because of mining activities.

Working hypothesis

11. Bull trout are still present in smaller tributaries as non-migratory ecotypes.
12. Spawning and early rearing habitat will not limit bull trout re-introduction.
13. Competition with exogenous species will reduce the success of bull trout re-introduction.
14. All life histories of bull trout can be successfully reintroduced into the Chelan Basin

Key Assumptions

- Bull trout populations may be discovered in headwater tributaries.
- Spawning and rearing habitat is mostly intact.
- Because of established species assemblages (see below), establishment of adfluvial forms of bull trout is not possible.
- Competition with brook and lake trout, and potentially Chinook salmon may decrease the likelihood that bull trout can be re-introduced into the Basin.
- Redd imposition by kokanee may decrease the viability of bull trout eggs.

Kokanee salmon

Key findings

- Kokanee were introduced in 1917 and have provided a large recreational fishery ever since.
- Kokanee populations have been volatile and could be related to predator abundance, competition with native and exotic species for forage, and general lake productivity.
- Spawning habitat is not limiting.
- Introductions of hatchery fish have not been shown to increase natural production or harvest rates.

Working hypothesis

15. Rearing in Lake Chelan is limited by lake productivity and competition with other species.
16. Total adult abundance is impacted by predation by lake trout and chinook.
17. Hatchery plantings increase the total abundance of kokanee available for spawning or harvest.

Key Assumptions

- Competition with mysids, juvenile WSCT, juvenile chinook salmon, and other native species may limit production of kokanee.
- Predation by lake trout and Chinook salmon has a significant effect on the number of spawners in a given year.

7.2.3 Reference Conditions

Westslope cutthroat trout

From anecdotal information on early catch rates of WSCT in newspapers and other sources, the current population of WSCT appears to be much reduced from historic times. High catch rates in the 19th century, hatchery practices in the early 20th century, and negative interactions with exogenous species have all lead to their decline.

Abundance and productivity

Table 29. Abundance and productivity currently, historically and projected

	Current	Historic	Potential	Future w/no action
WSCT	Low	high	moderate	low

Near-term opportunities

- Spawning habitat in most Lake Chelan tributaries (excluding the Stehekin Basin) is naturally limited, although in relatively good shape. Chelan PUD has agreed to physically remove some barriers and modify lake levels under the terms of their new license (CPUD 2003). This will increase the likelihood that WSCT will be able to access spawning habitat in those streams where barriers have been documented within the presumed historic time frame, which probably will increase production.
- Eliminating rainbow trout plantings will help reduce negative interactions during spawning and potentially during rearing too. Reducing brook trout will also aid in reducing the potential negative interactions during rearing. Reductions of Chinook salmon and lake trout may also increase the likelihood for increased production by lowering predation.
- Preservation of existing high quality habitat in the Stehekin Basin is essential in maintaining the largest spawning and early rearing habitat in the Basin.

Bull trout

Bull trout were originally the apex predator of the Chelan Basin. While the total historic population will never be known, it was large enough to support a fishery until the early 1950s.

Abundance and productivity

Table 30. Abundance and productivity currently, historically and projected

	Current	Historic	Potential	Future w/no action
Bull trout	Potentially extinct	Mod.-high	Low-mod.	Potentially extinct

Near-term opportunities

- Eliminating or reducing lake trout will help reduce the potential negative interactions during rearing if a reintroduction program is started for adfluvial fish. Reducing or eliminating brook trout will also aid in reducing the negative interactions during spawning and rearing within streams. Reducing the abundance of Chinook salmon may also increase the likelihood of successful re-introduction.
- Preservation of existing high quality habitat in the Stehekin Basin is essential in maintaining the largest spawning and early rearing habitat in the Basin.

Kokanee

Kokanee salmon were introduced into Lake Chelan in 1917, and subsequent plantings have been ongoing.

Abundance and productivity

Table 31. Abundance and productivity currently, historically and projected

	Current	Historic	Potential	Future w/no action
Kokanee	Mod.-high	Mod.-high	Mod.-high	Mod.-high

Near-term opportunities

- Eliminating lake trout and chinook salmon plantings will help reduce predation, however, a species interaction model developed in coordination with Chelan PUD will help determine the trophic affects of removing top predators and its impact on other species. While it is probable that a reduction of chinook and lake trout is possible, it is unlikely that tot removal is possible since both species reproduce naturally within the basin.
- Preservation of existing high quality habitat in the Stehekin Basin is essential in maintaining the largest spawning habitat in the Basin.
- Reduction of mysids will increase survival of juvenile kokanee (trophic consequences of this action will be inferred from the model mentioned above).

Table 32. Summary of abundance and productivity

	Current	Historic	Potential	Future w/no action
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Aquatic				
Westslope cutthroat	Low	High	Moderate	Low
Bull trout	Potentially extinct	Mod.-high	Low-mod.	Potentially extinct
Kokanee	Mod.-high	Mod.-high	Mod.-high	Mod.-high