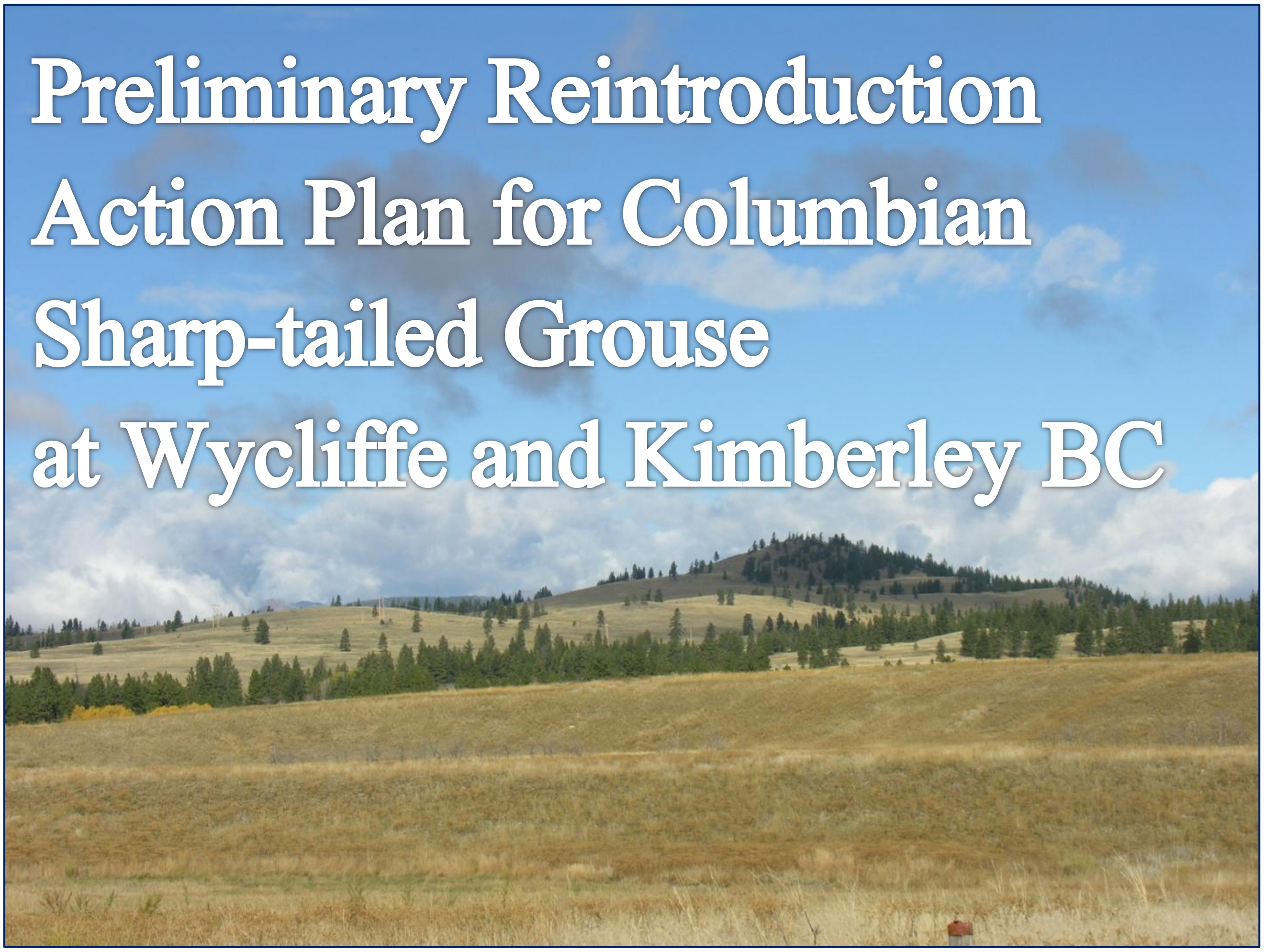
Preliminary Reintroduction Action Plan for Columbian Sharp-tailed Grouse at Wycliffe and Kimberley BC



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1.0 Introduction

The Columbian subspecies of Sharp-tailed Grouse, *Tympanuchus phasianellus columbianus*, was considered to be the most abundant game bird following its ”discovery” by the Lewis and Clark expedition (Yocom 1952). Its historic range extended from central British Columbia south to California, Nevada and Utah and east to western Montana, Colorado, and Wyoming (Schroeder and Tirhi 2003). Columbian Sharp-tailed Grouse declined drastically throughout the twentieth century, however, as a result of massive habitat destruction - bunchgrass prairie was converted to cropland, was over-grazed by cattle, or was lost to urban development (Buss and Dziedzic 1955; Hays et al. 1998; McDonald and Reese 1998; Marks and Marks 1987). In Washington state its decline has been described as “precipitous and extreme” (Warheit and Schroeder 2001). In British Columbia, the subspecies is Blue-listed (Conservation Data Centre 2013) and has been extirpated from the Okanagan and the East Kootenay (Campbell et al. 1990, Cannings 2002, Ohanjanian 2007, 2011). Causes of this include over-grazing by cattle, urban development, flooding of riparian over-wintering habitat and tree ingrowth as a result of fire suppression (IWMS 2004, Northwest Power Planning Council 2001). In the East Kootenay, removal of residual vegetation by over-wintering ungulates has also been identified as having an impact on availability of nesting habitat the following spring (Ohanjanian 2007).

In the early to mid-twentieth century, Sharp-tailed Grouse were common on Wycliffe Prairie as well as at Sharptail Pasture in Newgate, Ta Ta Creek, and near Invermere (Ohanjanian 1990, Farr 1977). In the Wycliffe area alone, at least eight historic dancing grounds were reported (Ohanjanian 1990). The species was apparently abundant and twelve were transplanted to Montana in 1973 (K. Smith, pers. comm.). In 1988, there was a reliable report of seven Sharp-tailed Grouse in Wycliffe (B. Warkentin, pers. comm.). In 1989, concern about the species led to a series of attempts to locate them in their historic locations, with special emphasis paid to previously occupied dancing grounds (Ohanjanian 1990). All historic dancing grounds were inactive, and only three individuals were found at Wycliffe in 1989. A house has since been built 100 m from the detection site. The most recent reliable report of Sharp-tailed Grouse at Wycliffe was in the late 1990s (T. Ross, pers. comm.).

In the area between Ta Ta Creek and Wycliffe Prairie, forest ingrowth advanced rapidly as a result of fire suppression; previously open grasslands became thick dense stands of small Douglas fir and ponderosa pine. Forest ingrowth is estimated to be advancing at a rate of 1% to 3% annually in the East Kootenay (Gayton 1998).

In Invermere, development impacted Sharp-tailed Grouse. The land occupied by a dancing ground on the Invermere access road is now an industrial area.

Further to the south near Newgate, reliable sources reported seeing them in 2000 and 2001 (T. Antifeau, T. Wideski, pers. comm.) near the eponymous “Sharptail pasture”. Follow up surveys utilizing trained pointers were carried out in 2006, but detected only blue grouse. It was concluded in 2007 that habitats in Newgate and at Wycliffe were not adequate and reintroduction was, therefore, not justified (Ohanjanian 2007).

Since that time, several factors have coincided to alter that conclusion and increase the likelihood of success of a Sharp-tailed Grouse reintroduction to the Wycliffe / Kimberley area. These are:

1. The acquisition and consolidation of grassland conservation properties at Wycliffe.

2. Reclamation has occurred on Teck Resources Ltd.’s property in Kimberley, and the company is interested in supporting the reintroduction of sharptails.

3. Ecological Restoration Program (ER). ER is a program undertaken by the Ministry of Forests, Lands and Natural Resource Operations to mitigate the effects of fire suppression on fire-dependent ecosystems, by re-establishing the ecosystem’s structural characteristics, species composition and ecological processes

(BC MFLNRO 2012). This tree removal increases the opportunity for the species to expand to other areas in which they occurred historically, such as Ta Ta Creek.

4. The recognition by the Wildlife Branch that the elk population (both resident and migratory) in the Wycliffe area is high and having an impact on range condition as well as other considerations. This has led to an increase in hunting permits for that area, and a concomitant decrease in elk numbers.

5. The "forest ecotype" (Leupin and Chutter 2007) of Sharp-tailed Grouse could function as a source population for a transplant to the East Kootenay without jeopardy; these birds occupy the cut-blocks of the central interior, have increased in number, and appear to show greater behavioural adaptability than their grassland counterparts (E. Leupin, pers. comm.).

6. Two years of habitat analysis in the Wycliffe area and adjacent Teck lands at Kimberley have led to the conclusion that the habitat could, at this time, support Sharp-tailed Grouse.

What follows is a draft Reintroduction Action Plan to re-establish Sharp-tailed Grouse in the Wycliffe and Kimberley areas. This plan rests on a two year feasibility study that was carried out in 2011 and 2012 to assess habitat quality for Sharp-tailed Grouse at this locale. It includes a brief outline of sharptail habitat requirements, status and habitat condition of proposed release sites, source population and transplant methodology, monitoring, mortality factors, measures of success and timelines[1]. It also includes a synopsis of potential pitfalls and caveats derived from a review of the biological literature and interviews with experts. (A list of individuals consulted is provided in Appendix A).

2.0 Sharp-tailed Grouse Habitat Requirements

Sharp-tailed Grouse require different habitats at different times of the year (Marks and Marks 1987, IWMS 2004, Leupin and Chutter 2007). In spring, male Sharp-tailed Grouse congregate on lek sites (or "dancing grounds") to perform displays that attract females (Connelly et al. 1998). These sites are typically on elevated areas of a grassland such as knolls or ridge tops where they may be seen by visiting females, who arrive to mate (Ritcey 1995, IWMS 2004, Giesen and Connelly 1993). Following mating, the females seek out nesting habitat that is high and dense, usually within 2 km of the lek (Boisvert et al. 2005, Goddard et al. 2009, Leupin and Chutter 2007). Habitats with well-developed perennial bunchgrasses, including bluebunch wheatgrass, *Pseudoroegneria spicatum*, Idaho fescue, *Festuca idahoensis*, and rough fescue, *F. scabrella*, and a high diversity of forbs are favoured by Sharp-tailed Grouse (IWMS 2004, Marks and Marks 1987).

