WINTER BAT RECORDS FOR BRITISH COLUMBIA

DAVID W. NAGORSEN, ANDREW A. BRYANT, DAVID KERRIDGE, GINA ROBERTS, ANNA ROBERTS, AND MICHAEL J. SARELL

ABSTRACT—A review of all known museum records and limited surveys of potential hibernacula in parts of southern British Columbia revealed low numbers and few species of bats in winter. Winter records exist for only seven of the 16 species that inhabit the province in summer. *Plecotus townsendii* was the only species regularly found in hibernacula. The largest winter aggregations ranged from 10-48 bats. The northern limits of the winter range for several species are near Williams Lake, where the mean minimum January temperature is −15°C. The few species and low numbers in winter are consistent with observations from adjacent areas of the western United States.

There are 16 species of bats that breed in British Columbia, giving it the most diverse bat fauna of any Canadian province (van Zyll de Jong 1985; Nagorsen and Brigham, in press). Most of these species reach the northern limits of their range in British Columbia where they presumably have adapted to the pronounced seasonality in climate and food resources associated with a northern temperate region. Winter is a particularly critical season for temperate bats and, except for such migratory species as the western red bat (*Lasiurus blossevilli*) and hoary bat (*Lasiurus cinereus*), British Columbian bats are generally assumed to hibernate within the province. Nonetheless, information on the distribution and roosting habitat of bats in the province during winter is limited to anecdotal observational records for a few species (Cowan 1933, 1942, 1944, 1945; Jobin 1952). Herein we review all known winter records and discuss the winter range of bats in the province.

MATERIALS AND METHODS

We defined winter as the period extending from 1 November to 31 March. Although arbitrary, this is consistent with the definition used by previous researchers (Hoffmeister 1970; Perkins et al. 1990). Winter occurrences were derived from three sources: published literature, museum records, and limited surveys of potential hibernacula. Museum records were based on a review of data associated with 1600 bat specimens collected in British Columbia that are housed in 14 North American museums (winter specimens were found in three collections) and miscellaneous observational records held at the Royal British Columbia Museum. Surveys included a twelve-year (1968-1991) study of a cave hibernaculum on Thetis Island, an inventory of caves and mine adits in the Similkameen and southern Okanagan valleys (February 1988 to March 1992), and surveys of potential hibernacula in the Kamloops-Williams Lake region (March 1989 to March 1992). Species observed during inventories were identified using the keys in van Zyll de Jong (1985). Temperatures were surface temperatures recorded to the nearest °C. To protect hibernacula from disturbance, we have not given local names or exact locations of caves and mines.

RESULTS AND DISCUSSION

Eight species have been found in British Columbia during winter (Table 1, Fig. 1). Seven were recorded at multiple locations; two species, Yuma myotis (*Myotis yumanensis*) and big free-tailed bat (*Nyctinomops macrotis*) are known from single occurrences. The male *N. macrotis* found at New Westminster in November 1938 was probably an accidental occurrence. The nearest known breeding populations are located in Utah and there are a number of extralimital records for this species during the autumn migration period (Barbour and Davis 1969).

TABLE 1. Known winter (November–March) bat records from British Columbia. Locality numbers refer to Figure 1. BCPM = Royal British Columbia Museum, NMC = Canadian Museum of Nature, UBC = Cowan Vertebrate Museum, University of British Columbia.

