Tacoma/Trimble Area Management Plan

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EXECUTIVE SUMMARY

In 2000 and 2001, the Kalispel Natural Resource Department (KNRD) continued to mitigate the wildlife habitat losses as part of the Albeni Falls Wildlife Mitigation Project. Utilizing Bonneville Power Administration (BPA) funds, the Kalispel Tribe of Indians (Tribe) purchased three projects totaling nearly 1,200 acres. The Tacoma/Trimble Wildlife Management Area is a conglomeration of properties now estimated at 1,700 acres. It is the Tribe's intent to manage these properties in cooperation and collaboration with the Pend Oreille County Public Utility District (PUD) No. 1 and the U.S. Fish and Wildlife Service (USFWS) to benefit wildlife habitats and associated species, populations, and guilds.

INTRODUCTION

The Tribe recommends the Tacoma/Trimble Area Management Plan (Plan) for restoration, enhancement and management of wildlife habitat in the Tacoma/Trimble Wildlife Management Area (Project Area). The Project Area is located in the Cusick valley of the Pend Oreille River (Figure_1).

Land ownership in the Pend Oreille valley is largely private. In 2000 and 2001, the Tribe and the Pend Oreille County PUD purchased property in the lower reaches of Tacoma Creek and Trimble Creek as wildlife mitigation for Albeni Falls and Box Canyon Dams, respectively. Including USFWS Refuge properties, the amount of protected acreage that is managed for wildlife exceeds 1,700 acres. The purpose of this Plan is to outline baseline habitat conditions and management strategies that would be employed in the Project Area. The Tribe recommends that these lands be managed by the Tribe to minimize costs and maximize on-the-ground management efforts.

Figure 1. Project Area general vicinity map.

The Tribe followed an extensive process to formulate and prioritize wildlife resource goals. The KNRD provided guidance in identifying on-site opportunities. To prioritize specific goals, the Albeni Falls Interagency Work Group (AFIWG) and the Columbia Basin Fish and Wildlife Authority (CBFWA) Wildlife Caucus were consulted for the Albeni Falls mitigation sites. The Tribe consulted the Pend Oreille PUD for the Project Area, and the USFWS for the Little Pend Oreille Refuge property. From this consultation process, the Tribe identified the primary goal for the area:

"Protect and restore riparian deciduous forest and freshwater wetlands to mitigate losses resulting from reservoir inundation and operations at Albeni Falls and Box Canyon Dams."

Indicator target species benefiting from management will include mallard, breeding and wintering bald eagle, Canada goose, black-capped chickadee, yellow warbler, pond breeding amphibians, white-tailed deer, muskrat, and beaver. Additional plant and animal community data will give the Tribe a better understanding of ecosystem health and will aid the Tribe in deciding which management actions produce the desired results.

The construction of Box Canyon Dam in 1952 and Albeni Falls Dam in 1954 inundated nearly 9,000 acres of wetlands once used by the Tribe and area residents. Fluctuations in water levels both above and below the dams impacted riparian habitat and precluded the re-establishment of riparian plant communities. Habitat impacts have occurred for 40 years and caused cumulative wildlife impacts. These factors have resulted in both direct and indirect impacts to wildlife. Other limiting factors impairing wildlife habitat quantity, quality and function include habitat conversion and land use practices such as farming, grazing, and residential and recreational development.

Restoration and enhancement of the Pend Oreille River floodplain and its tributaries are the basis of this Plan. The Tribe, USFWS, and the Pend Oreille PUD own targeted lands within the Project Area. This area will be incorporated into a single management plan.

Project Scope

The Project Area is intended to partially mitigate wildlife habitat losses due to construction and inundation by Albeni Falls Dam. This complex of nearly 1,200 acres of mitigation properties, purchased by BPA, will contribute approximately 842 baseline Habitat Units (HUs) (Figure_2). The remaining habitat values will be realized through restoration and enhancement activities outlined in this Plan. The HU increases due to restoration and enhancement will be determined through Habitat Evaluation Procedure (HEP) evaluations conducted at five-year intervals. Vegetation and wildlife populations/guilds will be monitored to determine habitat function and an appropriate approach to adaptive management.

GENERAL SITE DESCRIPTION

The Project Area is located in Pend Oreille County in northeast Washington. The Project Area is in the Cusick valley, with three projects located on the Pend Oreille River shoreline, and two projects located on Trimble Creek just west of the river (Figure_2). The Pend Oreille River is large, averaging 25,000 cubic feet per second (cfs) annually, with a spring peak average of 90,000 cfs. The Selkirk Mountains rise 6,000-7,000 feet above mean sea level on both sides of the valley.

The valley floor has been developed from river alluvium. Wetlands are well distributed in these rich deposits. Most of the valley floor is considered to be, or to have once been, wetland (USFWS 1980). The combination of wetlands, river, and north-south aligned mountains has resulted in an important migratory flyway for waterfowl, bald eagles, and other migrating birds.

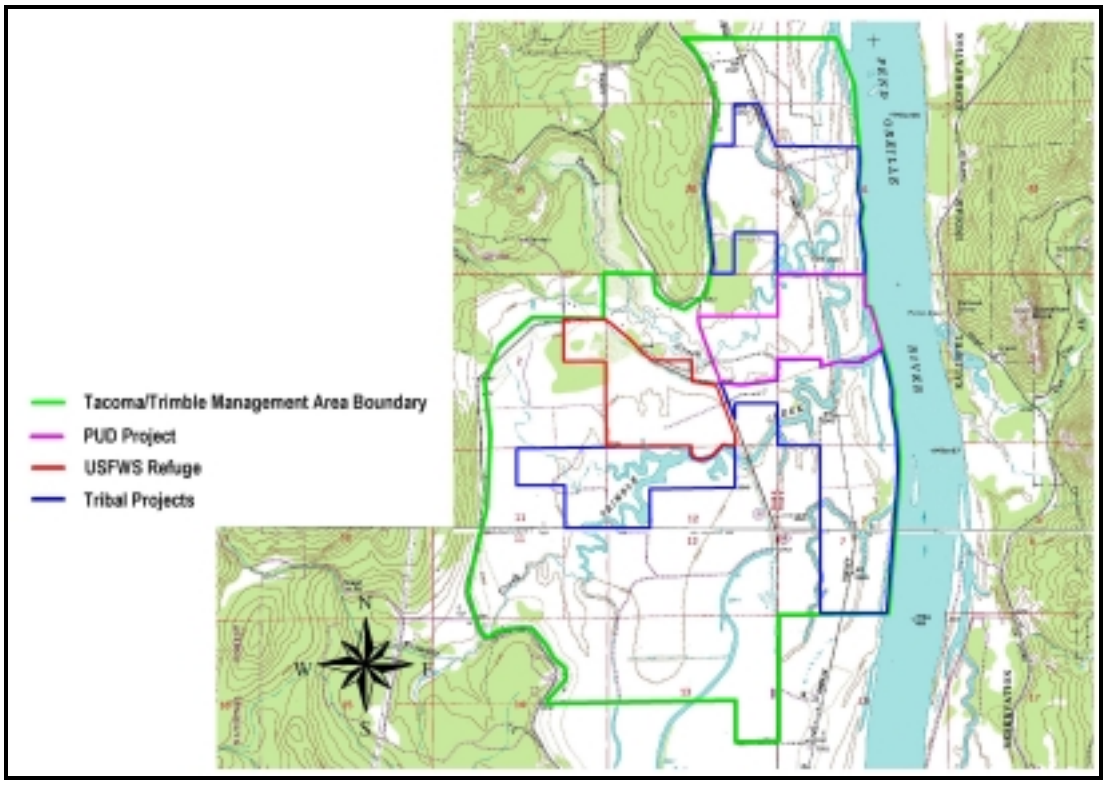


Figure 2. Project Area location map.

Climate

In Pend Oreille County, summers are warm to hot in the valleys and much cooler in the mountains. Winters are generally cold. Valleys are cooler than the lower slopes of the adjacent mountains due to the drainage of cold air. Precipitation occurs in the mountains throughout the year, and a deep snow pack accumulates during winter. Snowmelt usually supplies more water than can be used for agriculture in the Project Area. In the valleys, summer precipitation falls in the form of isolated showers and thunderstorms. In winter, the average temperature is 27-28° F and the average daily minimum temperature is 20-21° F. In summer, the average temperature is 63° F and the average daily maximum temperature is 79° F. The total annual precipitation is about 27 inches with about 9-11 inches, or 30-40 percent, occurring from April through September. Growing seasons also fall in this time frame. The average seasonal snowfall is about 62 inches at Boundary Dam and 70 inches at Newport.

Soils

The importance of soils to wetland establishment and function cannot be overlooked. Soils in the area have been described and mapped (Figure_3).

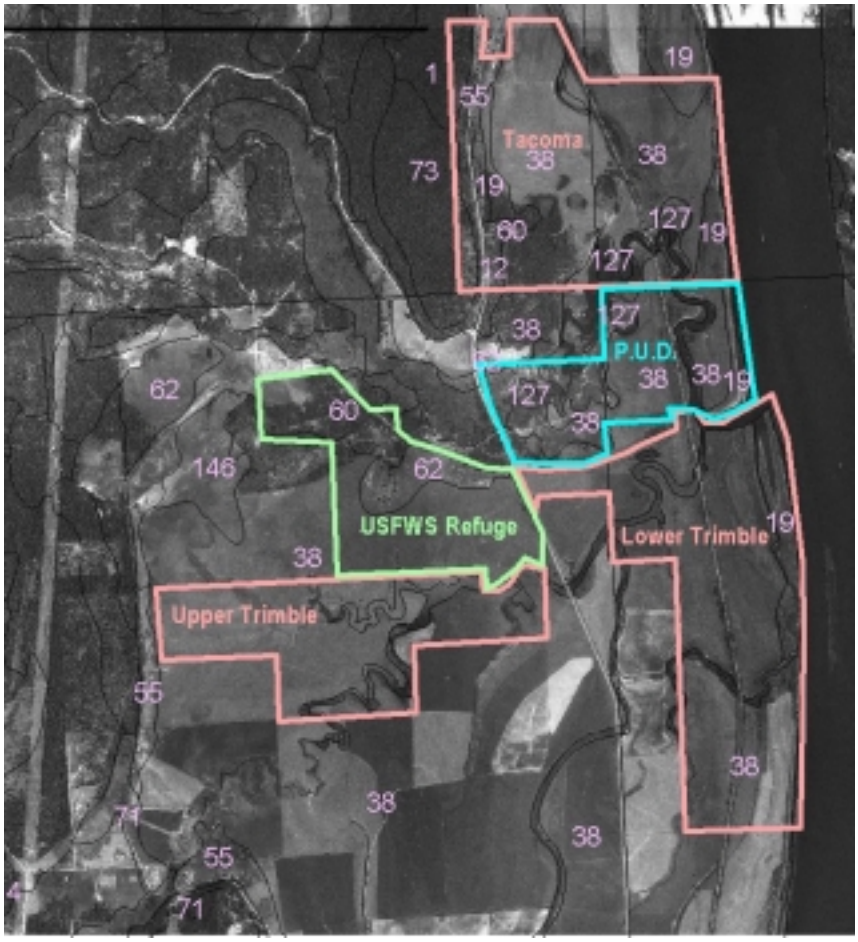


Figure 3. Project Area soils map.

Kaniksu sandy loam (60) 0-15% slopes: This very deep, well-drained soil is on terraces. It formed in sandy glacial outwash of mixed mineralogy. The native vegetation is mainly conifers, shrubs, forbs and grasses. The average annual precipitation is 25-32 inches, the average annual air temperature is about 44º F, the average growing season (at 28° F) is 90-100 days, and the average frost-free period (at 32° F) is 75-105 days.

Permeability is moderately rapid to a depth of 30 inches in this Kaniksu soil and rapid below that depth. Available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Inkler gravelly silt loam (55) 0-20% slopes: This very deep, well-drained soil is on the toe slopes of foothills and mountains. It formed in glacial till and in residuum and colluvium derived dominantly from igneous or metamorphic rock. The native vegetation is mainly conifers, shrubs, forbs and grasses. The average annual precipitation is 25-35 inches, the average annual temperature is about 43° F, the average growing season (at 28° F) is 90-120 days, and the average frost-free period (at 32° F) is 75-105 days.

Permeability is moderate in this Inkler soil. Available water capacity also is moderate. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Blueslide silt loam (19) 0-3% slopes: This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived dominantly from granitic rock, lacustrine sediments, volcanic ash and loess. The native vegetation is mainly conifers, shrubs, forbs and grasses. The average annual precipitation is 25-30 inches, the average annual temperature is about 44° F, the average growing season (at 28° F) is 80-100 days, and the average frost-free period (at 32° F) is 75-105 days.

Permeability is moderately slow in the Blueslide soil. Available water capacity is high. The effective rooting depth is limited by a seasonal high water table at a depth of 0.5-3.0 feet from February through April. Runoff is very slow, and the hazard of water erosion is slight.

Borosaprists, ponded (22) 0-2% slopes: These very deep, very poorly drained soils are in upland basins and on the perimeter of lakes and beaver ponds. They formed in organic material over alluvium derived dominantly from volcanic ash. The native vegetation is mainly wetland forbs and grasses, including rushes, sedges, cattails and reeds. The average annual precipitation is 27-35 inches, the average annual temperature is about 41° F, and the average growing season (at 28° F) is 60-110 days.

Permeability is moderate. Available water capacity is very high. The effective rooting depth is limited by a seasonal high water table that is 1 foot above the surface from October through June. Runoff is ponded, and water erosion typically is not a hazard.

Anglen silt loam (12) 0-7% slopes: This very deep, moderately well drained soil is on terraces. It formed in a mantle of volcanic ash and loess over fine textured glacial lake sediments. The native vegetation is mainly conifers, shrubs, forbs and grasses. The average annual precipitation is 27-30 inches, the average annual temperature is about 44° F, the average growing season (at 28° F) is 90-110 days, and the average frost-free period (at 32° F) 75-105 days.

Permeability is moderately slow in this Anglen soil. Available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. A perched seasonal high water table is at a depth of 2.5-3.5 feet from December through April.

Martella silt loam (73) 25-40% slopes: This very deep, moderately well drained soil is on terraces. It formed in a mantle of volcanic ash and loess over silty glacial lake sediments. The native vegetation is mainly conifers, shrubs, forbs and grasses. The average annual precipitation is 22-30 inches, the average annual air temperature is about 44° F, the average growing season (at 28° F) is 90-100 days, and the average frost-free period is 75-105 days.

Permeability is moderately slow in this Martella soil. Available water capacity is high. The effective rooting depth is limited by a perched seasonal high water table at a depth of 2-3 feet from February through April. Runoff is rapid, and the hazard of water erosion is severe.

Sacheen Variant silt loam (127) 0-3% slopes: This very deep, somewhat poorly drained soil is in lake basins and on flood plains along streams. It formed in sandy alluvium in mixed mineralogy. The native vegetation is mainly conifers, shrubs, forbs and grasses. The average annual

precipitation is 25-27 inches, the average annual air temperature is about 44° F, the average annual air temperature is about 44° F, the average growing season (at 28° F) is 90-100 days, and the average frost-free period is 75-105 days.

Permeability is moderate to a depth of 10 inches in the Sacheen Variant soil and very rapid below that depth. Available water capacity is low. The effective rooting depth is limited by a seasonal high water table at a depth of 1-3 feet from March through May.

Cusick silty loam (38) 0-3% slopes: This very deep, somewhat poorly drained soil is in basins. It formed in fine textured glacial lake sediments. The native vegetation is mainly shrubs, forbs, and grasses. The average annual precipitation is 25-27 inches, the average annual air temperature is about 44° F, the average annual air temperature is about 44° F, the average growing season (at 28° F) is 90-100 days, and the average frost-free period is 75-105 days.

Permeability is very slow in the Cusick soil. Available water capacity is high. The effective rooting depth is limited by a perched seasonal high water table within a depth of 2 feet from November through April. Runoff is very slow, and the hazard of erosion is slight. This unit is suited to non-irrigated and irrigated oats and grass-legume hay. The main limitation is the seasonal wetness. A tillage pan forms if the soil is tilled when wet.

Historic and Present Habitat Condition

Given the wide valley floor in this section of the Pend Oreille River, the Project Area was likely an important wintering ground for large ungulates and resident and migratory avian species prior to development. Abercrombie (1896) stated that the floodplain grasses around Cusick grew tall and marvelously. Additionally, he stated that the surrounding foothills were productive and could support a great number of livestock. Lands once dominated by western white pine (*Pinus monticola*) *Betula* and *Poplar* species and numerous wetlands (Thomason *in* Belyea 1998) were transformed by the onset of development as seasonal wetlands were drained and shrub and tree vegetation removed to make way for pasture and agricultural lands. Dikes and drainage ditches now control the hydrology of this portion of the floodplain. The remaining habitat available to wildlife is open pasturelands, the dominant landscape feature, pockets of deciduous and coniferous forest, and scattered shrubs. Prior land management practices dictate the habitat availability in the baseline condition. The Upper Trimble property is virtually 100 percent pastureland, giving it the most restoration potential to benefit wildlife (Figure_4). By aggregating the three Tribal purchases with the USFWS and Pend Oreille PUD parcels, over 1,700 contiguous acres can be effectively managed to restore the natural hydrologic

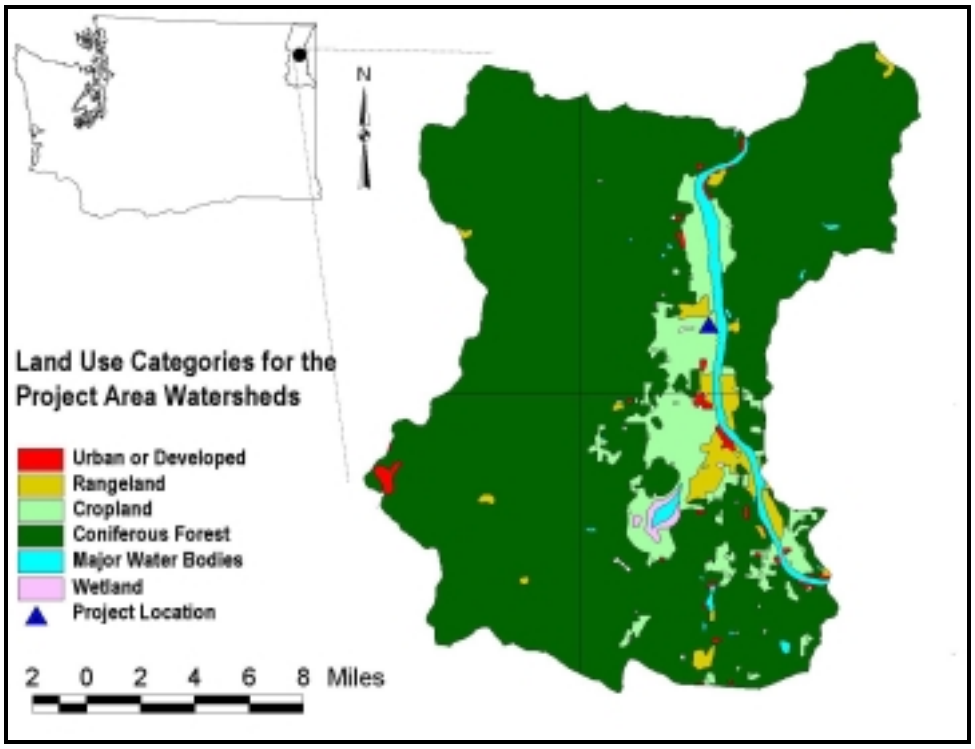


Figure 4. Project Area land use map.

function and vegetative composition of the entire area. Bordered by private agricultural lands, the Project Area will serve as important refugia in an area lacking protected tracts of native habitat. The Project Area also provides important connectivity with federal forestlands to the west and a migratory connection to the east side of river (Figure_5). Re-establishment of these corridors in their natural condition provides crucial links to habitats that have been largely disjunct due to valley development.

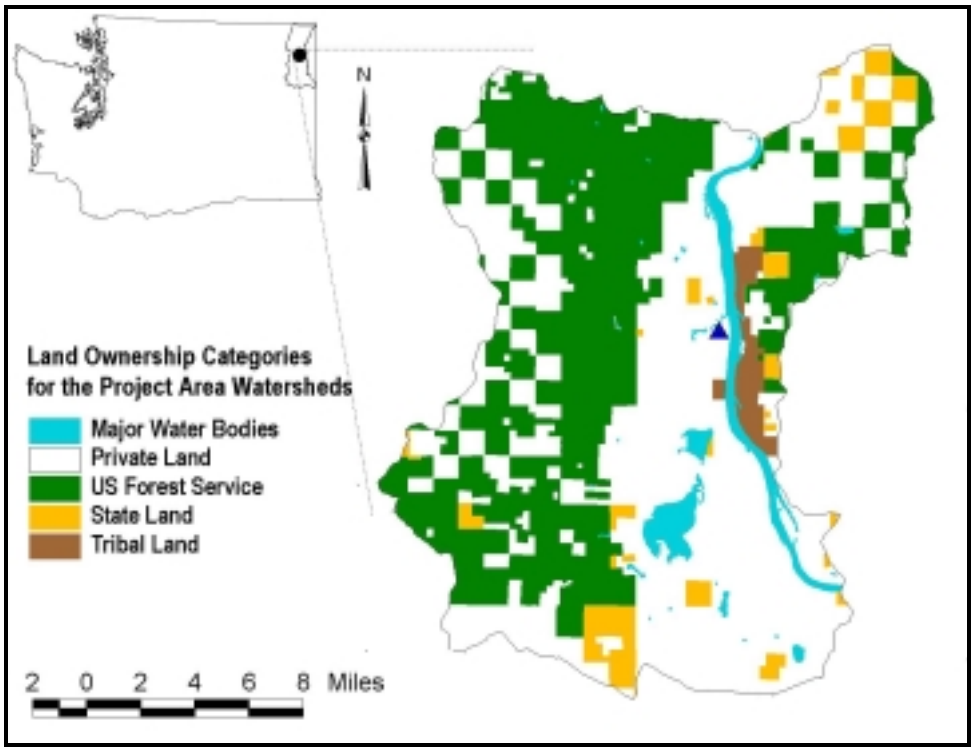


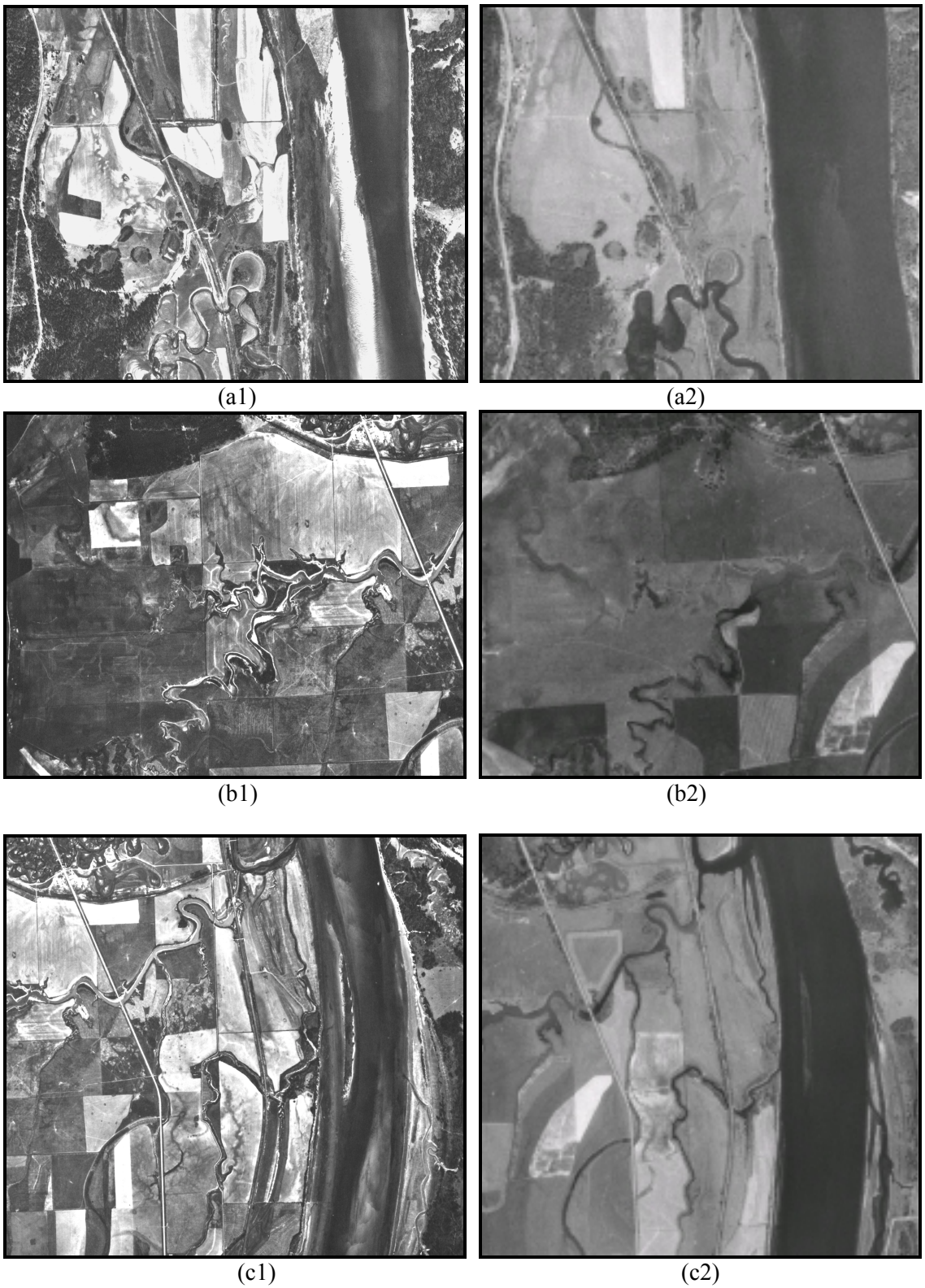
Figure 5. Project Area land ownership map.

METHODS

General

The evaluation of current habitat quality and quantity as well as the potential for restoration and/or enhancement required the use of multiple tools. Baseline conditions for both the vegetative and animal communities were assessed through the use of plot and transect data collection to describe community composition and distribution across the Project Area (Appendix B). Enhancement recommendations were derived by the use of comparative analysis. Remote sensing imagery (aerial photography) was compared to detect former vegetation and hydrologic composition prior to habitat alteration (Figure_6a-c). Although completely undisturbed reference sites are virtually non-existent for comparison of composition and function, a limited number of predominantly undisturbed sites served as additional references toward which Tribal management actions should strive to achieve.

Habitat Evaluation Procedures (HEP) were applied to measure baseline habitat conditions (Appendix A). These procedures were the standard loss estimator in all hydroelectric loss statements submitted to the Northwest Power Planning Council (NPPC). Bonneville Power Administration required the use of HEP on a project-specific basis for increased detail and accuracy. In conjunction with the HEP analysis, a series of data was collected at permanent grid plots within each of the proposed habitat management types (Appendix B). These data will provide baseline composition and abundance information for avian, small mammal, and amphibian populations as well as additional vegetative composition detail for specific habitat types. These data will also serve as the means for evaluating the success and/or failure of management activities. The HEP analysis, plot data and public comments from open house sessions were used to formulate management goals, objectives and tasks.



(a1) (a2)

(b1) (b2)

(c1) (c2)

Figure 6 (a-c). Aerial comparisons between 1943 and 1995 views of (a) Tacoma, (b) Upper Trimble, and (c) Lower Trimble wildlife management areas.

Habitat Evaluation Procedure (HEP)

The objective of the baseline HEP survey for the Project Area was to rate the quality of lands under consideration for easement and management as mitigation for losses to wildlife due to the construction of Albeni Falls Dam. The product of the baseline survey will determine the number of HUs, a measure of habitat quality and quantity, currently available for the indicator species and the amount that will become available through management. Indicator species were used to determine the habitat quality rating and available HUs. These species included bald eagle, Canada goose, muskrat, black-capped chickadee, yellow warbler and mallard. Martin *et al.* (1988) also used white-tailed deer in determining Albeni Falls Dam wildlife losses. The Tribe chose not to use white-tailed deer as an indicator species because it is a habitat generalist. The other species are more dependent on specific habitats and are better indicators of habitat condition. White-tailed deer should respond positively to habitat manipulations for the other indicator species.

The KNRD assembled an interdisciplinary team to conduct the HEP. Habitat suitability models for the indicator species were used to aid the team in rating the quality of the habitat. These models describe the life requisites for each indicator species. The models are used to derive a Habitat Suitability Index (HSI), a numeric value between 0.0-1.0, which corresponds to the quality of the habitat. The HEP team conducted site surveys and collected data on habitat type, quantity, quality and wildlife use under existing conditions at established sites. For a full explanation of the HEP process for the Tacoma/Trimble Wildlife Management Area, including models, data collection and interpretation, see Appendices A1 and A2.

Monitoring and Evaluation

Several methods were employed to determine the baseline condition of wildlife guilds and vegetation. Baseline conditions for small mammals, neo-tropical migratory birds, migratory waterfowl, and vegetative characteristics for each representative habitat were collected in 2001 and 2002. The data for the mitigation areas will be compared to the reference sites in order to provide the managers with information crucial to the function of each habitat type. In future years, comparisons will be made to determine habitat progress toward meeting the goals and objectives for the project. The Albeni Falls Monitoring and Evaluation Plan (M&E Plan) (Appendix B), was developed in response to Independent Scientific Review Panel (ISRP) questions regarding project monitoring and adaptive management. The M&E Plan was implemented in order to determine project success as compared to reference site conditions for the various habitats types under modification.

RESULTS AND DISCUSSION

Utilizing field data, HSIs were calculated from models and multiplied by acres of habitat type, resulting in the number of baseline (current) HUs for each indicator species. See Appendices A.1 and A.2 for a full explanation of HEP results, and identification of limiting factors that will be targeted under a management plan based on HEP results. Two of the three properties exhibited fair to good habitat quality (Table_1).

Table 1. Summary of baseline HEP data associated with properties within the Tacoma/Trimble Wildlife Management Area.

Target Species by Property	Associated Acreage*	Habitat Units Measured	Habitat Units Estimated**
Tacoma			
Bald Eagle – breeding	138	126.1	
Bald Eagle – wintering	138	130.6	
Black-capped Chickadee	28	14.1	
Canada Goose	324.7	194.8	
Mallard	85.9	25.8	
Muskrat	28.3	9.2	
Yellow Warbler	36.6	12.7	
Sub-Total	780	513.3	485
Lower Trimble			
Bald Eagle – breeding	28	16.7	
Bald Eagle – wintering	28	11.1	
Black-capped Chickadee	17	13.7	
Canada Goose	269	174.8	
Mallard	70	21.1	
Muskrat	39	0.0	
Yellow Warbler	44	0.0	
Sub-Total	450	237.4	450
Upper Trimble			
Bald Eagle – breeding	0	0.0	
Bald Eagle – wintering	0	0.0	
Black-capped Chickadee	0	0.0	
Canada Goose	250	96.7	
Mallard	0	0.0	
Muskrat	56	0.0	
Yellow Warbler	0	0.0	
Sub-Total	306	96.7	151
Total	**1,536**	**847.4**	**1,086**

* Associated acreage is a conglomeration of associated habitat types and is not reflective of the total management area size due to duplication.
** HUs were estimated at the time of purchase and the actual values were derived in 2001 via the HEP process.

The cover type acreage (Appendices A.1 and A.2), HSI scores, and number of baseline HUs identify the Tacoma/Trimble Wildlife Management Area as an area with both high quality and restorable degraded habitats (Appendices A.1 and A.2).

Monitoring and evaluation data from the first year showed some significant differences between baselines vs. restored areas vs. reference sites. The highest diversity and densities were found on the "Flying Goose Ranch" which was higher than baseline conditions for newly acquired properties and reference sites (Appendix C). These data indicate that restoration actions applied to date have had beneficial results to wildlife populations. However enlightening these data

appear, they are still preliminary and more will be known after full baseline data are collected for the mitigation properties and reference sites.

Implementation

Seven indicator species were chosen to gauge the current condition of the existing habitat and to set future improvement goals. The HEP process discussed earlier measured existing habitat condition. The HEP variables are used as the basis for management. However, additional data collected under the M&E Plan will be used to suggest management actions to increase both habitat and wildlife diversity in the Project Area as well as identify adaptive management principles for altering management course.

Land acquisition is the most critical step in the management process. In 2000, the Tribe purchased two pieces of land from private landowners. Following acquisition, property protection and management practices will be implemented to increase HUs. Numerous site visits, observations of wildlife, the HEP process and wetlands engineering were used to formulate objectives. These objectives will be met by performing a series of tasks (refer to annual Scopes of Work and budgets for detail). The order or level of task implementation was determined by a variety of factors such as ease of implementation, cost, and urgency. At either end of the spectrum, for example, are cessation of cattle grazing and restoration of riparian forest. The former is most urgent, due to its severe impact to the existing riparian forest (on Tacoma) and shorelines of all three project areas. It is clear that by eliminating cattle grazing, the forest, shoreline, wetlands and pasture begin to recover. However, riparian forest restoration is an interactive, financial and time-dependent endeavor.

Management Objectives and Tasks

Level 1

Objective 1.1 Baseline Inventory

Baseline surveys will be conducted on all three project areas to determine plant and animal community composition, abundance and distributions. A HEP analysis will be conducted to determine habitat availability by cover type and as a means of crediting BPA the appropriate amount of HUs. Baseline wildlife surveys will be conducted by target species guild. For example, bald eagle winter use will be determined by total counts from November to April. The entire area will be surveyed using binoculars and spotting scopes. Spring pair and brood counts will measure waterfowl response on wetlands and adjacent nesting habitat, using binoculars from slough access and observation platforms. Breeding bird populations, including black-capped chickadee and yellow warbler, will be determined initially and monitored throughout the management area, using a point count method. For a full version of monitoring methodologies and strategies, including baseline surveys, (Level 4, Task 4.1) refer to Appendix B.

Objective 1.2 Cattle Grazing

Task 1.2.1 Cessation

Shortly after the Tribe purchased the three properties, all unrestricted grazing was terminated, and the cattle owners land leases will not be renewed. Unrestricted, season-long cattle grazing over a period of many years have resulted in degraded and/or declining stream banks and riparian forest. Restrictive grazing may be used in the future on a limited basis to meet specific goals for wildlife, e.g. to open up dense stands of cattails, or to prepare for planting of woody vegetation. Grazing will not occur near the river shoreline, or in any habitat type dominated by aspen or black

cottonwood. Sedgewick and Knopf (1991) concluded that cattle seek these species and even eat fallen leaves.

Task 1.2.2 Modified Use

If cattle grazing were used in the future, electric fence will be used, at the lessee's expense, to contain the livestock. No new barbed wire fence will be established; it is a potential hazard to birds and deer, and to some extent moose, which are increasing locally. Old interior fences will be removed. Perimeter fences will be repaired and maintained.

Objective 1.3 Weed Control

Undesirable plant data for the property was collected in 2001 (Appendix D). The Pend Oreille County Noxious Weed Control Board generated a plant list after the initial year of weed control. Class A Noxious Weeds and Class B-Designate Noxious Weeds have mandatory control requirements.

Task 1.3.1 Control and Maintenance

Most weeds occur as a result of soil disturbance. Intensive, season-long grazing not only increases soil disturbance but also increases the extent of bare ground in the landscape. By removing grazing disturbance, weeds such as bull thistle and mullein are expected to disappear as grass competition increases. Sorby (2001) (Appendix C) provided a set of recommendations for prioritizing weed control efforts for the management area. The Tribe will work closely with the Weed Board in implementing these recommendations. Following control during implementation, regular spot maintenance control will occur as an annual operations and maintenance activity.

Weed species, life cycles, abundance and dispersion will dictate the mechanism(s) for control and/or elimination. Several types of control mechanisms are likely to be used individually or in combination. In most cases, the initial weed compositions are such that large-scale chemical treatments will likely be necessary. Subsequent treatments may consist of spot spraying, manual removal, controlled burns, short-term inundation, and reseeding and planting desired species of native vegetation.

Level 2

Restoration and enhancement opportunities (presented as objectives) were identified through assessment techniques such as remote sensing, vegetative data collection, wildlife population information, HEP analysis, and public input (Figures 7, 8, and 9). The following list includes identified limiting factors for wildlife habitats and will include priority habitat implementation actions with associated target species in parenthesis:

- Increased perch size (bald eagle)
- Increased tree density in deciduous forest (black-capped chickadee/bald eagle)
- Increased availability of preferred nesting forest stands (bald eagle)
- Revegetation of river shoreline (Canada goose and muskrat)
- Restoration of wetland shrubs (yellow warbler and mallard)
- Increased grass nesting cover (mallard)
- Seasonally flooded wetland enhancement (mallard/Canada goose/muskrat)
- Increase total wetland diversity, density and distribution (mallard/Canada goose/muskrat)
- Restoration of deciduous forest (black-capped chickadee/bald eagle)

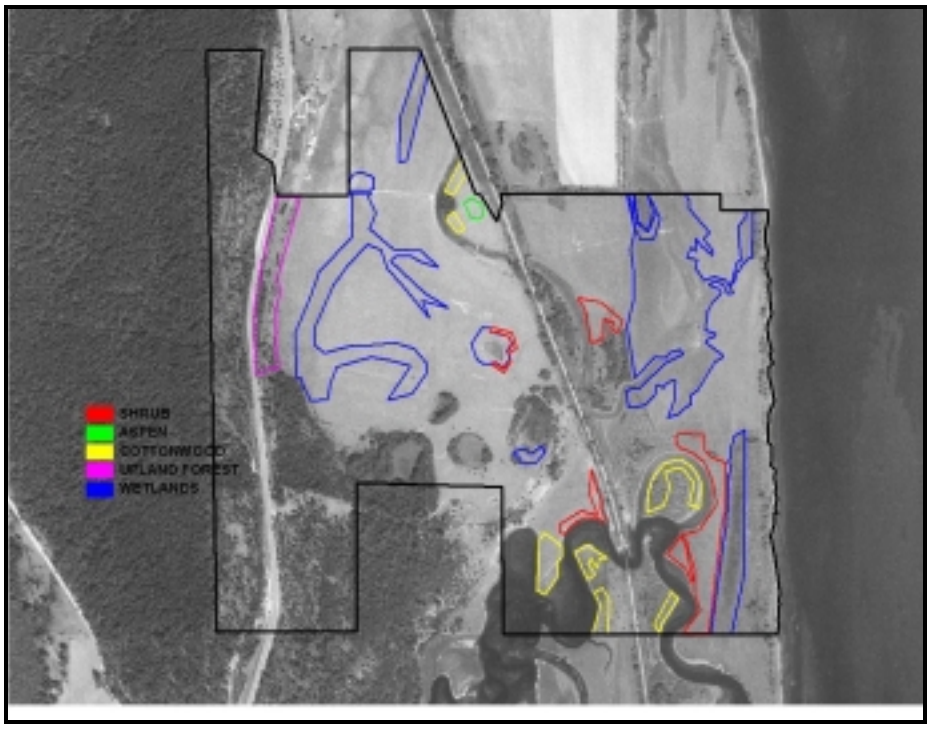


Figure 7. Habitat types at Tacoma Wildlife Management Area.