In April and early May the current year's growth is still too low to provide adequate cover for nesting. Therefore, residual vegetation from the previous year's growing season is a vital component of successful Sharp-tailed Grouse nesting habitat and females select for it preferentially (Leupin and Chutter 2007, Meints et al. 1992, Marks and Marks 1987, Goddard et al. 2009, Prose et al. 2002, Connelly 2010). This may be standing upright or be partially recumbent - in the latter case, females will tunnel into it and raise it during nest construction. Minimum residual vegetation heights are at least 25 cm (Meints et al 1992) as females select areas which maximize concealment.

Reproductive success is positively correlated with higher and denser nesting habitat (Goddard et al. 2009, Leupin and Chutter 2007, Manzer and Hannon 2005). Five of six nests found in the Kamloops area were located in dense stands of climax grasses and herbs, which included rough fescue, bluebunch wheatgrass, and arrowleaf balsamroot. The mean height at nests was 36 cm (range 27 – 45) (Leupin 2003). Marks and Marks (1987) found

[1] For more detailed life history and other information please refer to Leupin and Chutter (2007) and Stinson and Schroeder (2010)

that grouse chose sites with significantly higher arrowleaf balsamroot than that found in random plots. That forb is particularly abundant in Wycliffe and on Teck's native grassland sites (see below).

Both males and females spend the summer in habitat with good cover, with broods often occupying shrubby areas and sites with abundant insects. Long travel distances decrease the survivorship of Sharp-tailed Grouse chicks (Goddard and Dawson 2009). In the fall, males again may gather on leks, however the females do not arrive, and displays are limited and less intense.

Spring to fall home range sizes (spring to fall) are generally between 75 and 187 ha (Boisvert 2005, Marks and Marks 1987, Giesen 1997;cited in Boisvert 2005). In the winter, Sharp-tailed Grouse depend on riparian or montane shrub communities, where they feed on water birch, saskatoon, snowberry, chokecherry and other shrubs. In some low snow years, they have been reported feeding on alfalfa Water birch is used extensively in cold winters (Leupin and Chutter2007).

The juxtaposition of these different habitats is important, females typically nest within 1.5 to 2 km of dancing grounds (Leupin and Chutter 2007, Boisvert 2005, Marks and Marks 1987). Several authors report that typical movements to over-wintering habitats were < 5 km from leks (Marks and Marks 1987, Giesen 1987, cited in Giesen and Connelly 1993), with reports of maximum distances of 20 km and 10 km (Meints 1991, Ulliman 1995, respectively). These and other observations led to recommendations in a Habitat Suitability Index that over-wintering habitat should ideally be within a 6.5 km radius from breeding areas (Meints et al. 1992). Boisvert (2002) however, found that Sharp-tailed Grouse moved further. In her Colorado study, 87% of radio-marked birds wintered more than 10 km from where they were trapped (median 21.5 km, range 3.1− 41.5 km, n = 30) despite abundant suitable wintering habitat near breeding sites. To assess availability of over-wintering habitat, a conservative value of 7 km radius from breeding areas has been used.

3.0 Status and Habitat Condition of Proposed Release Sites

3.1 Overview

The study area is in the East Kootenay Trench Eco-section (Demarchi 1996), approximately 15 - 20 km north of Cranbrook. It is located in the PPdh2 (Dry Hot Ponderosa Pine Variant) and the IDF dm2 (Kootenay Dry Mild Interior Douglas Fir Variant) Biogeoclimatic subzones (Braumandl and Curran 1992). Elevation ranges from 850 m to 1050 m and the climate is dry, with hot summers, mild winters and low snow accumulations (Braumandl and Curran 1992). Annual precipitation is only 35 cm with most of the rain falling in June (Kemper 1971). It is a mixture of climax grasslands and forest – with the latter dominated by Douglas fir and ponderosa pine. In addition, there is a large area (approximately 9,000 ha) of reclamation lands owned by Teck Resources Ltd. (hereafter "Teck") with a small (20 ha), native grassland knoll in the centre of the reclamation area. The St. Mary River runs along the study area in the south with a healthy, well-structured deciduous riparian community.

To evaluate the feasibility of reintroducing Sharp-tailed Grouse we assessed quality, quantity and spatial arrangement of lekking, nesting/brood-rearing and wintering habitats in the Kimberley and Wycliffe areas. This assessment took place over two years (2011 & 2012)[2] and included conservation properties owned by Nature Conservancy Canada (Upper and Lower Lone Pine Hill, DL 11608, 6629 & 11607) the Land Conservancy (TLC) Skeet Grassland, DL 7009), and the province of British Columbia (Porteous Butte, DL 6667, 6034 & 7318), as well as crown land, reclamation lands and the grassland knoll owned by Teck Resources Ltd. in Kimberley (Figures 1 & 2).

[2] NOTE: All results and recommendations pending ocular review of residual vegetation in 2013 and comparison with photoplots

Figure 1. Wycliffe Conservation Lands (*after MoE 2012*.)

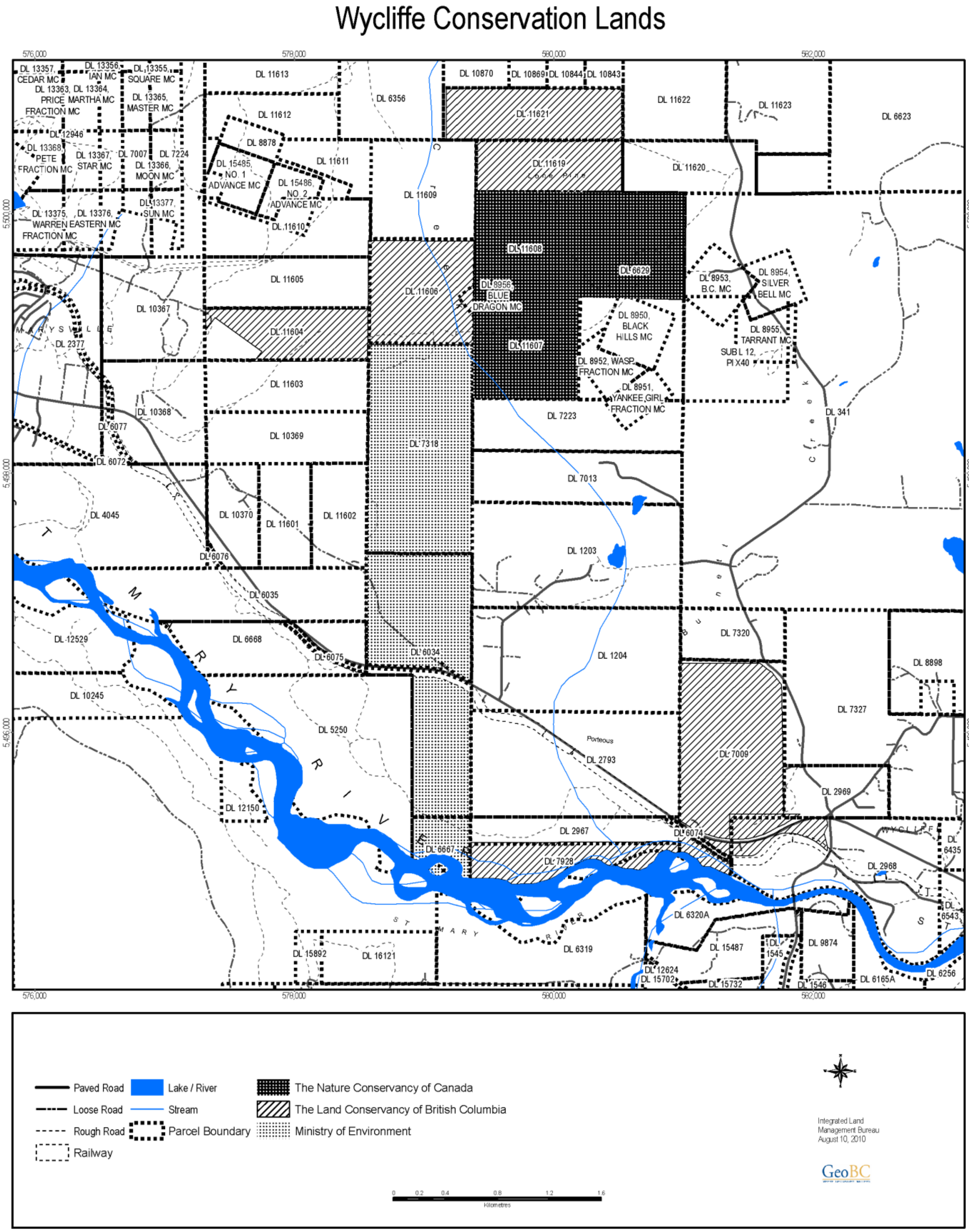
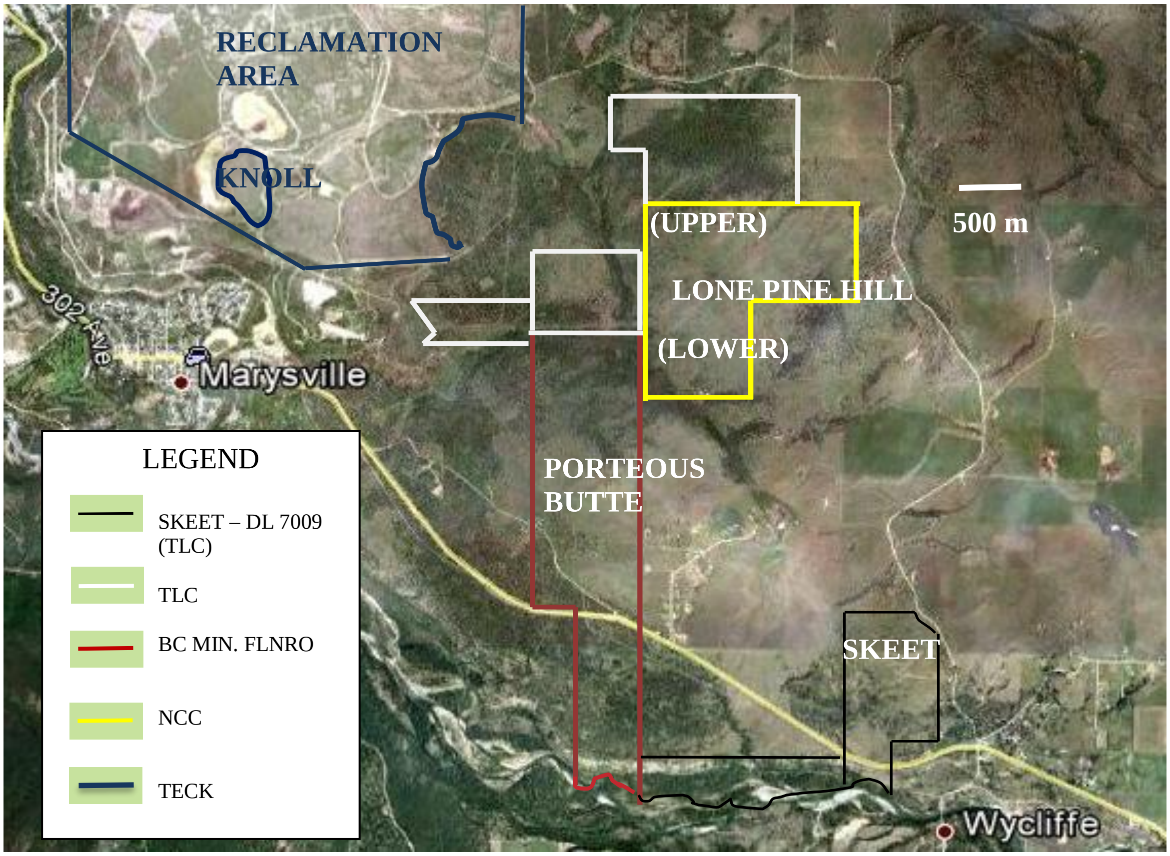


