BC hydro

FOR GENERATIONS

Report Title: *Peace River Wildlife Surveys – Baseline Inventory Surveys - 2006*
Project: Peace River Site C Hydro Project
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Prepared for: BC Hydro

NOTE TO READER:

This is a report on a study commissioned toward the development of engineering, environmental and technical work conducted to further define the potential Site C project.

For environmental studies, the focus is on the development of an environmental and socio-economic baseline around the area of the potential Site C Project. Baseline studies are generally a survey of existing conditions within a project study area.

This report and other information may be used for future planning work or an environmental assessment or regulatory applications related to the potential Site C Project.

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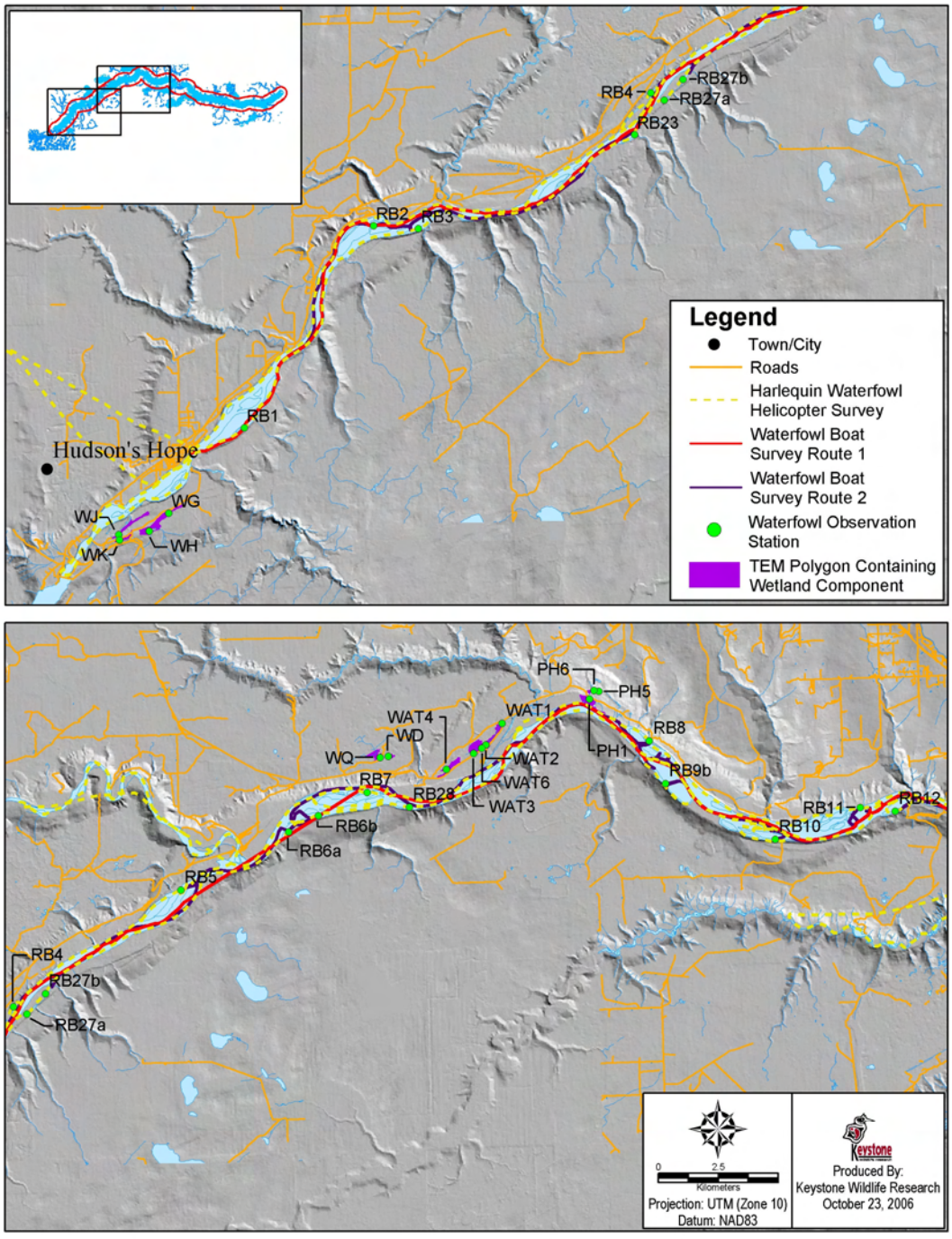

Figure 7.1a. Aerial transects, boat transects and wetland / backchannel survey sites completed during waterfowl surveys in the western portion of the Peace corridor.

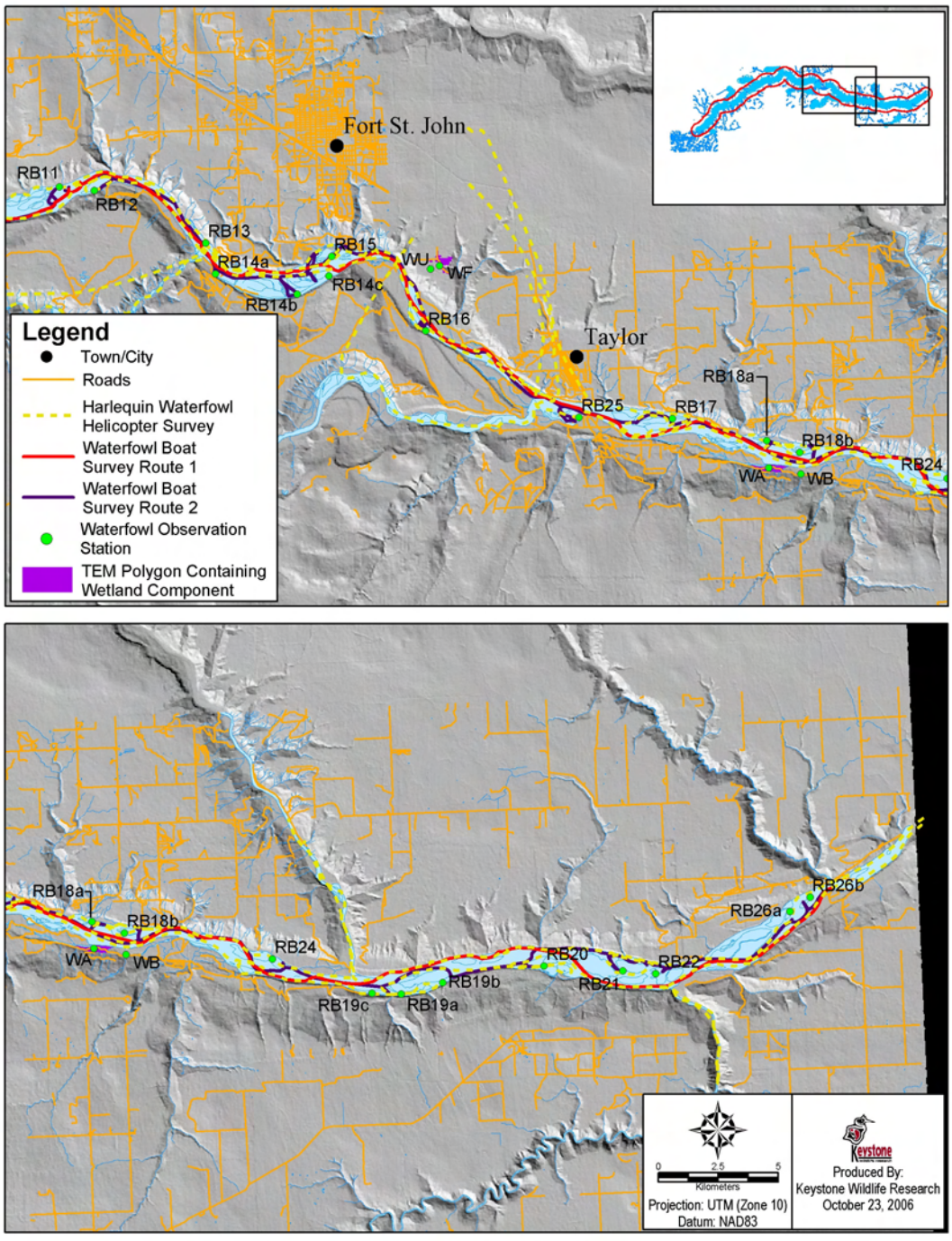

Figure 7.1b. Aerial transects, boat transects and wetland / backchannel survey sites completed during waterfowl surveys in the eastern portion of the Peace corridor.

7.3 Results

Over 100 hours were spent in active observation of waterfowl in the spring, summer and fall of 2006 (Table 7.1). This included 76.1 hours of river surveys (9.2 hour of aerial surveys and 67 hours of boat surveys), 20.9 hours of backchannel surveys and 4.7 hours of wetland surveys (access by vehicle and boat). It should be noted that backchannels were also surveyed during helicopter surveys, but these segments have not been separated from the main river channel.

Adverse survey conditions (heavy wind) were experienced during seven observation stations at 3 survey sites (1%). However, the conditions did not interfere with the detection of waterfowl and waterfowl were observed at all sites. In addition, 2 of the 3 sites were re-surveyed on another day.

Table 7.1 Survey time and type for waterfowl surveys completed in 2006.

Survey Month	Stratum	Total Survey Minutes	Total Survey Hours
April	Backchannel	232	3.9
	River (Boat)	877	14.6
	Wetland	270	4.5
April Total		1379	23.0
May	Backchannel	5	0.1
	River (Aerial)	264	4.4
	Wetland	5	0.1
May Total		274	4.6
August	River (Aerial)	286	4.8
August Total		286	4.8
September	Backchannel	1016	16.9
	River (Boat)	1685	28.1
	River (Boat)	1456	24.3
September Total		4157	69.3
Total Survey Effort		**6096**	**101.6**

River/Backchannel Surveys

Five complete river surveys were completed in 2006, including 2 aerial surveys and 3 riverboat surveys. Surveys took place from April 26-29, May 25-26, August 7, September 5-8 and September 25-October 2. Backchannel surveys were completed

from a helicopter, boat or from ground observation stations accessed by road or boat. Wetlands were accessed from the road.

Waterfowl species (loons, ducks, geese, swans, gulls, coots) and shorebirds (plovers, sandpipers, rails and cranes), recorded in the study area are listed in Table 7.2. Overall, 42 species were recorded, including five Blue-listed species, namely Surf Scoter, Sandhill Crane, Great Blue Heron (Plate 7.1), California Gull and Caspian Tern. Canada Goose and Mallard were the most common species of goose and duck, respectively, and were recorded during all surveys. Franklin's Gull was the most common gull observed in 2006, and was also the most common gull reported by Hawkes *et al.* (2006).

Table 7.2. Waterfowl, shorebird, loon, rail and crane species observed during the Peace River surveys.

Species	Red/Blue Listed	Detected on Waterfowl Surveys	Detected only on Other Surveys
American Coot		*	
American Wigeon		*	
Barrow's Goldeneye		*	
Black-bellied Plover		*	
Bonaparte's Gull		*	
Bufflehead		*	
Blue-winged Teal		*	
Canada Goose		*	
California Gull	B		*
Caspian Tern	B	*	
Common Goldeneye		*	
Common Loon		*	
Common Merganser		*	
Franklin's Gull		*	
Gadwall		*	
Great Blue Heron	B	*	
Greater Scaup		*	
Greater Yellowlegs		*	
Greater White-fronted Goose		*	
American Green-winged Teal		*	
Herring Gull		*	
Hooded Merganser		*	
Killdeer		*	
Least Sandpiper		*	

Species	Red/Blue Listed	Detected on Waterfowl Surveys	Detected only on Other Surveys
Lesser Yellowlegs		*	
Mallard		*	
Mew Gull		*	
Northern Pintail		*	
Northern Shoveler		*	
Pacific Loon		*	
Ring-billed Gull		*	
Ring-necked Duck		*	
Red-necked Grebe		*	
Red-throated Loon		*	
Ruddy Duck			*
Sabine's Gull		*	
Sandhill Crane	B		*
Snow Goose		*	
Sora			*
Solitary Sandpiper		*	
Spotted Sandpiper		*	
Surf Scoter	B	*	
Trumpeter Swan		*	
Wilson's Snipe		*	

Hawkes *et al.* (2006) reported several additional species not observed during the 2006 surveys, including White-winged Scoter, Black Tern, Horned Grebe, Pied-billed Grebe, and Upland Sandpiper. Species not reported by Hawkes *et al.* (2006) but observed in 2006 included Black-bellied Plover, Sabine's Gull, Snow Goose, Surf Scoter, Hooded Merganser, Pacific Loon, Great Blue Heron, Caspian Tern, Greater White-fronted Goose, Northern Shoveler, Red-throated Loon, Least Sandpiper, and Greater Scaup. bureaucracy

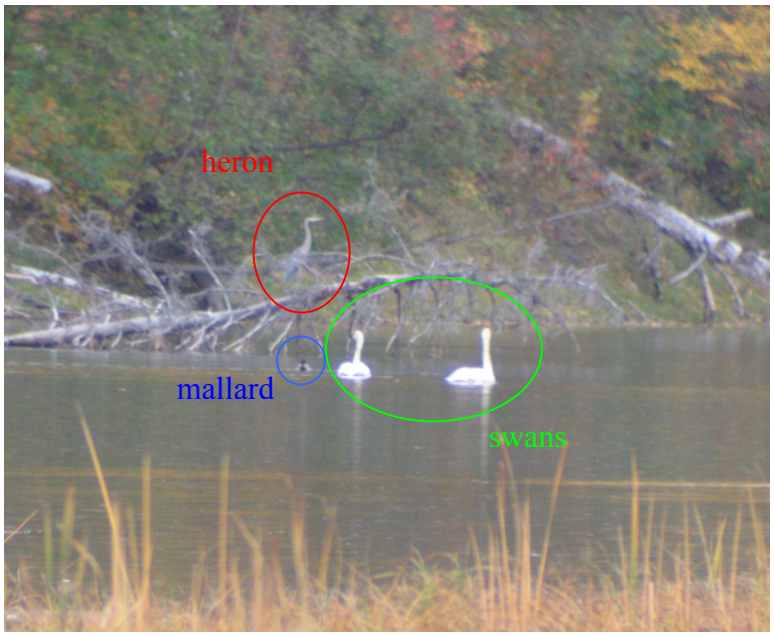

Plate 7.1. Trumpeter Swans, a Mallard and a Great Blue Heron along the banks of the Peace River. L. Law photo.

Several waterfowl species appeared to heavily use the Peace River and its backchannels (>200 total observations), including the Ring-billed Gull, Mallard, American Green-winged Teal, Franklin's Gull, Bonaparte's Gull, Canada Goose, American Wigeon, and Common Merganser. Eight species were recorded on all surveys including American Green-winged Teal, Canada Goose, Mallard, American Wigeon, Bufflehead, Common Loon and Common Merganser. Overall, waterfowl species appeared to use the river most heavily during the fall migration (Table 7.3). These data provide a picture of the level of use over time.

Table 7.3. Numbers of waterfowl observed on the Peace River during boat and helicopter surveys. (excludes waterfowl not identified to species).

	Number Observations Recorded					
Species	**Apr (boat survey)**	**May (helicopter survey)**	**Aug (helicopter survey)**	**Sept shorebird (boat survey)**	**Sept waterfowl (boat survey)**	**Total**
American Wigeon	163	103	67	190	63	586
Barrow's Goldeneye		1		2		3
Black-bellied Plover					1	1
Bonaparte's Gull				482	205	687
Bufflehead	13	31	11	2	3	60

	Number Observations Recorded					
Species	**Apr (boat survey)**	**May (helicopter survey)**	**Aug (helicopter survey)**	**Sept shorebird (boat survey)**	**Sept waterfowl (boat survey)**	**Total**
Blue-winged Teal	1	44				45
Canada Goose	286	892	441	2480	1331	5430
Caspian Tern*					1	1
Common Goldeneye	62	32		10	8	112
Common Loon	2	1	1	17	5	26
Common Merganser	53	54	47	168	126	448
Franklin's Gull	81		40		3563	3684
Gadwall		9				9
Great Blue Heron *				1		1
Greater Scaup				5		5
Greater Yellowlegs		1			1	2
Greater White-fronted Goose					5	5
American Green-winged Teal	99	43	147	103	117	509
Herring Gull	2			29	12	43
Hooded Merganser				15		15
Killdeer	1	13	57	4	53	128
Least Sandpiper					5	5
Lesser Yellowlegs	2	30			7	39
Mallard	402	343	484	624	373	2226
Mew Gull					1	1
Northern Pintail	63			20	11	94
Northern Shoveler	9	7		14		30
Pacific Loon				2		2
Ring-billed Gull	10			457	430	897
Ring-necked Duck		31	3	2	11	47
Red-necked Grebe				1		1
Red-throated Loon				1		1
Sabine's Gull				2		2
Snow Goose		1				1
Solitary Sandpiper		12				12
Spotted Sandpiper	1	16		3	117	137
Surf Scoter*				22	14	36

Species	Number Observations Recorded					
	Apr (boat survey)	May (helicopter survey)	Aug (helicopter survey)	Sept shorebird (boat survey)	Sept waterfowl (boat survey)	Total
Trumpeter Swan	2	14	7	30	27	80
Grand Total	1252	1678	1305	4686	6490	15411

*Blue-listed

Species recorded only in May included the Gadwall and the Snow Goose. Species recorded only in September include Greater Scaup, Black-bellied Plover, Red-necked Grebe, Red-throated Loon, Caspian Tern, Mew Gull, Great Blue Heron, Hooded Merganser, Greater White-fronted Goose, Least Sandpiper, Pacific Loon, Sabine's Gull, Surf Scoter and Bonaparte's Gull (Table 7.3). Those species are likely seasonal migrants.

Species-specific differences in habitat use were also observed during surveys. Species observed in September were recorded as occurring on the main river channel or in a backchannel. Although most species were found in both areas, some species showed an apparent preference for one habitat type (Table 7.4). Species mainly (more than 70% of the individuals observed) found on the main river channel included gulls, Canada Geese, Common Loons, Common Mergansers, Spotted Sandpiper and Surf Scoter. Species mostly found on river backchannels (>70% of individuals) included Green-winged Teal, Mallard, Northern Shoveler, Northern Pintail, Ring-necked Duck and Trumpeter Swan. Generally, gulls were found on open gravel bars along the main river channel, diving ducks appeared to prefer the fast moving, main river channel, and dabbling ducks were most commonly found in slow-flowing or stagnant backchannels.

Table 7.4. Number of waterbirds recorded in riverine habitats during boat surveys in September 2006.

Species	Number observed	
	Backchannel	Main River Channel
Bonaparte's Gull	40	647
Common Loon	3	19
Common Merganser	87	207
Franklin's Gull		3563
Green-winged Teal	171	49
Herring Gull	2	39

Mallard	732	265
Northern Pintail	30	1
Northern Shoveler	14	
Ring-billed Gull	4	883
Ring-necked Duck	12	1
Spotted Sandpiper	6	114
Surf Scoter	4	32
Trumpeter Swan	47	10

Wetland Surveys

Thirty-six wetlands were identified from the TEM map prior to surveys. All were surveyed between April 23rd and May 23rd, 2006 but only 18 contained habitat suitable for waterfowl surveys. At least one waterfowl species was observed in 16 of the 18 wetlands surveyed.

