

Habitat Management Plan for the Creston Valley Wildlife Management Area



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Executive Summary

Since the legal creation of the Creston Valley Wildlife Management Area (CVWMA) in 1968, habitat management has transformed thousands of hectares of the Kootenay River flats from a seasonally flooded delta system to a unique complex of highly productive habitats that provide refuge for hundreds of wildlife species.

The Creston Valley Wildlife Management Authority is developing a new vision for habitat management on the Area that is based both on science and on the priorities of those who enjoy the CVWMA. This report outlines a new habitat management plan, based on a review of the Area's management history and relevant scientific literature, as well as on an extensive public consultation.

Habitat management on the CVMWA has largely been focussed on the creation of habitat suitable to meet the life history requisites of waterfowl. Dykes and water control structures built in the 1970's and 1980's altered natural water regimes and created a series of permanent and seasonally flooded wetlands as well as upland nesting meadows. Succession also led to extensive shrub communities and large areas of cottonwood forest. In general, attempts to generate a large population of nesting waterfowl were unsuccessful (with the possible exception of Canada Geese), but a fortunate by-product of these attempts was the colonization of the CVWMA by a stunning diversity of bird species and other wildlife. This diversity has attracted a large number of research and inventory projects over the years (conducted largely by universities and government agencies).

Both the public consultation and comments by technical experts revealed strong support for the current direction of the Management Area with respect to habitat management. In general, those who attended meetings and provided written or verbal comments were very supportive of the CVWMA and the efforts of staff to maintain wetland productivity through active habitat management (i.e., drawdowns). There was some displeasure voiced over fisheries management; in particular, the Management Area's role in the anecdotal decline in the largemouth bass fishery in Duck Lake, and the effects of dyking and water control on spawning habitat for important fish species of the Columbia-Kootenay River system, such as white sturgeon, burbot, and salmonids.

As part of the development of the habitat management plan, we defined and mapped 10 broad habitat types. The Management Area is comprised of approximately equal proportions of open water, wetland habitats and upland habitats. There are a total of 354 terrestrial vertebrate species that use these habitats, which represent 59% of all terrestrial vertebrate species occurring in British Columbia. Of these, 50 species are considered at risk in British Columbia and 15 are listed federally as "endangered." Other listed species include the white sturgeon and burbot, as well as three dragonfly species and 11 vascular plants. Based on these data, the CVWMA is arguably the most important reservoir of biological diversity of any protected area in western Canada.

Based on information reviewed and on analyses of species-habitat relationships, we developed a general management approach that recognizes:

- The importance of active habitat management to maintain the productivity of some habitats (primarily permanent wetlands and seasonally flooded wetlands) in some units (generally those traditionally used heavily by migrating and breeding waterfowl).
- The likely successional trajectories of the CVWMA's habitat types and the consequences of allowing "natural" processes to persist in large parts of the Management Area.
- The increasingly important role that management for species at risk will play in the political, social and ecological context of the CVWMA's future.
- A public desire for a greater focus on recreational fisheries.

The result is a series of objectives for each management unit, as well as specific prescriptions for different habitat types and species of interest. Some key features of the plan that depart from management approaches used in the past include:

1. Habitat enhancement for salmonids in Boulder Creek and Summit Creek.
2. Recommended infrastructure upgrades for Corn Creek 2b to expand wetland habitat.
3. Restoration of natural water regimes in Corn Creek 4.
4. Providing nesting habitat for American White Pelicans in Leach Lake 1 and Six Mile Slough 4.
5. Using West Meadows Farm to demonstrate wildlife-friendly farming techniques.
6. Increasing use of deep water flooding to control emergent vegetation.
7. Allowing succession in upland grassland, shrub and forested habitats.
8. Cooperating with efforts to assess and restore (if necessary) the Duck Lake bass fishery.
9. A rare plant inventory and the creation of “no management zones” around occurrences.
10. An inventory for insect species at risk.

We make a series of other recommendations to address more general public concerns and to improve implementation of the habitat management plan:

1. The development of policies to address access management concerns and third-party right-of-ways on the CVWMA.
2. An effectiveness monitoring program to adaptively manage the core habitat management functions of the CVWMA.
3. The creation of a technical advisory committee to assist with future management decisions.
4. An inventory of current infrastructure and required upgrades.
5. A greater role for the CVWMA in species at risk recovery teams.

We also provide a five-year plan to outline implementation of the habitat management plan, including possible partner agencies and funding requirements.

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Introduction

The Creston Valley Wildlife Management Area (CVWMA) is an ecologically unique wildlife area shaped by a unique political history. Annual floods of the Kootenay River once scoured the Creston valley flats, creating vast mudflats that were used extensively by migrating waterfowl. Much of the valley was reclaimed for agriculture, but 7,000 ha in the CVWMA were designated specifically for the purpose of wildlife habitat management under an act (*Creston Valley Wildlife Act*) of the provincial legislature.

The prevailing opinion of biologists during the late 1960's and 1970's was that relatively small areas of wildlife habitat could be intensively managed to mitigate more extensive habitat losses elsewhere. Hence, the principal goal of habitat management in the CVWMA became the creation of waterfowl breeding habitat to compensate for losses due to reclamation for agriculture or hydroelectric power development.

The fish and wildlife of the CVWMA changed dramatically during the 1970's as dykes were constructed to control water levels. This resulted in the creation of upland areas with dense nesting cover protected from spring flooding and permanent ponds with excellent staging and brood-rearing habitat. A secondary benefit of CVWMA habitat management was the positive response shown by a number of other wildlife species including many species of regional and/or national significance.

Fish habitat did not benefit from the creation of the CVWMA. Native stocks were negatively impacted first by flood control and agricultural dyking activities in the 1940s. Major changes to the river hydrograph resulting from construction of the Libby Dam in Montana led to significant impacts, particularly to the burbot, sturgeon and kokanee populations. Riparian interface habitat was lost due to channelization of tributaries and dyke construction. Large portions of potential habitat are now inaccessible to fish because of flow control structures or lack of connectivity between the mainstem Kootenay River and off-channel wetland habitats. Non-native, principally warm-water species such as sunfish, were introduced, confounding fisheries management issues in this area.

There were a number of factors working against the CVWMA's stated mission to provide increased waterfowl nesting habitat. Firstly, habitat management as practiced by the CVWMA was expensive. Wetlands are early successional habitats, and drawdowns, burning and brushing were used extensively to maintain their productivity. Secondly, the concept of intensively managing small wildlife habitat areas for a single purpose (e.g., waterfowl habitat) began falling out of favour in the 1980's. This was because (a) similar experiments failed elsewhere, (b) biologists continued to acknowledge the complexity of natural systems, and (c) the public's interest in wildlife expanded beyond traditional constituencies (e.g., hunters). Thirdly, the CVWMA's status as an agency of the crown left it vulnerable to funding cutbacks as both federal and provincial governments focussed on core responsibilities through the 1990's. Finally, the CVWMA's responsibility with respect to public education (the Wildlife Centre) and agricultural impacts (problem wildlife, noxious weeds, demands for grazing opportunities) increased or remained constant during this time, thereby creating additional fiscal and public pressures.

Considering the large-scale conversion or disappearance of wetland habitat in British Columbia (Nolan and Jeffries 1996), Canada (Rubec et al. 1988) and the United States (Dahl and Johnson 1991), the regional, national, and international significance of the CVWMA for wetland conservation is undisputed. This was formally acknowledged in 1994, when the CVWMA was officially declared a wetland of international importance under the Ramsar Convention on Wetlands (www.ramsar.org). The vision for the Ramsar convention is to "maintain an international network of wetlands which are important for the conservation of global biological diversity and for sustaining human life through the ecological and hydrological functions they perform." Continuation of habitat management and conservation in the CVWMA is therefore of particular importance.

The CVWMA is also important in terms of regional biodiversity management and planning. The CVWMA is a significant protected area that provides an important link between the Purcell and Selkirk mountains. A variety of regionally important species such as grizzly bears and mountain caribou are known to use the area as a movement corridor.

The CVWMA is currently in transition from being funded mostly from government sources (currently via BC Hydro, donations and revenue from permits and licences) to deriving necessary revenue directly from the public. At the same time, the Authority is committed to its responsibility to manage the CVWMA for biodiversity, while recognizing its legacy as a waterfowl habitat area. As a result, the Area requires a comprehensive habitat management plan that can address its suite of habitats and associated wildlife, while strengthening support within the local and broader community.

The broad, strategic goals of the CVWMA were articulated in a Strategic Plan (CVWMA 2001). With respect to habitat management, the Management Authority approved a Conceptual Management Plan in 1983 (CVWMA 1983), which outlined general habitat management objectives for each management unit of the CVWMA. This habitat management plan takes a more comprehensive approach, first reviewing management history and outcomes, then characterizing the Area's habitats and related animal and plant communities. We use this information to develop specific management objectives and prescriptions to maintain the productivity of the Management Area's habitats and biodiversity.

The Plan is organized into 5 chapters. Chapter 1 reviews the management history of the CVWMA and highlights relevant inventory work related to various wildlife populations. Chapter 2 characterizes the CVWMA according to habitat types and associated wildlife and plant communities, with special attention paid to listed species. Chapter 3 presents the actual habitat management plan, with objectives organized by management unit, but also with specific management prescriptions presented for habitat types and species of interest. Chapter 4 summarizes recommendations arising from Chapters 1-3, as well as from a technical review session that was held in Creston in June 2004 (minutes are presented in Appendix I). Chapter 5 provides a table for a 5-year plan, which outlines the various action items, timelines and associated costs with implementing the management plan from 2005-9.

English names are used for species (with the exception of plants) throughout the document and Latin names are listed in Appendix II.

Chapter 1. History and Current Management

Area Description and History

The CVWMA was established in 1968 by an act of the BC legislature. Under the *Creston Valley Wildlife Act*, 6,885 ha (17,000 acres) of the Kootenay River floodplain were protected for “wildlife conservation, management and development... and, in particular, as a waterfowl Management Area” (Province of British Columbia 1974).

The CVWMA area is located south of Kootenay Lake and north of the Canada – US border, nestled between the Selkirk and Purcell Mountain ranges. The area encompasses a substantial portion of the Kootenay River floodplain (≈530 m elevation) and consists primarily of dyked marshland, lakes, sloughs, agricultural fields, and adjacent river terraces. The CVWMA is located within the very dry warm variant of the Interior Cedar-Hemlock (ICHxw) biogeoclimatic subzone, and experiences very hot dry summers and very mild winters with light snowfall of short duration. These climatic conditions combined with an abundance of wetland and riparian habitat make the Creston Valley a critical breeding, staging and wintering area for a broad diversity of wildlife species.

With assistance from Ducks Unlimited and BC Hydro, a system of dykes, water control structures, and pumps was constructed in the CVWMA in the early 1970’s. The resulting wetland compartments could be managed to enhance wildlife production during flood and drought cycles, and to prevent habitat losses associated with management of the Kootenay River system for hydroelectric power generation and flood control. Management of the water levels within these compartments maintains a rich diversity of habitat types. These habitats support an estimated 370 vertebrate species (286 bird, 56 mammal, 6 reptile, 6 amphibian and 16 fish; Van Damme 2002; CVWMA 2003; see species lists in Appendix 1), as well as thousands of plant species, invertebrates and other biota, many of which are considered rare or endangered.

Habitat and Wildlife Management Objectives

The initial goal of habitat management on the CVWMA was to improve selected area lands to ensure continued and/or enhanced use by targeted wildlife species (Wilson 1992). Historically, most of the Management Area flooded with the spring freshet, scouring away most of the rooted vegetation. The water then receded in summer to expose vast mudflats, with seasonal vegetative cover provided by moist-soil plants, such as horsetail (*Equisetum spp.*) and sedge (*Carex spp.*) species (Munro 1950). Traditional livestock grazing privileges were maintained over most of the area, thereby minimizing upland grass cover. Waterfowl attempting to nest were faced with floodwaters, poor nesting and brood cover, and limited permanent water. Early habitat management therefore focused on controlling water levels and encouraging emergent and upland vegetative cover. Over time, the focus shifted to maintaining the productivity of the marshes in the face of ecological succession.

In addition to the stated wildlife conservation goals, public recreation and education was recognized as an important part of the Authority’s mandate. The CVWMA has operated a public Wildlife Centre seasonally since 1972, and portions of the Management Area are used by hunters (both waterfowl and big game), anglers, and a variety of non-consumptive users. A campground was operated at Summit Creek until 2001, when public safety and liability concerns were raised and the campground was closed.

The recently adopted CVWMA Strategic Plan (CVWMA 2001) identifies and reaffirms two strategic priorities within the core business functions of the organization: (1) habitat and wildlife management (by maintaining species and habitat diversity), and (2) public outreach.

Summary of Habitat Management Initiatives and Outcomes

A variety of habitat management techniques have been applied in the CVWMA since its inception in 1968 (review in Wilson 1992). These are reviewed in this section with a brief summary of outcomes based on available data, and perceptions of CVWMA staff.

Water Level Management

Management of water levels in the CVWMA was made possible through the construction of several dykes, water control structures and pumps. The objectives of water level management were to (1) reduce flooding during the nesting period, (2) encourage growth of persistent emergent and upland vegetation, and (3) provide permanent water areas. Water level management was initiated in 1972 with the completion of the Duck Lake nesting area, and by 1975 most of the area was under active management. Currently, managed portions of the CVWMA are comprised of Duck Lake, Duck Lake Nesting Area, and most of the marshes of Six Mile Slough, Leach Lake, and Corn Creek. The remainder of the CVWMA consists of unmanaged marshes, riverine habitats, forests, and portions designated for other uses. In total, the Management Area has over 30 km of dykes, 35 water control structures, and covers approximately 40% of the Kootenay River floodplain south of Kootenay Lake.

Dyking stabilized water levels and resulted in dramatic changes to available habitats and the wildlife species using them (reviews in Wilson 1992 and Wilson and Stushnoff 1992). Wetland areas became dominated by emergent cattail (*Typha latifolia*) and to a lesser extent bulrush (*Scirpus spp.*). Common submergents included water milfoil (*Myriophyllum spicatum* var. *exalbescens*), bladderwort (*Utricularia spp.*), coontail (*Ceratophyllum demersum*), Canada waterweed (*Elodea canadensis*), and moss (*Fontinalis antipyretica*). Moist soil vegetation was dominated by smartweed (*Polygonum lapathifolium*), dwarf spikerush (*Eleocharis acicularis*), nodding beggar-ticks (*Bidens cernua*), and often young cattail. In the uplands, large meadows dominated by reed canarygrass (*Phalaris arundinacea*) became established. Unmanaged areas of the CVWMA did not experience extensive changes in habitats, although some areas on higher ground were invaded by upland vegetation due to the reduced flooding following the construction of the Libby Dam in 1974.

Water level stabilization promoted ecological succession and, over time, resulted in a decline in wetland productivity. In response, CVWMA staff initiated a program involving complete draining, or drawdown of each pond at 7-10 year intervals (Table 1). The objective of the drawdown program was to increase wetland productivity by (1) encouraging decomposition of accumulated organic matter, and (2) increasing plant diversity by stressing monotypic stands and encouraging the germination of moist soil vegetation. Although early season drawdowns were effective in promoting the growth of moist-soil vegetation, they left ponds vulnerable to invasion by persistent emergents. Over time, these required control to achieve a favourable interspersion of open water versus emergent vegetation. Control involved labour-intensive mowing and tilling followed by flooding. Baling were used to reduce the litter left after mowing.

Table 1. Summary of drawdowns undertaken in the CVWMA, by pond unit (adapted from Wilson 1992).

Pond unit/ Year	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Duck Lake Nesting Area							•																							
Six Mile Slough pond 2	•	•	•					•							•										•					
Six Mile Slough pond 3	•	•	•			•										•									•					
Six Mile Slough pond 4		•	•	•		•											•													
Six Mile Slough pond 5		•	•	•	•																									
Leach Lake pond 1	•	•	•	•								•	•					•												•
Leach Lake pond 2	•	•		•		•	•																							
Leach Lake pond 3	•	•		•		•	•	•	•	•	•		•																	
Leach Lake pond 4	•	•		•		•				•			•																	
Leach Lake pond 6		•																												
Leach Lake pond 7		•																												

Pond unit/ Year	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Corn Creek pond 2(A)*											•										•									
Corn Creek pond 2B*																	•				•									
Corn Creek pond 3																	•	•												
Dale Marsh																														

*Pond 2 was split into two compartments with the construction of a cross dyke in 1987.

Drawdowns were conducted relatively frequently up until 1987 (Table 1). Since then, water regimes have been kept relatively constant from year to year (with the exception of select ponds on which drawdowns have been undertaken), and habitat conditions have stabilized. In practice, many drawdowns were conducted for purposes other than habitat management such as the repair of dykes and water control structures.

Many factors potentially influence the success of drawdowns, including inter-year variation in temperature and rainfall, and variation between ponds in topography, hydrology, pedology, and plant community structure. Through experience and timing adjustments, CVWMA staff developed a procedure involving complete drawdown in spring, mowing of emergent cover in late summer, followed by removal of litter (by baling or other means), tillage and immediate re-flooding. In many instances, this procedure provided (1) stands of moist season annuals in the drawdown season, (2) good responses from a diversity of submergent species in subsequent years, and (3) long-term control of emergent vegetation. However, not all attempted drawdowns were successful or resulted in anticipated outcomes consistent with management goals. This is not surprising given the variability in physical and climatic characteristics that can influence such management interventions.

Currently large portions of several ponds are filled in with dense stands of emergents and a thick layer (up to 30 cm) of accumulated organic matter. Site-specific adjustments to current procedures (e.g., multiple mowings prior to re-flooding, ploughing with agricultural equipment) are being considered to improve effectiveness with respect to control of tough and persistent bulrush/cattail stands (B. Stushnoff, pers. comm.).

Management of Encroaching Woody Vegetation

Succession also impacted upland areas and mechanical brushing and burning were used to control woody vegetation such as Willow (*Salix spp.*) and Black Cottonwood (*Populus trichocarpa*) encroaching onto nesting meadows. Burning areas tended to reduce the competitive advantage that reed canarygrass has over Canada thistle. Burning activity also raised public concerns regarding smoke. Furthermore funding for brushing crews became scarcer, so these practices were phased out over time (B. Stushnoff, pers. comm.).

Flood protection dykes such as those surrounding Duck Lake and the Duck Lake Nesting Area continue to require vegetation management to comply with the BC *Dyke Maintenance Act* (Ministry of Water, Land and Air Protection and Department of Fisheries and Oceans Canada 1999). Such maintenance is intended to permit observation, inspection and access if emergency work is required during floods. Mandatory guidelines require that dyke vegetation consist only of mowed grass, however funding restrictions have prohibited the practice of annually mowing the Duck Lake dyke for many years. To comply with existing guidelines, removal of all brush and trees from dyke slopes, as well as trees for 2-3 m beyond the toe of the dyke would be required (Ministry of Water, Land and Air Protection and Department of Fisheries and Oceans Canada 1999). Dyke clearing was attempted in 1996, but could not be completed, and additional funding was secured for dyke maintenance in 2002. Members of the public expressed concerns regarding loss of songbird habitat and/or potential breeding disturbance (B. Stushnoff, pers. comm.). An exemption from the guidelines was sought, but not granted, so a modification of the required maintenance work (i.e., a reduction in the amount of brush cleared with clearing restricted to cottonwoods only) was conducted in early January to late March of 2002. The Ministry has since re-evaluated the issue and concluded that these dykes are over-width (having standard side slopes and a minimum 9 m crest width), over-height (relative to

the one in two hundred year flood level), and generally set back greater than 10 m from the river. For these reasons, and because of the reduced flood threat following construction of the Libby Dam, the Duck Lake dykes have a low risk rating and future maintenance will only require clearing of trees taller than 6 m and some brushing (D. Boyer, Ministry of Water, Land and Air Protection).

Livestock Management

Once water levels stabilized, livestock-grazing pressure in the CVWMA was gradually reduced through attrition. This change promoted an increase in grass cover and the establishment of large upland meadows. However over time, the Management Authority came under increasing pressure to permit more livestock grazing in the CVWMA (B. Stushnoff, pers. comm.). An experimental grazing program was undertaken using cows in an attempt to control cattail and reed canarygrass (Dennington and Asquith 1993). The program concluded that (1) cows consumed target plant species but were non-selective in their feeding habits; (2) fencing was required to adequately control cows and exclude them from sensitive and/or non-target areas; (3) cows ate moist soil vegetation in drawdown areas, thereby competing directly with waterfowl for food; and (4) cows exacerbated weed problems by eating grasses that compete with thistles and other weed species. Furthermore conflicts between cows and visitors using the CVWMA were reported during the program (B. Stushnoff, pers. comm.). In response to these findings, a policy was implemented to permit grazing only where it clearly assists in meeting priority habitat management objectives (B. Stushnoff, pers. comm.).

Noxious Weed Management

Pioneering species such as Canada thistle (*Cirsium arvense*) and sow-thistle (*Sonchus arvense*) were the first to appear on newly created upland areas. These were successfully out-competed as extensive stands of grass dominated by reed canarygrass became established with more stable water levels and reduced grazing pressure. Mowing and burning were also used to control noxious weeds (mainly Canada thistle), although these measures proved less effective than leaving areas idle and allowing grasses to invade through natural succession.

Many areas now consist of degraded grass stands and are being invaded by weed species such as common tansy (*Tanacetum vulgare*), goldenrod (*Solidago spp.*), Canada thistle, rush skeleton weed (*Chondrilla juncea*), and knapweed (*Centaurea spp.*). Invasion of the Leach Lake and Six Mile Slough units has become a persistent problem (B. Stushnoff, pers. comm.). To date this issue has been addressed primarily through the planting of lure crops (alfalfa, grass and clover mixture) in problem areas on a rotational basis, with mixed success (B. Stushnoff, pers. comm.). No systematic weed inventories have been undertaken in the CVWMA.