Figure 2. Conservation properties and Teck lands at Wycliffe and Kimberley (*PRELIM. MAP)*



Vegetation on the grasslands in the study area is characterized by bunchgrasses, including Idaho fescue, *Festuca idahoensis*, rough fescue, *F. scabrella*, and bluebunch wheatgrass, *Pseudoroegneria spicata* (formerly *Agropyron spicatum*) (Stewart and Hebda 2000). Forbs observed on vegetation plots in 2011 and 2012 were diverse, ranging from 8 to 17 species per plot (Figure 3). The most frequently occurring forbs were arrowleaf balsamroot, *Balsamorrhiza sagitatta*, and silky lupine, *Lupinus sericeus*, both forbs that provide good cover for Sharp-tailed Grouse (Marks and Marks 1987). Other forbs included gromwell, *Lithospermum ruderale*, Pacific anemone, *Anemone multifida*, hairy golden aster, *Chrysopsis villosa*, mariposa lily, *Calochortus macrocarpum*, western yarrow, *Achillea millefolium,* rosy pussytoes, *Antennaria microphylla*, dandelion, *Taraxacum officinale*, nine-leaved desert parsley, *Lomatium triternatum*, shaggy fleabane, *Erigeron speciosus*, sulphur buckwheat, *Eriogonum umbellatum*, and the invasive, sulphur cinquefoil, *Potentilla recta*.

Vegetation on the reclamation lands is dominated by stands of alfalfa, *Medicago sativa*, crested wheatgrass, *Agropyron cristatum*, and other, non-native grasses. The alfalfa is not harvested nor irrigated; it becomes very tall and dense in June, and dries out and dies back during late summer.

Montane shrubs on the grasslands and in the reclamation areas show signs of heavy browsing by ungulates. The main species are chokecherry, *Prunus vulgaris*, prickly rose, *Rosa acicularis*, snowberry, *Symphoricarpos albus*, birch-leaved spirea, *Spirea betuilfolia*, and saskatoon, *Amelanchier alnifolia*. Teck has also planted non-native caragana, *Caragana arborescens* behind ungulate-proof fencing as well as the ornamental, Russian olive, *Eleagnus angustifolia.* Native shrubs planted as part of the reclamation failed to establish due to ungulate pressure (D. Ryder, pers. comm.)

Riparian shrubs show vigorous growth along the St. Mary River and to the north, along Luke Creek. Species include water birch, *Betula glandulosa,* chokecherry, black hawthorn, *Crataegus douglasii,* aspen, *Populus tremuloides* and willow, *Salix spp*.

Figure 3. Diverse forb and grass community – Teck grassland knoll, 2011

3.2 Habitat measurements and assessment

3.2.1 Methods

The study area was first stratified into native bunchgrass habitats, reclaimed grass/forb communities, open forest, closed forest, and riparian areas. Open and closed forest habitats were removed from the analysis unless they contained a significant deciduous component for over-wintering habitat. Habitat at five areas on the conservation properties and at Teck was then stratified based on grouse nesting attributes using a reconnaissance level survey (Figure 2). This consisted of site visits during which all areas were walked and general condition of the existing plant communities (EPCs) determined by ocular estimate of percent foliar cover for each vegetation layer - shrubs, forbs and grass. [3]

Vegetation cover and species composition was quantified using a Daubenmire frame (n = 50 plots per site). Data, including species lists, percent cover and percent frequency are presented in Appendix B. Polygons were delineated on forest cover maps and ranked as low, medium or high value for Sharp-tailed Grouse nesting. The

[3] In 2011, vegetation plots were randomly placed. Although the use of randomly placed transects provided science-based, detailed information, it did not "capture" potential habitats that a grouse might detect and occupy - areas that may have been avoided, or missed by over-wintering elk and therefore had residual grasses and forbs. To address this and complete the assessment additional, non-random sampling was carried out in 2012 and provides the basis of this habitat evaluation.

final determination of suitable reintroduction sites (including non-vegetative considerations) was based on the following:

1.	% RESID	Presence of residual vegetation in spring (ocular estimate)
2.	% COVER	Percent cover calculated using Daubenmire frame (> 75%)
3.	RANGE CONDITION	(Good to excellent)
4.	DIVERS.	Plant species diversity (high diversity)
5.	PROX.	Proximity of nesting, brood rearing habitat to lek (< 2 km away)
6.	DIST TO WINT.	Distance to over-wintering habitats (< 6.5 km)
7.	HUM DISTURB.	Quantity of human disturbance (minimal access, no vehicular access).
8.	EXP. OPIN.	Expert opinion of Sharp-tailed Grouse researchers Ernest Leupin and Doug Jury.

Data were then compared with the Sharp-tailed Grouse literature. The five sites were ranked for each variable and the most suitable release site(s) determined.

3.2.2 Results of habitat assessment

Lekking habitat

Lekking habitat, in the form of elevated knolls or ridge tops, was not a limiting factor. It was available at all conservation properties and at the Teck grasslands, and it also occurred within 2 km of nesting habitat.

Residual vegetation and nesting habitat

Wycliffe is an important winter range for elk. Residual vegetation (primarily bunchgrasses) has been removed by heavy winter ungulate grazing in past years (Ohanjanian 2006). In 2011, data from plots on randomly placed transects appeared to show that spring residual vegetation on grasslands and reclamation lands was inadequate for nesting (Ohanjanian 2011). This was re-assessed in 2012, however, when new information was received[4].

When areas were targeted for assessment as potential grouse nesting habitat in 2012, residual vegetation was found to be present at those locations. For example, residual vegetation in Figure 4 is largely recumbent, but it is abundant and adequate for Sharp-tailed Grouse nesting at the lower elevations slopes of Porteous Butte. It was also available at Upper Lone Pine Hill and at Skeet grassland (Figures 5 and 6).

At the Teck Grassland Knoll there was evidence of high elk use and residual vegetation was inadequate in 2012 (E. Leupin, pers. comm.). On the reclamation areas, residual vegetation was highly variable; some remnant alfalfa along with crested wheatgrass could potentially provide good concealment. The latter lacks nutritional value for ungulates in winter (USDA 2000), is less likely to be eaten off in winter, and therefore could provide structure in the spring.

In 2013, residual vegetation will be again assessed at all sites and compared with photoplots from previous springs and the fall.

[4] In 2011 a grouse vision board and stadia rod (Robel pole) had been used to quantify remnant grasses (after Marks and Marks 1987). This was abandoned in 2012 when it was learned that recumbent residual grass is also utilized by female grouse - they tunnel into it during nest construction and hide their eggs underneath (E. Leupin, pers. comm.). The grouse vision board and pole only measured vertical cover, thus underestimating the nesting habitat that was available in 2011.

Figure 4. Recumbent residual vegetation at Porteous Butte (above). Photo demonstrating inapplicability of vision board as a measuring tool for residual vegetation at the same site (below).

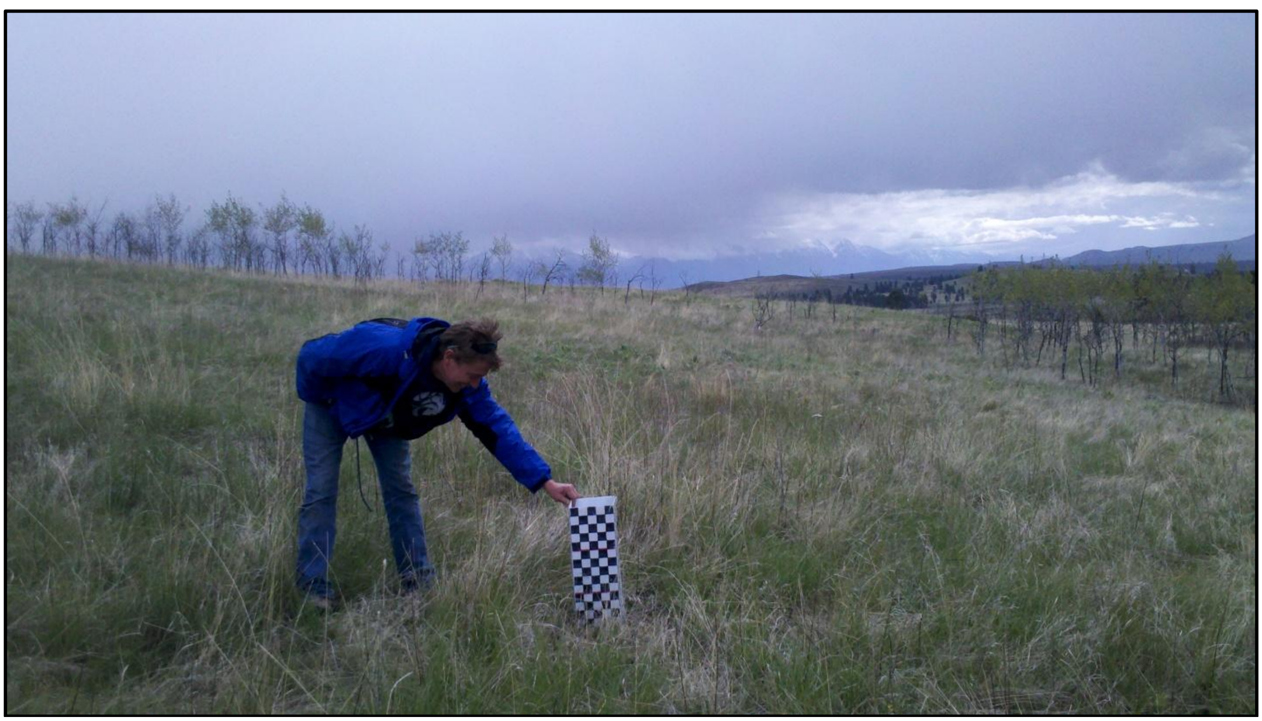


Figure 5. Residual vegetation on upper Lone Pine Hill in 2012.