Surveys were not repeated in the fall since most wetland habitats that held water in the spring were dry in the fall, leaving only marginal habitat for waterfowl. Therefore, to maximize productivity, fall surveys concentrated on the Peace River.

Far fewer species were observed during wetland surveys compared to river/backchannel surveys (Table 7.5). Only 11 species of waterfowl and one shorebird species (Wilson's Snipe) were detected. All of the species observed on the wetlands surveys were also detected on the river surveys.

Table 7.5. Waterfowl species observed during wetland / pothole observation station surveys and transects.

	Number Observations Recorded		
Species	**Apr**	**May**	**Total**
American Coot	5		5
American Wigeon	23		23
Bufflehead	11		11
Canada Goose	15		15
Common Goldeneye	12		12
Gadwall		2	2
American Green-winged Teal	17	4	21
Hooded Merganser	3		3
Mallard	40	2	42
Northern Pintail	6		6
Ring-necked Duck	10		10
Wilson's Snipe	4		4
Grand Total	**146**	**8**	**154**

7.4 Recommendations

In 2006, the highest use of the river occurred during fall migration, when the number of waterfowl observed was three to four times those recorded at other times of the year. This result could be typical for the region or it might have been a result of the hot and dry weather experienced in 2006. Since most wetlands surveyed in the spring had dried up by late August, waterfowl might be more likely to congregate on the river in the fall.

No rare species appear to nest along the river and species that do nest in the area are common. Five Blue-listed species were observed and four of the five were only observed during the fall migration. The California Gull was recorded during the breeding season (May and June), however it is unlikely that the California Gull is breeding in the area since this species breeds in colonies of 400 to 43,000 birds and only 4 birds were actually observed (Winkler 1996).

Robertson (1999) reported a species-specific difference in species occurrence between the mainstem of the river and non-mainstem or backchannel habitats. This study found that Canada Geese, Common Mergansers, Spotted Sandpipers and gulls mainly used the mainstem while dabbling ducks preferred backchannels. Similarly, 2006 surveys indicate that Mallards, Northern Shovelers, Northern Pintails, Green-winged Teal, all other dabbling ducks, and Trumpeter Swans used mostly backchannel habitats.

Most waterfowl species that occur on the Peace River will be affected to some extent by potential hydroelectric development. Species with the greatest potential to be affected include those that breed in the area and prefer backchannels. These species primarily include dabbling ducks.

Additional surveys should focus on gathering additional, multi-year baseline data to further document the numbers, species, distribution, timing and habitat use of spring and fall migrants. This data can be compared to observations of waterfowl from previous surveys to determine species distribution and abundance throughout the year. Surveys should be completed during the spring and fall migrations as well as during the breeding season.

8.0 HARLEQUIN DUCK SURVEY

No systematic surveys have been conducted for harlequins in the study area. Determination of the relative abundance of harlequins in the Peace River and identification of breeding habitats in the tributaries is necessary to complete an assessment for this species.

8.1 Introduction

Western Canadian populations of Harlequin Duck, including those of British Columbia, are part of a much larger North Pacific Rim population and are not currently considered endangered. Recent preliminary estimates of female recruitment in British Columbia suggest a declining population, but further analysis is needed (Rodway *et al.* 2003). Currently, the Harlequin Duck is not considered immediately at risk, but is of conservation concern because of possible provincial declines and a perceived long-term threat (BC Conservation Data Centre 2006). Declines in the population have been attributed to loss of nesting sites due to the degradation of riparian habitat from logging, mining, road construction, and hydroelectric development, as well as nesting disturbance from recreational activities (Cassirer *et al*. 1993).

During the nesting season (April-June), adult Harlequin Ducks are found on fast-flowing mountain streams and rivers with nearby loafing sites. Midstream loafing sites appear to be an important component of suitable habitat (Cassirer and Groves 1994), possibly reducing the risk of predation (Machmer 2001). Broods have been recorded in BC between mid- June and early September, with most found from the 10th of July to the 13th of August (Campbell *et al.* 1990). Broods remain near nesting areas for the first few weeks after hatching then move downstream during the summer (Cassirer and Groves 1989). Broods prefer low-gradient streams with adequate macroinvertebrate fauna (Bengtson and Ulfstrand 1971).

Thurber (1976) reported seven pairs 47 miles downstream of the Chetwynd Bridge on the Peace River, during May waterfowl surveys in 1975. However, no broods were located later in the summer, suggesting that harlequins use the Peace River as a staging

and feeding area, but actual breeding occurs in the smaller tributaries of the Peace River. Thurber (1976) did not report harlequins during similar surveys in 1974.

Hawkes *et al.* (2006) completed aerial and boat waterfowl surveys along the Peace River between June 15th and July 24th. They did not observe any harlequins.

8.2 Methods

Low level, visual surveys from a helicopter were used to survey for harlequins and other riverine birds following the methods described in ***Inventory Methods for Riverine Birds - Harlequin Duck, Belted Kingfisher and American Dipper*** (RIC 1998d). During the surveys, one observer sat in the front beside the pilot so observations could be made to the left, right, and below the helicopter as it followed the river upstream. A second observer sat behind the pilot for better observation on the right side. All waterfowl and riverine birds observed were recorded and locations were recorded in transect segments. The recorder (sitting behind the front observer) marked segment start and end locations using a real-time GPS tracking system. Information was recorded on RISC standard data forms modified for this project (Appendix 1). The GPS tracking system was used to assist with navigation and generate a data log of the survey route, an approach that provides an efficient and practical method to catalogue data collected over large areas.

Aerial surveys (helicopter) were conducted in May to search for harlequins at staging areas when males and females would most likely be paired. A second survey (brood survey) was conducted in August to locate juvenile harlequins with adult females. Surveys followed the banks of the Peace River and travelled up to ten km up the major tributaries including the Halfway, Beatton, Moberly, Pine and Kiskatinaw Rivers.

8.3 Results

Aerial surveys were conducted on May 25-26 (pair survey), and August 7, 2006 (brood survey) (Figure 7.1a,b). The surveys included both banks of the Peace River between Hudson Hope and the Alberta border, and up the major drainages into the Peace (Kiskatinaw, Pine, Beatton, Halfway and Moberly Rivers).

No harlequins were observed during aerial surveys. Harlequins were also not observed during waterfowl boat surveys in May and September 2006. Although aerial surveys can consistently underestimate harlequin populations, the boat surveys support the observation that no harlequins were breeding on the Peace River in the study area in 2006.

8.4 Recommendations

The Peace River does not appear to provide suitable breeding habitat for Harlequin Ducks and surveys in 2005 and 2006 confirm this assumption. The potential presence of harlequins should be monitored during additional waterfowl surveys conducted along the river. If Harlequin duck pairs and/or broods are observed using the Peace River during the breeding season then brood rearing areas and possible nesting sites should be investigated.

9.0 SONGBIRD SURVEY

Rare songbirds are known to use valley bottom forests in the Peace Region. Information on their occurrence and habitat preferences is required to assess effects of potential hydroelectric development in the Peace valley.

9.1 Introduction

There are several Red- or Blue-listed passerines known to occur in the study area: Black-throated Green Warbler, Canada Warbler, Connecticut Warbler, Bay-breasted Warbler, Cape May Warbler, Rusty Blackbird, Barn Swallow, Le Conte's Sparrow and Nelson's Sharp-tailed Sparrow. In 2006, the Philadelphia Vireo was removed from the provincial Blue-list and the Rusty Blackbird was added. Some of these species are associated with riparian habitats, and up to 66% of the passerine species reported in the Boreal and Taiga Plains of British Columbia use White-Spruce-Trembling Aspen and White Spruce-Cottonwood riparian forests (Enns and Siddle 1996), both of which are common in the study area.

Canada Warblers (Blue-listed) most often occur along steep slopes with unstable banks and an abundance of shrubby undergrowth (Enns and Siddle 1996; Campbell *et al.* 2001). Specifically, slopes with a dense birch understory or riparian willow and alder shrubbery appear to be important (Conway 1999). This warbler was detected frequently during 2005 surveys, with most detections occurring in mixed deciduous-leading stands (Hawkes *et al.* 2006)

The Blue-listed Black-throated Green Warbler breeds mainly in mature and old-growth mixed-wood stands containing white spruce with aspen or poplar (Morse and Poole 2005). Older riparian stands associated with river floodplains can be especially important (Enns and Siddle 1996). This warbler was also detected frequently during passerine surveys in 2005 and most detections occurred in mixed woodlands (Hawkes *et al.* 2006).

The Red-listed Connecticut Warbler prefers mature and old, pure and mixed aspen-dominated forests with rich understories. Understorey development, less than 3 m high,

is critical for this warbler as it forages on or near the forest floor (Enns and Siddle 1996). Penner (1976) located the warbler in mixed balsam poplar and white spruce stands on islands in the Peace River. Hawkes *et al.* (2006) detected one Connecticut Warbler along the river corridor during 2005 surveys. This detection occurred in edge habitat with a pure aspen overstorey on the north side of the Peace River.

The Red-listed Bay-breasted and Cape May Warblers are found in mature, closed canopy white spruce forest, either in pure stands or mixed with clumps of aspens, birch, and cottonwood (Enns and Siddle 1996). The numbers of these species within the study area are thought to be low. Hawkes *et al*. (2006) did not detect either of these species in the core study area during 2005 surveys. Historical observations of these species have been reported in the upland areas but not in the river corridor.

Hawkes *et al.* (2006) sampled 118 point count stations in the core stratum and recorded 73 passerine species. They reported that the Red-eyed Vireo had the highest frequency of occurrence, and the American Robin had the highest encounter frequency.

The objective of the bird surveys in 2006 was to document Red- or Blue-listed species occurring in the study area and identify habitat associations for those species.

9.2 Methods

General sampling methodology followed that described in ***Inventory Methods for Forest and Grassland Songbirds*** (RIC 1999c) for simple point counts along an encounter transect. At northern latitudes, it is recommended that surveys occur between May 1 and July 10th (RIC 1999c). Transects were laid out prior to surveys and were designed to sample different habitat types. Floodplain habitats that are known to be used by rare bird species and might be affected by potential hydroelectric development were also targeted.

Transects were laid out at least 200 m apart, with point count stations on each transect at least 200 m apart. Ease of access and habitat polygon size were also considered during transect design. Each transect was visited twice during the sampling period, and

observers were exchanged between transects to minimize observer bias. Seventeen transects were established for bird surveys (Figure 9.1a, b).

Transects were visited by a crew of at least two persons. A GPS and handheld compass were used to determine bearings, distance travelled and UTM co-ordinates. At each point count station, one person recorded habitat attributes (subzone, site unit, structural stage), while the other looked and listened for birds during a 5-minute listening period.

All bird species seen or heard at point count stations and along encounter transects between stations were recorded. If a Red or Blue-listed species was observed, a Ground Inspection Form (GIF) was completed to record the habitat attributes. All bird observations were recorded on standard RISC datasheets customized for the project (Appendix 1).

Surveys took place in the morning, during the first four hours after sunrise. Any significant incidental bird observations made while travelling to and from transects were also recorded. Locations and descriptions of any nests found were recorded on RIC standard nest site description forms.

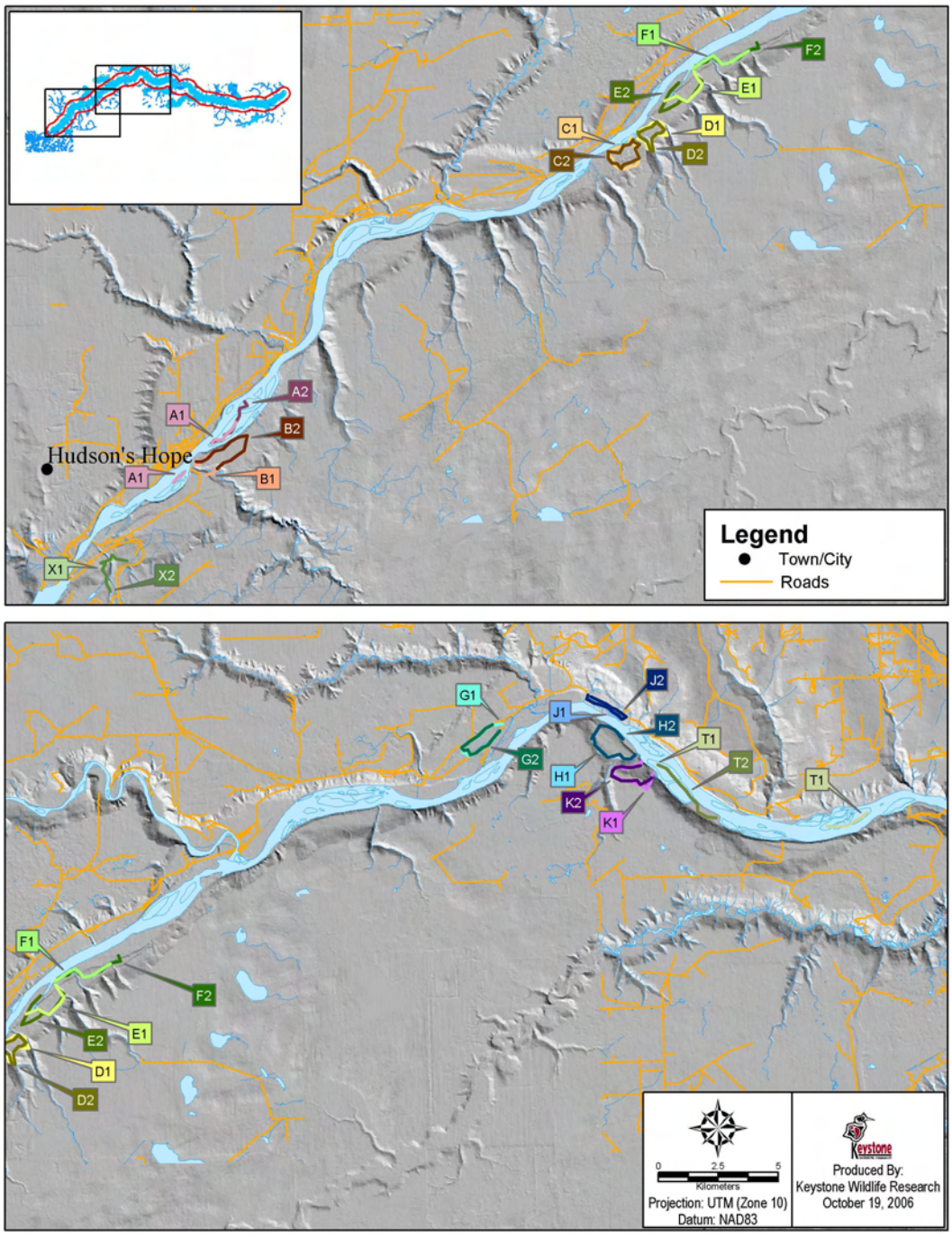

Figure 9.1a. Breeding bird transects completed in the western portion of the Peace corridor, where the lighter colour indicates trip 1 and the darker colour indicates trip 2.

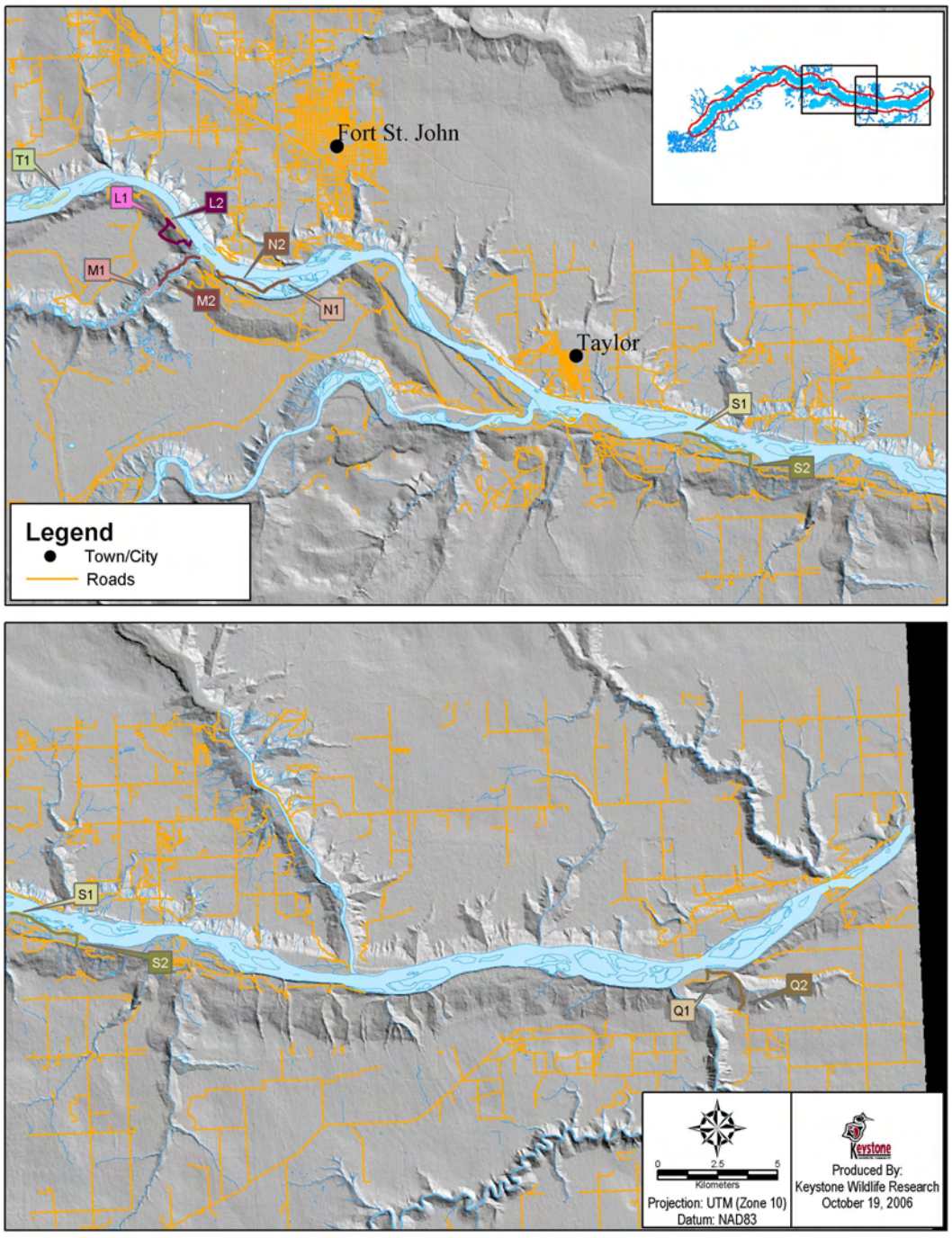

Figure 9.1b. Breeding bird transects completed in the eastern portion of the Peace corridor, where the lighter colour indicates trip 1 and the darker colour indicates trip 2.