Planting/Baiting

In an attempt to attract wildlife, management staff has planted a variety of crops over the years, including corn, barley, alfalfa (*Medicago sativa*), wild rice (*Zizania aquatica*) and Japanese millet (*Echinochloa crusgalli*). Baiting with grain has occasionally been used to attract waterfowl for viewing purposes in the vicinity of the wildlife centre. Although wildlife consume these food sources, the success of these treatments has been mixed (B. Stushnoff, pers. comm.).

Since 1986, approximately 40 ha in lure crops (i.e., alfalfa, grass and clover mixture) have been planted annually in an attempt to reduce elk damage to nearby agricultural fields. Some preparatory work involving a bulldozer and spot herbicide use is sometimes necessary during the establishment phase (B. Stushnoff, pers. comm.). However, based on feedback from local farmers, lure crops have been successful in reducing wildlife damage and promoting positive relationships with the local agricultural community.

Nest Structure Establishment

Nest boxes, baskets, and platforms were erected in the CVWMA to supplement specific habitat attributes that appeared to be limiting waterfowl nesting. From 1973-1986, up to 450 nest boxes for cavity nesters and 101 nest platforms were made available (Wilson 1992). In 1972, 95 nesting islands were constructed in the

Duck Lake Nesting Area, and by 1986, 164 islands were available for nesting throughout the CVWMA. Occupancy and species use of nest boxes and other nesting structures were assessed through annual inspection after the nesting season. Canada Goose nests on nesting structures and other sites were monitored annually using ground and/or aerial surveys.

Between 1972 and 1990, success of waterfowl nests (mainly Common Goldeneye, Hooded Merganser, and Wood Duck) in boxes averaged $74 \pm 15\%$ for all species combined (Wilson 1992). Up to 29 baskets were used by ducks (mostly Mallard) and these had relatively high nest success ($79 \pm 30\%$), but very low occupancy ($14 \pm 9\%$). Use of nesting islands increased from 0 to 63 nests from 1972 to 1983 respectively, with nest success averaging $49 \pm 27\%$. Canada Geese used the nesting structures supplied, but they also used Osprey nests, islands, round bales, muskrat houses, and upland meadows for nesting. Nesting success was high in all cases ($95 \pm 4\%$) and did not differ significantly between the nesting structures and other sites (Wilson 1992).

It was clear that artificial nesting structures were used by ducks and geese, however their actual contribution to observed increases in nesting populations remains unclear, since many other changes were occurring simultaneously. The use of natural sites increased quickly and based on several lines of evidence, natural sites may have contributed more to observed increases in breeding populations: (1) nesting baskets were infrequently used, (2) Canada Geese tended to select sites other than nesting structures and their success was similar on structures and other sites, (3) productivity of cavity-nesting waterfowl in natural sites appeared to exceed that in nest boxes, and (4) average duck success on the ground greatly exceeded the 25% required to replace the breeding population (review in Wilson 1992).

Other nest structure initiatives included the establishment of wooden nesting platforms on poles for Canada Geese (provided by the Creston Rod & Gun Club), as well as several hundred swallow nest boxes used for specific graduate research projects (Rendell 1992; Beasley 1994; Burness 2000; Wardrop 2000). These structures continue to be used, but it is unclear whether there is a demonstrated need for them or whether numbers of natural sites are sufficient to support existing populations. These initiatives have generated mixed feedback from the public and concerns are being expressed regarding the growing Canada Goose population and the fact that the boxes are not being adequately maintained (B. Stushnoff, pers. comm.).

Beginning in 1998, management staff placed bales at Six Mile Slough, and later at Leach Lake. Close to 1,000 bales have been placed to date, as individuals (which decompose quickly), and more recently in piles to provide island habitat. The bales are used as nesting sites by Canada Geese and as loafing habitat by a variety of birds, including American White Pelicans.

Access Management

Access restrictions were tightened up during the early 1980's in an effort to reduce human-induced wildlife disturbance, and for the most part, these restrictions are being adhered to, with few trespass or vandalism incidents (B. Stushnoff, pers. comm.). Duck Lake can be accessed by vehicle from the western edge and from the Sirdar side. Powerboats are not permitted on Duck Lake, but use of rowboats, and to a lesser extent canoes and kayaks is common. Vehicle access to Leach Lake continues to be restricted and boating is not an issue there. Horses are permitted access only on dykes at Duck Lake and along the Wood Duck Walk in Corn Creek Marsh. Dogs are permitted throughout the Management Area as long as they are leashed. Dogs off leashes are frequently observed, and this sometimes results in wildlife disturbance. Currently, hunters may obtain permission to enter restricted areas for the purpose of retrieving harvested game. This measure provides a good opportunity to inspect tags and animals and exchange information with this user group (B. Stushnoff, pers. comm.).

Consumptive Use

Hunting has been allowed on the CVWMA since its inception and bag limits and season lengths continue to follow provincial regulations, with the exception of a delayed season for waterfowl. From 1972-1991, Management Area staff made opportunistic checks of waterfowl hunters to estimate their use and success (birds bagged per hunter-day) in the CVWMA. Total hunter-days were estimated from vehicle counts, and

the average number of waterfowl hunters per vehicle. Success was estimated using the average number of birds bagged per hunter. Sampling was stratified by weekend, weekday, and by month. Total hunter-days peaked at about 3,000 in 1976 and declined to approximately 600 in 1991. This decline is partially attributed to access restrictions that were tightened in the early 1980's, but remaining hunters have experienced high hunting success relative to other waterfowl hunters in BC (Wilson 1992; B. Stushnoff, pers. comm.). Use of the CVWMA by big game hunters is more difficult to assess and was only estimated in 1991, when the area supported 823 big-game hunter days (Wilson 1992). There has been some conflict between hunters and wildlife watchers, particularly in areas that are highly frequented by both user groups, such as Corn Creek Marsh (B. Stushnoff, pers. comm.). Signs recently posted near the Wildlife Interpretation Centre that inform people that the area is used for hunting have drawn attention to this issue. There is pressure to close this area in particular to hunting to increase public safety and promote wildlife visibility (B. Stushnoff, pers. comm.). The onset of the waterfowl-hunting season is already delayed throughout the CVWMA to reduce conflicts between hunters and other visitors.

Trapping is not permitted in the CVWMA, except in rare circumstances when it is necessary to target beavers and muskrats that are causing substantial damage to dykes and water control facilities. Trappers are required to take whatever precautions are available to them to avoid trapping non-target species and ensure public safety.

No estimates of the extent of other consumptive uses (e.g., berry and mushroom picking, collection of other materials) are available for the CVWMA at this time.

Fishing has probably been practiced in the Management Area as long as hunting. We received a large volume of information related to fishing in the Area since the early 1900's with the general trend of the comments being related to how the fishing quality and quantity has diminished over time. There is no data indicating the total number of rod/days sustained over the Area in a year but it is likely that Duck Lake receives the large majority of the fishing pressure.

Today, Duck Lake is a popular fishing destination and areas along the western shore and near Sirdar are used most intensively (Ohanjanian 1998). Boat activity tends to be highest from April to September. An estimated 10,650 cars used the Duck Lake area in 2002, based on a car counter installed at Duck Lake (A. de Jager, pers. comm.). It was emphasized to us by fisherman that Duck Lake provides a high value fishing experience for children as it is an accessible fishery for perch, sunfish and shiners that children can catch.

As mentioned above, kokanee stocks in the south arm of the lake are severely depleted. With recent initiatives to fertilize the south arm and thus bring back kokanee populations, the spawning habitat for kokanee in Management Area streams such as Boundary, Boulder and Summit Creeks will become especially important. Concerns have been raised about the negative impacts of boating on Western Grebes, because boating causes the grebes to leave their nests, thereby predisposing them to predation, exposure and overheating (Ohanjanian 1997, 1998).

Non-consumptive Use

The CVWMA is used for various types of recreational activities, including wildlife viewing, hiking, biking, camping, boating, canoeing, kayaking, horseback riding, etc. Both the Dewdney and Trans-Canada Trails traverse the area, but no estimates of user days are currently available. The Wildlife Centre, where much of the recreational activity is centered, receives over 9,000 visitors each season (May to October), and offers on-site interpretive services, a public information and outreach program, as well as school-based programs.

Summit Creek Campground began operating in 1972 and received an average of 4,000 visitors annually, prior to its closure in summer 2001. It is also frequented by the general public as a day use area, and provides access to the Leach Lake unit. In 2001, concerns were raised about the safety of visitors and workers due to the abundance of large old trees in various stages of decay that are located in the campground area. A hazard tree assessment conducted in spring of 2001 determined that all campground facilities as well as 82% of the 50 designated campsites were unsafe due to the proximity of hazard trees, many of which had evidence of previous failure (Steger and Raymond 2001). The campground is located in a stand of riparian black cottonwood and contains many old-growth attributes. Such old-seral stands have

high wildlife habitat value and are becoming increasingly rare in British Columbia and throughout the Pacific Northwest. Based on the findings of the assessment, two options were provided for the campground: (1) removal of all hazard trees followed by annual re-assessment, or (2) permanent campground closure to eliminate the safety risk and to maintain the ecological values of the area. The campground was closed in May of 2001.

Wildlife Management Initiatives and Outcomes

Wildlife surveys were conducted in the years following the creation of the CVWMA to evaluate the effects of the habitat manipulations undertaken and to guide future habitat management. Due to the mandate of the CVWMA, these surveys focused principally on waterfowl, however data on many other species (waterbirds in particular) were collected concurrently. Species with highly visible and/or colonial nests were counted on nests in the spring. Management Area staff also kept anecdotal nest or sight records of other species (see reviews in Wilson 1992; Wilson and Stushnoff 1992).

Since its inception, university students, researchers, government and non-government agency personnel, consultants and naturalists have been involved in various research, inventory, and management initiatives within the CVWMA. These initiatives have covered a broad variety of theoretical and applied topics, and some have focused on rare or poorly known species and habitats of management concern. With respect to fish species, apparently only two fish inventories (Forbes 1985, Gebhart and Roberge 2001) have been conducted specifically within the CVWMA.

This section provides a summary of selected findings considered relevant to the wildlife and habitat management of the area. Where available, such information is presented by species.

Waterfowl

Prior to 1988, waterfowl abundance was estimated using periodic counts through ground or aerial surveys (Butler et al. 1986, Wilson 1992, Wilson and Stushnoff 1992). Methods were variable and the timing of most surveys varied from year to year. Peak waterfowl migration numbers were determined through aerial surveys conducted most years on April and October 1st. Similarly, waterfowl breeding populations were estimated using a variety of techniques. These included all-terrain vehicle surveys of uplands (1975-1980), nesting island searches and post-hatch checks (1972-1986), airboat transects for waterfowl broods (1974-1987), annual post-season nest box and nest structure inspections (1972-1991), ground and/or annual surveys for Canada Goose nests on nesting structures or other sites (1972-1991), and pair counts using the aerial transect method (1991-2003). Beginning in 1988, a systematic aerial transect survey, involving counts of waterfowl and other identifiable water bird species was conducted weekly from mid-March through to mid-November.

The stabilization of water levels during the spring was the single most extensive and significant habitat change within the CVWMA. Measured against the objective of establishing a breeding waterfowl population, the outcome of this management initiative was very successful. Prior to water level control, the CVWMA supported only cavity-nesting ducks, Canada Geese breeding in Osprey nests, and occasionally nests of dabbling duck species found on benchlands and mountain slopes adjacent to the flats (Munro 1950, 1957). From 1966 to 1985, breeding populations were established of all endemic ground-nesting waterfowl species, and an approximate fivefold increase in waterfowl broods was recorded (Butler et al. 1986; Wilson 1992; Wilson and Stushnoff 1992). A concomitant reduction in livestock grazing pressure that permitted establishment of dense nesting cover was critical to this successful outcome. In addition to benefiting breeding waterfowl populations, the increase in permanent water areas improved habitat for broods and moulting birds as well.

From 1969 to the mid 1970's the maximum number of waterfowl counted during spring and fall migration was relatively stable, but by about 1978, populations began to decline (Butler et al. 1986; Wilson 1992). Interpreting the effects of habitat management in the 1970's on migrating waterfowl population trends is difficult because of other concurrent changes. These included a reduction in grain availability caused by a shift from grain to forage crops grown in the Creston Valley bottom, improved drainage and reduced

sheetwater pond availability on agricultural lands, and a shift away from waterfowl sampling methods that overestimate the size of large bird aggregations (Wilson 1992).

In addition to waterfowl, populations of waterbirds (at least 31 species including herons, grebes, rails, terns, ospreys, etc.) using the CVWMA increased after water level stabilization. Selected tree-nesting species also benefited, presumably through the maturation of cottonwoods (Butler et al. 1986). With the exception of Tundra Swans, no naturally occurring bird species declined, and counts indicate that land birds increased from the 1950's to the mid 1980's as well (Butler et al. 1986). Furthermore, based on Munro's (1950) study, several listed bird species (e.g., Western Grebe, Forster's Tern, American White Pelican, Great Blue Heron, Double-crested Cormorant) were present in lower numbers prior to water level stabilization. Many of these species benefited from the availability of small fishes (e.g., black bullhead, yellow perch, pumpkinseed, largemouth bass). Species usually associated with marshes, such as Yellow-headed Blackbirds, American Bitterns, and Sora also increased. With the loss of mudflats, shorebird use declined during migration periods, although nesting by shorebirds probably increased in the absence of severe flooding (Butler et al. 1986).

American Bittern (blue-listed)

During a 2003 inventory of American Bitterns conducted throughout the Columbia Basin, 43 calling males (and 81% of all calling males recorded in the Columbia Basin) were detected within the CVWMA (Cooper and Beauchesne 2003). This makes the CVWMA the most significant breeding concentration of American Bitterns in BC. They were located in four wetlands: Six Mile Slough (29 males), Duck Lake Nesting Area (6 males), Leach Lake (4 males), and Corn Creek Marsh (4 males).

American White Pelicans (red-listed)

American White Pelicans appeared in the CVWMA in the 1970's after water level stabilization. This population does not breed locally, but is present in the CVWMA from June to early October. Numbers have been steadily increasing in recent years, and as many as 300 individuals were counted in 2004 (B. Stushnoff, pers. comm.). Based on data collected in 2000, pelicans use the Leach Lake (58% of observations), Six Mile Slough (40%), and Duck Lake (2%) areas exclusively, and their activity shifts between these areas over time (Gowans and Ohanjanian 2000).

Double-crested Cormorants (red-listed)

Sightings have been rare but consistent in the CVWMA since the early 1980's. Breeding was confirmed locally in 2003 based on the presence of chicks in nests, and 18 active nests were counted in June of 2004 (M. Machmer, pers. obs.). No formal studies of this species have been undertaken in the Management Area and an inventory and evaluation of their habitat use is warranted.

Great Blue Herons (blue-listed)

Munro (1950) reported 40 nesting pairs of Great Blue Herons in the CVWMA. Numbers of occupied nests at the Duck Lake colony suggest an increasing trend through to the mid 1970's (90 in 1971; 95-1972; 114-1973; 122-1975; 93-1977; 70-1981; 66 in 1983; Forbes et al. 1985; Butler et al. 1986). The Duck Lake site was abandoned in 1989 and a new colony was established in 1990 at Leach Lake (Wilson 1992). The latter did not fledge young until 1992 and only a single nest at Duck Lake was active in 1991. McMann (1996) counted four breeding colonies in 1996; three of these were active in 1997, however numbers of active nests were not counted (McMann 1997).

Recent surveys found three active breeding sites with a total of 58 active nests in 2002 (53 at Leach Lake; 4 at West Branch; 1 at Duck Lake; Machmer and Steeger 2003). Only the Leach Lake colony was active (86 nests) and successful in 2003 (Machmer and Steeger 2004). Fledging success per successful nest averaged 2.52 ± 0.13 and 2.27 ± 0.16 in 2002 and 2003, respectively.

Forster's Tern (red-listed)

The CVWMA is the only confirmed breeding site for Forster's Terns in BC. They were first recorded in small numbers in 1980 (Goossen et al. 1982), and have bred consistently since then at Duck and Leach

Lake. No formal studies or inventories have been conducted on this species in the CVWMA although incidental information was gathered in conjunction with research projects on Black Terns (Chapman-Mosher 1986).

Long-billed Curlew (blue-listed)

This species is rare, but a few pairs nest in the Creston Valley (Butler et al. 1986). Recent inventories (2002-2003) detected an estimated two breeding pairs in cultivated fields in West Creston, but no breeding activity was confirmed within the Management Area (P. Ohanjanian, pers. comm.).

Ospreys (yellow-listed)

No formal counts of nesting Ospreys were conducted by CVWMA staff, but the population was the focus of a long term university research project (Flook and Forbes 1983; Forbes 1989; Steeger 1990; Steeger and Ydenberg 1991; Steeger et al. 1992; Machmer 1992; Machmer and Ydenberg 1992; Green 1993). Census data for a large portion of the CVWMA indicate 45 and 49 occupied Osprey nests in 1987 and 1988, respectively (Steeger et al. 1992). A stable population of about 60 pairs is thought to nest annually on the Management Area and adjacent lands; this population has doubled since water level management first began (Butler et al. 1986; Wilson 1992). McMann (1996, 1997) counted 18 and 55 occupied Osprey nests in 1996 and 1997, respectively. Assuming that only the 1997 survey was comprehensive, Osprey numbers in the CVWMA appear to be relatively stable through time.

Sandhill Crane (blue-listed)

This species is seen rarely within the CVWMA from April to October, but no nesting records are available. In 2003, Sandhill Cranes were detected in the Leach Lake and Corn Creek units (B. Stushnoff, pers. comm.) and repeated observations (up to four at once and a single juvenile) were made, but breeding could not be confirmed. No formal study of this species has been conducted in the CVWMA.

Short-eared Owl (blue-listed)

Short-eared Owls breed in the Management Area and most historical sightings have been from Duck Lake and West Creston (Butler et al. 1986). One active nest was found in the Duck Lake Nesting Area in 2002 (M.A. Beaucher, pers. comm.), but no breeding activity was confirmed in the CVWMA during a 2003 inventory conducted throughout the Columbia Basin (Cooper and Beauchesne 2003).

Western Grebes (red-listed)

Western Grebes are currently red-listed in BC and only two colonies (i.e., Salmon Arm and CVWMA) have been consistently occupied in recent years. Although common summer residents, Western Grebes did not begin to nest on Duck Lake until sometime in the early 1960's, at which time lake levels were already regulated (Forbes 1985a). Nest records are scant (15 in 1968; 40 in 1973; 65 in 1976; 48 in 1978; 1984), but from 75-90 pairs nested from 1981-1983 (Forbes 1985a). An estimated 160 (157 in 1997 and 166 in 1998) Western Grebes live in the CVWMA from mid-June through August (Ohanjanian 1998). Breeding activity was detected at Duck Lake (82 birds in 1997 and 87 in 1998), Leach Lake (22 birds in 1997 and 26 birds in 1998) and Kootenay Lake (50 non-breeders or failed breeders in 1997; 53 in 1998).

Western Screech Owl (red-listed)

An inventory of Western Screech Owls in the East and West Kootenay confirmed at least one active nest of this species in the CVWMA during 2002 and again in 2003 (T. Antifeau, pers. comm.).

Yellow-breasted Chat (red-listed)

Anecdotal evidence suggests that Yellow-breasted Chat have been heard singing during the breeding season but no nests have been confirmed in the CVWMA (C. Bishop, pers. comm.). No formal study of its breeding habitat use has been conducted locally.

Muskrats

Based on a count of muskrat houses from 1973-1991, this species increased its use of the CVWMA after water level stabilization. Counts peaked in 1991 (>1,200 houses), and muskrats were most abundant in

ponds dominated by horsetail (Wilson 1992). Muskrat houses have provided nesting substrates for an increasing population of breeding Canada Geese. No systematic inventory data is available for other species of mammals in response to water level stabilization.

Northern Pocket Gopher (red-listed)

Based on existing inventory information, the Wynndel Pocket Gopher is restricted to two areas in the Creston Valley near Wynndel and Huscroft (Fraker et al. 1997). It has not been confirmed within the Management Area, but was detected on the floodplain proper just east of the area, near Wynndel. This species can tolerate a wide range of soils on shallow slopes, and occupies mainly perennial hay and alfalfa fields and orchards (Fraker et al. 1997).

Northern Leopard Frog (red-listed)

The CVWMA currently supports the only known population of Northern Leopard Frogs in BC, and beginning in 1997, this population has been the focus of intensive study (Ohanjanian 1997; Waye 1998, 2000; Waye and Cooper 1999, 2001; Gebhart and Roberge 2001; Beaucher 2001). The study has involved surveys for calling males, egg masses and tadpoles, mark-capture, radio-telemetry, habitat use and suitability assessments, fish sampling and predation evaluation, aquatic invertebrate sampling, pathology testing and dissolved oxygen, temperature and water level monitoring. Frog activity appears to be confined to the Duck Lake Nesting Area, Duck Lake and Goat Channel, while breeding activity is restricted to the nesting area.

In 2003, only six egg masses were detected in the Duck Lake nesting area, and the small population size, restricted distribution, and low reproductive and survival rates in the CVWMA continues to leave this population highly susceptible to extirpation (D. Adama, pers. comm.).

Several agencies are working together as part of a recovery initiative to rear frogs in an effort to re-establish populations within their historic range. Since 2001, a facility in the CVWMA has successfully reared and released more than 5,000 juvenile frogs and several thousand tadpoles into the Management Area and monitoring is underway. An estimated 1,500 juvenile frogs, raised from egg masses at the CVWMA facility, were reintroduced into the Bummer's Flat Conservation Area (East Kootenay) in August of 2003.