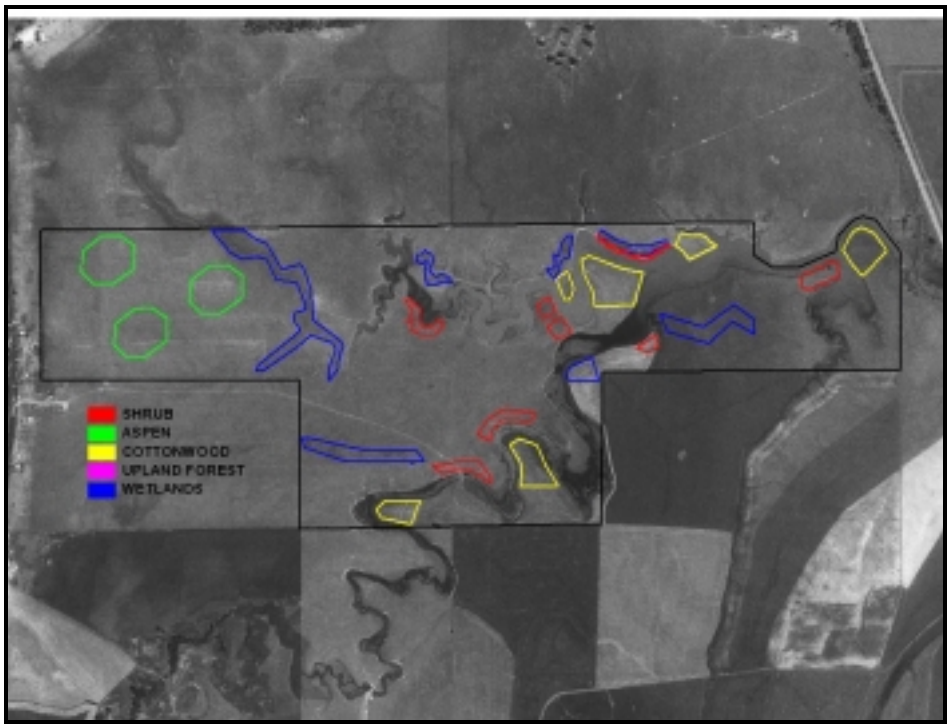


Figure 8. Habitat types at Upper Trimble Wildlife Management Area.

Figure 9. Habitat types at Lower Trimble Wildlife Management Area

Objective 2.1 Upland Forest Management

Task 2.1.1 Forest Health

Accepted techniques will be applied to maintain healthy tree stands and/or, where needed, to re-establish pre-existing stands. Specific methods will include pre-commercial thinning, diseased tree removal, desired species conversion, and general harvest where required for forest health.

Objective 2.2 Increased Deciduous Tree Density

Task 2.2.1 Aspen Release

Within the mixed forest, the KNRD will encourage a release of aspen by removing competing vegetation, especially conifer, from within and near aspen stands. Aspen prefers full sunlight and higher moisture than conifers. Stands should sucker well and expand following removal of competition and minor root disturbance.

Task 2.2.2 Cottonwood Enhancement

Within the riparian forest, two techniques will be employed to increase deciduous tree density. The primary species is black cottonwood. Restriction/removal of cattle grazing has been discussed earlier. An indication of cottonwood sprouting potential and cattle impacts were evident through 1996 on the Pend Oreille Wetlands Wildlife Mitigation Project.

Following the restriction of livestock grazing, planting of cuttings will commence. A low density planting on an annual basis is intended to speed both increased density and mean height following years of cattle grazing. The planting density was chosen to provide some assurances that the recovery may approach the same density of a relatively undisturbed cottonwood stand on 20 acres of U.S. Forest Service land adjacent to the Pend Oreille Wetlands Wildlife Mitigation Project.

Level 3

This level of effort includes the most detailed items of implementation. Due to engineering and permitting challenges, the implementation phase of management activities is more complex. The conversion of active pasture, a low value cover type, to riparian forest and emergent palustrine wetland, two of the highest valued cover types, will result in increased biological benefits. Maturation time, permitting timelines and constraints, and the amount of acreage involved in restoring riparian forest habitats are factors that must be taken into account during implementation.

Objective 3.1 Riparian Forest Restoration

The construction of Albeni Falls Dam produced extensive losses of forested wetlands habitat. Bald eagles are dependent on this habitat for nesting, roosting, and perching. The loss of bald eagle HUs was the greatest of all target species on the Kalispel Indian Reservation.

The KNRD proposes to restore damaged areas to black cottonwood-dominated forests, with an understory of willow and red-osier dogwood to be planted simultaneously. Local stock will be collected and rooted prior to planting to increase survival. During the summer prior to planting, a certain amount of acres will be fallowed in each of 3 years to control weeds. The plantings will occur in the following spring.

Task 3.1.1 Scrape and Seed

The scrape and seed method has proven to be effective on the Pend Oreille Wetlands Wildlife Mitigation Project. A tractor and a tilling attachment is used to break up the sod. Spring runoff is held near the surface to kill competition and saturate the soil, producing optimal conditions for cottonwood seed germination.

Task 3.1.2 Pole Cuttings

The KNRD will follow the guidelines for planting un-rooted cuttings outlined by Hoag *et al.* (undated) and Swenson (1988):

- In year prior to planting, weaken pasture grass competition by intense grazing, herbicide or tillage.
- Collect cuttings in dormant season, remove all side branches, seal the top if necessary, and store in cooler at 3-6°C until planting.
- Cuttings should be a minimum of 1.5-3.0" dbh – larger is better.
- Length of cuttings should be great enough to reach mid-summer water table (about 3' deep on project), 3-10' long is recommended.
- Soak cuttings in water 1-10 days prior to planting in April.
- Planting depth should be ½-2/3 length of cutting for best soil-stem contact.
- For ease and greatest efficiency of planting, a tractor with an auger should be used to create a hole of sufficient size and depth.
- Planting supplements did not increase survival or performance (removal of competition was not addressed).
- Back fill the holes carefully to avoid air pockets.
- Remove all buds and stems as they grow from the lower two-thirds of the pole.
- Only 1/8 to ¼ of the non-wetland pasture acreage will be planted. Randomized group plantings will be made with openings between to maximize edge.
- Control competition through mowing, seeding, spraying and/or tilling.

Task 3.1.3 Rooted Cuttings

Plant materials will be acquired through area native plant nurseries.

Task 3.1.4 Irrigation and Costs

The KNRD will investigate different methods of irrigating individual small plots of land. Methods may include culverts with gate valves or removal of an existing dike.

Objective 3.2 Pasture Management

In order to increase Canada goose HUs, high quality brood habitat needs to be restored or enhanced. Brood habitat may well be more restrictive to populations than nesting sites, as evidenced by long travel distances to brood areas following hatching (Ball *et al*. 1981). Mackey *et al.* (1987) found that grazing broods generally remained within 30 meters (m) of the security of water. Management of brood pasture will entail keeping grass lengths at 4" or less, during the brood season (April-July 15). Pastures should be managed out to 100 m from the water's edge to provide visual security. Based on these parameters and planned wetland expansion, there are an estimated 195 acres of brood pasture on the Tacoma project and 250 acres of brood pasture on the Upper Trimble project that could be enhanced.

A top seeding or plug planting of camas (*Camassia quamash*) will occur after year three of management to allow for seed collection and potential development of nursery stock. Once common and a preferred cultural food item of the Tribe, camas is now much reduced over its range. Improper livestock grazing quickly removes it from the flora. It is still common on the reservation where livestock grazing is less intense. Seed will be collected on the Kalispel Indian Reservation during the fall.

Following wild pasture establishment, annual mowing or haying will occur following camas seeding in order to prevent invasion by undesired species and maintain the vigor of grasses.

Objective 3.3 Wetland Restoration

Due to past farming practices, most of the wetlands are now pasture land. In order to recreate this important habitat type, different engineering practices must be used and may include the use of heavy equipment, explosives, and/or plantings.

Level 4

Long-term analysis of results and assurance of benefits is essential, yet often ignored or improperly funded in mitigation projects. Kusler and Kentula (1990) in their database noted that monitoring of mitigation projects has been uncommon so that the potential information gained to improve future projects is not being accrued.

Objective 4.1 Monitoring and Evaluation

The NPPC, BPA, CBFWA, and the Tribe need to monitor and evaluate the effectiveness of the Columbia Basin Fish and Wildlife Program. Assessment of conditions before and after habitat enhancement is essential for auditing purposes. The Tacoma/Trimble mitigation project offers a unique opportunity to rectify current deficiencies in method knowledge. In the creation of a wetlands restoration database, Ischinger and Schneller-McDonald (1988) looked at study length duration. Based on 79 records, they found the majority of records were based on monitoring and evaluation efforts of one year or less. Few studies were sufficient to provide useful knowledge as to long-term relationships and success.

The M&E Plan was written to encompass all AFIWG projects. Partial implementation of the M&E Plan began in 2002 through a subcontract with Eastern Washington University and will be fully implemented in 2003. By implementing the Albeni Falls M&E Plan, the KNRD will monitor wildlife populations and vegetative cover. The results of these efforts will then be correlated with follow-up HEP analysis on five-year intervals.

Reference data concerning changes relative to the baseline condition (Objective 1.1) will be continued throughout the life of the Tacoma/Trimble mitigation project. In addition, habitat and vegetation responses will be measured and correlated with trends in wildlife populations. Permanent plots in each habitat type will be established and measured every five years using HEP and transect data.

The HEP sites in each of the cover types were randomly selected and permanently marked to monitor habitat and crediting value. Parameters to be measured include HEP variables; species of trees, shrubs, forbs and grasses; height, density and distribution of these species; percent tree and shrub canopy cover; and acres of wetlands and riparian forest successfully established. Water table levels will be monitored and correlated with vegetation development. Annual photographic documentation will occur at each HEP site and at each planting site to record vegetation development.

Objective 4.2 Operations and Maintenance

Operations and maintenance, like monitoring and evaluation, are largely ignored in the literature. The only way to assure long-term project success and effective adaptive management is to apply them both for a term equal to the life of the hydroelectric project to which they are assigned.

Objective 4.3 Budget

Project costs are incorporated into and are part of the NPPC Columbia Basin Fish and Wildlife Program budget and are estimated using a variety of methods. Examples of the methods used to derive cost estimates include an extensive literature review, personal communications with resource personnel, equipment and nursery estimates, and KNRD personnel costs. Costs were multiplied by the number of acres to be converted, restored, and/or enhanced to develop the final cost measures (Table_2). Project cost estimates are in 2002 dollars. Inflation was figured for the baseline objective only (Table_3).

It was necessary to develop a strategy to determine annual budget targets for 2002 through 2006 for the Tacoma/Trimble Wildlife Management Area that the KNRD can use to plan contracting and budgeting for the Albeni Falls Wildlife Mitigation Project (1992-061-02). To do this, it is essential to determine the degree of change that will occur in each area (Table_2) and match those acreage changes with the appropriate method and cost estimate. The major cover type changes that are planned to occur were used to derive final budget estimates for the next five years (Table_3).

The KNRD estimates that the Tacoma/Trimble Wildlife Management Area will require a baseline operations budget of approximately $95,000 annually with restoration and enhancement costs reaching $450,250 over the next five years (Table_4).

Table 2. Acreage changes in the three management areas.

Management Area and Cover Type	Existing Acreage	Managed Acres	Net Change
Tacoma Management Area			
Pasture	225	-104	121
Deciduous Forest	34	52	86
Scrub-Shrub Wetland	43	45	66
Emergent Wetland	12	32	44
Conifer Forest	94	-25	69
Subtotal	408	0	408
Upper Trimble Management Area			
Pasture	250	-42	208
Deciduous Forest	0	22	22
Scrub-Shrub Wetland	0	5	5
Emergent Wetland	0	15	15
Subtotal	250	0	250
Lower Trimble Management Area			
Pasture	269	-146	123
Deciduous Forest	17	44	61
Scrub-Shrub Wetland	43	30	73
Emergent Wetland	70	72	142
Subtotal	399	0	399

Table 3. Management area costs by objective through 2006.

	Cost by Year					
Objective	**1**	**2**	**3**	**4**	**5**	**6**
Baseline Inventory	35,000	50,000	25,000	-	-	-
Weed Control	7,500	20,000	20,000	10,000	10,000	5,000
Tree Density	5,000	7,500	8,000	5,000	2,500	-
Shoreline Vegetation	7,500	7,500	5,000	2,500	2,500	1,000
Riparian Restoration	7,500	7,500	7,500	7,500	7,500	5,000
Pasture	10,000	10,000	4,000	2,000	2,000	2,000
Wetland Restoration	20,000	20,000	15,000	10,000	5,000	5,000
O&M and M&E	94,983	98,782	102,734	106,843	111,117	115,561
Annual Total	**$160,983**	**$206,282**	**$182,734**	**$142,343**	**$134,117**	**$128,561**

Table 4. Baseline Operations Budget

Item	Description	Total
Personnel		
Program Manager	.2 FTE	$12,500
Biologist	.75 FTE	$28,080
Bio-technician	1.3 FTE	$33,800
Benefits	29%	$21,570
Annual Contract Needs		
Supplies, material, travel, etc.	Necessary O&M Items	$28,650
Indirect Costs		
	12.6% of Annual Costs	$15,700
Annual Subtotal		**$140,300**
Objective 1.1	**Baseline Inventory**	
Initial Data Collection	Subcontract and Technicians	$30,000
Objective 1.2	**Cattle Grazing**	
Control	Fencing and trespass mgmt.	$30,000
Modified Use	Potential use for vegetation control	$0
Objective 1.3	**Weed Control**	
Initial Control	First three years	$47,500
Initial Maintenance	Next two years	$20,000
Annual Maintenance	Annually	$5,000
Objective 2.1	**Upland Forest Management**	
Thinning	50 acres @ $100/acre/year	$5,000
Species Conversion	25 acres @ $100 acre/year	$2,500
Objective 2.2	**Increase Deciduous Tree Density**	
Supplemental Planting	50 acres @ $250/acre/year	$8,000
Aspen Release	20 acres @ $250/acre/year	$5,000
Cottonwood Release	30 acres @ $250/acre/year	$7,500
Objective 3.1	**Riparian Forest Restoration**	
Reforestation	75 acres @ $450/acre	$33,750
Objective 3.2	**Wetland Restoration**	
Wetland Restoration	100 acres @ $450/acre/year	$45,000
Shoreline Vegetation	30 acres @ $250/acre/year	$26,000
Hydrology Restoration	100 acres @ $250/acre/year	$75,000
Objective 3.3	**Pasture Management**	
Mowing	250 acres @ $100/acre/year	$25,000
Tilling	50 acres @ $100/acre/year	$5,000
Objective 4.1	**Monitoring and Evaluation**	
Property Surveys	EWU subcontract for four years	$80,000
Objective 4.2	**Operations and Maintenance**	
Operations and Maintenance	Included in Objective 1.1	$0
Total Improvements	**Not Including Annual Costs Above**	**$450,250**

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APPENDIX A.1

2000
Habitat Evaluation Procedure (HEP)
Report

Tacoma/Upper Trimble
Projects

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March 8, 2001

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INTRODUCTION

The Habitat Evaluation Procedures (HEP) is used extensively within the Northwest Power Planning Council's (NPPC) Columbia River Basin Fish and Wildlife Program (Program). Wildlife managers use this methodology to determine habitat losses attributed to the construction of federal hydroelectric projects and habitat gained through the NPPC Program.

In 1987, the Albeni Falls Interagency Work Group (AFIWG) collected baseline HEP data for the area affected by the construction of Albeni Falls Dam. Estimates of lost habitat for eight target species were provided. Habitat Suitability Index (HSI) models for each of the target species were used to determine lost habitat quality and quantity for representative habitat cover types.

In 2000, a HEP team determined the baseline habitat condition of the 436-acre Tacoma and 306-acre Upper Trimble projects. The 2000 HEP team consisted of the following members and agencies: Darren Holmes, Kalispel Natural Resource Department (KNRD); Paul Ashley, Washington Department of Fish and Game (WDFW); Arlen Auld, KNRD; Brian Merson, KNRD; and Roy Finley, KNRD. The baseline Habitat Units (HUs) will be provided as credit to the Bonneville Power Administration (BPA) for protection of habitats within the project. The HSI models used were the same as those modified for use in 1991 (Appendix).

METHODS

The HSI is a value based on a 0.0-1.0 scale to determine quality of habitat. Habitat Units are determined by multiplying the HSI value by the area (acres) within that cover type. The HSI values are determined through the measurement of specific life requisites of each target species for its association with specific cover types.

Each target species associated cover type was estimated visually using modified HSI models for seven of the original eight target species (white-tailed deer were not used due to cover type similarities). A randomly selected HEP point was used for each HSI model.

For the Tacoma project, black-capped chickadee HSI values were averaged from two sites, and yellow warbler HSI values were averaged from three sites. The muskrat value was averaged across three sites. Canada Goose and mallard values were averaged from two sites. Bald eagle values were derived from one site at each cover type within the project area. For the Upper Trimble project, muskrat values were averaged from seven sites, and Canada goose and mallard values were averaged from two sites. The four other species cover types were not present to measure at this time. The HSI scores reflected group consensus of each habitat variable. The HSI values (Table 1) were determined using the equations provided for each HSI model (Tables 2 and 3, respectively).

Habitat cover types were mapped using aerial photos and ground truthing. Cover type area was measured in acres and determined using Arcview 3.1 software. The HUs were calculated using the HSI score and cover type areas.

Table 1. Target species HSI values.

Target Species	Life Requisite	HSI Equation	HSI Value
Bald Eagle – breeding	Reproduction	$(V_2xV_3xV_4)^{1/3}$	HSI score
Bald Eagle – wintering	Food	V_1	Lower value
	Perch	V_2	
Black-capped	Food	$(V_1xV_2)^{1/2}$	Lower value
Chickadee	Reproduction	V_3	
Canada Goose	Reproduction	$[(V_1+V_2)V_3]^{1/2}$	HSI score
Mallard	Reproduction	V_1 or V_2 or V_3	Lower value
Muskrat	Food	$(V_1xV_2)^{1/2}$	Lower value
	Cover	$(V_1xV_3)^{1/2}$	
Yellow Warbler	Reproduction	$(V_1xV_2XV_3)^{1/2}$	HSI score

RESULTS

Acreage by cover type (Table 2) and HSI values provided HUs that identify the Tacoma project as high quality habitat.

Table 2. Management area acreage by cover type (2000-2001).

	Tacoma Project	Upper Trimble Project
Coniferous cover	120.3	0
Deciduous cover	18.1	0
Deciduous Forested Wetlands	28.2	0
Scrub-Shrub Wetlands	36.6	0
Open Pasture	324.7	249.6
Open water	28.3	56.4
Emergent Wetlands	85.9	0

Most habitat types on the Upper Trimble project received a 0.0 value due to their absence. Only open water and pastures exist at this time. The Tacoma project has high quality bald eagle breeding habitat in coniferous cover while the deciduous breeding received a moderate HSI value. The yellow warbler HSI value was below moderate, as were mallard and muskrat values. Tables 2 and 3 condense the HEP results for the Tacoma and Upper Trimble projects by species and habitat cover type.

DISCUSSION

In November 2000, cattle grazing on the Tacoma project were eliminated, and the Upper Trimble project was fenced to exclude neighboring cattle. Pasture grasses will be managed for wetlands. Reforestation and forest enhancements will occur, and water control is expected to increase wetland size and diversity. These management strategies are designed to improve the overall quality and quantity of available habitat.

Bald eagle habitat values on the Tacoma project for the nest/perch variable were determined as separate variables at each site. Nest values were used to determine the breeding HSI value and perch values were used to determine the wintering HSI value. Tribal efforts will focus on enhancing the nesting and perching variables in the deciduous cover type for bald eagle since its value as lower than desired.

Eventual snag recruitment within the deciduous forest and deciduous forest wetland cover types are expected to improve black-capped chickadee HSI values. Scrub-shrub enhancements are likely to improve HSI values in this cover type. Increased wetland diversity along the slough and elimination of grazing will improve HSI values for muskrat, mallard and Canada goose on both projects.

Canada goose HSI values for the Tacoma project indicate high quality habitat, while those for the Upper Trimble project indicate potentially high quality habitat. Information provided by the HSI values will help direct management considerations.

Improvements to emergent wetland vegetation (*Typha spp*. and *Scirpus spp*.) establishment will increase muskrat HSI scores and HUs on both projects.

Table 3. Baseline HEP for the Upper Trimble project.

HEP Cover Type/Species	HEP Variable	Var. Score	HSI Equation	HSI Score	Acres	HUs
Bald Eagle (breeding)	V1 - Food	0	(V2*V3*V4)1/3	0.00	0	0.0
Coniferous Cover	V2 - Nest	0				
	V3 - Dist. to H2O	0.4				
	V4 - Human Disturbance	0.5				
Bald Eagle (breeding)	V1 - Food	0	(V2*V3*V4)1/3	0.00	0	0.0
Deciduous Cover	V2 - Nest	0				
	V3 - Dist. to H2O	0.4				
	V4 - Human Disturbance	0.5				
Bald Eagle (wintering)	V1 - Food	0	[(V1)2*V2]1/3	0.00	0	0.0
Coniferous Cover	V2 - Perch	0				
	V3 - Dist. to H2O	0.4				
	V4 - Human Disturbance	0.5				
Bald Eagle (wintering)	V1 - Food	0	[(V1)2*V2]1/3	0.00	0	0.0
Deciduous Cover	V2 - Perch	0				
	V3 - Dist. to H2O	0.4				
	V4 - Human Disturbance	0.5				
Black-capped Chickadee	V1 -% Canopy Closure	0	(V1*V2)1/2 or V3	0.00	0	0.0
Deciduous Forested	V2 - Avg. Tree Height	0				
Wetlands	V3 - No. Snags/acre	0				
Yellow Warbler	V1 - % Shrub Cover	0	(V1*V2*V3)1/3	0.00	0	0.0
Scrub-Shrub Wetlands	V2 - Avg. Shrub Height	0				
	V3 - % Wetland Obl.	0				
Canada Goose	V1 - Island Nesting Habitat	0	[(V1+V2)+V3]1/2	0.39	249.6	96.7
	V2 - Shoreline Nesting	0.3				
	V3 - Brood Rearing Habitat	0.5				
Mallard	V1 - Wetland Type	0.2	Lowest Value	0.10	0	0.0
	V2 - Nesting Cover	0.3				
	V3 - Shoreline Cover	0.1				
Muskrat	V1 - % Cover	0	(V1*V2)1/2 or	0.00	56.4	0.0
	V2 - % of Year w/ H2O	1	(V1*V3)1/2			
	V3 - % Preferred Veg.	0	Lowest Value			

Total					**306.0**	**96.7**

Table 4. Baseline HEP for the Tacoma project.

HEP Cover Type/Species	HEP Variable	Var. Score	HSI Equation	HSI Score	Acres	HUs
Bald Eagle (breeding)	V1 - Food	1	(V2*V3*V4)1/3	0.93	120.3	112.2
Coniferous Cover	V2 - Nest	0.9				
	V3 - Dist. to H2O	1				
	V4 - Human Disturbance	0.9				
Bald Eagle (breeding)	V1 - Food	1	(V2*V3*V4)1/3	0.77	18.1	13.9
Deciduous Cover	V2 - Nest	0.5				
	V3 - Dist. to H2O	1				
	V4 - Human Disturbance	0.9				
Bald Eagle (wintering)	V1 - Food	1	[(V1)2*V2]1/3	0.97	120.3	116.2
Coniferous Cover	V2 - Perch	0.9				
	V3 - Dist. to H2O	1				
	V4 - Human Disturbance	0.9				
Bald Eagle (wintering)	V1 - Food	1	[(V1)2*V2]1/3	0.80	18.1	14.4
Deciduous Cover	V2 - Perch	0.5				
	V3 - Dist. to H2O	1				
	V4 - Human Disturbance	0.9				
Black-capped Chickadee	V1 -% Canopy Closure	0.25	(V1*V2)1/2 or V3	0.50	28.2	14.1
Deciduous Forested	V2 - Avg. Tree Height	1				
Wetlands	V3 - No. Snags/acre	1				
Yellow Warbler	V1 - % Shrub Cover	1	(V1*V2*V3)1/3	0.35	36.6	12.7
Scrub-Shrub Wetlands	V2 - Avg. Shrub Height	0.4				
	V3 - % Wetland Obl.	0.3				
Canada Goose	V1 - Island Nesting Habitat	0.4	[(V1+V2)+V3]1/2	0.60	324.7	194.8
	V2 - Shoreline Nesting	0.5				
	V3 - Brood Rearing Habitat	0.4				
Mallard	V1 - Wetland Type	0.3	Lowest Value	0.30	85.9	25.8
	V2 - Nesting Cover	0.3				
	V3 - Shoreline Cover	0.3				
Muskrat	V1 - % Cover	0.3	(V1*V2)1/2 or	0.32	28.3	9.2
	V2 - % of Year w/ H2O	0.35	(V1*V3)1/2			
	V3 - % Preferred Vegetation	0.35	Lowest Value			
Total					**780.5**	**513.3**

Figure 1. Project locations in Pend Oreille County, Washington.

Figure 2. HEP Points on Sivert's Project

Figure 3. HEP Points on Duramus Project

APPENDIX

Habitat Evaluation Procedure HSI Species Models

Bald Eagle HSI Model (wintering and breeding)

VI Bald eagle (b and w). Food requirements

Good. Abundant prey base (ungulate carrion, fish of several species, waterfowl, and small mammals) available throughout the year within three miles of potential nest/perch site. SI value = 1.0.

Moderate. Moderate prey availability within three miles of potential nest/perch site. Water sometime frozen over early in the nesting period, but sometimes frozen over early in the nesting period, but some ungulate carrion available during that time. Alternative food sources may be with five miles of the nest or perch. SI value = 0.8.

Fair. Minimal prey base within five miles of potential nest/perch site. Water frozen over late into the nesting cycle within alternative food sources. SI value = 0.3.

Poor. Insufficient prey base to sustain eagles. SI value = 0.0.

V3 Bald eagle (b). Distance to water body with sufficient prey availability

A. $\leq$ 1 kilometer. SI value = 1.0.

B. 2 kilometers. SI value = 0.9.

C. 3 kilometers. SI value = 0.6.

D. 4 kilometers. SI value = 0.2.

E. $\geq$ 4.5 kilometers. SI value = 0.0.

V2 Bald eagle (b and w). Nest/perch structure type, form, and density

Best. Old growth spruce, Douglas fir, or ponderosa pine in coniferous areas; old growth cottonwood in deciduous stands; stands dense and continuous and exceeding 10 acres in size. SI value = 1.0.

Good. Scattered old growth trees in stands of moderate (mature) aged trees as above exceeding 10 acres in size. SI value = 0.9.

Fair. Scattered old growth trees, as above, in open areas (without screening from younger aged trees). SI value = 0.6/

Poor. Dominant trees available are old growth lodgepole pine in coniferous areas or aspen in deciduous stands. SI value = 0.4.

Minimal. Potential nest or perch structures are shrubs or young trees, no screening present. SI value = 0.0.

V4 Bald eagle (b). Human activity level

Good. Natural vegetation dominates area; no permanent development or human structures; no human activity within the area during the nesting period. SI value = 1.0.

Moderate. Area of farming ground or pasture surrounds site; occasional use of area by predictable humans, such as a farmer or stockman; human activity occurs late in the eagle nesting cycle. SI value = 0.9.

Fair. Dispersed recreation campsites or trails, or occasionally used boat docks within vicinity of potential nest or perch site; activity occurs during brooding period only. SI value = 0.4.

Poor. Developed sites, e.g. campgrounds, boat launches, etc., within vicinity of potential nest or perch site; heavy human

use of area during incubation period. SI value = 0.0.

Equation

Wintering - Food = V_2, and Perch = V_2 The HSI value is equal to the lower of the two variables.

Breeding - Food = V1, Nest/Perch sites = V2, Reproduction = $(V_2 \times V_3 \times V_4)^{1/3}$. The HSI value for breeding bald eagles is calculated as follows: $[(V_1)^2 \times V_2]^{1/3}$.

Bald eagle overview

The model recognizes that proximity to prey base, quality of prey base, and quality of nesting and perching habitat, and amount of human disturbances are the most important components determining the quality of breeding and wintering bald eagle habitat.

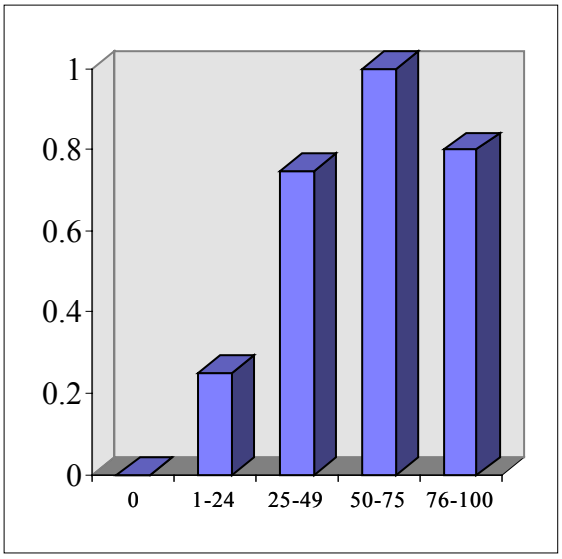
This HSI model was taken from the Albeni Falls Wildlife Protection, Mitigation and Enhancement Plan (Martin et. Al 1987).

Black-capped chickadee overview

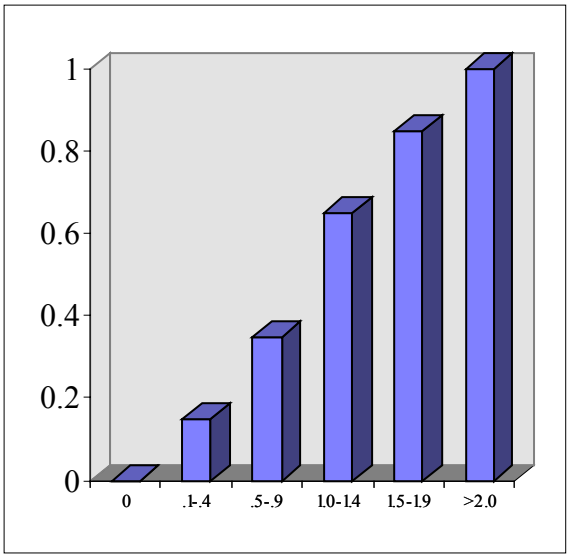
This model considers the ability of the habitat to meet the food and reproductive needs of the black capped-chickadee as an indication of the overall habitat suitability. Cover needs are assumed to be met by the food and reproductive requisites and water is assumed not to be limiting. The food component assesses vegetation conditions, and the reproduction component assess the abundance of suitable snags.

This HSI model was modified into a histogram from the HSI models: black-capped chickadee, FWS/OBS-82/10.37 by R.L. Schroeder, 1983.

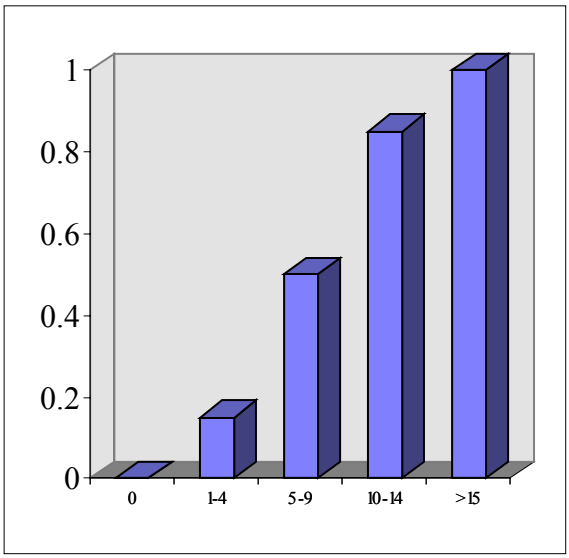
Black Capped-Chickadee HSI Model



VI Percent tree canopy closure



V3 Number of snags 10 to 25 cm/.4 ha.



V2 Average Height of overstory trees

Black capped-chickadee definitions -

V1 - Black capped-chickadee. Percent tree canopy
closure is the percent of canopy closed by vertical
projection of the canopy in the cover type.

V2 - Black capped-chickadee. The average height of overstory trees is the average height from the ground of the overstory trees present in the cover type.

V3 - Black capped-chickadee. Number of snags 10-25 cm/0.4 ha. is the number of snags usable by black capped-chickadee in the cover type.

Equation -

Life requisite	Cover type	Equation
Food	DF, DFW	$(V_1 \times V_2)^{1/2}$
Reproduction	DF, DFW	V_3

The HSI value for the black capped-chickadee is equal to the lowest life requisite value.

Canada Goose HSI Model

V1Canada goose: Island nesting habitat
Good. Stable islands present, relatively high shoreline/area ratio; ground cover on portions of islands 4 to 16 inches high; brood habitat within 1 mile of area. SI values between 0.8 and 1.0.

Fair. Stable islands present; relatively low shoreline/area ratio; or cover on islands < 4 or > 16 inches in height or brood habitat within 1 to 2 miles from area. SI values between 0.5 and 0.7.

Poor. No stable islands present: or islands with limited or no cover; or brood habitat $\geq$ 2 miles from area. SI value between 0.0 and 0.4.

V2Canada goose. Shoreline nesting habitat

Good. Portions of cover within 10 meters of water; ground cover 4 to 16 inches high; adjacent wetland buffer within 50 meters of
shoreline, may include sloughs of open water; brood habitat within 1 mile. SI value = 0.5.

Fair. Portions of shoreline cover within 10 meters of water; ground cover 4 to 16 inches high; adjacent wetland buffer within 50 meters of shoreline (Does not include open water wetlands); or brood habitat 1 to 2 miles away. SI value between 0.3 and 0.4.

Poor. No shoreline cover or shoreline cover taller than 16 inches and/or shorter than 4 inches; or wetland buffer > 50 meters to absent or brood habitat > 2 miles away. SI value between 0.0 and 0.2.

V3Canada goose. Brood-rearing habitat

Good. Brood pasture easily accessible from main water body; foraging zones common; vegetation < 4 inches tall; average > 1 acre in size; open water wetlands are present within 1 mile of nesting habitat. SI value between 0.7 and 1.0.

Fair. Less than above and/or no open water wetlands; or area is 1 to 2 mile miles from nesting habitat. SI value between 0.4 and 0.6.

Poor. Little or no brooding area; or area is $\geq$ 2 miles from nesting habitat. SI value between 0.0 and 0.3.

Equation

The HSI value is calculated as follows: $[(V_1 + V_2) V_3]^{1/2}$

Canadian goose overview

The model recognized that the quality of shoreline habitat, the presence of islands, and quality of brood-rearing habitat are the most important components determining the quality of Canada goose breeding habitat.
This HSI model was taken from the Albeni Falls Wildlife Protection, Mitigation, and Enhancement Plan by Martin et. Al, 1987.

Habitat Suitability Index
Mallard (Anas platyrhyncos)
Breeding Season Only

Life Requisite Values

Food (X1)--Related to the area of various wetland types within a sampling area that are shallow enough for a dabbling duck to feed (<60 cm water depth is optimum) during the breeding season. Model assumes that seasonally flooded wetlands (i.e. wet meadows, etc.) provide a better food source than permanently flooded wetlands.

Reproduction (X2)--Related to the height and density of nesting cover (residual vegetation).

Cover (X3)--Related to the percent of shoreline dominated by emergent or scrub-shrub wetland vegetation. Shorelines with little or nor vegetation provide marginal escape cover for broods. Only wetlands with open water available during the brooding season should be evaluated.

Habitat Evaluation Criteria

Food (X1): Seasonal wetlands, which produce highest quantities of aquatic invertebrates, are preferred feeding habitat for laying mallard hens. The density of mallard pairs/hectare is assumed to be higher in seasonal rather than semipermanent wetlands.

A - Temporarily flooded: surface water is present for brief periods during growing season. SI value = 0.3

B - Seasonally flooded: surface water is present for extended periods especially early in the growing season, but is absent by the end of the season in most years. SI value = 1.0

C - Semipermanently flooded: surface water persists throughout the growing season during most years. SI value = 0.8
D - Permanent flooded: water covers the land surface throughout the year in all years. Vegetation is composed of obligate hydrophytes. SI value = 0.5

Reproduction (X2): Mallard nesting success is the highest in cover with the greatest height-density of residual vegetation (i.e. concealed from all directions). Robel method was used as the visual obstruction technique (height and density). Reproduction value (X2) is a function of the height and density of nesting cover (residual vegetation).
Shoreline Cover (X3): Mallard broods will utilize wetlands having sparse to dense emergent of scrub-shrub vegetation. Wetlands devoid of wetland vegetation or open water are usually avoided. Marshes with shorelines bare of emergent vegetation are used less.

Measure the percent of shoreline dominated by emergent and/or scrub/shrub wetland vegetation for brood rearing wetlands (>2 acres in size with some open water during brooding season):

A - 50% to 100% of shoreline.	SI value = 0.7 to 1.0
B - 15% to 50% of shoreline.	SI value = 0.4 to 0.6
C - 0% to 15% of shoreline.	SI value = 0.1 to 0.3

The habitat suitability index is the lowest X_n value.

Suggested Measurement Techniques

Large sampling areas that are representative should be randomly selected: At least four sampling areas per area should be used. Variables X1 and X3 can be measured from aerial photography with field ground truthing. Variable X2 should be measured in the field in upland habitat adjacent to wetlands. Specific suggestions on measurement techniques of each variable are provided below.

X1 = Calculate area of various wetland types within each sampling area using a digitizer or dot grid or planimeter. Multiply each wetland area by its SI for a weighted value. Sum the weighted values in the sampling area and divide by the total wetland acreage for a weighted sample area SI value.

X2 = Field measure height and density of residual vegetation using the visual obstruction technique (Robel pole used here). Sampling areas should be located on aerial photographs.

X3 = Measure the amount of shoreline vegetation for each wetland type >2 acres in size and with some open water during brood-rearing season from aerial photographs. Calculate SI value for each wetland based on measurements. Multiple SI value times wetland area for a weighted value. A standard for lacustrine systems (i.e. littoral zone or 100 meters from shore) will need to be established as providing brood-rearing habitat. Sum weighted values in each sampling area and divide by total wetland acreage for a sample area SI value. Some field verification of shoreline vegetation should be conducted.

Equation

Life requisite	Cover type	Equation
Cover	HW	$(V_1 \times V_2)^{1/2}$
Food	HW	$(V_1 \times V_8)^{1/2}$

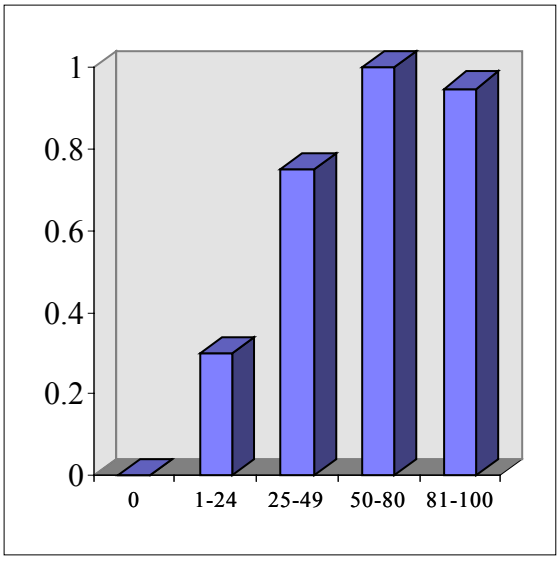
This HSI value for the muskrat is equal to the lowest life requisite value.