9.3 Results

Two trips were completed between April 23 to June 5th and June 18 to 27, 2006. All 17 transects were surveyed twice, resulting in 478 bird count stations. The survey route completed on trip 1 varied slightly from trip 2 due to field conditions. A total of 6,371 bird observations was recorded during point count transects, representing 113 species of passerines, owls, raptors, waterfowl and water-associated birds.

Of these observations, 5731 were identified as passerines, representing 77 species (Appendix 3). The White-throated Sparrow was the most frequently recorded bird on the point count surveys (392 observations recorded). This species also had the highest encounter frequency.

Passerines recorded at fewer than one percent of the point count stations (4 stations or fewer) included: Blackpoll Warbler, Brewer's Blackbird, Brown Creeper, Common Grackle, Gray Catbird, Northern Shrike, Philadelphia Vireo, Pine Siskin, Rusty Blackbird, Savannah Sparrow, Swamp Sparrow, Townsend's Solitaire, Townsend's Warbler, Vesper Sparrow, Violet-green Swallow, Wilson's Warbler, White-winged Crossbill and Yellow-bellied Flycatcher. Several of these species are not listed as normally occurring in north-central B.C. including the Gray Catbird, Common Grackle and Philadelphia Vireo (Prince George Naturalists Club 1996).

The Connecticut Warbler was the only Red-listed species detected during standardized breeding bird surveys in 2006 (the Red-listed Nelson's Sharp-tailed Sparrow was observed incidentally and not in the bird survey). Three Blue-listed species were recorded, including the Rusty Blackbird, Canada Warbler, and Black-throated Green Warbler. The Black-throated Green Warbler was detected on all transects except Transect J, while the Rusty Blackbird was only detected on two transects (Table 9.1).

Table 9.1. Numbers of detections of Red and Blue-listed species by transect (note: number of detections is not equivalent to number of birds or territories).

	Transect																
Species	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**J**	**K**	**L**	**M**	**N**	**Q**	**S**	**T**	**X**
Black-throated Green Warbler	11	13	8	14	20	23	1	28		10	10	7	22	11	5	22	12
Canada Warbler	2	2	3	16	12	5		14		20	20	1	1	4	1		14
Connecticut Warbler		3	1					1		4							

Species	Transect																
	A	B	C	D	E	F	G	H	J	K	L	M	N	Q	S	T	X
Rusty Blackbird							2		2								
Grand Total	19	23	16	36	34	35	3	47	2	36	37	9	35	16	8	38	36

Hawkes *et al.* (2006) recorded the Red-listed Cape May Warbler on four occasions in the 2005 bird surveys. All observations were outside of the core study area (i.e. Peace River Valley) on the surrounding uplands. They also detected two additional Blue-listed species not recorded in 2006 (LeConte's Sparrow and Barn Swallow, each detected once). The Ruby-throated Hummingbird was also detected in 2005 surveys but not in 2006.

Species recorded in 2006 but not reported in 2005 by Hawkes *et al.* (2006) include Yellow-bellied Flycatcher, Violet-green Swallow, Townsend's Solitaire, Red Crossbill, Nelson's Sharp-tailed Sparrow (Red-listed; incidental observation), Northern Shrike, Lapland Longspur, Horned Lark, Gray Catbird, Golden-crowned Sparrow, Eastern Kingbird, Calliope Hummingbird, Brown Creeper, Brewer's Blackbird, Black-billed Magpie, American Dipper and American Pipit.

Ecosystem units were determined and recorded at each point count station. Twenty different habitat units were sampled in 2006 (Table 9.2). These units correspond to the ecosystem at the centre of the point count station (location of the surveyor) and may not represent the habitat in which the bird was present. However, surveyors attempted to locate point count stations in the centre of polygons in an attempt to sample uniform habitat types.

Table 9.2 Summary of ecosystem units in which point count stations were completed in 2006.

Ecosystem Unit Name	Ecosystem Unit Symbol	Number of point count stations
Cottonwood - Dogwood	$ab	5
Cottonwood - Horsetail	$ac	62
Aspen - Rose - Soopolallie	$ap	154
Aspen Soopolallie - Fuzzy-spiked Wildrye	$as	2
Alder - Horsetail Floodplain	AH	20
Spruce - Aspen - Rose	AM	73

Aspen - Saskatoon	AS	4
Paper Birch - Red-osier Dogwood	BD	21
Black Spruce - Lingonberry - Coltsfoot	BL	1
Black Spruce - Labrador tea - Sphagnum	BT	1
Cultivated Field	CF	10
Gravel Bar	GB	1
Pine - Lingonberry	LL	5
Road	RZ	2
Spruce - Dogwood	SC	6
Spruce Horsetail	SH	37
Spruce - Cranberry	SO	47
Spruce - Fuzzy-spiked Wildrye	SW	20
Tamarack - Sedge - Fen	TS	3
Wolf Willow - Fuzzy-spiked Wildrye	WW	4
Total point count stations		478

Thirty nests were found during the bird survey, including incidental observations (Table 9.3). Nests of the Yellow-bellied Sapsucker were most commonly observed.

Table 9.3. Nests located during the bird survey (includes incidental observations).

Species	Number Nests Observed
American Robin	1
Baltimore Oriole	1
Bank Swallow	1
Common Raven	1
Dark-eyed Junco	1
Downy Woodpecker	1
Ovenbird	1
Swainson's Thrush	1
Tennessee Warbler	1
White-throated Sparrow	1
Violet-green Swallow	1
Yellow-bellied Sapsucker	18
Yellow Warbler	1
Grand Total	**30**

Incidental Observations

An additional 442 observations were made of passerines outside of standard breeding bird surveys. These included 56 species, four of which were not observed during point count surveys. Additional bird species include the Cliff Swallow, Northern Rough-winged Swallow, Nelson's Sharp-tailed Sparrow and Varied Thrush. The Red-listed Nelson's Sharp-tailed Sparrow was recorded as an incidental observation during amphibian surveys at Watson's Slough on May 23, 2006.

9.4 Recommendations

Black-throated Green Warblers and Canada Warblers are relatively common in the study area and the Peace Lowlands makes up the centre of abundance for both species in B.C (Morse and Poole 2005; Conway 1999). Analysis of the point locations for these species revealed that 50% and 22%, of the Black-Throated Green Warbler and Canada Warbler observations, respectively, were within or directly adjacent to the river floodplain. Sufficient information is available to confirm habitat associations for these species.

Cape May Warblers and Bay-breasted Warblers have not been located in the core study area. These species are associated with mature coniferous stands, and are more likely to inhabit upland habitats.

Nelson's Sharp-tailed Sparrow and Le Conte's Sparrow are associated with herbaceous wetlands, which are not common in the core study area. The lack of suitable habitat likely accounts for the low number detected in the study area.

The recently Blue-listed Rusty Blackbird nests in small trees and shrubs close to water (Avery 1995). Five Rusty Blackbirds were detected along the Peace River in 2006. Four were located in wetland habitats and one on a river island. Additional surveys need to be completed that focus on the expected habitats for this species in the study area.

Northeastern B.C. is the western limit of the breeding range for the Connecticut Warbler (Pitocchelli *et al.* 1997). This species was detected less frequently than expected based on the amount of available suitable habitat present in the study area. Penner (1976) indicated that the Connecticut Warbler is associated with balsam poplar/ spruce islands along the Peace River. Data from 2005 and 2006 suggests that the floodplain habitats might not be used as much as previously suspected.

Additional surveys should be completed to gather additional baseline data on Red- and Blue-listed species including the Black-throated Green Warbler, Canada Warbler, Connecticut Warbler, Bay-breasted Warbler, Cape May Warbler, Barn Swallow, Nelson's

Sharp-tailed Sparrow, LeConte's Sparrow, and Rusty Blackbird. Transects should be established in suitable habitat for these species and emphasis placed on documenting habitat associations of listed species in the Peace River corridor.

10.0 SUMMARY OF RARE WILDLIFE SPECIES LOCATIONS

Rare wildlife species were observed during species-specific surveys and as incidental observations during other surveys. The occurrence of Red and Blue-listed species observed in the study area is illustrated on Figures 10.1a and 10.1b.

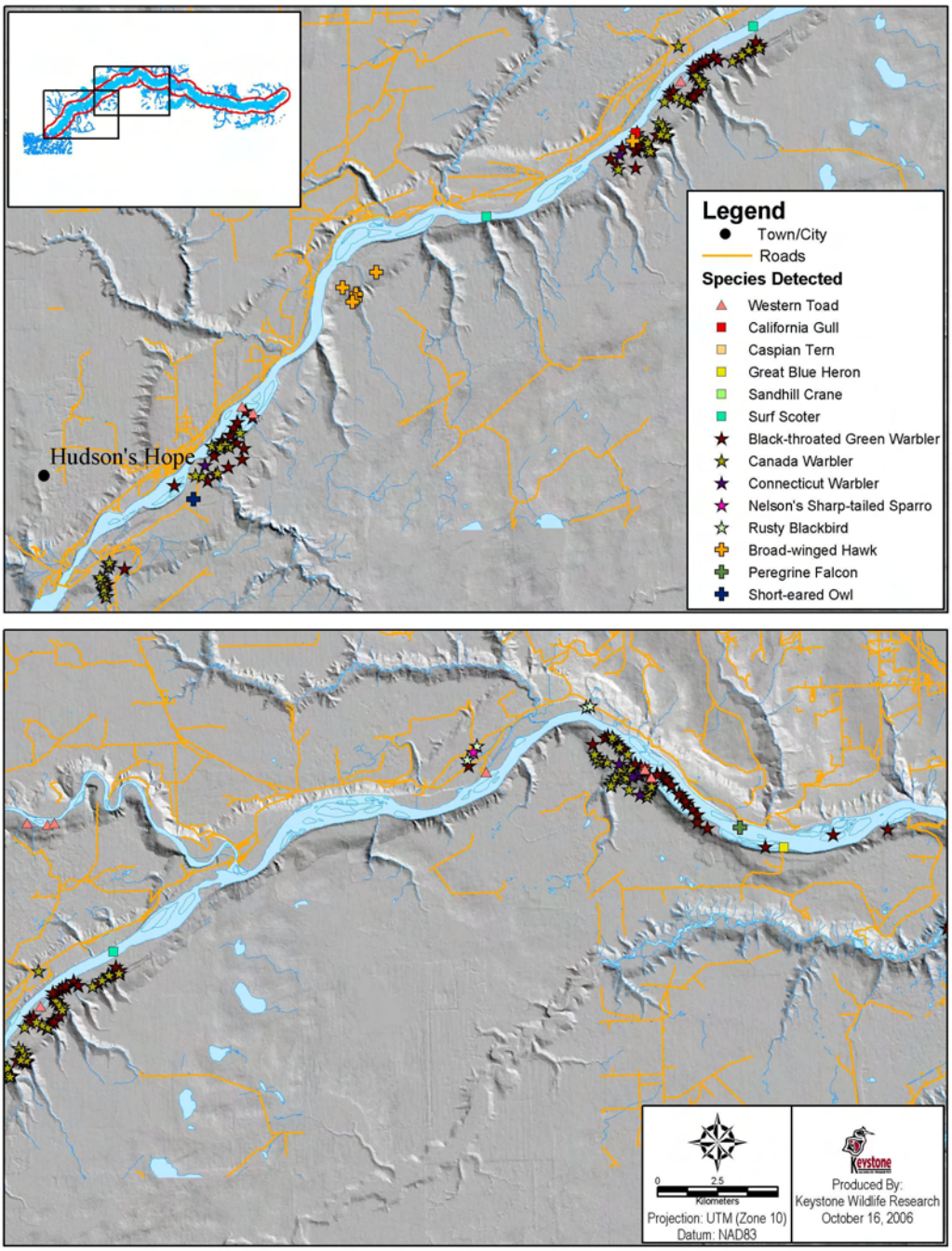

Figure 10.1a. Rare species located during surveys in 2006 in the western portion of the Peace corridor.

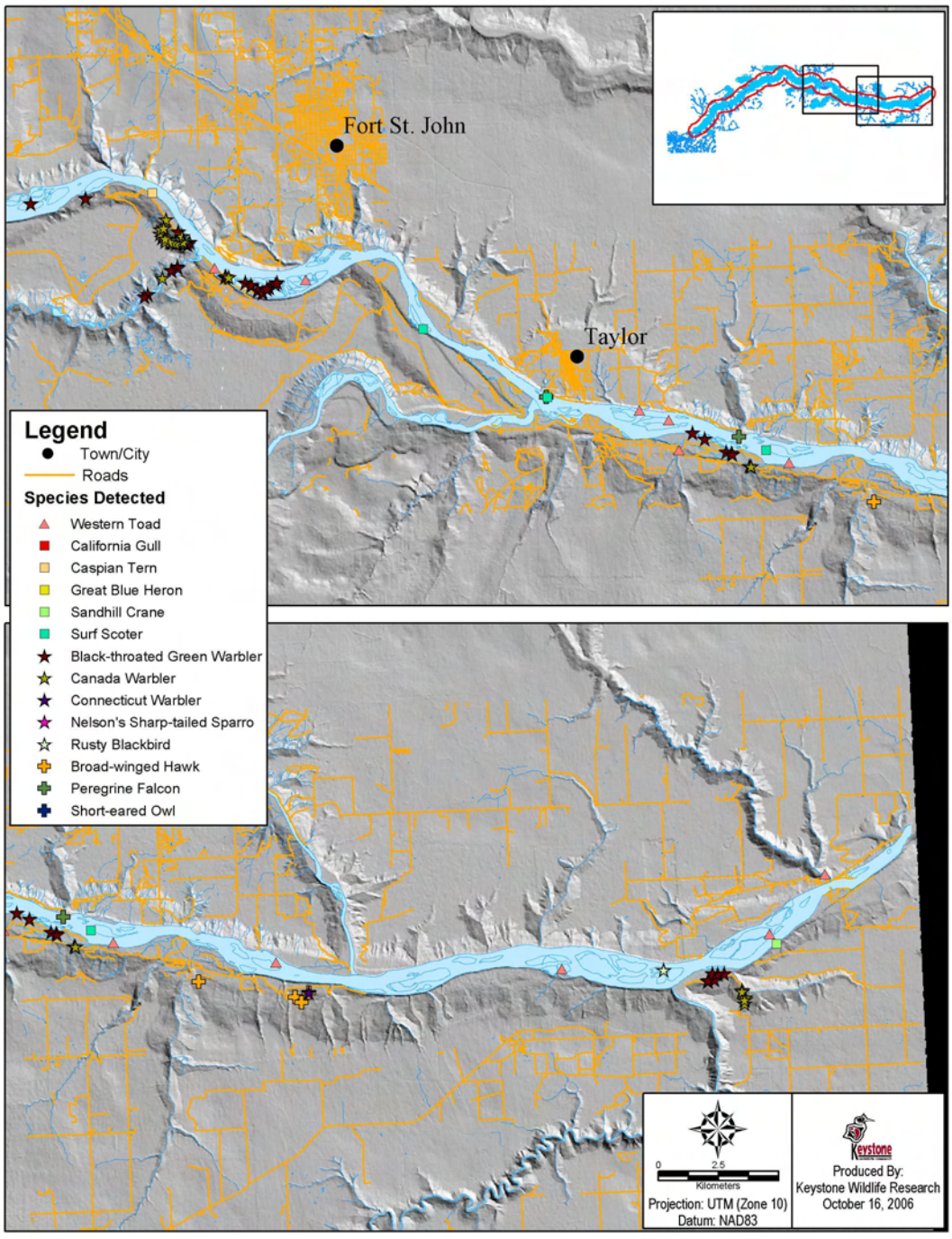

Figure 10.2b. Rare species located during surveys in 2006 in the eastern portion of the Peace corridor.

11.0 BEAVER SURVEYS

Beaver are valued furbearers in the Peace region and a large population is resident in the Peace corridor. An aerial census for beaver was conducted to document lodge locations and estimate the population size within the study area.

11.1 Introduction

Beaver lodge and food cache counts along the Peace River were completed by Keystone on September 13 and 14, 2005 to augment previous surveys completed by Blood in 1976 (Blood 1979) and Simpson in 1990 (Simpson 1991). Beaver surveys generally involve low-level aerial reconnaissance to determine the number of visible lodges, dams and food caches.

Blood (1979) surveyed the Peace River from the Moberly River to Hudson Hope on November 26, 1976 and reported that beavers were abundant in the study area, particularly in back channels. Beaver sign was noted on all creeks, with bank dens built where banks were low and stable. Typical lodges were only seen in a few quiet backchannels. Blood noted that population estimation was hindered by the predominance of bank dens, which are difficult to detect from the air. In addition, many colonies along the Peace River do not establish food caches (the usual indicator of an active den), presumably because they can continue to feed all winter unhindered by ice formation. Both limitations may have reduced the number of colonies counted by Blood (1979) since they would be missed or presumed inactive (no visible cache). During the aerial survey, Blood (1979) observed 18 active colonies, 11 probably active colonies and 16 old colonies. Based on the limitations, the number of beavers expected to be present was adjusted to 30-40 active colonies by Blood (1979). This was equivalent to 150 to 200 animals, assuming 5 beavers occupy each colony (Denny 1952). It was noted that despite the adjustments these figures are probably conservative (Blood 1979).

Simpson (1991) completed an aerial survey to locate beaver lodges and food caches from the Moberly River to Hudson Hope on October 11, 1990. A boat survey was also completed between Halfway River and Wilder Creek on October 12 and 13, 1990 to

locate bank colonies not visible from the air. Seventy-five active lodges and 27 inactive lodges were located during the October surveys. The boat survey confirmed these numbers and resulted in no additional dens counted. Inactive lodges were re-checked in November resulting in a corrected count of 76 active and 26 inactive lodges. Using the same figure as Blood (1979), (5 beavers per colony) the population estimate from this survey was approximately 380 beavers.

Results of the 2006 surveys are summarized below. A more detailed reporting of these surveys is presented in the full text report (Keystone Wildlife Research Ltd. 2009).

11.2 Methods

A food cache count was completed to verify the expected population of beavers, following the methods in ***Inventory Methods for Beaver and Muskrat*** (RIC 1998f). A helicopter was used to fly survey transects along the Peace River. Observers noted the presence of beaver caches and lodges and recorded their location using a GPS and a hardcopy map.

11.3 Results

Surveys conducted by Keystone on September 13, 2005 located 67 active and 60 inactive lodges between Moberly and Hudson Hope (Plates 11.1, 11.2; Figure 11.1). Assuming 5 beavers per colony, these counts result in a population estimate of 335 beavers. Follow-up surveys completed by Simpson in November of 1990 resulted in the change of only one colony from inactive to active, so repeat surveys were not done in 2005.

Plate 11.1. Large lodge and cache, aerial view.

Plate 11.2. Lodge and cache on the banks of the Peace River.