Coeur d'Alene Salamander (blue-listed)

This species has been found at sites near Wynndel and Sirdar along the eastern side of the Creston Valley (Ohanjanian and Teske 1996), but there are no confirmed records within the Management Area. It occupies very specialized habitats (i.e., wet seeps, waterfall splash zones and streamside riparian habitats) and requires deeply fractured rock formations into which it can retreat to avoid desiccation or freezing temperatures (Cannings et al. 1999). Overland movements are restricted, especially in arid areas or areas with little canopy cover. Logging, water diversion, and road-building and maintenance activities have the potential to impact this species.

Western Skink (blue-listed)

A study investigating the occurrence, distribution, habitat use, and movements of the Western Skink and the Northern Alligator Lizard was conducted in the CVWMA from 1996-1998 (Rutherford and Gregory 2001). Both species are found within the Management Area.

Rare Plants and Plant Communities

Based on information provided in the CVWMA plant list and by the CDC, at least five red-listed and six blue-listed plant species have been confirmed in the Management Area. None of these species are listed by COSEWIC. The exact locations of the plants within the Management Area are generally unknown. Also, based on information provided by the CDC, no rare plant communities have been identified within the CVWMA.

Invertebrates

The CVWMA supports a rich diversity of dragonfly species according to a recent systematic dragonfly inventory of the Columbia Basin (Cannings et al. 2000; Appendix 2). No other systematic invertebrate inventories have been conducted in the CVWMA.

Chapter 2. Habitats and Wildlife of the CVWMA

Introduction

In this chapter, we describe and discuss the biological features of the CVWMA. We start by characterizing broad habitat types and then describe the vertebrate species richness of the Management Area. We use vertebrate species richness as a surrogate for biodiversity. We place particular emphasis on species at risk because they will increasingly become a focus of management on the CVWMA. Finally we describe the habitat elements most important for the sustainability of the Area's species. This information is used in Chapter 3 as the basis for developing the specific objectives of the habitat management plan.

Methods

Habitat Mapping

Mapping was based on a digital mosaic of standard BC aerial photos from circa 1995 (B. Stushnoff, *pers. comm.*). Map features were digitized from this photo base map. Maximum resolution of mapped features was approximately 15 m. We defined 10 broad habitat types that were practical to distinguish from the aerial photos and were ecologically relevant (Table 2, Figure 1). We also identified linear features such as narrow channels, potential fish-bearing stream reaches (based on the BC Ministry of Water, Land and Air Protection's Stream Inventory Summary System and Fish Information Summary System databases), high-gradient streams and highways and roads.

Features were flagged as field sampling points during mapping if they could not be identified confidently as one of the habitat types during digitizing. An additional 30 features were randomly identified as sampling points to test mapping accuracy.

Sampling points were visited in June 2004 and were classified to habitat type. Photos were taken at each site. In addition, aerial photos of several areas were taken from a fixed wing aircraft. Photos were later examined, and the map was adjusted as necessary.

Use of the Columbia Basin Database of Wildlife-Habitat Relationships

To compile species lists by habitat type and to identify important associations between wildlife species and their habitat, we used the habitat classification system of the Columbia Basin Database for Wildlife-Habitat Relationships (Johnson and O'Neil 2001, Steeger et al. 2001). The Columbia Basin classification system was subject to extensive peer review and is now available as a database for all vertebrate species and habitats occurring in the Basin (<http://www.habitat.cbt.org>). The advantage of this system is that it ties habitat characteristics directly to wildlife species by defining:

- *Wildlife Habitat Types*: These are groups of vegetation cover types (or land use/land cover types) that are broadly based on wildlife-habitat relationships.
- *Level of association between wildlife and habitat types*: Three categories are used to describe the degree of association between wildlife species and habitat types:
 - *Closely Associated*. A species is widely known to depend on a habitat for part or all of its life history requirements. It has an essential need for this habitat for its maintenance and viability.
 - *Generally Associated*. A species exhibits a high degree of adaptability and may be supported by a number of habitats. The habitats play a supportive role for its maintenance and viability.
 - *Present*. A species demonstrates occasional use of a habitat. The habitat provides marginal support to the species for its maintenance and viability.
- *Habitat Elements*: Components of the environment believed to most influence the distribution, abundance, fitness, and viability of wildlife species. Habitat elements include natural attributes, both biological and physical.

Species Lists

We compiled three types of species lists:

1. Lists of all terrestrial and aquatic vertebrate species (birds, mammals, amphibians, reptiles, and fish) and the insect order Odonata (dragonflies; no other data on insect species abundance were available). For the vertebrates, we included species on the CVWMA 2003 wildlife checklist and/or the 2002 Creston Valley checklist of birds compiled by Van Damme (2002). We noted the provincial conservation status of the BC Conservation Data Centre (CDC) and the federal status assigned by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). For birds only, we also noted the known breeding status in the Creston Valley (Van Damme 2002). These lists are provided in Appendix 2.
2. Plant species listed by the CDC and COSEWIC.
3. Lists of species by habitat type. We used the following steps to compile lists of species for each habitat type in the CVWMA:
 - (i) We determined species that were *closely associated* with habitat types of the Columbia Basin Database that corresponded to the habitat types we classified for the CVWMA. For example, the habitat type Permanent Wetland corresponded to the Columbia Basin Database habitat type “Herbaceous Wetlands”. We therefore included the species listed in the database as closely associated with herbaceous wetlands.
 - (ii) Because some species were only *generally associated* or *present* in a given habitat type, we also included species that were associated with habitat elements relevant to the habitat type. For example, for the Permanent Wetland habitat type, we included species associated with the “Freshwater Riparian and Aquatic Bodies Habitat Elements” (Johnson and O’Neil 2001; <http://www.habitat.cbt.org>).
 - (iii) Finally, we removed those species not reported to occur in the Creston Valley and introduced species.

Species at Risk

We identified species at risk (red or blue-listed) and of other conservation concern (yellow subnational - S4 or introduced) via the current listings by the CDC and COSEWIC. We also compiled their habitat element requirements based on the Columbia Basin Database for Wildlife-Habitat Relationships. Because of the relatively large number of species, we developed a method to rank their management priorities. We based our *very high*, *high*, *medium*, and *low* priority rankings on:

1. Uniqueness to the CVWMA in the context of regional, national and international distribution.
2. Breeding status on the CVWMA.
3. Conservation status according to the CDC and COSEWIC.
4. Frequency and/or probability of occurrence on the CVWMA.
5. Availability of suitable habitat and habitat elements.
6. Responsiveness to management intervention.

Management objectives and prescriptions developed in Chapter 3 were then based on species at risk of highest management priority (*very high* and *high*).

Identification of Key Habitat Elements

We used the Columbia Basin Database for Wildlife-Habitat Relationships to identify important habitat elements associated with species occurring in the habitat types of the CVWMA. For each habitat type, we ranked the habitat elements according to the number of species associated with them. We then identified the top five habitat elements for possible management intervention. Note that the Columbia Basin Database table for habitat elements was organized hierarchically and includes some higher categories that were too general for management applications. For example, while most species were associated with the habitat

element “trees”, we selected a lower category such as, for example, “trees >40 cm diameter” as a focal habitat element for management.

Results and Discussion

Wetland, Aquatic and Upland Habitats of the CVWMA

The CVWMA is currently comprised of approximately equal proportions of open water, wetland habitats (including both permanent and seasonal wetlands) and upland habitats (grasslands, shrublands and forest; Table 2, Figure 1). There are also 23 km of narrow channels and 2.0 km of potential fish-bearing stream reaches. High-gradient streams are generally rare within the Management Area boundaries.

Table 2. Habitat types of the Creston Valley Wildlife Management Area.

Habitat Type	Area (ha)	Description	
Permanent Wetland	875	Areas flooded throughout the year dominated by a mix of open water and emergent vegetation (generally cattail, bulrush, reed canarygrass)	
Seasonally-flooded Wetland	622	Areas inundated during spring but dry by summer. Usually dominated by emergent wetland vegetation (e.g., cattail) and flood-tolerant upland species (e.g., reed canarygrass)	
Lowland Forest (Coniferous)	9	Coniferous or mixed coniferous-deciduous stands with areas of seasonally-inundated marsh-bog. Characteristic vegetation includes western redcedar, red alder, black cottonwood, rose, elderberry, skunk cabbage.	
Lakes and Open Water	2317	Permanently flooded, open water	
Rivers and Wide Channels	389	Created waterways, including borrow ditches	
Upland Grassland	1141	Rarely-flooded areas dominated by graminoids such as reed canarygrass and <i>Poa</i> species	

Habitat Type	Area (ha)	Description	
Upland Forest (Deciduous)	743	Rarely-flooded areas dominated primarily by stands of mature cottonwoods and an understory of rose, bracken fern and red-osier dogwood.	
Upland Forest (Coniferous)	694	Areas generally upslope of marshes and dominated by ponderosa pine (in hottest, driest areas), Douglas-fir and western redcedar, with an understory of Saskatoon and red-osier dogwood.	
Upland Shrub	153	Rarely-flooded areas dominated by suckering black cottonwoods, willow species, red-osier dogwood and rose.	
Agricultural Fields	202	Lure crops for elk, currently planted with alfalfa, grass and clover mixture	

The habitat types we defined for the Management Area were necessarily broad because of the resolution of available air photos. However, many of the habitat types (particularly permanent and seasonal wetlands, upland grassland and upland forest (deciduous) were remarkably uniform when investigated in the field. This uniformity is a legacy of the management history of the CVWMA, which has provided optimal conditions for the establishment of aggressive species such as cattail and reed canarygrass. With the exception of forest habitat types, the habitats we classified were either extremely rare or non-existent in the Creston Valley prior to the creation of the CVMWA and subsequent construction of dykes and water control structures.

Species Richness

The CVWMA supports a large number of vertebrate species, including many that are considered at risk and of provincial and federal conservation concern (Table 3, Appendix 2). The majority of listed species that reside on the CVWMA also breed. Total richness of terrestrial vertebrate species (354 species) in the CVWMA constitutes 59% and 79% of all terrestrial vertebrate species occurring in British Columbia and the BC portion of the Columbia River Basin, respectively. Maintenance of this outstanding wildlife richness is one of the primary objectives of this management plan – a goal strongly supported by the public (Betts and Morley 2004).

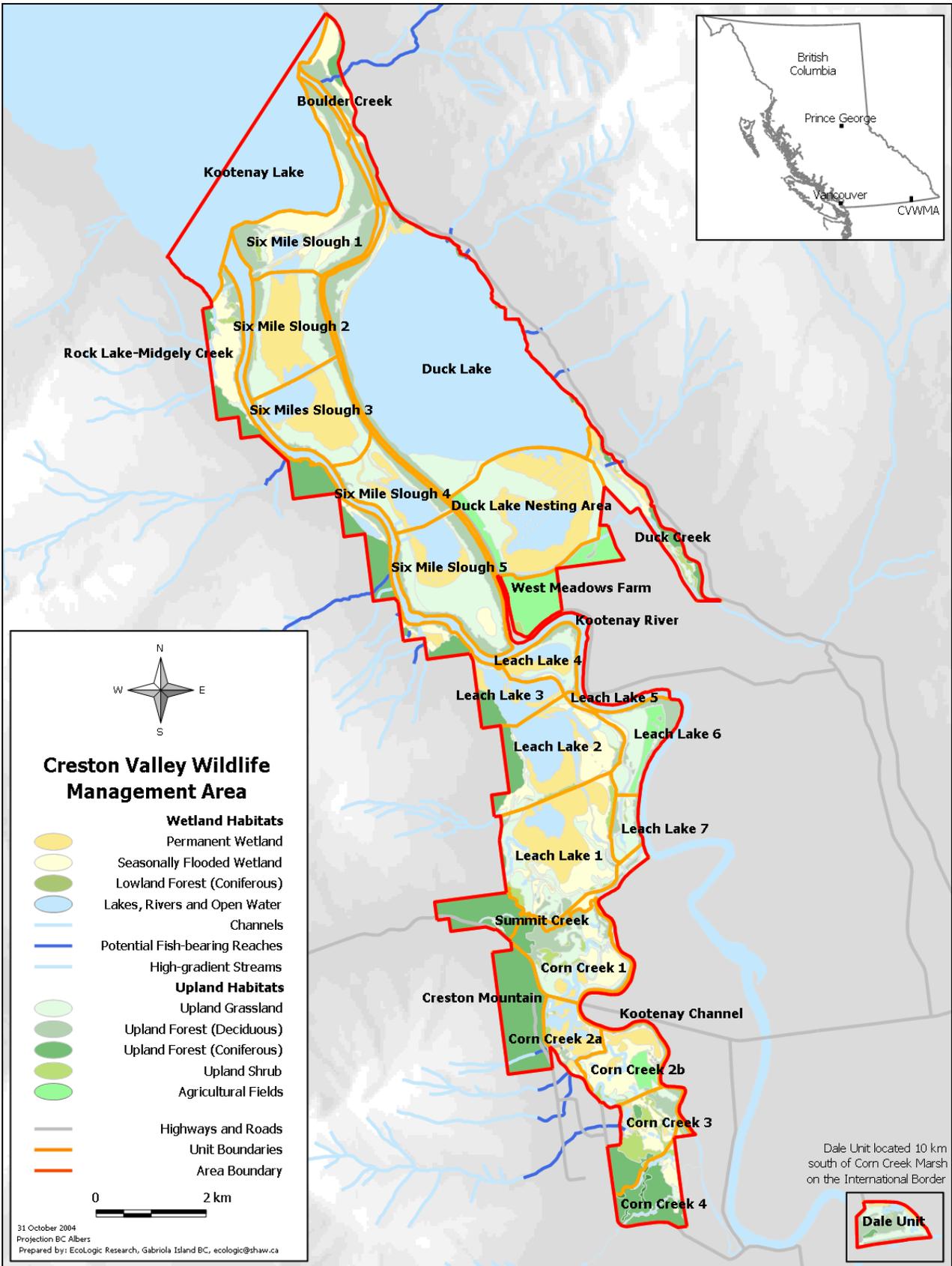


Figure 1. Creston Valley Wildlife Management Area.

Table 3. Number and conservation status (%) of vertebrate species documented on the CVWMA and surrounding areas.

Conservation Status	Terrestrial Species					Fish	Total Vertebrates
	Amphibians	Reptiles	Birds	Breeding Birds	Mammals		
Total # of species ¹	6	6	286	148	56	16	370
Red list ²	1 (16.7)	0 (0)	16 (5.6)	5 (3.4)	3 (5.4)	2 (12.5)	22 (5.9)
Blue list ²	1 (16.7)	2 (33)	19 (6.6)	5 (3.4)	4 (7.1)	2 (12.5)	28 (7.6)
Total Red & Blue ²	2 (33.3)	2 (33.3)	35 (12.2)	10 (6.8)	7 (12.5)	4 (25)	50 (13.5)
COSEWIC list ²	3 (50)	1 (16.7)	10 (3.5)	4 (2.7)	4 (7.1)	1 (6.3)	19 (5.1)
Introduced ²	0 (0)	0 (0)	10 (3.5)	6 (4.1)	1 (1.8)	4 (25)	15 (4.1)

¹Numbers are based on the CVWMA 2003 Wildlife Checklist and 2002 Creston Valley Checklist of Birds by van Damme (2002).

²Status is based on the 2004 *red* (threatened or endangered) and *blue* (special concern) designations of the BC Conservation Data Centre and the *endangered*, *threatened*, and *special concern* designations of the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

The majority of terrestrial vertebrate species occurring on the CVWMA are birds, and due to its outstanding bird species richness (286 species), the CVWMA was selected as one of 10 *Important Bird Areas* of the Canadian Intermountain Joint Venture (CIJV 2003). The CIJV is a partnership of government agencies, First Nations, non-governmental conservation organizations, universities, industry and landowners that was established to help conserve the region's bird and other wildlife species. The Intermountain plan area covers all mountain regions east of the BC coastal range to and including the Rocky Mountains. The CIJV compiled a list of priority and focal bird species to define critical attributes and structure within selected habitat types, with the eventual goal to provide land managers with best management practices for important habitats. Considering that, for the relevant habitat types, the CVWMA provides habitat for 89% and 80% of the CIJV priority and focal bird species, respectively, the Management Area will be an important land manager and collaborator for this initiative.

The CVWMA reports 16 fish species occurring within the Management Area boundaries (CVWMA Wildlife Checklist 2003). Due to a paucity of fish inventories conducted in the CVWMA, it is unclear how accurate this figure is, however dyking and water management regimes that have affected the Creston Valley flats have likely also decreased historical fish species richness.

Fewer data are available on the species richness of non-vertebrates. With respect to plants, the current CVWMA database comprised >1300 specimens (although not all are unique species). The only insect taxa that have been inventoried on the CVWMA are dragonflies (Odonata) and butterflies (Lepidoptera). At least 26 dragonfly species (Cannings et al. 2000; Appendix 2) occur on the CVWMA. The fluctuating water levels of the Management Area do not provide good habitat for butterflies native to the region (N. Kondla, pers. comm.).

Species at Risk

Concern for threatened and endangered species in Canada has resulted in the passing of the federal Species At Risk Act (SARA) in 2002. This Act maintains lists of species at risk via COSEWIC. While SARA applies directly only to federal lands, aquatic species, and migratory birds covered by the *Migratory Birds Convention Act, 1994*, Canadian provinces and territories have an obligation to address the needs of listed species. In British Columbia, the Conservation Data Centre (CDC) of the Ministry of Sustainable Resource Management coordinates the compilation and distribution of information on rare elements of the province's biodiversity. Based on the current CDC and COSEWIC lists, 50 red and blue-listed vertebrate species and 19 federally listed species occur on the CVWMA (Table 3, Appendix 2). Of the 19 species listed by COSEWIC, 10 are on Schedule 1 (the official SARA list), none are on Schedule 2, six are on Schedule 3, and three species (Western Screech-owl, Western Toad, and Western Skink) are not yet on any schedule (SASA Public Registry 2004; Appendix II). Species that were designated at risk by COSEWIC prior to October 1999 must be reassessed using revised criteria before they can be considered for addition to Schedule 1 of SARA (SASA Public Registry 2004).

The following sections provide details on the conservation status and habitat use or requirements (where available) of specific species.

Terrestrial Vertebrates - A total of 46 listed terrestrial vertebrate species occur on the CVWMA. These species, their habitat element requirements and management priority are presented in Table 4.

Table 4. Management priorities and habitat element requirements of terrestrial vertebrate species at risk in the CVWMA.

Common Name	Management Priority ¹	Habitat Element Requirements
Western Grebe	VH	open water, submergent/emergent vegetation, floating mats, marshes
Forster's Tern	VH	open water, submergent/emergent vegetation, floating mats, shoreline
Northern Leopard Frog	VH	submergent/emergent vegetation, sand/mud, wetlands/marshes, seasonal flooding
Great Blue Heron <i>herodias</i>	VH	large trees, shoreline, emergent vegetation, wetlands/marshes, seasonal flooding
American Bittern	VH	emergent vegetation, wetlands/marshes, seasonal flooding
American White Pelican	VH	open water, sand/gravel bars, shoreline, marshes
Western Screech-Owl	H	wildlife trees ² , riparian areas, wetland/marshes
Double-crested Cormorant	H	open water, sand/gravel bars, marshes
Short-eared Owl	H	shrub/grassland elements, marshes, seasonal flooding
Painted Turtle	H	open water, submergent/emergent vegetation, floating mats, marshes, in-stream coarse woody debris
Western Skink	H	coarse woody debris, rocky habitat, fire
American Avocet	M	marshes, wetlands, shoreline
Peregrine Falcon <i>anatum</i>	M	wildlife trees, shrub land elements, shoreline, wetlands/marshes, seasonal flooding
Prairie Falcon	M	shrub land elements, fire
American Badger	M	undisturbed soils
Caribou	M	wildlife trees
Sage Thrasher	M	shrub land elements
Yellow-breasted Chat	M	shrub land elements, wetlands/marshes
Townsend's Big-eared Bat	M	wildlife trees, shrubs, open water, wetlands/marshes
Long-billed Curlew	M	shrub/grassland elements, open water, sand/mud, wetlands
Sandhill Crane	M	open water, shoreline, emergent vegetation, seasonal flooding, herbaceous layer (shrub/grassland)
Surf Scoter	M	open water, marshes
Bobolink	M	shrub/grassland elements, wetlands, seasonal flooding
California Gull	M	open water, shoreline, sand/gravel bars, marshes, seasonal flooding
Caspian Tern	M	open water, shoreline, sand/gravel bars, marshes
Coeur d'Alene Salamander	M	coarse woody debris, litter, moss, river banks, seeps/springs, shoreline
Grizzly Bear	M	coarse woody debris, trees, forbs, shrub land elements, wetlands/marshes
Lewis's Woodpecker	M	wildlife trees, fire
Long-tailed Duck	M	open water, marshes
White-headed Woodpecker	L	wildlife trees
Grasshopper Sparrow	L	shrub land elements

Common Name	Management Priority ¹	Habitat Element Requirements
Lark Sparrow	L	shrub land elements
Northern Pocket Gopher <i>segregatus</i>	L	coarse woody debris, underground part parts, forbs
Swainson's Hawk	L	wildlife trees, shrub land elements
Purple Martin	L	wildlife trees
Ferruginous Hawk	L	shrub land elements
Short-billed Dowitcher	L	open water, shoreline, sand/mud, sand/gravel bars, islands
American Golden-Plover	L	shoreline, sand/mud, seasonal flooding
Red-necked Phalarope	L	open water, shoreline, sand/mud, floating mats
Green Heron	L	wetlands/marshes, trees
Red-tailed Chipmunk <i>simulans</i>	L	coarse woody debris, trees, shrubs, fruits/seeds/nuts, forbs
White-throated Swift	L	cliffs, rock outcrops
Barn Owl	L	wildlife trees, shrub land elements
Gray Flycatcher	L	shrub land elements
Gyrfalcon	L	open water, shoreline, wetlands/marshes
Wolverine	L	wetland/marshes in forested context

¹Criteria for setting management priorities for species at risk include, in that order: (1) uniqueness to CVWMA, (2) breeding status, (3) conservation status, (4) frequency/probability of occurrence, (5) habitat type and element abundance, and (6) estimated responsiveness to management intervention (VH = Very High, H = High, M = Medium, L = Low).