Muskrat overview

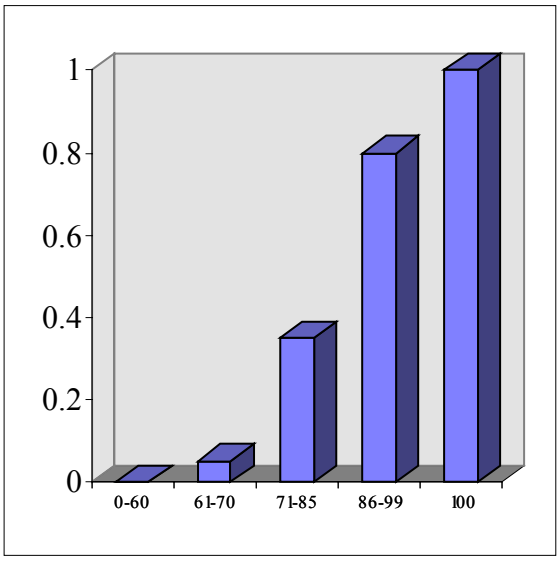
Year-round habitat requirements of the muskrat can be fulfilled within wetland habitats that provide herbaceous vegetation and permanent surface water with minor fluctuations in water levels. Wetlands characterized by seasonal drying, an absence of emergent vegetation, or both, have less potential as year-round muskrat habitat than wetlands with permanent water and an abundance of emergent vegetation. It is assumed that food and cover are interdependent characteristics of the muskrat's habitat and that measures of vegetative abundance and water permanence within a wetland can be aggregated to reflect habitat conditions favoring maintenance of the muskrat's food and cover requirements. The reproductive habitat requirements of the species are assumed to be met when adequate water, food, and cover conditions are present.

This HSI model was modified into a histogram from the HSI Models: muskrat, FWS/OBS-82/10.46 by A.W. Allen and R.D. Hoffman, 1984.

Muskrat HSI Model



V1 Percent canopy cover of emergent herbaceous vegetation



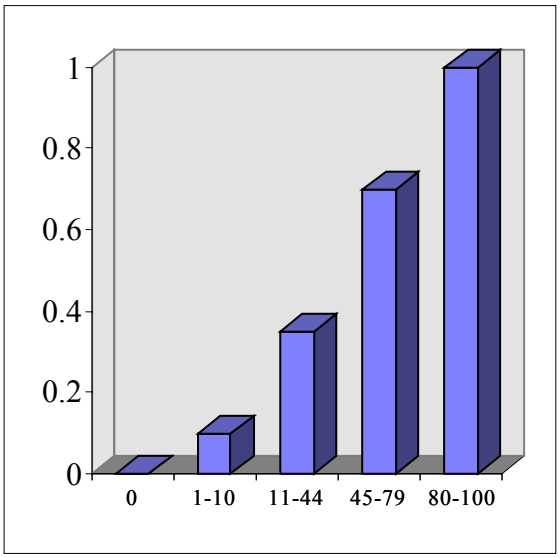
V2 Percent of year with surface water present

Muskrat variable definitions -

V1 - Muskrat. Percent canopy cover of emergent herbaceous vegetation is the percent of the water surface shaded by a vertical projection of the canopies of all emergent herbaceous vegetation, both persistent and non-persistent.

V2 - Muskrat. Percent of year with surface water present is the proportion of the year in which the cover type has surface water present.

V8 - Muskrat. Percent of emergent herbaceous vegetation consisting of Olney bulrush, common three square bulrush, or cattail considering both persistent and non-persistent types.



V8 Percent of emergent herbaceous vegetation of preferred types

Equation

Life requisite	Cover type	Equation
Reproduction	DS, DSW	$(V_1 \times V_2 \times V_3)^{1/2}$

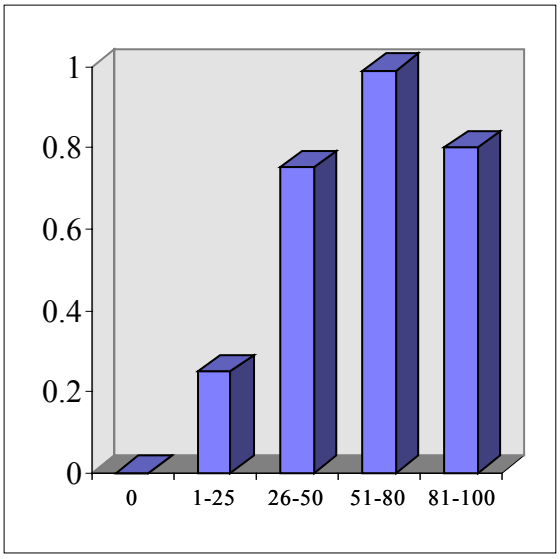
The HSI value for the yellow warbler is equal to the reproduction value.

Yellow warbler overview

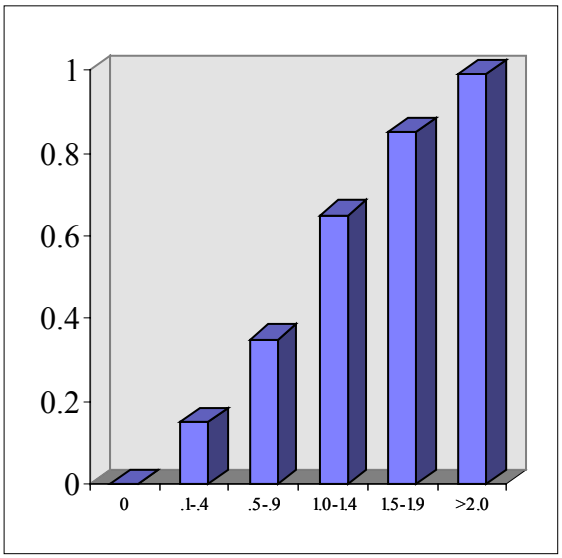
It is assumed that optimal habitats contain 100% hydrophytic deciduous shrubs and that habitats with no hydrophytic shrubs will provide marginal suitability. Shrub densities between 60 and 80% crown cover are assumed to be optimal. As shrub densities approach zero cover suitability also approaches zero. Totally closed shrub canopies are assumed to be of only moderate suitability, due to the probable restrictions on movement of the warbles in those conditions. Shrub heights of 2 m or greater are assumed to be optimal, and suitability will decrease as the heights decrease.

This HSI model was modified into a histogram from the HSI Models: yellow warbler, FWS/OBS-82/10.27 by R.L. Schroeder, 1982.

Yellow Warbler HSI Model



V1 Percent deciduous shrub crown cover



V2 Avg. height of deciduous shrub canopy

Yellow warbler variable definitions -

V1 - Yellow warbler. Percent deciduous shrub crown is the percent of the ground shaded by a vertical projection of the canopies of woody deciduous vegetation that is less than 5 m in height.

V2 - Yellow warbler. Average height of deciduous shrub canopy is the average height from the ground to the top of those shrubs, which comprise the uppermost shrub canopy.

V3 - Yellow warbler. Percent of deciduous shrub canopy comprised of hydrophytic shrubs is the relative percent of the amount of hydrophytic shrubs as compared to all shrubs based on variable 2.

0	0		
1-24	0.3		
25-49	0.45		
50-74	0.7		
75-99	0.9		
100	0.99		

V3 Percent of deciduous shrub canopy comprised of hydrophytic shrubs

APPENDIX A.2

2001 Habitat Evaluation Procedure (HEP) Report for the Lower Trimble Project

Contract # 00004009
Project # 199206700

Darren Holmes
Wildlife Project Manager
Kalispel Natural Resource Department

December 3, 2001

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ACKNOWLEDGEMENTS

I would like to extend my appreciation to each of the HEP team members, without whose participation the baseline evaluation could not have been accomplished. These team members are Paul Ashley (Washington Department of Fish and Wildlife) and Roy Finley (Kalispel Tribe of Indians).

Introduction

The Habitat Evaluation Procedure (HEP), developed in 1980 by the U.S. Fish and Wildlife Service (USFWS 1980a, USFWS 1980b), uses a habitat/species based approach to assessing project impacts, and is a convenient tool to document the predicted effects of proposed management actions. The Northwest Power Planning Council (NPPC) endorsed the use of HEP in its Columbia River Basin Fish and Wildlife Program to evaluate wildlife benefits and impacts associated with the development and operation of the federal Columbia River Basin hydroelectric system (NPPC 1994). The Albeni Falls Interagency Work Group (AFIWG) used HEP in 1987 to evaluate wildlife habitat losses attributed to the Albeni Falls hydroelectric facility (Martin et al. 1988).

In 1992, the AFIWG (Idaho Department of Fish and Game; Kalispel, Coeur d'Alene, and Kootenai Tribes) began implementing activities to mitigate these losses. Implementation activities include protecting, restoring and enhancing wildlife habitat. HEPs are used extensively within the NPPC's Columbia River Basin Fish and Wildlife Program. Wildlife managers use HEP to determine habitat lost from the construction of the federal hydroelectric projects and habitat gained through NPPC mitigation program.

Habitat Suitability Index (HSI) models for each of the seven target species are used to determine habitat quality and quantity losses for representative habitat cover types for this project. Target species include Bald Eagle, black-capped chickadee, Canada goose, mallard, muskrat, white-tailed deer and yellow warbler.

In 2001, a HEP team determined the baseline habitat condition of the 450-acre Lower Trimble Project (Figure 1). The HEP team consisted of the following members and agencies: Darren Holmes, Kalispel Natural Resource Department (KNRD); Paul Ashley, Washington Dept. of Fish and Game (WDFW); and Roy Finley, KNRD. Baseline Habitat Units (HU) will be credited to Bonneville Power Administration (BPA) for protection of habitats within the project area. The HSI models used were identical to those modified for use in 1991 (Appendix).

Figure 1. Project location in relationship to Eastern Washington and Northern Idaho.

The objective of using HEP as an assessment tool is two-fold. First, it provides an unbiased and measured assessment of wildlife habitats within the mitigation parcel. This

data is used to offset the Albeni Falls Dam HU loss ledger. That ledger accounts for the loss of wildlife habitat that resulted from the construction and inundation of Albeni Falls hydroelectric project and the extent to which those losses have been mitigated. Additionally, the baseline HEP evaluation describes existing habitat conditions on the property and will be used, along with other tools, to determine initial management, restoration, and enhancement activities. HEP analyses will be completed every five years to quantitatively evaluate the effectiveness of management strategies in improving and maintaining habitat conditions while providing additional HU crediting to BPA for enhanced habitat values.

METHODS

The HSI is a value based on a 0.0-1.0 scale, which determines habitat quality. HU's are determined by multiplying the HSI value by the area (acres) within that cover type. HSI values are determined by measuring specific life requisites for each target species and associated cover types.

Each target species' associated cover type was estimated visually using the modified HSI models for seven of the original eight target species (white-tailed deer were not used due to cover type similarities). A randomly selected HEP point(s) was used for each HSI model.

On the Lower Trimble Project, black-capped chickadee HSI values were averaged from three sites, and yellow warbler HSI values were averaged from two sites. The muskrat value was averaged across two sites. Canada goose and mallard values were averaged from three sites. Bald Eagle values were derived from two sites. The HSI scores reflect group consensus of each habitat variable. HSI values were determined using equations provided for each HSI model (Table 1).

Table 1. Life requisite equations and HSI values for each target species.*

Target Species	Life Requisite	HSI Equation	HSI Value
Bald Eagle – breeding	Reproduction	$(V_2xV_3xV_4)^{1/3}$	HSI score
Bald Eagle – wintering	Food	V_1	Lower value
	Perch	V_2	
Black-capped	Food	$(V_1xV_2)^{1/2}$	Lower value
Chickadee	Reproduction	V_3	
Canada Goose	Reproduction	$[(V_1+V_2)V_3]^{1/2}$	HSI score
Mallard	Reproduction	V_1 or V_2 or V_3	Lower value
Muskrat	Food	$(V_1xV_2)^{1/2}$	Lower value
	Cover	$(V_1xV_3)^{1/2}$	
Yellow Warbler	Reproduction	$(V_1xV_2XV_3)^{1/2}$	HSI score

*See Appendix A for V values.

Habitat cover types were delineated using aerial photos and on-the-ground verification (Table 2). Cover type area (measured in acres) was determined using Arcview 3.1 software. Habitat units were then calculated using the HSI score and cover type areas for each HEP species.

The HEP team collected habitat data along a transect (100 foot intervals) within each cover type. Sampling transects were lengthened to achieve a 90% confidence level for our parameter point estimates. Adequacy of habitat sampling was determined using the formula (Lapin 1980):

$$\frac{\alpha^2 \times \sigma^2}{e^2}$$

Where:

α = critical normal value (p=0.1) from any standard statistical reference
σ = standard deviation
e = tolerable error level

Shrub presence, species, and height data were collected at 2-foot intervals along the sampling transect. Percent herbaceous cover and percent herbaceous cover composed of grass were measured using a 0.5 by 1.0 meter sampling frame (Daubenmire 1959) at 50 foot intervals along the transect. Height of the herbaceous layer was measured at 5 points within the sampling frame. A Robel pole (Robel et al. 1970) was used to determine the height-density of the herbaceous layer. Visual obstruction rating (VOR) was determined by four Robel pole measurements, two parallel and two perpendicular to the transect, were taken at 50 foot intervals along the transect. Distances to water, size of water bodies, ratios of open water to emergent vegetation, and road densities, were derived from a combination of field estimation and evaluation of aerial photographs and topographic maps.

Table 2. Target species for HEP analysis by cover type.

	Cover Type					
HSI Species Model	**Forested Wetland**	**Herbaceous Wetland**	**Shrub-Scrub Wetland**	**Forested Upland**	**Upland Shrub**	**Open Water**
Bald Eagle	**X**					
Mallard	**X**	**X**	**X**			**X**
Black-capped Chickadee	**X**					
Canada Goose		**X**				**X**
Yellow Warbler			**X**			
White-tailed Deer			**X**	**X**	**X**	
Muskrat		**X**				**X**

Results and Discussion

Overall, the Lower Trimble property contributes 237.4 baseline HUs to the Albeni Falls Dam ledger, less than 0.55 HUs/acre. Project cover type area (Table 3) and HSI values (Table 4) indicate the Lower Trimble project as low quality habitat for five of the seven target species.

Table 3. Cover type acreage for the Lower Trimble Project.

Cover Type	Acreage
Forested Upland	10.86
Deciduous Forested Wetland	16.65
Scrub-Shrub Wetland	43.84
Pasture (converted wetland)	268.88
Open water	39.53
Herbaceous Wetland	70.24
Total	450.0

The Lower Trimble Project has low quality Bald Eagle breeding habitat in coniferous and deciduous cover due to stand size and a lack of appropriate nesting trees. However, this site does have an active and longstanding Bald Eagle nesting site located at the mouth of the main slough near the center of the property. Yellow warbler HSI values were low due to the absence of hydrophytic shrubs within the cover type. Muskrat HSI values are low due to the absence of preferred edible vegetation. Black-capped chickadee scores were moderate, although the overall availability of this cover type kept the HUs from being higher. Mallard HSI values were low due to lack of persistent nesting cover and preferred wetlands hydrology.

Excess areas in prior converted wetland status or pasture will be restored to target cover types. Hydrological restoration using water control, ditch plugs, topographic relief, and dike removal are expected to increase wetland area and diversity. These management strategies are designed to improve the overall quality and quantity of available wetland habitat. Increased wetland diversity along the slough and elimination of trespass grazing in the southern section will improve habitat variables for muskrat, mallard and Canada goose.

Bald Eagle scores on the Lower Trimble Project for the nest and perch variables were determined using differing perspectives. Nesting values were determined the by assessing the overall stand composition, while perch values were determined by assessing individual trees within the stand. Our efforts will focus on enhancing and expanding stands to provide both nest and perch sites in both deciduous and coniferous cover types.

Eventually snag recruitment within the deciduous forest and deciduous forest wetland cover types are expected to improve black-capped chickadee nesting variables. Additionally, hydrophytic shrub enhancement/restoration will improve HSI scores and habitat diversity in this cover type.

Canada goose HSI values indicate high quality habitat. Information provided by the model will help direct management considerations. Some pasture areas will be maintained for Canada goose brood habitat and fall migration feeding.

Increased availability of preferred emergent vegetation, *Typha spp*. and *Scirpus spp*., availability would increase muskrat HSI scores and HUs. Table 4 summarizes the HEP results for the Lower Trimble Project by species and habitat cover type.

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Table 4. Habitat Evaluation Procedure for the baseline Lower Trimble Project HSI scores and HU's.

HEP Cover Type/Species	HEP Variable	Var. Score	HSI Equation	HSI Score	Acres	H.U.'s
Bald Eagle (breeding)	V1 - Food	1	(V2*V3*V4)1/3	0.7	10.9	7.6
Coniferous Cover	V2 - Nest	0.4				
	V3 - Dist. to H2O	0.9				
	V4 - Human Disturbance	0.9				
Bald Eagle (breeding)	V1 - Food	1	(V2*V3*V4)1/3	0.7	16.7	9.1
Deciduous Cover	V2 - Nest	0.4				
	V3 - Dist. to H2O	0.9				
	V4 - Human Disturbance	0.9				
Bald Eagle (wintering)	V1 - Food	1	[(V1)2*V2]1/3	0.4	10.9	4.4
Coniferous Cover	V2 - Perch	0.4				
	V3 - Dist. to H2O	0.9				
	V4 - Human Disturbance	0.9				
Bald Eagle (wintering)	V1 - Food	1	[(V1)2*V2]1/3	0.4	16.7	6.7
Deciduous Cover	V2 - Perch	0.4				
	V3 - Dist. to H2O	0.9				
	V4 - Human Disturbance	0.9				
Black-capped Chickadee	V1 -% Canopy Closure	0.8	(V1*V2)1/2 or V3	0.82	16.7	13.7
Deciduous Forested Wetlands	V2 - Avg. Tree Height	0.85				
	V3 - No. Snags/acre	1				
Yellow Warbler	V1 - % Shrub Cover	0.8	(V1*V2*V3)1/3	0.00	43.8	0.0
Scrub-Shrub Wetlands	V2 - Avg. Shrub Height	0.65				
	V3 - % Wetland Obl.	0				
Canada Goose	V1 - Island Nesting Habitat	0	[(V1+V2)+V3]1/2	0.65	268.9	174.8
	V2 - Shoreline Nesting	0.5				
	V3 - Brood Rearing Habitat	0.8				
Mallard	V1 - Wetland Type	0.3	Lowest Value	0.3	70.2	21.1
	V2 - Nesting Cover	0.3				
	V3 - Shoreline Cover	0.5				
Muskrat	V1 - % Cover	095	(V1*V2)1/2 or	0.00	39.5	0
	V2 - % of Year w/ H2O	1	(V1*V3)1/2			
	V3 - % Preferred Veg.	0	Lowest Value			
Total					**450.0**	**237.4**

Figure 2. Project location in Pend Oreille County, Washington

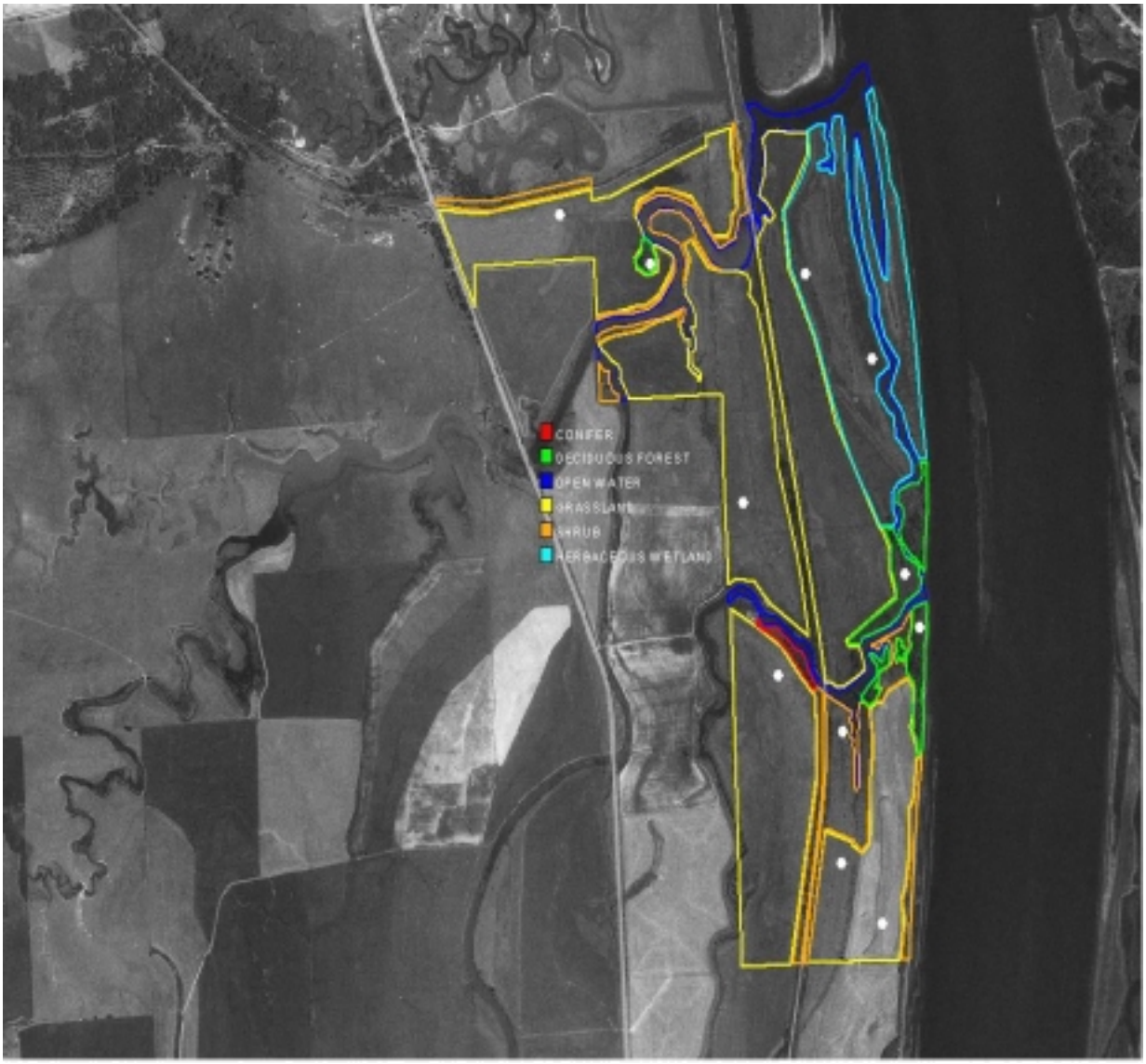


Figure 3. HEP transect locations and cover typing for the Lower Trimble Project.

APPENDIX

Habitat Evaluation Procedure HSI Species Models

VI Bald eagle (b and w). Food requirements

Good. Abundant prey base (ungulate carrion, fish of several species, waterfowl, and small mammals) available throughout the year within three miles of potential nest/perch site. SI value = 1.0.

Moderate. Moderate prey availability within three miles of potential nest/perch site. Water sometime frozen over early in the nesting period, but sometimes frozen over early in the nesting period, but some ungulate carrion available during that time. Alternative food sources may be with five miles of the nest or perch. SI value = 0.8.

Fair. Minimal prey base within five miles of potential nest/perch site. Water frozen over late into the nesting cycle within alternative food sources. SI value = 0.3.

Poor. Insufficient prey base to sustain eagles. SI value = 0.0.

V3 Bald eagle (b). Distance to water body with sufficient prey availability

A. $\leq$ 1 kilometer. SI value = 1.0.

B. 2 kilometers. SI value = 0.9.

C. 3 kilometers. SI value = 0.6.

D. 4 kilometers. SI value = 0.2.

E. $\geq$ 4.5 kilometers. SI value = 0.0.

V2 Bald eagle (b and w). Nest/perch structure type, form, and density

Best. Old growth spruce, Douglas fir, or ponderosa pine in coniferous areas; old growth cottonwood in deciduous stands; stands dense and continuous and exceeding 10 acres in size. SI value = 1.0.

Good. Scattered old growth trees in stands of moderate (mature) aged trees as above exceeding 10 acres in size. SI value = 0.9.

Fair. Scattered old growth trees, as above, in open areas (without screening from younger aged trees). SI value = 0.6/

Poor. Dominant trees available are old growth lodgepole pine in coniferous areas or aspen in deciduous stands. SI value = 0.4.

Minimal. Potential nest or perch structures are shrubs or young trees, no screening present. SI value = 0.0.

V4 Bald eagle (b). Human activity level

Good. Natural vegetation dominates area; no permanent development or human structures; no human activity within the area during the nesting period. SI value = 1.0.

Moderate. Area of farming ground or pasture surrounds site; occasional use of area by predictable humans, such as a farmer or stockman; human activity occurs late in the eagle nesting cycle. SI value = 0.9.

Fair. Dispersed recreation campsites or trails, or occasionally used boat docks within vicinity of potential nest or perch site; activity occurs during brooding period only. SI value = 0.4.

Poor. Developed sites, e.g. campgrounds, boat launches, etc., within vicinity of potential nest or perch site; heavy human use of area during incubation period. SI value = 0.0.

Equation

Wintering - Food = V_2, and Perch = V_2 The HSI value is equal to the lower of the two variables.

Breeding - Food = V1, Nest/Perch sites = V2, Reproduction = $(V_2 \times V_3 \times V_4)^{1/3}$. The HSI value for breeding bald eagles is calculated as follows: $[(V_1)^2 \times V_2]^{1/3}$.

Bald eagle overview

The model recognizes that proximity to prey base, quality of prey base, and quality of nesting and perching habitat, and amount of human disturbances are the most important components determining the quality of breeding and wintering bald eagle habitat.

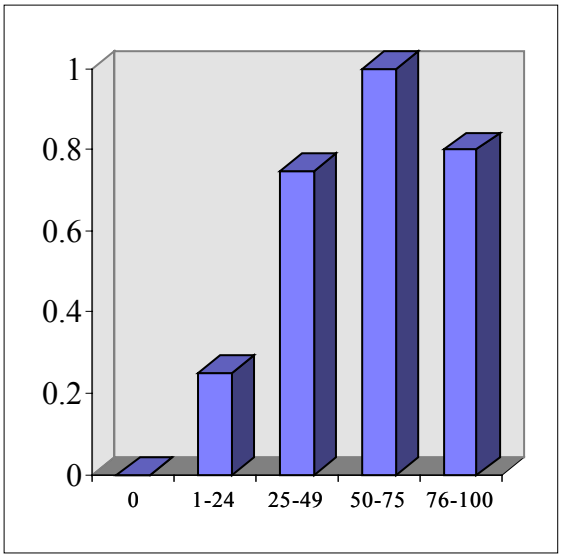
This HSI model was taken from the Albeni Falls Wildlife Protection, Mitigation and Enhancement Plan (Martin et. Al 1987).

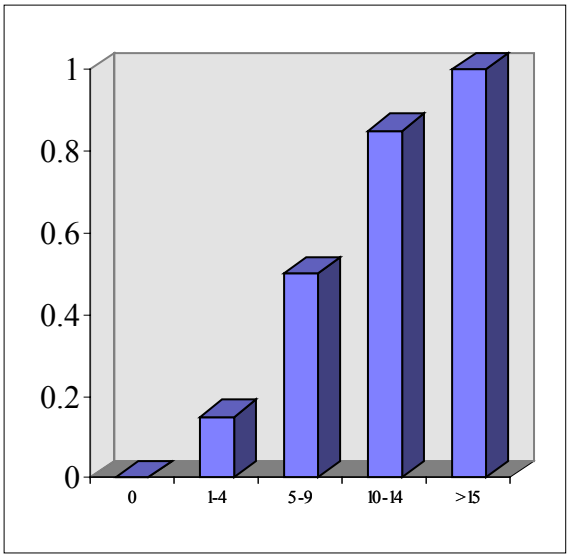
Black-capped chickadee overview

This model considers the ability of the habitat to meet the food and reproductive needs of the black capped-chickadee as an indication of the overall habitat suitability. Cover needs are assumed to be met by the food and reproductive requisites and water is assumed not to be limiting. The food component assess vegetation conditions, and the reproduction component assess the abundance of suitable snags.

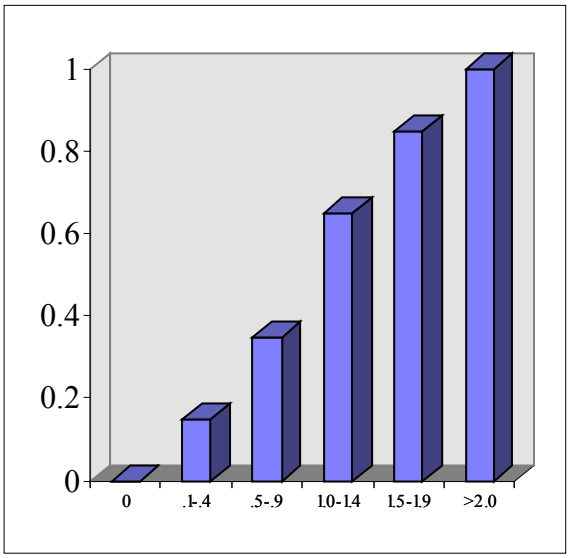
This HSI model was modified into a histogram from the HSI models: black-capped chickadee, FWS/OBS-82/10.37 by R.L. Schroeder, 1983.

Black Capped-Chickadee HSI Model





VI Percent tree canopy closure



V3 Number of snags 10 to 25 cm/.4 ha.

V2 Average Height of overstory trees

Black capped-chickadee definitions -

V1 - Black capped-chickadee. Percent tree canopy closure is the percent of canopy closed by vertical projection of the canopy in the cover type.

V2 - Black capped-chickadee. The average height of overstory trees is the average height from the ground of the overstory trees present in the cover type.

V3 - Black capped-chickadee. Number of snags 10-25 cm/0.4 ha. is the number of snags usable by black capped-chickadee's in the cover type.

Equation -

Life requisite	Cover type	Equation
Food	DF, DFW	$(V_1 \times V_2)^{1/2}$
Reproduction	DF, DFW	V_3

The HSI value for the black capped-chickadee is equal to the lowest life requisite value.

V1Canada goose: Island nesting habitat

Canada Goose HSI Model

Good. Stable islands present, relatively high shoreline/area ratio; ground cover on portions of islands 4 to 16 inches high; brood habitat within 1 mile of area. SI values between 0.8 and 1.0.

Fair. Stable islands present; relatively low shoreline/area ratio; or cover on islands < 4 or > 16 inches in height or brood habitat within 1 to 2 miles from area. SI values between 0.5 and 0.7.

Poor. No stable islands present: or islands with limited or no cover; or brood habitat ≥ 2 miles from area. SI value between 0.0 and 0.4.

V2Canada goose. Shoreline nesting habitat

Good. Portions of cover within 10 meters of water; ground cover 4 to 16 inches high; adjacent wetland buffer within 50 meters of shoreline, may include sloughs of open water; brood habitat within 1 mile. SI value = 0.5.

Fair. Portions of shoreline cover within 10 meters of water; ground cover 4 to 16 inches high; adjacent wetland buffer within 50 meters of shoreline (Does not include open water wetlands); or brood habitat 1 to 2 miles away. SI value between 0.3 and 0.4.

Poor. No shoreline cover or shoreline cover taller than 16 inches and/or shorter than 4 inches; or wetland buffer > 50 meters to absent or brood habitat > 2 miles away. SI value between 0.0 and 0.2.

V3Canada goose. Brood-rearing habitat

Good. Brood pasture easily accessible from main water body; foraging zones common; vegetation < 4 inches tall; average > 1 acre in size; open water wetlands are present within 1 mile of nesting habitat. SI value between 0.7 and 1.0.

Fair. Less than above and/or no open water wetlands; or area is 1 to 2 mile miles from nesting habitat. SI value between 0.4 and 0.6.

Poor. Little or no brooding area; or area is ≥ 2 miles from nesting habitat. SI value between 0.0 and 0.3.

Equation

The HSI value is calculated as follows: $[(V_1 + V_2) V_3]^{1/2}$

Canadian goose overview

The model recognized that the quality of shoreline habitat, the presence of islands, and quality of brood-rearing habitat are the most important components determining the quality of Canada goose breeding habitat.

This HSI model was taken from the Albeni Falls Wildlife Protection, Mitigation, and Enhancement Plan by Martin et. Al, 1987.

Habitat Suitability Index
Mallard (Anas platyrhyncos)
Breeding Season Only

Life Requisite Values

Food (X1)--Related to the area of various wetland types within a sampling area that are shallow enough for a dabbling duck to feed (<60 cm water depth is optimum) during the breeding season. Model assumes that seasonally flooded wetlands (i.e. wet meadows, etc.) provide a better food source than permanently flooded wetlands.

Reproduction (X2)--Related to the height and density of nesting cover (residual vegetation).

Cover (X3)--Related to the percent of shoreline dominated by emergent or scrub-shrub wetland vegetation. Shorelines with little or nor vegetation provide marginal escape cover for broods. Only wetlands with open water available during the brooding season should be evaluated.

Habitat Evaluation Criteria

Food (X1): Seasonal wetlands, which produce highest quantities of aquatic invertebrates, are preferred feeding habitat for laying mallard hens. The density of mallard pairs/hectare is assumed to be higher in seasonal rather than semipermanent wetlands.

A - Temporarily flooded: surface water is present for brief periods during growing season. SI value = 0.3

B - Seasonally flooded: surface water is present for extended periods especially early in the growing season, but is absent by the end of the season in most years. SI value = 1.0

C - Semipermanently flooded: surface water persists throughout the growing season during most years. SI value = 0.8

D - Permanent flooded: water covers the land surface throughout the year in all years. Vegetation is composed of obligate hydrophytes. SI value = 0.5

Reproduction (X2): Mallard nesting success is the highest in cover with the greatest height-density of residual vegetation (i.e. concealed from all directions). Robel method was used as the visual obstruction technique (height and density). Reproduction value (X2) is a function of the height and density of nesting cover (residual vegetation).
Shoreline Cover (X3): Mallard broods will utilize wetlands having sparse to dense emergent of scrub-shrub vegetation. Wetlands devoid of wetland vegetation or open water are usually avoided. Marshes with shorelines bare of emergent vegetation are used less.

Measure the percent of shoreline dominated by emergent and/or scrub/shrub wetland vegetation for brood rearing wetlands (>2 acres in size with some open water during brooding season):

A - 50% to 100% of shoreline. SI value = 0.7 to 1.0

B - 15% to 50% of shoreline. SI value = 0.4 to 0.6
C - 0% to 15% of shoreline. SI value = 0.1 to 0.3

The habitat suitability index is the lowest X_n value.

Suggested Measurement Techniques

Large sampling areas that are representative should be randomly selected: At least four sampling areas per area should be used. Variables X1 and X3 can be measured from aerial photography with field ground truthing. Variable X2 should be measured in the field in upland habitat adjacent to wetlands. Specific suggestions on measurement techniques of each variable are provided below.

X1 = Calculate area of various wetland types within each sampling area using a digitizer or dot grid or planimeter. Multiply each wetland area by its SI for a weighted value. Sum the weighted values in the sampling area and divide by the total wetland acreage for a weighted sample area SI value.

X2 = Field measure height and density of residual vegetation using the visual obstruction technique (Robel pole used here). Sampling areas should be located on aerial photographs.

X3 = Measure the amount of shoreline vegetation for each wetland type >2 acres in size and with some open water during brood-rearing season from aerial photographs. Calculate SI value for each wetland based on measurements. Multiple SI value times wetland area for a weighted value. A standard for lacustrine systems (i.e. littoral zone or 100 meters from shore) will need to be established as providing brood-rearing habitat. Sum weighted values in each sampling area and divide by total wetland acreage for a sample area SI value. Some field verification of shoreline vegetation should be conducted.

Equation

Life requisite	Cover type	Equation
Cover	HW	$(V_1 \times V_2)^{1/2}$
Food	HW	$(V_1 \times V_3)^{1/2}$

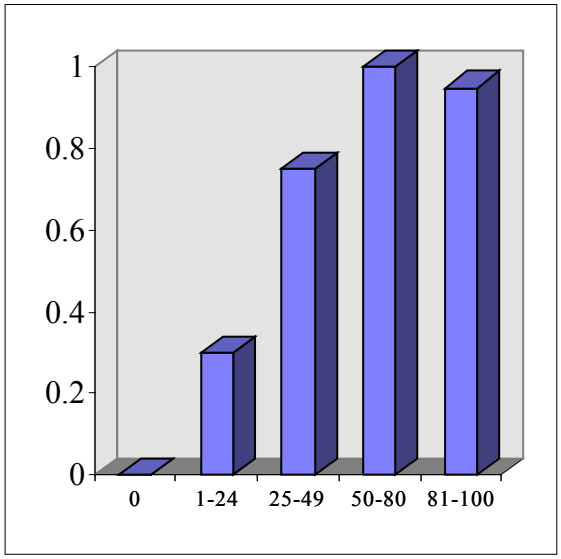
This HSI value for the muskrat is equal to the lowest life requisite value.

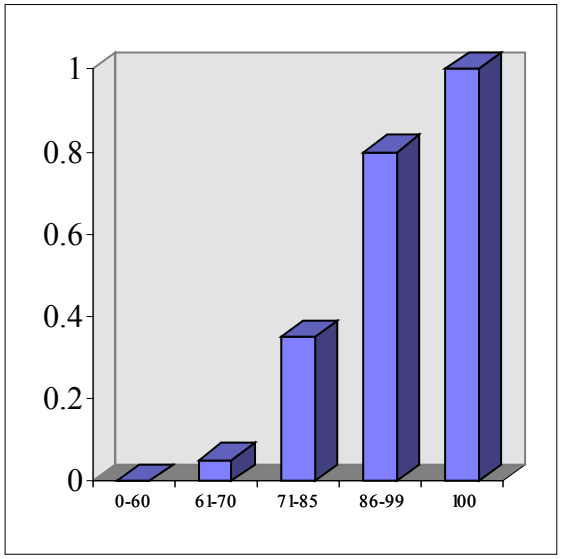
Muskrat overview

Year-round habitat requirements of the muskrat can be fulfilled within wetland habitats that provide herbaceous vegetation and permanent surface water with minor fluctuations in water levels. Wetlands characterized by seasonal drying, an absence of emergent vegetation, or both, have less potential as year-round muskrat habitat than wetlands with permanent water and an abundance of emergent vegetation. It is assumed that food and cover are interdependent characteristics of the muskrat's habitat and that measures of vegetative abundance and water permanence within a wetland can be aggregated to reflect habitat conditions favoring maintenance of the muskrat's food and cover requirements. The reproductive habitat requirements of the species are assumed to be met when adequate water, food, and cover conditions are present.

This HSI model was modified into a histogram from the HSI Models: muskrat, FWS/OBS-82/10.46 by A.W. Allen and R.D. Hoffman, 1984.