Brood-rearing habitat

As May advances, the current year's growth proceeds and this provides ever-increasing cover throughout incubation and subsequent brood-rearing. In 2011 (all sites combined) sampling indicated that cover values were only moderate in late June (mean = 63.1%, range 52.6% to 71.4%). In 2012, however, with targeted sampling of what appeared to be good Sharp-tailed Grouse habitat, overall values were higher (Table 1).

Table 1. Mean percent cover at five potential reintroduction sites, Aug 2012 (n=50 plots per site).

	Porteous Butte	**Skeet Grassland**	**Lone Pine (Lower)**	**Lone Pine (Upper)**	**Teck* Knoll**
Total Grass and Grass-like	46.7	62.7	36.0	56.0	45.6
Total Forbs	12.9	16.0	22.6	11.8	14.4
Total Shrubs	2.8	2.2	3.2	2.9	6.6
Total:	**62.4**	**80.9**	**61.8**	**70.7**	**66.6**
Total trees	5.6	2.6	10.6	7.4	3.1
Total litter	74.8	83.9	64.7	87.6	71.5
Average hgt (cm)	32	34	31	38	No data
Elk feces	0.3	0.5	0.1	0.1	1.4

*Note: data from 2011

Non-forested vegetative cover was highest on Skeet Grassland (DL 7009) and on the upper flanks of Lone Pine Hill, with total values of 80.9% and 70.7%, respectively. In addition, litter (which is an indirect measure of range condition) was highest on the two sites (83.9% and 87.6%), as was average height (34 and 38 cm).

Good potential Sharp-tailed Grouse habitat at Skeet Grassland (DL 7009) is shown in Figure 6. Healthy rough fescue is visible in the foreground while a potential lek site is present on the raised ridge in the background.

Figure 6. Rough fescue in foreground, abundant residual in mid-ground, and lekking habitat (knoll) in background at Skeet Grassland (DL 7009). (Photo taken on May 25, 2012)

By the brood-rearing period, alfalfa on most of the Teck reclamation lands becomes a solid wall of plants that would greatly restrict brood movements. It is largely monotypic (Sharp-tailed Grouse require high plant species diversity (Boisvert 2002)), and cannot yet be considered a functioning ecosystem. Soil structure is still undeveloped and there are no data on abundance of insect prey for chicks (Figure 7).

However, more structurally diverse grassy areas that are on the edges of these stands could potentially be occupied, with the dense alfalfa used as cover (A. Goddard pers. comm.). While it cannot be recommended as a reintroduction site, it will be interesting to observe the extent to which reintroduced grouse utilize this reclamation, especially along edges where diversity is higher and native grasslands are close by.

Figure 7. Vegetation structure of Teck reclamation land during brood-rearing period. Note low species diversity.

Over-wintering habitat

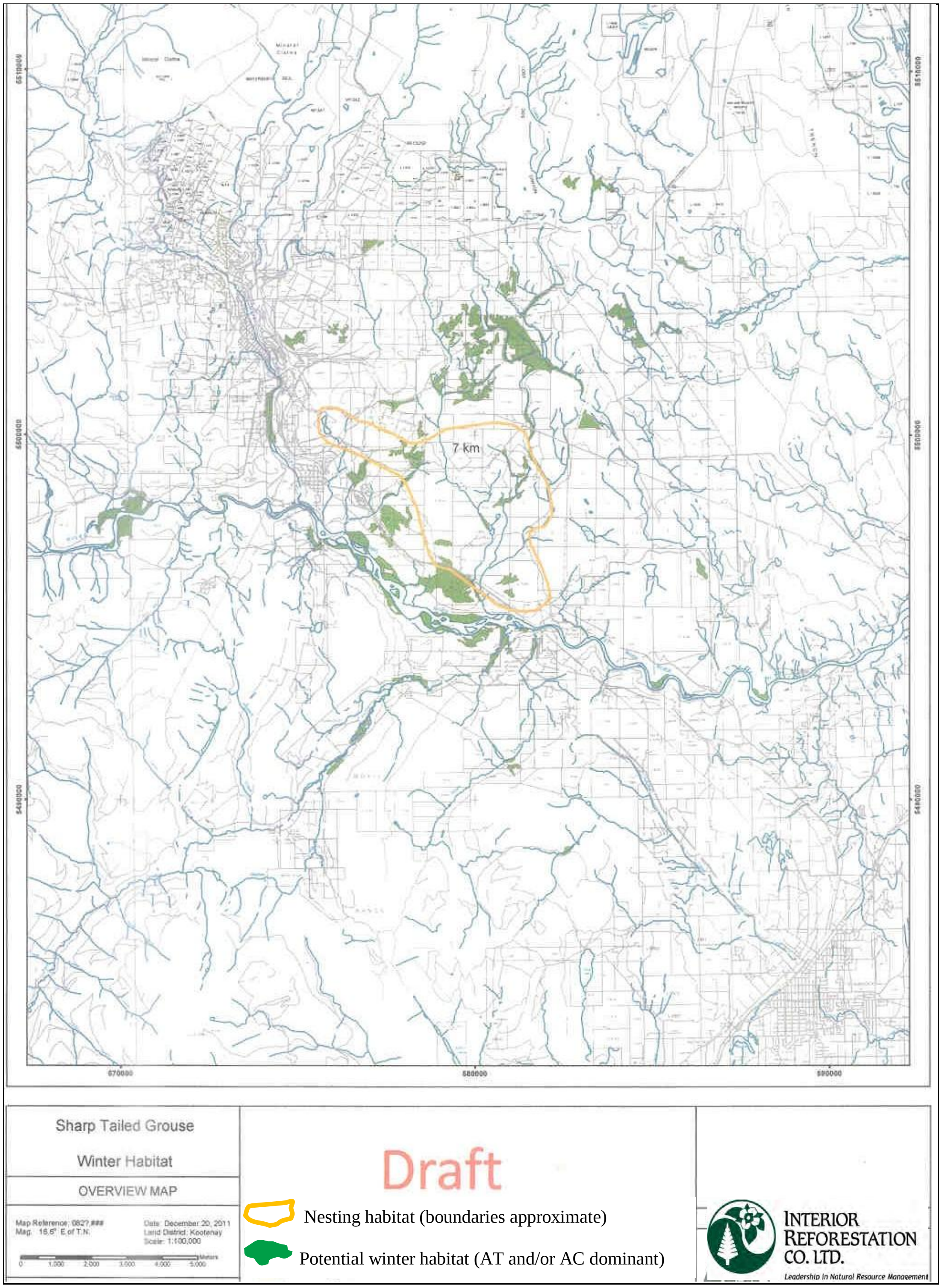
There are approximately 1088 ha of aspen and/or cottonwood dominated stands[5] within 7 km of the potential nesting habitat (Figure 8). If we include stands where aspen or cottonwood are subdominant (i.e. a component of the forest unit) an additional 1588 ha may be added to this. As these values are derived from forest-based Vegetation Resource Inventory (i.e. forested polygons), additional small shrub stands that would not appear on the mapping are not included. This would include roadside stands of species such as chokecherry that are found throughout the study area.

Good quality riparian shrubs occur less than 2 km away, along the St. Mary's River and Luke Creek. Those stands contain a diverse shrub community, including water birch, chokecherry, and rose. Water birch, a preferred food when winters are harsh (E. Leupin, pers. comm.), is particularly abundant on the Teck property to the north of the grasslands. There are also some aspen-dominant stands with a dense understory of rose and snowberry in the reclamation area.

Montane shrub communities are more limited. Small aspen copses with understories of snowberry and rose are scattered on the conservation lands at Wycliffe. Chokecherries are found along roadsides and on the Skeet grassland, in particular. On the Teck lands the effect of ungulate grazing on saskatoon and other shrubs planted as part of the reclamation program has been extreme. Shrubs have been stunted, with few plants taller than 30 to 40 cm. Without protection from elk and deer these shrubs will not become vigorous nor provide significant over-

[5]The two species in the stand add up to > 50% of the species

Figure 8. Aspen and/or cottonwood-dominated stands within 7 km of potential nesting habitat



wintering habitat for Sharp-tailed Grouse. In 2011 and 2012, Teck planted non-native shrubs, caragana and Russian olive. The latter are known to be a food resource for Sharp-tailed Grouse (ref) and caragana will provide good cover (D. Ryder pers. comm., Merrill 1941). These plantings have been protected from elk and deer browsing.

3.3 Other considerations

Human disturbance

Human disturbance can negatively impact the lek (Stinson and Shroeder 2010). Baydack and Hein (1987) found that males and females responded differentially - males left when humans were present, but returned later, while females did not visit the lek and failed to mate. This can have serious implications. Dogs can flush grouse from cover and this could lead to higher predation levels. Upper and Lower Lone Pine Hill, the Skeet Grassland and the Teck Knoll have lowest human visitation due to road closures, and gates. Porteous Butte is a popular hiking area for people with their dogs.

Potential contaminants

The Teck Grassland Knoll is an elevated site located near a fenced Acid Rock Drainage pond from which water gets pumped underground to a treatment plant. Ecotoxicological work is being carried out at present to identify potential pathways of concern. Results from that study will inform actions on the Teck lands when analyzed and compiled this spring.

3.2.4 Ranking of potential Sharp-tailed Grouse reintroduction sites.

A matrix with weighted attributes (1 = low, 2 = mod, and 3 = high) is shown below (Table 2). The highest totals represent those sites with the best pooled habitat characteristics.

Table 2. Weighted matrix of habitat parameters for conservation areas at Wycliffe[6]

ATTRIBUTE	UPPER LONE PINE HILL	LOWER LONE PINE HILL	SKEET GRASSLAND	PORTEOUS BUTTE	TECK KNOLL
RESIDUAL VEG	3	1	3	3	2
% COVER	3	1	3	2	3
RANGE CONDIT.	3	1	2	2	3
SP. DIVERSITY	3	3	3	3	3
PROXIMITY	3	2	3	2	3
DIST TO WINTER	3	3	3	3	3
HUMAN DISTURB.	3	2	3	1	3
EXPERT OPINION	3	1	3	2	2
Total:	**24**	**14**	**23**	**18**	**22**

[6] Although the Teck reclamation lands have some valuable attributes, they are not included here as Sharp-tailed Grouse response is not known.