A survey was also conducted downstream from the Moberly River to the Alberta border on September 13, 2005. This survey recorded 75 active and 50 inactive lodges.

The results in Simpson (1991) show that the beaver population in 1990 was close to double that estimated in 1976 (Table 11.1). The results of the 2005 survey show that

the population has remained relatively stable over the last 15 years. The increase in the number of old/abandoned lodges suggests the persistence of disused sites in the now stable river environment. The adjacency of many old inactive lodges to active lodges supports this.

Table 11.1. Summary of beaver lodge counts, between Moberly River and Hudson Hope, completed between 1976 and 2005.

Survey	Active Colonies	Inactive Colonies	Population estimate
Blood (Nov. 1976)	18	27	150-200
Simpson (Oct. 1990)	76	26	380
Keystone (Sept. 2005)	67	60	335

11.4 Recommendations

The beaver population appears to have stabilized along the Peace River mainstem. An additional survey should be completed to document current numbers if and when significant development or habitat alteration is undertaken in the valley.

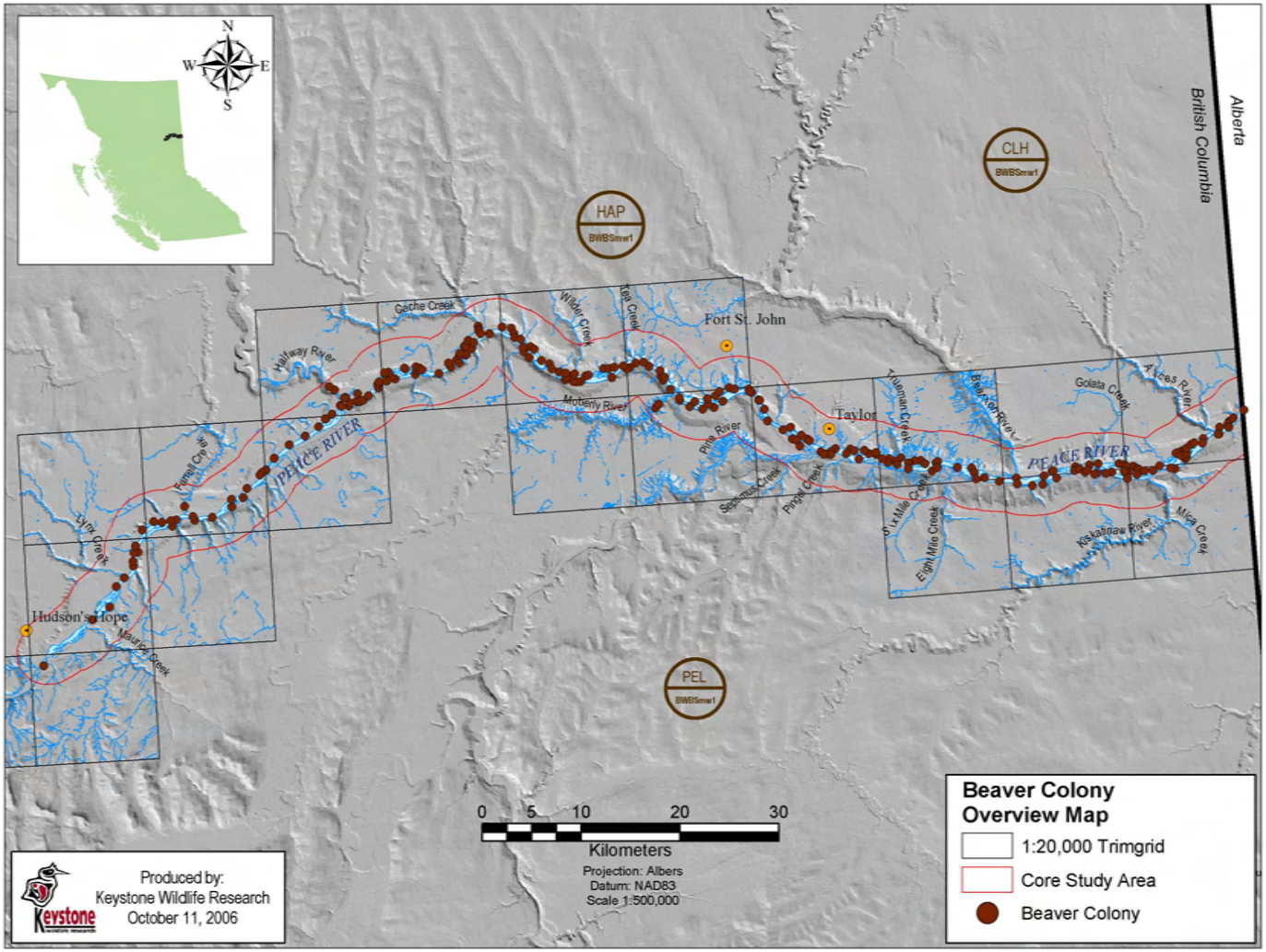

Figure 11.1. Locations of beaver colonies observed during the Peace River survey.

12.0 UNGULATE SURVEYS

12.1 Introduction

Ungulate surveys were completed in mid-winter to estimate the numbers of deer, moose and elk in the study area and compare them with earlier surveys.

Results of the 2006 surveys are summarized below. A more detailed reporting of these surveys is presented in the full text report (Keystone Wildlife Research Ltd. 2009).

12.2 Methods

The study area was divided into survey blocks. The survey blocks defined in 1991 were transferred to TRIM base maps. Some were adjusted in size due to changes in habitat quality (clearing for agricultural use) and some were eliminated due to lack of suitable habitat. Additional survey blocks were delineated in areas downstream of the Moberly River that were not surveyed in 1991.

A pre-stratification flight using a fixed-wing aircraft was conducted to stratify the blocks. The stratification was completed to classify each block as high, moderate or low abundance of each species, based on the current conditions (e.g. snow cover). Count surveys used a Bell Jet Ranger helicopter. Survey methods followed Unsworth *et al.* (1991) and ***Aerial-based Inventory Methods for Selected Ungulates: Bison, Mountain Goat, Mountain Sheep, Moose, Elk, Deer and Caribou*** (RIC 2002). Count data was analysed using Aerial Survey software (University of Idaho 2004). Count data collected in 1991 were not recorded in the same form (i.e. group sizes and vegetative cover were not recorded) but were re-analysed using the 2004 software to enable the closest possible comparisons. The University of Alaska model (Gasaway *et al.* 1986) was used to estimate the population size and confidence limits for each species in 1991.

12.3 Results

Twenty-nine survey blocks were defined in 1991: 6 in the valley bottom upstream of the Moberly River, 14 on south aspect river breaks and 9 on north aspect breaks (total 29). Those same blocks were included in the census area for 2006 except blocks 12 and 14 (south aspects) were eliminated due to extensive clearing and development. Additional

blocks were added downstream of the Moberly river, including nine new blocks on south aspects, seven on north aspects and four on the river valley bottom. The 2006 survey therefore included 21 south aspect blocks (stratum 1), six blocks in the Peace River valley bottom upstream of the Moberly River (stratum 2), 16 north aspect blocks (stratum 3) and four blocks in the Peace River valley bottom downstream of the Moberly River (stratum 4). Forty-seven blocks were defined in 2006 (Table 12.1, Figure 12.1).

Pre-stratification was completed on Feb 14 using a fixed wing aircraft and block counts were completed using a Bell Jet Ranger with three observers from February 15 to 18, 2006. Weather conditions were mainly cloudy with temperatures from -5 to -22^{o} C. Snow cover was over 90% in valleys and on north aspects. There was limited snow on south aspects except on level forested benches.

Table 12.1. Ungulate block counts completed along the Peace River in February 1991 and 2006.

Block #	Area (Ha)	Search Time (min)	# Moose		# Mule Deer		# Elk	
			2006	1991	2006	1991	2006	1991
Peace River valley bottom upstream of the Moberly River (Stratum 2)								
1	1072	25	6	14	3	5	0	0
2	1536	37	18	25	2	21	23	5
3	2075	48	11	35	53	33	56	0
4	1838	38	20	24	19	31	26	2
5	1505	40	3	10	7	13	0	0
6	1988	46	8	6	30	78	0	0
Subtotals		234	66	114	114	181	105	7
Peace River valley bottom downstream of Moberly River (Stratum 4)								
32	1727	37	10		10		5	
33	2313	40	19		10		20	
Subtotals		77	29		20		25	
South aspect breaks (Stratum 1)								
11	746	24	25		70		0	
12	486			18		293		0
13	492	32	17	8	97	160	81	22
14	897			7		121		0
15	587			13		260		0
16	567	20	6		27	72	48	
17	423			4		248		0
18	408	28	7		99		16	
19	279			7		64		50
20	530			17				19
37	572	38	15		225		14	
41	675	22	11		84		0	
Subtotals		164	81	74	602	1332	159	91
North aspect breaks (Stratum 3)								
22	601			14		52		0
24	487			8		0		0
26	590	28	5	9	9	35	0	1
27	596	29	1		18		0	
28	613	26	3	8	1	9	0	0
48	779	21	3		11		0	
50	753	26	9		99		0	
Subtotals		130	21	39	138	96	0	1

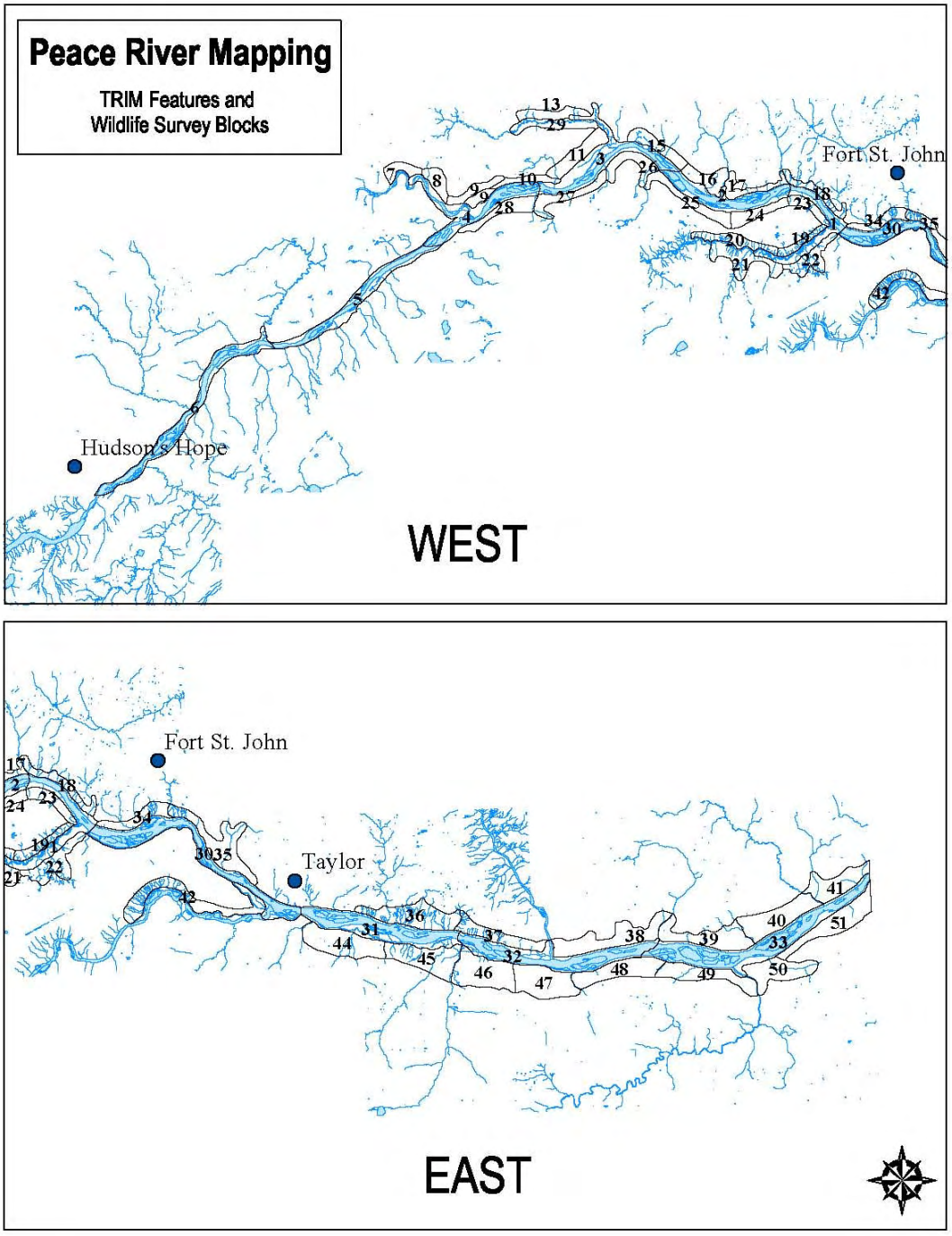

Figure 12.1. Blocks defined to census deer, moose and elk along the Peace River in February 2006.

Strata 2 and 4 were expected to support similar numbers of animals but were separated in order to maintain a separate comparative sample for the area upstream and downstream of the Moberly River. Blocks were bounded by obvious geographical features and varied in size from 3 to 20 km^2. The largest blocks were along the river where a large portion was open water and gravel bars. All sample blocks were searched in less than one hour of helicopter time. Nineteen blocks were counted including all 6 upstream of the Moberly River and 13 randomly selected from other strata using a computer random number table.

The numbers of moose counted were similar to 1991 in all strata (Table 12.1). Numbers of deer seen were similar on north aspects and in the valley bottom, but were substantially lower on south aspects than in 1991. Numbers of elk were greater on south aspects and in the valley bottom and they occurred mainly in a few large groups (Table 12.1). Few (10) white-tailed deer were observed and population size was not estimated. Snow depths were 15-20 cm, well below average (50 cm; Simpson 1991). Ungulates were widely dispersed in many locations on the plateau and in agricultural areas. These areas are not considered critical winter range. It is expected that with more normal snow depths, counts would be 2-3 times greater than those observed, particularly for mule deer and elk.

Population estimates incorporate sampling variability as well as small sightability corrections generated by the University of Idaho software (2004). Numbers of moose and mule deer in the valley bottom upstream of the Moberly River were similar to 1991 but there was a large (10x) increase in the number of elk (Table 12.2). Similar numbers were noted for all three species downstream along the Peace River mainstem. The number of blocks included on north and south aspect breaks was 1/3 greater in 2006 so the population estimates are not directly comparable.

Table 12.2. Computer-generated ungulate population estimates along the Peace River in 1991 and 2006, generated from survey results, sampling variability and sightability corrections.

Strata	# blocks	Year	# Moose	# Mule Deer	# Elk
Valley bottom upstream of the Moberly River	6	1991	118±16	243±79	8±3
	6	2006	115±69	197±48	119±13

Strata	# blocks	Year	# Moose	# Mule Deer	# Elk
Valley bottom downstream of the Moberly River	not surveyed	1991			
	4	2006	66±29	64±24	53±36
South Aspect Breaks	14	1991	135±36	2340±267	159±97
	21	2006	396±124	3663±1214	595±419
North Aspect Breaks	9	1991	90±19	284±152	3±3
	16	2006	205±193	615±484	0
Totals	29	1991	343±43	2867±317	170±97
	47	2006	782±241	4539±1308	767±461

± 90% confidence interval, 1991 results approximated using re-analysis of old data

12.4 Recommendations

Estimated numbers of mule deer, moose and elk were similar on the breaks between 1991 and 2006. It is clear that the south aspect breaks support the highest numbers of all three species and in a normal winter, with deeper snow on the plateau, we expect that the 2006 estimates would be much higher. The surveys in 1991 were done under more normal conditions (snow depths > 50cm; Simpson 1991) when ungulates would have been more concentrated on the breaks. The variability of the counts and wide confidence limits also reflect the dispersed distribution of the animals. Regional populations of mule deer and elk have increased since 1991 and moose have remained fairly stable (J. Elliot - pers. comm). These survey data and associated population estimates support that conclusion. It would be advisable to repeat the census with more normal winter snow conditions to confirm the numbers of ungulates using each area.

13.0 RAPTOR/HERON SURVEYS

Large stick nests (most created by eagles) are a prominent feature along the Peace River. They are associated with large older trees and are vulnerable to disturbance and changes to flood regimes. An inventory of nest sites was undertaken to identify species using the nests and quantify the number of active nests in the valley.

13.1 Introduction

Diurnal predatory birds or raptors including eagles, Osprey, hawks, and falcons were identified in the 2005 scope of study (Keystone Wildlife Research Ltd. 2005) as potential species of concern. The Osprey and Bald Eagle are strongly associated with riparian habitats and are expected to use the river corridor, while hawks and falcons inhabit upland habitats. Priority species expected to occur in the study area include the Blue-listed Broad-winged Hawk and the regionally important Bald Eagle.

Thurber (1976) reported a number of raptor species in the Peace River area, including the Bald Eagle, Golden Eagle, Osprey, Red-tailed Hawk, Swainson's Hawk, Rough-Legged Hawk, Northern Goshawk, Sharp-shinned Hawk, Northern Harrier, American Kestrel, and Merlin. Generally, these species nest in mature to old forests and cumulative loss of that habitat through previous inundation and forestry has increased the value of the remaining habitat in the study area.

Sightings of Broad-winged Hawks have been recorded by local naturalist groups, but there are no confirmed nest records for the study area. Broad-Winged Hawks have also been reported in the area by Fraser *et al.* (1999).

Thurber (1976) and Robertson (1999) also reported Great Blue Herons in the study area during the breeding season. In addition, a local bird expert reported the possible presence of a small heron colony near the confluence of the Peace and Pine Rivers (Robertson 1999).

Hawkes *et al.* (2006) surveyed the study area for raptors in June and July of 2005 using a number of methods including road-transect surveys, aerial surveys, boat surveys and incidental observations. Eleven species of diurnal raptors were documented in the core

and periphery area, including Bald Eagle, Golden Eagle, Red-tailed Hawk, Northern Goshawk, Northern Harrier, Sharp-shinned Hawk, Cooper's Hawk, Osprey, American Kestrel, Merlin and Broad-winged Hawk. Twenty-one active Bald Eagle nests were reported from an aerial survey.

The primary objective of this survey was to quantify the number of raptors nesting in the river corridor, with emphasis on determining the status of the potential heron colony and locating potential Broad-winged Hawk nest sites. All raptors sighted during other survey work were recorded.

13.2 Methods

An aerial reconnaissance was completed during the non-breeding season prior to leaf-out in February 2006. Nests located during the reconnaissance survey were revisited in the breeding season to confirm activity. Procedures for aerial surveys followed those outlined in ***Inventory Methods for Raptors*** (RIC 2001) and ***Inventory for Colonial-nesting Freshwater Birds: Eared Grebe, Red-Necked Grebe, Western Grebe, American White Pelican, and Great Blue Heron*** (RIC 1998c).

The winter flights were completed in conjunction with ungulate surveys to optimize flight time. Nest sites were recorded during the ungulate census and blocks 31 and 32, which were not selected for the ungulate census, were searched specifically for nests (Figure 12.1).