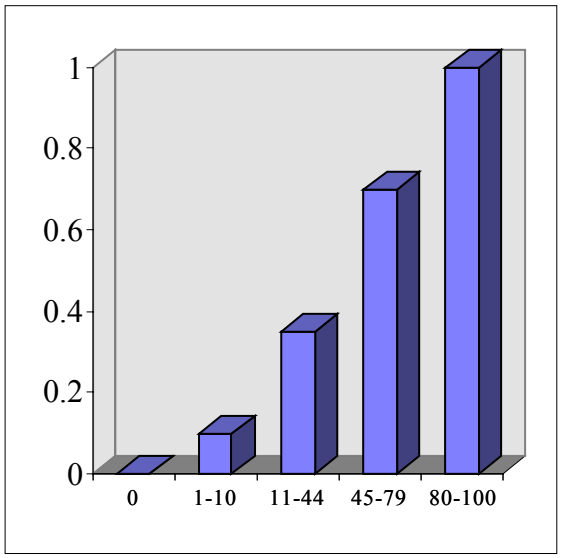
Muskrat HSI Model





V1 Percent canopy cover of emergent herbaceous vegetation

V2 Percent of year with surface water present



V8 Percent of emergent herbaceous vegetation of perferred types

Muskrat variable definitions -

V1 - Muskrat. Percent canopy cover of emergent herbaceous vegetation is the percent of the water surface shaded by a vertical projection of the canopies of all emergent herbaceous vegetation, both persistent and non-persistent.

V2 - Muskrat. Percent of year with surface water present is the proportion of the year in which the cover type has surface water present.

V8 - Muskrat. Percent of emergent herbaceous vegetation consisting of Olney bulrush, common threesquare bulrush, or cattail considering both persistent and non-persistent types.

Equation

Life requisite	Cover type	Equation
Reproduction	DS, DSW	$(V_1 \times V_2 \times V_3)^{1/2}$

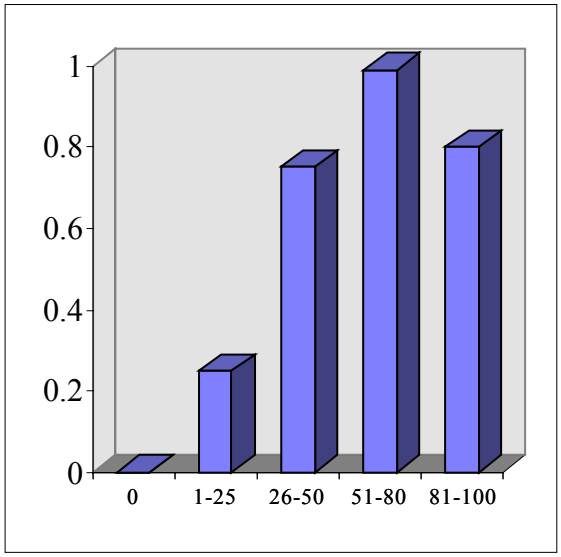
The HSI value for the yellow warbler is equal to the reproduction value.

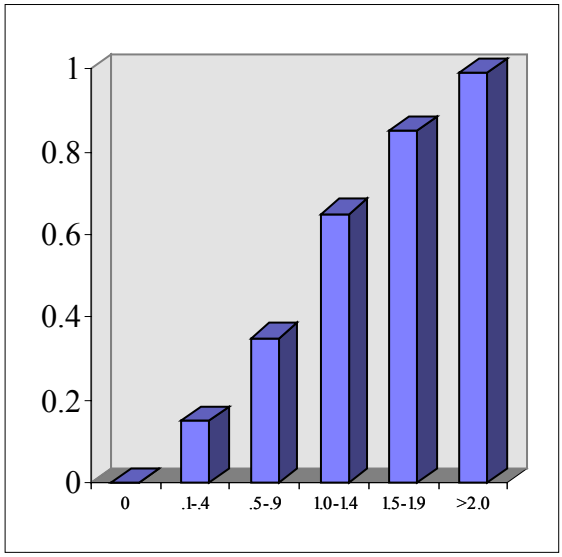
Yellow warbler overview

It is assumed that optimal habitats contain 100% hydrophytic deciduous shrubs and that habitats with no hydrophytic shrubs will provide marginal suitability. Shrub densities between 60 and 80% crown cover are assumed to be optimal. As shrub densities approach zero cover suitability also approaches zero. Totally closed shrub canopies are assumed to be of only moderate suitability, due to the probable restrictions on movement of the warbles in those conditions. Shrub heights of 2 m or greater are assumed to be optimal, and suitability will decrease as the heights decrease.

This HSI model was modified into a histogram from the HSI Models: yellow warbler, FWS/OBS-82/10.27 by R.L. Schroeder, 1982.

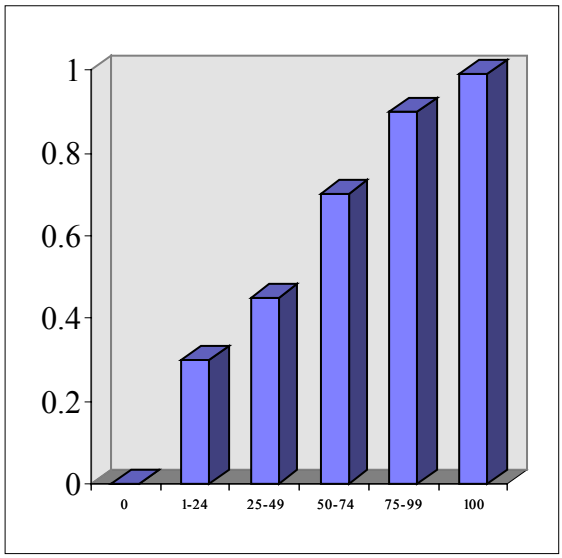
Yellow Warbler HSI Model





V1 Percent deciduous shrub crown cover canopy

V2 Average height of deciduous shrub



V3 Percent of deciduous shrub canopy comprised of hydrophytic shrubs

Yellow warbler variable definitions -

V1 - Yellow warbler. Percent deciduous shrub crown is the percent of the ground shaded by a vertical projection of the canopies of woody deciduous vegetation that is less than 5 m in height.

V2 - Yellow warbler. Average height of deciduous shrub canopy is the average height from the ground to the top of those shrubs which comprise the uppermost shrub canopy.

V3 - Yellow warbler. Percent of deciduous shrub canopy comprised of hydrophytic shrubs is the relative percent of the amount of hydrophytic shrubs as compared to all shrubs based on variable 2.

APPENDIX B

FINAL DRAFT

Monitoring and Evaluation Plan For The Albeni Falls Wildlife Mitigation Project

(BPA Project Numbers 199206100 and 19910600)

Prepared By:

Albeni Falls Interagency Work Group

August 2001

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Acknowledgements

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the chapter on herptofauna monitoring. Mr. Steve Rust of the Idaho Conservation Data Center wrote the chapter on vegetation monitoring. Their contributions to this project are greatly appreciated.

Introduction

Background

Congress passed the Northwest Power Planning and Conservation Act on 5 December 1980. Section 4(h)(10)(A) of the Act directed the Bonneville Power Administration (BPA) "to protect, mitigate, and enhance fish and wildlife to the extent affected by the development and operation of any hydroelectric project of the Columbia River and its tributaries in a manner consistent with the Northwest Power Planning Council's (NPPC) Fish and Wildlife Program." In 1986 the Idaho Department of Fish and Game (IDFG) formed the Albeni Falls Interagency Work Group (Work Group). Under the direction of the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program, the Work Group used U.S. Fish and Wildlife Service (USFWS) Habitat Evaluation Procedure (HEP) methodology (U.S. Fish and Wildlife Service 1980a, 1980b) to calculated the wildlife impacts caused by the construction and operation of Albeni Falls Dam, and developed a mitigation plan (Martin et al. 1988). Construction of the dam resulted in the loss of 6,617 acres of wetland habitat and the inundation of 8,900 acres of deep-water marsh. Estimated wildlife losses were 28,587 habitat units (HUs) for a variety of target species (Martin et al. 1988). The goal of the mitigation plan is to provide benefits equal to the HEP target species habitat units lost due to development and operation of the Albeni Falls Dam. In lieu of annualizing HU losses the NPPC has decided to mitigate losses at a 2:1 ratio. That is, for every 2 HUs protected the HU ledger will be reduced by 1 HU. The principal mitigation strategies forwarded by the plan are the protection of in-place, in-kind habitats through fee-title acquisition or the purchase of conservation easements, enhancement of those habitats with restoration potential, and maintaining the long-term quality of these habitats.

The Albeni Falls Wildlife Mitigation Project was developed to protect, restore, enhance and maintain the long-term quality of wetland and riparian habitat in northern Idaho and eastern Washington (Figure 1) as on-going mitigation for the construction and inundation of the Albeni Falls hydroelectric project (NPPC 2000, NPPC 1995 program measures 11.2D.1, 11.2E.1, 11.3D.4, 11.3D.5). The long-term conservation potential of implementing the NPPC Fish and Wildlife Program through the Albeni Falls Wildlife Mitigation Project is principally the protection of existing high quality wetland habitats and associated target species, but also includes protection and development of habitats with high restoration potential.

The NPPC Fish and Wildlife Program addresses the need for monitoring and evaluation (M&E) to ensure that mitigation goals are attained (NPPC 2000). Section 3.1B (NPPC 1995) calls for evaluation that "will monitor overall program implementation, evaluate the effectiveness of actions taken, and judge their scientific merits." Section 11.4 (NPPC 1995) states that the Council is interested in ensuring that mitigation actually occurs on the ground, and accordingly, is providing for monitoring to determine if projected benefits to wildlife result from the Program. The Program calls for an independent scientific review group to evaluate the progress and success of wildlife mitigation efforts (NPPC 1995, Section 11.4A.2). Consequently, the Independent Scientific Review Panel

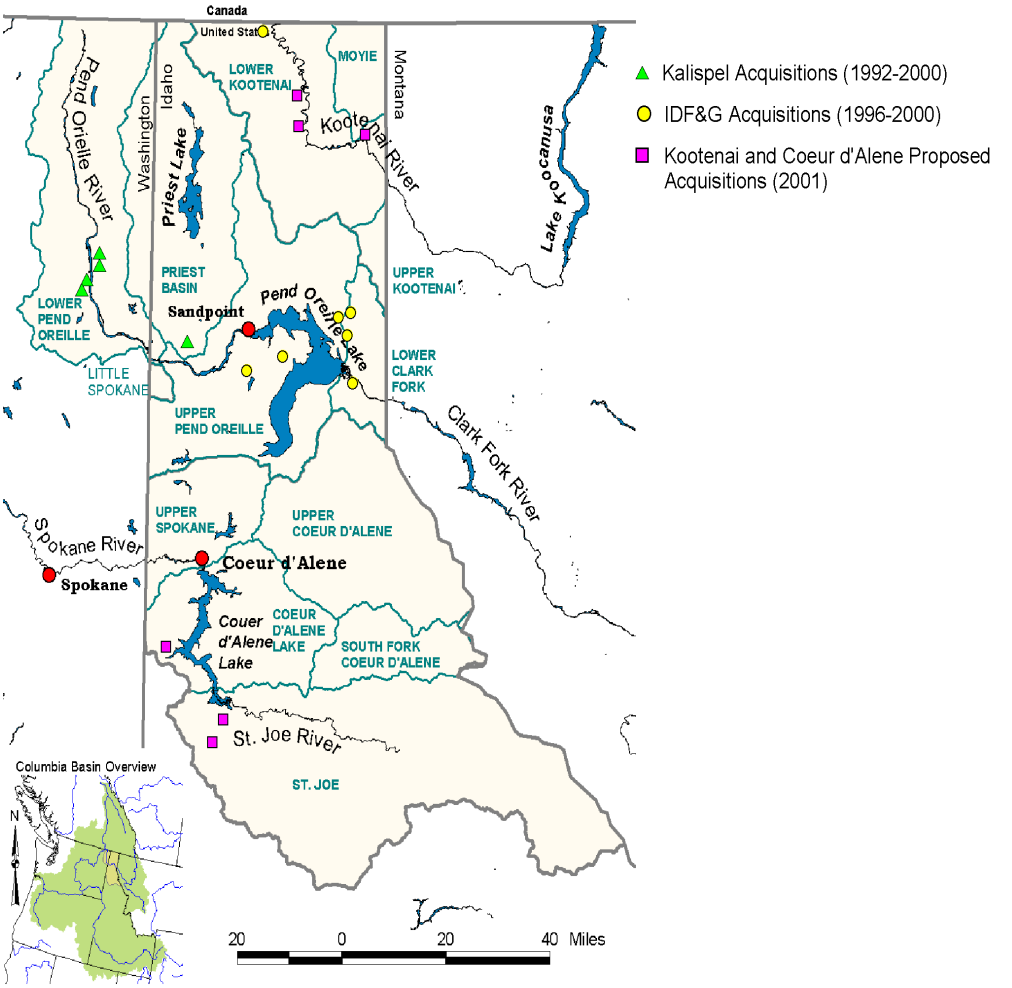

Figure 1. Location of the Albeni Falls Mitigation implementation area and existing and proposed project locations.

(ISRP) was formed and, after a review of the NPPC Fish and Wildlife Program and implementation, made among others, the following recommendation: Monitoring, which is now based on HUs determined by HEP analysis, be expanded to include a requirement for some degree of direct monitoring of target (and perhaps some non-target) wildlife populations (III.B.25, ISRP Report 97-1, July 1997). Sponsors of the Albeni Falls Wildlife Mitigation project recognize and strongly support the need for a M&E program that goes beyond HEP, is based in good science and standard methodologies, can be applied in an adaptive management context, and balances the need for information with an appropriate level of effort when conducted in a management context. This monitoring and evaluation plan is a response to these Program and Project needs.

Monitoring Framework

Monitoring Scale and Intensity

The scale at which a monitoring program will be applied is a defining consideration in the development of a monitoring program. Spatial scales can be geographic (regional or local), ecological (landscape or habitat), or jurisdictional (Federal, State, Tribal). Biological scales may incorporate entire ecosystems or local populations of a featured species. Temporal scale may

consider seasonal, annual or long-term variability/stability and outputs of a community. An ideal monitoring program would transcend all spatial, biological, and temporal scales. In reality, broad-scale extensive monitoring programs often lack the sensitivity to detect local level perturbations. Conversely, more intensive monitoring methods applicable to research on a site-specific basis are too costly and labor intensive to apply on a broad scale. This M&E plan attempts to balance both of these needs.

Monitoring can be conducted at three qualitative levels of intensity:

1) Tier I Trend monitoring is sufficient to answer questions about the trend in population or habitat condition over a broad scale. It has the advantage of being relatively inexpensive to implement. However, its lack of precision makes it relatively insensitive to local conditions or management actions. On a programmatic scale (the NPPC Fish and Wildlife Program) we believe that HEP analysis (U.S. Fish and Wildlife Service 1980a) falls into this category. Particularly for projects that endeavor to mitigate a finite ledger of HUs associated with losses from a specific hydropower project, HEP adequately meets the monitoring needs, at a programmatic level, to ensure mitigation goals are being achieved. Consequently, HEP will remain an integral part of our overall monitoring strategy.

2) Tier II Statistical monitoring is able to answer questions about population trends, community diversity, and species relative abundance in the context of local habitat condition or management action. Although more costly to implement, this level of monitoring has sufficient sensitivity to provide feedback on management actions in an adaptive management context. Additionally, by collecting site-specific data according to standardized protocols these data may be used across multiple spatial and biological scales. Consequently, they may contribute data points to regional, national, or international monitoring efforts. Conversely, by collecting data that contributes and are comparable to a broader data set the manager can better interpret results (e.g. declines in amphibian populations as a local verses more general biological problem). Most of the methods outlined in the M&E plan fall into this level of monitoring. A purposeful effort was made to select methods that are widely employed in field biology or to adopt appropriate monitoring protocols from national monitoring programs to maximize the utility of the data collected. A significant limit of this level of monitoring intensity is that it is not sufficient to evaluate the causes of change in habitat or population trends.

3) Tier III Research monitoring is the most sensitive level of monitoring. At this level we are able to answer questions about causal relationships between specific habitat attributes and population demographic parameters. The data demands to achieve the statistical power to answer these types of questions make this the most expensive level of monitoring to employ on a per area basis. Basically this is research and beyond the management context of this M&E plan. However, if Tier II Statistical monitoring suggests a management problem that can not be adequately addressed by a review of the literature and through the managers experience, nothing in this M&E plan constrains a manager from developing a site-specific monitoring program at this intensity level to address specific problems.

Monitoring Goals and Objectives

Monitoring and evaluation consists of assessing changes in habitats, populations, or communities that test the effectiveness of mitigation measures. Adaptive management is the process of using scientific information to evaluate and improve management decisions. Conceptually, adaptive management is based on the need to maintain operational flexibility to respond to monitoring and research findings. Hence, adaptive management is the practical application that links monitoring

and management. The goal of any monitoring program is to provide information that verifies whether management objectives are being met. Therefore, monitoring goals are dependent on management goals. The Albeni Falls Wildlife Mitigation Project has two major management goals. The first goal is programmatic while the second goal is strategic. The primary project goals are:

1. To fully mitigate the wildlife habitat losses associated with the construction and operation of Albeni Falls Dam.

2. To protect, restore, enhance, and maintain wetland/riparian wildlife habitat within all of the Mountain Columbia Subbasins (except the Bitterroot, Flathead, and Blackfoot). Implicit in this goal is the maintenance or enhancement of wetland/riparian associated wildlife populations, maintenance or enhancement of wetland/riparian species diversity, and, to the extent possible, protection or restoration of native communities.

In support of these management goals the objectives of this monitoring and evaluation plan are to:

1. Track progress toward full mitigation of the 28,587 HUs identified in the Albeni Falls Dam loss assessment.

2. Evaluate the success or failure of mitigation management activities by:

    a. Monitoring secondary population parameters (relative abundance, distribution, and population trends) of selected target and non-target wildlife species, and their habitats as an indicator of management effectiveness.

    b. Monitoring trends in overall diversity of select wildlife communities.

    c. Comparing managed site data against reference site data and the literature to evaluate project movement toward meeting desired future conditions within each major cover type.

3. Adopt standardized monitoring methodologies that are compatible with monitoring at larger scales and the scientific literature. This will maximize the usefulness of the data collected within the NPPC Fish and Wildlife Program as well as at regional or national scales.

Program Sampling Design

Introduction

This wildlife-monitoring program is designed to provide managers with information on population and community trends through time that can be used in an adaptive management context. Monitoring is an ongoing obligation of management and should itself be viewed as an adaptive process. Currently the Albeni Falls Dam HU ledger is less than 20% mitigated. Consequently, most of the land base that will eventually be managed and monitored is not currently identified. Without good knowledge of the total land base, distribution, juxtaposition, block size, and condition (degree of restoration required) of mitigation properties it is difficult to design an efficient monitoring program that anticipates all future needs. Upon completing full mitigation of the Albeni Falls Dam HU ledger this monitoring program will be reviewed and revised. In the interim the managers of the Albeni Falls Interagency Work Group will be guided by this monitoring program's design and principals but retain the flexibility to modify it to meet individual needs and management challenges.

The long-term monitoring database for this project will be developed through both observational and quantitative monitoring. Observational monitoring includes the use of such things as photo plots and incidental wildlife observations that may suggest changes in plant or wildlife communities at a qualitative level. These data have the advantage of being relatively inexpensive to obtain but are limited because they depend on subjective interpretation. Quantitative monitoring depends on actual measurement of population or community attributes and these data are amenable to statistical analysis. The primary disadvantage of quantitative monitoring is that it is expensive and time consuming. However, quantitative monitoring can provide estimates of direction and magnitude of change before change is grossly evident, is less biased than observational monitoring, and is the most objective way to evaluate the success of our mitigation and management programs.

Monitoring and Evaluation Sampling Strategy

The focus of this project is wetland mitigation. Monitoring will focus on wetland/riparian habitats. For the purpose of this monitoring plan upland monitoring will be limited to observational techniques and documentation of weed control. However, nothing constrains a manager from doing more intensive monitoring of uplands as deemed appropriate. For example, a high disturbance upland prescription to selectively log and prescribe burn an upland site to improve white-tailed deer forage availability should include a site-specific monitoring plan.

Using the Universal Transverse Mercator coordinate system a permanent grid with spacing of 200 m or less will be established by each Work Group cooperator on each mitigation property they own and manage. By ownership, grid points will be sequentially numbered and represent potential monitoring sample points that can be randomly selected by use of a random numbers generator. The 200-m spacing is equal to the preferred sample point separation for land bird point-count stations (Huff et al. 2000), and yields one potential sample point for every 4 ha of habitat. Closer grid-point spacing decreases the probability that data from adjacent sample points are independent and increases the risk of double counting birds when using variable-radius point-count sampling techniques in particular. Three wetland cover types will be monitored: emergent herbaceous, shrub-scrub, and forested wetlands.

Drawing the sample of points to be monitored is complicated by the fact that we are still in the implementation phase and additional properties will be added on an annual basis for the next 10+

years. The sampling scheme must be cost effective, provide a data set that provides a long-term perspective on meeting management objectives, and is flexible enough to incorporate new properties as they are acquired. Consideration must also be given to the fact that cover types do not occur in equal proportions and that some habitats are intact while others require restoration. Taking these concerns into consideration we have devised the following sampling scheme:

Sampling will be done with a constant intensity of 10% of all potential sample points. As additional properties are purchased, additional permanent sample points will be identified to maintain a sampling intensity of 10% of all possible sample points. One-third of the selected sample points will be visited each year on a three-year rotating basis. The use of rotating panels of sample points will allow us to effectively increase the sample size while still meeting the objectives of long-term monitoring within time and cost constraints (McDonald et al. 1998). Permanent sample sites that are visited every three years are revisited at a sufficient frequency to capture long-term trends in population and community change.

A random sample of long-term monitoring sample points will be drawn from all possible sample points. Once identified as part of the sample to be monitored, these points will become part of a permanent subset of points to be used for long-term monitoring.

This random sampling design makes no *a priori* distinction between sample points that fall on intact wetlands where management is custodial and restoration sites where the management is active and community changes may be dramatic even in a short amount of time. At a programmatic and project scale this is appropriate to document the success or failure of conservation strategies from a long-term monitoring perspective. However, it may not provide managers with adequate feedback on the success of site-specific management prescriptions. Managers may choose to supplement this basic sampling scheme with additional sample points randomly selected from within a site-specific prescription area for Tier III Research monitoring. These supplemental sample points will not become part of the long-term permanent sample-point set. They may be revisited more or less frequently than every three years and/or dropped from monitoring altogether at any time at the manager's discretion.

Monitoring in an adaptive management context implies benchmarks or desired outcomes against which management success can be measured. The vegetative and wildlife community structure of intact wetland habitats can act as one benchmark for the effectiveness of restoration management. We will retrospectively (that is after the random sample has been drawn) identify a subset of the permanent sample points of intact wetlands from each cover type to serve as reference sites against which restoration management may be evaluated. Additional reference sites, both within and outside of the project boundaries, may need to be subjectively identified to secure a minimum of three reference sites for each cover type. Sample points selected as reference sites will initially be sampled for three consecutive years to establish a strong baseline data set. Based on initial results permanent baseline monitoring plots may also be established (to the extent possible) within formally designated ecological reference areas (e.g. USDA Forest Service Research Natural Areas) that are located in areas adjacent to mitigation properties but are functionally independent of mitigation properties and associated management. When available and applicable the scientific literature will provide an additional source of reference benchmarks for project evaluation.

Habitat Evaluation Procedures

Introduction

The Habitat Evaluation Procedure (HEP) was developed in 1980 by the U.S. Fish and Wildlife Service (USFWS 1980a, USFWS 1980b, USFWS 1981). HEP uses a species-habitat based approach to impact assessment, and is a convenient tool to document the predicted effects of proposed management actions. The Northwest Power Planning Council endorsed the use of HEP in its Columbia River Basin Fish and Wildlife Program to evaluate wildlife benefits and impacts associated with the development and operation of the federal Columbia River basin hydroelectric system. The Albeni Falls Interagency Work Group used HEP in 1987 to evaluate wildlife habitat losses attributed to the Albeni Falls hydroelectric facility (Martin et al. 1988).

The objective of using HEP is two-fold. First, it provides an objective and quantitative assessment of the wildlife habitat value of land purchased for mitigation. This will be used to offset the Albeni Falls Dam HU ledger. That ledger accounts for the loss of wildlife habitat that resulted from the Albeni Falls hydroelectric project and the extent to which those losses have been mitigated. On a programmatic scale (the NPPC Fish and Wildlife Program) HEP analysis provides one useful tracking metric for the entire mitigation program, especially for projects that endeavor to mitigate a finite ledger of HUs associated with losses from a specific hydropower project. Secondly, the baseline HEP evaluation describes existing ecological conditions (limiting factors) on the property and may be used to assist managers in developing future management activities. On a gross scale, future HEP analyses will be used as a check to quantitatively evaluate the effectiveness of management strategies in improving habitat conditions.

Methods

The HEP is based on the assumption that habitat for a selected species can be described by a Habitat Suitability Index (HSI). This value is derived by evaluating the ability of key habitat components (hiding cover, snag density) to supply the life requisites of selected wildlife species. Habitat quality, expressed as the index or HSI, measures how suitable the habitat is for a particular species when compared to optimum habitat. The HSI varies from 0.0 to1.0 (optimal). The value of an area to a given species of wildlife is the product of the size of that area and the quality (HSI) of the area for the species. This product is comparable to "habitat value" and is expressed as a habitat unit (HU). One HU is equal to a unit of area (e.g. one acre) that has optimal value (HSI=1.0) to the evaluation (target) species. Target species are used in HEP to quantify habitat suitability and determine changes in the number of HUs available. Consequently, a HEP assessment is only directly applicable to the target species selected. The degree to which predicted effects can be extrapolated to a larger segment of the wildlife community depends on careful species selection (USFWS 1980b). Target species selection in this analysis will follow that used in the Abeni Falls loss assessment (Martin et al. 1988).

HEP habitat data are collected along a 1000-foot transect within each cover type.
Sampling transects are lengthened or occasionally shortened to achieve a 90% confidence level for our parameter point estimates. Adequacy of habitat sampling is determined using the formula (Zar 1984):

$$\frac{z^2 \times s^2}{e^2}$$

Where:

z= the critical normal value (p=0.1) from any standard statistical reference

s= standard deviation

e= tolerable error level

Shrub presence, species, and height data are collected at 2-foot intervals along the sampling transect. Percent herbaceous cover and percent herbaceous cover composed of grass are measured using a 0.5 by 1.0 m sampling frame (Daubenmire 1959) at 50 foot intervals along the transect. Height of the herbaceous layer is measured at 5 points within the sampling frame. A Robel pole (Robel et al. 1970) is used to determine the height-density of the herbaceous layer. Visual obstruction ratings (VOR) are determined by four Robel pole measurements, two parallel and two perpendicular to the transect, taken at 50 foot intervals along the transect. Deer hiding cover is estimated by taking two visual obstruction readings (both parallel to the transect) on a 1.5 m Robel-type pole from a standing position 50 feet from the pole at 50-foot intervals along the sampling transect. Tree height is estimated using trigonometric hypsometry (Hays and Seitz 1981) by subjectively selecting two "typical" overstory trees at 100-foot intervals along the sample transect. Canopy closure is measured at 10-foot intervals using a GRS densitometer. Trees recorded as "hits" with the densitometer have their species and DBH recorded. Snag densities are calculated using 0.1 acre plots at 100-foot intervals along the sampling transect. Distances to water, size of water bodies, ratios of open water to emergent vegetation, and road densities, are derived from a combination of field estimation and evaluation of aerial photographs and topographic maps. GIS will be used to estimate these parameters when accurate data layers are available.

Data Analysis

Habitat cover types are outlined on aerial photographs and a planimeter or dot grid is used to estimate the total acreage of each cover type. GIS will be used to estimate total acreage of each cover type when accurate data layers are available. The habitat units for each target species in each cover type are calculated using the formula:

HU= (cover type area)(HSI value).

Published and modified HSI models are used in this analysis. Where published models are modified to better reflect local conditions, modifications meet U.S. Fish and Wildlife Service standards (USFWS 1981). Habitat units are tabulated across target species and cover types to get total HUs for each species and each cover type for the project.
The NPPC Fish and Wildlife Program requires that a baseline HEP analysis be completed within two years of acquisition of a mitigation property and every 5 years thereafter. This schedule will be followed as part of the ongoing M&E efforts on this project. Some acquisitions are intact wetlands where management is largely custodial and significant increases in HUs are not anticipated. Other acquisitions require extensive restoration and substantial gains in HUs are the expected outcome. Results of HEP analysis must be interpreted in this context. For the purposes of adaptive management we expect to maintain, within the limits of normal temporal variability, at least the baseline number of HUs on every property. A 20% drop in baseline HUs will trigger a management response.

Land Birds

Introduction

Birds are important components of biological diversity in most ecosystems. Monitoring the health and long-term stability of bird communities can provide an important measure of overall environmental health (Morrison 1986). Birds are good environmental monitors for several reasons: many species can be monitored simultaneously with a single method, methods for monitoring are well understood and standardized, birds occupy all habitat types, and as a community represent several trophic levels and habitat use guilds. Monitoring species abundance, community diversity, and trends provides information that can be used to determine the effectiveness of management actions in moving towards conservation goals.

Perhaps more than any other species or community proposed for monitoring, land birds present the opportunity for standardized data collection that can be incorporated into national monitoring programs. Dovetailing our monitoring efforts with national monitoring efforts can be important in interpreting the results of our monitoring efforts. Many species of birds are neo-tropical migrants whose populations are effected by factors remote from the data collection point. Standardized methods allow for recognition of declines in abundance or diversity as a local phenomenon (triggering a change in local management) or a broader scale phenomenon that does not necessarily implicate failed management at the local level.

Methods

Point counts will be used to monitor land birds on this project. Point counts are the most widely used quantitative method used for monitoring land birds and involve an observer recording birds from a single point for a standardized time period (Ralph et al. 1995). The methodology follows the recommendations of Ralph et al. (1995) and is consistent with the methodology employed by the U.S.D.A Forest Service Northern Region Land bird Monitoring Project (Hutto et al. 2001) and recommendations for the Idaho Partners in Flight Bird Monitoring Plan (Leukering et al 2000).

A ten-minute point count will be conducted at each of the randomly selected permanent sample points within a cover type. All points will be visited a minimum of two and preferably three times during the breeding season (mid-May to early July) with a minimum of 7 days between counts. Point counts should be started at 15 minutes after official sunrise and completed by 10:00 a.m. Weather conditions should be warm and calm enough for bird detection by sight or sound. All birds seen or heard within the 10-minute count period are recorded. During the count, data should be recorded in three time periods (0-3 minutes, 3-5 minutes, and 5-10 minutes). This will allow the data to be partitioned or pooled for comparison to the U.S. Fish and Wildlife breeding bird survey data, research data reported in the literature that commonly use 5-minute point counts, and 10-minute point count data recommended and collected by national bird monitoring programs. Field observers should be highly qualified to detect birds by sight and sound. Fixed-radius plots (where the radius is arbitrarily small) reduce the interspecific difference in delectability by assuming that: a) all the birds within the fixed radius are detectable; b) observers do not actively attract or repel birds; and c) birds do not move into or out of the fix-radius during the counting period. This allows for comparisons of abundance among species. Unlimited radius plots maximize the amount of data collected because they include all detections and are appropriate when the objective is to monitor population changes within a single population (Ralph et al. 1995). Birds should be tallied in two distance bands, one 0-50 meters from the point center and one >50 meters from the point center. This will maximize data collection while permitting

interspecific analysis. If density estimation is desired then additional distance data must be collected. However, density estimation is beyond the scope of this monitoring plan. Additional information on establishing point count stations, data collection, and sample data forms can be found by referencing Ralph et al. (1993, 1995) and Huff et al. (2000).

Data Analysis

Data will be pooled both within cover types, and across cover types within land management units. The mean number of detections per point (by species) within a cover type will used as an index to species abundance. Abundance across cover types within a land management unit will be expressed as the grand mean of the individual cover-type data pooled across the land management unit and weighted by the proportionate areal extent of each cover type. Trend analysis on abundance data will be done by regressing abundance on time and testing the null hypothesis that the slope of the regression is equal to 0 (Zar 1984). Regression analysis will not be conducted with less than 6 data points. The Shannon-Weaver information function (H') will be used to measure land bird community diversity, and Pielou's equitability index (J') will be used to measure the evenness of species distribution with in the community (Hair 1980). Diversity indices will be compared using a t-test following methodology described by Hutcheson (1970) and Zar (1984). A species list will also be developed as a measure of diversity. The species list will be developed and supplemented with incidental sightings from throughout the year.

WATERFOWL

INTRODUCTION

Waterfowl are comprised of a diverse group of birds with widely different habitat needs for survival and recruitment. Some goose populations have expanded in the face of extensive national wetland losses. Conversely many duck species, which are less terrestrial and more dependent on wetland quality and availability, have experienced substantial population declines. The Canada goose, mallard, and redhead duck are BPA target species that were used in the HEP analysis habitat loss assessment. Waterfowl breeding-pair and brood surveys are conducted to provide trend data for local breeding populations. Our survey protocols are modeled after waterfowl production survey methods developed and used by the U.S. Fish and Wildlife Service (Hammond 1970, Dan Pennington, Kootenai National Wildlife Refuge, pers. comm.).

Methods

All open water areas and associated uplands within and adjacent to mitigation acquisitions will be surveyed annually. Four different types of waterfowl production surveys will be conducted: goose breeding pair counts, goose brood counts, duck breeding pair counts, and duck brood counts. Because of differences in nesting phenology between geese and ducks some different surveys may be conducted concurrently on the same visit to a site (e.g. goose brood counts concurrent with duck pair counts). Surveys will be conducted as a combination of observation point counts, walk/wade surveys, and boat and motor runs as appropriate for the landscape.

Observation point counts are used where there is good visibility, especially from elevated positions, to observe open water areas. When using observation points, disturbance must be kept to a minimum. Observation points are best conducted with the aid of a spotting scope. After data are gathered via observation points a walk/wade survey may need to be conducted to observe additional open water areas that are not visible from observation points.

Walk/wade surveys are best applied to wetlands with shorelines having little emergent vegetation and can be walked efficiently. Small wetlands should be approached carefully and quietly because the broods of some species (especially mallards and pintails) may move overland to avoid detection by the observer. When properly conducted a high proportion of all broods may be seen with this method.

Boat and motor runs are most efficient on open shorelines. Two observers will see more birds than one observer will. However, a single observer is generally a more efficient use of manpower. Consequently, a single observer will always be used to minimize variability in the trend data. Boat speed should be moderate (5-10 mph) and consistent throughout the survey, stopping only to count broods or identify species.

SURVEY TIMING AND FREQUENCY

Counts should be completed within the three-hour periods beginning either 15 minutes after sunrise or ending 15 minutes before sunset. Wade/walk surveys may be conducted throughout the day. All surveys will be conducted as close as practicable to the identified target dates for data consistency. Surveys should be conducted when temperatures are moderate and wind speeds are

less than 10 mph. Excessive wind moves birds into protected areas. If practical, rain should be avoided.

Goose breeding pair surveys are conducted twice, once each on or near April 15th and May 2nd. Goose brood counts are conducted twice, once each on or near May 16th and June 6th. Goose brood surveys will be done in conjunction with second duck breeding-pair survey and the first duck brood survey.

Duck breeding-pair surveys will be conducted twice, once on or near May 2 for early nesters, and once on or near May 16 for late nesters. Although some protocols call for only two duck brood sampling periods. Three sampling periods provide a more adequate index than two sampling periods. Three duck brood surveys will be conducted on or near June 6, June 28, and July 26.

For waterfowl pair-counts the species and number of pairs should be recorded. For ducks both paired ducks and lone males representing indicated pairs should be tabulated for all species. During brood counts the observer should record species, number in brood, and the age class of the brood. Data will be summarized by species and land management unit and reported annually. Long-term local trends will be monitored against the national waterfowl surveys.

Bald Eagle

Introduction

Bald eagles are a target species of the Albeni Falls Wildlife Mitigation Project. Because of their status as a threatened species bald eagle nest monitoring is conducted under the guidance of the U.S. Fish and Wildlife Service (USFWS). Each member agency of the Albeni Falls Interagency Work Group participates in the annual (USFWS) bald eagle nesting survey. All member agencies will continue their cooperation with this long-term national monitoring effort without changes in current protocol.

Methods

Known nest sites are visited by ground, boat, or air at least once during the pre/egg-laying (3/1-3/15), incubation (3/15-5/1), nesting (5/1-6/20), and fledgling (6/20-7/20) periods and information on eagle activity and nest success is reported to the USFWS. Newly discovered nesting sites are reported as they are found and added to the annual nest survey. Eagle nesting data will be incorporated into periodic monitoring and evaluation reports. Should the bald eagle be delisted and the USFWS discontinue their eagle-nest monitoring program, we will continues to collect these data as part of the ongoing M&E effort of this project.

Small Mammals

Introduction

The small mammal community is an important component of biological diversity in most ecosystems. Small mammals act as seed dispersal agents, their burrowing disturbs soil and creates microsites for seedling development, and they provide a prey base for higher trophic level consumers. Monitoring species abundance, community diversity, and trends provides information that can be used to determine the effectiveness of management actions in moving towards conservation goals.

Methods

Small mammal populations will be sampled by snap trapping with museum special traps at the randomly selected sample points. Traps will be baited with a mixture of peanut butter and rolled oats. An array of traps will be laid out as follows. A 100-meter baseline transect centered at the sample point and running along a random compass bearing and its back azimuth will be established. From the baseline transect, five 50-meter long trap-lines that are centered on and run perpendicular to the baseline transect at 25-meter intervals will be established. Pairs of museum special snap traps will be placed at 12.5-meter intervals along the trap-lines. Trapping will be conducted for two consecutive nights yielding a total of 100 trap nights per sample point. Sample point, cover type, date of capture, and species will be recorded for each small mammal captured. Small mammals killed in snap traps will be disposed of off site.

Snap trapping will be the backbone of our small mammal sampling effort. However, snap traps are known to underestimate the relative abundance of shrews in the small mammal community (Mangak and Guynn 1987, McComb et al. 1991). Managers, at their discretion, may augment their snap trapping efforts with pit trap arrays. Trap night data from pit traps will be recorded separately from the snap trap data.

Data Analysis

Data be will be pooled both within cover types, and across cover types within land management units. An index of the abundance of each species within a cover type will be expressed as number caught/100 trap nights. Indices of abundance across cover types within a land management unit will be expressed as the mean of the individual cover type data pooled across the land management unit and weighted by the proportionate areal extent of each cover type. Trend analysis on abundance data will be done by regressing abundance on time and testing the null hypothesis that the slope of the regression is equal to 0 (Zar 1984). Regression analysis will not be performed with less than 6 data points. The Shannon-Weaver information function (H') will be used to measure small mammal community diversity, and Pielou's equitability index (J') will be used to measure the evenness of species distribution with in the community (Hair 1980). Diversity indices will be compared using a t-test (P=0.1) following methodology described by Hutcheson (1970) and Zar (1984). A species list of all mammals will be developed and supplemented with observations throughout each year.