²Includes dead trees, defective trees, large old trees, and trees with cavities, lichen loads, mistletoe brooms, large branches, and other habitat elements important to wildlife.

Fish – Two red-listed species (white sturgeon - Kootenay River population and burbot - Lower Kootenay population) and two blue-listed species (westslope cutthroat trout and bull trout) are known to inhabit waters within the CVWMA. Only the white sturgeon is federally listed as “endangered”. The sturgeon and burbot are generally restricted to Kootenay Lake and River, while the bull trout and cutthroat trout also occur in tributaries on the Management Area.

Insects - Three CDC-listed dragonfly species have been reported on the CVWMA: the red-listed lance-tailed darter, and blue-listed twelve-spotted skimmer and yellow-headed meadowhawk. Since the last regional dragonfly survey by Cannings et al. (2000), the Lance-tailed Darter listing was changed from blue to red. In British Columbia, the lance-tailed darter is known only from “the Kootenay River marshes at Creston” and the Goat River near Kitchener (Cannings et al. 2000). The yellow-headed meadowhawk is known provincially only from “the Creston marshes” (Cannings et al. 2000). None of the dragonfly species are listed by COSEWIC. No listed butterfly species are known to occur in the CVWMA (N. Kondla, pers. comm.).

Plants and Plant Communities - Based on information provided in the preliminary CVWMA plant list and by the CDC, at least five red-listed and six blue-listed plant species have been confirmed in the Management Area (Table 5). None of these species are listed by COSEWIC. The exact locations of the plants within the Management Area are generally unknown. Also, based on information provided by the CDC, no rare plant communities have been identified within the CVWMA.

Table 5. Plant species at risk known to inhabit the CVWMA, their provincial conservation status, and habitat information and comments provided by Douglas et al. (2002).

Species	CDC Status ¹	Habitat /Comments
Tall Beggarticks (<i>Bidens vulgata</i>)	Red - S1	- moist to wet ditches, streambanks and lakeshores
Common Downingia (<i>Downingia elegans</i>)	Red - SX	- wet meadows and ponds - presumed extirpated in BC; previously known only from Leach Lake, CVWMA - the habitat (muddy shorelines) for this species was eliminated during a waterfowl enhancement project

Species	CDC Status ¹	Habitat /Comments
Scalegod (<i>Idahoia scapigera</i>)	Red – S2	- moist seepages to dry rocky slopes
Montana Lupine (<i>Lupinus arbustus</i>) <i>ssp. pseudoparviflorvus</i>)	Red - S1	- moist forests
Alkali-marsh Butterweed (<i>Senecio hydrophilus</i>)	Red - SH	- wet, often alkaline swamps and meadows - possibly extirpated in BC; last collected in 1929 at Kootenay River Flats
American Sweet-Flag (<i>Acorus americanus</i>)	Blue – S2S3	- shallow water
Fox Sedge (<i>Carex vulpinoidea</i>)	Blue – S2S3	- wet meadows, swamps, marshes and streambanks
Crested Wood Fern (<i>Dryopteris cristata</i>)	Blue – S2S3	- swamps and wet meadows
Nuttall's Waterweed (<i>Elodea nuttallii</i>)	Blue – S2S3	- lakes, ponds and stream
Mountain Sneezeweed (<i>Helenium autumnale</i> <i>var. grandiflorum</i>)	Blue – S2S3	- moist to mesic streambanks, meadows and forest openings
Spurless Touch-Me-Not (<i>Impatiens ecalcarata</i>)	Blue – S2S3	- moist forests

Red = threatened or endangered; Blue = special concern; S1 = critically imperilled in BC; S2 = imperilled in BC; S3 = vulnerable in BC; SH = possibly extirpated in BC; and SX = presumed extirpated in BC.

Recovery Plans for Species at Risk

In an effort to prevent the continuing decline of species at risk, and to meet federal SARA obligations, the province has initiated the development of recovery plans for certain species. Currently, plans are being developed for the following species known to occur on the CVWMA:

Terrestrial Vertebrates (10): American badger, caribou, northern leopard frog, Peregrine Falcon, Sage Thrasher, White-headed Woodpecker, Western Screech-Owl, western skink, western toad, Yellow-breasted Chat.

Plants (4): tall beggarticks, scalegod, fox sedge, and mountain sneezeweed.

Dragonflies (3): lance-tailed damer, twelve-spotted skimmer, and yellow-headed meadowhawk.

No recovery plans are currently being developed for listed fish species. However, efforts by both US and BC fisheries agencies are underway to begin recovery plans for the lower Kootenay burbot population and white sturgeon.

In consideration of the high number of species at risk that inhabit the CVWMA (several of which occur exclusively in the Management Area) and the official recovery initiatives that address a total of 17 species at risk, the role of the CVWMA as a refuge and possible source habitat for these species is becoming increasingly obvious. An important objective of this habitat management plan is therefore to ensure the maintenance of habitat for species at risk, as supported by public opinion (Betts and Morley 2004), and to continue or begin collaboration with the provincial species recovery teams.

Other Species of Interest

Aside from species at risk, several other species groups have been of special interest to managers and/or visitors and users of the CVWMA. These include waterfowl, ungulates, and recreational fish species.

Waterfowl

Waterfowl (i.e., the taxonomic family of ducks, geese, and swans) are abundant in the CVWMA. Maintaining the productivity of wetland and upland habitats for waterfowl has always been and remains a primary focus of management in the CVWMA. The current species list (Appendix 2) indicates that 34 waterfowl species have been reported in the Management Area, including three species that are currently blue listed: Long-tailed Duck, Sandhill Crane, and Surf Scoter.

Ungulates

Five ungulate species inhabit the CVWMA: moose, elk, white-tailed deer, mule deer, and caribou. White-tailed deer and elk are the most abundant species, while moose and mule deer are less common. With the exception of caribou (which use the Management Area only as a travel corridor between the South Selkirk and South Purcell Mountain Ranges), ungulates use a variety of habitat types in the area. Ungulate hunting is permitted anywhere in the CVWMA, except in Corn Creek 2a, 2b and the Summit Creek day-use area. Corn Creek 1 is often used by herds of elk that can sometimes be viewed by visitors, especially during early fall.

Recreational Fish Species

The Area's recreational fishery focuses primarily on largemouth bass and salmonid species (i.e., brook, bull, cutthroat, and rainbow trout and kokanee). The largemouth bass is primarily restricted to Duck Lake where it is the focus of a popular sport fishery. Other warm-water exotic fishes are common in Duck Lake and throughout the marshes. They provide an important prey base for fish-eating birds, including several listed species. The salmonids are primarily found in Kootenay Lake and Kootenay River and the Boulder and Summit Creek tributaries.

Species-Habitat Relationships

Table 6 lists the most important five habitat elements known to be *closely associated* with the species occupying different habitat types (Johnson and O'Neil 2001, Steeger et al. 2001). We consider these habitat elements essential for the maintenance of species richness and species at risk in the CVWMA and therefore emphasize these elements in the management recommendations of this plan (see Chapter 4).

Table 6. Essential habitat elements by habitat type for focal species of the CVMWA.

Habitat Type Name	No. of Focal Species	Essential Habitat Elements¹
Permanent Wetland	82	<ul style="list-style-type: none">➤ marshes➤ open water➤ emergent vegetation➤ submergent vegetation➤ floating mats
Seasonally-flooded Wetland	38	<ul style="list-style-type: none">➤ open water➤ seasonal flooding➤ sand/mud (in-water substrate)➤ submerged/benthic➤ wet meadows
Lowland Forest (Coniferous)	41	<ul style="list-style-type: none">➤ seasonal flooding➤ large live trees (> 50 cm diameter)➤ large snags (> 50 cm diameter)➤ down wood in riparian areas➤ shrub layer
Lakes and Open Water	71	<ul style="list-style-type: none">➤ open water➤ shoreline➤ submergent vegetation➤ sand/mud (in-water substrate)➤ sand bars
Rivers and Wide Channels	72	<ul style="list-style-type: none">➤ open water➤ shoreline➤ oxbows➤ sand bars➤ gravel bars
Upland Grassland	41	<ul style="list-style-type: none">➤ herbaceous layer➤ forbs➤ fruits/seeds➤ bulbs/tubers
Upland Forest (Deciduous)	74	<ul style="list-style-type: none">➤ seasonal flooding➤ large live trees (> 40 cm diameter)➤ large snags (> 40 cm diameter)

Habitat Type Name	No. of Focal Species	Essential Habitat Elements ¹
		<ul style="list-style-type: none"> ➤ down wood ➤ herb and shrub layer
Upland Forest (Coniferous)	41	<ul style="list-style-type: none"> ➤ large live trees (> 40 cm diameter) ➤ large snags (> 40 cm diameter) ➤ down wood ➤ shrub layer ➤ roots, tubers, underground plant parts
Upland Shrub (#11)	55	<ul style="list-style-type: none"> ➤ herbaceous layer ➤ grasses ➤ shrubs ➤ forbs ➤ trees (in shrub land context)
High-gradient Streams	72	<ul style="list-style-type: none"> ➤ open water ➤ shoreline ➤ sand bars ➤ gravel bars ➤ water velocity

¹Essential habitat elements are those used by most species that depend on this habitat type and which are relevant in a management context.

Several trends can be identified with respect to the habitat elements listed in Table 6.

1. In aquatic and wetland habitats, most species tend to be associated with:
 - open water;
 - submergent/emergent vegetation,
 - floating mats;
 - sand/mud (as in-water substrates);
 - gravel bars and sand bars; and
 - seasonal flooding events (for wetland complexes).
2. At the interface between the aquatic/wetland and upland habitats, most species tend to be associated with:
 - Shoreline; and
 - down wood in riparian areas.
3. In forested upland habitats, most species tend to be associated with:
 - large live trees;
 - large snags;
 - down wood; and
 - shrubs.
4. In grassland/shrub land habitats, most species tend to be associated with:
 - herbaceous layer;
 - forbs and grasses;
 - fruits/seeds and bulbs/tubers; and
 - trees (usually sparse in a shrub land context).

In summary, important aquatic wildlife-habitat relationships in the CVWMA involve primarily associations of species with open water in combination with biotic (vegetation) and abiotic (sand/mud) elements within or adjacent to permanent or seasonal water bodies. Important upland wildlife-habitat relationships involve associations of species with the various vegetation layers created by natural succession in grassland, shrub land, and forest habitats. In forested habitats, habitat elements of late successional stages such as large-sized live and dead trees, old trees, trees with cavities and coarse woody debris are essential for many vertebrate species.

Our analyses suggest that habitat management directed at relatively few key habitat elements within habitat types will benefit most of the species, including rare and endangered species, which occupy those habitat types. As a result, general biodiversity (using vertebrate species richness as a surrogate), as well as specific species of interest will benefit from maintaining the productivity of the CVWMA's habitat types. This is not surprising given that it was the creation of these habitat types that allowed many species to initially colonize the CVWMA. Some species will require specific management attention and both general management by habitat type, and specific management by species of interest are addressed in Chapter 3.

Chapter 3. Habitat Management Plan

Introduction

Previous chapters have outlined the management history of the CVWMA and the priorities for future management that were identified through the public participation process. Chapter 2 classified the habitats of the Management Area and identified important species, species groups and habitat elements. In this chapter, we collate these results into a comprehensive habitat management plan for the CVWMA.

Methods

Development of the habitat management plan was based on the following:

1. Legal obligations under the Creston Valley Wildlife Act, Wildlife Act, and other major statutes.
2. The CVWMA's Strategic Plan (CVWMA 2001).
3. Values expressed by the public, as gathered through the public participation process (Betts and Morley 2004). These values can be broadly summarized as:
 - a. Species and habitat protection should be the guiding principle for all habitat management.
 - b. Active management to maintain the productivity of habitats should continue.
 - c. Management should continue to focus on waterfowl but should also achieve broader biodiversity objectives, including protection of rare animals and plants.
 - d. Fisheries management should receive greater attention.
4. Ecological values of different habitat types occurring on the CVWMA, with respect to:
 - a. Red and blue-listed species.
 - b. Vertebrate species richness.
 - c. Management for other species/species groups of interest, including:
 - i. Waterfowl.
 - ii. Ungulates.
 - iii. Recreational fish species.
5. Results of previous habitat management activities by CVWMA staff.

The habitat management plan consists of a series of objectives organized in order of priority, for different management units (in alphabetical order). Specific prescriptions related to habitat types or species identified in objectives (bold and underlined text) are cross-referenced and outlined in subsequent sections. For readers of the electronic copy of this management plan, the bold and underlined text provides hyperlinks to the respective sections.

General Management Approach

At the onset of this project, the question of what general management philosophy to adopt on the CVWMA was raised by the public and the technical advisory group. The two extremes were: (i) a "no management" option (aside from meeting legal obligations) that allows natural habitat succession to proceed, and (ii) an "intensive management" option that modifies habitats extensively to meet specific objectives for certain species or species groups, such as waterfowl or species at risk.

The successional pathways are understood sufficiently to estimate the future condition of the Management Area under a "no management option." Water regimes have changed (due to dyking and to the construction of Libby Dam) such that returning the area to its original delta system is unlikely. Assuming current hydrology, but allowing succession and deterioration of infrastructure, the following is likely to occur:

- The driest upland forest will succeed to fir-pine.
- The extent of cottonwood forest will increase.
- Upland grassland will be invaded by woody shrubs in many areas.

- Limits of tree-shrub invasion will be related to seasonal high water.
- Seasonally flooded and wetland areas will become drier through in-filling of ponds.
- Lowest areas will continue to hold water throughout the year but will likely be completely in-grown with cattail.

Based on feedback from the public (Betts and Morley 2004) and technical advisors, the “no management option” was considered unacceptable, especially in the broader context of wetland losses elsewhere and potential future impacts of global warming. There was support for maintaining the productivity of wetland habitats and, to a large extent, the biological status quo.

An “intensive management” option would likely result in a narrow focus on waterfowl habitat, with larger portions of the CVWMA under cultivation, more frequent drawdowns, and brushing and/or burning to control upland vegetation. Intensive single species or species group management would likely result in detrimental habitat conditions for other species. This management extreme was therefore deemed unacceptable if the biological status quo is to be maintained.

We adopted a blended approach that recommends active management in some habitat types and management units, while allowing others to reach a “natural” equilibrium or continue to change through succession. Wetland areas will require active management; however allowing natural tree and shrub succession in upland areas has biodiversity benefits that outweigh costs. For example, there is no reason to actively manage coniferous forests because (i) aging forests fit with the regional old growth management strategy, (ii) logging roads create access and associated increases in the establishment and spread of noxious weeds, and (iii) the current regional directive is to not manage for ungulate winter range near caribou habitat.

Although current ecological conditions on the CVWMA enjoy public support, there have been costs. For example, the loss of mudflats has resulted in decreased habitat availability for shorebirds and migrating swans are less common in the CVWMA than they were in the 1960’s (Butler et al. 1986). At least one plant species, formerly known only from Leach Lake (Common Downingia; Table 5) was likely extirpated as a result of habitat management activities (Douglas et al. 2002). One objective of this management plan is therefore to optimize ecological and social benefits, while minimizing costs to individual species or guilds.

Objectives by Management Unit

Boulder Creek

Objectives:

1. Maintain fisheries values and where possible, enhance spawning and rearing habitats for [salmonids](#).
2. Eliminate domestic grazing pressure.

Site Implications and Management Options:

Boulder Creek has been identified as one of the low-gradient streams with potential to enhance kokanee and trout populations. Other habitats are currently unmanaged and we recommend they remain so, except for the eventual removal of domestic grazing pressure to restore upland grassland habitats.

Corn Creek 1

Objectives:

1. Maintain productivity of [seasonally flooded wetlands](#).
2. Improve productivity of [permanent wetlands](#).

Site Implications and Management Options:

This unit provides productive seasonal ponds that are heavily used by waterfowl in the spring. Some areas contain permanent wetlands dominated by dense cattail stands and bur-reed. Management should be restricted to holding water levels high in spring and allowing the pond to dry naturally during summer. Additionally, permanent wetland areas could be treated to enhance productivity, although given current water regimes, these efforts might not be successful.

Corn Creek 2a

Objectives:

1. Maintain deep, open water areas for public canoe trips and wildlife viewing.
2. Maintain or enhance habitat for [painted turtles](#).
3. Maintain habitat for [American Bitterns](#).
4. Improve productivity of [permanent wetlands](#).
5. Maintain nesting structures for public viewing.
6. Control the spread of yellow iris (*Iris pseudacorusis*).

Site Implications and Management Options:

The primary objective for this pond is to maintain deep water for summer public use (i.e., canoeing). As a result, objectives for permanent wetland areas (which dominate the unit) should be relaxed. The dense cattail stands will continue to encroach, requiring some management action (rare drawdowns or deep water flooding). Yellow iris is very difficult to control once it has become established. Burning and mechanical treatment are the only known control measures.

There are a number of nesting structures that are popular for public viewing; however, many have fallen into disrepair. Public groups should be encouraged to replace and maintain at least a portion of these structures.

Maintaining dense cattail stands is consistent with management for American Bitterns. In-pond coarse woody debris is key to management for painted turtles.

Corn Creek 2b

Objectives:

1. Maintain productivity of [seasonally flooded wetlands](#).
2. Improve productivity of [permanent wetlands](#).
3. Maintain habitat for [American Bitterns](#).
4. Improve infrastructure to increase productivity of wetland habitats.

Site Implications and Management Options:

This unit floods in the spring but holds little water in the summer. A natural water regime will likely maintain dense reed canarygrass and dense stands of cattail in wetter areas. Some shrub invasion is expected in the south end. Management options are limited due to current infrastructure. Infrastructure upgrades should be considered to improve water level management and, hence, the productivity and size of permanent and seasonally flooded wetland areas.

There have been some sightings of American Bitterns nesting in permanent wetland areas of this unit.

Corn Creek 3

Objectives:

1. Maintain productivity of [seasonally flooded wetlands](#).

2. Maintain productivity of [permanent wetlands](#).

Site Implications and Management Options:

This pond floods seasonally and also holds summer water in deep areas. The natural water regime has created a productive wetland with a variety of habitat types and high levels of wildlife use.

Corn Creek 4

Objectives:

1. Restore natural water regime.

Site Implications and Management Options:

This unit is unmanaged and maintains a high diversity of habitats within the lowland forest (coniferous) habitat type. Water diversions completed in the early 1990's resulted in altered water regimes and, as a result, most of the lowland forest area in this pond no longer floods. Restoring the natural flooding regime to this area would enhance its biodiversity values. Removing the diversion is the most likely way to restore the natural water regime, although this needs to be further investigated.

Creston Mountain

Objectives:

1. Maintain [painted turtle](#) nesting habitat.
2. Maintain [western skink](#) habitat.

Site Implications and Management Options:

The area upslope of the Wildlife Centre is dominated by open coniferous forest. This area is considered ungulate winter range, but current habitat conditions and regional policy do not warrant any active habitat management. Toe slopes are important painted turtle nesting habitat and should not be altered. Upper slopes provide western skink habitat; rocks and talus areas should not be altered.

Dale Unit

Objectives:

1. Maintain or enhance [salmonid](#) habitat in access channels.

Site Implications and Management Options:

The Dale Unit is comprised of upland grassland and forest habitat with deepwater channels. It has not been actively managed in the past and current habitat conditions do not warrant active management. Some of the driest areas appear to be succeeding from deciduous to coniferous forest stands, and halting this succession would be labour intensive and expensive compared to the expected benefits. As a result, the main management options are related to improving fisheries values in Boundary Creek.

Duck Creek

Objectives:

1. Maintain or enhance habitat for [northern leopard frogs](#).
2. Explore opportunities for fisheries enhancement, particularly with respect to [largemouth bass](#).
3. Eliminate domestic grazing pressure.

Site Implications and Management Options:

The Duck Creek area is generally unmanaged and a good mix of habitats has been maintained naturally. There is anecdotal evidence that fisheries values have declined and could be enhanced in cooperation with local groups interested in leading such projects. Domestic livestock are currently removing much of the

upland grass cover in parts of the unit. Northern leopard frogs have been detected, but are not known to breed in this area.

Duck Lake

Objectives:

1. Provide flood protection for adjacent private agricultural fields.
2. Maintain or enhance habitat conditions suitable for successful [Western Grebe](#) and [Forster's Tern](#) nesting.
3. Maintain or enhance habitat for [northern leopard frogs](#).
4. Maintain habitat for [American Bitterns](#).
5. Maintain habitat for the [Yellow-breasted Chat](#).
6. Provide mudflats in spring for migrating shorebirds.
7. Maintain or enhance recreational fisheries values, particularly [largemouth bass](#) populations.

Site Implications and Management Options:

Although objectives for Duck Lake have been considered by some to conflict, both largemouth bass and Western Grebes have flourished for many years under a largely consistent water regime. It is unlikely that the long-term decline in the bass fishery is related to water regime changes. The bigger question is the extent to which resources should be directed towards management of the fishery.

Managing water levels for bass requires that sufficient water depths be maintained in littoral areas in order to provide extensive nest building sites. Such water levels would have to be maintained until the males have abandoned guarding the young. Additional studies of largemouth bass in Duck Lake are needed to refine information related to their populations, but if water temperatures are assumed to reach optimal levels for spawning in mid June, then water levels would need to be maintained, theoretically, to the third week of July to ensure maximum juvenile bass survival.