Species	Date	Location	Source
Eptesicus fuscus	26 Dec	(3) Fraser River, Cave 2	survey 1991
Eptesicus fuscus	winter	(15) Okanagan, mine 6	survey 1986
Eptesicus fuscus	4 Mar	(1) Prince George	NMC
Eptesicus fuscus	12 Dec–21 Mar	(4) Victoria	BCPM
Eptesicus fuscus	12 Dec–3 Feb	(2) Williams Lake	BCPM, UBC, NMC, Cowan (1944)
Lasionycteris noctivagans	13 Feb	(6) Bestwick Hill	BCPM files
Lasionycteris noctivagans	26 Jan	(16) Okanagan, mine 2	survey 1992
Lasionycteris noctivagans	21 Dec–5 Mar	(5) Vancouver	UBC, Cowan (1933)
Lasionycteris noctivagans	Nov–17 Dec	(4) Victoria	BCPM
Lasionycteris noctivagans	21 Feb	(2) Williams Lake	NMC
Myotis californicus	17 Feb	(8) East Sooke	BCPM
Myotis californicus	27 Jan	(10) Hope	UBC
Myotis californicus	23 Mar	(11) Okanagan Landing	BCPM
Myotis californicus	4 Nov	(9) Port Hardy	UBC
Myotis californicus	11 Jan	(7) Rogers Pass	Fenton et al. (1983)
Myotis californicus	9 Jan	(5) Vancouver	UBC, Cowan (1942)
Myotis ciliolabrum	26 Dec–25 Jan	(3) Fraser River, cave 3	surveys 1991–1992
Myotis ciliolabrum	30 Dec	(3) Fraser River, cave 2	survey 1992
Myotis ciliolabrum	6 Dec	(15) Okanagan, mine 10	survey 1989
Myotis ciliolabrum	12 Jan–15 Mar	(16) Okanagan, mine 2	surveys 1991–1992
Myotis lucifugus	1 Nov	(12) Gallagher Lake	NMC
Myotis lucifugus	10 Dec	(13) Olalla	BCPM
Myotis lucifugus	22 Mar	(4) Victoria	BCPM
Myotis lucifugus	17 Nov	(2) Williams Lake	Jobin (1952)
Myotis yumanensis	27 Mar	(5) Vancouver	UBC
Nyctinomops macrotis	Nov	(14) Essondale	UBC, Cowan (1945)
Plecotus townsendii	11 Jan	(19) Fraser River, cave 1	survey 1992
Plecotus townsendii	11 Nov–21 Mar	(3) Fraser River, cave 2	surveys 1989–1992
Plecotus townsendii	11 Nov–30 Mar	(3) Fraser River, cave 3	surveys 1989–1992
Plecotus townsendii	30 Dec–30 Mar	(3) Fraser River, cave 4	surveys 1990–1992
Plecotus townsendii	18 Jan–15 Feb	(17) Kamloops Lake, mine	surveys 1990–1992
Plecotus townsendii	Jan	(21) Klanawa River	BCPM files
Plecotus townsendii	Feb–Mar	(15) Okanagan, mine 3	survey 1988
Plecotus townsendii	29 Nov	(15) Okanagan, mine 4	UBC
Plecotus townsendii	29 Feb	(15) Okanagan, mine 5	survey 1992
Plecotus townsendii	3 Nov–9 Feb	(15) Okanagan, mine 7	surveys 1990–1992
Plecotus townsendii	13 Feb	(15) Okanagan, mine 8	survey 1992
Plecotus townsendii	5 Feb	(15) Okanagan, mine 9	survey 1992
Plecotus townsendii	4 Jan–18 Mar	(16) Okanagan, mine 1	surveys 1988–1990
Plecotus townsendii	1 Dec–16 Mar	(16) Okanagan, mine 2	surveys 1988–1992
Plecotus townsendii	5 Dec–16 Mar	(18) Thetis Island caves	surveys 1968–1991
Plecotus townsendii	17 Mar	(5) Vancouver	UBC
Plecotus townsendii	20 Mar	(4) Victoria	BCPM
Plecotus townsendii	8 Nov–17 Jan	(2) Williams Lake	NMC, UBC, BCPM, Jobin (1952)
Plecotus townsendii	25 Mar	(20) Williams Lake, cave	survey 1989
Plecotus townsendii	2 Feb–28 Mar	(2) Williams lake, mine	surveys 1992

Although solitary big brown bats (*Eptesicus fuscus*) have been found in caves and mines in the British Columbia interior, most winter records are from buildings. Schowalter and Gunson (1979) and Perkins et al. (1990) also noted the tendency of this species to hibernate in buildings in western North America.

Schowalter et al. (1978) and Izor (1979) considered the winter range of the silver-haired bat (*Lasionycteris noctivagans*) in British Columbia to be restricted to the south coast, but our data suggest that the winter range also extends across the southern interior

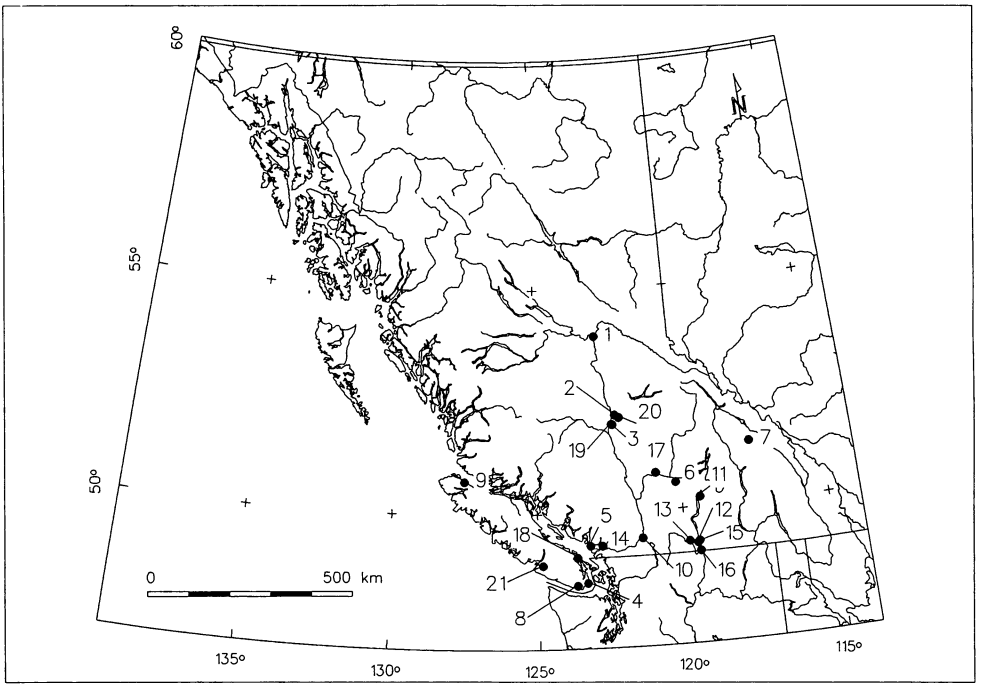

FIGURE 1. Locations of known winter occurrences of bats in British Columbia. Locality numbers refer to Table 1.

of the province. Although this species occasionally hibernates in caves and mines in central and eastern North America (Izor 1979), the only record we have from a mine or cave was an active individual found in a mine adit in the southern Okanagan Valley on 26 January. In British Columbia, *L. noctivagans* appears to roost mainly in trees. There are observations of this species hibernating under the bark of western red cedar (*Thuja plicata*) trees in Vancouver and under the bark of a Douglas-fir (*Pseudotsuga menziesii*) snag near Kamloops. There is also a museum specimen that was taken in January from the attic of a house in Vancouver.

Of the nine *Myotis* species that inhabit the province in summer, only four including the California myotis (*Myotis californicus*), western small-footed myotis (*Myotis ciliolabrum*), little brown myotis (*Myotis lucifugus*), and *M. yumanensis* have been found in winter. Remarkably, no winter aggregations are known for any of these species. The few observations of *M. californicus* suggest that its winter range extends across much of southern British Columbia. In coastal regions of the Pacific Northwest, there is evidence that this species occasionally arouses from torpor in winter to feed (Cowan 1942; Maser et al. 1981). *Myotis ciliolabrum* was observed in limestone caves and mine adits where temperatures ranged from −3–9°C. Numbers of individuals ranged from one to four hibernating singly or in clusters of two individuals. Three of these hibernacula were used also by Townsend's big-eared bat (*Plecotus townsendii*). Torpid *M. ciliolabrum* were found in hibernacula as late as 3 April. Although *M. lucifugus* and *M. yumanensis* are two of the most abundant bats in summer, with maternity colonies of several thousand individuals, their winter biology in British Columbia is essentially unknown. Except for a single *M. lucifugus* found hibernating in a mine shaft near Williams Lake by Jobin (1952), winter occurrences of both species are limited to a few museum specimens that lack roosting data.

Plecotus townsendii is the only bat regularly found hibernating in British Columbia. All

TABLE 2. Location, population size, and temperature data for 16 *Plecotus townsendii* hibernacula in British Columbia.

Site	Lat	Elev (m)	Population	Temp °C	Date
Fraser River, cave 1	51°54′	450	2	—	11 Jan
Fraser River, cave 2	51°56′	775	0–2	+2–+4	11 Nov–21 Mar
Fraser River, cave 3	51°56′	740	1–3	−7–+6	11 Nov–30 Mar
Fraser River, cave 4	51°56′	770	0–2	0–+7	25 Jan–30 Mar
Kamloops Lake, mine	50°47′	530	16–17	−4–+5	18 Jan–15 Feb
Okanagan, mine 1	49°01′	528	1–5	+5–+6	4 Jan–18 Mar
Okanagan, mine 2	40°00′	490	0–6	+5–+12	1 Dec–22 Mar
Okanagan, mine 3	49°12′	576	0–5	+4	2 Dec–18 Mar
Okanagan, mine 5	49°12′	945	1	+8	29 Feb
Okanagan, mine 7	49°12′	550	3–4	—	3 Nov–9 Feb
Okanagan, mine 8	49°13′	595	2	+8	13 Feb
Okanagan, mine 9	49°12′	940	5	+3–+5	5 Feb
Orofino, mine	49°17′	1005	1	—	winter
Thetis Island, mine	49°01′	50	10–48	+4–+12	5 Dec–16 Mar
Williams Lake, cave	52°05′	885	2	—	25 Mar
Williams Lake, mine	52°06′	890	0–3	+7	7 Nov–28 Mar

known hibernacula are caves or mine adits. Data from 16 hibernacula indicate that this species overwinters in small populations that are sporadically distributed across its range (Table 2). According to Barbour and Davis (1969) and Humphrey and Kunz (1976) extreme ambient temperatures in *P. townsendii* hibernacula range from −2–12°C with mean temperatures ranging from 5–7°C. Temperatures in British Columbian sites generally fall within this range, although we have found *P. townsendii* hibernating at temperatures as low as −4–−7°C in the Kamloops and Williams Lake regions. Our observations suggest that this species may tolerate brief periods of freezing temperatures in hibernacula at the northern limits of its range. Most hibernating individuals that we observed were solitary; clustering in British Columbian hibernacula by *P. townsendii* is rare. In addition to these winter records, we observed *P. townsendii* at interior hibernacula in April, May, September, and October with the latest date 23 May and the earliest, 16 September. Both torpid and active individuals have been observed during these months. *Plecotus townsendii* has not been found in any caves or mines in the province during June, July, or August.

There is evidence (Fenton 1972; Izor 1979) that the winter range of bats is limited by mean minimum January temperature. Several bats reach their northern limits in the British Columbia interior near Williams Lake where the mean minimum January temperature is −15°C (Chilton 1981). However, because of sampling biases, this correlation may be spurious. *Eptesicus fuscus, M. ciliolabrum,* and *P. townsendii* evidently overwinter successfully at the northern periphery of their summer range. The ability of *E. fuscus* to overwinter in northern latitudes may depend on the availability of heated buildings. The museum specimen from Prince George (53°55′N), the northernmost winter occurrence in the province, was an individual found in a building when the ambient temperature outside was −40°C. Populations of *M. ciliolabrum* and *P. townsendii* that hibernate near Williams Lake (52°08′N) demonstrate that these species can overwinter at the extreme northern limits of their summer range if suitable hibernacula are available. Winter occurrences of other species are far south of the northern limits of their summer ranges. *Lasionycteris noctivagans* has been found as far north as 56°53′N in summer (Nagorsen and Brigham, in press); given this species' migratory abilities, these northern populations may migrate to southern regions of the province to overwinter. Other species probably overwinter in northern regions of British Columbia. The northernmost winter record for *M. lucifugus* (Williams Lake), for example, is 600 km south of the northernmost (60°N)

maternity colonies known from the province. Presumably, these northern populations hibernate in unknown northern hibernacula.

Our results and those of other workers (Twente 1960; Genter 1986; Perkins et al. 1990) indicate that in western North America relatively few bat species overwinter, and those that do are represented by small numbers of individuals. Of the 16 species that inhabit the province in summer, only four were found during our inventories of hibernacula and winter museum specimens exist for three others. Species that inhabit cliffs and rock faces in summer, such as the pallid bat (*Antrozous pallidus*), spotted bat (*Euderma maculatum*), and fringed myotis (*Myotis thysanodes*), may hibernate in inaccessible rock crevices and thus escape detection. However, bats such as the long-legged myotis (*Myotis volans*), northern myotis (*Myotis septentrionalis*), and *M. lucifugus* hibernate in caves and mines in other regions of western Canada and one would expect them to overwinter in the province. More striking than the few species found, however, were the low numbers of individuals. Hibernacula in eastern Canada may contain 10,000–15,000 bats in winter (Fenton 1970), but the largest winter aggregations (all *P. townsendii*) found in British Columbia ranged from 10–48 bats.

Because we surveyed only a few caves and mines from a small part of the province, it is difficult to interpret our results. Although *P. townsendii* is the most abundant bat in cave and mine hibernacula in some western states (Marcot 1984; Genter 1986), the dominance of this species in British Columbian hibernacula may be a sampling effect. Our surveys were biased for low elevation (<1000 m) sites in southern parts of the province. Temperature or humidity conditions in these sites may be inappropriate for other bat species. Human disturbance may also have had an impact on bat populations in our study areas. Most of the caves and mines that we examined showed evidence of human activity (fire pits, garbage). Clearly, a comprehensive inventory of potential hibernacula from representative elevations and habitats throughout the province is required to determine winter populations and distributions of bats in British Columbia.

ACKNOWLEDGMENTS

Surveys of hibernacula in the province were funded in part by the British Columbia Ministry of Environment, World Wildlife Fund (Canada), and the Federation of British Columbia Naturalists. We thank Cheryl Bryant, Kelly Chapman, Juliet Craig, Chris Dodd, Alison Haney, Rick Howie, Wayne Lamphier, Dave Low, and Barry Shay for information on hibernating bats and assisting in the field. R. M. Brigham provided comments on the manuscript.

LITERATURE CITED

BARBOUR, R. W., AND W. H. DAVIS. 1969. Bats of America. Univ. Kentucky Press, Lexington. 286 pp.

CHILTON, R. H. 1981. A summary of climatic regimes of British Columbia. Min. Environ., Assessment and Planning Div., Air Studies Branch. 46 pp.

COWAN, I. MCT. 1933. Some notes on the hibernation of *Lasionycteris noctivagans*. Can. Field-Nat. 47:74–75.

COWAN, I. MCT. 1942. Notes on the winter occurrence of bats in British Columbia. Murrelet 23:61.

COWAN, I. MCT. 1944. Further notes on the winter occurrence of bats in British Columbia. Murrelet 25:45.

COWAN, I. MCT. 1945. The free-tailed bat, *Tadarida macrotis*, in British Columbia. Can. Field-Nat. 59:149.

FENTON, M. B. 1970. Population studies of *Myotis lucifugus* (Chiroptera: Vespertilionidae) in Ontario. Royal Ontario Mus., Life Sci. Contrib. 77:1–34.

FENTON, M. B. 1972. Distribution and overwintering of *Myotis leibii* and *Eptesicus fuscus* (Chiroptera: Vespertilionidae) in Ontario. Royal Ontario Mus., Life Sci. Occas. Papers 21:1–8.

FENTON, M. B., H. G. MERRIAM, AND G. L. HOLROYD. 1983. Bats of Kootenay, Glacier, and Mount Revelstoke national parks in Canada: identification by echolocation calls, distribution, and biology. Can. J. Zool. 61:2503–2508.

GENTER, D. L. 1986. Wintering bats of the upper Snake River plain: occurrences in lava-tube caves. Great Basin Nat. 46:241–244.

HOFFMEISTER, D. F. 1970. The seasonal distribution of bats in Arizona: a case for improving mammalian range maps. Southwest. Nat. 15:11–22.

HUMPHREY, S. P., AND T. H. KUNZ. 1976. Ecology of a Pleistocene relict, the western big-eared bat (*Plecotus townsendii*), in the southern Great Plains. J. Mammal. 57:470–494.

IZOR, R. J. 1979. Winter range of the silver-haired bat. J. Mammal 60:641–643.

JOBIN, L. 1952. New winter records of bats in British Columbia. Murrelet 33:42.

MARCOT, B. G. 1984. Winter use of some northwestern California caves by western big-eared bats and long-eared myotis. Murrelet 65:46.

MASER, C., B. R. MATE, J. F. FRANKLIN, AND C. T. DRYNESS. 1981. Natural history of Oregon Coast mammals. USDA Forest Service Gen. Tech. Rept. PNW-GTR-133. 496 pp.

NAGORSEN, D. W., AND R. M. BRIGHAM. In press. The mammals of British Columbia. 1. Bats (Chiroptera). Royal British Columbia Mus. Handbook.

PERKINS, J. M., J. M. BARSS, AND J. PETERSON. 1990. Winter records of bats in Oregon and Washington. Northwest. Nat. 71:59–62.

SCHOWALTER, D. B., W. J. DORWARD, AND J. R. GUNSON. 1978. Seasonal occurrence of silver-haired bats (*Lasionycteris noctivagans*) in Alberta and British Columbia. Can. Field-Nat. 92:288–291.

SCHOWALTER, D. B., AND J. R. GUNSON. 1979. Reproductive biology of the big brown bat (*Eptesicus fuscus*) in Alberta. Can. Field-Nat. 93:48–54.

TWENTE, J. W. 1960. Environmental problems involving the hibernation of bats in Utah. Proc. Utah Acad. Sci. Arts Letters 37:67–71.

VAN ZYLL DE JONG, C. G. 1985. Handbook of Canadian mammals. 2. Bats. Nat. Mus. Nat. Sci., Nat. Mus. Canada, Ottawa. 212 pp.

Royal British Columbia Museum, Vertebrate Unit, Victoria, BC V8V 1X5 (DWN); *Andrew A. Bryant Services, Box 100, Site SW, RR 4, Nanaimo, BC V9R 5X9* (AAB); *Biology Department, Malaspina College, 900 5th Street, Nanaimo, BC V9R 5S5* (DK); *2002 Grebe Drive, RR 3, Williams Lake, BC V2G 1M3* (GR, AR); *and Ophius Consulting, RR 1, S-1, C-19, Okanagan Falls, BC V0H 1R0* (MJS). *Received 8 February 1993, accepted 21 December 1993.*

Corresponding editor: K. B. Aubry