Herptofauna

Introduction

Amphibians are important components of ecosystem biodiversity that are frequently overlooked by fish and wildlife habitat managers. There is growing worldwide concern about perceived and actual declines in populations of amphibians. Permeable skin and a life cycle that involves both aquatic and terrestrial habitats makes amphibians especially susceptible to altered conditions they may encounter in their habitat. They can serve as indicators of environmental health. Local management activities may disproportionately effect amphibians (and reptiles) because of their relatively sedentary lives in contrast to species with greater mobility such as larger mammals and birds.

Many wildlife mitigation properties, especially those not yet acquired, have never been intensively surveyed for herptofauna. We have designed this monitoring program to provide managers with information about what species presently occur on individual projects (the inventory phase) and to provide them with information about the effectiveness of their habitat management practices (monitoring phase) toward benefiting the species assemblages that occur there.

Methods

Amphibian activity and reproductive biology are closely tied to local weather patterns. Consequently, weather data is a necessary component of amphibian monitoring. Basic weather data should include daily min-max temperature and precipitation. Other information about microhabitats could include water temperature and other factors known to influence distribution and abundance of amphibians including relative humidity, substrate moisture, barometric pressure, wind speed and direction, water level at breeding sites, and water pH.

Heyer et al. (1994) suggest the use of several standard sampling techniques to monitor amphibians. Managers should not be constrained by these suggestions and further development of these and other techniques is encouraged.

Visual Encounter Survey (VES)

1. A trained observer walks through a defined area for a prescribed period of time searching for and recording the presence of animals.
2. Time searching is expressed in man-hours.
3. This technique yields species richness and species lists and count data can be used to estimate relative abundance.
4. Repeated VES surveys combined with marking-recapture techniques can be used to estimate animal density.

Audio Strip Transects (AST)

1. A trained observer moves along a strip transect and records all animals heard.
2. Transect width is approximately 2 times the maximum distance the target animals can be heard.
3. Linear habitats (shorelines) can be sampled by counting calling individuals with no need to determine detection distance.

4. Calling-male density is calculated as the number of calling males per linear unit of transect.

Surveys at known breeding sites can be done using VES and AST techniques. Breeding site surveys can be used to estimate effective population size and operational sex ratio but must be done over an extended period (several nights) because of nightly variation in breeding populations. Managers must keep in mind that calling (by frogs) does not necessarily indicate breeding. More explicit indicators such as amplexus, egg masses or larvae are needed to demonstrate breeding. Managers may, at their option, decide to augment VES and AST methodologies with larval traps and dip net transects to determine abundance and reproductive status.

Data Analysis

Data be will be pooled both within cover types, and across cover types within land management units. An index of the abundance of each species within a cover type will be expressed as number/man-hour effort. Indices of abundance across cover types within a land management unit will be expressed as the mean of the individual cover type data pooled across the land management unit and weighted by the proportionate areal extent of each cover type. Trend analysis on abundance data will be done by regressing abundance on time and testing the null hypothesis that the slope of the regression is equal to 0 (Zar 1984). Regression analysis will not be performed with less than 6 data points. The Shannon-Weaver information function (H') will be used to measure herptofauna community diversity, and Pielou's equitability index (J') will be used to measure the evenness of species distribution with in the community (Hair 1980). Diversity indices will be compared using a t-test (P=0.1) following methodology described by Hutcheson (1970) and Zar (1984). A species list to include all reptiles and amphibians will be developed and supplemented with incidental observations from throughout the year.

Vegetation

Introduction

Vegetation provides habitat for most fish and wildlife species. The primary issues regarding the conservation and restoration of vegetation and wildlife habitats are plant community composition, structure, and ecosystem function. Three broad vegetation cover types are targeted for monitoring within the Albeni Falls Wildlife Mitigation Project: emergent herbaceous wetland, shrub-scrub wetland, and forested wetland. Through a number of studies the targeted vegetation has been classified on the basis of composition and structure into plant associations and community types. Plant associations and community types provide groupings of similarity in composition and structure. Several different plant associations or community types may be present within each of these broad cover types. Methods appropriate for monitoring plant community composition, structure, and ecosystem function within these three broad cover types are both constant and variable.

Methods

Emergent Herbaceous and Shrub-Scrub Wetland

1. In initiation of the monitoring protocol plant associations (e.g., using classifications provided by Jankovsky-Jones 1997) present within each 4 ha stratified random sampling unit will be delineation to a detailed resolution of 25 m^2.

2. Coarse-scale composition and structure will be monitored by measuring the boundary between each plant association or community type along six 200 m transects; three each placed at 50 m intervals perpendicular to the opposing sides of the square 4 ha sampling unit. The boundary of changes in shrub height class will be measured along each of these six transects.

3. A comprehensive inventory of vascular (and to the extent possible, non-vascular) plant species present within each 4 ha sampling unit will be completed each monitoring cycle.

4. The abundance of species present within each 4 ha sampling unit will be sub-sampled on twenty 0.01 ha square (i.e., 10x10 m) plots located randomly within a 10 m grid and stratified to proportionally represent the plant associations or community types present. Ocular estimates of absolute percent cover will be recorded for each vascular (and to the extent possible, non-vascular) plant species present on the 0.01 ha plot.

Forested Wetland

1. In initiation of the monitoring protocol, plant associations (e.g., using the classification provided by Cooper et al. 1991) present within each 4 ha stratified random sampling unit will be delineation to a detailed resolution of 25 m^2. Plant associations will be identified to the smallest possible classification unit (e.g., the *phase*, in reference to Cooper et al. 1991).

2. Coarse-scale composition will be monitored by measuring the boundary between each plant association or community type along six 200 m transects; three each placed at 50 m intervals perpendicular to the opposing sides of the square 4 ha sampling unit. The boundary of changes in shrub height class and stand structural class (using classes identified by Hall et al. 1995) will be measured along each of these six transects.

3. A comprehensive inventory of vascular (and to the extent possible, non-vascular) plant species present within each 4 ha sampling unit will be completed each monitoring cycle.

4. Stand structure and the abundance of species present within each 4 ha sampling unit will be sub-sampled on 10 nested circular plots (a 0.04 ha plot nested within a 0.1 ha plot; using the method similar to Rust 1998). Plot center points will be located randomly within a 40-m grid and stratified to proportionally represent the forest structural classes present. Ocular estimates of absolute percent cover will be recorded for each vascular (and to the extent possible, non-vascular) plant species present on the 0.01 ha plot.

Noxious Weeds

Introduction

Noxious weeds are aggressive plants that are not native to an area. They frequently create a large monoculture of themselves. Noxious weeds degrade wildlife habitat; can choke streams and waterways; crowd out native beneficial plants; create fire hazards; poison humans, wildlife, or livestock; and foul recreational sites for use. The spread of noxious weeds can signal the decline of entire ecological watersheds (Morishita and Lass 1999). Noxious weed law requires landowners to control noxious weeds on their land. Control of noxious weeds is consistent with the management objective of the Albeni Falls Wildlife Mitigation Project to restore and maintain native wetland habitats. Noxious weed control will be a costly and annual management action on this project.

Methods

Effectiveness of noxious weed management will be tracked by providing estimates of total area of noxious weed invasion and percent cover of noxious weeds by species. Ocular estimation will be used to determine cover by species in five cover class categories: 0-20%, 21-40%, 41-60%, 61-80%, and 81-100%. A 1.0 by 0.5 meter sampling frame may be used to aid in cover estimation. GPS mapping will be used to calculate the area of large (>1 hectare) areas of weed invasion. Alternatively, if these areas are sprayed and the spray equipment has the ability to calculate total area treated this will be an acceptable area estimate. Smaller ($\leq$ 1 hectare) areas of weed invasion may be mapped with GPS or by ocular estimation.

Photo Points

Although qualitative, photographic documentation of habitat change as it occurs over time can provide an intuitive and compelling record of that change. This record can be especially effective for relating a project's effect to administrators or the public who more easily identify with a picture than a theoretical mathematical function of community diversity. Consequently, a photographic record will be established for each long-term monitoring sample point. One or more photographs will be taken in the direction of each of the four cardinal compass directions at each permanent sample point during its triennial monitoring visit. Photographs will be cataloged and archived for future reference. A digital camera will be used for documenting photo points to simplify archiving and reproduction for reports and presentations.

Reporting

Habitat Evaluation Procedures

The NPPC fish and wildlife program requires that HEP analysis be conducted on each acquisition at 5-year intervals. This has been the backbone of the NPPC monitoring and evaluation program to date. No change in reporting procedures for HEP analysis obligations is proposed. Each work group member will submit HEP reports for properties under their ownership/management at the required time interval under a separate cover as a stand-alone document.

Expanded Monitoring and Evaluation

Permanent long-term monitoring sample sites are visited on a three-year rotating basis. A monitoring and evaluation report that describes the current year's monitoring activities and summarizes finding will be submitted annually. A complete analysis of these data including trend analysis, diversity indices, and comparisons to reference sites will be performed on a triennial basis to coincide with the 3-year rotating sampling scheme.

Each cooperating Agency/Tribe will be responsible for conducting the monitoring and evaluation program on their respective ownership. We have intentionally designed some flexibility into the program to make it adaptable to the needs and constraints of the local manager. Consequently, it will be important for the core data sets coming from each agency/tribe to be in a compatible format so that these data can be easily and appropriately combined for overall project evaluation and reporting. A common pool of data entry templates will be developed for the core data sets and used by all cooperators to facilitate combining data sets.

Supplemental Reporting

Where appropriate, Work Group members are encouraged to augment this monitoring and evaluation plan to address site specific problems or management actions. Supplemental reports will be written as stand-alone documents and attached to the annual report as an appendix.

Costs

Currently, moderate to high levels of monitoring intensity will require between $250 and $500/plot collecting data. These costs will be reduced over time as efficiency increases and base levels of staffing and equipment benefits are realized by increasing the number of sample points.

The level of monitoring and evaluation effort requested by the ISRP and described by the above plan significantly expands sponsor M&E obligations beyond the original Fish and Wildlife Program requirements. Consequently, the original budgets for M&E in the currently approved management plans are inadequate to meet these new requirements. Several of the proposed monitoring methods require specialized skills (such as auditory recognition of birds) and may be best performed by subcontractors who possess these special skills. Supplemental funding will be required if we are to implement this new obligation. Costs for the expanded M&E program will be addressed during the annual contacting process.

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APPENDIX C

MONITORING VERTEBRATE POPULATIONS AND THEIR HABITAT:

KALISPEL TRIBE HABITAT RESTORATION PROJECT

DRAFT REPORT

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MONITORING VERTEBRATE POPULATIONS AND THEIR HABITAT

PROJECT BACKGROUND

The restoration of degraded habitats to support native wildlife is an increasingly important component of natural resource management. The restoration process might incorporate habitat changes to promote natural hydrological processes, removal of non-native plant and animal species, and propagation of native plants. A critical element of restoration projects is the design and implementation of programs to monitor habitat changes and wildlife response to those changes. Funding for long-term monitoring is often limited; therefore monitoring programs must be efficient and focus on the primary management objectives of each project.

The Kalispel Tribe has begun a restoration project of riparian habitats along the Pend Oreille River of northeastern Washington. Natural vegetation communities of the area include cottonwood stands, wetland shrubs such as red osier dogwood, and grass and sedge meadows. Farming and grazing have altered much of the area. In addition, the introduction of non-native wildlife species, such as the bullfrog, has had potential impacts on native species. The Tribe has recently acquired additional lands that are targeted for restoration and plans to develop long-term monitoring programs. This project was designed to 1) conduct initial vegetation and wildlife surveys to provide baseline information and 2) to use the baseline information to design a long-term, efficient monitoring program for the restoration project.

STUDY DESIGN

Study Area. – The project was conducted adjacent to the Pend Oreille River near Usk, Washington. The first area "Flying Goose Ranch" is located on the east side of the river (T59N; R44E) and encompasses mature cottonwood stands, native wetland shrub stands, and cattail and bulrush wetlands. Also on the east side of the river is a 7-yr old restored grass and sedge meadow (T58N;R44E) that is known as the "Wetland Reference". These areas served as the reference areas for comparisons. The 2 newly acquired areas, "Trimble Creek" (T58N; R43E) and "Tacoma Creek" (T59N; R43E), are both located on the west side of the river. These areas are targeted for habitat restoration. Based on topography and hydrology, specific areas within these restoration sites have been designated for cottonwood, riparian shrub, wetland, or aspen restoration. These are referred to as "restoration habitat" sites in general and as "restoration cottonwood" (or other type) more specifically. Two aspen stands on the Tacoma site served as reference aspen habitat.

Sampling Layout. –Grids of 120 m spacing were established in each of the 2 restoration areas and entered into a GIS database. These grids served as the reference points for all vegetation and wildlife sampling.

The reference sites were not entirely gridded with permanent stakes, but specific UTM coordinates will be established on each site for sampling purposes. For the Flying Goose site, permanent grid points were established on the dike on the west side of the site in the cottonwood riparian forest. Sampling points were established at 120 m intervals along the dike. On the Wetland Reference site, sampling points were established at 120 m intervals along a transect that paralleled the Pend Oreille River.

METHODS

Vegetation Sampling. – The goals of the vegetation sampling were 1) to provide baseline information on the current vegetation conditions on the restoration sites, 2) to provide comparative information on the vegetation on the reference sites, and 3) to allow monitoring of vegetation changes on the restoration sites.

Field Protocol: Vegetation was sampled within 16x16 m sampling plots during June, July, and August, 2001. On the restoration sites, sampling plots were located in each of the targeted habitats. Locations were referenced to the nearest permanent grid point. On the reference sites, sampling plots were located on the predetermined coordinates (Table 1).

Ground vegetation and substrate was measured within 20 x 50 cm metal plot frames placed at the center of each plot and on alternating sides of the transect at 4, 8, 12, 16 m for a total of 9 for each plot. Plot frames were placed with the long (50 cm) side of the plot frame perpendicular to the measuring tape. Species of herbaceous vegetation were recorded and assigned to 1 of 6 cover categories (1 - < 5%; 2 – 6 to 25 %; 3 – 26 to 50%; 4 – 51 to 75%; 5 – 76 to 95 %; 6 - > 95% (Daubenmire 1959). The percent cover of bare ground, litter, or rock was measured in the same way. The height (to nearest cm) of the tallest vegetation was measured at three points along the midline of the plot frame. In tall marsh vegetation, the plot frame used was a 3-sided (open on 1 of the 50-cm sides) to be able to slide the plot into the vegetation rather than placing over the vegetation. Instead of cover class, the number of stems of cattails and bulrushes were recorded. Height of vegetation was measured as above.

Shrubs were measured along 2-m wide belt transects radiating from the center of the plot. The species of each shrub was recorded, being careful not to double count shrubs near the center of the plot. To determine the size of each shrub the following measurements were taken: 1) as each shrub was encountered along the transect, the start point (to nearest cm) and end point (to nearest cm) along the transect was recorded (this gave the length of the shrub), 2) the width of the shrub was measured perpendicular to the transect, and 3) the height of the shrub was assigned to 1 of 4 categories (1 – below knee; 2- knee to waist; 3 – waist to shoulder; 4 – above shoulder).

Within each 16x16 m plot the number of trees in each plot was recorded by species and diameter at breast height (dbh) size class. The size classes were: 1) 4-10 cm; 2) 11-25 cm; 3) 26-50 cm; 4) 51-75 cm; 5) 76-100 cm; 6) > 100 cm. The number of standing dead trees (i.e., snags) was recorded by species, size class, and stage of decay. The three classes were (1) recently dead, little decay, retention of bark, branches, and top, (2) evidence of decay, loss of some bark and branches and possibly part of the top, and (3) extensive decay, missing bark and most branches, and broken top. This classification scheme is easier to apply consistently in the field than other schemes that include as many as nine classes (e.g., Thomas et al. 1979).

Data Analysis:

To calculate ground cover for each plant species or substrate category, the percentage corresponding to the mid-point for the 6 cover categories was assigned. For example, if the cover class was 1 (>0 to 5 %) the mid-point was assigned as 2.5%. Percentages for each plant species, plant category (i.e., grass, herb), and each substrate category were summed for each sampling. Mean cover percentages between the 4 study sites were compared using ANOVA with Tukey's mean separation procedure. To compare the means between pairs of habitat types (i.e., reference cottonwood to target cottonwood), t-tests were used.

Ground cover vegetation heights were averaged for each sampling plot. Mean vegetation heights between the 4 study sites were compared using ANOVA with Tukey's mean separation procedure. To compare the mean heights between pairs of habitat types (i.e., reference cottonwood to target cottonwood), t-tests were used.

To examine the shrub data, the lengths and widths of each individual shrub were multiplied to yield an area (in cm^2) for each shrub. Shrub areas were then summed for each sampling plot for each of the four height categories. To compare species differences between the 4 study sites and between the pairs of habitat types, shrub areas across all 4 height categories were summed. To compare differences in shrub heights between the 4 study sites and between the pairs of habitat types, total area for all species was calculated for each of the 4 height categories. Data were log transformed before statistical analyses. ANOVA with Tukey's mean separation procedure were used to compare mean shrub coverage between the 4 study sites for each shrub species and also for each height category. T-tests were used to compare mean shrub coverage between each of the pairs of habitat types for each shrub species and also for each height category.

The number of trees in each size class was summed for each tree species. Data are compared qualitatively for each study site and habitat type.

Small Mammal Sampling. – The permanent grid plots on restoration sites and predetermined coordinate points served as reference points for the small mammal sampling.

Field and Specimen Preparation Protocol:

Populations of small mammals were sampled by snap-trapping. Although snap traps do not effectively capture all small mammals species, they can be moved about easily to take advantage of a stratified random sampling design. Snap traps are effective for most of the terrestrial, above-ground rodent species in the region.

Pairs of traps were placed at 12-m intervals along 96-m transects with the grid station at the center point if there were 1, 3, or 5 transects per grid point. If there were 2 transects per grid point, the center point for each transect was 6 meters on either side of the grid point (unless grid point was on edge of target habitat type). Transects were 9 stations in length (center point + 4 stations on either side), but might have curved or otherwise been configured to fit into target habitat type. Trapping effort was standardized by trap night and total area of target habitat (Table 1).

Traps were baited with a mixture of oats and peanut butter. They were set in the evening and checked the following morning. They were set for 3 nights per site. Trapping was conducted during July, August, and early September, 2001.

Upon capture, specimens were weighed (to nearest 0.1 gram), examined for sex, and measured (total body length, tail length, hind foot length, and ear length). Specimens were frozen and later autopsied to examine reproductive condition. For females, the length and width of ovaries, the number of placental scars (indicative of past pregnancies), the number and length of any embryos were measured. The testes length and width and length of the seminal vesicles were measured for males. Skulls were labeled and cleaned for positive species identification and some specimens were prepared as study skins.

Data Analysis:

Mammal species richness was calculated by summing the number of species captured at each trapping grid. Mean species richness was then calculated for each study site and for each habitat type. Mean species richness between study sites was compared using ANOVA with Tukey's mean separation procedure. Mean species richness between paired habitat types was compared using a t-test.

Mammal abundance was calculated by dividing the number of small mammals of each species captured at a single trapping grid by the total number of trap nights at that particular trapping grid. Mammal abundance was then expressed as the number of captures per 100 trap nights. Mean mammal abundance was calculated for each study site and also for each habitat type. Mean abundance between study sites was compared using ANOVA with Tukey's mean separation procedure. Mean abundance between paired habitat types was compared using a t-test.

The mean body mass of adult males was calculated for each species with sufficient ($\geq$ 15 captures) for each study site and for each habitat type and was compared using an ANOVA with Tukey's mean separation procedure (study site comparisons) or a t-test (paired habitat type comparisons). Sex ratios were calculated for each species by study site and also by habitat types. Chi-square analysis was used to compare these sex ratios. The proportion of reproductive and nonreproductive individuals was calculated for each species at both the study site and habitat level. Females were defined as nonreproductive if they had no placental scars, no embryos, and not enlarged ovaries (size definitions vary between species). Females with placental scars, but no embryos were defined as post reproductive and females with enlarged ovaries or embryos were defined as currently reproductive. Males were defined as reproductive if they had enlarged testes and seminal vesicles and nonreproductive if not.

Bird Sampling. – Songbird populations were sampled by the point-count method.

Field Protocol:

On the restoration sites (Tacoma and Trimble), the grid plots served as reference points to establish the point-count stations. One point-count station was place at the center of a grid plot to reduce potential of double counting birds. Points were established in a representative sample of target habitats for restoration (i.e., aspen, shrub, wetland, cottonwood) (Table 1). Point-count stations had previously been established at the Flying Goose reference site along a transect that paralleled the Pend Oreille River. No avian sampling was conducted at the Wetland Reference site.

The focal survey area consisted of a 50-m (25-m radius) circle around each birding station. This design resulted in the circles from consecutive birding stations being separated by >70 m. Thus the entire length of a birding transect is surveyed without double counting in any areas. Birds observed outside the 50-m circle or between point-count stations were recorded for presence/absence data.

> Bird surveys were conducted during May and June 2001 using a circular point count design. Each survey began at approximately 0500 hours. A single observer walked each transect and conducted an 8-min survey at all birding stations. For sites that were accessible from both ends of the birding transect, the starting point was alternated between the low and high numbered end. This pattern increases the probability of observing both early and late morning singers on the entire transect. All sites were visited 3 times during the breeding season. In order to maximize the probability of recording all bird species present on a site regardless of variable arrival and breeding times, surveys were scheduled so that each site was visited at regular intervals throughout the breeding season. Sufficient numbers and variety of birds have arrived in northeastern Washington and begun singing by the second week in May. A period of extensive singing occurs during the mate selection period, but bird song begins to decline

once nest building and egglaying start. In northeastern Washington an observable song decline begins around the second week in June. In a normal year only a 4-week window of ideal bird survey conditions exists. Every attempt was made to complete all bird surveys during this period.

Weather conditions can have a great influence on the effectiveness of a survey. Since most birds are observed by sound, wind or rain can mask songs or call notes enough that they are not discernible to the observer. High wind and heavy rain can also force high canopy foragers to take shelter or generally decrease the morning activity of most birds. Surveys were not conducted, or were discontinued, if these weather conditions existed.

Data Analysis:

Avian species richness was calculated by summing the number of species observed at each point-count station. Mean species richness was then calculated for each study site and for each habitat type. Mean species richness between study sites was compared using ANOVA with Tukey's mean separation procedure. Mean species richness between paired habitat types was compared using a t-test.

Avian abundance was calculated by dividing the number of birds of each species observed within 50-m circle of a single point-count station by the total number of point-count samples conducted at each station. Avian abundance was then expressed as the number of observations per point-count sample. Mean avian abundance was calculated for each study site and also for each habitat type. Mean abundance between study sites and between habitats was compared using ANOVA with Tukey's mean separation procedure.

Amphibian Sampling. – A target amphibian species for the restoration project is the northern leopard frog that is on the Washington State Endangered Species List. Populations of this species are very low and restoring habitat suitable for the northern leopard frog is one management goal of the Kalispel Tribe biologists. Conversely, another management goal of the biologists is to decrease populations of the non-native bullfrog. Therefore amphibian sampling procedures were designed to be appropriate for frogs. Heyer et at. (1994) suggest that visual encounter surveys and larval trapping are sampling methods well-suited for frogs.

Larval traps were constructed from 2-liter soda bottles. Tops with the funnel-shaped portion of the bottle were cut off one bottle and inverted and stapled into a second bottle that had its bottom portion removed. Two traps were attached to 1.75 m (5 ft) fiberglass electric fence posts by two plastic clothespins pop riveted onto the bottles. Transects of traps were established in marshes and bends of streams. A pair of posts with 2 traps each was tied to rebar stakes. Three pairs were placed at each location for a total of 12 traps. Traps were set for 5 days at each site during June and July 2001. Any salamander or frog larvae will be identified (using keys in Nussbaum et al. 1983), measured for snout-vent length, and examined for larval stage.

Visual encounter surveys (VES) involve field personnel searching a prescribed area for a specified length of time for amphibians. VES transects were conducted for 20 minutes per sample along the edges of the marshes and slow bends in streams during early September, 2001. Two people searched each transect in the evening with a headlamp. Two observers helped in spotting frogs and ensured that frogs were not double counted. All frogs observed were identified to species and habitat and distance from shore were recorded.

RESULTS

Vegetation. – The composition, mean percent ground cover by species, species category, and substrate types, and the vegetation height are compared between the 4 study sites in Table 2 and between the 4 habitat types in Table 3. The mean total shrub area at each height class and the mean area of each shrub species are compared between the 4 sites in Table 4 and 4 habitat types is Table 5. The mean number of each tree species by size class is presented in Table 6.

The majority of the 6 grass species identified were introduced species from Eurasia, whereas the majority of the sedges, rushes, and other herbaceous plants were native to North America (Table 2). A total of 31 species of non-graminoid herbaceous plants were identified (Table 2); another 12 were distinguished, but not identified because of lack of flower or seed parts. These species were incorporated into the total herbaceous plant cover measure (Tables 2 and 3). Eight shrub species and small trees of 2 different species were encountered on the shrub transects (Table 4). One conifer species and 6 species of deciduous trees were counted in the plots (Table 5).

The 4 study sites differed with respect to both the composition and structure of the vegetation. Reflecting its history of cattle grazing, Trimble had the greatest percentage of grass cover but lowest vegetation height (Table 2). Although several species of shrubs were present at Trimble, they were small in area and most were limited to the lower height classes (Table 4). No trees or snags were encountered in any of the plots, although several pine and hawthorn trees are present. The other restoration site, Tacoma, was a more diverse site than Trimble, encompassing aspen stands, open grasslands, seasonally flooded wetlands, and hawthorn thickets. This diversity of habitat types was reflected in the greater number of different species of ground cover plants found on this site as compared to the others (Table 2). With respect to percent ground cover of herbaceous plants, amount of shrubs, and number of trees, the Tacoma restoration site was more similar to one cottonwood reference site, the Flying Goose, than to the other restoration site (Tables 2, 4, and 6). The Flying Goose site was characterized by the greatest amount of litter, the greatest height of ground cover vegetation, greater area of taller shrubs, and the most trees (Tables 2, 4, and 6). The composition and structure of the Wetland Reference site reflects the annual flooding of this site. The total coverage of sedges and rushes was greatest on this site as was the amount of exposed bareground (Table 2). There were no shrubs or trees on any of the plots at this site (Tables 4 and 6).

There were also distinct differences between the composition and structure of the vegetation between the paired reference and target restorations habitats. The aspen reference habitat had less grass coverage, lower herbaceous vegetation height, more shrub coverage and more trees than the aspen restoration habitat (Tables 3, 5, and 6). Although the total grass and herb percent coverage was similar between the cottonwood reference and the cottonwood restoration habitats, the percent cover of individual species differed between the two habitats (Table 3). The herbaceous vegetation height, shrub coverage, and number of trees was greater on the cottonwood reference than restoration habitat (Tables 3, 5, and 6). There was only 1 plot in the reference shrub habitat, but this plot was characterized by less grass coverage, less litter, higher vegetation height, and more shrub coverage than plots in the shrub restoration habitat (Tables 3 and 4). The reference wetland habitat had a higher percent cover of sedges and rushes and lower percent cover of herbs than the wetland restoration habitat (Tables 3).

Small Mammals. – There was a total of 1,160 captures of 2 species of shrews and 6 species of rodents (Tables 7 and 8). Captures of 1 shrew species (masked shrew – *Sorex cinereus*) and 3 rodent species (yellow-pine chipmunk – *Tamias amoenus*; northern pocket gopher – *Thomomys talpoides*; western jumping mouse – *Zapus princeps*) were too few to be included in the individual species analyses of abundance but were incorporated into the measures of total small mammal abundance and of species richness.

Comparison of mean mammal species richness between sites revealed that the Flying Goose had significantly more species than any of the other sites. Paired habitat comparisons between the cottonwood, aspen, and wetland reference and restoration habitats revealed greater species richness on the cottonwood reference as compared to the cottonwood restoration habitats. Species richness was similar between the aspen and wetland reference and restoration habitats (Table 9).

The mean abundance of all small mammals was greater on the Wetland Reference site than the other 3 sites and was greater on the wetland reference as compared the wetland restoration habitat (Table 10). The mean abundance of three species, *Sorex vagrans* (vagrant shrew*), Peromyscus maniculatus* (deermouse), and *Microtus montanus* (montane vole) was greater on the Flying Goose site than the other sites (Table 10). In contrast, the mean abundance of *Microtus pennsylvanicus* (meadow vole) was greater on the Wetland Reference site (Table 10). The mean abundances of *Sorex vagrans* and *Peromyscus maniculatus* were greater in the aspen reference than restoration habitat (Table 10). *Sorex vagrans* was also more common in the cottonwood reference as compared to cottonwood restoration habitat (Table 11). *Microtus pennsylvanicus* was much more common in the reference wetland as compared to the restoration wetland habitat (Table 10).

Mean body masses of adult male *Sorex vagrans* ($F = 2.11$; $P = 0.15$) and *Peromyscus maniculatus* ($F = 0.14$; $P = 0.87$) were similar between the 4 study sites, but male *Microtus pennsylvanicus* ($F = 2.75$; $P = 0.04$) were significantly heavier on the Wetland Reference site as compared to the other 3 sites (Table 11). In a similar vein, t-tests comparing the mean body masses of adult males between paired reference and restoration habitats revealed that males on the reference wetland habitat were heavier ($t = 2.8$; $P = 0.006$) than on the wetland restoration habitat (Table 12). Body masses of adult males did not differ between paired reference and restoration habitats of the other 3 habitat types.

Sex ratios of *Sorex vagrans* tended to be biased towards females (Tables 7 and 8), but those of the other small mammal species were equal. The proportion of females that were reproductive tended to be similar between the sites and habitat types (Tables 11 and 12), but there were species differences. Relatively few female *Sorex vagrans* or *Peromyscus maniculatus* were reproductive, but ca. 25% or more of the female Microtus were reproductive. The higher proportion of nonreproductive male *Sorex vagrans* and *Peromyscus maniculatus* on the Flying Goose (and, correspondingly, the reference cottonwood habitat) and the higher proportion of nonreproductive male *Microtus pennsylvanicus* on the Wetland reference site (and, correspondingly, the reference wetland habitat) most likely reflect recent recruitment of subadult males into these populations.

Birds. – Of the 81 different species observed on the Trimble, Tacoma, and Flying Goose study sites (Table 13), 13% were observed on all 3 sites; 27% on Tacoma and Flying Goose, 6% on Tacoma and Trimble, 10% on Flying Goose and Trimble, 24% on Flying Goose alone, 13% on Tacoma alone, and 5% on Trimble alone. A total of 66 species was observed within the 25-m radius around a point-count station and therefore included in the calculations of avian richness and abundance (Tables 14, 15, and 16). Comparing avian species richness between sites, more species were observed per point count station at the Flying Goose site than at either Tacoma or Trimble sites (Table 14). Avian species richness was greater in the reference aspen and cottonwood habitats as compared to the respective restoration habitats (Table 14).

The Flying Goose site also had a greater abundance of birds. Of the 14 species whose mean abundance differed significantly between the 3 sites, 10 of the species were more abundant at the Flying Goose (Table 15). When species were grouped as waterfowl, primary cavity nesters, or migratory songbirds, the abundance of birds in the latter 2 categories was greater at the Flying Goose. The species that were more abundant at the Flying Goose were those requiring a well-developed tree canopy and dense

understory (e.g., Common Yellowthroat, Black-capped chickadee, Red-eyed Vireo). In contrast, individual species of waterfowl and of open habitat species (e.g., bobolink, savannah sparrow, killdeer) were more abundant at the more open Trimble and Tacoma sites (Table 15). Several species whose abundance was similar between the 3 sites were more abundant in a particular habitat type (Table 16). For example, the American Robin, Solitary Vireo, Northern Flicker, and Willow Flycatcher were more abundant in the reference aspen habitat than any other habitat type (Table 16).

Amphibians. – Capture rates of larval amphibians were low. No tadpoles were captured at any of the 4 trapping locations (= 120 trap nights) at Trimble Creek. At Tacoma Creek, no tadpoles were trapped in any of the traps (= 90 trap nights) set in the Creek itself. Traps set in sloughs unconnected to the main stream yielded 4 *Pseudacris regilla* (Pacific chorus frog = *Hyla regilla*) and 3 *Rana catesbeiana* (bullfrog; year 2000 cohort) tadpoles for a total abundance of 7.78 tadpoles per 100 trapping nights).

Visual encounter surveys along the main streams of Trimble and Tacoma Creeks resulted in no observations of frogs or tadpoles. Likewise, there were not sightings of frogs or tadpoles along the main Pend Oreille River at the Tacoma Creek site. Four adult bullfrogs and 1 bullfrog tadpole were observed (= 1.25 per 20-min sample) in slough unconnected to the main creek. Visual encounter surveys at the Flying Goose site resulted in observations of 3.5 Pacific chorus frog per 20-min sample adjacent to the main Pend Oreille River and 0.75 Pacific chorus frog per 20-min sample adjacent to sloughs. Visual encounter surveys at the Wetland Reference site resulted in observations of 1.5 Pacific chorus frogs per 20-min sample adjacent to the main Pend Oreille River and 2.4 Pacific chorus frog and 1 bullfrog per 20-min sample adjacent to sloughs.

Table 1. Sampling efforts in each habitat type at the 4 study sites of the Kalispel Habitat Restoration Project. Vegetation effort refers to number of 16x16 m plots. Small mammal effort refers to the number of trap nights. Bird effort refers to the number of point-count stations. Amphibian effort refers to the number of Visual Encounter Surveys (V) and number of trap nights (TN).

	ASPEN		**COTTONWOOD**		**SHRUB**		**WETLAND**	
	Reference	Restoration	Reference	Restoration	Reference	Restoration	Reference	Restoration
FLYING GOOSE								
Vegetation			21		1			
Small Mammal			2,430					
Bird			20					
Amphibian V/TN			4 / 0					
TACOMA								
Vegetation	3	1		7		6		14
Small Mammal	162	36		432		540		2,322
Bird	3	1		1	1			4
Amphibian V/TN				3 / 90		2 / 60		2 / 30
TRIMBLE								
Vegetation		3		8		2		6
Small Mammal		648		486		324		594
Bird		3		2		2		5
Amphibian V/TN				2 / 90		2 /60	2 / 30	
Wetland Reference								
Vegetation							6	
Small Mammal							1,620	
Bird							0	
Amphibian V/TN							4 / 0	

Table 2. Comparison of mean (± se) percent cover of native (N) and introduced (I) plants, plant categories, substrate and of mean (± se) vegetation height (cm) at the 4 project sites of the Kalispel Habitat Restoration Project. Comparisons between sites are based on ANOVA with Tukey's Mean Separation; < or > indicates $P < 0.05$; ns indicates $P > 0.05$. Site abbreviations are: FG = Flying Goose, TA = Tacoma, TR = Trimble, WR = Wetland Reference.

Species	Status	Flying Goose $\bar{x}$ ± se	Tacoma $\bar{x}$ ± se	Trimble $\bar{x}$ ± se	Wetland Ref $\bar{x}$ ± se	ANOVA w/ Tukey
GRASS/SEDGE						
Agrostis alba Red-top Grass	I	0	0	2.68 ± 0.22	0	ns
Alopecurus pratensis Meadow Foxtail	I	0.91 ± 0.29	0.68 ± 0.23	4.05 ± 0.99	1.5 ± 0.67	TR>WR=FG=TA
Bromus tectorum Cheatgrass	I	0	0	0.16 ± 0.16	0	ns
Carex species Unknown Sedge	N	15.96 ± 3.04	16.84 ± 3.62	4.74 ± 1.17	24.83 ± 6.20	ns
Carex vesicaria Inflated Sedge	N	0	1.61 ± 1.22	0.31 ± 0.22	0	ns
Carex vulpinoidea Fox Sedge	N	0	0.19 ± 0.13	0.16 ± 0.16	0	ns
Dactylus glomerata Orchard Grass	I	0	0	0	1.0 ± 0.63	WR>FG=TA=TR
Eleocharus palustris Creeping Spike-rush	N	0.26 ± 0.18	0	0	1.0 ± 0.63	WR>FG=TR=TA
Luzula campestris Rush; Sweep's brush	N	0	0.10 ± 0.10	0.16 ± 0.16	0	ns
Phalaris arundinacea Reed Canary-grass	N	4.09 ± 1.80	0.97 ± 0.26	14.42 ± 5.02	0	TR>FG=TA=WR
Phleum pratense Timothy Grass	I	0.78 ± 0.28	4.74 ± 1.03	4.1 ± 1.25	1.0 ± 0.63	TA=TR>FG
Scirpus validus Bulrush	N	0.13 ± 0.13	0	0	0	ns
Sparganium eurycarpum Bur-reed	N	0.26 ± 0.18	1.74 ± 1.31	0	0	ns

Table 2. Continued.

Species	Status	Flying Goose $\bar{x}$ ± se	Tacoma $\bar{x}$ ± se	Trimble $\bar{x}$ ± se	Wetland Ref $\bar{x}$ ± se	ANOVA w/ Tukey
Typha latifolia Cat-tail	N	0.65 ± 0.26	0.10 ± 0.10	0	0	FG=TA>TR=WR
TOTAL GRASS		17.17 ± 3.88	29.74 ± 4.17	50.0 ± 5.24	11.67 ± 2.7	TR>TA=FG>WR
Total Sedge/Rush		17.52 ± 1.76	20.94 ± 4.33	5.84 ± 1.37	27.33 ± 6.3`	WR>TA=FG>TR
HERB						
Achillea millefolium Yarrow	N	0.52 ± 0.24	1.84 ± 0.27	2.68 ± 0.22	0.5 ± 0.5	TR=TA>FG=WR
Camassia quamash Camas	N	0	0.10 ± 0.10	0	0	ns
Centauria cyanus Bachelor Button	I	0	0.97 ± 0.97	0	0	ns
Centauria species Knapweed	I	0	0.48 ± 0.2	0	0	ns
Cerastium nutans Nodding Chickweed	N	0	0	0.47 ± 0.47	0	TR>TA=FG=WR
Chrysanthemum leucanthemum Oxeye daisy	N	0.13 ± 0.13	1.55 ± 0.27	0.79 ± 0.31	0.5 ± 0.5	TA>WR=FG
Collomia linearis Narrow leaved Colombine	N	0	0.10 ± 0.10	0.32 ± 0.16	0	ns
Dianthus armeria Deptford Pink	I	0	0.87 ± 0.13	1.11 ± 0.34	0	TR>FG=WR
Dowingia elegans Dowingia	N	0.13 ± 0.13	0.19 ± 0.13	0	0	ns
Equisetum species Horsetail		0.52 ± 0.24	0.67 ± 0.23	0.32 ± 0.22	1.50 ± 0.67	WR>FG=TR
Fragaria virginiana Wild Strawberry	N	0.52 ± 0.24	1.35 ± 0.27	0	0	TA>TR=WR
Galium aparine Cleavers	N	0	0.10 ± 0.10	0	0	ns
Galium boreale Smooth Bedstraw	N	1.57 ± 0.32	0.68 ± 0.23	0	0	FG>TA=TR=WR

Table 2. Continued.