Another element of this option would be the acquisition of enough data on Duck Lake to calculate water levels that would provide early water temperatures to stimulate bass spawning and, simultaneously, provide maximum area for nest building. A number of years of temperature and water level measurements would be required to have confidence in such calculations.

The principle concerns about Western Grebes nesting at the south end of the lake are related to high water levels and wind action flooding nests, as well as disturbance during the critical nesting season.

Duck Lake Nesting Area

Objectives:

1. Maintain or enhance habitat for [northern leopard frogs](#).
2. Maintain habitat for [Short-eared Owls](#).
3. Control water shield invasion (*Brasenia schreberi*).
4. Enhance productivity of [permanent wetlands](#).
5. Maintain productivity of [upland grasslands](#).

Site Implications and Management Options:

The Duck Lake nesting area is a large unit that receives extensive use by waterfowl. Parts of the unit have dense stands of cattail that exceed stated objectives for permanent wetland areas. Improving the productivity of the nesting area through drawdowns and treatment of cattail stands is likely impractical due to the size of the unit and due to the conflicting objective of maintaining northern leopard frog habitat.

Water shield has become a significant problem in the nesting area and there are few effective control measures. Water shield thrives in water <2 m deep; as a result, deep-water flooding may be effective in some areas. Otherwise, a drawdown followed by mechanical treatment will likely result in effective control. Care will be required to prevent the spread to other ponds via equipment.

Shrubs are generally not invading upland grasslands on the west side of the Nesting Area. These areas could be important nesting meadows for waterfowl and other species (including listed species) and their productivity should be maintained.

Kootenay Channel

Objectives:

1. Explore opportunities to improve fisheries values, particularly with respect to [largemouth bass](#).

Site Implications and Management Options:

The Kootenay Channel bordering Corn Creek Marsh to the east holds water in deeper areas throughout the year and provides some habitat for recreational fish species. Fish habitat could be improved by coordinating habitat restoration efforts with an outside non-profit group.

Kootenay Lake and Kootenay River

Objectives:

1. Cooperate with initiatives to improve fisheries values, with particular emphasis on [salmonids](#), [burbot](#) and [white sturgeon](#).

Site Implications and Management Options:

The open water of Kootenay Lake and the Kootenay River that falls within the CVWMA is managed as part of the Columbia River system for flood control, power generation and fisheries values. As a result, its management falls outside the CVWMA's jurisdiction. However, the CVWMA should cooperate with initiatives designed to improve the lake's fishery.

Leach Lake 1

Objectives:

1. Maintain habitat for [American Bitterns](#).
2. Enhance nesting habitat for [American White Pelicans](#).
3. Maintain productivity of [permanent wetlands](#).
4. Maintain productivity of [seasonally flooded wetlands](#).

Site Implications and Management Options:

This unit is dominated by large areas of open water and permanent wetlands and is important for waterfowl throughout the ice-free season. Maintaining the productivity of these wetlands is a priority. The creation of small bare islands would provide the opportunity to encourage nesting by American White Pelicans.

Leach Lake 2, 3 and 4

Objectives:

1. Maintain habitat for [American Bitterns](#).
2. Maintain productivity of [permanent wetlands](#).
3. Maintain productivity of [seasonally flooded wetlands](#).

Site Implications and Management Options:

These units are similar to Leach Lake 1. They receive use by pelicans but do not provide the same opportunity for encouraging nesting.

Leach Lake 5

Objectives:

1. Maintain productivity of [upland grasslands](#).

Site Implications and Management Options:

This unit is very small with little wetland surface area. It is not actively managed.

Leach Lake 6

Objectives:

1. Maintain habitat for nesting [Great Blue Herons](#) and [Double-crested Cormorants](#).
2. Maintain [agricultural fields](#) for use as lure crops and to control noxious weed invasion.
3. Maintain productivity of [upland grasslands](#).

Site Implications and Management Options:

A heron rookery that also contains ≈20 cormorant nests is currently located in cottonwood stands along the Kootenay River in this unit. Otherwise, the unit is dominated by a large permanent wetland area which is heavily used by waterfowl. Maintaining the productivity of wetland areas will require active management.

This unit is largely an upland dominated by grassland and deciduous forest. A significant area is currently under cultivation as a lure crop that is considered effective in reducing weed invasion and depredation of surrounding private land by elk.

Leach Lake 7

Objectives:

1. Maintain productivity of [upland grasslands](#).
2. Establish an [agricultural field](#) for use as lure crops and to control noxious weed invasion.

Site Implications and Management Options:

This unit is dominated by upland grassland and deciduous forest bordering the Kootenay River. The wetland area is relatively small and not actively managed. Extensive problems with noxious weeds exist; a lure crop will be established in this unit to replace the field in Leach Lake 6.

Rock Lake-Midgely Creek

Objectives:

1. Maintain habitat for [western skinks](#).

Site Implications and Management Options:

This unit is a diverse mix of unmanaged marshes adjacent to the Kootenay River and upland coniferous forest. It is currently unmanaged and should remain so as long as the upland forests remain productive. Along with other upland forested areas, the habitat is important for some listed species such as the western skink.

Six Mile Slough 1

Objectives:

1. Control access by motorized vehicles at the south end of Kootenay Lake.

Site Implications and Management Options:

The northernmost pond in Six Mile Slough is dominated by Kootenay Lake's water regime and is considered unmanaged. The dynamics of Kootenay Lake water levels currently maintain the productivity of habitats there. The main management issues are related to illegal use of the area by off-road vehicles. Additional signage and volunteer patrols might promote compliance. Seasonal water regimes result in productive upland grasslands and mudflats at the south end of Kootenay Lake.

Six Mile Slough 2-3, 5

Objectives:

1. Maintain habitat for [American Bitterns](#).
2. Maintain productivity of [permanent wetlands](#).
3. Maintain productivity of [upland grasslands](#).

Site Implications and Management Options:

These units cover hundreds of hectares and are heavily used by waterfowl. Water level management is practically restricted by Kootenay River levels. Maintaining the productivity of the wetland habitats will require active habitat management. The area also represents one of the most important sites in the province for nesting American Bitterns (Cooper and Beauchesne 2003).

Six Mile Slough 4

Objectives:

1. Maintain habitat for [American Bitterns](#).
2. Enhance nesting habitat for [American White Pelicans](#).
3. Maintain productivity of [permanent wetlands](#).
4. Maintain productivity of [upland grasslands](#).

Site Implications and Management Options:

This unit is also a large pond that receives extensive use by waterfowl. It is further distinguished by its use by American White Pelicans.

Summit Creek

Objectives:

1. Develop seasonal access policy for Summit Creek campground area and Leach Lake access.
2. Enhance [salmonid](#) habitat.

Management Rationale:

Betts and Morley (2004) highlighted access management issues in the Summit Creek area that should be clarified (see Recommendations). All existing infrastructure in Summit Creek Campground should be removed to discourage use.

Most of this unit consists of unmanaged upland forest (coniferous); however, Summit Creek has important fisheries values that could be enhanced.

West Meadows Farm

Objectives:

1. Encourage wildlife-friendly farming practices.
2. Maintain barn for [Townsend's Big-eared Bat](#) and other bat species roosting and maternity habitat.

Management Rationale:

The farm is currently leased but there are no restrictions on farming practices. The barn is a known roost site for a large colony of listed bats but requires a new roof and siding repair.

Management Prescriptions by Habitat Type

Permanent Wetland

- a. Maintain an approximately equal interspersed of open water and preferred emergent vegetation.
 - i. Area covered by emergent vegetation should not exceed 75%.
 - ii. Contiguous patches of emergent wetland vegetation should be <1 ha.
 - iii. Bulrush is preferred to cattail.
- b. Maintain or enhance abundance of preferred submergent vegetation.
 - i. Encourage vigorous growth of native pondweed species.
 - ii. Encourage formation of floating mats of native milfoil.

Permanent wetlands on the CVWMA are notable for their high vertebrate species richness (Chapter 2) and importance to waterfowl. To maintain the productivity of wetlands, the ongoing focus of habitat management will continue to be the control of cattails. Dense stands of cattails were an unintended consequence of the move during the 1970's towards active wetland management. The proliferation of cattail is also a phenomenon that has been noted in the US Great Plains (Kantrud 1992). Reducing the size and extent of cattail patches is currently one of the principle objectives of drawdowns conducted by CVWMA staff.

An equal mix of open water and emergent vegetation (so-called "hemi-marsh" conditions) is often cited as optimal (Weller 1978). Emergent vegetation provides an important subsurface substrate for macro-invertebrate production as well as cover for a variety of waterfowl species. Permanent wetlands with more than 50% open water can also provide good habitat, but when emergent cover exceeds 75% of the permanent wetland area, productivity is likely to decline because dense stands of cattail effectively reduce the area of functioning wetland (Kantrud 1992).

Although waterbirds often use dense stands of cattails for nesting (e.g., diving waterfowl such as Redheads, and also [American Bitterns](#)), nests are usually located near the interface with open water. Therefore, contiguous patches of dense cattails should be <1 ha.

Bulrushes are preferred to cattails because stem densities are lower and can be penetrated by swimming birds. As well, seeds from bulrushes are an important source of food for waterfowl (Bellrose 1976). There are no known reliable management methods of encouraging bulrushes over cattails.

Pondweeds are preferred submergent vegetation species because they provide important food sources for waterfowl and other waterbirds. These species also provide a substrate for macro-invertebrates. Floating mats of milfoil are an important habitat feature for many species (Chapter 2), including [Western Grebes](#).

Maintaining the productivity of permanent wetlands is also important for a number of listed species, including the [lance-tipped darner](#).

Seasonally-flooded Wetland

- a. Maintain vigour of preferred emergent vegetation.

Seasonally flooded portions of the CVWMA consist primarily of dense stands of reed canarygrass and cattails. Grasses are preferred over cattails because shallow flooding in the spring creates an

excellent substrate for macro-invertebrates. Management to maintain the productivity of these areas should continue to focus on control of cattails.

Lowland Forest (Coniferous)

- a. Maintain or restore natural water regimes.
- b. Maintain original stand characteristics or
 - i. enhance large-sized live and dead trees;
 - ii. enhance large-diameter coarse woody debris; and
 - iii. maintain shrub layer (i.e., avoid brushing).

The area of lowland coniferous forest on the CVWMA is relatively small and occurs only in [Corn Creek 4](#), but it represents a unique habitat with potentially high biodiversity values. No management is required beyond retaining important habitat elements associated with a large number of vertebrate wildlife species, namely, large trees (both live and dead), coarse woody debris and a dense shrub layer.

Lakes and Open Water

- a. Maintain open water areas.
- b. Maintain water levels to preserve fish habitat.
- c. Maintain integrity of shoreline habitat, and in particular, sand bars.
- d. Maintain vigorous growth of submergent vegetation.

Open water areas provide habitat for moulting and migrating waterfowl, as well as habitat for fish species. No management is required beyond maintaining these open water areas. Open water areas in some units are not under management control (e.g., [Kootenay Lake](#)), while others can be affected by drawdowns, etc. Objectives for specific ponds are provided in the next section.

Rivers and Wide Channels

- a. Enhance or rehabilitate specific channels known to have been fish-bearing.
- b. Maintain riparian vegetation and habitats.

Channels on the CVWMA are comprised of borrow ditches and other, generally created waterways that have limited value as habitat for waterfowl or other birds or mammals. Habitat values are limited because channels are generally deep and have steep bank-water interfaces. This limits the growth of both submergent and emergent wetland vegetation. Still, channels provide deep water during dry seasons/years and are therefore important as habitat for fish and for species that prey upon them (e.g., [Great Blue Herons](#)). In general, little management is required beyond maintaining water and any associated riparian cover, which is limited. There may be instances where management in channels could be undertaken to enhance specific fisheries values (Andrusak et al. 2003).

High-gradient Streams

- a. Maintain integrity of streambeds, gravel bars, riparian and upland vegetation.

High gradient streams occur in upland areas of the CVWMA. Although they are not associated with fisheries values, they are important for maintaining water quality/temperature for fish in lower reaches, and are suitable habitat for a variety of species such as salamanders.

Upland Grassland

- a) Maintain vigour of dense stands of preferred grass species.

b) Allow succession to other habitat types.

Reed canarygrass is the dominant graminoid on the CVWMA. It is an aggressive, mat-forming species that forms extensive monocultures, is capable of excluding other grasses, and may resist the encroachment of shrubs and trees. Although native, several European cultivars were introduced to North America for haying (White et al. 1993). The European and North American plants are indistinguishable. Reed canarygrass is considered an invasive species of wetlands in some jurisdictions, and it is very difficult to control (Apfelbaum and Sams 1987).

When water management on the CVWMA began, moist soil conditions were created that were perfect for the spread of reed canarygrass. The dense stands were considered prime habitat for nesting waterfowl, and maintaining the vigour of reed canarygrass stands was a management priority.

The actual value of reed canarygrass for wildlife is a topic of debate. Its reputation as an invasive species originated in prairie ecosystems where it displaced native upland grasses. Many researchers and managers also question its value as nesting cover (i.e., too dense for ducks to penetrate) and as forage for grazing ungulates (i.e., too coarse). Others point to the value of its seeds as food for birds, and to its use for control of bank erosion and noxious weed invasion.

The ongoing debate regarding the wildlife value of reed canarygrass is largely irrelevant with respect to management of the CVWMA, because reed canarygrass will surely continue to dominate upland areas, despite any management efforts. In addition, there is little basis for considering the species an invasive exotic because it is unclear what other grass species would be considered “native” in the created habitats of the CVWMA. Therefore, management should focus on enhancing the species’ positive benefits:

- Resisting noxious weed invasion. Weeds are uncommon in vigorous stands of reed canarygrass. Seasonal flooding, mowing or burning can improve the vigour of reed canarygrass stands that are in decline.
- Substrate for macro-invertebrates. Seasonally flooded reed canarygrass provides very productive habitats for insects and, in turn, these wet meadow areas are heavily used by waterfowl in the spring.
- Food source for birds. Reed canarygrass stands produce enormous seed crops.

Upland grasslands also provide important habitat for some listed species such as [Short-eared Owls](#).

Upland Forest (Deciduous)

a. Allow forest succession.

Deciduous forests on the CVWMA are dominated by black cottonwood ecosystems, which are among the highest value habitats for terrestrial vertebrates in British Columbia (Bunnell et al. 1999, Jamieson et al. 2001). The abundant cottonwood stands of the CVWMA are of particular importance for the maintenance of the area’s species richness and species at risk. Jamieson et al. (2001) described the use of hardwoods (including cottonwood) of different age classes by vertebrate species of the Columbia Basin. In general, mammals such as bears, ungulates, beavers, rodents and hares use younger age classes for feeding while older cottonwoods are used for summer thermal cover (bears and ungulates) or cavity-nesting and roosting (marten, bats, and squirrels). Birds use cottonwoods primarily for cavity nesting (e.g., woodpeckers, chickadees, nuthatches, small owls, American Kestrel, and ducks such as mergansers, goldeneyes, Buffelhead and Wood Duck) and platform nesting (e.g., Osprey, Bald Eagle, Cooper’s Hawk, Northern Goshawk, Great-horned and Great Grey Owl). Bird species at risk that have a particular preference for cottonwood habitat include Lewis’s Woodpecker, [Western Screech Owl](#), and [Great Blue Heron](#). The

CVWMA's Great Blue Heron colony is currently the largest in the BC Columbia River Basin (M. Machmer, unpublished data) and is located in a mature cottonwood stand at [Leach Lake 6](#).

On the CVWMA, significant stands of cottonwood are found along the Kootenay River and its tributaries. These occur both as pure mature stands and as a component of mixed coniferous-deciduous stands. In areas where flooding is frequent and/or prolonged, cottonwoods are dominant relative to other tree species.

Cottonwoods are shade intolerant and establish only in canopy gaps or openings. Recruitment occurs via (1) seedling establishment, (2) sprouting from base of stumps, (3) suckering from roots, (4) shoot establishment from broken stems or branches, and (5) the process of cladoptosis (i.e., the establishment of roots on lateral leaved twigs that have become detached from upper branches (Simard and Vyse 1992, Jamieson et al. 2001). Growth rates may differ among regeneration types. For example, cottonwoods from sprouts grow at faster rates than those from seeds (Simard and Vyse 1992). Where soil moisture conditions are favourable (i.e., moist or wet), most regeneration occurs via seedling establishment. Cladoptosis is fairly common in the southern interior (S. Simard, pers. comm.) and suckering is evident on the CVWMA.

In general, cottonwood recruitment is dependent on the dynamics of fluvial processes. Seedling establishment occurs on exposed sediment along stream channels following flooding in late spring. Roots develop rapidly to maintain access to moisture as flood levels recede. When soils dry out too rapidly, seedlings will not survive (Jamieson et al. 2001).

Due to the species' high ecological value, pivotal role in riparian habitats, and declining abundance in the Columbia Basin, maintenance of mature as well as regenerating cottonwoods is one of the management priorities of this plan. Concern has been raised regarding a possible shortage of regeneration and younger age classes in the CVWMA and other areas of the Columbia Basin (Jamieson et al. 2001, B. Stushnoff, pers. comm.). However, several factors of cottonwood biology suggest that the current dominance of mature- and old-age classes on the CVWMA is not unnatural and should not be a concern. The lack of regeneration in mature stands is caused by the high canopy closure in such stands, preventing the establishment of the shade intolerant young trees. Once mature trees fall, the resulting gaps will create more favourable light conditions for regeneration.

With respect to the interface of the upland deciduous forest and the permanent or seasonally flooded wetlands, the question arises whether and to what extent reed canarygrass prevents cottonwood establishment. Again, while seedling establishment may not be successful due to dense mats of grass, other regeneration processes such as suckering and cladoptosis will likely maintain a continuing supply of cottonwoods.

While these conclusions are consistent with the biology of cottonwoods, it will be important to monitor the distribution, abundance, and age class distribution of cottonwoods in the Management Area. Should areas require artificial regeneration, planting of stem cuttings with healthy buds will likely result in successful growth of new trees (Simard and Vyse 1992).

Upland Forest (Coniferous)

- a. Allow coniferous forest succession except in over-stocked stands.

Upland forests within the boundaries of the CVWMA are generally mid-seral to mature stands typical of the ICHxw biogeoclimatic zone (Braumandl and Curran 2002). Input received through the public participation process and technical review suggests that there is no strong rationale for introducing active forest management to the CVWMA. The merchantability of existing stands does not appear to be particularly high, and simply allowing stands to age is consistent with the Province's regional old growth strategy (G. Woods, *pers. comm.*). Active forest management would also require roads, which would introduce additional access management issues. The warm, dry upland forested slopes within the CVWMA are also important for listed species such as the [western skink](#).

Upland Shrub

- a. Allow succession to shrub cover except where it threatens current infrastructure (e.g., integrity of dykes).

Mechanical brushing and burning to maintain the integrity of grassland areas used by nesting waterfowl were once common activities on the CVWMA. Our review suggested that shrub succession should be allowed to proceed for the following reasons:

- Shrub habitats have biodiversity values equal to, or greater than, grassland habitats (Chapter 2).
- Vigorous stands of reed canarygrass might limit or halt encroaching shrub cover.
- Shrubs in many areas are heavily browsed by ungulates, again limiting their establishment in new areas.
- The water table in ponds will ultimately halt the succession of shrubs.
- Ducks will nest under shrub cover, which provides additional protection from avian predation.

Agricultural Fields

- a. Maintain or expand the current extent of lure crops, as needed.
- b. Rotate lure crops to address habitat deterioration (i.e., decadent grass stands, weed invasion).

Lure crops were established on the CVMWA to reduce damage to adjacent agricultural lands by elk. The crops were established in areas where it was practical to do so, and also in areas that were comprised of degraded grass stands (i.e., areas with noxious weeds). The lure crops have improved relationships with the agricultural community; farmers consider the crops to be successful in reducing wildlife damage. As a result, the current policy of establishing lure crops should continue, particularly where “native” habitats suffer from degradation. There is no reason to significantly alter the area devoted to lure crops.

Highways and Roads

- a. Allow no net increase in roads or other right-of-ways without compensatory habitat improvements.
- b. Maintain current access restrictions to existing roads.
- c. Collate current access rules into an access management policy.

Access management was consistently raised as an issue of concern during the public participation, although no serious concerns were raised about current practices (Betts and Morley 2004). The access management policy of the CVWMA has evolved over the years to address various issues. The current policy appears to be working, with the notable exception of access to the south end of Kootenay Lake by all-terrain vehicles. Management related to public access should focus on:

- Collating the current policy into a single, publicly accessible document.
- Ensuring compliance with the policy in specific areas of concern.

There have been occasional proposals by agencies and private sector interests to develop roads or rights-of-way on the CVWMA. These proposals have been considered on an ad-hoc basis. We recommend that a policy be established that guides the consideration of such proposals. The policy would be based on the following principals:

- All proposals should conform to a “no net habitat loss” concept. That is, any loss of habitat resulting from the construction of roads and/or rights-of-way should be compensated by corresponding habitat improvements elsewhere on the CVWMA

- The habitat “footprint” of a road or right-of-way might exceed the simple area affected by its construction. For example, a permanent logging road represents an impact that far exceeds the area covered by the road because it allows access that further compromises additional habitat (e.g., noxious weed invasion, direct wildlife mortality, displacement of wildlife, other edge effects). As a result, an environmental assessment (funded by the proponent) should be conducted prior to consideration of the proposal, in order to estimate impacts and to provide mitigative and compensatory actions.

Management Prescriptions for Species at Risk

Western Grebe

- Maintain relatively low water levels in [Duck Lake](#) during spring and minimize the rate of increase of water levels in early summer.
- Encourage the development of floating mats and emergent/submergent vegetation.
- Restrict boat access near nest colonies to create disturbance free zones of 400 m around nest sites.