This analysis shows that two sites, Upper Lone Pine Hill and the Skeet Grassland, have the best attributes for reintroducing Sharp-tailed Grouse (Figure 2). They had the best residual vegetation, best range condition, and least human access. The Teck knoll is next in rank, however residual vegetation was marginal in 2012. Other attributes of that site are very good, however, and methods to deter elk, including aversive conditioning, should be examined. Porteous butte is not recommended as a reintroduction site because of high human activity. Lower Lone Pine Hill was also not recommended as it had poorest range condition, residual and cover values.

4.0 Source population, genetic and behavioural considerations and minimum viable population (MVP)

Recent DNA work on Sharp-tailed Grouse has shown that genetic distinctions between the Columbian and the Plains subspecies are less than previously thought, and that the continental divide is not a clear barrier to gene flow between populations in the US (Warheit and Dean 2009). Nevertheless, evidence from a small sample of museum specimens in Cranbrook has indicated that the subspecies that occurred historically were the Columbian subspecies of Sharp-tailed Grouse (Warheit and Dean 2009) and the birds from the potential source population are also the Columbian subspecies (Warheit and Schroeder 2003, Spaulding 2006).

Sharp-tailed Grouse in British Columbia occur in two distinct “ecotypes” the “grassland” and the “forest” ecotype (Leupin and Chutter 2007). While the grassland ecotype occupies grasslands primarily in the Thompson / Nicola areas, the forest ecotype occupies open areas created by large-scale harvesting or stand-replacing fires. To a lesser degree, the forest ecotype lives in climax grasslands adjacent to forests and sedge meadow complexes (Leupin and Chutter 2007). The present understanding is that the source population will be forest ecotype birds from the area around 70-mile house and north (D. Jury, E. Leupin, P. Dielman pers. comm.). Preliminary reconnaissance visits of known leks are planned for 2013, to confirm they are still occupied and to assist in pre-planning the reintroduction.

The rationale for using the forest ecotype for the translocation is as follows:

- **Abundance.** The forest ecotype is more abundant than the grassland population (Leupin and Chutter 2007); the former appeared to expand its range and increase in number in response to large clear cuts from salvage logging of trees infested by the mountain pine beetle (Ritcey 1995).
- **Population stability.** In the years between 1995 and 2006, forest ecotype Sharp-tailed Grouse appeared to be stable[7]. There is little data and only anecdotal information on population trends since, but it is believed that the forest ecotype can be expected to continue to respond positively to ongoing salvage logging (Leupin and Chutter 2007, P. Dielman, pers. comm.).
- **Hypothesized population surplus.** There is some thought that there may be a surplus of birds (E. Leupin, pers. comm.); the numbers of grouse are currently or will be greater than the carrying capacity of the environment when forest succession reduces size of openings and fragments that population.
- **Behavioural adaptability.** The forest ecotype demonstrates a certain plasticity in habitat choice in their response to massive clear cuts. Recent thought on phenotypic plasticity suggests that, by responding very rapidly to changing environments, different behavioural features can provide certain individuals with energetic benefits and improved fitness (Piersma and van Gils 2011, Dingemanse and Reale 2005). The forest ecotype has demonstrated its behavioral plasticity in its response to the large scale clear cutting. There is also anecdotal information that the forest ecotype birds exhibit less overt stress responses than the grassland ecotype and are also likely more adaptable (E. Leupin, pers. comm.)
- **Behavioral adaptability especially suited to East Kootenay situation.** The population expansion experienced by the forest ecotype Sharp-tailed Grouse in response to the opening of pine forests may be analogous to a similar population expansion in the East Kootenay. Here, very large open areas were

[7] These numbers are based on the assumption that lek attendance is a valid surrogate for population trend sampling

created by fires in the 1920s and 1930s in the Rocky Mountain trench (Demarchi 1971). During the 1940s and 1950s, Sharp-tailed Grouse became extremely common in response to this (L Cannings, pers. comm.). As a result of fire suppression, however, tree ingrowth advanced and Sharp-tailed Grouse habitat became highly fragmented and restricted to the relic grasslands of today. I would suggest that historically the East Kootenay birds would have had an irruptive expansion of their range when large scale, stand-replacing fires created habitat – this is similar to the responses of the forest ecotype birds of central BC. Furthermore the forest ecotype is more adaptable, utilizing grasslands as well as open forest environments. This may allow them to expand onto other sites that are not climax grassland, but that have very low stem density from Ecosystem Restoration.

- **Successful transplants.** The forest ecotype has been successfully transplanted before.

Minimum viable population

A general definition of minimum viable population (MVP) provided by Stinson and Schroeder (2010 is “the smallest size at which populations can maintain genetic variability over time. It also relates to the ability of a population to withstand fluctuations in population and recruitment associated with annual variation in food supplies, predation, disease and habitat condition”. Within that population (*N*) only some individuals pass genes on to the next generation, with the result that the effective population size (*Ne*) is actually smaller yet. Although it would seem to be germaine to population recovery, the calculation of this value is highly speculative and can be fatally flawed. For example, one model of sharptails used to calculate probable population viability (and therefore, likelihood of persistence) assumed one male would fertilize 10 females (Akacaya et al. 2004). Genetic work on other lekking gallinaceous birds, including the closely related Greater Prairie Chicken, *Tympanuchus cupido*, and Greater Sage Grouse, *Centrocercus urophasianus*, has shown that females may mate with numerous males on the lek (Hess et al. 2012, Semple et al. 2001). This decreases loss of genetic variability and increases the *Ne*, thus illustrating the problems with the validity of modelling. Nevertheless, with more data on population dynamics of Sharp-tailed Grouse, a general MVP could theoretically be calculated based on general principles of conservation biology and a recognition that stochastic events (such as weather and disease) could alter the findings. Such an analysis is beyond the scope of this paper, but will be discussed by the Scientific Advisory Team.

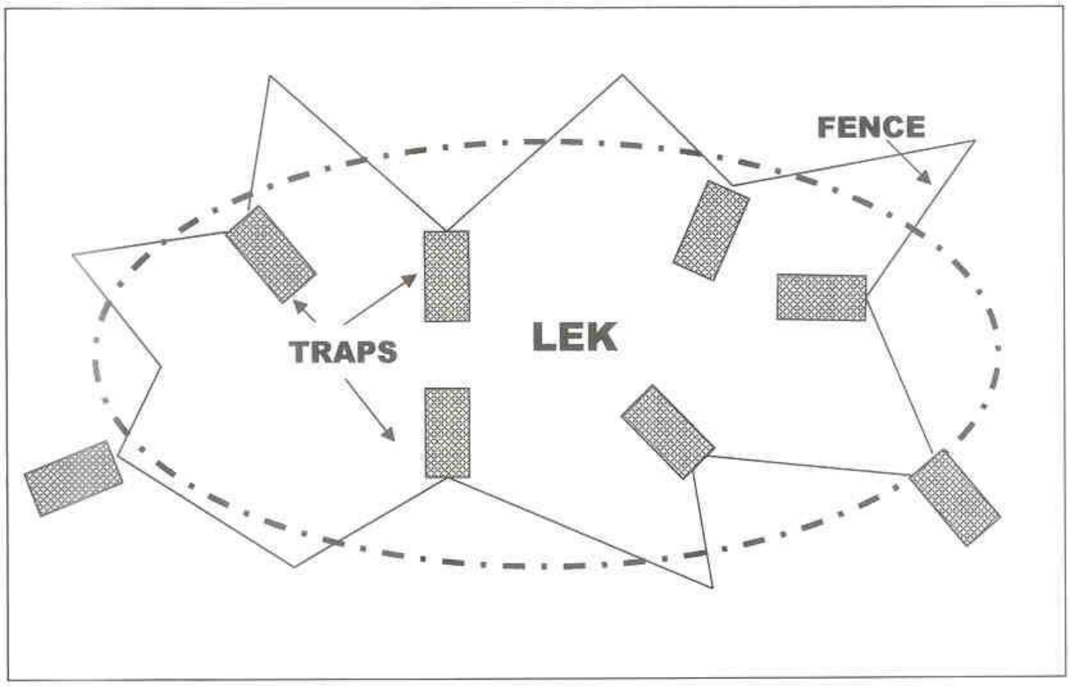
In the meantime, numbers of birds to be trans-located over 2-3 years is approximately 100-120 (see below). Whether these would reproduce and represent a viable population over the long term without additional augmentation in south eastern British Columbia is not known, and future augmentation may be required to increase genetic variability.

5.0 Transplant methodology

5.1 Trapping and Transport

The general methodology and procedure for trapping Sharp-tailed Grouse for translocation will follow published accounts of Schroeder and Braun (1991), Leupin (2001) and Boisvert (2005), who all used walk-in traps. In addition, a biologist with trapping experience will be “on the ground” to supervise activities and determine sex and age of trapped individuals (after Amman 1947 and Henderson et al. 1967). Traps will consist of a wire drift fence and funnel trap array (see Appendix C. for list of materials). One example of a successful configuration is shown in Figure 9.

Figure 9. Stylized representation of a trap array used successfully to capture Sharp-tailed Grouse (after Leupin 2001).



Males arrive on dancing grounds before the females in spring (Boisvert et al. 2005). Two people will be present at each dancing ground, hidden in a blind or observing out of site with spotting scopes. They will determine departure and arrival directions of grouse attending the lek prior to setting up a trap array. At the onset of dancing (early April) a wire fence with funnel traps will be placed around two? five? dancing grounds and left un-opened on site to habituate the birds to their presence. Coates and Delehanty (2006) showed that females captured later in the lek-visitation period, were more likely to be inseminated and more likely to nest upon release. Therefore, traps will be opened after females have been observed visiting the lek for several days to one week. They will be positioned facing outward or neutral as capture rates were lowest when pointed in (Schroeder and Braun 1991).

A preliminary goal of 80% females and 20% males will be set to maximize the numbers of chicks produced (E. Leupin, pers. comm.). (This may be altered after discussion by Scientific Advisory Team). About 120 birds will be captured and translocated to Upper Lone Pine Hill and Skeet Grassland (approximately 30 birds per site) over two years. This number is based upon an examination of multiple translocation projects carried out by Synder et al. (1999). The authors found that those projects that released more than 100 grouse were 8.8 times more likely to succeed than projects in which fewer grouse were released (see Table 4, below). However, excessive numbers are not good – Sharp-tailed Grouse leks usually have < 25 birds displaying (Sisson 1976, cited in Rodgers 1992), and too large a number of released birds may fail due to social instability (Rodgers 1992, Griffith et al. 1989)

When trapping commences, field personnel will remove birds every 30 to 45 minutes. As males will fight when two are caught in the same trap (E. Leupin, pers. comm.), they will be removed immediately. In addition, if a predator such as a red-tailed hawk or coyote is observed nearby, the trapped grouse will be removed straightaway. Upon capture, birds will be sexed, weighed, measured, colour-banded and outfitted with a Holohil 15 g RI-2B(M) necklace-style transmitter (Goddard et al. 2009). Blood samples will be taken for subsequent genetic analysis and birds will then be placed in a dark box to minimize stress. Captured grouse will be driven to the release site daily (estimated 10 to 12 hours travel time) for release the next morning. Prior to release, transmitters will be tested.