Species	Status	Flying Goose $\bar{x}$ ± se	Tacoma $\bar{x}$ ± se	Trimble $\bar{x}$ ± se	Wetland Ref $\bar{x}$ ± se	ANOVA w/ Tukey
Lotus purshiana Lotus	N	0	3.23 ± 0.93	4.05 ± 0.99	0	TR=TA;TA=WR;TR>FG
Lupinus polyphyllus Bigealf Lupine	N	1.35 ± 0.72	2.84 ± 0.95	13.47 ± 4.47	0	TR>TA=FG=WR
Lupinus species Uknown Lupine		0	0	0.32 ± 0.22	0	ns
Mentha arvensis Field Mint		0.52 ± 0.24	0.87 ± 0.25	0.32 ± 0.31	0.5 ± 0.5	ns
Montia linearis Narrow-leaved Montia	N	0	0.19 ± 0.13	0.79 ± 0.31	0	TR>FG=WR
Myosotis laxa Forget-me-not	N	0	0	0.84 ± 0.84	0	ns
Myosotis species Forget-me-not		0	0.10 ± 0.10	0	0	ns
Osmorhiza chilensis Mt. Sweet-cicely	N	0	0.19 ± 0.13	0	0	ns
Potentilla gracilis Cinquefoil	N	0.52 ± .024	1.26 ± 1.03	2.26 ± 0.84	0	ns
Polemoniaceae spp. Phlox		0	0.19 ± 0.13	0.63 ± 0.29	0	ns
Prunella vulgaris Heal All	I	0.13 ± 0.13	0.19 ± 0.13	0	0	ns
Ranunculus unkn Buttercup		0	0	0.16 ± 0.16	0	ns
Rumex crispus Curly Dock	I	0	0	0	1.0 ± 0.63	WR>FG=TA=TR
Rumex species Curly Dock unknown		0.13 ± 0.13	0.10 ± 0.10	0.32 ± 0.22	0	ns
Smilacina racemosa False Solomon's Seal	N	1.30 ± 0.13	0.29 ± 0.16	0	0	FG>TATR=WR
Taraxicum officinale Dandelion	I	1.30 ± 0.32	2.12 ± 0.55	1.42 ± 0.35	0.5 ± 0.5	ns

Table 2. Continued.

Species	Status	Flying Goose $\bar{x}$ ± se	Tacoma $\bar{x}$ ± se	Trimble $\bar{x}$ ± se	Wetland Ref $\bar{x}$ ± se	ANOVA w/ Tukey
Trifolium hybridium Clover		1.30 ± 0.32	7.68 ± 2.53	5.89 ± 2.04	0	ns
Vicia americana Vetch	N	0.78 ± 0.28	0.48 ± 0.20	0	0	ns
Verbascum thapsus Common Mullein	I	0	0.10 ± 0.10	0	0	ns
Zigadenus species Death-camas		0	0.18 ± 0.09	0	0	ns
TOTAL HERB		12.70 ± 1.76	26.9 ± 3.31	22.53 ± 3.07	8.0 ± 2.4	TA >TR>FG>WR
Moss		1.43 ± 0.32	2.84 ± 0.49	3.42 ± 1.95	1.5 ± 0.67	ns
Litter		82.17 ± 5.15	79.90 ± 3.1	78.21 ± 2.82	64.67 ± 13.13	FG>WR
Bare Ground		2.0 ± 0.71	2.65 ± 0.50	2.68 ± 0.32	7.83 ± 2.63	WR>TR=TA=FG
Mean Vegetation Height		56.7 ±	52.7 ±	47.9 ±	57.5 ±	WR=FG>TA>TR

Table 3. Comparison of mean (± se) percent cover of plants, plant categories, substrate and of mean (± se) vegetation height (cm) between the paired restoration and reference habitats of the Kalispel Habitat Restoration Project. Comparisons between habitats are based on T-tests. Values in bold and underlined are significantly greater than their pair * = $P < 0.05$; ** $P < 0.01$.

	ASPEN		COTTON		WETLAND		SHRUB	
	Restoration	Reference	Restoration	Reference	Restoration	Reference	Restoration	Reference
Species	$\bar{x}$ ± se	$\bar{x}$ ± se	$\bar{x}$ ± se	$\bar{x}$ ± se	$\bar{x}$ ± se	$\bar{x}$ ± se	$\bar{x}$ ± s e	$\bar{x}$ ± se
GRASS/SEDGE								
Agrostis alba Red-top Grass	0.75 ± 0.75	0	0	0	0	0	0	0
Alopecurus pratensis Meadow Foxtail	1.5 ± 0.8	0	2.27 ± 1.05	0.95 ± 0.30	1.8 ± 0.34	1.5 ± 0.67	2.75 ± 1.95	0
Bromus tectorum *Cheatgrass*	0.75 ± 0.75	0	0	0	0	0	0	0
Carex species Unknown Sedge	2.5 ± 0.75	1.0 ± 1.0	16.4 ± 6.68	16.54 ± 3.12	13.0 ± 2.34	**<u>24.83*</u>** ± 6.20	11.75 ± 5.73	3.0
Carex vesicaria Inflated Sedge	0 0	2.0 ± 1.0	0.2 ± 0.2	0	2.35 ± 1.89	0	0	0
Carex vulpinoidea Fox Sedge	0.75 ± 0.75	0	0	0	0.15 ± 0.15	0	0.38 ± .038	0
Dactylus glomerata Orchard Grass	0 0	1.0 ± 1.0	0	0	0	1.0 ± 0.63	0	0
Eleocharus palustris Creeping Spike-rush	0	0	0	0.27 ± 0.19	0	1.0 ± 0.63	0	0
Luzula campestris Rush; Sweep's brush	0.75 ± 0.75	0	0	0	0.15 ± 0.15	0	0	0
Phalaris arundinacea Reed Canary-grass	0.75 ± 0.75	1.0 ± .0	13.0 ± 5.83	4.23 ± 1.88	3.1 ± 1.87	0	5.13 ± 4.71	0
Phleum pratense Timothy Grass	9.5 ± 3.75	3.0 ± 0	2.47 ± 1.04	0.82 ± 0.29	**<u>4.7*</u>** ± 1.33	1.0 ± 0.63	5.88 ± 2.24	0
Scirpus validus Bulrush	0	0	0	0.14 ± 0.14	0	0	0	0
Sparganium eurycarpum Bur-reed	3.15± 1.0	0	0	0.27 ± 0.19	2.7 ± 2.02	0	0	0
Typha latifolia Cat-tail	0	0	0	0.55 ± 0.25	0.15 ± 0.15	0	0	3.0

Table 3. Continued.

	ASPEN		COTTON		WETLAND		SHRUB	
	Restoration	Reference	Restoration	Reference	Restoration	Reference	Restoration	Reference
Total Grass	**74.5**** ± 6.64	3.0 ± 0	34.4 ± 6.74	17.82 ± 4.00	**33.5*** ± 4.82	11.67 ± 2.74	**43.8****± 4.3	3.0
Total Sedge/Rush	5.25 ± 1.89	5.0 ± 2.64	19.62 ± 8.26	19.91 ± 3.15	17.57 ± 4.01	**27.33***± 6.31	11.11 ± 5.37	9.0
HERB								
Achillea millefolium Yarrow	**3.0*** ± 0.0	0	**2.20**** ± 0.35	0.55 ± 0.25	**1.95*** ± 0.33	0.5 ± 0.5	**3.0*** ± 0	0
Centauria cyanus Bachelor Button	0.75 ± 0.75	0	0 0	0	0	0	0	0
Camassia quamash Camas	0 0	0	0	0	0	0	0.38 ± 0.38	0
Cerastium nutans Nodding Chickweed	0 0	0	0.4 ± 0.27	0	0.15 ± 0.15	0	0	0
Centauria species Knapweed	0 0	0	0	0	0.45 ± 0.25	0	0.75 ± 0.49	0
Chrysanthemum leucanthemum Oxeye daisy	0.75 ± 0.75	0	1.2 ± 0.39	0.14 ± .014	1.35 ± 0.34	0.5 ± 0.5	1.88 ± 0.55	0
Collomia linearis Narrow leaved Colombine	0	0	0.4 ± 0.27	0	0.15 ± 0.15	0	0	0
Dianthus armeria Deptford Pink	0.75 ± 0.75	1.0 ± 1.0	**1.2*** ± 0.39	0	**1.05*** ± 0.33	0	.038 ± 0.38	0
Dowingia elegans Dowingia		0	0	0.14 ± 0.14	0.3 ± 0.21	0	0	0
Equisetum species Horsetail	2.5 ± 0.75	0	0.6 ± 0.32	0.41 ± 0.22	0.3 ± 0.21	**1.5*** ± 0.67	0.38 ± 0.38	3.0
Fragaria virginiana Wild Strawberry		1.0 ± 1.0	0.6 ± 0.32	0.55 ± 0.25	**0.9*** ± 0.32	0	1.5 ± 0.57	0
Galium aparine Cleavers		1.0 ± 1.0		0	0	0	0	0
Galium species Bedstraw		1.0 ± 1.0	0.4 ± .027	**1.50*** ± 0.33	0.45 ± 0.25	0	0.38 ± 0.38	3.0

Table 3. Continued.

	ASPEN		COTTON		WETLAND		SHRUB	
	Restoration	Reference	Restoration	Reference	Restoration	Reference	Restoration	Reference
Heracleum lanatum Cow-parsnip		0	0.2 ± 0.2	0.14 ± 0.14	0.15 ± 0.15	0	0	0
Lotus purshiana Lotus	5.5 ± 3.57	2.0 ± 1.0	**2.87*** ± 1.00	0	**3.9*** ± 1.21	0.5 ± 0.5	3.5 ± 4.69	0
Lupinus polyphyllus Biglf Lupine	0.75 ± 0.75	0	13.1 ± 4.92	1.41 ± 0.75	**4.10*** ± 2.09	0	7.88 ± 4.69	0
Lupinus species Uknown Lupine	0	0	0.4 ± 0.27	0	0	0	0	0
Mentha arvensis Field Mint	0	1.0 ± 1.0	0.4 ± 0.27	0.41± 0.22	0.6 ± 0.27	0.5 ± 0.5	1.5 ± 0.57	3.0
Montia linearis Narrow-leaved Montia	0.75 ± 0.75	0	0.6 ± 0.32	0	0.45 ± 0.25	0	0	0
Myosotis laxa Forget-me-not	0	0	0	0	0.8 ± 0.8	0	0	0
Myosotis species Forget-me-not	0	0	0.2 ± 0.2	0	0	0	0	0
Osmorhiza chilensis Mt. Sweet-cicely	0	2.0 ± 1.0	0	0	0	0	0	0
Potentilla gracilis Cinquefoil	5.5 ± 0.75	0	1.2 ± 0.39	0.55 ± 0.25	1.35 ± 0.34	0.5 ± 0.5	1.88 ± 0.55	0
Polemoniaceae spp. Phlox	0.75 ± 0.75	0	0	0	0.75 ± 0.29	0	0	0
Prunella vulgaris Heal All	0	0	0.2 ± 0.2	0.14 ± 0.14	0.14 ± 0.14	0	0	0
Ranunculus unkn Buttercup	0	0	0	0	0.15 ± 0.15	0	0	0
Rumex crispus Curly Dock	0	0	0	0	0	1.0 ± 0.63	0	0
Rumex species Curly Dock unknown	0	0	0.4 ± 0.27	0.14 ± 0.14	0.15 ± 0.15	0	0	0
Smilacina racemosa False Solomon's Seal	0	2.0 ± 1.0	0.2 ± 0.2	**1.36****± 0.33	0	0	0	0

Table 3. Continued.

	ASPEN		COTTON		WETLAND		SHRUB	
	Restoration	Reference	Restoration	Reference	Restoration	Reference	Restoration	Reference
Taraxicum officinale Dandelion	4.75 ± 3.82	2.0 ± 1.0	1.0 ± 0.38	1.36 ± 0.33	1.65 ± 0.41	0.5 ± 0.5	2.63 ± 0.38	0
Trifolium hybridium Clover	6.25 ± 3.25	1.0 ± 10.	5.40 ± 2.53	1.36 ± 0.33	10.35 ± 3.75	0	4.25 ± 1.72	0
Vicia americana Vetch	0	0	0	0.82 ± 0.29	0.3 ± 0.21	0	1.13 ± 0.55	0
Verbascum thalpsis Common Mullein	0	0	0	0	0	0	0.38 ± 0.38	0
Zigadenus species Death-camas	0	1.0 ± 1.0	0	0	0.15 ± 0.15	0	0	0
Total Herb	23.25 ± 7.66	27.0 ± 7.94	21.31 ± 5.19	12.0 ± 1.69	**28.38**** ±4.09	8.0 ± 2.41	23.89 ± 3.47	28.1±
Moss	11.75 ± 8.75	2.0 ± 1.0	1.4 ± 0.4	1.36 ± 0.33	3.35 ± 0.69	1.5 ± 0.67	1.5 ± 0.57	3.0
Litter	80.25 ± 5.75	82.67 ± 10.53	83.33 ± 3.58	84.18 ± 4.97	72.0 ± 3.59	64.67 ± 13.13	**88.0**** ± 4.23	38
Bare Ground	3.0 ± 0	3.0 ± 0	2.40 ± 0.43	2.09 ± 0.73	3.2 ± 0.72	7.83 ± 2.63	1.5 ± 0.57	0
Mean Vegetation Height	**35.4*** ± 1.3	27.8± 1.1	51.2 ± 1.0	**55.4**** ± 1.1	54.1 ± 0.7	**57.5*** ±1.51	56.1 ± 1.0	**83.9** ± 7.6

Table 4. Comparison of mean (± se) shrub area by species with all height classes combined and by total shrub area for the 4 height classes at the 4 project sites of the Kalispel Habitat Restoration Project. Comparisons between sites are based on ANOVA with Tukey's Mean Separation; < or > indicates significant difference (*P* value given); ns indicates $P > 0.05$. Site abbreviations are: FG = Flying Goose, TA = Tacoma, TR = Trimble, WR = Wetland Reference.

Species	Height	Flying Goose $\bar{x}$ ± se	Tacoma $\bar{x}$ ± se	Trimble $\bar{x}$ ± se	Wetland Reference $\bar{x}$ ± se	ANOVA w/ Tukey
AMALANCHIE RALNIFOLIA	All	0	156 ± 156	0	0	ns
Cornus stolonifera	All	78,394 ± 42,282	1,607 ± 1,531	0	0	FG>TA>TR=WR (*P*= 0.007)
Crataegus douglasii	All	125,994 ± 59,904	69,962 ± 36,240	1,722 ± 1,495	0	FG=TA>WR; TA=TR (*P* = 0.05)
Pinus ponderosa	All	0	0	10 ± 10	0	ns
Populus balsamifera	All	63,046 ± 31,293	0	0	0	FG>others (*P*=.0001)
Ribes spp.	All	0	100 ± 100	0	0	ns
Rosa woodsi	All	16,587 ± 7,331	36,408 ± 21,517	270 ± 270	0	FG=TA>WR (*P* = 0.02)
Salix spp.	All	3,707 ± 3,707	0	0	0	ns
Spiraea douglasii	All	29,068 ± 15,280	38,552 ± 20,606	0	0	TA=FG>TR=WR (*P* = 0.01)
Symphoricarpus alba	All	200,936 ± 81,483	56,587 ± 29,908	140 ± 140	0	FG=TA; FG>TR=WR; TA=TR=WR (*P* = 0.004)
TOTAL AREA	1	35,398 ± 13,373	17,494 ± 10,946	608.5 ± 391	0	FG=TA>TR=WR(*P* = 0.02)
	2	173,001 ± 63,179	115,177 ± 49,707	1,170 ± 1,170	0	FG=TA>TR=WR (*P* = 0.001)
	3	170,890 ± 56,795	56,533 ± 30,073	1,020 ± 1,020	0	FG=TA; FG>TR=WR; TA>WR (*P* = 0.003)
	4	247,148 ± 92,236	95,859 ± 58,859	0	0	FG>TA>TR=WR (*P* = 0.0003)

Table 5. Comparison of mean (± se) shrub area by species with all height classes combined and by total shrub area for the 4 height classes between the paired restoration and reference habitats of the Kalispel Habitat Restoration Project. Comparisons between habitats are based on T-tests. Values in bold and underlined are significantly greater than their pair * = $P < 0.05$; ** $P < 0.01$.

		Aspen		Cottonwood		Wetland		Shrub	
		Target	Reference	Target	Reference	Target	Reference	Target	Reference
Species	HT	X ± se	X ± se	X ± se	X ± se	X ± se	X ±s e	X ± se	X ± se
Amelanchier alnifolia	All	0	0	0	0	0	0	500 ± 500	0
Cornus stolinifera	All	0	0	0	**81,957*** ± 44,092	2,334 ± 2,225	0	0	0
Crataegus douglasii	All	303 ± 201	1,000 ± 1,000	101,891 ± 83,181	131,721± 62,405	**35,568*** ± **20,827**	0	16,193 ± 12,990	0
Pinus ponderosa	All	0	0	0	0	0	0	20 ± 20	0
Populus balsamifera	All	0	0	0	**65,908**** ± 32,6118	0	0	0	0
Ribes spp.	All	0	0	0	0	0	0	320 ± 320	0
Rosa woodsi	All	0	**318,467*** ± 166,172	424 ± 276	**17,341*** ± 7,631	8,896 ± 8,054	0	1,382 ± 700	0
Salix spp.		0	0		0	0	0	0	**85,250*****
Spiraea douglasii	All	0	**191,667*** ± 184,218	0	30,390 ±15,931	10,129 ± 7,127	0	8,003 ±4,742	0
Symphoricarpus albus	All	0	**346,643**** ± 106,749	90 ± 90	**210,070**** ± 84,737	34,746 ± 34,009	0	808 ± 556	0
TOTAL AREA	1	303 ± 201	20,700± 12,300	25,831± 24,935	35398± 13373	4677 ± 3209	0	6,189 ± 3,852	0
	2	0	573,977 ± 246,204	15,383 ± 15298	173,001 ± 63,179	**69,261*** ± 48,305	0	8,109 ± 3,015	0
	3	0	**405,000*** ± 235,000	22,620 ± 15,331	**170,890*** ± **56,795**	3,474 ± 2267	0	28,717 ± 25,297	0
	4	0	0	105,400 ± 105,400	**255,669**** ± 96,810	42,562 ± 26,590	0	0	**85250****

Table 6. Number of trees counted on the 4 study sites of the Kalispel Habitat Restoration Project.

	Flying Goose		Tacoma		Trimble	Wetland
	Cottonwood Reference	Shrub Reference	Aspen Reference	Restoration	Restoration	Reference Reference
ABIES LASIOCARPA						
4-10 cm dbh			2	0	0	0
Alnus spp.						
4-10 cm dbh		85		0	0	0
Amalenchier alnifolia						
4-10 cm dbh	11					
Crataegus douglasii						
4-10 cm dbh	383		238	0	0	0
11-25 cm dbh	51		24	0	0	0
26-50 cm dbh	3		6	0	0	0
PINUS CORTATA						
4-10 cm dbh			7	0	0	0
11-25 cm dbh			4	0	0	0
26-50 cm dbh	1		2	0	0	0
51-75 cm dbh	2		0	0	0	0
Populus balsamifera						
4-10 cm dbh	25			0	0	0
11-25 cm dbh	52			0	0	0
26-50 cm dbh	89			0	0	0
51-75 cm dbh	38			0	0	0
76-100 cm dbh	8			0	0	0
>100 cm dbh	2			0	0	0
Populus tremuloides						
4-10 cm dbh	3		134	0	0	0
11-25 cm dbh			45	0	0	0
26-50 cm dbh				0	0	0
PRUNUS VIRGINIANA						
4-10 cm dbh			3			
11-25 cm dbh						
***SALIX* SPP**.						
4-10 CM DBH						
SNAG - RECENT						
4-10 cm dbh	5		19	0	0	0
11-25 cm dbh	0		6	0	0	0
26-50 cm dbh	3		2	0	0	0
51-75 CM DBH	3		0	0	0	0

Table 6. Continued

	Flying Goose		Tacoma		Trimble	Wetland
	Cottonwood Reference	Shrub Reference	Aspen Reference	Restoration	Restoration	Reference Reference
SNAG - MID						
4-10 cm dbh	3		8	0	0	0
11-25 cm dbh	0		13	0	0	0
26-50 cm dbh	1		1	0	0	0
SNAG - OLD						
4-10 cm dbh	0		3			
11-25 cm dbh	7		3			
26-50 cm dbh	5		1			
51-75 cm dbh	1		0	0	0	0
76-100 cm dbh	2		0	0	0	0

Table 7. Number of captures, % females, and χ^2 value if $P < 0.05$ or ns if χ^2 value > 0.05 for the small mammal species captured at the 4 sites of the Kalispel Habitat Restoration Project.

	Flying Goose	Tacoma	Trimble	Wetland Reference
SOREX CINEREUS				
# captures	4	0	0	0
% female	50			
χ	ns			
SOREX VAGRANS				
# captures	48	22	5	15
% female	72.3	72.7	60	53.3
χ^2	9.38	4.54	ns	ns
TAMIAS AMOENUS				
# captures	0	1	0	0
% female		0		
χ^2		ns		
THOMOMYS TALPOIDES				
# captures	0	1	0	0
% female		100		
χ^2		ns		
PEROMYSCUS MANICULATUS				
# captures	75	24	10	4
% female	52.05	13 10	60	50
χ^2	ns	ns	ns	ns
MICROTUS MONTANUS				
# captures	15	0	0	0
% female	42.8			
χ^2	ns			
MICROTUS PENNSYLVANICUS				
# captures	165	171	247	346
% female	49.7	54.7 93 77	52.4	50.1
χ^2	ns	ns	ns	ns
ZAPUS PRINCEPS				
# captures	2	1	0	0
% female	50	100		
χ^2	ns	ns		

Table 8. Number of captures, % females, and χ^2 value if $P < 0.05$ or ns if χ^2 value > 0.05 for the small mammal species captured on the reference (Ref.) and Restoration (Restor.) habitats of the Kalispel Habitat Restoration Project.

	Aspen		**Cottonwood**		**Shrub**	Wetland	
	Ref.	Restor.	Ref.	Restor.	Restor.	Ref.	Restor.
SOREX CINEREUS							
# captures	0	0	4	0	0	0	0
% female			50				
χ^2			ns				
SOREX VAGRANS							
# captures	12	0	48	1	4	10	15
% female	75		70.8	100	2	70	53.3
χ^2	ns		9.4	ns	ns	ns	
TAMIAS AMOENUS							
# captures							
% female							
χ^2							
THOMOMYS TALPOIDES							
# captures	0	1	0	0	0	0	0
% female		100					
χ^2		ns					
PEROMYSCUS MANICULATUS							
# captures	7	0	75	8	4	14	4
% female	50		50.7	57	50	64.3	50
χ^2	ns		ns	ns	ns	ns	ns
MICROTUS MONTANUS							
# captures	0	0	15	0	0	0	0
% female			53.3				
χ^2			ns				
MICROTUS PENNSYLVANICUS							
# captures	3	52	165	121	64	178	346
% female	100	55.6	56.3	54.2	50	51.7	50.7
χ^2		ns	ns	ns	ns	ns	ns
ZAPUS PRINCEPS							
# captures	0	1	2	0	04	0	0
% female		100	50				
χ^2		ns	ns				

Table 9. Comparisons of mean (± se) mammal species richness between the 4 study sites and the reference and restoration habitats of the Kalispel Habitat Restoration Project. Comparisons between sites are based on ANOVA with Tukey's Mean Separation; < or > indicates $P < 0.05$. Site abbreviations are: FG = Flying Goose, TA = Tacoma, TR = Trimble, WR = Wetland Reference. Comparisons between habitats are based on T-tests. Values in bold are significantly greater than their pair; ns indicates $P > 0.05$.

	Richness	ANOVA/t-test
SITE		
Flying Goose	4.1 ± 0.3	F = 25.0; P = 0.0001 FG > WR=TA=TR
Tacoma	1.7 ± 0.2	
Trimble	1.7 ± 0.2	
Wetland Reference	2.2 ± 0.3	
HABITAT		
Aspen - Reference	2.0 ± 0	t = 0.4; ns
Aspen - Restoration	1.7 ± 0.7	
Cottonwood - Reference	**4.1 ± 0.3**	t = 5.2; P = 0.0002
Cottonwood - Restoration	1.8 ± 0.4	
Shrub - Restoration	1. 8 ± 0.1	
Wetland - Reference	2.2 ± 0.3	t = 1.7; ns
Wetland - Restoration	1.5 ± 0.2	

Table 10. Comparisons of mean (± se) abundance (captures/100 trap nights) of 4 small mammal species and of total small mammal abundance (8 species combined) at the 4 study sites and on the reference and restoration habitats of the Kalispel Habitat Restoration Project. Comparisons between sites are based on ANOVA with Tukey's Mean Separation; < or > indicates $P < 0.05$. Site abbreviations are: FG = Flying Goose, TA = Tacoma, TR = Trimble, WR = Wetland Reference. Comparisons between habitats are based on T-tests. Values in bold are significantly greater than their pair; ns indicates $P > 0.05$.

	Sorex vagrans	*Permoyscus maniculatus*	*Microtus montanus*	*Microtus pennsylvanicus*	Total Abundance
SITE					
Flying Goose	2.0 ± 0.5	3.1 ± 0.9	0.6 ± 0.3	6.8 ± 2.2	12.6 ± 3.4
Tacoma	0.3 ± 0.2	0.8 ± 0.4	0	4.4 ± 0.9	5.6 ± 0.9
Trimble	0.3 ± 0.2	0.6 ± 0.3	0	13.7 ±5.0	14.6 ± 5.1
Wetland Ref.	0.9 ± 0.2	0.24 ± 0.16	0	21.4 ± 5.4	22.5 ± 5.2
ANOVA	$P = 0.001$	$P = 0.004$	$P = 0.009$	$P = 0.002$	$P = 0.006$
Tukey	FG>others	FG>others	FG>others	WR >FG=TA	WR > TA
HABITAT					
ASPEN					
Reference	**4.4**	**0.6**	0	0	5.0
Restoration	0	0	0	9.9 ± 7.7	10.1 ± 7.6
t-test	$P = 0.001$	$P = 0.001$	ns	ns	ns
COTTONWOOD					
Reference	**2.0 ± 0.5**	3.1 ± 0.9	0.6 ± 0.3	6.8 ± 2.2	12.6 ± 3.4
Restoration	0	1.3 ± 0.6	0	14.4 ± 9.4	15.7 ± 9.6
t-test	$P = 0.003$	ns	ns	ns	ns
SHRUB					
Restoration	0.5 ± 0.3	0.2 ± 0.2	0	5.1 ± 1.5	5.7 ± 1.7
WETLAND					
Reference	0.9 ± 0.2	0.6 ± 0.4	0	**21.3 ± 5.4**	**22.5 ± 5.2**
Restoration	0.4 ± 0.3	0.2 ± 0.15	0	6.5 ± 2.2	7.6 ± 2.3
t-test	ns	ns	ns	$P = 0.007$	$P = 0.007$

Table 11. Body mass and reproductive condition of small mammals at the 4 study sites of the Kalispel Habitat Restoration Project. Reproductive category are defined in text.

	Flying Goose	Tacoma	Trimble	Wetland Reference
SOREX VAGRANS				
$\bar{x}$ body mass adult male	7.0 ± 1.0	7.5 ± 0.2	8.0 ± 0.2	6.7 ± 0.3
# (%) female nonreproductive	34 (100)	16 (100)	3 (100)	7 (87.5)
# (%) female reproductive	0	0	0	1 (12.5)
# (%) male nonreproductive	11 (84.6)	0	0	1 (14.3)
# (%) male reproductive	2 (15.4)	6 (100)	2 (100)	6 (85.7)
PEROMYSCUS MANICULATUS				
$\bar{x}$ body mass adult male	20.7 ± 1.3	20.1 ± 0.9	21.0 ± 1.0	-
# (%) female nonreproductive	30 (79)	7 (53.8)	1 (20)	1 (50)
# (%) female pregnant	1 (2.6)	1 (7.7)	1 (20)	0
# (%) female postreproductive	7 (18.4)	6 (38.5)	3 (60)	1 (50)
# (%) male nonreproductive	31 (88.6)	2 (20)	1 (33.3)	2 (100)
# (%) male reproductive	4 (11.4)	8 (80)	2 (67.7)	0
MICROTUS MONTANUS				
$\bar{x}$ body mass adult male	17.7 ± 3.8	-	-	-
# (%) female nonreproductive	3(37.5)	0	0	0
# (%) female reproductive	5(62,5)	0	0	0
# (%) male nonreproductive	0	0	0	0
# (%) male reproductive	6 (100)	0	0	0
MICROTUS PENNSYLVANICUS				
$\bar{x}$ body mass adult male	31.9 ± 1.7	32.0 ± 1.1	33.5 ± 1.5	36.7 ± 0.9
# (%) female nonreproductive	41 (48.2)	51 (54.8)	76 (58.9)	104 (60.1)
# (%) female pregnant	31 (36.5)	34 (36.6)	31 (24)	45 (26)
# (%) female postreproductive	13 (15.3)	8 (8.6)	22 (17.1)	24 (13.9)
# (%) male nonreproductive	43 (65.2)	11 (14.3)	81 (69.2)	134 (79.8)
# (%) male reproductive	23 (34.8)	66 85.7)	36 (30.8)	34 (20.2)

Table 12. Body mass and reproductive condition of small mammals on the reference and restoration (Restor.) habitats of the Kalispel Habitat Restoration Project. Reproductive category definitions in text.

	Aspen		Cottonwood		Shrub	Wetland	
	Reference	Restor.	Reference	Restor.	Restor.	Reference	Restor.
SOREX VAGRANS							
$\bar{x}$ body mass adult male	7.7 ± 0.3	-	7.0 ± 1.0	-	8 ± 0	6.7 ± 0.3	7.3 ± 0.3
# (%) female nonreproductive	9 (100)	0	34 (100)	1 (100)	2 (100)	7 (100)	7 (100)
# (%) female reproductive	0	0	0	0	0	0	0
# (%) male nonreproductive	0	0	11 (84.6)	0	0	1 (14.3)	0
# (%) male reproductive	3 (100)	0	2 (15.4)	0	2 (100)	6 (86.7)	3 (100)
PEROMYSCUS MANICULATUS							
$\bar{x}$ body mass adult male	15.5 ± 0.5	-	20.8 ± 1.3	20.5 ± 1.5	22 ± 0	-	20.6 ± 1.4
# (%) female nonreproductive	3 (100)	0	30 (79)	2 (50)	0	1 (50)	3 (33.3)
# (%) female pregnant	0	0	1 (2.6)	0	1 (50)	0	1 (11.1)
# (%) female postreproductive	0	0	7 (18.4)	2(50)	1 (50)	1 (50)	5 (55.6)
# (%) male nonreproductive	1 (33.3)	0	31 (88.6)	1 (33.3)	1 (50)	2 (100)	0
# (%) male reproductive	2 (66.7)	0	4 (11.4)	2 (66.7)	1 (50)	0	5 (100)
MICROTUS MONTANUS							
$\bar{x}$ body mass adult male			17.7 ± 3.8				
# (%) female nonreproductive	0	0	3 (37.5)	0	0	0	0
# (%) female reproductive	0	0	5 (62.5)	0	0	0	0
# (%) male nonreproductive	0	0	0	0	0	0	0
# (%) male reproductive	0	0	6 (100)	0	0	0	0
MICROTUS PENNSYLVANICUS							
$\bar{x}$ body mass adult male	-	32.7 ± 3.3	31.9 ± 1.7	33.7 ± 2.3	32.6 ± 2.2	36.7 ± 0.7	32.1 ± 1.1
# (%) female nonreproductive	3 (100)	17 (56.7)	41 (48.2)	33 (50.8)	17 (53.1)	104 (56.8)	57 (62)
# (%) female pregnant	0	7 (23.3)	31 (36.5)	18 (25.7)	12 (37.5)	45 (26)	28 (30.4)
# (%) female postreproductive	0	6 (20)	13 (15.3)	14 (21.5)	3 (9.4)	24 (13.9)	7 (7.6)
# (%) male nonreproductive	0	13 (59.1)	43 (65.2)	37 (67.3)	12 (38.7)	34 (20.2)	30 (34.9)
# (%) male reproductive	0	9 (40.1)	23 (34.80	18 (32.7)	19 (61.3)	134 (79.8)	56 (65.1)

Table 13. List of all bird species observed on 3 study sites of the Kalispel Habitat Restoration Project.

Species	Flying Goose	Tacoma	Trimble
AMERICAN BITTERN	x		
American Coot	x		
American Crow	x		x
American Goldfinch	x		
American Redstart	x		
American Robin	x	x	x
American Widgeon	x	x	x
Bald Eagle	x	x	
Bank Swallow		x	
Black-billed Magpie	x	x	x
Black-capped Chickadee	x	x	
Black Tern	x		
Brown-headed cowbird	x		x
Blue Winged Teal			x
Bobolink		x	x
Bullock's Oriole	x	x	
Canada Goose	x		x
CEDAR WAXWING	x	x	
CHIPPING SPARROW		x	
CINNAMON TEAL		x	x
Cliff Swallow		x	x
Common Goldeneye	x	x	
Common Loon	x		
Common Raven	x	x	x
Common Snipe	x	x	x
Common Yellowthroat	x	x	
Cooper’s Hawk		x	
Double-crested Cormorant	x		x
Eastern Kingbird	x	x	
European starling	x	x	
Gadwall	x		x
Great-blue Heron	x	x	x
Green-winged Teal	x		x
Grey Catbird	x	x	
Hammond’s Flycatcher		x	
Hummingbird	x		
Killdeer	x		x
Long-billed Curlew			x
MacGillvery’s Warbler	x		
Mallard	x	x	x
Mourning Dove	x	x	
Nashville Warbler	x		

Table 13. Continued.

Species	Flying Goose	Tacoma	Trimble
Northern Flicker	x	x	
Northern Harrier			x
Northern Shoveler	x	x	x
Osprey	x	x	x
Pie-billed Grebe	x		
Pine Siskin		x	
Red-breasted Nuthatch	x		
Red Crossbill	x		
Red-eyed Vireo	x		
Redhead Duck			x
Red-naped Sapsucker	x	x	
Red-tailed Hawk	x	x	x
Red-winged Blackbird	x	x	
Ring-necked Pheasant		x	
Rough-winged Swallow		x	
Ruffed Grouse	x		
Savannah Sparrow		x	x
Solitary Vireo		x	
Song Sparrow	x	x	
Sora Rail	x	x	
Spotted Sandpiper	x	x	
Sharp-shinned Hawk	x		
Swainson's Thrush	x		
Tree Swallow	x	x	x
Turkey Vulture		x	
Vaux's Swift	x	x	
Violet-green Swallow		x	
Warbling Vireo	x	x	
Western Bluebird	x		
Western Grebe	x		
Western Kingbird	x		
Western Meadowlark		x	x
Western Wood Peewee	x	x	
Willow Flycatcher		x	
Wilson's Phalarope	x		x
Wood Duck	x	x	
Yellow-headed Blackbird	x	x	
Yellow Warbler	x	x	
Yellow-rumped Warbler	x		

Table 14. Comparisons of mean (± se) avian species richness between the 3 study sites and the reference and restoration habitats of the Kalispel Habitat Restoration Project. Comparisons between sites are based on ANOVA with Tukey's Mean Separation; < or > indicates $P < 0.05$. Site abbreviations are: FG = Flying Goose, TA = Tacoma, TR = Trimble. Comparisons between habitats are based on T-tests. Values in bold are significantly greater than their pair; ns indicates $P > 0.05$.

	Richness	ANOVA/t-test
SITE		
Flying Goose	11.4 ± 0.88	F = 19; $P < 0.0001$
Tacoma	6.91 ± 1.01	FG > TA > TR
Trimble	3.92 ± 0.66	
HABITAT		
Aspen - Reference	8.67 ± 1.20	t = 2.74; $P = 0.04$
Aspen - Target	3.00 ± 1.68	
Cottonwood - Reference	**11.4 ± 0.88**	t = 5.36; $P < 0.0001$
Cottonwood - Target	6.33 ± 0.33	
Shrub - Target	4.25 ± 1.38	
Wetland - Target	5.44 ± 1.13	

Table 15.Comparisons of mean (± se) abundance (observations/point-count) of bird species at 3 study sites of the Kalispel Habitat Restoration Project. Comparisons between sites are based on ANOVA with Tukey's Mean Separation; < or > indicates $P < 0.05$. Site abbreviations are: FG = Flying Goose, TA = Tacoma, TR = Trimble.

Species	Flying Goose $\bar{x}$ ± se	Tacoma $\bar{x}$ ± se	Trimble $\bar{x}$ ± se	ANOVA w/ Tukey
AMERICAN BITTERN	0.033 ± 0.023	0	0	F =1.19; ns
American Crow	0.15 ± 0.06	0	0	F = 3.33; *P* = 0.04 FG>others
American Goldfinch	0.07 ± 0.04	0	0	F = 1.64; ns
American Redstart	0.02 ± 0.02	0	0	F = 0.56; ns
American Robin	0.05 ± 0.04	0.70 ± 0.70	0	F = 1.49; ns
American Widgeon	0	0.03 ± 0.03	0.14 ± 0.14	F = 1.12; ns
Bald Eagle	0.07 ± 0.03	0	0	F = 2.67; ns
Bank Swallow	0	0	0.06 ± 0.06	F = 1.31; ns
Black-billed Magpie	0.18 ± 0.09	0	0	F = 2.59; ns
Black-capped Chickadee	0.52 ± 0.165	0.21 ± 0.13	0	F = 3.45; *P* = 0.04 FG>TR
Black Tern	0.13 ± 0.08	0	0	F = 1.37; ns
Brown-headed cowbird	0.10 ± 0.06	0	0.08 ± 0.08	F = 0.65; ns
Blue Winged Teal	0	0	0.03 ± 0.03	F = 1.31; ns
Bobolink	0	0.36 ± 0.18	0.36 ± 0.10	F = 6.02; *P* = 0.0052 TA=TR>FG
Bullock's Oriole	0.49 ± 0.10	0.18 ± 0.12	0	F = 5.82; *P* = 0.006 FG>TA>TR
Canada Goose	0.28 ± 0.27	0	0.06 ± 0.06	F = 0.52; ns
CEDAR WAXWING	0.27 ± 0.11	0.12 ± 0.12	0	F = 1.71; ns
CINNAMON TEAL	0	0.03 ± 0.03	0.11 ± 0.07	F = 1.71; ns
Cliff Swallow	0	0.21 ± 0.06	1.86 ± 0.68	F = 9.01; *P* = 0.0006 TR>TA=FG
Common Goldeneye	0.13 ± 0.12	0	0	F = 0.73; ns
Common Snipe	0.10 ± 0.04	0.15 ± 0.07	0	F = 2.29; ns
Common Yellowthroat	0.20 ± 0.07	0	0	F = 4.57; *P* = 0.0163 FG>TA=TR
Double-crested Cormorant	0.05 ± 0.04	0	0	F = 1.05; ns

Table 15. Continued.