Nesting failures have been attributed to high water levels in Duck Lake (Forbes 1985a; Ohanjanian 1998), and nesting was also disrupted during the high water years of 1974 and 1983. A stable water regime appears essential for the success of the nesting colony; water must be shallow enough to allow the grebes to pull vegetation into nesting mounds, and stable enough to prevent flooding of nests during sudden increases in water levels. Wind action can swamp exposed nests; dense cattail and bulrush stands force grebes to nest in more exposed areas, leaving them more vulnerable to summer storms.

It is thought that by maintaining relatively low water levels in Duck Lake, the milfoil mat may grow more quickly and attain a critical mass suitable to protect Western Grebe nests earlier in spring (T. Antifeau, pers. comm.). At Leach Lake, floating nests were built in sheltering bulrush islands, where water levels are more stable, and nests are protected from wind by the dykes and emergent vegetation stands. There is also no human disturbance at Leach Lake, as vehicular access is restricted.

Boat activity is greatest at Duck Lake from late May to mid-June, when grebes are breeding. Areas along the western shore of Duck Lake and near Sirdar are most intensively used for boating (Ohanjanian 1998). Based on observation, boating has the potential to seriously disrupt breeding activity, by causing grebes to leave their nests and thereby predisposing them to predation, exposure and overheating (Ohanjanian 1997, 1998).

Forster’s Tern

- Minimize the rapid rate of water level increase in [Duck Lake](#) during spring and early summer.
- Restrict boat access near nest colonies to create disturbance free zones of 400 m around nest sites.
- Provide artificial nesting platforms.
- Explore provision of nesting platforms at other sites such as the south end of [Kootenay Lake](#).

Forster’s Terns have habitat requirements similar to those of Western Grebes.

Northern Leopard Frog

- Continue to participate and cooperate with the recovery team and their captive rearing program.

- b. Coordinate water level and vegetation management efforts such as to maintain optimal habitat conditions for the frogs.

Breeding habitat consists of shallow open water (<30 cm), sparsely vegetated with patches of spikerush or sparse milfoil or cattails. Fall and winter habitat is more widespread (Waye and Cooper 2001).

Northern leopard frogs hibernate from October-March in permanent ponds, streams, or lakes with mud or rubble substrate. Water bodies must have adequate oxygen and not freeze solid over winter (Province of BC 2001). In early spring, adults emerge from their wintering locations and disperse to breeding ponds, which are warmer and shallower with emergent vegetation. Further evaluation is required to determine the potential impacts of water level management on overwintering frogs and their habitat suitability (e.g., dissolved oxygen, ice formation, etc.).

Great Blue Heron *ssp. herodias*

- a. Monitor nest locations of Bald Eagles in the CVWMA.
- b. Prevent human disturbance at the main colony at [Leach Lake 6](#).

Nest counts at all heron colonies on the CVWMA were not done systematically prior to 2002; however, the number of active colonies has decreased in recent years for unknown reasons (Forbes et al. 1985; Butler et al. 1986; Machmer and Steeger 2003, 2004, unpublished data). This trend may in part be attributable to human or Bald Eagle disturbance in some years (Wilson 1992; Machmer and Steeger 2003; Machmer, in prep.). Monitoring Bald Eagle nest locations (especially in relation to heron colonies) would provide anecdotal information regarding the possible causes of future nesting failures. Users of the Management Area wishing to view herons should be encouraged to do so from the Kootenay River, rather than accessing the rookery from Leach Lake.

American Bittern

- a. Maintain water depth at ≤ 60 cm in units with breeding bitterns during the breeding season (April-August).
- b. Maintain emergent vegetation in large, relatively dense clumps.
- c. Avoid vegetation treatment during the breeding season.

Bitterns are found only in wetlands with shallow water (<60 cm deep) and with large and/or dense patches of emergent cattail, bulrush and sedges. The CVWMA (and the Six Mile Slough area in particular) comprises the densest and most significant population of American Bitterns in BC (Cooper and Beauchesne 2003).

American White Pelican

- a. Provide artificial bale islands for loafing, when possible.
- b. Consider encouraging pelicans to nest by providing a combination of fine gravel, sand, and soil with no shrub or tree cover on existing islands.
- c. Protect pelican sites from human disturbance (minimum 150 m buffer distance).

Pelicans use primarily shallow (0.35-1.02 m deep) water areas with well-developed submergent vegetation communities for foraging, and small islands or decaying mats of emergent vegetation with mud for loafing. Islands recently created by piling bales of cattails are being used as well (B. Stushnoff, pers. comm.). Pelicans are sensitive to approach by boaters, people and vehicles and reportedly flush at a distance of about 150 m (Gowans and Ohanjanian 2000).

Pelicans breed at only one site in BC; and encouraging nesting on the CVWMA could benefit this species. Data on pelican prey species composition, size distributions and feeding rates are currently lacking, so their potential impact on other rare fish-eating breeding birds cannot be evaluated. However, it is unlikely that other fish-eating birds (particularly listed species) are food-limited on the CVWMA, and that a small nesting colony of pelicans would have a significant impact on the prey base beyond what the current non-breeding residents consume. As a precautionary measure, we recommend that an evaluation of pelican foraging ecology (i.e., feeding rates, prey selection and foraging habitat use) be undertaken in the CVWMA. In the interim, enhancement of nesting islands in [Leach Lake 1](#) and [Six Mile Slough 4](#) for pelican nesting should be investigated.

Western Screech-Owl

- a. Maintain large-sized wildlife trees (dead or defective birch, aspen and cottonwood) with natural cavities or woodpecker holes in riparian areas.

The nest located within the CVWMA in 2002 and 2003 was within a mixed coniferous/deciduous forest patch adjacent to an open meadow with active cattle grazing. The potential need for fencing to protect the site was explored, but deemed unnecessary (T. Antifeau, pers. comm.).

Double-crested Cormorant

- a. Prevent human disturbance at the breeding colony.
- b. Monitor cormorant nesting activity and success.

Cormorants are nesting with herons in the rookery at [Leach Lake 6](#). At least 18 active nests were counted during 2004, most of which had young. Little is known about this species in the CVWMA and some low level monitoring of nest activity and success is warranted.

Short-eared Owl

- a. Maintain grassland areas for breeding and foraging and retain patches of shrubs and hedgerows between fields for roost cover.
- b. Minimize disturbance by people, vehicular traffic and domestic animals in areas frequented by owls.

This species nests in grassland and meadow habitats with an abundance of microtine rodents. Numerous sites in the CVWMA were rated as high quality breeding habitat (Cooper and Beauchesne 2003). Maintaining grasslands in those high-quality habitats should be considered.

Painted Turtle

- a. Maintain or enhance floating mats and coarse woody debris in streams and ponds frequented by turtles.
- b. Maintain turtle crossing signage on West Creston Road to prevent road kills.
- c. Avoid alterations to upslope breeding areas (i.e., maintain friable soils for nest building).
- d. Conduct an inventory of the painted turtle population on the CVWMA.

Painted turtles are found in all managed units of the CVWMA. Management is largely related to maintaining in-water structure and upland nesting habitat, as well as minimizing mortalities.

Western Skink

- a. Avoid alteration of rocky areas and talus slopes.
- b. Avoid establishment and spread of introduced weeds in upland areas.

Western skinks were found on the CVMWA mainly under rocks used for hibernation and retreat. They were also found in association with shrubs and forest edges, but were not commonly found on roads (Rutherford and Gregory 2001). Skinks were found at the same sites during spring, summer and fall, suggesting that they were using the same habitat for hibernation and summer activities.

Townsend's Big-eared Bat

- a. Maintain integrity of occupied maternity and roosting sites.
- b. Minimize human disturbance.

Townsend's big-eared bats are mostly at risk due to the loss of roosting and maternity sites in old barns and similar structures. A secondary factor in their decline is disturbance (Craig 2003).

Yellow-breasted Chat

- a. Avoid dyke maintenance activities from late April through August.
- b. Maintain non-fragmented dense riparian thickets.
- c. Avoid livestock grazing in chat habitats.

The chat nests in dense impenetrable thickets of tall shrubbery (typically rose and snowberry species) and brush near wood edges, streams and ponds (Fraser et al. 1999). Chat breeding habitat has been affected by widespread clearing of low-elevation dense riparian thickets. Concern was recently expressed regarding the potential impact of dyke maintenance activities on Yellow-breasted Chat nesting habitat (B. Stushnoff, pers. comm.).

Burbot Lower Kootenay adfluvial populations

- a. Cooperate with provincial and international recovery efforts.

Burbot are generally known in BC as "ling" and were fished extensively in Kootenay River and Lake in past decades. However, the species has declined dramatically in the Lower Kootenay system, especially since the construction of dams on the Kootenay and Duncan Rivers and resulting changes in run-off patterns. Also, construction of the dykes on the Creston Flats might have excluded burbot from previously occupied habitats (H. Andrusak, *pers. comm.*). There are considerable efforts being undertaken both by US and BC fisheries agencies to develop recovery plans for the lower Kootenay burbot populations. Within the CVWMA, any burbot would likely be found only in the Kootenay River and possibly its tributaries.

Bull Trout

- a. Enhance potential fish-bearing stream reaches.

Bull trout (until recently known as Dolly Varden) are relatively plentiful in Kootenay Lake, especially in the north and south arms where they are a valued sport fish. However, because bull trout are piscivorous, the health of their populations is tied to the health of their prey species (especially kokanee). The recent decline of the kokanee population in the South Arm of Kootenay Lake is reflected in the declining bull trout population.

Bull trout inhabit both the Kootenay River and Kootenay Lake and spawn in fall, often at significant distances up small tributary streams. Fry can readily be found in these tributaries and some specimens are likely present in all such streams in the Management Area. One known and fairly strong run of bull trout spawn in Summit Creek. Andrusak et al. (2003) provided enhancement options for kokanee and other salmonids.

Westslope Cutthroat Trout

- a. Enhance potential fish-bearing stream reaches.

- b. Conduct additional inventory.

This native trout has declined from competition with native and introduced fish, hybridization with rainbow trout, as well as habitat destruction and over-fishing. The species feeds almost exclusively on aquatic and terrestrial invertebrates.

Additional inventory is required to identify whether the species actually occurs on the Management Area. If so, likely reaches include Summit and Boulder Creeks.

White Sturgeon

- a. Cooperate with provincial and international recovery efforts.

The white sturgeon is Canada's largest freshwater fish and in the past, it was both an important commercial and sport fish. Due to diminishing populations most fisheries have been closed and recovery efforts are attempting to restore populations in many parts of western North America.

The species is long-lived and individuals begin spawning in fast flowing rivers at 10 years, but then only every 2-5 years. They are carnivorous bottom feeders and opportunistic scavengers that feed on a wide variety of fish, invertebrates, plants and bottom material (Ford et al. 1992).

Major flow alterations caused by damming of the Kootenay River at Libby are thought to have affected natural sturgeon spawning regimes in the Kootenay. Sampling data from a number of sources indicate very low numbers of young sturgeon age classes after dyking and construction of the Libby Dam. In addition, extensive dyking and channel alterations along the Kootenay River have alienated backwaters and sloughs, which represent possible rearing habitat for juvenile sturgeon (Ford et al. 1992).

Although sturgeon are not known to occur within dyked portions of the CVWMA, the Management Area should cooperate with recovery efforts and work towards restoring access habitat.

Lance-tipped Darner

- a. Conduct further inventory.

The Lance-tipped Darner is an uncommon species typical of small ponds and open, nutrient rich, warm marshes dominated by cattails and bulrushes. They are the only species of Aeshna in the Columbia Basin that regularly lays eggs above the water in emergent vegetation. The Creston occurrence records range from 14 to 22 August (Cannings et al. 2000).

Twelve-spotted Skimmer

- a. Conduct further inventory.

This large and boldly patterned *Libellula* lives in exposed, nutrient-rich marshy lakes and ponds mainly in calcareous soils. Females oviposit, like all Libellulidae, directly into the water, but place eggs in areas where submerged vegetation grows. Columbia Basin occurrence records range from 12 July to 15 August (Canning et al. 2000).

Yellow-headed Meadowhawk

- a. Conduct further inventory.

The Yellow-headed Meadowhawk lives in ponds, slow streams and lakes with dense emergent vegetation. While in tandem, the female deposits her eggs along the banks in moss or vegetation very close to, or in, the water. This species has the latest flight period of any species in British Columbia. The only Columbia Basin occurrence date is 7 October 1988 (Cannings et al. 2000).

Other Listed Species

Precise location of listed plant species on the CVWMA are unknown. Most of the species are found in wet and moist habitats and could be negatively affected by drawdowns and vegetation treatments. Additional inventory work needs to occur to identify sites occupied by rare plants and to establish small “no management zones” around these occurrences.

The life requisites of regionally important, wide-ranging species such as grizzly bears and mountain caribou should also be considered in the context of CVWMA habitat management. Grizzly bears infrequently use the CVWMA during spring, and benefit from low levels of human disturbance. Areas with grizzly bear activity should be identified, and efforts should be made to minimize human activity and potential for human-bear encounters. The endangered caribou use the CVWMA only occasionally as a travel corridor. However, the caribou are detrimentally affected by the presence of other ungulate species (e.g., white-tailed deer), which can draw predators such as cougars into high-elevation caribou habitat (Steeger et al. 2003). Management objectives must therefore be consistent with regional objectives for potentially conflicting species (see ungulates in next section).

Species at risk management on the CVWMA will increasingly dominate management efforts as new obligations under law are recognized. Recovery planning is considered a provincial and federal priority and the CVWMA should participate in the recovery planning process and implement committee recommendations on CVWMA lands.

Management Prescriptions for Species or Species Groups of Interest

Waterfowl

- a. Implement habitat objectives for open water, permanent wetland, seasonally flooded wetland, and upland grassland habitats.
- b. Discourage public groups from erecting nesting structures for Canada geese.
- c. Encourage public groups to replace and maintain other nesting structures for waterfowl.
- d. Implement moist soil management during drawdowns to encourage smartweed stands.

Management objectives for waterfowl are largely achieved through management of their habitats. The public has traditionally shown interest in constructing and erecting various nesting structures. Some of these structures are well used, but the CVWMA has limited resources to maintain them. Public groups should be encouraged to replace and maintain existing structures. Also, with Canada goose populations and associated human conflicts at an all-time high, the addition of new goose-nesting structures should be discouraged.

Ungulates

- a. Follow provincial/regional ungulate winter range guidelines and current hunting policies.

The Province is implementing regional and provincial strategies related to ungulate winter range. Locally, these policies are affected by mountain caribou that occasionally use the CVWMA as a travel corridor between ranges in the Selkirks and Purcells. Management policy for ungulates should follow regional WLAP policy, which currently calls for a relaxation of ungulate winter range habitat improvements near mountain caribou range to reduce alternate prey (e.g., deer) for the caribou’s predators (principally cougars in the South Selkirk mountains).

Recreational Fish Species

Largemouth Bass:

- a. Maintain sufficient water levels for spring spawning.
- b. Support studies to determine factors limiting the bass populations.

c. Support enhancement options in channel habitats.

Largemouth bass management is a public concern in [Duck Lake](#), and secondarily in channel habitats (Betts and Morley 2004). Bass were introduced to Idaho in 1916 and thereafter spread to the Columbia River system (Scott and Crossman 1973). Their biology is well documented and they have been a very popular North American sport fish for many decades. Bass are spring to early summer spawners with the males building nests to incubate and guard the young. The fry feed on aquatic invertebrates and as they grow larger, graduate to feed on other fish, amphibians, terrestrial insects and even small mammals. This species typically inhabits the upper levels of shallow lakes, shallow bays of larger lakes and, more rarely, larger slow rivers (Scott and Crossman 1973).

The largemouth bass fishery in [Duck Lake](#) is well known locally, provincially, and, according to some, internationally. It is reported by bass-fishing enthusiasts to be one of the best, if not the best bass fishery in northwestern North America (N. Simmons, pers. comm.). Anecdotal information from local fishers indicates the fishery has declined substantially over the past decade or more. Some attribute this decline to water level manipulation in Duck Lake, poor water quality, and over-harvesting.

Salmonids (Rainbow Trout, Bull Trout, Westslope Cutthroat Trout, Kokanee)

a. Support implementation of recommendations made by Andrusak et al. (2003)

Andrusak et al. (2003) made detailed recommendations for enhancing kokanee habitat in stream reaches of the CVWMA. Their recommendations largely involve the provision of in-stream coarse woody debris and the creation of riffle pools. These improvements will benefit salmonids in general. Although implementing the habitat improvements is impractical within the current budget, the CVWMA could apply for outside funding to finance the work. The CVWMA could also provide in-kind support to third-party groups who wish to undertake recommended projects. In addition to the listed species described in the previous section, important sport fishing salmonids resident within the CVWMA include:

Rainbow trout: This species is common throughout the Kootenay River drainage and exhibits several different life history strategies. Some individuals live in small streams, others spawn in small streams and then migrate into rivers or lakes (Ford et al. 1992). Rainbow trout within the CVWMA follow the first two of these life history strategies and most of the low-gradient streams harbour rainbow trout of one race or the other. They feed on aquatic and terrestrial invertebrates and are spring spawners.

Kokanee: This salmon species is widely distributed throughout the Kootenay River system and has been studied extensively throughout BC. In the South Arm of Kootenay Lake, including the waters of the CVWMA, kokanee escapements have diminished drastically over the past few decades and are now virtually nonexistent (Andrusak et al. 2003). However, historical information indicates that South Arm escapements of kokanee were in the low thousands 30-40 years ago, with some escapement coming from CVWMA waters (e.g., [Summit Creek](#), [Boulder Creek](#), and [Boundary Creek](#), among others).

Effectiveness Monitoring and Adaptive Management

Effectiveness monitoring (EM) is a critical component of an adaptive management approach to resource management (Taylor et al. 1997; Morrison 2001). It involves identifying and monitoring key indicators of ecosystem response and addressing the question of how successful a management initiative is, relative to its initial objectives (Noss and Cooperrider 1994; Morrison and Marcot 1995). Monitoring feedback is used to modify or refine practices, where required, to improve management results through time. EM can improve both the biological and cost effectiveness associated with planning, implementation, and/or evaluation of management activities. Furthermore, implementing an EM component will likely increase the confidence of potential funding agencies in the habitat management plan.

An effectiveness monitoring program for the CVWMA should be based on *indicators* with the following characteristics:

1. Cost-effective. Data related to indicators need to be collected on an on-going basis; therefore, resource requirements should be low to ensure that the monitoring program is sustainable during times of uncertain funding.
2. Related to core functions of the CVWMA. The purpose of management on the CVWMA is to maintain the productivity of the Area's habitats. Data that are collected should be related to this core function. There will continue to be projects conducted on the CVWMA that are initiated and/or funded by outside agencies and the CVWMA should seek to gain whatever monitoring information it can from such initiatives (see recommendation 10 in chapter 4).
3. Responsive to management intervention. The monitoring program should focus on indicators that are likely to change as a result of habitat management activities.
4. Related directly to objectives. The best indicators are those that measure outcomes with respect to objectives directly, although surrogates are sometimes required.

Table 7 lists recommended indicators that could form the basis for an effectiveness monitoring program. As with any monitoring, the scheduling of monitoring should be consistent from year to year and ideally, the same persons should conduct the work to minimize extraneous sources of variation in the data.

Monitoring of wetland productivity could be accomplished by measuring the ratio of emergent to open water in ponds where active management through drawdowns is applied. Interpreting these ratios in the context of water levels and waterfowl use numbers can indicate the effectiveness of the management regime, and indicate when drawdowns are required.

Upland productivity is related to maintaining the vigour of grass meadows. One indicator of the health of grass stands is the degree of noxious weed invasion. Although impractical to measure, invasions can at least be rated qualitatively (e.g., nil – no weeds observed; low – no impact on vigour of stands; moderate – degradation of grass evident; severe – grass stands widely compromised) if a systematic monitoring approach is used. This would best be accomplished by establishing permanent plots at key locations in the study area and using ground-based photographic monitoring (Hall 2001).

For other habitat types such as forests, we are recommending primarily a no management option, which in turn requires no specific monitoring.

Table 7. Recommended indicators of an effectiveness monitoring program for the CVWMA.

Focus	Indicator	Management Units	Frequency
Permanent and seasonally flooded wetland productivity	Estimated ratio of emergent vegetation to open water	Corn Creek 2a Leach Lake 1-4 Six Mile Slough 2-5 Duck Lake Nesting Area	Bi-annually at a consistent time of year
	Waterfowl use (aerial surveys)	All	Spring and fall
	Waterfowl brood counts	All	Spring
Water levels	Various, depending on unit	All	Throughout the year
Upland grassland and shrub productivity	Noxious weed invasion (qualitative estimate: nil, low, moderate, extreme)	All	Bi-annually in early summer when weeds are flowering
Species of interest	Western Grebe incubating adult counts and brood counts ¹	Duck Lake	Annually
	Great Blue Heron and Double-crested Cormorant active nest counts (and	Leach Lake	Annually

Focus	Indicator	Management Units	Frequency
	nesting success counts. ²		
	American White Pelican numbers and any evidence of nesting activity. ³	Leach Lake Six Mile Slough	Annually

¹ Early season grebe counts and late season brood counts should be conducted with a spotting scope from an observation point on the cross-dyke as described in recommendations for naturalist monitoring proposed by Ohanjanian (1998). Surveys would count the numbers of adults in mid-June and the numbers of successful broods (i.e., broods with ≥ 1 chick) in late July, respectively. Note that the timing of surveys may vary slightly from year to year, depending on weather.

² Early season active nest counts and late season nesting success counts should be conducted for both species with a spotting scope from an observation point on the dyke directly across from the current Leach Lake nests. The number of nests with an adult in attendance should be counted over a four-hour period on May 1st annually. This procedure should be repeated to count the number of nests with young on June 21st annually.