A database of potential nest locations was compiled from the winter nest surveys as well as from incidental observations made during TEM field truthing in 2005 and spring waterfowl surveys in 2006. Nests reported in 2005 (Hawkes *et al.* 2005) were also included. This process resulted in 78 potential nest sites, which were digitally represented on survey maps. Since the nest sites were compiled from multiple surveys, duplicate observations of the same nest site existed, therefore the number of actual nests was expected to be fewer than 78. However, since some sites might contain more than one nest, all points were visited in the field. Each potential nest site was added to the survey map and was visually assessed from the helicopter to determine if a nest was present, its status and what species occupied it.

Ozi Explorer software was used to navigate and to record the flight route. This program provides real time tracking on digital survey maps using a GPS signal The system allows surveyors to locate previously identified nests and to accurately georeference current nest locations. Nest locations were recorded on the survey maps and a digital log file was created for each point. Three observers, as well as the pilot, were used on all surveys.

Spring flights were completed in conjunction with waterfowl surveys. Potential nest sites were visually inspected from the air. If a nest was not observed then the immediate area was searched until surveyors could reasonable assume that a nest was not present. Points were digitally added in Ozi Explorer for each nest to get an accurate representation of the nest location.

Nests were classified based on the breeding activity and the potential species. A nest was active if an adult was on the nest or if chicks or eggs were present. Nests were classified as inactive if the nest had no sign of recent use. If no raptors were present at the nest site then the species group was deduced based on the size of the nest and location of the nest on the tree.

13.3 Results

Winter surveys were conducted by helicopter (Bell Jet Ranger) on February 15 to 18, 2006. Weather conditions in February were mainly cloudy with temperatures from –5 to -22^{o} C.

The winter nest search resulted in the identification of 32 (30) large stick nests, 20 of which were located west of the Moberly River. Most sites had single nests but four sites had two nests and one had five nests. The five-nest site located near the BCR bridge, was thought to be a potential heron colony.

Most of the nests were judged to be constructed by eagles and many had single or pairs of eagles on them. Six of the nests were judged to be hawk nests and one was probably osprey.

The spring nest searches took place between May 25th and 26th, 2006. The weather conditions were scattered clouds with temperatures ranging from 10 to 12^{o}C. The

observers viewed 78 potential nest sites, including duplicates. Of the 78 potential sites, 57 were judged to be distinct nest sites by identifying duplicate clusters of points. No nests were observed at 18 of the 57 sites. This may have been due to foliage obscuring the nest or the nest could have fallen from the tree over the winter. Thirty-nine nests were recorded (Figure 13.1).

Seventeen active Bald Eagle nests (Plate 13.1) were documented with adults on the nest or in the immediate vicinity. Fifteen of the active nests were productive, containing one or more chicks, one contained an egg (possibly abandoned) and one contained an incubating adult. Twenty-two nests were inactive; thirteen of those were probably eagle nests and nine were smaller, possibly those of crows or a small hawk. No Broad-winged Hawk nests were located during the survey.

A Bald Eagle pair occupied one nest at the location of the suspected heron colony identified in the spring survey. Four old, inactive nests (species undetermined) were observed in the immediate vicinity of the active nest.

All eagle nests were found in large balsam poplar trees. Aspen forests in the study area typically have dense canopies, making nests in this forest type difficult to detect from the air after green-up. The winter surveys located five nests outside the river corridor and four of the five nests were small. Balsam poplar along the river and islands definitely supported the majority of large conspicuous nests.

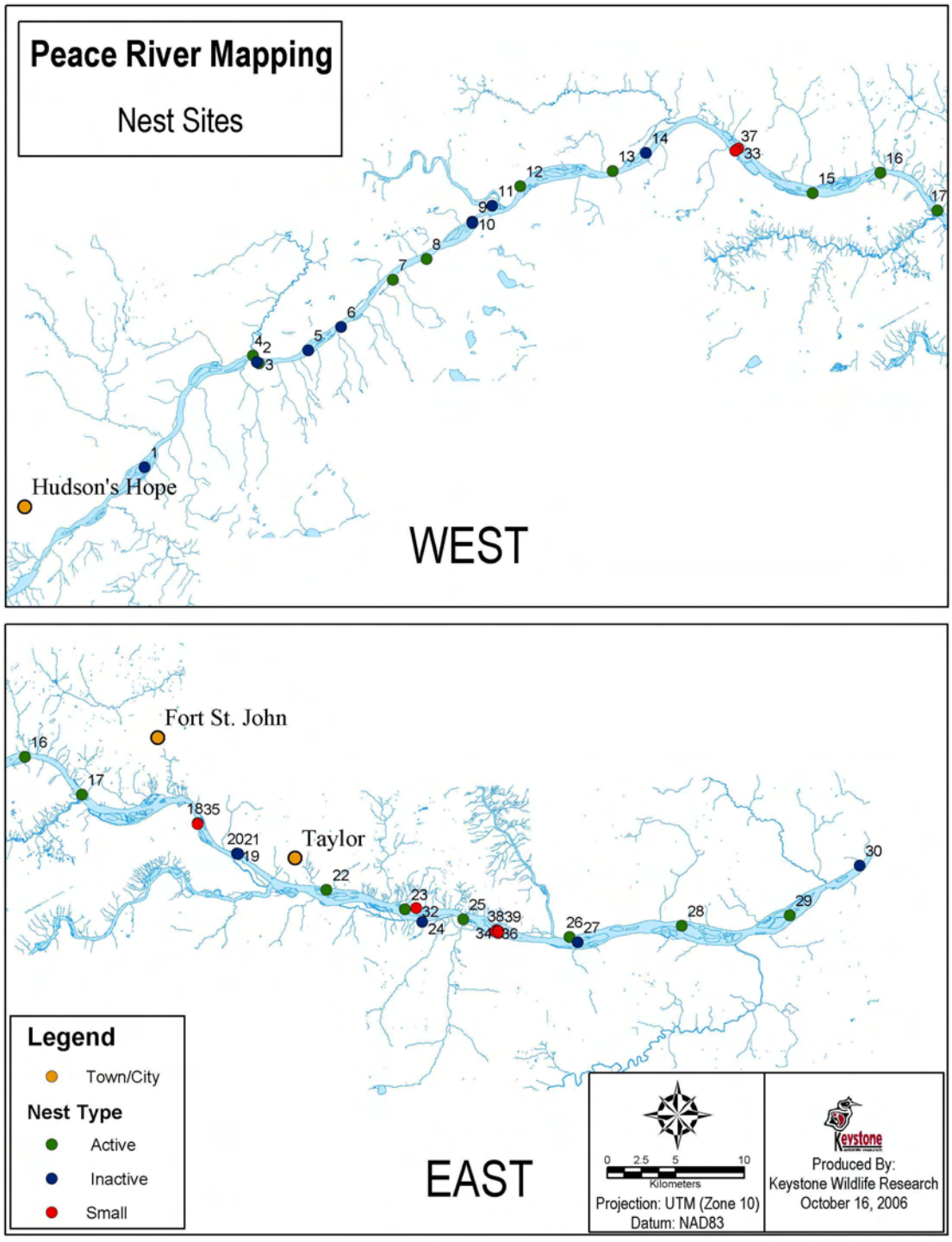

Figure 13.1. Large stick nest site locations along the Peace River, May 2006.

Plate 13.1. Bald Eagle nest (L. Simpson photo).

Incidental Observations

Observations of raptor were recorded on a number of surveys targeting other species groups (passerine birds, waterfowl, ungulates, beaver) as well as during TEM field-truthing. A list of species observed is presented in Table 13.1.

Table 13.1. Diurnal raptors observed during the Peace River surveys.

Species	Species Code	Number observed	Expected Occurrence in the Area	BC Status
American Kestrel	B-AMKE	55	Common	
Bald Eagle	B-BAEA	168	Common	
Broad-winged Hawk	B-BWHA	10	Rare	Blue
Golden Eagle	B-GOEA	1	Rare	
Merlin	B-MERL	11	Uncommon	
Northern Goshawk	B-NOGO	9	Rare	
Northern Harrier	B-NOHA	22	Uncommon	
Osprey	B-OSPR	1	Common	
Peregrine Falcon (ssp. *anatum**)	B-PEFA	4	Rare	Red
Red-tailed Hawk	B-RTHA	60	Uncommon	
Sharp-shinned Hawk	B-SSHA	20	Uncommon	
Rough-legged Hawk	B-RLHA	1	Common	

* assumed subspecies

Ten observations of the Blue-listed Broad-winged Hawk were recorded. Eight of the ten sightings occurred in September when Broad-winged Hawks are expected to be migrating (NatureServe 2006). The remaining observations were made in June and July, which could indicate breeding. Hawkes *et al.* also recorded several Broad-winged Hawks in June and July.

The home range of Broad-winged Hawks has been poorly studied, but distances between nests can range from 1.1 to 1.7 km (Goodrich *et al.* 1996). If ½ of the linear distance between two nests is assumed to be the radius of a circular home range, then the home range for a Broad-Winged Hawk can be 1.0 to 2.3 km^2. Home range estimates for hawks and falcons as a species group indicate that home ranges are on the order of 7 km^2, which would result in a 1.5 km radius for a circular home range (NatureServe 2006). If the estimated radius (0.55 to 1.5 km) is considered to be the maximum distance between observation points, and observation points within this distance are clumped to represent one individual or one pair, then surveys observations in 2006 represent four to six individual Broad-winged Hawks.

Peregrine Falcons were reported breeding in the Peace River area in 1964 but very little is known about the current population (Campbell *et al*. 1990). This Red-listed raptor was observed in the Peace River corridor in April and September of 2006, which coincides with spring and fall migration (White *et al.* 2002). The lack of suitable nesting habitat for this species also indicates that they are seasonal migrants within the study area.

13.4 Recommendations

Broad-winged Hawks nest in dense aspen forests, often on a slope, near wet areas or openings (Fraser *et al.* 1999). Nests are small, measuring 30 to 53 cm (outside diameter) and are found in the first main crotch of the tree in the bottom third of the canopy (Goodrich *et al.* 1996). Fraser *et al.* (1999) recommended that standardized surveys for Broad-winged Hawk nests be completed in the Peace Lowlands Ecosection using TEM mapping to identify suitable habitats.

The presence of Broad-winged Hawk along the Peace River in the breeding season suggests that the species is breeding in the area. The breeding population in B.C. is expected to be extremely small (Fraser *et al.* 1999). Habitat preferences of this species in conjunction with the observation records from 2005 and 2006 suggest that this

species is using the forested aspen slopes rather than the river corridor. It is also notable that the suitable habitat for this species is abundant outside the river corridor but likely has a limited distribution along the river corridor.

The presence of alternative nesting sites outside of the main river corridor should be investigated, and the river corridor should be re-surveyed to update nest location/activity data and provide trends for comparative purposes. Nest structures should be viewed from a helicopter to determine the species present and the activity at each site. In particular, efforts should be made to locate potential Broad-winged Hawk nest sites.

Most eagles nest in the large balsam poplar found in floodplain habitats along the Peace River. The estimated linear nesting density in the study area is 10.6 active Bald Eagle nests per 100 km of river shoreline. The presence of alternative nesting sites outside of the river corridor should be investigated. In addition, the impacts that other reservoirs (Peace-Williston) had on the resident eagle population should be researched to determine if eagles will use alternative habitats and what types of habitats are preferred. The nest surveys should be repeated prior to any potential hydroelectric development to update nest location data and provide trends for comparative purposes.

14.0 FURBEARER SURVEYS

Furbearers have economic and First Nation significance and fishers are Blue-listed provincially. Surveys were undertaken to confirm their presence in the valley and develop better predictors of habitat quality for the Peace ecosystems, which are unusual because they are predominantly deciduous forest.

14.1 Introduction

Furbearer surveys were undertaken primarily to document the occurrence and habitat associations of fishers, which are thought to be more common in the Omineca-Peace region than in other parts of the Province, based mainly on regional harvests reported to the Provincial Fur Harvest Database between 1993 and 2001 (Weir 2003).

Results of the 2006 surveys are summarized below. A more detailed reporting of these surveys is presented in the full text report (Keystone Wildlife Research Ltd. 2009).

14.2 Methods

Snow tracking was used to identify sites being used by marten or fisher. Tracks cannot be used to reliably distinguish between marten and fisher, so camera stations were set up to confirm use by fishers.

Snow Tracking

Tracking sites were selected based on known habitat preferences of fisher and varied from young to mature trembling aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), or white spruce (*Picea glauca*) stands, or mixed forest. Tracking surveys generally followed methodologies described in ***Inventory Methods for Medium-sized Territorial Carnivores: Coyote, Red Fox, Lynx, Bobcat, Wolverine, Fisher & Badger*** (RIC 1999). A tracking form was completed for any mustelid (weasel family) or lynx (Lynx canadensis) track encountered (Appendix 1). A ground inspection form (GIF; BC MELP and BC MoF 1998) was completed when a marten or fisher track was encountered. Habitat attributes recorded included elevation, slope, aspect, slope position, ecosystem unit and structural stage. Tracks of snowshoe hare, red squirrel, and coyote, which were abundant in many areas, were not recorded to save time and

increase the area searched for the target species. Other uncommon species such as otter, mink and lynx were recorded when encountered.

Remote Cameras

Camera stations were selected based on typical fisher habitat (young to mature deciduous and mixed forest, or white spruce stands) and/or areas where fisher or marten tracks had been found during the tracking survey. Seven bait/camera stations were set up using Trailmaster Second Generation TM1550 Active Infrared Trail Monitors and Canon 35 mm cameras between Taylor and Hudson's Hope, British Columbia. The Trail Monitors consisted of an infrared beam transmitter and receiver, with the receiver attached to the camera via a cable. Cameras were set up in trembling aspen or balsam poplar forest stands on flat or gentle slopes.

Trees selected were large enough to mount the bait and equipment and also large enough that the trees would not move significantly during windy conditions. The infrared receiver was mounted facing north so that the sun did not interfere with receiving the beam.

Three trees were selected in a general north-south direction, with the middle tree being slightly off-set (10-15 cm) from the outside trees (Figure 14.1). This arrangement would pass the infrared beam 5-15 cm in front of the tree with the camera. The camera was set on the tree with the receiver facing the bait tree, giving a side view of the station. When a fourth tree was available in front of the bait tree, the camera was set on this tree opposite the bait (Figure 14.2). The cameras were mounted to the trees using screws, washers, and the tripod provided. The camera was normally set up sideways to take a vertical photo of the tree. The beam transmitter and receiver were placed in trees approximately 2 m above ground to reduce the chances of interference from other non-target, terrestrial species (e.g. wolf, coyote, hare).

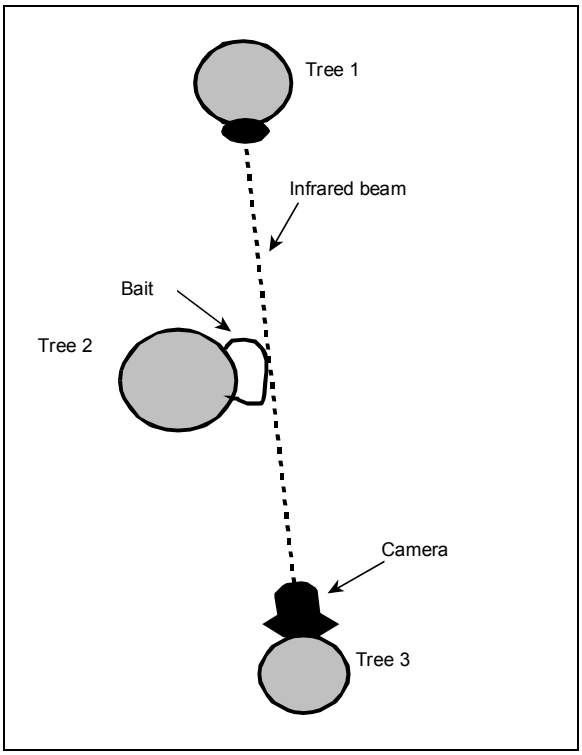

Figure 14.1. Cross-sectional diagram showing arrangement of remote camera station, three tree configuration.

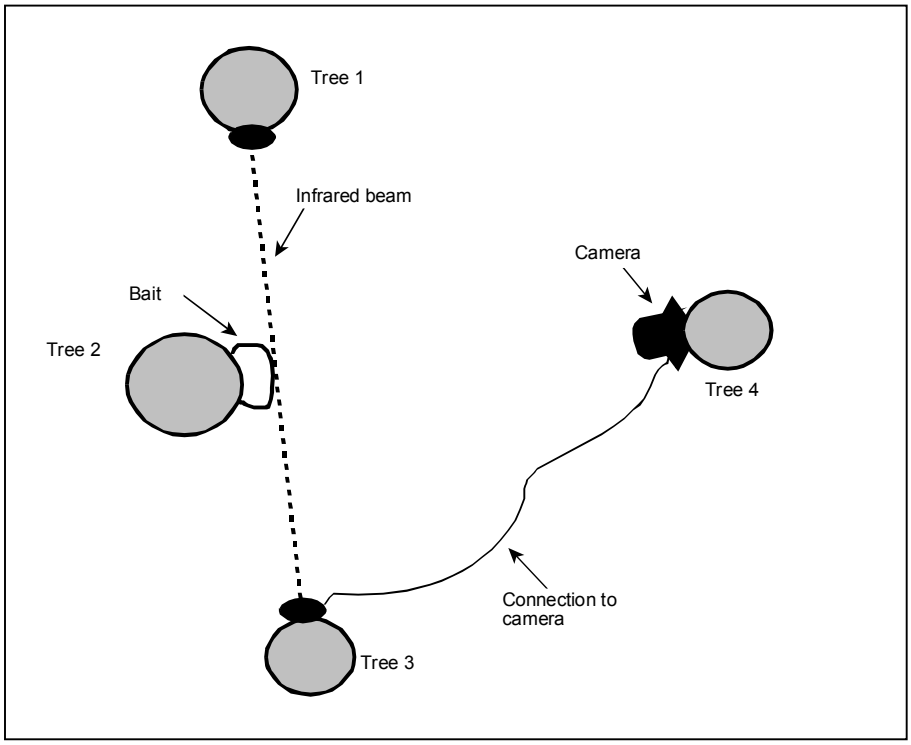

Figure 14.2. Cross-sectional diagram showing arrangement of remote camera station, four-tree configuration.

The bait for all the stations was beaver obtained from local trappers. Bait was wrapped in 5 mm metal mesh and secured onto a tree with fencing staples. This size was used to help deter avian scavengers (i.e. corvids) and squirrels. The bait was placed approximately 5-15 cm above where the beam would cross in front of the tree. Cameras were triggered when the infrared beam was broken. Three different scents where placed above the bait and with the bait. The scents used included a commercial canid lure (consisting of skunk scent), a fisher lure, and a marten lure mixed with raspberry jam and anise seed (Jones and Raphael 1993; Weir 2006). The scents were placed on the tree above the bait using a small stick to help disperse the smell via wind. The used stick was placed in the wire mesh with the beaver.