Species	Flying Goose $\bar{x}$ ± se	Tacoma $\bar{x}$ ± se	Trimble $\bar{x}$ ± se	ANOVA w/ Tukey
Eastern Kingbird	0.10 ± 0.05	0.18 ± 0.12	0	F = 1.49; ns
European starling	1.9 ± 0.27	0	0	F = 25.84; *P* < 0.0001 FG>TA=TR
Great-blue Heron	0.37 ± 0.19	0.03 ± 0.03	0.03 ± 0.03	F = 1.69; ns
Grey Catbird	0.15 ± 0.07	0.09 ± 0.03	0	F = 1.77; ns
Hammond's Flycatcher	0	0.06 ± 0.06	0	F = 1.49; ns
Hummingbird	0.02 ± 0.02	0	0	F = 0.56; ns
Killdeer	0.02 ± 0.02	0	0.17 ± 0.08	F = 4.80; *P* = 0.0136 TR>FG=TA
Long-billed Curlew	0	0	0.08 ± 0.08	F = 1.31; ns
MacGillvery's Warbler	0.02 ± 0.02	0	0	F = 0.56; ns
Mallard	0	0.09 ± 0.09	0	F = 1.49; ns
Mourning Dove	0.03 ± 0.02	0.03 ± 0.03	0	F = 0.60; ns
Nashville Warbler	0.03 ± 0.02	0	0	F = 1.19; ns
Northern Flicker	0.02 ± 0.02	0.06 ± 0.04	0	F = 1.58; ns
Northern Shoveler	0.03 ± 0.02	0.03 ± 0.03	0.03 ± 0.03	F = 0.01; ns
Osprey	0.13 ± 0.10	0	0	F = 0.93; ns
Pine Siskin	0	0.03 ± 0.03	0	F = 1.49; ns
Red-breasted Nuthatch	0.08 ± 0.05	0	0	F = 1.72; ns
Red Crossbill	0.08 ± 0.06	0	0	F = 1.14; ns
Red-eyed Vireo	0.15 ± 0.05	0	0	F = 4.80; *P* = 0.0135 FG>TA=TR
Red-naped Sapsucker	0.10 ± 0.04	0.03 ± 0.03	0	F = 2.11; ns
Red-tailed Hawk	0.02 ± 0.02	0	0	F = 0.56; ns
Red-winged Blackbird	0.27 ± 0.17	0.36 ± 0.14	0	F = 1.27; ns
Rough-winged Swallow	0	0.03 ± 0.03	0	F = 1.49; ns
Savannah Sparrow	0	0.58 ± 0.22	3.36 ± 0.44	F = 57.59; *P* < 0.0001 TR>TA=FG
Solitary Vireo	0	0.09 ± 0.06	0	F = 2.90; ns

Table 15. Continued.

Species	Flying Goose $\bar{x}$ ± se	Tacoma $\bar{x}$ ± se	Trimble $\bar{x}$ ± se	ANOVA w/ Tukey
Song Sparrow	0.48 ± 0.09	0.15 ± 0.08	0	F = 10.94; *P* = 0.0002 FG>TA=TR
Sora Rail	0.02 ± 0.02	0	0	F = 0.56; ns
Spotted Sandpiper	0.03 ± 0.02	0	0	F = 0.56; ns
Sharp-shinned Hawk	0.02 ± 0.02	0	0	F = 0.56; ns
Swainson's Thrush	0.03 ± 0.02	0	0	1.19; ns
Tree Swallow	3.9 ± 0.56	0.27 ± 0.12	0.28 ± 0.19	F = 22.10; *P* < 0.0001 FG>TR=TA
Vaux's Swift	0.02 ± 0.02	0	0	F = 0.56; ns
Violet-green Swallow	0	0.03 ± 0.03	0	F = 1.49; ns
Warbling Vireo	0.03 ± 0.03	0	0	F = 0.56; ns
Western Kingbird	0.02 ± 0.02	0	0	F = 0.56; ns
Western Meadowlark	0	0.06 ± 0.06	0.08 ± 0.06	F = 1.34; ns
Western Wood Peewee	0.07 ± 0.05	0.06 ± 0.04	0	F = 3.77; *P* = 0.0315 FG>TR
Willow Flycatcher	0	0.06 ± 0.06	0	F = 1.49; ns
Wilson's Phalarope	0.03 ± 0.03	0	0.05 ± 0.05	F = 0.43; ns
Wood Duck	0.07 ± 0.04	0.06 ± 0.06	0	F = 0.73; ns
Yellow-headed Blackbird	0.02 ± 0.02	0.24 ± 0.18	0	F = 2.40; ns
Yellow Warbler	0.90 ± 0.15	0.21 ± 0.10		F = 14.04; *P* < 0.0001 FG>TA=TR
Yellow-rumped Warbler	0.08 ± 0.07	0	0	F = 0.85; ns
Total Waterfowl	0.72 ± 0.40	0.30 ± 0.22	0.36 ± 0.15	F = 0.47; ns
Total Primary Cavity	0.72 ± 0.17	0.30 ± 0.16	0	F = 6.36; *P* = 0.0040 FG>TA>TR
Total Migrant Songbird	6.34 ± 0.76	2.45 ± 0.34	5.9 ± 1.04	F = 6.12; *P* = 0.0048 FG>TR>TA

Table 16. Comparisons of mean (± se) abundance (observations/point-count) of bird species on reference and restoration (Restor.) habitats of the Kalispel Habitat Restoration Project. Comparisons between habitats are based on ANOVA with Tukey's Mean Separation; < or > indicates $P < 0.05$. Site abbreviations are: RA = Reference Apsen; AS = Restoration Aspen; RC = Reference Cottonwood; CO = Restoration Cottonwood; WL = Restoration Wetland; SH = Restoration Shrub.

	Aspen		Cottonwood		Wetland	Shrub	ANOVA w/ Tukey's
	Restor.	Reference	Restor.	Reference	Restor.	Restor.	
Species	$\bar{x}$ ± se	$\bar{x}$ ± se	$\bar{x}$ ± se	$\bar{x}$ ± se	$\bar{x}$ ± se	$\bar{x}$ ± se	
AMERICAN BITTERN	0	0	0	0.03 ± 0.02	0	0	F = 0.44; ns
American Crow	0	0	0	0.15 ± 0.06	0	0	F = 1.23; ns
American Goldfinch	0	0	0	0.66 ± 0.04	0	0	F = 0.61; ns
American Redstart	0	0	0	0.02 ± 0.02	0	0	F = 0.21; ns
American Robin	0	2.44 ± 2.44	0	0.05 ± 0.03	0	0.08 ± 0.08	F = 3.30; $P = 0.01$ RA>others
American Widgeon	0	0	0	0	0.22 ± 0.18	0	F = 1.06; ns
Bald Eagle	0	0	0	0.07 ± 0.03	0	0	F = 0.99; ns
Bank Swallow	0	0	0	0	0.07 ± 0.07	0	F = 0.73; ns
Black-billed Magpie	0	0	0	0.18 ± 0.08	0	0	F = 0.96; ns
Black-capped Chickadee	0	0.67 ± 0.38	0	0.52 ± 0.16	0.04 ± 0.04	0	F = 1.93; ns
Black Tern	0	0	0	0.13 ± 0.08	0	0	F = 0.51; ns
Brown-headed Cowbird	0	0	0	0.1 ± 0.06	0.11 ± 0.11	0	F = 0.34; ns
Blue Winged Teal	0	0	0.11 ± 0.11	0	0	0	F = 3.44; $P = 0.01$ CO>others
Bobolink	0	0	0.22 ± 0.11	0	0.52 ± 0.19	0.75 ± 0.16	F = 8.29; $P < 0.0001$ SH=WL>RA=AS= RC
Bullock's Oriole	0.33 ± 0.33	0.11 ± 0.11	0	0.45 ± 0.10	0.04 ± 0.04	0	F = 2.39; $P = 0.05$
Canada Goose	0	0	0	0.28 ± 0.27	0.07 ± 0.07	0	F = 0.20; ns
CEDAR WAXWING	0	0	0	0.27 ± 0.11	0	0.33 ± 0.33	F = 1.00; ns
CINNAMON TEAL	0	0	0.22 ± 0.22	0	0.04 ± 0.04	0.17 ± 0.17	F = 2.11; ns
Cliff Swallow	0.08 ± 0.08	0	2.33 ± 1.15	0	1.81 ± 0.83	0.25 ± 0.16	F = 4.10; $P = 0.004$ CO>SH=AS=RA=RC
Common Goldeneye	0	0	0	0.13 ± 0.12	0	0	F = 0.27; ns
Common Snipe	0.08 ± 0.08	0	0.22 ± 0.22	0.10 ± 0.04	0.07 ± 0.05	0	F = 0.68; ns

Table 16. Continued.

Species	Aspen Restor. $\bar{x}$ ± se	Aspen Reference $\bar{x}$ ± se	Cottonwood Restor. $\bar{x}$ ± se	Cottonwood Reference $\bar{x}$ ± se	Wetland Restor. $\bar{x}$ ± se	Shrub Restor. $\bar{x}$ ± se	ANOVA w/ Tukey's
Common Yellowthroat	0	0	0	0.20 ± 0.07	0	0	F = 1.69; ns
Double-crested Cormorant	0	0	0	0.05 ± 0.04	0	0	F = 0.39; ns
Eastern Kingbird	0.34 ± 0.34	0.11 ± 0.11	0	0.10 ± 0.05	0.04 ± 0.04	0	F = 0.99; ns
European starling	0	0	0	1.85 ± 0.27	0	0	F = 9.56; *P* < 0.0001 RC>others
Great-blue Heron	0	0.11 ± 0.11	0	0.37 ± 0.19	0	0.08 ± 0.08	F = 0.65; ns
Grey Catbird	0.08 ± 0.08	0.11 ± 0.11	0	0.15 ± 0.07	0.04 ± 0.04	0	F = 0.60; ns
Hammond's Flycatcher	0	0.22 ± 0.22	0	0	0	0	F = 3.44; *P* = 0.01 RA>others
Hummingbird	0	0	0	0.02 ± 0.02	0	0	F = 0.21; ns
Killdeer	0	0	0.22 ± 0.22	0.02 ± 0.02	0.11 ± 0.07	0.08 ± 0.08	F = 1.33; ns
Long-billed Curlew	0	0	0	0	0.11 ± 0.11	0	F = 0.73; ns
MacGillvery's Warbler	0	0	0	0.02 ± 0.02	0	0	F = 0.21; ns
Mallard	0	0	0		0.11 ± 0.11	0	F = 0.73; ns
Mourning Dove	0	0.11 ± 0.11	0	0.03 ± 0.02	0	0	F = 0.97; ns
Nashville Warbler	0	0	0	0.03 ± 0.02	0	0	F = 0.44; ns
Northern Flicker	0	0.22 ± 0.11	0	0.02 ± 0.02	0	0	F = 5.37; *P* = 0.0008 RA>others
Northern Shoveler	0	0	0.11 ± 0.11	0.03 ± 0.02	0.04 ± 0.04	0	F = 0.60; ns
Osprey	0	0	0	0.13 ± 0.10	0	0	F = 0.34; ns
Pine Siskin	0	0.11 ± 0.11	0	0	0	0	F = 3.44; *P* = 0.01 RA>others
Red-breasted Nuthatch	0	0	0	0.08 ± 0.05	0	0	F = 0.64; ns
Red Crossbill	0	0	0	0.08 ± 0.06	0	0	F = 0.42; ns
Red-eyed Vireo	0	0	0	0.15 ± 0.05	0	0	F = 1.78; ns
Red-naped Sapsucker	0	0.11 ± 0.11	0	0.10 ± 0.04	0	0	F = 1.06
Red-tailed Hawk	0	0	0	0.02 ± 0.02	0	0	F = 0.21; ns
Red-winged Blackbird	0.08 ± 0.08	0.22 ± 0.11	0	0.27 ± 0.17	0.22 ± 0.16	0.25 ± 0.25	F = 0.14; ns

Table 16. Continued.

Species	Aspen Restor. $\bar{x}$ ± se	Aspen Reference $\bar{x}$ ± se	Cottonwood Restor. $\bar{x}$ ± se	Cottonwood Reference $\bar{x}$ ± se	Wetland Restor. $\bar{x}$ ± se	Shrub Restor. $\bar{x}$ ± se	ANOVA w/ Tukey's
Rough-winged Swallow	0	0	0.11 ± 0.11	0	0	0	F = 3.44; *P* = 0.01 CO>others
Savannah Sparrow	2.00 ± 0.43	0	1.89 ± 0.40	0	2.74 ± 0.68	2.09 ± 1.35	F = 7.75; *P* < 0.0001 WL=SH=AS=CO>RA=RC
Solitary Vireo	0	0.33 ± 0.19	0	0	0	0	F = 10.22; *P* < 0.0001 RA>others
Song Sparrow	0.17 ± 0.17	0.22 ± 0.22	0	0.48 ± 0.09	0.04 ± 0.04	0	F = 4.11; *P* = 0.004 RC>SH=CO
Sora Rail	0	0	0	0.02 ± 0.02	0	0	F = 0.21; ns
Spotted Sandpiper	0	0	0	0.03 ± 0.03	0	0	F = 0.21; ns
Sharp-shinned Hawk	0	0	0	0.02 ± 0.02	0	0	F = 0.21; ns
Swainson's Thrush	0	0	0	0.03 ± 0.02	0	0	F = 0.44; ns
Tree Swallow	0	0	0.67 ± 0.19	3.90 ± 0.57	0.37 ± 0.22	0.25 ± 0.25	F = 8.31; *P* < 0.0001 RC>others
Vaux's Swift	0	0	0	0.02 ± 0.02	0	0	F = 0.21; ns
Violet-green Swallow	0	0	0.11 ± 0.11	0	0	0	F = 3.44; *P* = 0.01 CO>others

Warbling Vireo	0	0	0	0.03 ± 0.03	0	0	F = 0.21; ns
Western Kingbird	0	0	0	0.02 ± 0.02	0	0	F = 0.21; ns
Western Meadowlark	0.08 ± 0.08	0	0	0	0.15 ± 0.10	0	F = 1.54; ns
Western Wood Peewee	0	0.22 ± 0.11	0	0.17 ± 0.05	0	0	F = 2.26; ns
Willow Flycatcher	0	0.22 ± 0.22	0	0	0	0	F = 3.44; *P* = 0.01 RA>others
Wilson's Phalarope	0	0	0	0.03 ± 0.03	0	0.17 ± 0.17	F = 0.90; ns
Wood Duck	0	0	0	0.07 ± 0.04	0.07 ± 0.07	0	F = 0.34; ns
Yellow-headed Blackbird	0	0	0.67 ± 0.67	0.02 ± 0.02	0.07 ± 0.05	0	F = 2.97; *P* = 0.02 CO>others
Yellow Warbler	0.08 ± 0.08	0.67 ± 0.19	0	0.87 ± 0.15	0	0	F = 6.49; *P* = 0.0002 RC=RA>others
Yellow-rumped Warbler	0	0	0	0.08 ± 0.07	0	0	F = 0.31; ns
Total Waterfowl	0	0	0.44 ± 0.22	0.72 ± 0.40	0.63 ± 0.29	0.17 ± 0.17	F = 0.37; ns
Total Primary Cavity	0	1.00 ± 0.33	0	0.72 ± 0.16	0.04 ± 0.04	0	F = 4.18; *P* = 0.004 RA=RC>others
Total Migrant Songbird	2.91 ± 0.64	2.21 ± 0.29	5.22 ± 1.66	6.33 ± 0.76	5.63 ± 1.35	3.34 ± 1.55	F = 1.64; ns

APPENDIX D

SCHEIBEL, SIVERT & TRIMBLE
PROPERTY ACQUISITIONS

UNDESIRABLE PLANT SURVEYS FOR THE KALISPEL TRIBE

July 24, 26 & 27, 2001 and

August 8 & 10, 2001

CONDUCTED BY
Sharon L Sorby and Jan Hirabayashi
of the Pend Oreille County Noxious Weed Control Board

TOTAL PROJECT COSTS
UNDESIRABLE PLANT SURVEY
FOR THE KALISPEL TRIBE
DEPARTMENT OF NATURAL RESOURCES

Labor Costs		
Survey	28 total hours @ $12.00/hour	$ 336.00
Survey	44 total hours @ $22.00/hour	968.00
Technical report	30 total hours @ $12.00/hour	360.00
Technical report	35 total hours @ $22.00/hour	770.00
Clerical	8 total hours @ $18.00/hour	144.00
Overhead Costs		
Report copies	200 copies @ $0.05/copy	$ 10.00
Supplies:		
Film		$ 115.00
Process film		171.00
Mileage	315 miles @ $0.40/mile	$ 126.00
TOTAL ALL COSTS FOR SURVEY		**$3,000.00**

SCHEIBEL PROPERTY ACQUISITION

UNDESIRABLE PLANT SURVEY

ABSTRACT

An undesirable plant survey of the Scheibel Property Acquisition was conducted during several visits in late July and August. We found no Washington State class A or class B-designate noxious weed growing on this property.

A number of class B non-designate noxious weeds were found including, meadow hawkweed, *(Hieracium caespitosum)*, ox-eye daisy, *(Leucanthemum vulgare),* spotted knapweed, *(Centaurea biebersteinii),* and sulfur cinquefoil, *(Potentilla recta)*.

The class C weeds found include absinth wormwood *(Artemisia absinthium)*, Canada thistle, *(Cirsium arvense)*, common tansy *(Tanecetum vulgare)*, reed canarygrass *(Phalaris aurundinacea)*, St. Johnswort, *(Hypericum perforatum)* and yellow toadflax *(Linaria vulgare)*. Although desirable to control these 2 classes of weeds, it is not mandatory under Pend Oreille County Noxious Weed Control Board policy.

Other undesirable plants found that are not on the noxious weed list, but considered a nuisance include bull thistle *(Cirsium vulgare)*, common burdock, *(Arctium minus)*, common mullein, *(Verbascum thapsus)*, and quackgrass *(Agropyron repens)*. These plants are unregulated.

Other non-native plants noted include asparagus *(Asparagus officianlis)*, curly dock, *(Rumex crispus)*, and meadow salsify, *(Tragopogon pratensis)*.

Appropriate broadcast and spot herbicide and fertilizer treatment is recommended for the primary infestation sites. Transline® (clopyralid) or Curtail® (clopyralid plus 2,4-D) with Garlon® (triclopyr) injection as needed or Redeem R&P® (clopyralid plus triclopyr) and with a base mix of Ammonium sulfate Fines® (ammonium sulfate) fertilizer and Sylgard 309® (silicone plus alcohols) spreader would be appropriate for the main infestations away from the water edge. Escort® (metsulfuron methyl) injection for the more problematical weeds such as tansy or toadflax species will be necessary. Garlon in a base of R-11® (alcohols plus compounded silicone) spreader-activator alone would be appropriate for weed populations along the water edge. Only Rodeo® (glyphosate - aquatic label) in a base of R-11® (alcohols plus compounded silicone) spreader-activator would be applicable for treating the reed canarygrass populations. Biological control is recommended for species that have agents available if some weed occupancy were acceptable.

SIVERTS PROPERTY ACQUISITION

UNDESIRABLE PLANT SURVEY

ABSTRACT

An undesirable plant survey of the Siverts Property Acquisition was conducted during several visits in late July and August. We found no Washington State class A or class B-designate noxious weed growing on this property.

A number of class B non-designate noxious weeds were found including, Dalmatian toadflax *(Linaria dalmatica dalmatica)*, orange and meadow hawkweeds, *(Hieracium aurantiacum and H. caespitosum)*, ox-eye daisy, *(Leucanthemum vulgare),* spotted knapweed, *(Centaurea biebersteinii),* and sulfur cinquefoil, *(Potentilla recta)*.

The class C weeds found include Canada thistle, *(Cirsium arvense)*, common tansy *(Tanecetum vulgare)*, reed canarygrass *(Phalaris aurundinacea)*, and St. Johnswort, *(Hypericum perforatum)*. Although desirable to control these 2 classes of weeds, it is not mandatory under Pend Oreille County Noxious Weed Control Board policy.

Other undesirable plants found that are not on the noxious weed list, but considered a nuisance include black medic *(Medicago lupulina),* bull thistle *(Cirsium vulgare)*, cluster tarweed, *(Madia glomerata),* a native, common mullein, *(Verbascum thapsus),* curly dock, *(Rumex crispus),* evening primrose, *(Oenothera biennis)*, a variety of annual, common garden variety, weedy mustards, (Brassicaceae), prickly lettuce, *(Lactuca serriola)*, red sorrel, *(Rumex acetosella),* stinking dog fennel, *(Anthemis cotula)*, and sweetclover *(Melilotus alba)*. These plants are unregulated.

On the west side of the railroad bed just to the north of the trestle, there was an interesting find of marsh betony *(Stachys paulustris),* a circumboreal species, growing in association with Balkan catch-fly, *(Silene csereii)*. Although well established in Montana, this is a first herbarium collection for the state of Washington. It will be a weed to watch for. Another non-native plant noted includes catnip, *(Nepeta cataria)*.

Appropriate broadcast and spot herbicide and fertilizer treatment is recommended for the primary infestation sites. Transline® (clopyralid) or Curtail® (clopyralid plus 2,4-D) with Garlon® (triclopyr) injection as needed or Redeem R&P® (clopyralid plus triclopyr) and with a base mix of Ammonium sulfate Fines® (ammonium sulfate) fertilizer and Sylgard 309® (silicone plus alcohols) spreader-activator would be appropriate for the main infestations away from the water edge. Escort® (metsulfuron methyl) injection for the more problematical weeds such as

tansy or toadflax species will be necessary. Garlon in a base of R-11® (alcohols plus compounded silicone) spreader-activator alone would be

appropriate for weed populations along the water edge. Only Rodeo® (glyphosate - aquatic label) in a base of R-11® (alcohols plus compounded silicone) spreader-activator would be applicable for treating the reed canarygrass populations. Biological control is recommended for species that have agents available if some weed occupancy were acceptable.

TRIMBLE CREEK PROPERTY ACQUISITION

UNDESIRABLE PLANT SURVEY

ABSTRACT

An undesirable plant survey of the Trimble Creek Property Acquisition was conducted during one visit July 24, 2001. We found no Washington State class A or class B-designate noxious weed growing on this property.

A number of class B non-designate noxious weeds were found including, orange and meadow hawkweeds, *(Hieracium aurantiacum and H. caespitosum)*, ox-eye daisy, *(Leucanthemum vulgare),* spotted knapweed, *(Centaurea biebersteinii),* and sulfur cinquefoil, *(Potentilla recta)*.

The class C weeds found include absinth wormwood, *(Artemisia absinthium)*, Canada thistle, *(Cirsium arvense)*, common tansy *(Tanecetum vulgare)*, reed canarygrass *(Phalaris aurundinacea)*, St. Johnswort, *(Hypericum perforatum)* and yellow toadflax *(Linaria vulgare)*. Although desirable to control these 2 classes of weeds, it is not mandatory under Pend Oreille County Noxious Weed Control Board policy.

Other undesirable plants found that are not on the noxious weed list, but considered a nuisance include bull thistle *(Cirsium vulgare)*, cluster tarweed, *(Madia glomerata),* a native, common mullein, *(Verbascum thapsus),* and stinking dog fennel, *(Anthemis cotula)*. Other non-native plants noted include curly dock, *(Rumex crispus)*, and meadow salsify, *(Tragopogon pratensis)*. These plants are unregulated.

Appropriate broadcast and spot herbicide and fertilizer treatment is recommended for the primary infestation sites. Transline® (clopyralid) or Curtail® (clopyralid plus 2,4-D) with Garlon® (triclopyr) injection as needed or Redeem R&P® (clopyralid plus triclopyr) and with a base mix of Ammonium sulfate Fines® (ammonium sulfate) fertilizer and Sylgard 309® (silicone plus alcohols) spreader-activator would be appropriate for the main infestations away from the water edge. Escort® (metsulfuron methyl) injection for the more problematical weeds such as tansy or toadflax species will be necessary. Garlon in a base of R-11® (alcohols plus compounded silicone) spreader-activator alone would be appropriate for weed populations along the water edge. Only Rodeo® (glyphosate - aquatic label) in a base of R-11® (alcohols plus compounded silicone) spreader-activator would be applicable for treating the reed canarygrass populations. Biological control is recommended for species that have agents available if some weed occupancy were acceptable.

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INTRODUCTION

This report has been prepared under and in accordance with an INTERGOVERNMENTAL AGREEMENT entered into on July 9, 2001.

Dates of survey: July 20, 26, 27 and August 8 and 10, 2001

Conducted by: Pend Oreille County Noxious Weed Control Board
Sharon L. Sorby and Jan Hirabayashi
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ATTACHMENTS

The key to the maps of the weed infestation locations, and the maps are attached as Appendix A. The photographs are captioned and attached as Appendix B. The Pend Oreille County Weed Board Philosophical and Policy Statements, the County Weed List and Contractor List are attached as Appendix C.

SITE DESCRIPTIONS

The Scheibel Property is located along the western shore of the Pend Oreille River, about midway along its length. The north end is accessed from a dike road that turns east off of Highway 20 at mile marker 415.5 -- just across from the north end of West Calispell Road. The south end is accessed by a turn to the east off Highway 20 at mile marker 416.4

The majority of the property is gravel deposition covered with silty clay loam and Blueslide silt loam along the River shoreline. The property is mostly old, open pastures and hay fields. A stand of hawthorn *(Crataegus sp.)* is establishing in pockets on the property. There are stands of cottonwood trees *(Populus trichocarpa)* and some Ponderosa pine *(Pinus ponderosa)* and lodgepole *(Pinus contorta)* trees in small scattered groves. It is primarily flat, and has been grazed and hayed for many years leaving the soils somewhat compacted and depleted, vulnerable to weed invasion.

The site, for the purpose of this report, is divided into 3 main areas, including the wet and scrubby area at the north end, south of the dike access road, the hay fields

in the middle and the area between the railroad bed and the river shore at the south end of the property.

The wet and scrubby area at the north end is infested with spotted knapweed, *(Centaurea biebersteinii),* ox-eye daisy, *(Leucanthemum vulgare),* Canada thistle, *(Cirsium arvense),* St. Johnswort *(Hypericum perforatum)* and to a lesser extent by meadow hawkweed, *(Hieracium caespitosum),* sulfur cinquefoil, *(Potentilla recta)*, absinth wormwood *(Artemisia absinthium)*, and common tansy, *(Tanecetum vulgare)*. The hay fields are ringed with spotted knapweed and hawkweed and they are slowly invading into the fields. The railroad bed contains most of the weed species, and some of the internal roadways have knapweed, hawkweed and ox-eye daisy, encroaching along them. The area at the south end between the railroad bed and river shore is scattered with most of the weed species.

The Siverts Property is located along the western shore of the Pend Oreille River, about midway along its length. It is accessed from a driveway onto the property off of Highway 20 at mile marker 414.6

The majority of the property is gravel deposition covered with silty clay loam, silt, gravely silt loam and sandy loam soils and Blueslide silt loam along the River shoreline. The property is mostly old, open pastures and hay fields. A stand of hawthorn *(Crataegus sp.)* is establishing between the railroad and river shore. There are pockets of cottonwood trees *(Populus trichocarpa)* and some Ponderosa pine *(Pinus ponderosa)* and lodgepole *(Pinus contorta)* trees in small scattered groves. The strips along the highway are mixed conifer stands. Except for the portion along the west side of the highway, it is primarily flat, and has been grazed and hayed for many years leaving the soils somewhat compacted and depleted, vulnerable to weed invasion.

The site, for the purpose of this report, is divided into 4 main areas, including the strips of remnant forest along the highway, the area south of the dike, the old pastures and hay field and the area between the railroad bed and the river shore.

The strips of remnant forest along the highway are heavily infested with spotted knapweed, *(Centaurea biebersteinii),* ox-eye daisy, *(Leucanthemum vulgare),* meadow hawkweed, *(Hieracium caespitosum),* St. Johnswort *(Hypericum perforatum)* and to a lesser extent by orange hawkweed, *(Hieracium aurantiacum),* sulfur cinquefoil, *(Potentilla recta)*, Canada thistle, *(Cirsium arvense),* common tansy, *(Tanecetum vulgare)* and sweetclover *(Melilotus alba)*. The dike is covered with spotted knapweed and the hawkweed complex, but the majority of the wet area is clean. The railroad bed contains most of the weed species, and some of the internal roadways are thick with knapweed, hawkweed and ox-eye daisy, but the fields and pastures are only beginning to be invaded. The area between the railroad bed and river shore is scattered with most of the weed species.

The Trimble Property surrounds a slough of Trimble Creek. It is about midway along the county's length. It is accessed from a driveway that turns east off of West Calispell Road at mile marker 19.2.

The entire soil profile of the property is Cusick silty clay loam. The property is mostly old, open pastures and a hay field. Trimble Creek has meandered through the property throughout the ages, leaving old depressions and oxbows. It has been grazed and hayed for many years leaving the soils somewhat compacted and depleted, vulnerable to weed invasion. The site, for the purpose of this report, is divided into 2 main areas, including the hay field at the west end and the pastures and wetland mosaic to the east.

The hay field at the west end of the property is mostly clean with a few scattered plants of spotted knapweed, *(Centaurea biebersteinii),* ox-eye daisy, *(Leucanthemum vulgare),* and sulfur cinquefoil, *(Potentilla recta)*. They occur a bit more abundantly in the fence lines. All the water courses are ringed with Canada thistle, *(Cirsium arvense),* with absinth wormwood, *(Artemisia absinthium)*, common mullein, *(Verbascum thapsus),* common tansy, *(Tanecetum vulgare)* and bull thistle *(Cirsium vulgare)* occasionally accompanying it. The cottonwood plots are covered with cluster tarweed, *(Madia glomerata),* a native, and meadow hawkweed, *(Hieracium caespitosum)*, and stinking dog fennel, *(Anthemis cotula)* occurs nearby. The wet areas that have dried leaving the soil more acidic have patches of curly dock, *(Rumex crispus)*. Plants of St. Johnswort *(Hypericum perforatum)* and patches of yellow toadflax *(Linaria vulgare)* are scattered throughout. The southeast end of the property is covered with meadow hawkweed and orange hawkweed *(Hieracium aurantiacum)* to a lesser extent.

DISCUSSION

WASHINGTON STATE LAW, RCW 17.10, AUTHORITY AND

PEND OREILLE COUNTY NOXIOUS WEED CONTROL BOARD POLICY

The Pend Oreille County Weed Board was established by decree of the Board of County Commissioners in December of 1985 upon petition by a group of farmers as allowed by RCW 17.10. The first two years (1986-1988) were operated on a part-time basis by the secretary of the Board, Don Hupp, with the assistance of a part-time contracted employee. The operation was granted full-time status with the hiring of a full-time coordinator in February of 1989.

The state of Washington governs noxious weed control as well as defines and lists noxious weeds under Chapter 16-750 WAC, State Noxious Weed List and Schedule of Monetary Penalties. The responsibility of property owners for controlling noxious weeds, and the authority granted to weed board coordinators to

police the control of noxious weeds is described in Chapter 17.10 RCW, Noxious Weeds - Control Boards.

Noxious weeds and other undesirable species present on the acquisition properties are covered individually in the following section. Since many of the species occur together and thus can be controlled together, management measures will be discussed in a following section. Species will be grouped accordingly, and all measures discussed to form a holistic management recommendation, including future management options. Information on specific herbicides that are included in the recommendation section will be discussed in the reference section.

CLASS A NOXIOUS WEEDS

Control mandatory in Pend Oreille County. None present.

CLASS B-DESIGNATE NOXIOUS WEEDS

Control mandatory in Pend Oreille County. None present.

CLASS B NOXIOUS WEEDS

Dalmatian toadflax (Linaria dalmatica dalmatica) * Scrophulariaceae *

Biology - Dalmatian toadflax is a short-lived perennial with a spreading fibrous root system. One to several stems can emerge from the crown, some upright (2'-4' in height), some lateral that run along the ground. Flowers are yellow, irregular (snap dragon in appearance) and form along a spike, blooming from the bottom up. It is amenable to hand-pulling and chemical control, once the waxy leaf cuticle is penetrated.

Occurrence - It is common throughout the county, preferring the gravely glacial out wash soils. **Siverts -** It is restricted on site to along the highway right-of-way and in a rock pile by the railroad bed, less than 1/4 acre, with a dominance rating of 2 on the Roché density scale.

Movement - It spreads into vulnerable areas by seed. It will be important to avoid unmitigated ground disturbance and earth movement in the affected area, as this would spread the seed already present, and open sites to further invasion.

Bioagents - Biological control agents include the defoliating moth, *Calophasia lunula)*, and the stem-boring weevil, *(Mecinus janthinus),* both present in the county, but not in the area.

Meadow (yellow) hawkweed, (Hieracium caespitosum) * Asteraceae *
Orange hawkweed, (Hieracium aurantiacum) * Asteraceae *

Biology - Meadow and orange hawkweeds are perennials, 18"-36" tall depending on competitive pressures. Each rosette has a fibrous root crown, with one mostly leafless upright stem with an umbelliform arrangement of bright yellow or orange composite ray flowers. They also sends out stolons, rapidly spreading into dense mat like infestations. The seeds have a pappus allowing wind borne dispersal. They do very well in Pend Oreille County along roads and other right-of-ways, invading pastures, hayfields, openings in wooded areas and forest floors.

Occurrence - There are many infestations in the north end of the county and the east side of the Pend Oreille River, fewer in the south county. Most infestations tend to be quite extensive. **Scheibel -** There is only the meadow hawkweed on this property. The infestation is heaviest in the south end and thins out to the north. The hay fields are ringed with it and it is starting to invade them. There are approximately 15 acres and the dominance rating varies from 1-5 on the Roché density scale. **Siverts -** They occur extensively in the strips of remnant forest along the highway, on the dike and the meadow is thick at the middle railroad crossing. There are approximately 5 acres, and its dominance rating would be 3-4 on the Roché density scale. **Trimble -** The meadow hawkweed is scattered throughout, although it becomes more dense at the eastern end. The orange is just invading into the southeast corner of the property. There is approximately 25 acres of the complex with the dominance rating varying from 1-5 on the Roché density scale.

Movement - If left untreated, it will continue to spread into the open areas and into the trees, where they occur. It will be important to avoid unmitigated ground disturbance and earth movement in the affected areas, as this would spread the seed already present, and open sites to further invasion.

Bioagents - There are no biologicals available at this time. A committee has formed to look at finding and bringing bioagents into the country. The initial insects have arrived, but at best, it will be 5 years before they would be available for general distribution.

Ox-eye daisy, (Leucanthemum vulgare) * Asteraceae *

Biology - Ox-eye daisy is a perennial, 12"-24" tall depending on competitive pressures and available moisture. Each rosette has a fibrous root crown, with many leafy upright stems and a single, white daisy flowerhead at the end of each stem. It has small seeds that can rapidly spread throughout an area to create an appearance of a carpet of snow when in bloom. It does very well in the poor soils of Pend Oreille County along roads and other right-of-ways, invading pastures, hayfields, meadows, and other openings in wooded areas.

Occurrence - There are many infestations throughout the county. Most infestations tend to be quite extensive. **Scheibel -** This property is not heavily invaded by this species. It occurs scattered and in patches throughout the property, except not in the hayfields. There is approximately 5 acres with a dominance rating of 1-2 on the Roché density scale**. Siverts -** It occurs in spots in the strips of remnant forest along the highway, along the roadways on the property and is encroaching in the pastures and the area between the railroad and river shore. There are approximately 5 acres, with a dominance rating of 2-3 on the Roché

density scale. **Trimble -** Despite the openness of this property, it is not heavily invaded by this species. It occurs scattered and in patches throughout the property. There is approximately 10 acres with a dominance rating of 2-3 on the Roché density scale**.**

Movement - If left untreated, it will continue to spread into the more open areas and along the roadways and into depleted fields. It will be important to avoid unmitigated ground disturbance and earth movement in the affected areas, as this would spread the seed already present, and open sites to further invasion.

Bioagents - There are no biologicals available at this time, and as yet, no work to find any has been initiated.

Spotted knapweed, (Centaurea biebersteinii) * Asteraceae *

Biology - Spotted knapweed is a short-lived perennial, (17+ years) 12"-66" tall depending on soil and available moisture. It has a deep taproot with one to many upright stems with spreading branches. It usually has purple (sometimes white) composite flowers at the end of each branch. The seedheads open upon maturity and the seeds are readily knocked out by the wind shaking them, or by passing wildlife, livestock, people or vehicles. It does very well in Pend Oreille County along roads, and other disturbed sites. It has invaded many forested areas where the soils are thin, and is now encroaching into hayfields and wildlife areas that are otherwise in good shape.

Occurrence - It is very common throughout the county. It prefers the more gravely glacial out wash soils common to much of our county. **Scheibel -** The dike access road has quite a bit of knapweed, the rest of the north end of the property has scattered plants and patches. The hay fields are relatively clear of it, although it shows up in some of the fence lines and along the access roads. The south end towards the river has a number of patches that have spread from initial dispersed introductions, probably from wildlife or cattle. There is about 7 acres and the dominance rating varies from 1-5 on the Roché density scale. **Siverts -** It is mostly restricted on site to the areas with the glacial out wash soil type, areas of fill, along the dike and right-of-ways. There are approximately 10 acres and the dominance rating varies from 1-5 on the Roché density scale. **Trimble -** There is some knapweed incursion along the fence lines from the adjoining properties and a few plants and patches scattered throughout the property. There are approximately 3 acres and the dominance rating varies from 1-2 on the Roché density scale.

Movement - It will continue to spread into vulnerable areas from seed dispersed by wildlife, soil movement and other human activities if left untreated. It will be important to avoid unmitigated ground disturbance and earth movement in the affected areas, as this would spread the seed already present, and open sites to further invasion.

Bioagents - The seedhead biologicals *(Urophora affinis and U. quadrifasciata, and Metznaria paucipunctella)* are already available and established throughout the county. The root boring moth *(Agapeta zoegana)* although introduced has not established in the county. Although the newer bioagents, the seedhead weevil *(Larinus minutus)* and the root-boring weevil

(Cyphocleonus achates) have been introduced into the county, it would be beneficial to introduce them on these sites.

Sulfur cinquefoil, (Potentilla recta) * Rosaceae *

Biology - Sulfur cinquefoil is a perennial 12"-30" tall depending on available moisture. The rootstock is well developed, supporting a multitude of erect stems that branch out at the open, flat-topped cyme inflorescence. The flowers are small and pale yellow. The leaves are palmately compound with serrated margins.

Occurrence - Infestations are common in disturbed and undisturbed areas such as roadsides and pastures throughout the county. **Scheibel -** There are a few scattered plants in the north end. There are scattered patches surrounding and encroaching into the hay fields. There is very little in the south end and east of the railroad tracks. There are approximately 7 acres with a dominance rating of 1-4 on the Roché density scale. **Siverts -** There are a few scattered plants in the strips of remnant forest along the highway, and scattered throughout the property where the seed has been introduced, but has yet to spread to problem levels. There is about 1 acre and its dominance rating would be 1-2 on the Roché density scale. **Trimble -** There are numerous patches and scattered plants throughout the property. There are approximately 10 acres and the dominance rating would be 1-4 on the Roché density scale.

Movement - It spreads by seed, with earth, vehicle, and animal movement into vulnerable areas. If left untreated, it will continue to spread. It will be important to avoid unmitigated ground disturbance and earth movement in the affected areas, as this could spread it, and open sites to further invasion.

Bioagents - Two agents have been identified from eastern Europe including a root moth, *(Tinthia myrmosaeformis)*, and a seedhead weevil, *(Anthonomus rubripes)*; however, they remain uncleared for release at this time.