³ American White Pelicans should be counted annually on one day (August 10) from vantage points along the dykes. The maximum count for the day should be used to estimate total numbers, as described in Gowans and Ohanjanian (2000).

There are specific species of interest that are ongoing concerns of the Management Area and that might not be captured under external programs. Numbers of incubating Western Grebes and their nesting success is directly related to CVWMA management policies on Duck Lake and, as a result, should be monitored annually (Table 7). The Great Blue Heron rookery at Leach Lake is also of interest because of its size and significance within the BC Columbia Basin. Ongoing monitoring of numbers of active and successful nests should therefore be monitored. Double-breasted Cormorants currently nest in the heron colony and can readily be monitored at the same time to provide additional information on the breeding ecology of this species in the CVWMA. Similarly, the numbers of American White Pelicans using Leach Lake and Six Mile Slough should be monitored, as well as any observations on nesting activity. The above monitoring initiatives may require some flexibility and adjustment as colonies abandon and/or move, but they will at least establish a baseline.

Effectiveness monitoring programs will be part of recovery efforts for listed species. These efforts will provide opportunities for the Management Area to expand its monitoring program with external funding.

Chapter 4. Recommendations

In addition to the habitat management plan, there are a number of specific recommendations that arose from our review of management history, technical analysis and public participation process (Betts and Morley 2004):

1. Establish a standing technical advisory committee. An unfortunate consequence of the CVWMA's unique ecology and legal status is that the Management Area's staff is isolated from a broader community of professionals who have experience in similar management challenges. We recommend establishing a technical advisory committee comprised of 4-6 biologists with experience in wildlife and habitat management, preferably related to the Management Area. Committee members would be volunteers and would commit to informal consultations by conference call, etc. to discuss specific issues or challenges faced by CVMWA staff. Costs would be limited, except where face-to-face meetings or field visits were required.
2. Conduct an inventory of current infrastructure and required upgrades. This is a required step to assessing financial requirements from outside agencies.
3. Provide additional opportunities for public review. Management decisions that trigger public review should be clearly articulated. A public review process could include invitations to comment on draft documents and/or public meetings. Input related to management of the Area's biological resources should be restricted to the Technical Advisory Committee. We suggest that decisions suitable for public review would include:
 - a. Changes to public access.
 - b. Substantive changes to public education activities.
 - c. Proposals for third-party commercial operations on the Management Area.
 - d. New or revised strategic-level direction.
4. Draft an access management policy. Concern regarding access management was a consistent theme; however, few specific examples were cited by the public.
5. Adopt a policy related to third party commercial proposals. This policy should include:
 - a. A "no net habitat loss" provisions.
 - b. Requirements for externally funded environmental assessments.
 - c. Provisions for public review and comment.
6. Initiate contact with existing recovery teams. The CVWMA will be a focus of future recovery efforts for listed species and it is important that the Management Area have a profile on recovery teams. Participating in all recovery efforts is clearly beyond the ability of current staff; however, correspondence with these groups is essential because opportunities will arise from recovery teams for funding species-specific initiatives.
7. Address outstanding inventory and research issues. Partnerships with outside agencies and groups should be sought to address pressing research and inventory needs:
 - a. Red and blue-listed plant inventory.
 - b. Red and blue-listed insects.
 - c. Duck Lake productivity studies.
8. Address fisheries enhancement opportunities. Funding is available for fisheries enhancement initiatives from a variety of sources and detailed proposals are available for some areas (e.g., Andrusak et al. 2003). White sturgeon recovery planning provides a unique opportunity that should be pursued.

9. Encourage use of the Management Area for research and inventory projects. Over the last two decades, numerous post-graduate field projects were conducted in the Management Area. Such projects increase the Area's knowledge base of its wildlife and habitats. A renewed dialog with Western Canada universities (including the new UBC Okanagan campus) may attract new graduate students to the Area. We also recommend maintaining or furthering collaboration with government and non-governmental organizations that have interest in the Area's ecological values.
10. Permitted research and inventory projects should be bound by data sharing agreements. Any individual, group or agency undertaking research or inventory work on the CVWMA should be bound by the terms of a data-sharing agreement. Data collected on the Management Area should be delivered to the CVMWA within a reasonable period of time after work is completed. In particular, any location information (e.g., UTM's) in relation to species at risk should be provided (and ultimately delivered to the Conservation Data Centre). The agreement should recognize that ownership of the data resides with the original funding agency, but that the CVWMA can use this information for management purposes.

Chapter 5. Five-year Plan

Action Item	Priority	Cooperating Agencies	Completion Target	Estimated Cost to CVWMA (000s, including staff time)				
				2005	2006	2007	2008	2009
Drawdowns: Corn Creek 2b Duck Lake Nesting Area Six Mile Slough 2 Six Mile Slough 3	1	CBFWCP	1 Unit/yr	20	30	40	30	30
Effectiveness monitoring program	1		Ongoing	5	5	5	5	5
Standing technical advisory committee	1	Various	2005	1	1	1	1	1
Conduct inventory of current infrastructure and required upgrades	2		2005	5				
Negotiate and conduct infrastructure upgrades (not including earthwork and equipment costs)	2	Ducks Unlimited Canada	2009		5	5	5	5
Draft and distribute an access management policy	2		2005	5				
Cooperation with species recovery efforts	2	CWS, DFO, WLAP, USFWS	Ongoing	5	5	5	5	5
Rare plant and insect inventories	2	CWS, WLAP, NGOs	2007	20	20	20		
Duck Lake productivity study	3	HCTF, WLAP, NGOs	2007	3	10	10		
Salmonid enhancement	1	HCTF, NGOs, DFO	2008	3	20	20	20	
Total				67	96	106	66	46

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Appendix I. Habitat Management Workshop Minutes

17 June 2004
Creston Valley Wildlife Centre
9:30-4:00

Purpose

The purpose of the workshop is to review and provide input on key aspects of a new habitat management plan for the CVWMA.

In Attendance

Name	Affiliation	Contact
Doug Adama	Northern Leopard Frog Recovery, Creston	adama@rockies.net
Marc-André Beaucher	Consultant, Creston	beaucher@uniserve.net
Stephen Bullock	CVWM Authority, Creston	blue-heron@uniserve.com
Dave Dunbar	BC Ministry of Water, Land and Air Protection, Cranbrook	dave.dunbar@gems3.gov.bc.ca
Darryl Kroeker	Ducks Unlimited Canada, Kamloops	d_kroeker@ducks.ca
John Krebs	Columbia Basin Fish and Wildlife Compensation Program, Nelson	john.krebs@bchydro.bc.ca
Rick McKelvey	CVWM Authority and Canadian Wildlife Service, Delta	Rick.McKelvey@ec.gc.ca
Rick Morley	Project Consultant, Nelson	rmorley@shaw.ca
Chris Steeger	Project Consultant, Nelson	csteeger@netidea.com
Brian Stushnoff	CVWMA, Creston	stushnoff@crestonwildlife.ca
Steve Wilson	Project Consultant, Gabriola Island	sfwilson@shaw.ca
Guy Woods	BC Ministry of Water, Land and Air Protection, Nelson	guy.woods@gems4.gov.bc.ca

Minutes

1. Overview of current situation:

- A plan is required to provide a vision for future habitat management of the CVWMA. The goal is develop a detailed habitat management plan that is based on sound biological principles and enjoys broad public support. The plan will be an important component of the Area's strategy for securing future funding.
- The public participation component of the plan has been completed. Phone interviews, meetings and written submissions from a variety of stakeholders indicate exceptional support for the Area and its current management. While there was recognition of the Area's traditional role as waterfowl habitat, there was support for a broader emphasis on biodiversity and species at risk.
- Negative feedback from stakeholders focussed on two issues: state of the Duck Lake bass fishery and motivation and retention of volunteers (which, although reported, is beyond the scope of the habitat management plan).

2. General Management Issues:

- Time horizon for the plan should be 25-50 years.
- To properly evaluate different management options, there should be a sense of the management envelope or "goalposts"; that is, what would the area look like under a "no management option" and under an "intensive management" option.
- The successional pathways are understood sufficiently to estimate the future condition of the Management Area under a "no management option." Water regimes have changed such that

returning the area to its original delta system is unlikely. Assuming current hydrology, but allowing succession and deterioration of infrastructure, the following is likely to occur:

- The driest upland forest will succeed to fir-pine
 - Extent of cottonwood forest will increase (some question regarding the successional pathway of cottonwood – inundation required for seeds to sprout, suckering occurring but heavily grazed, perhaps out-competed by reed canarygrass)
 - Upland grassland will be invaded by woody shrubs in many areas
 - Limits of tree-shrub invasion will be related to seasonal high water
 - Seasonally flooded and wetland areas will become drier through in-filling of ponds
 - Lowest areas will continue to hold water throughout the year but will likely be completed ingrown with cattail.
- Presumably, an “intensive management” option would result in a narrow focus on waterfowl habitat and would result in the area looking similar to Kootenai Wildlife Refuge; that is, larger areas under cultivation, more frequent drawdowns, brushing and/or burning to control upland vegetation (although the Refuge has recently increased management emphasis on restoring natural vegetation).
 - The “no management option” is unacceptable in the broader context of wetlands losses elsewhere, future impacts of global warming, etc.
 - Public consultation indicated support for maintaining marsh habitats.
 - Although current conditions enjoy public support, there have been costs; e.g., loss of mudflats and concurrent loss of habitat for shorebirds.
 - History suggests that the public is most likely to support current conditions and resist any change.
 - Neither management extreme is acceptable if the goal is to maintain the biological status quo.
 - Allowing tree and shrub succession has biodiversity benefits that outweigh costs.
 - Wetland areas will require active management.
 - No reason to actively manage coniferous forests:
 - Aging forests fit with regional old growth management strategy.
 - Roads for logging would create access problems.
 - Regional priority is not to manage for ungulate winter range near caribou habitat.

3. Wetland Management Issues:

- Current drawdown management is expensive but methods have evolved over many years to the point where they are effective in achieving vegetation management objectives.
- Vegetation management through water control only (e.g., deep water flooding) can achieve many objectives if infrastructure is adequate to manipulate water levels as required throughout the year. Management with water levels alone also has costs; e.g., dyke erosion, flooding upland nests, loss of emergent cover preferred by some rare species (e.g., nesting Bitterns). Shallow areas cannot be managed through deep water flooding.
- Focus of plan should be on desired outcomes and specific objectives rather than management techniques. Outcomes and objectives should be measurable to assess success. Let the CVWMA staff to continue to learn how best to manage.
- Objectives should be expressed as priorities to help direct limited funds.
- CVWMA is fundamentally different than other DU projects. As a “feature” area, it is logical to employ a more intensive management regime.
- Infrastructure needs to be reviewed to determine what needs to be repaired or upgraded.

- Management must be feasible, based on:
 - Biological characteristics.
 - Hydrology and topography.
 - Social acceptability.
 - Plan should not necessarily be constrained by funding levels. It is more important to ensure that the plan is sound and can be used to raise funds.

4. Species at Risk:

- A number of species at risk have been found on the CVWMA but management must be prioritized. C. Steeger presented a priority list that will be included in the management plan.
- Priority species fit well with wetland habitat management priorities.
- Regional context of CVWMA important for wide-ranging species such as grizzly bears and mountain caribou.
- CVWMA should cooperate with recovery efforts.

5. Duck Lake Management:

- Priorities should first be to protect adjacent agricultural lands.
- Second priority should be management of species at risk.
- Importance of recreational bass fishery should be acknowledged.
- CVWMA now has more flexibility with water levels since departure of IJC, but management should follow priorities.
- Some bass fishermen are requesting specific water levels; however, there is no evidence of a direct relationship between water levels and quality of the bass fishery.
- Also a perception of a direct trade-off between nesting grebes and the bass fishery; however, grebes established on the lake when the fishery was thriving.
- Current status of the bass fishery is unknown. There are anecdotal reports of a decline but some users report good fishing. If in fact there is a decline occurring, it could be for any number of reasons.
- The bass fishery is not a provincial priority because there are more pressing conservation concerns related to native species in decline. This is unlikely to change.
- There is nothing preventing conservation or rod and gun clubs from applying for funding from HCTF to investigate the fishery. CVWMA should do what it can to enable these studies, in the context of their other priorities.
- Other fisheries issues largely addressed through a recent consultant's report – “off the shelf” enhancement projects that could be undertaken by conservation groups or even largely completed in-house with existing CVWMA staff.

6. Lure Crops:

- Tansy, goldenrod and thistle are invading some areas of the CVWMA. Invasion seems to occur on high ground where reed canarygrass stands lose vigour over time. Reasons for this loss in vigour might be related to moisture and soil fertility. Lure crops have been planted in some of these areas.
- Farmers think lure crops are helping to reduce damage by elk in adjacent agricultural fields. There are no plans to expand the crops.

7. Artificial Nesting Structures:

- CVWMA receives complaints if nesting structures are not maintained; some think it detracts from the “natural” look of the Management Area.
- Goose nesting structures should be discouraged because of expanding Canada goose populations.

- Groups erecting structures are generally not interested in removing and replacing old structures or conducting routine maintenance on structures they erect.
 - Alternative projects to next box construction should be encouraged.
 - Erect signage acknowledging group's responsibility for construction *and* maintenance of structures?
8. Access Management:
- Public concerned about access management but didn't point to any persistent problems.
 - ATV access to the south end of Kootenay Lake is the major compliance issue.
 - Access management has evolved over the years in response to problems/concerns.
 - Policy should be articulated in a single, publicly accessible document (perhaps a brochure with a map).
 - Access for the disabled is an emerging issue provincially.
9. Other Issues:
- West Nile virus is an emerging issue. Information is available on DU's website. A pro-active policy should be in place in case there is pressure for spraying on the area. Mosquitoes closely associated with the spread of West Nile virus are most often associated with standing water in urban areas.
 - The collection of natural products was also flagged as a potential issue.

Appendix II. CVWMA Species Lists

Common and Scientific Names, CDC Status, COSEWIC Status, and Breeding Occurrence of Birds in the CVWMA. The superscript number after the COSEWIC designation denotes the SARA Schedule under which the species is listed.

Common Name	Scientific Name	CDC Status	COSEWIC	Breeding
American Avocet	<i>Recurvirostra americana</i>	Red - S2		B
American Bittern	<i>Botaurus lentiginosus</i>	Blue - S3		B
American Coot	<i>Fulica americana</i>			B
American Crow	<i>Corvus brachyrhynchos</i>			B
American Dipper	<i>Cinclus mexicanus</i>			B
American Golden-Plover	<i>Pluvialis dominica</i>	Blue - S3S4		
American Goldfinch	<i>Carduelis tristis</i>			B
American Kestrel	<i>Falco sparverius</i>			B
American Pipit	<i>Anthus rubescens</i>			
American Redstart	<i>Setophaga ruticilla</i>			B
American Robin	<i>Turdus migratorius</i>			B
American Tree Sparrow	<i>Spizella arborea</i>			
American White Pelican	<i>Pelecanus erythrorhynchos</i>	Red - S1	NAR (1987)	
American Wigeon	<i>Anas americana</i>			B
Anna's Hummingbird	<i>Calypte anna</i>			
Back and White Warbler	<i>Mniotilta varia</i>			
Baird's Sandpiper	<i>Calidris bairdii</i>			
Bald Eagle	<i>Haliaeetus leucocephalus</i>	Yellow - S4		B
Band-tailed Pigeon	<i>Columba fasciata</i>			
Bank Swallow	<i>Riparia riparia</i>			B
Barn Owl	<i>Tyto alba</i>	Blue - S3	SC (Nov 2001) ¹	
Barn Swallow	<i>Hirundo rustica</i>	Yellow - S4		B
Barred Owl	<i>Strix varia</i>			B
Barrow's Goldeneye	<i>Bucephala islandica</i>	Yellow - S4		B
Belted Kingfisher	<i>Ceryle alcyon</i>			B
Black Swift	<i>Cypseloides niger</i>			b
Black Tern	<i>Chlidonias niger</i>			B
Black-backed Woodpecker	<i>Picoides arcticus</i>			B
Black-bellied Plover	<i>Pluvialis squatarola</i>			
Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>			
Black-billed Magpie	<i>Pica hudsonia</i>			B
Black-capped Chickadee	<i>Poecile atricapilla</i>			B
Black-chinned Hummingbird	<i>Archilochus alexandri</i>	Yellow - S4		b
Black-crowned Night-Heron	<i>Nycticorax nycticorax</i>			
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>			B
Black-necked Stilt	<i>Himantopus mexicanus</i>			
Black-throated Blue Warbler	<i>Dendroica caerulescens</i>			
Blue Grosbeak	<i>Guiraca caerulea</i>			
Blue Grouse	<i>Dendragapus obscurus</i>	Yellow - S4		B
Blue Jay	<i>Cyanocitta cristata</i>			B
Blue-winged Teal	<i>Anas discors</i>			B

Common Name	Scientific Name	CDC Status	COSEWIC	Breeding
Bobolink	<i>Dolichonyx oryzivorus</i>	Blue - S3		B
Bohemian Waxwing	<i>Bombycilla garrulus</i>			
Bonaparte's Gull	<i>Larus philadelphia</i>			
Boreal Chickadee	<i>Poecile hudsonica</i>			
Boreal Owl	<i>Aegolius funereus</i>			
Brant	<i>Branta bernicla</i>			
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>			B
Brown Creeper	<i>Certhia americana</i>			B
Brown Thrasher	<i>Toxostoma rufum</i>			
Brown-headed Cowbird	<i>Molothrus ater</i>			B
Bufflehead	<i>Bucephala albeola</i>			B
Bullock's Oriole	<i>Icterus bullockii</i>			B
California Gull	<i>Larus californicus</i>	Blue - S3		
California Quail	<i>Callipepla californica</i>	Introduced		B
Calliope Hummingbird	<i>Stellula calliope</i>			B
Canada Goose	<i>Branta canadensis</i>			B
Canvasback	<i>Aythya valisineria</i>	Yellow - S4		B
Caspian Tern	<i>Sterna caspia</i>	Blue - S3		
Cassin's Vireo	<i>Vireo cassinii</i>			B
Cassin's Finch	<i>Carpodacus cassinii</i>			b
Cattle Egret	<i>Bubulcus ibis</i>			
Cedar Waxwing	<i>Bombycilla cedrorum</i>			B
Chestnut-backed Chickadee	<i>Poecile rufescens</i>			B
Chipping Sparrow	<i>Spizella passerina</i>			B
Chukar	<i>Alectoris chukar</i>	Introduced		
Cinnamon Teal	<i>Anas cyanoptera</i>			B
Clark's Grebe	<i>Aechmophorus clarkii</i>			B
Clark's Nutcracker	<i>Nucifraga columbiana</i>			b
Clay-colored Sparrow	<i>Spizella pallida</i>			B
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>			B
Common Goldeneye	<i>Bucephala clangula</i>			B
Common Grackle	<i>Quiscalus quiscula</i>			
Common Loon	<i>Gavia immer</i>			B
Common Merganser	<i>Mergus merganser</i>			B
Common Nighthawk	<i>Chordeiles minor</i>			B
Common Raven	<i>Corvus corax</i>			B
Common Redpoll	<i>Carduelis flammea</i>			
Common Snipe	<i>Gallinago gallinago</i>			B
Common Tern	<i>Sterna hirundo</i>			
Common Yellowthroat	<i>Geothlypis trichas</i>			B
Cooper's Hawk	<i>Accipiter cooperii</i>			B
Dark-eyed Junco	<i>Junco hyemalis</i>			B
Double-crested Cormorant	<i>Phalacrocorax auritus</i>	Red - S2	NAR (1987)	B
Downy Woodpecker	<i>Picoides pubescens</i>			B
Dunlin	<i>Calidris alpina</i>			
Dusky Flycatcher	<i>Empidonax oberholseri</i>			B

Common Name	Scientific Name	CDC Status	COSEWIC	Breeding
Eared Grebe	<i>Podiceps nigricollis</i>	Yellow - S4		B
Eastern Kingbird	<i>Tyrannus tyrannus</i>			B
Eastern Phoebe	<i>Sayornis phoebe</i>			
Eurasian Wigeon	<i>Anas penelope</i>			
European Starling	<i>Sturnus vulgaris</i>	Introduced		B
Evening Grosbeak	<i>Coccothraustes vespertinus</i>	Yellow - S4		B
Ferruginous Hawk	<i>Buteo regalis</i>	Red - S1	SC (April 1995) ³	
Forster's Tern	<i>Sterna forsteri</i>	Red - S1	DD (1996)	B
Fox Sparrow	<i>Passerella iliaca</i>			
Franklin's Gull	<i>Larus pipixcan</i>			
Gadwall	<i>Anas strepera</i>			B
Glaucous Gull	<i>Larus hyperboreus</i>			
Glaucous-winged Gull	<i>Larus glaucescens</i>			
Golden Eagle	<i>Aquila chrysaetos</i>	Yellow - S4		
Golden-crowned Kinglet	<i>Regulus satrapa</i>			B
Golden-crowned Sparrow	<i>Zonotrichia atricapilla</i>			
Grasshopper Sparrow	<i>Ammodramus savannarum</i>	Red - S2		
Gray Catbird	<i>Dumetella carolinensis</i>			B
Gray Flycatcher	<i>Empidonax wrightii</i>	Blue - S3		
Gray Jay	<i>Perisoreus canadensis</i>			B
Gray Partridge	<i>Perdix perdix</i>	Introduced		
Gray-crowned Rosy-Finch	<i>Leucosticte tephrocotis</i>			
Great Blue Heron <i>herodias</i>	<i>Ardea herodias herodias</i>	Blue - S3S4		B
Great Egret	<i>Ardea alba</i>			
Great Gray Owl	<i>Strix nebulosa</i>	Yellow - S4		
Great Horned Owl	<i>Bubo virginianus</i>			B
Greater Scaup	<i>Aythya marila</i>			
Greater White-fronted Goose	<i>Anser albifrons</i>			
Greater Yellowlegs	<i>Tringa melanoleuca</i>			
Green Heron	<i>Butorides virescens</i>	Blue - S3S4		
Green-winged Teal	<i>Anas crecca</i>			B
Gyr Falcon	<i>Falco rusticolus</i>	Blue - S3		
Hairy Woodpecker	<i>Picoides villosus</i>			B
Hammond's Flycatcher	<i>Empidonax hammondii</i>			B
Harlequin Duck	<i>Histrionicus histrionicus</i>	Yellow - S4		
Harris's Sparrow	<i>Zonotrichia querula</i>			
Hermit Thrush	<i>Catharus guttatus</i>			B
Herring Gull	<i>Larus argentatus</i>			
Hooded Merganser	<i>Lophodytes cucullatus</i>			B
Horned Grebe	<i>Podiceps auritus</i>			B
Horned Lark	<i>Eremophila alpestris</i>			
House Finch	<i>Carpodacus mexicanus</i>			B
House Sparrow	<i>Passer domesticus</i>	Introduced		B
House Wren	<i>Troglodytes aedon</i>			B
Indigo Bunting	<i>Passerina cyanea</i>			B
Killdeer	<i>Charadrius vociferus</i>			B