5.2 *Release method*

Translocation projects incorporating a soft-release method are 3.1 times more likely to succeed than those in which hard-release techniques were used (Snyder et al. 1999). Soft release incorporates the use of recordings and decoys of displaying males on the lek (Rodgers 1992). Boxes will be opened prior to first light to allow personnel to return to the blind and be out of sight when the grouse are able to see. At least one biologist with transplant experience will be present to oversee this aspect of the project.

5.3 *Anticipated death and injury*

Some mortality or injury of birds is possible during the transplant itself. With care and preparation this can be avoided or at least minimized. Haukos et al. (1990) reported that they had low mortality (0.4%) with Lesser Prairie Chickens, using walk-in traps. Schroeder and Braun (1991) had higher mortality of 3.5% of captured Greater Prairie Chickens (eight birds). The authors point out, however, that seven of these fatalities were the result of insufficient monitoring; sources of mortality included predation, heat stress and intraspecific fights inside traps. As stated above (section 5.1) crew will be aware and attentive to these possibilities, and act preventatively. Other sources of mortality, including post-release dispersal, are described below (Section 7.0)

5.4 *Personnel*

Depending on distance between leks, more than one trap array can be managed at once. Two people will be needed to set up. Two people per lek are required to constantly observe and remove birds from traps and one person needed to move from lek to lek and "collect" birds. Two drivers must be used to move birds to the East Kootenay as this will allow them to alternate and thus reduce the times birds will be held in captivity. At the release site, two more individuals will be required. At least one biologist with transplant experience will be at both capture and release sites.

5.5 *Transplant decision summary*

A summary of transplant decisions, their rationales and sources is presented in Table 3.

Table 3. Overview of transplant decisions - their rationales and sources

Decision	Rationale	Source
Source population is "forest ecotype" birds from cutblocks in central interior	• More abundant than grassland birds • May become over-populated as forest habitat grow in. • Appear behaviourally more adaptable than grassland birds • Have been reintroduced successfully to grassland habitat at in BC • Cut-block habitat mimics EK historical expansions and contractions of grasslands in response to fire	Leupin and Chutter 2007 E. Leupin, D. Jury pers. comm.
Translocate for multiple years (2-3)	• More likely to succeed	Griffith et al. 1989 Coates et al. 2006

		Snyder et al. 1999
Timing: in spring, on leks	• Birds congregating on leks • Fall / winter transplants have failed	Snyder et al 1999
Timing – after female visitation for 4-7 days	• More likely to be inseminated • More likely to nest • Females visit leks for several days before copulation	Coates and Delehanty 2006 Landel 1989
80% female 20% male	• Increase number of chicks produced	E. Leupin*
Approx. 120 birds	• Optimum number	Rodgers 1992, Coates et al. 2006
Release birds in good nesting habitat, not good lekking habitat	• Male and female post-release movements are different – females seek out nesting habitat so releasing there dampens female movements	Coates et al. 2006
Soft release	• Translocated males more likely to display if other males are present • Soft release found to be 3.1 times more likely to succeed.	Rodgers 1992 Snyder et al. 1999
Release in dark, 1 hr before dancing time	• Allows crew to retreat to observation posts • Should decrease stress as no visual on human	Experimental
Use movement patterns from first year to select release site(s) in second and third year, and change location if indicated.	• Grouse recognize best habitat • Release sites based on movement patterns substantially reduced post-release movement by females and promoted nesting near the release area and population establishment	Coates et al. 2006

*Expert opinion, however, this may be altered after discussions by Scientific Advisory Team

6.0 Post-release tracking and monitoring

Radio-tracking of transplanted grouse is a vital component of this project. Not only will it provide a measure of success, but will also inform grouse release locations in Year 2. Coates et al. (2006) argue that grouse themselves will select the best habitat - by choosing release sites based on movement patterns, the authors substantially reduced post-release movement by females and promoted nesting and population establishment.

Study design and intensity of monitoring will be determined in late summer of 2013 after discussions by the Scientific Advisory Team and consultations with US researchers. A detailed study design will be developed prior to transplant. As the battery life of transmitters is generally two years and possibly up to three (A. Goddard, pers. comm.), it is expected that monitoring using radio tracking will continue until 2017 or 2018. Radio-equipped grouse will be tracked on the ground using a 3 - element Yagi antenna and a Telonics or Lotek receiver, as well as via small aircraft. "Loudest signal" method will be used, sources of bias and error will be identified (Springer 1979).

Decisions to be made by the scientific team include, but are not limited to, the following:

i. What questions need to answered? What data will be collected? A minimum should include movement, habitat use, and survival/persistence. Other questions include productivity, sources of predation, etc

ii. What is best sample size for surveys? Cope (1992) located grouse up to four times per day. Coates and Delehanty (2006) located them one to three times per week for 160 - 200 days. If females were found repeatedly in the same location, this suggested incubation.

iii. Should efforts be made to locate nests (flush hens)? A cost/benefit analysis of this action should be a point of discussion for the Scientific Advisory Team. Observer visitation at sage grouse nests was not found to be a significant factor in nest failure (Nonne et al. 2012) and was successfully carried out with Sharp-tailed Grouse by Goddard (Goddard et al. 2009). If the female is not present for three days, visit the nest to determine status (abandoned, depredated or hatched)

iv. Calculate a Geographic Activity Centre using UTM coordinates to determine grouse persistence at release sites and elucidate movements away. Cope (1992) described two types of post release movements – the first, which he attributed to exploration of the Tobacco Plains, were very long (>1000 m) and a post-adjustment period, when daily movements became less than 1000 m.

v. Determine spring to fall home range size using 95% fixed kernel (FK) estimator (Worton 1989; Boisvert 2002).

vi. Determine where Sharp-tailed Grouse over-winter.

vii. Compare habitat in areas of use with areas of non-use as determined by sampling in random locations.

viii. Count numbers of males re-visiting lek in 2015 and locate new one(s).

ix. Set targets for minimal viable population

7.0 Sources of mortality

7.1 Weather

Gallinaceous birds have precocial chicks. Their survival is highly connected to weather conditions from both a thermo-regulatory perspective and from the perspective of insect prey availability. Inclement weather that occurs during the first week post-hatching negatively influences survival of young Sharp-tailed Grouse chicks (Goddard and Dawson 2009). Abundant rain prior to hatching may be positive, however, as it can increase cover values and speed up growth of vegetation. Over-winter survival of adults is also highly correlated with weather intensity and it varies greatly; in Idaho survival ranged from 86% in a mild winter to 29% in a severe one (Ulliman 1995).

7.2 Movement

The amount that a translocated grouse moves is also positively correlated to mortality. Cope (1992) found a positive relationship between mortality and amount of movement – post-release dispersal may therefore indirectly be a source of mortality. This also appears to vary with different individuals – work with chukars, *Alectoris chukar*, showed that some individuals established at a release site and others moved long distances and "disappeared" (Dickens et al. 2009). Translocated Sharp-tailed Grouse have been known to disperse up to 45 km from the release site, rapidly and far (Gardner 1997, cited Coates et al. 2006;). There is some evidence that females are less likely to do this if nesting habitat is locally available and previously selected by nesting females (Coates et al. 2006).

7.3 Predation

Aerial predators include corvids, Great Horned Owl, *Bubo virginiana*, Northern harrier, *Circus cyaneus*, red-tailed hawk, *Buteo jamaicensis*, and northern goshawk, *Accipiter gentilis*. (Ritcey 1995, Manzer and Hannon 2005; Leupin and Chutter 2007). Marks and Marks (1987) reported that avian predators were responsible for 86% of deaths in Idaho. In Alberta, Manzer and Hannon (2005) found Sharp-tailed Grouse nesting success to be 8 times higher when corvid density was <3 corvids/ km^2 than when density was ≥ 3 / km^2. These authors also found that nesting success was improved as cover heights increased and the percentage of cropland decreased.

Mammalian predators include badger, *Taxidea taxus*, long-tailed weasel, M*ustela frenata*, and coyote, *Canis latrans*. Continuous video cameras located at nests have currently determined that badgers can be a significant source of nest failure; the species actively seeks out nests and consumes eggs (G. Gillette, pers. comm.).

Although depredation of nests and predation on chicks may be an influential factor in limiting grouse productivity, recent work has illustrated how these prairie grouse have evolved anti-predator strategies that partially offset predation, providing habitat quality is good. Greater Sage grouse, *Centrocercus urophasianus*, have been shown to choose nest sites where there were lower densities of aerial predators such as ravens, magpies, golden eagles and hawks of the genus *Buteo* (Dinkins et al. 2012). Trees can act as perches for predators, and these are scattered throughout the potential release sites. Sharp-tailed Grouse hide from mammalian predators by selecting loafing sites in which wind direction, turbulence and speed allow updrafts to lift their odour plume above the predator's nose (Conover and Borgo 2009). These are often on south-facing slopes. At Wycliffe, the orientation of the proposed release sites *vis-a-vis* the direction of the prevailing winds (from the south west) should function to assist Sharp-tailed Grouse in ground predator avoidance.

7.4 Human disturbance and hunting

Human disturbance may cause females to avoid leks, resulting in abandonment over time (IWMS 2004). The vehicle prohibition on Lone Pine Hill as well as the inaccessibility of the Skeet grassland and the lack of public access to the Teck property is highly advantageous. To date, there has been little evidence that any of the conservation properties at Wycliffe have been subject to off-road vehicles.

Because male Sharp-tailed Grouse gather on dancing grounds in the fall, there is the potential that they could be over-harvested. In 1975, 15 Sharp-tailed Grouse were killed in Wycliffe by a hunter who misidentified the species (B. Warkentin, pers. comm.). To prevent this occurring in the reintroduction area a full closure on all grouse species is recommended for an area 10 km from Wycliffe to include potential over-wintering sites. The time this will be in effect will be determined later. In Idaho, opening of the hunting season was delayed to relieve hunting pressure on Sharp-tailed Grouse when they gather on dancing grounds in the fall (Connelly 2005; cited in Stinson and Schroeder 2010). This is a valid strategy in large open areas, however, it does not address the problem of misidentification of species, and the risk to the newly reintroduced Sharp-tailed Grouse is too great.