CLASS C NOXIOUS WEEDS

Absinth wormwood, (Artemisia absinthium) * Asteraceae *

Biology - Absinth wormwood is a bushy, semi-woody, perennial, 24"-54" tall depending on available moisture and competitive pressures. It has a fibrous root system with a deep taproot and many upright stems sprouting from the crown. Its flowers are borne on a spike and are not showy. It does very well in Pend Oreille County along roads and other disturbed sites. It has invaded many pastures that have thin soils to begin with and have also been overgrazed.

Occurrence - It occurs in isolated infestations throughout the county. It prefers disturbed sites, especially where horses have overgrazed. **Scheibel -** It is primarily restricted on site to the dike access road. There is less than 1 acre spread along the dike as individual plants or small clusters. The dominance rating would be a 1 on the Roche density scale. **Trimble -** It is across the fence on the adjoining

property to the west. It shows up on the property along the north side of the slough at the eastern end of the property, and scattered plants along the bank of the northern branch of the creek in the middle of the property. There is less than 1 acre with a dominance rating of 1-3 on the Roché density scale.

Movement - It will continue to spread by seed in the vulnerable areas along the dike onto the railroad bed, and potentially into the fields on the Scheibel property; and along the slough and into the fields on the Trimble property if left untreated. It will be important to avoid unmitigated ground disturbance and earth movement in the affected areas, as this would spread the seed already present, and open sites to further invasion.

Bioagents - There are currently no known biologicals at this time, and none are under study.

Canada thistle, (Cirsium arvense) * Asteraceae *

Biology - Canada thistle is a perennial, 24"-54" tall depending on available moisture and competitive pressures. It has a rhizomatous root system and stems grow up to form dense stands. It is smooth, with spines on the stems and leaf points, and has a panicle of pale purple, sometimes white composite flowerheads. It has been well established in Pend Oreille County for many years in moist areas, along roads, other right-of-ways, recently logged areas, and other disturbed sites. It can be invasive into open areas, especially if they are subirrigated.

Occurrence - Infestations are distributed throughout the county. It prefers moist sites. **Scheibel -** It occurs all along the dike access road at the north end of the property, and scattered throughout the rest. There are approximately 5 acres with a dominance rating of 1-3 on the Roché density scale. **Siverts -** It occurs scattered throughout the property. There are about 3 acres and the dominance rating would be a 1 on the Roché density scale. **Trimble -** It rings all of the water courses on the property. There are approximately 8 acres with a dominance rating of 1-2 on the Roché density scale.

Movement - It will spread by seed if the ground is disturbed and into vulnerable areas, particularly in the wetter areas. It will be important to avoid unmitigated ground disturbance and earth movement in the affected areas, as this would spread the seed already present as well as root fragments (the primary means of spread), and open sites to further invasion.

Bioagents - There have been no local biological releases. There are 3 agents available including the stem weevil, *(Ceutorynchus litura)*, the bud weevil, *(Larinus planus)*, and the gall-fly, *(Urophora cardui)*. None are highly effective, although the damage caused by the stem borer allows entry of secondary organisms that can seriously damage a colony. The effectiveness of the other two agents is nominal in that although they can greatly reduce seed production, Canada thistle reproduces primarily by root spread.

Common tansy, (Tanecetum vulgare) * Asteraceae *

Biology - Common tansy is a perennial 24" - 48" tall depending on available moisture and competitive pressures. A rhizomatous and fibrous root system supports a multitude of stems with dark green pinnately dissected leaves, giving them a fern-like appearance. The discoid flowerheads form in a panicle at the end of the branches, are small, yellow, and have a foul odor.

Occurrence - It is well established throughout the county in heavier, subirrigated soils that have been disturbed. **Scheibel -** We found tansy about midway on the property just to the west of the railroad tracks, at the southern tip of the eastern most slough of Trimble creek, along the northern bank of the unnamed creek at the south end of the property and along the river bank to the south of that. There was approximately 1 acre with a dominance rating of 1-2 on the Roché density scale. **Siverts -** We found one plant just getting started off the railroad bed near the south end of the trestle, and there was quite a bit along the access road into the strip of timber on the west side of the highway. There was about an acre with a dominance rating of 1-3 on the Roché density scale. **Trimble -** There are approximately 2 acres with varying dominance rating of 1-3 on the Roché density scale.

Movement - It spreads readily by seed into areas where the ground has been disturbed. If left untreated, it will continue to spread into vulnerable areas by wind, wildlife, livestock and human movement through the affected areas. It will be important to avoid unmitigated ground disturbance and earth movement in the affected areas, as this would spread the seed already present, and open sites to further invasion.

Bioagents - There are no known biologicals available.

Reed canarygrass, (Phalaris aurundinacea) * Poaceae *

Biology - A highly variable species, it is a rhizomatous perennial grass that can reach three to six feet in height. The sturdy, often hollow stems can be up to 1/2 inch in diameter, with some reddish coloration near the top. The leaf blades are flat and hairless, 1/4 to 3/4 of an inch wide. The flowers are borne in panicles on culms high above the leaves. The panicles are generally three to six inches in length. The species flowers in June and July. When in flower, the species produces abundant pollen and chaff, which aggravate hay fever and allergies. It forms dense, highly productive single species stands that pose a major threat to many wetland ecosystems. The species grows so vigorously that it is able to inhibit and eliminate competing species. In addition, areas that have existed as reed canarygrass monocultures for extended periods may have seed banks that are devoid of native species. Unlike native wetland vegetation, dense stands of reed canarygrass have little value for wildlife. Few species eat the grass, and the stems grow too densely to provide adequate cover for small mammals and waterfowl. Infestations can also increase siltation. Although reed canarygrass has been planted as a forage crop in some areas, the species poses a significant threat to the state's wetlands as it is extremely aggressive and often forms persistent,

monocultures in wetlands and riparian areas. A wetland plant, this species typically occurs in soils that are saturated or nearly saturated for most of the growing season, but where standing water does not persist for extended periods. However, established stands can tolerate extended periods of inundation.

Occurrence - Reed canarygrass is a circumboreal species. While possibly native to North America, European cultivars have been widely introduced for use as hay and forage on the continent; there are no easy traits known for differentiating between the native plants and European cultivars. The species is common throughout the county. It occurs along the river and creek shores and in wet areas. There are about 10 acres on the **Scheibel** property with a the dominance rating of 2-5 on the Roché density scale; about 5 acres on the **Siverts** property with a the dominance rating of 2-5 on the Roché density scale; and about 7 acres on the **Trimble** property with a the dominance rating of 2-5 on the Roché density scale.

Movement - It spreads by seeds or by creeping rhizomes -- either are carried with water currents. It has been planted extensively for forage, erosion control and for drying up wet areas. It can also be moved by equipment and vehicles, so it will be important to avoid unmitigated ground disturbance and earth movement in the affected areas, as this would spread the seed already present, and open sites to further invasion.

Bioagents - No bioagents are known.

St. Johnswort, (Hypericum perforatum) * Hypericaceae *

Biology - St Johnswort is a long-lived perennial growing 12"-36" tall depending on available moisture and sunlight. Each rosette is deeply taprooted and well crowned with fibrous rootlets. The plant also spreads from rhizomes and spreading stems above ground will root to form a new rosette. Upright stems are reddish and woody at the base with one to many from each rosette. Leaves are opposite and small with minute perforations along the veins. Black dots occur along the margins containing the bioactive chemical, hypericin. Flowers are bright yellow with many stamens and occur in a flat-topped cyme. They have 5 petals that also have the black dots along the margins containing hypericin. The seeds are small and hard, although they form a gelatinous slime when wet that aids in sticking to birds and animals to assist in dispersal. It does very well in the poor gravely soils of Pend Oreille County along roads and other right-of-ways, invading pastures, hayfields and openings in wooded areas.

Occurrence - It is spread in patches throughout the county. **Scheibel -** It occurs midway in the property just to the west of the railroad bed, at the southern tip of the last slough of Trimble Creek before it enters the River, along the unnamed creek at the south end of the property just before it enters the River, and along the River shore just to the south of this creek. There was less than an acre with a dominance rating of 1-2 on the Roché density scale. **Siverts -** We found it scattered in small patches throughout most of the property. There were about 5 acres with a dominance rating of 1-3 on the Roché density scale. **Trimble -** It

occurs scattered throughout the property. There are about 3 acres, and its dominance rating would be 2-3 on the Roché density scale.

Movement - Many plants were infected with the Chrysolina beetle, giving only some control so it will continue to spread into open areas. It will be important to avoid unmitigated ground disturbance and earth movement in the affected areas, as this would spread the seed already present, and open sites to further invasion.

Bioagents - There are several bioagents available including a borer, *(Agrilus hyperici)*, an inchworm, *(Aplocera plagiata)*, the two Kalamath weed beetles, *(Chrysolina hyperici and C. quadrigemina)* and a midge, *(Zeuxidiplosis giardi)*. Only the one beetle, *Chrysolina quadrigemina*, has established well in our climate zone and has reached the classic predator:prey response. It was present on site.

Yellow toadflax, (Linaria vulgaris) * Scrophulariaceae *

Biology - Yellow toadflax is a perennial 8" - 18" tall depending on available moisture and competitive pressures. It has a rhizomatous root system that supports a multitude of stems with many narrow, lance shaped leaves. The flowers are bright yellow with an orange throat, irregular (snap dragon in appearance) and form along a spike, blooming from the bottom up.

Occurrence - Infestations tend to be isolated throughout the county. **Scheibel -** There were a few small patches in the north end of the property, along both shores of the creek banks. There were some patches just off the property from the NW corner of the hay field in the middle of the property**.** There was about 5 acres with a dominance rating of 2-3 on the Roche density scale. **Siverts -** It is not abundant on site, occurring along the dikes in the northwestern corner, and at one site along the dike in the southwestern sector. There is less than 1 acre with a dominance rating of 3 on the Roche density scale. **Trimble -** There was a lot of this weed spread as small to large patches throughout the property. There was approximately 11 acres with a dominance rating of 3-4 on the Roche density scale.

Movement - It spreads readily by seed, root spread and fragmentation into areas where the ground has been disturbed. If left untreated, it will continue to spread into vulnerable areas. It will be important to avoid unmitigated ground disturbance and earth movement in the affected areas, as this would spread the seed already present, and open sites to further invasion.

Bioagents - Biologicals, (the defoliator, *Calophasia lunula*) are neither readily available nor established as feasible in this climate zone. If they should become available at a later date, they will be introduced throughout the county.

OTHER UNDESIRABLE PLANT SPECIES NOTED

Bull thistle, (Cirsium vulgare) * Asteraceae *

Biology - Bull thistle is a biennial, 12" - 54" tall depending on available moisture, sunlight, and competitive pressures. It has a deep taproot with a robust upright stalk. It is hairy, with spines on the stalk, leaf points, and flowerhead

bracts. It has a composite flowerhead of bright purple flowers. It has been well established in Pend Oreille County along roads, other right-of-ways, recently logged areas, and other disturbed sites. It is not invasive unless there has been significant ground disturbance or overgrazing.

Occurrence - Infestations are distributed throughout the county. It prefers disturbed sites, and is scattered on the property where disturbances occurred such as ground squirrel activity, or water level fluctuations. **Scheibel -** There were a few

scattered plants in the north end of the property along the dike access road and out along the creek and slough and along the hay field toward the River and along the eastern most slough of Trimble Creek. It was also found scattered along the bank of the unnamed creek at the south end of the property and spread into the field along the River there. There were about 5 acres and the dominance rating would be a 1-4 on the Roché density scale. **Siverts -** There is about 1 acre, spread around as individual plants or small clusters. The dominance rating would be a 1 on the Roché density scale. **Trimble -** There were scattered plants and patches from about midway along the northern fence line to the east, also in association with the wet areas. It also showed up along the southern fence line in the eastern end of the property and the wet areas there. There was about 2 acres and the dominance rating would be a 1-2 on the Roché density scale.

Movement - It will spread by seed into vulnerable areas where there is water fluctuations and into areas of other disturbance. It will be important to avoid unmitigated ground disturbance and earth movement in the affected areas, as this would spread the seed already present, and open sites to further invasion.

Bioagents - There have been no local biological releases, and those that are available are of questionable value.

Common burdock, (Arctium minus) * Asteraceae *

Biology - Burdock is a biennial 18" - 120" tall depending on available moisture and competitive pressures. A fibrous root system with a fleshy crown supports a rosette from which multitude of coarse stalks grow. The basal leaves are very large and heart-shaped, reducing and becoming more rounded up the stalk. The flowerheads are borne in clusters at the ends of branches arising from the leaf axials. They are well burred with hooks on the ends (from which the idea for Velcro came), the flowers are purple and recessed between the burrs.

Occurrence - Infestations tend to be isolated throughout the county. **Scheibel -** It only occurs on site, along the Trimble Creek, on the south bank, just east of the railroad bed. There is less than 1/8 acre with a dominance rating of 2 on the Roché density scale.

Movement - It spreads readily by seed, with the heads hooking into wildlife, livestock hair/fur and human clothing, distributing it into areas where the ground has been disturbed. If left untreated, it will continue to spread into vulnerable areas. It will be important to avoid unmitigated ground disturbance and earth movement in the affected areas, as this would spread the seed already present, and open sites to further invasion.

Bioagents - There are no known biologicals available.

Common mullein, (Verbascum thapsus) * Scrophulariaceae *

Biology - Mullein is a biennial, 12"-72" tall depending on available moisture, nutrients and competitive pressures. A fibrous root system supports a rosette from which a single stalk grows. The leaves are large and covered with soft hair, giving them a pale green appearance. The flowers are small and yellow, arranged on a spike. It is well established in Pend Oreille County in disturbed sites along roads, other right-of-ways, recently logged areas, and other disturbed sites that were either left unseeded or the seeding did not establish well.

Occurrence - Infestations are distributed throughout the county. It prefers disturbed sites. **Scheibel -** We found it scattered along the creek, river banks**,** along the roadways and railroad bed, and in brush lines. There was about 2 acres and the dominance rating would be a 1-2 on the Roché density scale. **Siverts -** We found it on site along the roadways, logged areas, the water line along the river and creeks and where disturbance occurred recently. There are about 2 acres and the dominance rating would be a 1-3 on the Roché density scale. **Trimble -** We found it along the causeway that crosses the creek, and along the water's edge of the creek in this same area. There was less than 1 acre and the dominance rating would be a 1 on the Roché density scale.

Movement - It will spread by seed if the ground is disturbed, whether current infestations are treated or not. It will be important to mitigate ground disturbance and earth movement in the affected areas, by including reseeding, as failure to do so would offer the opportunity to spread the seed already present, and open sites to further invasion.

Bioagents - There are no known biologicals available.

Evening primrose, (Oenothera biennis) * Onagraceae *

Biology - A biennial that forms a rosette, about 6 inches across in the first season. Leaves are linear-lanceolot with margins entire. It sends up a leafy stalk, 2-3 feet, the second season that branches within the last foot or so of the top. Bright yellow primrose flowers form in the upper leaf axils, blooming from May through October. The fruit is a 4 lobed capsule with small pale brown, conspicuously pitted, angular seeds arranged in rows.

Occurrence - Native to south and northeastern US, it's often cultivated as a medicinal ornamental. In the west it has escaped cultivation and is showing-up more commonly as a weed in our area. **Siverts -** It occurs in the logged area of the State property and near the trestle to the east. There are only a few plants with a 1 on the Roché density scale.

Movement - It spreads by seed, so it will be important to avoid unmitigated ground disturbance and earth movement in the affected areas, as this would spread the seed already present, and open sites to further invasion. If left untreated, it will continue to spread within and out of the areas it occurs.

Bioagents - There are no known biologicals available.

Stinking dog fennel, (Anthemis cotula) * Asteraceae *

Biology - An ill-smelling, many branched annual, 4-24 inches tall. Stems and leaves are fleshy, the leaves are bright green, alternate and finely dissected. Flowerheads are singular at the ends of the branches. They appear as a small daisy with outer rays white, about 3/8 inch long with the end rounded; and the multiple center disc flowers are yellow, crowded onto a cone-shaped base. The seeds are tiny, about 1/16 inch long, peg-shaped with several lengthwise warty ridges.

Occurrence - It is native to Eurasia and Africa. A common weed, it occurs in disturbed areas, primarily in the Cusick area. **Siverts -** We found it along the dike where the power line crosses it and at the northern railroad crossing. There were only a few plants with a 1 on the Roché density scale. **Trimble -** We found it in a wallow at the corner of the property where the access road enters it, under the trees more to the west end on the southern fence line and along the bank of the northern branch of the creek just west of the middle of the property. There were only a few plants in each patch with a 1 on the Roché density scale.

Movement - It reproduces by seed and so is moved with equipment and vehicles. It will be important to avoid unmitigated ground disturbance and earth movement in the affected areas, as this would spread the seed already present, and open sites to further invasion.

Bioagents - There are no known biologicals available.

Sweetclover, white *(Melilotus alba)* * Fabaceae *

Biology - Sweetclover can be annual, a winter annual, or biennial, with a tall, 2'-6', extensively branched stem growing from a woody taproot. The leaves are trifoliate with the leaflet margins serrated halfway or more back from the tip. The flowers are small, white and display the typical banner, wings, and keel of the legume family. They are arranged in many-flowered terminal and axillary racemes and produce abundant, sweet smelling nectar making them of value for honey production. Pods are 1-2 seeded. It can cause problems when baled with a hay crop as it often molds, producing coumarin (a blood anticoagulant).

Occurrence - White sweetclover is common throughout the country, along roadsides, waste areas and other disturbed sites. It has been used in reclamation, soil stabilization, soil improvement (it is a nitrogen fixer) and wildlife cover projects. **Siverts -** It grows on site where the gate opens onto the Tribe's property and along the railroad bed, especially in those areas where it was recently disturbed. It would be a 3-5 on the Roché density scale.

Movement - As sweetclover produces abundant seed, it is readily spread by animal, human and vehicle activities. It will be important to mitigate ground disturbance and earth movement in the affected areas, by including reseeding, as failure to do so would offer the opportunity to spread the seed already present, and open sites to further invasion. However, it is often a seed contaminant so it is important to use certified and tested seed for seeding projects.

Bioagents - There are no known biologicals available.

CONCLUSION

Scheibel - We started this survey by driving in the dike access road, then following a track taking off from the south side, toward the east end of the dike. We then crossed back over the dike to view the small portion of property to the north of the dike. Then returning to the south side of the dike, we covered the property on the north side of Trimble Creek, both sides of the railroad tracks. We then traveled to the access road into the south portion of the property, surveying the north hay field to the west of the railroad bed, then covering the area south of the unnamed creek and west of the railroad bed. We then turned north and to the east of the railroad bed and surveyed that area, then moving on to the area just south of Trimble Creek. We finished the survey in the south eastern corner of the property, south of the unnamed creek and east of the railroad bed.

Siverts - The survey began with a drive and walk along the road that enters the property from the farm buildings and parallels the highway. We turned east and followed the road to the north of the dike to the wet areas. We crossed the dike on foot and surveyed the wet area to the south, crossing the trestle and surveying the corner south of the creek on both sides of the railroad tracks. We crossed back over the trestle and surveyed the south end of the area between the creek and river shore. We then crossed back over the tracks to the west side and traveled north along the fields, crossing the tracks again to the east and surveying the mid area between the railroad and river shore. We crossed back over the tracks and continued north along the field, crossing the tracks at the north end of the property and surveyed the northern area between the railroad and river shore. We traveled north to the west of the tracks and inside the wet area, then came back around it to the northern most field to the east of the farm buildings. We then drove out along the roadway back to the beginning, crossed the highway and covered the steep timbered area to the west of the highway.

Trimble - We started this survey in the hay field at the west end. We traveled east along the northern fence line to the east end of the property, then turned back and followed the northern fork of the water course, covering the north shore, south shore, west end of the property, and both sides of the southern fork of Trimble Creek at that end. We then returned to the northeast corner of the property to access the south side of Trimble Creek at the east end of the property.

These surveys did not reveal any surprising weed infestations. Those found were typical of the county, both in species composition, extent of infestation and pattern of distribution. All in all, these property acquisitions are in fairly good shape, the

northern most field on the Sivert property is in excellent shape. The problems encountered could be relatively easily managed with appropriate initial herbicide and fertilizer treatments.

The railroad right-of-way, roadways, and dikes (as well as the state logged area, adjoining Siverts property) hold the most serious weed infestations. Roads and other right-of ways pose a special problem in that by their nature, they are a site of perpetual disturbance and weed seed reintroduction. With relief from grazing pressures, restoring the wet areas to riparian forests and by removing the weeds in the fields and natural areas, maintaining these properties for wildlife values should be relatively low maintenance.

RECOMMENDATIONS

The ideal first step is to prevent further introduction and on site spread of the weeds. Any contract that is let for any work to be done on the properties should include a clean equipment clause, a clean fill/materials clause, and an appropriate mechanical/vehicular use clause, each explicitly spelling out the measures a contractor must fulfill for contract compliance. Developing similar policies for Tribal vehicles and equipment entering or working on the properties would also be wise.

The second step is to identify an on-site weed management program manager who would become "on the ground" intimately familiar with weed problem areas on the properties. This person would need to be familiarized with weed identification, preventative and mitigative measures, basic integrated weed management procedure, and the understanding that the most integral part of a successful weed control program is persistence. S/he would need to determine and set weed presence damage threshold levels.

If any of the properties are to be visited by the public, the first priority would be to cleanup and target parking areas the roads to them and any roads open to travel on the properties for annual weed inspections. A brochure and briefing "talk" could be developed for personal interaction with visitors (or stored in a box for their taking) to the properties so they do not take any weeds home and know next time to be careful not to bring any from home when they return for a visit to the area.

All travel and parking areas are best treated with a Tordon (1 quart/acre) mixed with a R-900 (1 quart/100 gallons volume) or Transline (8 oz/acre) mixed with Sylgard (1 pint/100 gallons volume). It is best NOT to use a glyphosate based product for these areas as it creates a major disturbance by clearing too much vegetation from the travel surfaces and adjoining right-of-way areas, leaving it

vulnerable for invasion by weeds that establish more quickly than the grasses. Alternatively, it could be possible to use Roundup (a glyphosate product) at the reduced application concentration (6 oz/acre applied in a mix of 10 to 40 gallons of water) to produce a chemical mow. This could have a positive effect on the weeds by preventing them from maturing to the seed set stage. However, there is no data supporting this potential effect.

Any currently bare right-of-way shoulders should be seeded with a low-growing grass species (such as red or hard fescue, Canada bluegrass, and/or western wheatgrass) offering greater protection against weed reinvasion.

The areas where sweetclover occurs, using the best mix for effective sweetclover removal, would be 1 pint Hi-Dep plus 1 oz Escort plus 8 oz Transline or 2 quarts Curtail plus 1 oz Escort per acre mixed with Sylgard (1 pint/100 gallons of volume). Diligently following-up with selective weed removal by hand or selective spraying would need to complete the effort.

Gaining cooperation with the railroad to treat the bed and adjoining right-of-way both through the properties and adjoining properties will help minimize this avenue of spread. Also, permission from adjoining landowners to over spray the fence and property lines will forestall reinvasion from these properties.

The hay fields would be best treated with a broadcast treatment of Redeem or Curtail (clopyralid and triclopyr at 1:3 active ingredients) mixed with a fertilizer (Ammonium sulfate fines) that would target the weed species while conditioning the soil. The remaining areas will need to be spot treated by hand treated with a hose. The same mix can be used in these areas, and by targeting only the weed problem areas, specificity can be increased.

The more dispersed areas of weed treatment will not need reseeding for the most part as removal of the weeds by herbicide treatment with the addition of the fertilizer should be adequate to release the grasses and native forb seed bank. The area to the south of the dike at the entrance to the Scheibel property would be an exception as it is quite heavily infested with hawkweed. It will need restoring the fall following herbicide treatment and fertilizing. It should be seeded with a low-growing grass species (such as red or hard fescue, Canada bluegrass, and/or western wheatgrass) offering greater protection against weed reinvasion. The dike at the south end of the Siverts property should also be seeded to a drought tolerant

grass (20% Sheep Fescue, 30 % Hard Fescue, 20 % Creeping Red Fescue, 15% Chewings Fescue, 10% Canada bluegrass and 5% Regreen wheatgrass at a cost of approximately $2.50 per pound and a rate of 50-80 pounds per acre). On the Trimble property, the area of field in the south east corner may also need reseeding as it is heavily infested with hawkweed.

With reed canarygrass, maximum control depends on the timing of application. Herbicide will provide control for up to two years at the most. After this period, reed canarygrass recolonizes a treated area from adjacent stands or from seed bank recruitment. Rodeo application, followed in two to three weeks by prescribed burning has also been effective. The use of fire helps to ensure mortality by killing resprouts and germinants.

Heavy equipment has been used unsuccessfully in reed canarygrass removal. Clipping back plants at ground level and covering them with opaque black plastic tarps can reduce but not eliminate a population. However, this method is not always effective because reed canarygrass shoots can grow up through most materials, and seasonal inundation may displace covering materials. Mowing may be a valuable control method, since it removes seed heads before seed maturation and exposes the ground to light, which promotes the growth of native species. Studies in Wisconsin indicated that twice-yearly mowings (in early to mid-June and early October) led to increased numbers of native species in comparison to reed canarygrass-infested plots that were not mowed.

If significant areas of reed canarygrass are removed, then they will need replanting with an appropriate species. The native Spartina would be appropriate. Also, if the hawthorn patches are removed, they will need replanting with a native fescue.

If a level of spotted knapweed occupancy is deemed acceptable, keeping biocontrol levels elevated for it should mitigate its impact and spread throughout the properties.

I recognize that these recommendations are quite progressive and intensive in terms of commitment in time, energy, and dollars. However, considering potential public visitation and the value of the property, it seems prudent to take care of it. Properly managed, these properties can make a significant contribution to both human and wildlife resources of the county. In addition to these sociological benefits, a program based on the preceding recommendations will also promote improved ecological conditions.

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HERBICIDES AND ADJUVANTS

Curtail - Dow Agro Clopyralid and 2,4-D	Curtail is a selective, translocated herbicide for postemergent broadleaf weed control. It is only foliar active.
Escort - DuPont Metsulfuron methyl	Escort is a rate dependent selective, translocated herbicide used for pre- and postemergent broadleaf weed control and suppression activity on grasses. It is only foliar active; and, warm moist conditions enhance its activity.
R-11 - Wilbur-Ellis Alcohols+ compounded silicone	R-11 is a spreader-activator labeled for use in the aquatic environment that can greatly enhance the action of an herbicide.
Redeem R&P - Dow Agro Clopyralid and triclopyr	Redeem R&P (Range and Pasture) is a selective, translocated postemergent herbicide for broadleaf weed control. It is only foliar active. It has been found to be more effective with controlling hawkweeds.
Rodeo - Monsanto Glyphosate	Rodeo is a non-selective translocated postemergent herbicide. It is only foliar active and needs to be applied while the target plants are actively growing for maximum efficacy. It is labeled for use in the aquatic environment.
Sylgard 309 - Dow Agro Silicone+alcohols	Sylgard is a penetrator activator that can greatly enhance the action of an herbicide.
Transline - Dow Agro Clopyralid	Transline is very selective with weeds in the Asteraceae family. It is translocated and only foliar active. It's intended for postemergence weed control for industrial sites, right-of-ways, and forest openings for habitat enhancement. At lower rates (1/2 - 1 pint/acre), it will not damage the native brush and conifer species. Its application is limited in porous soils with near-surface water tables.

DOMINANCE RATING SCALE FOR ROCHÉ WEED DENSITIES

5 It dominates the site. It is dominant in the sense that it provides essentially total cover when viewed casually.

4 It is at least co-dominant. It shares dominance relative to cover or is considered slightly subordinate to other species.

3 It is easily seen by standing in one place and glancing around, but is not an obvious dominant. In a mixed stand, several species may fall into this category.

2 It can be seen only by moving through the vegetation or by searching for it while standing on one place. A patchy pattern observed by moving through the vegetation rates a "2."

1 It can be found by searching in and around other species. A "1" is not obvious.

0 Historically reported, no longer present.

APPENDIX A

MAP KEY

Maps only contain photo points.

Scheibel

Map 1 contains photo points 1-15, 21-24, 40-43 and 49-65
Map 2 contains photo points 16-20, 25-38, 44-48 and 66-75

Siverts

Map 1 contains photo points 76-88 and 148-152
Map 2 contains photo points 89-147

Trimble

Map 1 contains photo points 153-162 and 170-172
Map 2 contains photo points 163-169 and 173-180

APPENDIX - C

POLICY STATEMENT

The Weed Board recognizes the control of noxious weeds as a total community effort, requiring **ALL** landowners to control the growth and spread of noxious weeds on their land and to prevent infestation of adjacent lands. Landowners (as defined by RCW 17.10: possessor of legal title or such equity, or the possessor of an easement), are encouraged to report to this Board all known infestations of noxious weeds.

The Weed Board shall promote weed control through public education, as well as by personal and/or written contacts with landowners/operators. It is **NOT** the intent of the Weed Board to place any undue financial burden on any landowner, so for those who have a severe infestation of weeds an approved contract with a schedule indicating a reasonable, continuous effort towards control will be in compliance with our goals. The Weed Board Coordinator is available to assist in formulating an approved, consistent, progressive control plan and/or drawing up a contract.

The landowner, upon request, will be assisted in identifying all noxious weeds and the measures for controlling them. Control can be attained through appropriate pasture management, varied cultural practices, use of herbicides, biological control agents, or other means desired by the landowner and/or indicated by the site conditions. Minimal control standards for class A and B-designate weeds shall be prevention of all seed production and implementation of the best control strategies necessary to eliminate the infestation within a 5 year period. Minimal control standards for class B and C weeds shall be containment to within current infestation boundaries through implementation of the best control strategies indicated by the site conditions.

As vehicles are the primary means of spreading noxious weeds in Pend Oreille County, the Weed Board has established a priority to control noxious weeds on traffic corridors, right-of-ways, and lands adjoining right-of-ways. This will be accomplished by a weed seed free buffer strip the full width of the right-of-way on public roads, and a weed seed free buffer strip 30 feet out from the centerline each side of all private roads, forest roads, and other such tracks and trails. Also, land adjoining agricultural or other maintained areas will maintain a weed seed free 200 foot buffer strip along mutual property line(s).

In the case of noxious weeds intentionally grown or harvested with a known commercial value, a written agreement must be entered into with the Weed Board. The Weed Board personnel have the authority to enter all property for the purpose of enforcing the Weed Law; provided that a reasonable attempt is made to notify the landowner as to the purpose and need for entry (RCW 17.10.160). If a landowner/operator fails to take reasonable weed control measures to attain acceptable control standards, the Weed Board holds the right and intent to enforce all provisions of RCW 17.10.

The Weed Board will hold regular meetings the second Monday of each month at 1:00 PM in the courtroom of the old County Courthouse. Meetings are open to the public, whose input is encouraged. Special meetings and hearings will be legally advertised in the Newport Miner in accordance with RCW 17.10 and the Open Meetings Act.

PHILOSOPHICAL STATEMENT

Through the season of 1985, a group of farmers circulated a petition and presented it to the County Commissioners seeking activation of the County Noxious Weed Control Board. They established a need for a coordinated, countywide weed control program, and the Commissioners granted the request.

Since then, the state Noxious weed Law, RCW 17.10, has undergone some changes, establishing control priorities and duties. The County Board has been working to develop a program to reflect these priorities and duties. Beyond the definition in the law, **control** shall be defined as diminishing the impact of a noxious weed to below its specified level of tolerance, which shall be determined on a case by case basis.

First control priority goes to weeds that are uncommon or do not occur in the county but nonetheless pose a threat. Measures are required to prevent them from becoming established in the county. It is important to maintain survey information on these weeds as to where they occur or where they are likely to invade, and immediately develop an annual control program where they are found.

Second control priority goes to weeds that are more common, but not particularly widespread. The main objective in developing control strategies is to contain infestations within their current boundaries and prevent invasion into uninfested areas.

The last control priority goes to weeds that are widespread throughout the county. The objective for controlling these weeds is to minimize their further spread into areas that are being actively farmed and the landowner/manager is implementing a weed control program. Roadsides in such areas are targeted for herbicide treatment, and remaining shoulders are kept mowed.

As there are 897,280 acres under more than 20,000 different land owners and/or managers in this county, it is necessary to understand the Weed Board cannot personally control all the weeds. The law is clear that it is the landowner's/manager's responsibility to control the weeds on their property, and the Weed Board's responsibility to ensure their control to minimal standards.

A useful tool to generate landowner cooperation is through educational programs targeting weed identification, control methods and options, and the importance of noxious weed control in the big picture. When possible, the Weed Board makes every attempt to offer cost-sharing to the landowners for implementing a control program.

2002 PEND OREILLE COUNTY NOXIOUS WEED LIST

I. Noxious weeds currently found growing in Pend Oreille County:

Common Name	Scientific Name	Class	Toxicity
BIGHEAD KNAPWEED	*Centaurea macrocephala*	A	N
KNAPWEED, VOCHIN	*Centaurea nigrescens*	A	N
SAGE, CLARY	*Salvia sclarea*	A	N
SALTCEDAR	*Tamarix ramossisma*	A	N
STARTHISTLE, YELLOW	*Centaurea solstitialis*	B-designate	Y - to horses
TANSY RAGWORT	*Senecio jacobaea*	B-designate	Y - destroys liver
SCOTCH BROOM	*Cytisus scoparius*	B-designate	N
BUGLOSS, ANNUAL	*Anchusa arvensis*	B-designate	N
BUGLOSS, VIPER'S	*Echium vulgare*	B-designate	N
LOOSESTRIFE, PURPLE & WAND	*Lythrum salicaria, L. virgatum*	B-designate	N
POLICEMAN'S HELMET	*Impatiens glandulifera*	B-designate	N
LEAFY SPURGE	*Euphorbia esula*	B-designate	Y - dermal
MUSK THISTLE	*Carduus nutans*	B-designate	N
SCOTCH THISTLE	*Onopordum acanthium*	B-designate	N
PLUMELESS THISTLE	*Carduus acanthoides*	B-designate	N
MEADOW KNAPWEED	*Centaurea jacea x nigra*	B-designate	N
COMMON BUGLOSS	*Anchusa officianalis*	B-designate	N
KOCHIA	*Kochia scoparia*	B-designate	Y - Nitrate concntrtr
COMMON CATSEAR	*Hypochaeris radicata*	B-designate	N
RUSH SKELETONWEED	*Chondrilla juncea*	B-designate	N
EURASIAN WATERMILFOIL	*Myriophyllum spicatum*	B/B-designate	N
MEADOW HAWKWEED	*Hieracium caespitosum*	B/B-designate	N
ORANGE HAWKWEED	*Hieracium aurantiacum*	B	N
GIANT & JAPANESE KNOTWEEDS	*Polygonum sachalinense, P. cuspidatum*	B	N
DIFFUSE KNAPWEED	*Centaurea diffusa*	B	N
SPOTTED KNAPWEED	*Centaurea biebersteinii*	B	N
DALMATIAN TOADFLAX	*Linaria dalmatica* ssp. *dalmatica*	B	N
OXEYE DAISY	*Leucanthemum vulgare*	B	N
SULFUR CINQUEFOIL	*Potentilla recta*	B	N
HOUNDSTONGUE	*Cynoglossum officianale*	C	Y -destroys liver
BABYSBREATH	*Gypsophila paniculata*	C	N
CANADA THISTLE	*Cirsium arvense*	C	N
POISON HEMLOCK	*Conium maculatum*	C	Y - no antidote
COMMON TANSY	*Tanecetum vulgare*	C	Y - dermal allergen
ST. JOHNSWORT	*Hypericum perforatum*	C	Y - photosensitizes
REED CANARYGRASS	*Phalaris arundinacea*	C	N
ENGLISH IVY (4 cultivars)	*Hedera helix, H. hibernica*	C	N
YELLOW FLAG IRIS	*Iris psuedocorus*	C	Y

CLASS A AND B-DESIGNATE: Weeds in these classes occur at a few sites within the county, are considered an economic threat, and the landowner will control them annually to prevent seed production until eradication is secured.

CLASS B AND C: These classes are mostly common in the county and will be controlled on right-of-ways and other areas where requested with the overall goal of containment and reducing the negative impact to below an acceptable level.

II. Noxious weeds **NOT** currently found growing in Pend Oreille County, but will be monitored and controlled if discovered:

Class A:

Common Name	Scientific Name	Common Name	Scientific Name
bean caper, Syrian	*Zygophyllum fabago*	Johnsongrass	*Sorghum halepense*
blueweed, Texas	*Helianthus ciliaris*	lawnweed	*Soliva sessilis*
buffalobur	*Solanum rostratum*	nightshade, silverleaf	*Solanum elaeagnifolium*
broom, Spanish	*Spartium junceum*	sage, Mediterranean	*Salvia aethiopis*
clary, meadow	*Salvia pratensis*	spurge, eggleaf	*Euphorbia oblongata*
cordgrass, salt meadow	*Spartina patens*	spurge flax	*Thymelaea passerina*
crupina, common	*Crupina vulgare*	starthistle, purple	*Centaurea calcitrapa*
four o'clock, wild	*Mirabilis nyctaginea*	thistle, Italian	*Carduus pynocephalus*
garlic mustard	*Alliaria petiolata*	thistle, milk	*Silybum marianum*
goatsrue	*Galega officinalis*	thistle, slenderflower	*Carduus tenuiflorus*
hawkweed, yellow devil	*Hieracium floribundum*	velvetleaf	*Abutilon theophrasti*
hogweed, giant	*Heracleum mantegazzianum*	woad, dyer's	*Isatis tinctoria*
hydrilla	*hydrilla verticillata*		

Class B-DESIGNATE:

Common Name	Scientific Name	Common Name	Scientific Name
blackgrass	*Alopecurus myosuroides*	knapweed, black	*Centaurea nigra*
brony, white	*Bryonia alba*	knapweed, brown	*Centaurea jacea*
camelthorn	*Alhagi maurorum*	knapweed, Russian	*Acroptilon repens*
cordgrass, common	*Spartina anglica*	lepyrodiclis	*Lepyrodiclis holosteoides*
cordgrass, smooth	*Spartina alterniflora*	loosestrife, garden	*Lysimachia vulgaris*
elodea, Brazilian	*Egeria densa*	nutsedge, yellow	*Cyperus esculentes*
fanwort	*Cabomba caroliniana*	oxtongue, hawkweed	*Picris hieracioides*
fieldcress, Austrian	*Rorippa austiaca*	parrotfeather	*Myriophyllum aquaticum*
floating yellow heart	*Nymphoides pelata*	pepperweed, perennial	*Lepidium latifolium*
gorse	*Ulex europaeus*	puncturevine	*Tribulus terrestris*
hawkweed, mousear	*Hieracium pilosella*	sandbur, longspine	*Cenchrus longispinus*
hawkweed, polar	*Hieracium atratum*	sowthistle, perennial	*Sonchus arvensis arvensis*
hawkweed, smooth	*Hieracium laevigatum*	Swainsonpea	*Sphaerophysa salsula*
herb-Robert	*Geranium robertianum*	water primrose	*Ludwigia hexapetala*
hedgeparsley	*Torilis arvensis*	wild chervil	*Anthriscus sylvestris*
indigobush	*Amorpha fruiticosa*		

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