The transmitters and receivers were attached to the trees using the provided adjustable straps, or duct tape if the tree was too large for the straps. The transmitters, receivers, camera tripod and cables were duct-taped around the tree for additional support when needed. If cables crossed from one tree to another, they were first wrapped around each tree as high as possible and then duct-taped in place. The station number was written in black marker on a note card and placed in a clear ziplock bag, then taped to the bait tree facing the camera (Plate 14.1).

The **pulses to miss (-P)** of the receivers (and consequently cameras) was set to record an event and take a photograph when the beam pulse was missed for a minimum of 0.25 seconds (-P 5).

The **delay function (cd)** for all receivers was set to take a photograph at a maximum of one photograph every 5 minutes (cd5.0). If the beam was broken again within 5 minutes after a photograph is taken (i.e. the same animal at the bait), the camera would not trigger again until 5 minutes had passed. The receiver continued to record events regardless of the time passed between the events. The **camera time zones (CTZ)** were set to take photographs 24 hours a day. Each camera had an automatic flash.

Once a station was set up, the transmitter and receiver were tested to ensure proper function of the data-logger (receiver) and then reset. The camera was then turned on and a test photo was taken to ensure the whole station was properly functioning.

Plate 14.1. Typical bait and beam transmitter set-up.

14.3 Results

Snow Tracking

Fourteen separate fisher/marten tracks were found over 41.4 km traversed (Table 14.1; Figure 14.3), resulting in a track every 2957 m. A track was assumed to indicate one individual. It is difficult to distinguish between marten and fisher tracks in snow unless tracking conditions are excellent so separation of the two species is rarely possible (RIC 1999). Eight tracks were encountered that were thought to be from fisher based on size and gait (Table 14.2).

Table 14.1. Summary of fisher (MAPE) and marten (MAAM) tracking results in the Peace River Valley.

Number of days surveyed	Number of transects completed	Distance surveyed (km)	Number tracks encountered (MAPE or MAAM)
9	19	41.4	14

Other species encountered included: lynx, otter, mink, and unknown weasel (Table 14.2). Red squirrels, snowshoe hare, coyote and wolf tracks were also observed but these non-target species were not recorded.

Table 14.2. Species track totals found during surveys.

Fisher	Marten	Lynx	River Otter	Mink	Unk. Weasel
8	6	1	1	3	8

Marten/fisher tracks were encountered in structural stages 4 (15-40 years) to 6 (80-140 years) forest, on slopes ranging from flat to 35%, indicating their use of a variety of structural stages during the winter (Table 14.3). The ease of finding tracks increased after light snowfalls of 1 - 2 cm, conditions that occurred on four of the nine sample days. Light snow over a harder crust provided the best substrate for finding furbearer tracks. Many areas in the study area had little or no snow cover (i.e. south aspect slopes or white spruce dominated canopies). North aspects and deciduous-dominated forest had more continuous snow cover and were the areas selected for tracking surveys.

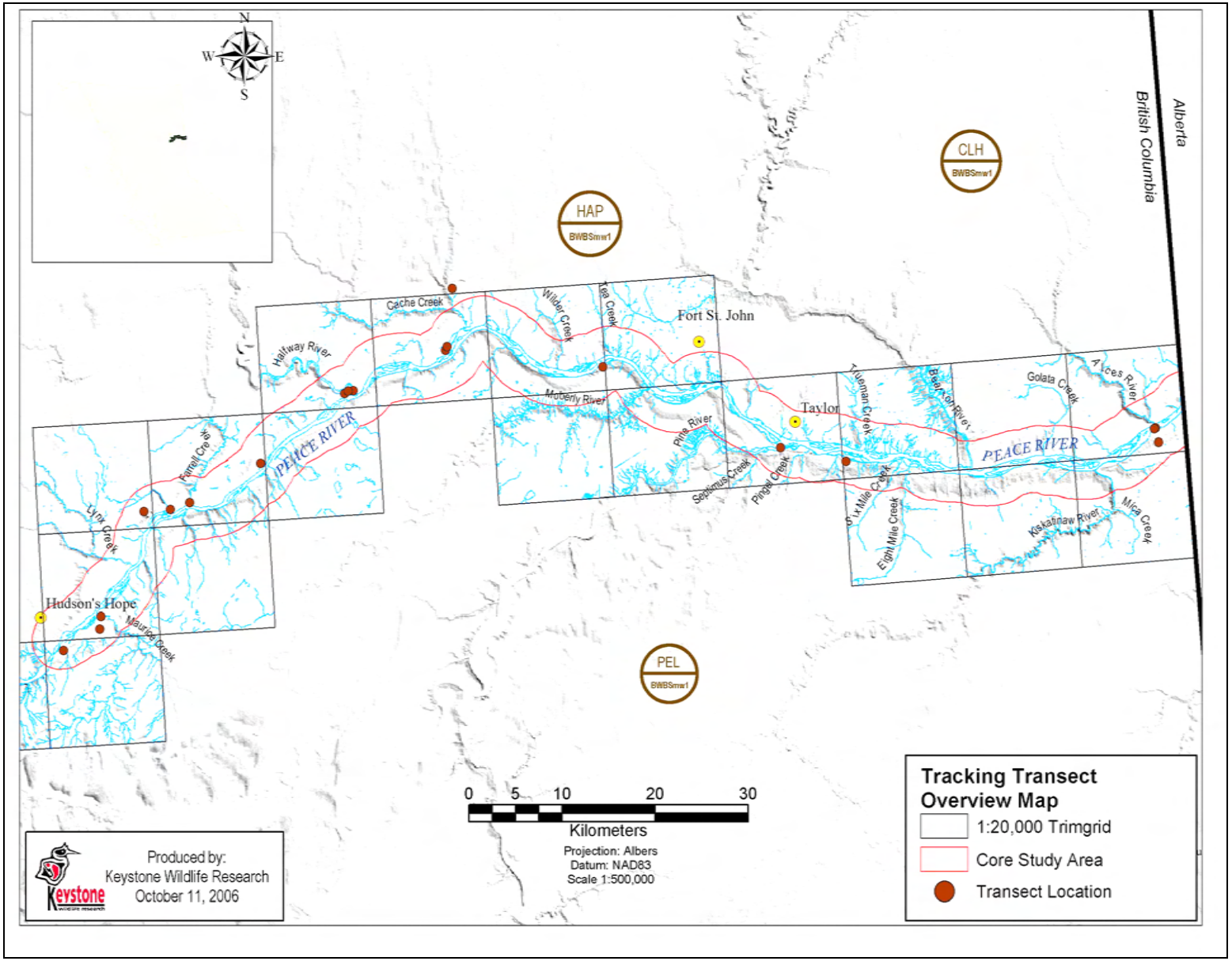

Figure 14.3. Locations of furbearer tracking transects.

Table 14.3. Site conditions at plots where marten/fisher tracks were found.

Plot	Date	Site Series *	Site Series Symbol*	Struct. Stage*	Slope Gradient	Aspect (degrees)	Meso Slope Position	Site Notes
WS2-1	Feb 19, 2006	$01	$ap	4	0	N/a	CREST	Fisher 27cm STRIDE 14cm STRADDLE HIND L 8cm W 5.5cm UTM 6078/62414
WS2-2	Feb 19, 2006	00	AS	4	35	270		Marten 37cm STRIDE 11cm STRADDLE HIND L 6.5cm W 5cm
WS4-3	Feb 20, 2006	$01	$ap	5	2	360	CREST	Marten STRADDLE 8.8cm STRIDE 13.5cm HIND W 5cm L 6.3cm TRAIL GOES UP TREE, SQUIRREL TRACKS ALONG SAME TRAIL PLOT #CD4-4 OLD TRACK 62075/5672 MARTEN 2X2 BOUND STRADDLE 49.5cm STRIDE 19.5 50/50 AT/SW - LOW SHRUBS
WS7-1	Feb 21, 2006	07	SH	6	0	N/a	LEVEL	FISHER W-6.5cm L 6.5cm STRADDLE 14.5cm STRIDE 23.5cm old track, snowed on and melted, maybe 2+ days old
WS7-5A	Feb 21, 2006	07	SH	3	0	N/a	LEVEL	FISHER W 6.5cm L 7.5cm STRIDE 33cm STRADDLE 11.5cm

Plot	Date	Site Series *	Site Series Symbol*	Struct. Stage*	Slope Gradient	Aspect (degrees)	Meso Slope Position	Site Notes
WS16-5	Feb 25, 2006	05	SO	6	0	N/a	LEVEL	FISHER WALK L 5.5cm W 5.5cm STRADDLE 12cm STRIDE20cm track goes into open area across frozen water.
WS17-1	Feb 26, 2006	$01	$ap	5	0	N/a	LOWER	FISHER L 5.5cm W 7cm STRADDLE 10cm STRIDE 58cm OLD TRACK BEFORE LAST SNOW
WS17-2	Feb 26, 2006	$01	$ap		9	320	LOWER	FISHER OLD- SNOW COVERED STRADDLE 10CM/10CM STRIDE 51CM/57CM W 4/5CM L 6.5/7CM
WS17-3	Feb 26, 2006	03	SW	6	10	355	DEPRESSION	MARTEN 2X2 BOUND STRADDLE 10CM STRIDE 46CM W 4.5CM L 55. CM FISHER CD17-4 POLY27 STRIDE 17CM STRADDLE 13CM W 5.5CM L 6CM FOLLOWING UPSTREAM
WS17-7	Feb 26, 2006	$05	$ab		18	335	MIDSLOPE	MARTEN 2X2 BOUND FRESH TRACKS - OVERNIGHT STRADDLE 8.5cm STRIDE 59CM HIND W 4CM L 6.5CM FRONT W 3.5 L 6CM 1X2X1 RUN STRADDLE 8CM STRIDE 67CM

*see Appendix 4 for definitions.

Remote Cameras

Seven camera stations were set up (Table 14.4; Figure 14.4). The Taylor (Stn. 7), Hudson's Hope (Stn. 1) and Red Creek (Stn. 2) sites were accessed by road, and the remaining 4 sites (Stns 3-6) were accessed by helicopter.

Table 14.4. Locations and habitat attributes of camera stations.

Camera	Mapsheet	UTMx	UTMy	Polygon	Habitat*	Structural stage*
#1 - Hudson's Hope	93P.091	564400	6205500	49	AMap	5
#2 - Red Creek	94A.024	607900	6241200	off mapped area	AMap	4
#3 - Big island	94A.016	632300	6229100	3254	SH	6
#4 - Moberly	94A.016	628200	6229800	3347	SH	6
#5 - Pond	94A.026	624000	6232600	3917	SHac	7
#6 - Little island	94A.025	618700	6231900	3804	SCab	5
#7 - Taylor (Pine R.)	94A.017	642800	6223400	2275	SH	6

*see Appendix 4 for definitions

The first cameras were set up on Feb. 28, 2006. The intent was to sample for the required 28 day period that was expected to "capture" all furbearers using the area. Sampling effort varied between stations, as some stations ran out of film due to intense marten or squirrel activity. Since film was expended on some cameras and the actual sample period could not be determined until after the data was analysed, it was decided to extend the sampling period into the spring season when bears became active. All of the cameras were collected by May 25, 2006. Total sampling effort was 216 camera/days in winter (Feb 28- March 31) and 245 days in spring (after March 31, Table 14.5).

No fishers were detected (Table 14.6) but marten were detected at five of the stations (Plate 14.2). Marten were photographed both at night and during the daylight hours. Some stations had the bait removed or camera dislodged by bears in April. The effectiveness of the spring sampling was likely limited due to disturbance by bears. One fisher was incidentally observed on the shoulder of Highway 29, near Flash Creek, on March 10, 2006.

Other wildlife, including elk, black bear, red squirrels and Gray Jays, were also attracted to the bait (Plate 14.3). Black bears in spring were a particular problem in that they usually ripped the bait off the tree.

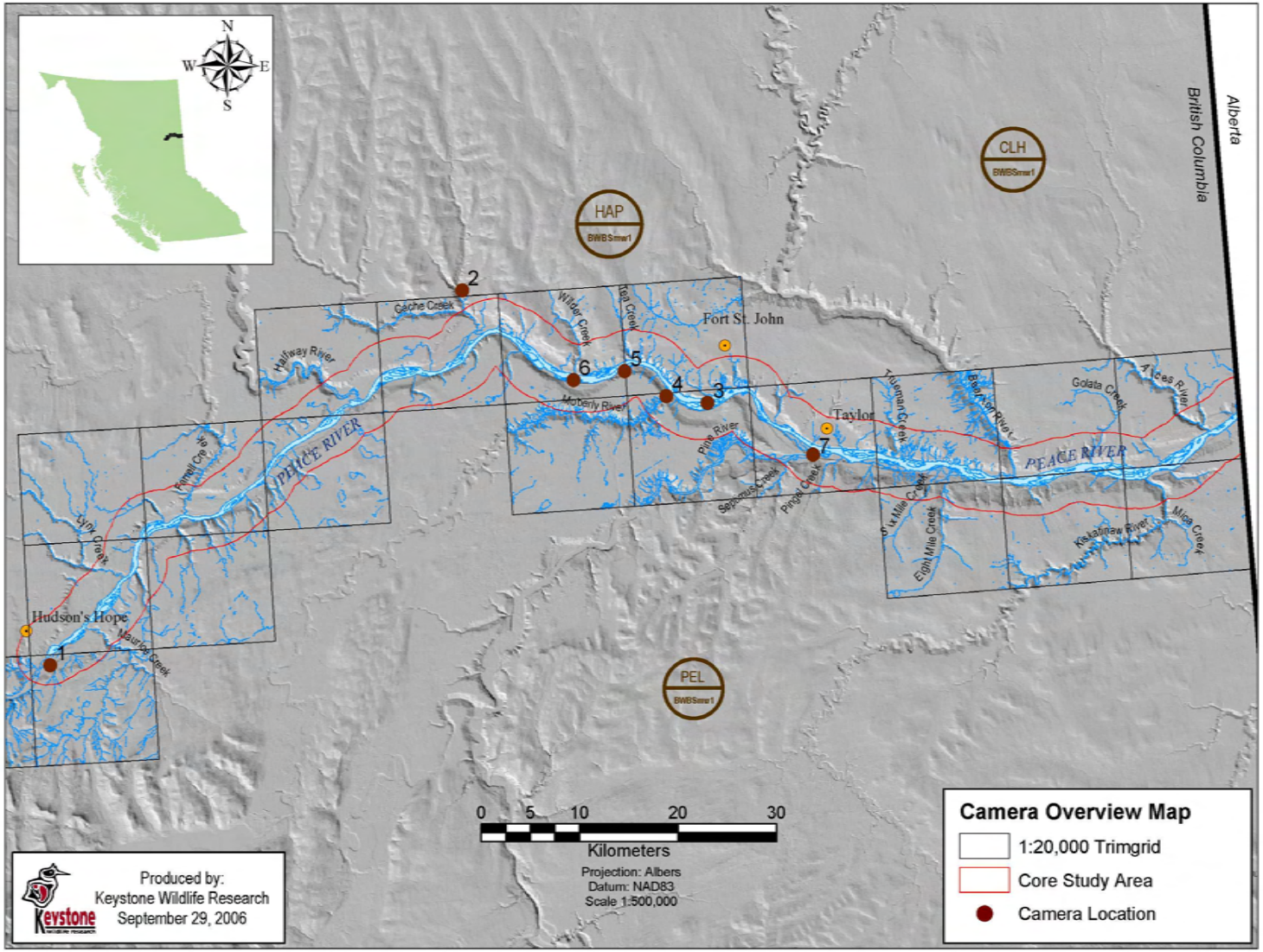

Figure 14.4. Locations of camera stations.

Table 14.5. Summary of sampling effort.

Unit	Total sampling days*	Total Winter Sampling days (before Apr. 1)	Total Spring Sampling days (After Mar. 31)	Marten detected?
#1 – Hudson's Hope	88	29	59	Y
#2 – Red Creek	46	32	14	Y
#3 – Big Island	83	31	52	N
#4 – Moberly	62	31	31	N
#5 – Pond	43	31	12	Y
#6 – Little island	49	31	18	Y
#7 – Taylor (Pine R).	90	31	59	Y
Total	**461**	216	245	

*Total includes the day the camera was set up and the day the camera was removed or the last photo was taken.

Table 14.6. Summary of remote camera results.

Unit	Species detected
#1 – Hudson's Hope	Marten
#2 – Red Creek	Marten, Elk, Black Bear
#3 – Big island	Red Squirrel, Elk
#4 – Moberly	Elk, Black Bear
#5 – Pond	Marten, Black Bear (ripped down bait)
#6 – Little island	Marten, Gray Jay, Elk
#7 – Taylor (Pine R).	Marten

Distinguishing fisher from marten tracks based on track size has been reported to be unreliable due to the extensive overlap between the species (RIC 1999). Although suspected fisher tracks were found, camera surveys at 7 sites suggested that only marten are present.

Large balsam poplars, which are rare on the landscape except in the main river valleys, are known to be a key reproductive and resting habitat for fisher. The Peace River corridor is considered to be excellent habitat for fisher based on the prevalence of the balsam poplar floodplains in the valley. Some successful telemetry and census studies have been undertaken in the Kiskatinaw drainage near Dawson Creek (Rich Weir pers. comm.) and fishers have been reported in the Peace River area (Rob Woods pers comm). Therefore, the results of our surveys do not follow expectations.

In a recent census study using hair snagging and DNA analysis, approximately 10% of the over 200 hair samples were determined to be fisher (R. Weir pers. comm.). Preliminary findings suggest that fisher may be less abundant than previously estimated in the Peace Region. In addition, 52 fisher traps within a 220 km^2 study area captured only three fishers in the Kiskatinaw drainage (Weir 2005, 2006). Surprisingly, six

individuals were captured at the same three stations with none at many nearby stations. These results vary from expectations, since all furbearers using a large area are expected to visit widely spaced bait stations if they are maintained over a reasonable period (28 days – RIC 1999; Zeilinski and Kucera 1995). This suggests that fishers in the Peace Region are very specific in their response to bait and that they may be easily missed using standard survey techniques (few stations maintained over a long period).

Plate 14.2. A sample of the marten detected at different stations.

Plate 14.3. Other wildlife detected at the bait stations included black bears, elk, Gray Jays and red squirrels.

14.4 Recommendations

Information from recent fisher studies in the Kiskatinaw drainage indicate that fishers may be easily missed using standard survey techniques, such as few remote camera stations maintained over a long period (R. Weir, pers. comm.). Therefore, a follow-up furbearer study is recommended as part of future wildlife programs. A large number of hair snagging stations (~90) should be established and maintained from January to March in order to adequately census the Peace River corridor for fisher and confirm expected habitat associations. Remote cameras will also be used at hair snagging stations to further document species presence.

Approximately thirty, 20 km^2 grid cells should be established along the Peace River Corridor with one hair snagging station per grid cell. The size of each grid cell corresponds to the lower home range size of an adult female. This grid improves the probability that all the resident fishers will encounter a sample station within their home range, thus improving the probability that they will be detected (Weir 2007). Each grid cell will be sampled over three sample periods. The final sample design should be developed in consultation with fisher expert Rich Weir. Camera stations should also be set-up at or in proximity to hair snagging stations and/or in areas where fisher or marten tracks were previously found during tracking surveys.

15.0 BAT SURVEYS

A number of bat species were expected to use the Peace River valley based on studies completed in other areas. Information on the species present, their habitat associations and their seasonal movements was required to assess the effects of potential hydroelectric developments in the valley.

15.1 Introduction

Knowledge of bats in the Peace River Corridor is limited to early collections at Hudson's Hope in 1931 (mentioned in Nagorsen and Brigham 1993), specimens from the general region in 1977-1981 (in Caceres and Pybus 1997) and studies of silver-haired bats and big brown bats (Schowalter *et al.* 1978, cited in Nagorsen and Brigham 1993; Schowalter and Gunson 1979, cited in Nagorsen and Brigham 1993). There is also a growing body of literature on bats in boreal ecosystems, including research in the BWBS biogeoclimatic zone at the Liard River located about 700 km northwest of Dawson Creek (Wilkinson *et al*. 1995; Vonhof *et al*. 1997) and Prophet Rivers located 250 km northwest of Fort St. John (Crampton *et al.* 1997). At least four studies have been conducted in the boreal mixedwood forests in northwestern Alberta (Patriquin and Barclay 2003), northcentral Alberta (Crampton and Barclay 1998), and northeastern Alberta (Hubbs and Schowalter 2003; Stefan 2004).

Nine bat species potentially occur in the Peace River Corridor, based on Nagorsen and Brigham (1993) and other studies mentioned above (Table 15.1). All nine species are insectivores, and will forage anywhere insects concentrate, including in open forests, over slow-moving water or ponds, and along cliffs. Body size, manoeuvrability, and flight speed vary between species and smaller, more manoeuvrable bats can forage in dense forests, while larger species tend to fly over the canopy or along cliff edges (Nagorsen and Brigham 1993).

Table 15.1. Nine bat species expected or captured in the Peace River Corridor listed by size.

Species	Common name	Average weight and range (g) [1]
Myotis californicus	Californian Myotis	4.4 (3.3-5.4)
Myotis evotis	Long-Eared Myotis	5.5 (4.2-8.6)
Myotis lucifugus[2]	Little Brown Myotis	6.2 (6.2–10.2)
Myotis septentrionalis[2]	Northern Myotis	6.5 (5.0–10.0)
Myotis volans[2]	Long-legged Myotis	7.2 (5.5-10.0)
Lasionycteris noctivagans[2]	Silver-haired bat	9.0 (5.8-12.4)
Lasiurus borealis	Eastern Red Bat	(7.0-16.0)
Eptesicus fuscus[2]	Big Brown Bat	15.2 (8.8-21.9)
Lasiurus cinereus[2]	Hoary Bat	28.4 (20.1-37.9)

1. Data from Nagorsen and Brigham (1993) except *L. borealis* (Alberta SRD)
2. captured in the area

All nine species are known to roost in trees, with some also documented to use buildings, rock crevices or cliffs. In boreal forests, the limited research done to-date on roost selection by little brown myotis, northern myotis and silver-haired bat suggests that bats predominantly roost in dying or dead poplar trees (balsam poplar and trembling aspen) (Vonhof *et al.* 1997; Crampton and Barclay 1998). Roost sites include cracks, cavities, loose bark and foliage clusters (hoary bat and eastern red bat), on trees or snags that are larger in height and diameter than other available wildlife trees, and are in older, more open forest stands (Barclay and Brigham 1996).

All bats in BC mate in the late summer or fall, prior to hibernation. Females store sperm over the winter, and fertilization occurs in the spring (Nagorsen and Brigham 1993). Most pregnant female bats gather in maternity colonies of the same species, and the young are born in June or July. The developmental rate of the foetus is temperature dependent; thus in cooler climates, birth may occur later in the summer. In the Liard area in 1995, bats gave birth between the last week of June and the first week of July, with the first post-lactating female captured in late July (Wilkinson *et al*. 1995). In the same region in 1997, bats were lactating throughout July and the first post-lactating female was caught in August (Vonhof *et al*. 1997).

Field studies of bats in the Peace River Valley were initiated in 2005 and continued in 2006. Eight days of sampling for bats in 2005 confirmed the presence of the little brown myotis, long-legged myotis and northern myotis. Acoustic surveys also resulted in potential detections of hoary bats, silver-haired bats, big brown bats, and eastern red bats. Based on these results, additional surveys in 2006 were designed to:

- Determine species presence and their reproductive status in the study area.

- Identify roosting habitat in the Peace River Corridor. Habitat for maternity colonies is particularly important, given that maternity roosts are essential for the survival of bat populations.

- Determine the relative activity of roosting / foraging areas. Baseline data on activity levels should be collected using bat detectors. These data can be used to verify the assumptions for the preliminary habitat assessment.

Results of the 2005 and 2006 surveys are summarized below. A more detailed reporting of these surveys is presented in the full text report (Kellner and Simpson 2009).

15.2 Methods

Surveys were completed in the Boreal White and Black Spruce moist warm (BWBSmw1) subzone in the Peace River corridor between Hudson's Hope and the Alberta border. Mist-netting and acoustic sampling occurred simultaneously during three sampling periods: August 2005, July 2006, and August 2006. Radio-tracking occurred from July to August in 2006.

Netting sites that were successful in 2005 were re-visited in 2006 to increase the probability of successful captures. High-activity sites were visited multiple times, but were rarely netted on consecutive days. Acoustic monitoring sites were selected in the field based on accessibility and the presence of suitable habitat features.

Sample sites were stratified into six broad habitat types: mature aspen forest, balsam poplar floodplain forest, river edge (rapidly moving, deep water with a wide channel), slow-moving creek (occasionally with pool areas), wetland (stagnant or very slow-moving water with emergent vegetation), and forest edge habitat (the transitional area between a forest and an open area such as a clearcut, old road, or cleared field). These broad habitat types represent the major foraging and roosting habitat types that are available in the project area. Coniferous forests were not sampled due to their scarcity on the north side of the river, which is the side most accessible by road. Ground

Inspection Forms (GIFs) were completed at all netting, detector, and roost sites and the site series and structural stage was recorded.

Species Inventory

Mist-nets were used for sampling, as outlined in ***Inventory Methods for Bats*** (RIC 1998e). Three to seven nets were set up across slow-moving creeks, ponds, wetlands, forest gaps, and forest trails. A net-night is a standard measure of effort and is defined as one 2x6 m net-equivalent set up for 1 night (RIC 1998e); thus the 18 m net resulted in 3 net-nights of effort for each night it was used. Nets were opened at dusk (20:30 – 22:30), and monitored approximately every 10 minutes for 2-4 hours, depending on the amount of bat activity.

Captured bats were removed promptly and kept in cloth bags for at least a 1/2 hour, handled for identification purposes only, and then released on-site. Weight, sex, age, reproductive condition, forearm length (mm), and presence/absence of a prominent keel on the calcar were recorded for each bat captured. Since bats were not held for the requisite hour to allow food to clear their digestive tract, the recorded weights may be higher than averages reported elsewhere. The identification key in Nagorsen and Brigham (1993) was used to confirm species.

Relative Activity

Bat detectors were used for acoustic sampling, as outlined in RIC (1998e). Bat activity was recorded at each netting site with a narrow-band bat detector (QMC Mini-3 Bat, Ultra Sound Advice, UK). The detector was tuned to 20, 30, and 40 kilohertz (kHz), for 5-minute listening intervals throughout the netting session. A remote detector (Anabat, Titley Electronics, Australia) was also set up each night in stands that were not suitable for netting. Calls were recorded after dusk on 45 or 90 minute cassette tapes.

Acoustic sampling was used to verify bat activity, quantify activity levels, and to document the presence of species or species groups that were not captured. Calls detected at 40 kilohertz (kHz) were recorded as *Myotis* species (little brown, Californian, long-legged, long-eared and northern), calls at 30 kHz were big bats (silver-haired, big brown, eastern red and hoary bat) and calls at 20 kHz were hoary bats (RIC 1998a). The assumptions of this methodology include:

- Frequency of call detection reflects bat activity

- Calls can be accurately separated into species/species group using the criteria above.

The relative activity rate was determined for each site as the average number of calls (passes and buzzes), per minute. A pass was defined as an uninterrupted series of echolocation calls as a bat travelled past a microphone and a buzz was the buzzy sound of accelerating calls as a bat homed in on its insect prey. Foraging rate was also determined as the average number of feeding buzzes per minute. Data from sites that were sampled multiple times were pooled to calculate the activity and foraging rate for that site.

Roost Identification

Telemetry was used to locate day-roosts used by bats in the Peace River Corridor. Holohil Systems BD-2N transmitters were attached to healthy bats with weights greater than 7.4 g (weighed after 1 hour). Female bats in late stages of pregnancy and juveniles were not radio-tagged. These transmitters have an expected lifespan range of 8 to 15 days.

Radio-tagged bats were located by vehicle and foot for a minimum of seven days after capture. If the bat's location was inaccessible (e.g. across the Peace River), the location was triangulated from three or more locations to obtain a UTM location. Roost trees were located on foot when feasible. If sites could not be accessed the habitat type was determined from the TEM map.

Roost trees were described using the methodology for describing wildlife trees in the ***Field Manual for Describing Terrestrial Ecosystems*** (BC MOELP and MOF 1998). The diameter at breast height, tree species, percentage bark remaining, estimated height, crown class, appearance class, crown condition class, bark retention class and decay class were recorded for each roost tree.

15.3 Results

Thirty-five bats were captured in 179.5 net-nights of effort or 212 netting hours, completed over 22 evenings at 10 sites (Table 15.2). This effort resulted in an overall capture rate of 0.19 bats per net night (0.16 bats per net-hour). Inclement weather

conditions (low temperatures, precipitation and strong wind) were experienced on six evenings, accounting for 42 net nights. Six bats were still captured on four of those six evenings. Excluding these data increased the overall capture rate to 0.21 bats per night.

Table 15.2. Summary of sampling effort and capture rates for each sampling site and stratum in the Peace River Corridor from 2005-2006.

Sample Period	Sample Station	Stratum	Number of nights sampled	Number of bats captured	Net-hours	Net-nights	Bats per Net-night
Aug 22 -29, 2005	Blackfoot	Wetland	1	0	9	5.5	0.00
	Cache Creek	Slow-Moving Creek	1	4	17.5	9	0.44
	Farrell Creek	Slow-Moving Creek	1	1	16.3	9	0.11
	Gravel Pit*	Wetland	1	1	10	7.5	0.13
	Halfway River*	River	1	0	9.3	7.5	0.00
	Lynx Creek	Slow-Moving Creek	1	1	16	9	0.11
	Peace Island Channel	Backchannel	1	0	4.5	6	0.00
	Peace Island Wetland	Wetland	1	1	9.8	5.5	0.18
	Sample Period Total		**8**	**8**	**92.3**	**59**	**0.14**
Jul 10-17, 2006	Alces River	Slow-Moving Creek	4	4	19.64	17.5	0.23
	Cache Creek	Slow-Moving Creek	2	6	26.15	20.5	0.29
	Johnson Backchannel	Wetland	1	0	13.75	11.5	0.00
	Peace Island Wetland*	Wetland	2	4	18.12	16.5	0.24
	Sample Period Total		**7**	**14**	**77.66**	**66**	**0.21**
Jul 8 - Aug 4, 2006	Cache Creek*	Slow-Moving Creek	3	6	18.35	20.5	0.29
	Farrell Creek*	Slow-Moving Creek	2	5	12.08	13.5	0.37
	Lynx Creek	Slow-Moving Creek	2	2	12.01	20.5	0.10
	Sample Period Total		**7**	**13**	**42.44**	**54.5**	**0.24**
Total			**22**	**35**	**212.42**	**179.5**	**0.19**
Total (excluding net nights with poor conditions)			**16**	**29**	**165.25**	**137.5**	**0.21**

* indicates sample stations with inclement weather conditions

Species Inventory

Over the two years of sampling, thirty-five bats of six species were captured, including little brown myotis, long-legged myotis, northern myotis, big brown bats, silver-haired bats and hoary bats (Table 15.3). The species most commonly captured in each sample period and overall was the little brown myotis (57% of the bats captured).

All species were confirmed to be reproducing in the area (based on the capture of juveniles, or pregnant or lactating females) except the big brown bat, of which only two adult males were captured. Pregnant females were observed on July 13, 16, and Aug 26, lactating females were observed on July 11, 13, and 28, and post-lactating females were first captured on Jul 17.

The Californian myotis and long-legged myotis were not captured, although these species were documented from the Liard River in northern BC. The eastern red bat, for which the nearest recorded location is the Fort McMurray area of northeastern Alberta, was also not captured (Stefan 2004). Evidence of the eastern red bat was detected at one site (Cache Creek) in 2005, but five nights of mist-netting and concurrent detector sampling at this site in 2006 did not provide any further evidence of this species' presence. The presence of these three species would represent significant range expansions.

Table 15.3. Summary of bat species captured during the three surveys periods in 2005 and 2006.

Sample Period	Species	Total captured
Aug 22 -29, 2005	Little brown myotis	5
	Northern myotis	1
	Long-legged myotis	2
Total period 1		**8**
Jul 10-17, 2006	Big brown bat	1
	Hoary bat	1
	Silver-haired bat	4
	Little brown myotis	7
	Northern myotis	1
Total period 2		**14**
Jul 8 - Aug 4, 2006	Big brown bat	1
	Hoary bat	1
	Silver-haired bat	1
	Little brown myotis	8
	Northern myotis	2
Total period 3		**13**
Grand Total		**35**

Relative Activity

Twenty-two sites were sampled over 32 nights in three survey periods. Bat activity data was recorded for 3547 minutes, or approximately 59 hours, in six habitat strata. The length of sampling time ranged from 38 to 225 minutes per site and was dependent on the survey conditions. Bats were detected at all sites, with overall activity levels ranging from 0.06 to 1.02 calls/minute (Table 4).

When relative activity for all species was compared across all strata, the highest activity levels were detected at balsam poplar, wetland, and slow-moving creek sites. Sample sizes were small for all habitats types (balsam poplar n = 3, wetland n = 6, creek n = 7,

aspen n = 1, edge n = 3, river n = 3) and only limited inferences can be made about activity levels associated with each stratum.

Foraging rates were compared across strata to assist in identifying foraging habitats. The foraging rate for all bat species combined varied from 0 to 0.15 buzzes/minute between sites. Foraging activity was greatest at wetland and slow-moving creek sites. Sample sizes were small for all habitats types (balsam poplar n = 3, wetland n = 6, creek n = 7, aspen n = 1, edge n = 3, river n = 3) and only limited inferences can be made about foraging levels associated with each stratum.

Plate 15.1. The Blue- listed northern myotis (*Myotis septentrionalis).*

Roost Identification

Radio-tags were attached to 12 adult bats, two of which could not be relocated. Of the ten bats that were tracked, six were reproductively active females, one was a non-reproductive female, and three were males. These bats were radio-tracked to 22 roost

structures in 23 habitat types. Bats roosted mainly in balsam poplar trees or snags. Aspens were also used, as were cliffs and buildings. Although some bats used only one roost, others switched roosts frequently. Individual bats used up to four roosts in 17 days of monitoring, in roost areas up to 12 ha in size. The average commuting distance, inferred from the distance between foraging (capture) and roosting sites, was 730 m.

Twenty-two specific roost structures were identified for nine tagged bats (one bat could only be located by triangulation). Roost structures were found in 14 balsam poplars (64%), 5 trembling aspens (23%), 2 steep cutbanks (9%), and 1 tin-roofed garage (4%). The majority of reproductive females used balsam poplars for roosting (Figure 15.1).

Bats that roosted in trees generally used large-diameter trees or snags (avg. dbh = 55.8 cm), in appearance classes 2 (injured or dying) through 7 (standing stub). Roost trees offered specific microsites such as small to large pieces of exfoliating bark, cracks in a bole, healing scars where branches had dropped, and obvious cavity entrances into trees with heart rot.

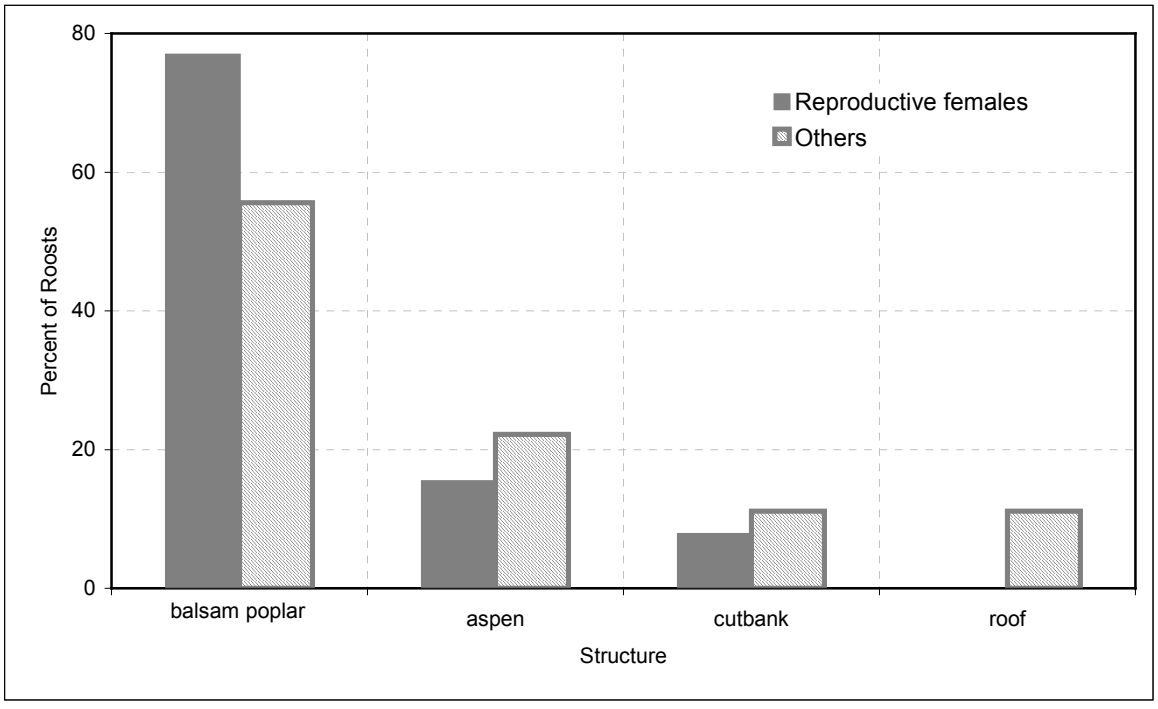

Figure 15.1. Roost structures used by 5 reproductive female bats (13 roosts) and 4 other bats (9 roosts).

Bats selected balsam poplar - horsetail habitats (site series $07 - SHac), in structural stages 3b (tall shrub) through 6 (mature) for day roosts. Young stands (3b and 4) were used only when veteran balsam poplar snags were present. The value of balsam poplar habitats probably lies in the abundance of potential roost structures in this habitat type, and the proximity to foraging areas such as wetlands and sloughs. Cutbanks were also used, although use was limited to two tagged bats in 2 roost sites. One of these was a maternity roost of the Blue-listed northern myotis. Thirteen of the 23 roosts were in balsam poplar - horsetail habitat (SHac), showing relatively heavy use of this habitat type, compared to its availability.

Aspen forests (mesic site series AM:ap ($01), Aspen – Rose and Aspen - dogwood) were used for roosting to a lesser degree. Aspen-dominated stands were often denser, resulting in less sun exposure and poorer access for roosting, and they did not appear to provide the multitude of microsites for roosting that balsam poplar stands did. Nevertheless, aspen forests, particularly older stands or those with damaged trees and heart rot, did provide bat roost habitat.

One female hoary bat used the 03 site series, structural stage 6 (SW, Saskatoon – Fuzzy-spiked wildrye). Hoary bats are foliage-roosters and have very rarely been known to use cavities. No day-roosts were located in other forested site series.

Based on what is known about bat roosting and foraging preferences and the results from detector data collected during this study, a preliminary draft ratings table for bat foraging habitat was developed. This table identifies ecosystem units from the draft TEM map (Keystone Wildlife Research Ltd. 2006a) that are likely to be suitable for bats. The four-class rating scheme is consistent with that outlined in ***British Columbia Wildlife Habitat Ratings Standards*** (RIC 1999e). All bat species were rated as one species group since species-specific habitat preferences cannot be represented at this scale.

The most suitable foraging habitats are assumed to be wetlands and the least suitable sites are young, dry, pine-dominated forests. Ratings should be increased for polygons adjacent to prime feeding habitat (wetlands, creeks).

The most suitable roosting habitats are assumed to be old balsam poplar floodplains and the least suitable sites are young forests. Polygon ratings should be increased when emergent (protruding) and/or veteran balsam poplar snags are present.

15.4 Recommendations

The primary objectives of this study were to determine species presence and to identify roosting habitat in the Peace River Corridor, from Hudson's Hope to the Alberta border. Sampling effort was concentrated in suspected high-use areas that were suitable for netting, in order to maximize the number of bats captured. Consequently, little information was obtained on the use of some habitat types, particularly coniferous forests and dry ecosystem units. The relative use data that was collected for the six broad habitat types (mature aspen forest, balsam poplar floodplain forest, river edge, slow-moving creek, wetland, and forest edge habitat) can be loosely extrapolated to the TEM ecosystem units but additional surveys are required to confirm suitability and verify the draft habitat ratings.

Additional studies are recommended to measure relative activity of bats in the TEM habitat units. This can be completed by detector surveys to determine relative activity. The study should include multiple detector sites in habitats in the TEM mapped area. Mist-netting and radio-tagging of bats should also be incorporated to continue to investigate species presence and roost selection in the Peace River Corridor. Methods to locate potential hibernacula should also be investigated.

Information obtained will be used to verify the assumed habitat associations between bats and the TEM ecosystem units. The preliminary draft habitat suitability ratings can then be updated and a habitat suitability map can be created. This map will represent the predicted distribution of bat species in the study area.

Future surveys can also provide additional information on the Blue-listed northern myotis. Because of the low capture rate for this species, projects focussing solely on northern myotis are not feasible, however more information can be obtained as a component of a larger project. Any suitable adults captured should be radio-tagged to obtain additional information on roosting habitat for this species in the study area.

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APPENDICES

Appendix 1. Field Data forms.

Animal Observation Form - Owl Call Playback-*Part A* **Page ___/___**

Project _____ **Survey** _____ **Study Area** _____

Transect Label _____ Stratum _____ Trans Comment _____

Trans: Lgth _____ Bearing _____ UTM: Start _10_/_____/_____ End _10_/_____/_____ Interstation Dist _____

Obs Date: Start _____/_____/_____ End _____/_____/_____ Call Type(s) _____

Surveyors _____

Call Sta	Sta UTM Zone/East/North			Time Start	Time End	Wind	Precip	CC	Temp	Comments
1	10									
2	10									
3	10									
4	10									
5	10									
6	10									
7	10									
8	10									
9	10									
10	10									
11	10									
12	10									
13	10									
14	10									
15	10									
16	10									

Animal Observation Form - Owl Call Playback -*Part B* **Page ___/___**

Transect Label ______________________________ **Obs Date:** Start ______/______/_______ End ______/______/_______

Project ________________________ **Survey** ____ **Study Area** _______________________________

Call Sta	Obs #	Spp	Cnt	Time Elapsed	Response Time	V/C	Call Type	Detect Dir	Dist to Detect	Detect Durat'n	Des	Sex	Age Class	Nest Label / Fm		Comments
		B-														
		B-														
		B-														
		B-														
		B-														
		B-														
		B-														
		B-														
		B-														
		B-														
		B-														
		B-														
		B-														
		B-														
		B-														
		B-														
		B-														
		B-														
		B-														

Animal Observation Form - Frog Auditory Survey **Page ___/___**

Project **Survey** _____ **Study Area**

DC

Interstation Dist _____ __ DCV **ObsDate**_____/_____/_____ Call Types _____

Call Sta	Sta UTM Zone/East/North			Ecosystem Form Type / #		Site Series	Time Start	Time End	Ceiling	CC	Wind	Precip	Recent Rain 24/48 hours		Temp
	10			GIF											
	10			GIF											
	10			GIF											
	10			GIF											
	10			GIF											
	10			GIF											

Surveyors _____

OBS

Call Sta	Obs #	Spp	Detect Noise	Detect Dir	Dist to Detect	Cnt Abs / Est		V/C	Comments / Voucher Label
		A-							
		A-							
		A-							
		A-							
		A-							
		A-							
		A-							
		A-							
		A-							
		A-							
		A-							
		A-							
		A-							
		A-							
		A-							
		A-							
		A-							
		A-							

Amphibians Wetland Search **Page ___/___**

Project_____ **Survey** _____ **Study Area** _____

DC

Transect Label _____ Zone _____ Site Series _____ GIF_____ Trans Comment_____

Trans: Lgth _____ Bearing _____ UTM: Start _10_/_____/ _____ End _10_/_____/ _____

DCV

Obs Date _____/____/____ Surveyors _____*Total Search Time* _____*% wetland searched*_____

Obs Day	Time	Ceiling	CC	Wind	Precip	Temp		H_2O Cond (cm)	Habitat Type	% Open H_2O	Size (m)		% Expos	pH	Durat'n
						Air	Water				L	W			
Start															
End															

OBS

Obs #	Spp	Time	Devel Stage	Cnt		Aggreg Size (cm)		Size (mm)		Dpth top obs (cm)	Dist obs shore	Sweep Size (cm)		Water Dpth (cm)		Attach substr	Bot Sub	Mac Hab	Comments/Voucher Lbl
				Abs	Est	D/W	Lgth	TL	SVL			Lgth	Wdth	Ave	drop				
	A-																		
	A-																		
	A-																		
	A-																		
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	A-																		

Animal Observations Form - Waterfowl - Breeding Pair / Brood / Non-breeding Surveys - *Part A* **Page ___ / ___**

Project: . **Survey:** **Survey Date:** **Study Area:**

DCV

NB: below weather information is for 1 station or 1 transect.

Obs Day	Time	CC	Wind / SC	Temp	Precip	Tide
Start						
End						

Ground ☐ Boat ☐ Aerial ☐ Flt Alt: _____ Air Spd: _____ Grd Spd: _____

Surveyors: _____/_____ Pilot _____ Navigator _____

DC

Observation **Station** **Label** _____ GIF _____ UTM _10_/_____/_____

Wetland Survey: ☐ Complete _____ % or ☐ Sampling: Station Area _____

OR

DC

Transect Label _____ GIF _____ Trans Comment _____

Trans: Lgth _____ Width _____ Bearing _____ UTM: Start _10_/_____/_____ End _10_/_____/_____

Transect Segments - use as needed (e.g. for numerous sequential transects along a shoreline)

Sgmt #	Time		Sgmt UTM: Start / End						Sgmt Lgth	Dist from Shore	Comments
	Start	End	Zone	East	North	Zone	East	North			
			10			10					
			10			10					
			10			10					
			10			10					
			10			10					
			10			10					
			10			10					
			10			10					
			10			10					

Animal Observations Form - Waterfowl - Non-Breeding Survey - *Part B* **Page ___ / ___**

DC

DCV

OBS

Project: . **Survey:** **Study Area :**

Observation Station Label: _____ ***OR*** **Transect Label:** _____

Obs Date: _____/ / Surveyors:

Sgmt or GPS #	Obs #	Spp	Adult			Juv	UC	Boat			Comments
			M	F	UC	UC	UC	0-150	151-300	>300	
		B-									
		B-									
		B-									
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		B-									
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		B-									

Animal Observations Form - Songbird Encounter Transect & Simple Point Counts **Page ___/___**

Project Area_____ **Survey** _____ **Obs Date** _____/_____/ _____

DC

Transect Comment _____

Transect: Lgth _____ Bearing _____ UTM: Start __10_/_____/_____ End _10_/_____/_____

DCV

Obs Day	Time	Ceiling	CC	Wind	Precip	Temp
Start						
End						

Surveyors _____

Way pt	Sta UTM East	Sta UTM North	Pt Cnt Sta	Spp	Cnt	V/C/S	Sex	Age Cl.	Det Dir	Det Dist	Nest Label / Fm	GIF	SS/ST		Comments (Projected UTM)
				B-											
				B-											
				B-											
				B-											
				B-											
				B-											
				B-											
				B-											
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				B-											
				B-											

BCHY Snow Tracking Data Sheet	**Surveyors**	**year**	**month**	**day**	CC	
Mapsheet	**Transect**	**Start Bearing**	0 6		Wind	
Drainage Peace River	**days since snow**	**page of**	**Temp.**	**°C**	Precip	
start UTMx	**UTMy**	**Stop UTM x**	**UTM y**			

plot no	Poly no.	m from start	Activ. type		Sign type	sign #	Vis Y/N	sink depth cm		snow depth cm	species code	comments (change bearing)

Appendix 2. Survey codes for amphibian surveys (adapted from RIC 1998b)

Field Name	Description
Temp: Ambient / Water	The ambient and water temperatures at the start and end of the survey (degrees Celsius).
Water Cond [cm]	The turbidity of the water during observations. Record the maximum vertical depth of visibility as viewed from above (cm).
Habitat Type	LA = Lake, Wb = Bog, Wf = Fen, Wm = Marsh, Ws = Swamp, SW = shallow water, DT = ditch, PD = rain puddle, RB = river back channel (use wetland guide)
% Open Water	% open water, where remaining percentage is covered by emergent veg.
Size (m)	length x width
Exposure	% water exposed to solar radiation (not covered by vegetative canopy)
Duration	Permanent water, Semi permanent (water present most years), Seasonal (water present at some point in the year), results flooding, short duration (2-4 weeks).
Dev Stg	The stage of development of the observed animal. Eggs; Hatchling (salamanders w/o hind legs); Larva (free-swimming salamanders); Tadpole (early hatchlings), Tadpole B (back legs); Tadpole F (front and back legs/stubs); Juvenile (terrestrial, but not sexually mature); Adult.
Cnt: Abs / Est	Count of eggs masses / larvae / adults. Estimated or absolute
Aggreg Size [cm]	Diameter or length/width of single egg mass (cm). In Comment field indicate egg masses that are in close approximation (grouped).
TL [mm]	The total length of the animal on the ventral surface from the tip of the snout to the tip of tail (mm). Note: Record and 'X' if a portion of the tail is missing or if there is evidence of recent regeneration.
SVL [mm]	The snout-vent length of the captured animal (mm). Take this measurement in the manner prescribed in the associated species manual. If this measurement can not be collected for some reason (i.e. animal escaped), then provide an explanation in the "Comment" field. For salamanders, measure to the nearest 0.1 mm with a vernier caliper from the tip of the snout to the anterior end of the cloacal vent. For frogs, measure with a ruler with a stop at one end from the tip of the nose to the anterior end of the vent (base of the hind legs).
Dist top obs [cm]	Distance below the surface of water to the top of an egg mass or animals (cm).
Dist obs Shore [cm]	The distance the animal is from shore (cm). Note: if the animal is located in the water use the prefix (-); if the animal is located on land use the prefix (+).
Water Dpth [cm]	The average depth measured 1 metre from the shore
Water Dpth: Drop	Measure of the steepness of the bottom of the pond. GD – Gradual drop off (<15% Slope), MD - moderate (15-45% slope), SD - steep dropoff (>45% slope)
Attach Substr	Substrate to which the egg mass is attached.
Bot Sub	The substrate class of the bottom of the pond/wetland at the location where the animal was found (or at the Capture Station).
Mac Hab	The macrohabitat in which the animal is found (or the macrohabit at the capture station).

Appendix 3. Bird species detected during the 2006 surveys (songbird survey transect data plus incidental observations). Note: does not include raptors, shorebirds or waterfowl, which are reported elsewhere.

Name	Incidental*	Red/Blue List**
Alder Flycatcher		
American Crow		
American Dipper	*	
American Pipit		
American Redstart		
American Tree Sparrow	*	
American Robin		
Baltimore Oriole		
Black and White Warbler		
Black-billed Magpie		
Black-capped Chickadee		
Belted Kingfisher		
Brown-headed Cowbird		
Blue-headed Vireo		
Blackpoll Warbler		
Bank Swallow		
Blue Jay		
Boreal Chickadee		
Brewer's Blackbird		
Brown Creeper		
Black-throated Green Warbler		B
Calliope Hummingbird		
Canada Warbler		B
Clay-coloured Sparrow		
Cedar Waxwing		
Chipping Sparrow		
Cliff Swallow	*	
Common Goldeneye		
Common Grackle		
Common Nighthawk	*	
Common Raven		
Connecticut Warbler		R
Common Yellowthroat		
Dark-eyed Junco		
Downy Woodpecker		
Eastern Kingbird		
Eastern Phoebe		
European Starling	*	
Evening Grosbeak		
Fox Sparrow		
Golden-crowned Kinglet		
Golden-crowned Sparrow	*	
Gray Catbird		
Gray Jay		
Hammond's Flycatcher		
Hairy Woodpecker		

Name	Incidental*	Red/Blue List**
Hermit Thrush		
Horned Lark	*	
House Wren		
Lapland Longspur	*	
Least Flycatcher		
Lincoln's Sparrow		
Marsh Wren		
Magnolia Warbler		
Mourning Dove	*	
Mourning Warbler		
Northern Flicker		
Northern Shrike		
Northern Waterthrush		
Northern Rough-winged Swallow	*	
Nelson’s Sharp-tailed Sparrow	*	R
Orange-crowned Warbler		
Olive-sided Flycatcher		
Ovenbird		
Philadelphia Vireo		
Pine Grosbeak	*	
Pine Siskin		
Pileated Woodpecker		
Pacific-slope Flycatcher		
Purple Finch		
Red-breasted Grosbeak		
Red-breasted Nuthatch		
Ruby-crowned Kinglet		
Red Crossbill		
Red-eyed Vireo		
Rusty Blackbird		B
Ruffed Grouse		
Red-winged Blackbird		
Savannah Sparrow		
Sharp-tailed Grouse	*	
Song Sparrow		
Swamp Sparrow		
Swainson's Thrush		
Tennessee Warbler		
Townsend's Solitaire		
Townsend's Warbler		
Tree Swallow		
Three-toed Woodpecker		
Varied Thrush	*	
Vesper Sparrow		
Violet-green Swallow		
Warbling Vireo		
Western Tanager		
Wilson's Warbler		
White-breasted Nuthatch	*	

Name	Incidental*	Red/Blue List**
White-crowned Sparrow	*	
Winter Wren		
White-throated Sparrow		
White-winged Crossbill		
Western Wood-pewee		
Yellow-bellied Flycatcher		
Yellow-bellied Sapsucker		
Yellow Warbler		
Yellow-rumped Warbler		

*Incidental detection only (i.e. not recorded on transects).
**Provincial status as of October 2006 (CDC 2006).

Appendix 4. Site series and structural stage definitions.

Ecosystem units mapped in the study area (excludes non-vegetated and anthropogenic units).

Map Code	Site Series #	Ecosystem Name
AM	01	SwAt - Step moss
AM: ap	01-$	$At - Creamy peavine (seral association)
AMy: ap	01-$	$At - Creamy peavine, moist (seral association)
AMk: ap	01-$	$At - Creamy peavine, cool aspect (seral association)
AMw: ap	01-$	$At - Creamy peavine, warm aspect (seral association)
AS	00	SwAt – Soopolallie
BL	04	Sb - Lingonberry - Coltsfoot
BL: al	04-$	$At - Labrador tea (seral association)
BT	08	Sb - Labrador tea – Sphagnum
Fm02	09	ActSw - Red-osier dogwood
LL	02	Pl - Lingonberry - Velvet-leaved blueberry
LL: ak	02-$	$At - Kinnikinnick (seral association)
SC	06	Sw - Currant – Bluebells
SC: ab	05-$	$At – Black Twinberry (seral association)
SC: ep	05-$	$Ep – red-osier dogwood (seral association)
SE	00	Sedge Wetland
SH	07	Sw - Currant – Horsetail
SH: ac	07-$	$Ac – Cow parsnip (seral association)
SH: ep	07-$	$Ep – Ep-Dogwood (seral association)
SO	05	Sw - Currant - Oak fern
SW	03	Sw - Wildrye – Peavine
SW: as	03-$	$At - Soopolallie (seral association)
TS	10	Tamarack - Sedge – Fen
WH	00	Willow – Horsetail – Sedge – Riparian Wetland
WS	00	Willow – Sedge – Wetland
WW	00	Fuzzy-spiked Wildrye - Wolf willow

Structural stage definitions (RIC 1998a).

Structural Stage	Definition
1	Sparse/bryoid (< 20 yrs since major disturbance unless disclimax ecosystem)
1a	Sparse (less than 10% vegetation cover)
1b	Bryoid (bryophyte and lichen-dominated communities (>50% of total vegetation cover))
2	Herb (< 20 yrs old unless disclimax)
2a	Forb-dominated (dominated by non-graminoid herbs)
2b	Graminoid-dominated (dominated by grasses, sedges, reeds and rushes)
2d	Dwarf Shrub (dominated by dwarf woody species)
3	Shrub (shrubs <10 m tall, < 20 yrs old for forested sites)
3a	Low Shrub (shrubs < 2 m tall)
3b	Tall Shrub (shrubs 2-10 m tall)
4	Pole /Sapling (trees > 10 m tall & usually < 40 yrs old)
5	Young Forest (trees > 10 m tall & 40-80 yrs old)
6	Mature Forest (trees > 10 m tall; 80-140 yrs old)
7	Old Forest (trees > 10 m tall; >140 yrs old)