7.5 Other

West Nile Virus has caused high mortality in greater sage grouse although it is not yet reported for Sharp-tailed Grouse (Naugle et al 2005; cited in Stinson and Schroeder 2010). Other potential diseases include histomoniasis (or "blackhead"), avian influenza, mycoplasma, and Salmonella Pullorum-typhoid. Ticks are a vector for tularemia, *Francisella tularensis*, a bacterial disease to which Sharp-tailed Grouse are susceptible (NWHC 2013). A full assessment of potential disease is beyond the scope of this document. Disease screening should be considered and necropsies carried out on any transplanted birds found dead.

An ecological risk assessment of Teck's Kimberley Operations is underway (Azimuth Consulting Group *in prep*) which identifies potential contaminants and food chain pathways. Aspects of this assessment that may be relevant to Sharp-tailed Grouse will be identified and evaluated in spring/summer of 2013. At this time, this is not anticipated to be a factor, however, further examination is required.

In his analysis of Sharp-tailed Grouse habitat needs and protection, Connelly (2010) concludes that "predation, hunting, and disease have not been identified as important constraints on sharp-tailed grouse populations but habitat loss and degradation, in general, have been implicated in population declines." In a small, newly transplanted population, however, a "perfect storm" of numerous mortality factors could combine and lead to local extinction. Efforts to mitigate this must be considered and evaluated prior to reintroduction (see below 8.0).

8.0 Caveats and potential pitfalls of reintroducing Sharp-tailed Grouse

Sharptails and other prairie grouse are difficult to re-establish by translocation. There are numerous examples of failed translocation projects from releases in Montana, Utah and Washington (Snyder et al. 1999; Hays et al. 1998). There have also been successful transplants in Washington, Nevada, Idaho, Oregon and British Columbia (Schroeder et al. 2010, Coates and Delehanty 2006, Snyder et al 1999, Crawford and Coggins 2000, E. Leupin, pers. comm.), although long term persistence of any of those populations is yet to be finally determined.

Griffith et al. (1989) identified and evaluated factors that determined success of translocations (Table 4). In their review of translocations between 1973 to 1986, they found that transplants of native game species were highly successful (86%) when compared with endangered or sensitive species. Those authors also determined the following attributes with which success was highly correlated:

Table 4. Factors that determine success of translocations (Griffith et al. 1989)

Good habitat quality (see also Coates et al. 2006)

Large founder populations[8]
Earlier breeding
Higher clutch sizes
Multi-year translocations
Herbivory
Release sites that are in the core of a species range (rather than the periphery)
Release into areas without competitors, or with a *congeneric* competitor present.
Population trend of the source population (i.e. increasing, declining or stable) if it's increasing, have a higher chance of success.
Transplants to two sites versus only one have a slightly higher probability of success, but only IF there are at least 40 birds released (but see footnote).

In addition to these factors, Snyder et al. (1999) identified release type (soft-release) and season (spring) as important correlates to the success of prairie grouse transplants. The Sharp-tailed Grouse transplant proposed here may suffer the pitfalls experienced by the failed transplants. Alternatively, this project may lead to successful re-establishment of the species in the East Kootenay. It is vital that the factors identified by others be addressed in the current project. What follows, therefore, is a table that evaluates whether this project meets those requirements (Table 5).

Table 5. Degree to which the proposed East Kootenay Sharp-tailed Grouse project meets requirements identified by Griffith et al. (1989) and Snyder et al. (1999).

Factor	Correspondence		
	High	Moderate	Low or Nil
Good habitat quality	X		
Large founder pop. (80-120 birds)	X		
Earlier breeding	X		
Higher clutch sizes	X		
Multi-year translocations	X		
Herbivory*	X		
Core of species range			X
Without competitors or with congeneric present			X
Source pop increasing		X	
Transplant to 2 sites	X		

[8] But more is not necessarily better – the optimum number of transplanted individuals reaches an asymptote, beyond which increasing the numbers does not increase chance of success, and may, in fact, have deleterious effects (Rodgers 1992; Griffith et al. 1989). This asymptote is between 80 and 120 birds.

Soft release	X		
Season (spring)	X		

Other factors that can lead to failure include:

a. Sex ratio too heavily weighted towards males (E. Leupin, pers. comm.)

b. Translocation stress. Transplantation alters stress physiology in gallinaceous birds (Dickens et al. 2009a). Experimentation on chukars, *Alectoris chukar*, provided empirical evidence that stressors, such as capture, handling, transport, captivity and release to a new location, cause both acute and chronic physiological stress effects. In addition to endocrine disruptions, the stress led to weight loss. The conservation effort to establish new populations is consequently dependent on individuals that are physiologically compromised and therefore, we assume, likely have lower reproductive rates and higher vulnerabilities to both predation and weather effects.

c. Dispersal. Increased post-release movements are negatively correlated with survival and decrease the chances of successful re-establishment (Toepfer et al. 1990, Cope 1992, Dickens et al. 2009b). Dispersal may be caused by unsuitable release site selection (Coates et al. 2006), a limiting resource (Dickens et al. 2009b), and individual variation in homing behavior (*ibid*).

d. Low genetic diversity.

Several of these can be at least partially addressed. The project goal is to transplant 80% females and 20% males, so trapping effort will be directed at capturing females. Efforts to reduce translocation stress will focus on efficient, careful handling and prompt re-location[9]. Dispersal cannot be controlled for, however, recent research suggests that movements, particularly of females, can be dampened by :

a) delaying capture of females on the lek until it is more likely that they have been inseminated (and therefore more likely to nest) (Coates and Delehanty 2006) and

b) Releasing near good nesting habitat (Coates et al. 2006).

Cope (1992) hypothesized that the island of prairie, surrounded by mountains and coniferous forest on the Tobacco Plains, may have minimized the tendency of transplants to disperse from the release site. If that is correct, it is possible that birds transplanted into Wycliffe may be less likely to disperse than if the sites consisted of extensive, contiguous open areas

Factors specific to the East Kootenay that may lead to failure include:

1. Loss of residual vegetation. Even the best sites could be rendered unsuitable in future years if too many elk remove too much residual vegetation. This will lead to increased predation.

2. Tree ingrowth. Bunchgrasses respond to canopy removal, becoming more numerous and vigorous. The Ecosystem Restoration program on crown lands near the release sites must be sustained over the long term – if lands are not maintained in that early seral state and trees re-encroach, options for dispersal will not be available.

[9]Rodgers (1992) held Sharp-tailed Grouse for up to 10 weeks and speculated that this allowed social bonds to form and a hierarchy to develop, thus facilitating lek establishment when they were released as a unit. Mortality, however, was high (10%). He attributed this largely to the fact that many were emaciated from the harsh winter prior to capture.

3. While the conservation properties a Wycliffe represent a series of secured grasslands, loss of genetic diversity that comes from a small population can cause extinction (ref). It is for this reason that supplemental releases should occur in future to increase genetic variability.

4. Even in ideal habitat, reintroduction may fail. This must be kept in mind.

9.0 Measures of success

Success will be evidenced by:

1. Increasing numbers of males dancing at leks over the long term (thus allowing for yearly variation)
2. Reproduction by offspring of transplanted individuals.
3. Establishment of other additional leks by grouse
4. A self-sustaining population will be created

10.0 Habitat Enhancement

Habitat enhancement should be carefully planned and is beyond the scope of this paper. Some options might include:

1. Planting grasses and montane shrubs and protecting the latter from ungulate browsing. A Sharp-tailed Grouse management plan on the Colville Indian Reservation in WA included planting 50,000 bunchgrass plugs annually for 5 years as well as 2500 shrubs (Berger et al. 2004). Planting water birch at the foot of Lone Pine Hill and at Pighin's slough on Teck lands may be among the many options.

2. Increasing species diversity on Teck reclamation lands. Boisevert (2002) found greater nesting success in areas with a high diversity of forbs and grass species than in areas of low species diversity. One reason for this is that food items are available over longer time periods as different species mature or produce seeds/berries at different times. She recommends that seed mixes include at least 8–12 different species and be planted at a rate ≥ 10–12 kg/ha to provide a diversity of 7 species within a 1-m area of a nest site.

3. Control ingrowth by using one-ton pick-up trucks in winter with blades to snap off stems during very cold spells. This method has been used elsewhere in BC (E. Leupin, pers. comm.).

4. Coordinate with Ecosystem Restoration program to continue to benefit Sharp-tailed Grouse. It is vital that the ER program continue and that it creates and maintains suitable habitat in areas adjacent to the newly translocated birds. Stem density should be kept down and regeneration controlled. This is needed to provide habitat for dispersing juveniles and to decrease habitat fragmentation. Proximity will foster genetic interchange between metapopulations in future and will be advantageous.

5. Examine effectiveness of aversive conditioning, using border collies and/or "poppers" to deter elk from utilizing the highest quality Sharp-tailed Grouse habitat during the winter, thus retaining more residual.

11.0 Public Involvement

The Wycliffe Grouse Group is a loose body of individuals who either live in the Wycliffe area or represent non-governmental organizations, including the Rocky Mountain Naturalists, East Kootenay Wildlife Association, the Trench Society, Wildsite, and Teck Resources, Ltd. At this time, meetings have been informal prior to the final decision on the grouse transplant. If the choice to reintroduce Sharp-tailed Grouse is made, the inclusion of this group as a volunteer pool to monitor and assist in the project will be valuable and germaine to the project's success. In addition, it is expected that awareness of the importance of healthy grasslands and shrub communities will be increased. That, in turn, will have a positive effect on the private land holdings in the area, many of which are grasslands.