Common Name	Scientific Name	CDC Status	COSEWIC	Breeding
Lapland Longspur	<i>Calcarius lapponicus</i>			
Lark Bunting	<i>Calamospiza melanocorys</i>			
Lark Sparrow	<i>Chondestes grammacus</i>	Red - S2		
Lazuli Bunting	<i>Passerina amoena</i>			B
Least Flycatcher	<i>Empidonax minimus</i>			B
Least Sandpiper	<i>Calidris minutilla</i>			
Lesser Scaup	<i>Aythya affinis</i>			B
Lesser Yellowlegs	<i>Tringa flavipes</i>			
Lewis's Woodpecker	<i>Melanerpes lewis</i>	Blue - S3	SC (Nov 2001) ¹	
Lincoln's Sparrow	<i>Melospiza lincolni</i>			
Loggerhead Shrike	<i>Lanius ludovicianus</i>			
Long-billed Curlew	<i>Numenius americanus</i>	Blue - S3	SC (Nov 2002) ³	B
Long-billed Dowitcher	<i>Limnodromus scolopaceus</i>			
Long-eared Owl	<i>Asio otus</i>	Yellow - S4		B
Long-tailed Duck	<i>Clangula hyemalis</i>	Blue - S3S4		
Long-tailed Jaeger	<i>Stercorarius longicaudus</i>			
MacGillivray's Warbler	<i>Oporornis tolmiei</i>			B
Mallard	<i>Anas platyrhynchos</i>			B
Marbled Godwit	<i>Limosa fedoa</i>			
Marsh Wren	<i>Cistothorus palustris</i>			B
Merlin	<i>Falco columbarius</i>			b
Mew Gull	<i>Larus canus</i>			
Mountain Bluebird	<i>Sialia currucoides</i>			B
Mountain Chickadee	<i>Poecile gambeli</i>			B
Mountain Quail	<i>Oreortyx pictus</i>	Introduced		
Mourning Dove	<i>Zenaida macroura</i>	Yellow - S4		B
Mute Swan	<i>Cygnus olor</i>	Introduced		
Nashville Warbler	<i>Vermivora ruficapilla</i>			B
Northern Bobwhite	<i>Colinus virginianus</i>	Introduced		
Northern Flicker	<i>Colaptes auratus</i>			B
Northern Goshawk <i>atricapillus</i>	<i>Accipiter gentilis atricapillus</i>	Yellow - S4		B
Northern Harrier	<i>Circus cyaneus</i>	Yellow - S4		B
Northern Hawk Owl	<i>Surnia ulula</i>			
Northern Mockingbird	<i>Mimus polyglottos</i>			
Northern Pintail	<i>Anas acuta</i>			B
Northern Pygmy-Owl	<i>Glaucidium gnoma</i>			
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>			B
Northern Saw-whet Owl	<i>Aegolius acadicus</i>			b
Northern Shoveler	<i>Anas clypeata</i>			B
Northern Shrike	<i>Lanius excubitor</i>			
Northern Waterthrush	<i>Seiurus noveboracensis</i>			B
Olive-sided Flycatcher	<i>Contopus cooperi</i>	Yellow - S4		
Orange-crowned Warbler	<i>Vermivora celata</i>			B
Orchard Oriole	<i>Icterus spurius</i>			
Osprey	<i>Pandion haliaetus</i>			B
Pacific Loon	<i>Gavia pacifica</i>			

Common Name	Scientific Name	CDC Status	COSEWIC	Breeding
Pacific-slope Flycatcher	<i>Empidonax difficilis</i>			
Parasitic Jaeger	<i>Stercorarius parasiticus</i>			
Pectoral Sandpiper	<i>Calidris melanotos</i>			
Peregrine Falcon <i>anatum</i>	<i>Falco peregrinus anatum</i>	Red - S2	T (May 2000) ¹	
Pied-billed Grebe	<i>Podilymbus podiceps</i>			B
Pileated Woodpecker	<i>Dryocopus pileatus</i>			B
Pine Grosbeak	<i>Pinicola enucleator</i>			
Pine Siskin	<i>Carduelis pinus</i>			B
Pomarine Jaeger	<i>Stercorarius pomarinus</i>			
Prairie Falcon	<i>Falco mexicanus</i>	Red - S2	NAR (1996)	
Purple Finch	<i>Carpodacus purpureus</i>			
Purple Martin	<i>Progne subis</i>	Red - S2		
Red Crossbill	<i>Loxia curvirostra</i>			b
Red Phalarope	<i>Phalaropus fulicaria</i>			
Red-breasted Merganser	<i>Mergus serrator</i>	Yellow - S4		
Red-breasted Nuthatch	<i>Sitta canadensis</i>			B
Red-eyed Vireo	<i>Vireo olivaceus</i>	Yellow - S4		B
Redhead	<i>Aythya americana</i>	Yellow - S3S4		B
Red-naped Sapsucker	<i>Sphyrapicus nuchalis</i>			B
Red-necked Grebe	<i>Podiceps grisegena</i>			B
Red-necked Phalarope	<i>Phalaropus lobatus</i>	Blue - S3S4		
Red-tailed Hawk	<i>Buteo jamaicensis</i>			B
Red-winged Blackbird	<i>Agelaius phoeniceus</i>			B
Ring-billed Gull	<i>Larus delawarensis</i>	Yellow - S4		
Ring-necked Duck	<i>Aythya collaris</i>			B
Ring-necked Pheasant	<i>Phasianus colchicus</i>	Introduced		B
Rock Dove	<i>Columba livia</i>	Introduced		B
Rock Wren	<i>Salpinctes obsoletus</i>			
Ross's Goose	<i>Chen rossii</i>			
Rough-legged Hawk	<i>Buteo lagopus</i>	Yellow - S2S3		
Ruby-crowned Kinglet	<i>Regulus calendula</i>			B
Ruddy Duck	<i>Oxyura jamaicensis</i>			B
Ruffed Grouse	<i>Bonasa umbellus</i>	Yellow - S4		B
Rufous Hummingbird	<i>Selasphorus rufus</i>			B
Rusty Blackbird	<i>Euphagus carolinus</i>			
Sabine's Gull	<i>Xema sabini</i>			
Sage Thrasher	<i>Oreoscoptes montanus</i>	Red - S1	E (Nov 2000) ¹	
Sanderling	<i>Calidris alba</i>			
Sandhill Crane	<i>Grus canadensis</i>	Blue - S3S4		
Savannah Sparrow	<i>Passerculus sandwichensis</i>			B
Say's Phoebe	<i>Sayornis saya</i>			B
Scissor-tailed Flycatcher	<i>Tyrannus forficatus</i>			
Semipalmated Plover	<i>Charadrius semipalmatus</i>			
Semipalmated Sandpiper	<i>Calidris pusilla</i>			
Sharp-shinned Hawk	<i>Accipiter striatus</i>			b
Short-billed Dowitcher	<i>Limnodromus griseus</i>	Blue - S2S4		

Common Name	Scientific Name	CDC Status	COSEWIC	Breeding
Short-eared Owl	<i>Asio flammeus</i>	Blue - S2S3	SC (April 1994) ³	B
Snow Bunting	<i>Plectrophenax nivalis</i>			
Snow Goose	<i>Chen caerulescens</i>			
Snowy Owl	<i>Nyctea scandiaca</i>			
Solitary Sandpiper	<i>Tringa solitaria</i>			
Song Sparrow	<i>Melospiza melodia</i>			B
Sora	<i>Porzana carolina</i>			B
Spotted Sandpiper	<i>Actitis macularia</i>			B
Spotted Towhee	<i>Pipilo maculatus</i>			B
Spruce Grouse	<i>Falcapennis canadensis</i>			
Steller's Jay	<i>Cyanocitta stelleri</i>			B
Stilt Sandpiper	<i>Calidris himantopus</i>			
Surf Scoter	<i>Melanitta perspicillata</i>	Blue - S3S4		
Swainson's Hawk	<i>Buteo swainsoni</i>	Red - S2		
Swainson's Thrush	<i>Catharus ustulatus</i>			B
Tennessee Warbler	<i>Vermivora peregrina</i>			
Three-toed Woodpecker	<i>Picoides tridactylus</i>			B
Townsend's Solitaire	<i>Myadestes townsendi</i>			B
Townsend's Warbler	<i>Dendroica townsendi</i>			B
Tree Swallow	<i>Tachycineta bicolor</i>			B
Trumpeter Swan	<i>Cygnus buccinator</i>	Yellow - S4		
Tundra Swan	<i>Cygnus columbianus</i>	Yellow - S4		
Turkey Vulture	<i>Cathartes aura</i>	Yellow - S4		
Varied Thrush	<i>Ixoreus naevius</i>			B
Vaux's Swift	<i>Chaetura vauxi</i>	Yellow - S4		B
Veery	<i>Catharus fuscescens</i>			B
Vermilion Flycatcher	<i>Pyrocephalus rubinus</i>			
Vesper Sparrow	<i>Pooecetes gramineus</i>			
Violet-green Swallow	<i>Tachycineta thalassina</i>			B
Virginia Rail	<i>Rallus limicola</i>			B
Warbling Vireo	<i>Vireo gilvus</i>			B
Western Bluebird	<i>Sialia mexicana</i>	Yellow - S4		B
Western Grebe	<i>Aechmophorus occidentalis</i>	Red - S1S3		B
Western Kingbird	<i>Tyrannus verticalis</i>			B
Western Meadowlark	<i>Sturnella neglecta</i>			B
Western Sandpiper	<i>Calidris mauri</i>			
Western Screech-Owl	<i>Otus kennicottii macfarlanei</i>	Red -S1	E (May 2002)	
Western Tanager	<i>Piranga ludoviciana</i>			B
Western Wood-Pewee	<i>Contopus sordidulus</i>	Yellow - S4		B
Whimbrel	<i>Numenius phaeopus</i>			
White-breasted Nuthatch	<i>Sitta carolinensis</i>	Yellow - S4		
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>			
White-faced Ibis	<i>Plegadis chihi</i>			
White-headed Woodpecker	<i>Picoides albolarvatus</i>	Red -S1	E (Nov 2000) ¹	
White-throated Sparrow	<i>Zonotrichia albicollis</i>			
White-throated Swift	<i>Aeronautes saxatilis</i>	Blue - S3S4		

Common Name	Scientific Name	CDC Status	COSEWIC	Breeding
White-winged Crossbill	<i>Loxia leucoptera</i>			
White-winged Scoter	<i>Melanitta fusca</i>			
Wild Turkey	<i>Meleagris gallopavo</i>	Introduced		B
Willet	<i>Catoptrophorus semipalmatus</i>			
Willow Flycatcher	<i>Empidonax traillii</i>			B
Wilson's Phalarope	<i>Phalaropus tricolor</i>			B
Wilson's Warbler	<i>Wilsonia pusilla</i>			b
Winter Wren	<i>Troglodytes troglodytes</i>			B
Wood Duck	<i>Aix sponsa</i>	Yellow - S4		B
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>			
Yellow Warbler	<i>Dendroica petechia</i>			B
Yellow-billed Loon	<i>Gavia adamsii</i>			
Yellow-breasted Chat	<i>Icteria virens</i>	Red - S1	E (Nov 2000) ¹	B
Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>	Yellow - S4		B
Yellow-rumped Warbler	<i>Dendroica coronata</i>)			B

Common and Scientific Names, CDC and COSEWIC Status of Mammals in the CVWMA.

Common Name	Scientific Name	CDC Status	COSEWIC
American Badger	<i>Taxidea taxus</i>	Red - S1	E (May 2000) ¹
Beaver	<i>Castor canadensis</i>		
Big Brown Bat	<i>Eptesicus fuscus</i>		
Black Bear	<i>Ursus americanus</i>		
Bobcat	<i>Lynx rufus</i>	Yellow - S4	
Bushy-tailed Woodrat	<i>Neotoma cinerea</i>		
Caribou	<i>Rangifer tarandus (southern pop.)</i>	Red - S1	T (May 2000) ¹
Columbian Ground Squirrel	<i>Spermophilus columbianus</i>		
Common Shrew	<i>Sorex cinereus</i>		
Common Water Shrew	<i>Sorex palustris</i>		
Cougar	<i>Puma concolor</i>	Yellow - S4	
Coyote	<i>Canis latrans</i>		
Deer Mouse	<i>Peromyscus maniculatus</i>		
Dusky Shrew	<i>Sorex monticolus</i>		
Elk	<i>Cervus elaphus</i>		
Ermine	<i>Mustela erminea</i>		
Golden-mantled Ground Squirrel	<i>Spermophilus lateralis</i>		
Grizzly Bear	<i>Ursus arctos</i>	Blue - S3	SC (May 2002) ³
Heather Vole	<i>Phenacomys intermedius</i>		
Hoary Bat	<i>Lasiurus cinereus</i>	Yellow -S4	
House Mouse	<i>Mus musculus</i>	Introduced	
Little Brown Myotis	<i>Myotis lucifugus</i>		
Long-legged Myotis	<i>Myotis volans</i>		
Long-tailed Vole	<i>Microtus longicaudus</i>		
Long-tailed Weasel	<i>Mustela frenata</i>		
Lynx	<i>Lynx canadensis</i>	Yellow - S4	
Marten	<i>Martes americana</i>		

Common Name	Scientific Name	CDC Status	COSEWIC
Meadow Vole	<i>Microtus pennsylvanicus</i>		
Mink	<i>Mustela vison</i>		
Moose	<i>Alces alces</i>		
Mountain Goat	<i>Oreamnos americanus</i>	Yellow - S4	
Mule Deer	<i>Odocoileus hemionus</i>		
Muskrat	<i>Ondatra zibethicus</i>		
Northern Flying Squirrel	<i>Glaucomys sabrinus</i>		
Northern Pocket Gopher <i>segregatus</i>	<i>Thomomys talpoides segregatus</i>	Red - S2	
Porcupine	<i>Erethizon dorsatum</i>		
Pygmy Shrew	<i>Sorex hoyi</i>		
Raccoon	<i>Procyon lotor</i>		
Red Fox	<i>Vulpes vulpes</i>		
Red Squirrel	<i>Tamiasciurus hudsonicus</i>		
Red-tailed Chipmunk <i>simulans</i>	<i>Tamias ruficaudus simulans</i>	Blue - S3S4	
River Otter	<i>Lontra canadensis</i>		
Silver-haired Bat	<i>Lasionycteris noctivagans</i>	Yellow - S4	
Snowshoe Hare	<i>Lepus americanus</i>		
Southern Red-backed Vole	<i>Clethrionomys gapperi</i>		
Striped Skunk	<i>Mephitis mephitis</i>		
Townsend's Big-eared Bat	<i>Corynorhinus townsendii</i>	Blue - S2S3	
Vagrant Shrew	<i>Sorex vagrans</i>		
Water Vole	<i>Microtus richardsoni</i>		
Western Jumping Mouse	<i>Zapus princeps</i>		
Western Long-eared Myotis	<i>Myotis evotis</i>		
White-tailed Deer	<i>Odocoileus virginianus</i>		
Wolverine	<i>Gulo gulo luscus</i>	Blue - S3	SC (May 2003) ³
Woodchuck	<i>Marmota monax</i>		
Yellow-pine Chipmunk	<i>Tamias amoenus</i>		
Yuma Myotis	<i>Myotis yumanensis</i>		

Common and Scientific Names, CDC and COSEWIC Status of Fish in the CVWMA.

Common Name	Scientific Name	CDC Status	COSEWIC
Black Bullhead	<i>Ameiurus melas</i>	Introduced	
Brook Trout	<i>Salvelinus fontinalis</i>	Introduced	
Burbot (lower Kootenay pop.)	<i>Lota lota</i>	Red - S1	
Cutthroat Trout	<i>Oncorhynchus clarki</i>	Blue - S3	
Bull Trout	<i>Salvelinus confluentus</i>	Blue - S3	
Largemouth Bass	<i>Micropterus salmoides</i>	Introduced	
Largescale Sucker	<i>Catostomus macrocheilus</i>		
Mountain Whitefish	<i>Prosopium williamsoni</i>	Yellow - S4	
Peamouth	<i>Mylocheilus caurinus</i>		
Pikeminnow	<i>Ptychocheilus oregonensis</i>		
Pumpkinseed	<i>Lepomis gibbosus</i>	Introduced	
Rainbow Trout	<i>Oncorhynchus mykiss</i>		
Redside Shiner	<i>Richardsonius balteatus</i>		

Common Name	Scientific Name	CDC Status	COSEWIC
Sockeye Salmon (Kokanee)	<i>Oncorhynchus nerka</i>	Yellow - S4	
White Sturgeon	<i>Acipenser transmontanus</i>	Red - S1	E (Nov 2003) ³
Yellow Perch	<i>Perca flavescens</i>		

Common and Scientific Names, CDC and COSEWIC Status of Reptiles in the CVWMA.

Common Name	Scientific Name	CDC Status	COSEWIC
Common Garter Snake	<i>Thamnophis sirtalis</i>		
Northern Alligator Lizard	<i>Elgaria coerulea</i>		
Painted Turtle	<i>Chrysemys picta</i>	Blue - S3S4	
Rubber Boa	<i>Charina bottae</i>	Yellow - S4	
Western Skink	<i>Eumeces skiltonianus</i>	Blue - S2S3	SC (May 2002)
Western Terrestrial Garter Snake	<i>Thamnophis elegans</i>		

Common and Scientific Names, CDC and COSEWIC Status of Amphibians in the CVWMA.

Common Name	Scientific Name	CDC Status	COSEWIC
Coeur d'Alene Salamander	<i>Plethodon idahoensis</i>	Blue - S3	SC (Nov 2001) ¹
Columbia Spotted Frog	<i>Rana luteiventris</i>	Yellow - S4	
Long-toed Salamander	<i>Ambystoma macrodactylum</i>		
Northern Leopard Frog	<i>Rana pipiens</i>	Red - S1	E (May 2000) ¹
Pacific Treefrog	<i>Hyla regilla</i>		
Western Toad	<i>Bufo boreas</i>	Yellow - S4	SC (Nov 2002)

Common and Scientific Names, CDC and COSEWIC Status of Dragonflies in the CVWMA.

Common Name	Scientific Name	CDC Status	COSEWIC	Location
Spotted Spreadwing	<i>Lestes congener</i>			Creston
Common Spreadwing	<i>Lestes disjunctus</i>			Creston
Emerald Spreadwing	<i>Lestes dryas</i>			Creston
Lyre-tipped Spreadwing	<i>Lestes unguiculatus</i>			Creston, Creston Marsh
Taiga Bluet	<i>Coenagrion resolutum</i>			Creston
Boreal Bluet	<i>Enallagma boreale</i>			Creston
Marsh Bluet	<i>Enallagma ebrium</i>			Creston, Creston Marsh, Duck Lake
Pacific Forktail	<i>Ischnura cervula</i>			Creston, Creston Marsh, Duck Lake
Sedge Sprite	<i>Nehalennia irene</i>			Creston, Creston Marsh
California Darner	<i>Aeshna californica</i>			Creston, Duck Lake
Lance-tailed Darner	<i>Aeshna constricta</i>	Red - S2		Creston, Summit Creek
Variable Darner	<i>Aeshna interrupta</i>			Creston, Summit Creek
Paddle-tailed Darner	<i>Aeshna palmata</i>			Creston, Summit Creek
Green Darner	<i>Anax junius</i>			Creston, Creston Marsh
American Emerald	<i>Cordulia shurtleffi</i>			Creston, Creston John Bull Mountain

Common Name	Scientific Name	CDC Status	COSEWIC	Location
Hudsonian Whiteface	<i>Leucorrhinia hudsonica</i>			Creston
Dot-tailed Whiteface	<i>Leucorrhinia intacta</i>			Creston, Creston Marsh
Red-waisted Whiteface	<i>Leucorrhinia proxima</i>			Creston
Common Whitetail	<i>Libellula lydia</i>			Creston, Creston Marsh
Twelve-spotted Skimmer	<i>Libellula pulchella</i>	Blue - S3		Creston
Four-spotted Skimmer	<i>Libellula quadrimaculata</i>			Creston
Variegated Meadowhawk	<i>Sympetrum corruptum</i>			Creston, Duck Lake
Saffron-winged Meadowhawk	<i>Sympetrum costiferum</i>			Creston
Black Meadowhawk	<i>Sympetrum danae</i>			Creston, Creston Marsh
White-faced Meadowhawk	<i>Sympetrum obtrusum</i>			Creston, Creston Marsh
Yellow-legged Meadowhawk	<i>Sympetrum vicinum</i>	Blue - S3S4		Creston