12.0 Activities and Timelines

Activity	Timeline
Visit potential source leks one year in advance and make preliminary selection for 2014	April 10 to 20, 2013
Scientific review and responses to draft Reintroduction Action Plan	March 15 to May 15
Photoplots of residual vegetation	May 1 to 8, 2013
Meetings with Wycliffe Grouse Group (ongoing) and formal notification of intent to partners	June 2013
Confirm hunting closure on grouse in release area in Hunting Regs 2014	June 2013
Apply for permits for handling and banding birds	June - July 2013
Finalize methodology with Scientific Advisory Team	June 2013
Purchase of transmitters and colour bands	2013
Apply for funding for transplant proper and purchase of 2015 transmitters (one year ahead)	Fall 2013
Obtain receivers, audio recordings and grouse decoys and colour bands	Winter 2013
Second meeting of Scientific Advisory Team to organize 2014	Oct 2013 to Nov 2013
Coordinating volunteers for capture and transport of grouse in 2014	Oct 2013 to March 2014
Press release/announcement of transplant	March to April 2014
Purchase materials and construct wire traps & transport boxes	Dec 2014 to March 2015
Final pre-capture meeting of scientific team	March 2014
Test of transmitters and receivers, print data sheets	March 2014
Finalize source leks and set out traps	April 1 to 20, 2014
Set up soft release audio and decoys	April 10 to 25, 2014
Transport and release birds	April 10 to 25, 2014
Monitor radio-collared birds (nesting season) (include fixed wing)	April 10 to Aug 30, 2014
Monitor radio-collared birds (wintering habitat) (include fixed wing)	Nov 1 to Feb 28, 2015
Write and submit draft progress report to funders and scientific advisory team	Sept 15, 2014
Meeting of scientific advisory team to review results	Sept 30, 2014
Apply for funding for 2015 transplant and monitoring	Fall 2014
Monitor radio-collared birds – counts at leks	April 1 to May 15, 2015
Identify new release sites (based on data collected in 2014) incorporate new info & repeat relevant steps (above)	April 2015

13.0 Conclusion

Several factors have converged that make transplants of Sharp-tailed Grouse to the Wycliffe and Kimberley areas feasible at this time. Conservation properties have been consolidated, range condition is good, the Ecosystem Restoration Program is underway, Teck Resources Ltd. has expressed interest in and is providing support for the reintroduction, the elk population on Wycliffe appears to have been reduced and the populations of forest ecotype Sharp-tailed Grouse in the central interior of BC appear to be healthy and/or increasing. There has been much interest expressed by potential partners in this enterprise in the East Kootenay. The Ktunaxa First Nation's "chicken dance" represents the dancing of prairie grouse on leks, and sharptails are a species of great interest to them (D.Wigle, pers.comm.). All these partners will be formally brought into discussions after the scientific advisory team has reviewed the Reintroduction Action Plan and made modifications where needed.

Reintroductions are rarely easy and straightforward, and much can go wrong as evidenced above. In Washington state, Schroeder et al. (2010) are cautiously optimistic that, following transplants, population increases are real. It is hoped that the Sharp-tailed Grouse can once again be established in the East Kootenay.

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APPENDIX B. Species lists and cover values for five potential Sharp-tailed Grouse release sites at Wycliffe and Kimberley

Porteous Road - Aug 2012

Species	Cover (%)	Frequency (%)
Grass and Grasslike		
Western wheatgrass	18.9	76
Idaho fescue	14.8	84
Bluebunch wheatgrass	6.9	28
Prairie Junegrass	2.4	26
Rough fescue	1.9	16
Kentucky bluegrass	1.9	8
Cheatgrass	0.1	2
Total Grass and Grasslike	**46.7**	
Forbs		
Balsamroot	5.7	32
Western yarrow	1.8	32
Sulphur cinquefoil	1.7	16
Silky lupine	1.5	20
Stoneseed	1.1	4
Hairy goldaster	0.4	6
Tiny penstemon	0.3	2
Bastard toadflax	0.2	6
Indian wheat	0.1	4
Dandelion	0.1	4
Fairy candelabra	0.1	2
Timber milkvetch	0.1	2
Purple owl-clover	0.1	2
Total Forbs	**12.9**	
Shrubs		
Prickly rose	2.7	38
Bearberry	0.1	2
Snowberry	0.1	2
Total Shrubs	**2.8**	
Trees		
Trembling aspen - overstory	4.2	12
Trembling aspen - regen layer	1.5	28
Total Trees	**5.6**	
Substrate Cover		
Litter	74.8	100
Soil	11.1	62
Bryophytes	6.0	46
Rock	2.0	20
Elk feces	0.3	10
Litter > 2 cm	0.3	2
Average Height (cm)	32	

Lower Lone Pine Hill - Aug 2012

Species	Cover (%)	Frequency (%)
Grass and Grasslike		
Kentucky bluegrass	8.3	30
Bluebunch wheatgrass	7.9	44
Western wheatgrass	7.6	34
Idaho fescue	5.8	50
Prairie Junegrass	3.9	36
Western needlegrass	1.4	6
Rough fescue	1.1	4
Canada bluegrass	0.1	2
Needle-and-thread	0.1	2
Sandberg bluegrass	0.1	2
Total Grass and Grasslike	**36.0**	
Forbs		
Balsamroot	12.6	74
Silky lupine	4.2	22
Sulphur cinquefoil	1.9	16
Pacific anemone	1.4	14
Dandelion	1.0	10
Rosy pussytoes	0.6	4
Tiny penstemon	0.4	6
Alumroot	0.3	2
Goatsbeard	0.1	4
Ball mustard	0.1	2
Bastard toadflax	0.1	2
Nodding onion	0.1	2
Norway cinquefoil	0.1	2
Total Forbs	**22.6**	
Shrubs		
Saskatoon	2.5	20
Chokecherry	0.4	6
Bearberry	0.3	2
Total Shrubs	**3.2**	
Trees		
Ponderosa pine - overstory	5.8	10
Trembling aspen - overstory	2.9	10
Ponderosa pine - understory	1.1	4
Trembling aspen - regen layer	0.9	14
Total Trees	**10.6**	
Substrate Cover		
Litter	64.7	100
Rock	9.6	38
Bryophytes	7.9	66

Lower Lone Pine Hill

Upper Lone Pine Hill - Aug 2012

Grass and Grasslike		
Western wheatgrass	26.7	64
Rough fescue	10.7	38
Idaho fescue	7.4	42
Kentucky bluegrass	3.4	18
Richardson's needlegrass	3.2	12
Pinegrass	2.5	20
Bluebunch wheatgrass	1.0	10
Prairie Junegrass	1.0	8
Western needlegrass	0.3	2
Northwest sedge	0.1	2
Total Grass and Grasslike	**56.0**	
Forbs		
Silky lupine	5.5	48
Tiny penstemon	2.3	14
Dandelion	0.7	18
Sulphur cinquefoil	0.7	6
Stoneseed	0.6	4
Filago	0.4	6
Pacific anemone	0.4	6
Balsamroot	0.4	4
Western yarrow	0.4	4
Wild strawberry	0.3	2
Silky phacelia	0.1	4
Spreading dogbane	0.1	4
Canada thistle	0.1	2
Total Forbs	**11.8**	
Shrubs		
Prickly rose	1.3	10
Birch-leaved spirea	1.0	38
Chokecherry	0.6	4
Saskatoon	0.1	2
Total Shrubs	**2.9**	
Trees		
Ponderosa pine - overstory	4.9	6
Douglas-fir - understory	2.0	4
Trembling aspen - layer	0.4	6
Douglas-fir - overstory	0.1	2
Total Trees	**7.4**	
Substrate Cover		
Litter	87.6	100
Bryophytes	4.5	36
Cattle feces	2.1	8
Litter > 2 cm	2.1	8
Horse feces	0.3	2

(cont'd)

Soil	7.8	58
Litter > 2 cm	1.0	8
Cattle feces	0.3	2
Elk feces	0.1	4
Average Height (cm)	31	

Skeet Grassland - Aug 2012

Grass and Grasslike		
Rough fescue	21.7	54
Kentucky bluegrass	14.7	48
Western needlegrass	8.5	46
Richardson's needlegrass	5.5	34
Idaho fescue	5.5	26
Columbia needlegrass	4.2	24
Pinegrass	1.4	6
Bluebunch wheatgrass	0.9	6
Prairie Junegrass	0.4	6
Cheatgrass	0.1	4
Total Grass and Grasslike	**62.7**	
Forbs		
Silky lupine	8.0	60
Stoneseed	2.4	18
Western yarrow	1.5	12
Old man's whiskers	1.1	6
Tiny penstemon	0.7	8
Sulphur cinquefoil	0.7	6
Dandelion	0.5	20
Holboell's rockcress	0.4	6
Rosy pussytoes	0.3	2
Pacific anemone	0.3	10
Chickweed	0.1	2
Common harebell	0.1	2
Darnel	0.1	2
Death camus	0.1	2
Total Forbs	**16.0**	
Shrubs		
Prickly rose	1.2	8
Ceanothus	0.6	4
Saskatoon	0.4	4
Total Shrubs	**2.2**	
Trees		
Ponderosa pine	0.6	4
Trembling aspen - overstory	1.4	6
Trembling aspen - regen layer	0.6	14
Total Trees	**2.6**	

Upper Lone Pine Hill (cont'd)

Soil	0.25	10
Elk feces	0.1	4
Average Height (cm)	38	

Teck Grassland Knoll- June 25, 2011

Grass and Grasslike		
Idaho fescue	12.6	70
Western wheatgrass	11.1	35
Rough fescue	8.3	40
Prairie Junegrass	6.0	45
Kentucky bluegrass	5.3	35
Bluebunch wheatgrass	1.5	10
Columbia needlegrass	0.8	5
Cheatgrass	0.1	5
Total Grass and Grasslike	**45.6**	
Forbs		
Silky lupine	9.5	40
Balsamroot	3.5	20
Baker's mariposa lily	0.5	20
Western yarrow	0.3	10
Alumroot	0.3	10
Smooth agoseris	0.1	5
Fairy candelabra	0.1	5
Nine-leafed lomatium	0.1	5
Total Forbs	**14.4**	
Shrubs		
Chokecherry	3.8	10
Snowberry	1.9	5
Prickly rose	0.8	5
Birch-leaved spirea	0.3	10
Total Shrubs	**6.6**	
Trees		
Douglas-fir	3.1	5
Total Trees	**3.1**	
Substrate Cover		
Litter	71.5	100
Soil	12.0	70
Bryophytes	1.9	50
Rock	1.9	25
Elk feces	1.4	30

Skeet Grassland (cont'd)

Substrate Cover		
Litter	83.9	100
Bryophytes	6.7	42
Soil	2.5	22
Litter > 2 cm	0.6	4
Elk feces	0.5	10
Rock	0.2	6
Average Height (cm)	34	

APPENDIX C. MATERIALS

Traps: 5 X 10 m welded wire, each trap made with a 83 x 46 cm section of roll. Roll size: 30.5 m x 91 cm tall, made 32 traps. Funnels from chicken wire
Nylon net 1.27 x 1.27 to cover each trap, laced with string so birds could be recovered through.
Chicken wire "drift fence" to 46 cm high.

Transport boxes: