Survey of the Bat Fauna Of the Yukon Territory 1998 Field Studies

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Introduction

Bats are a neglected yet vitally important component of many ecosystems, being the second most diverse order of mammals. Bat species found in and near the Yukon are insectivorous with a single little brown myotis eating 600 or more nocturnal flying insects in an hour. A nursing mother will eat up to 2400 insects in a night. Many of the insects consumed by bats are human, agricultural or forest pests. Forest nutrients, in the form of guano, are deposited throughout the forest. Bats are declining worldwide due to habitat loss, the use of pesticides and wanton destruction by humans fueled by misinformation and fear.

We have virtually no baseline data on Yukon bats that can be used to evaluate abundance, species richness, population trends, habitat use, or the impacts of human activities. Information on bats is also needed for management purposes. Since bats are migratory and likely hibernate in Alaska (AK) or British Columbia (BC), inter-jurisdictional management efforts are required. Finally, there is a steady public demand for information on bats for education, interpretive programs, bat conservation, health concerns and the removal of unwanted bats from buildings.

A study was initiated in 1997 to determine bat species composition and distribution, daily activity patterns, migration routes and habitat associations, including roosting, foraging and hibernation sites (Slough 1998). The following summarizes the 1997 studies:

1. 13 bats were live-captured and 4 specimens were obtained from other sources. All bats were identified as little brown myotis, mostly adult males. 14 live bats were banded and tissue samples were obtained from 13.
2. Bats emerged from roosts to forage between 11 and 51 minutes after sunset. Emergence was sooner after sunset on overcast nights and on dates with less civil twilight, further from the summer solstice.

3. Bats make extensive use of the large number of cabins and outbuildings near waterways of the southern YT. Two natural roosts, both behind the peeling bark of dead trees, were reported. Maternity colonies may be restricted to the southern YT. Bats occupy bat houses that are properly designed for northern conditions and placed in suitable habitat.
4. Bats migrate to the YT between early May and early June and remain until early August through mid-September. There is no evidence of hibernation in the YT.
5. The bat colony in the Chadburn Lake Cabin is ideally situated for interpretive talks and research. Unfortunately, vandalism and exclusion of the bats from the cabin by the City of Whitehorse may result in the loss of this colony.

Goals of the 1998 research were to continue the systematic survey of the bats of the Yukon including:

1. Determine species composition and distribution. At least 5 species other than the little brown myotis have been observed near the Yukon borders and likely occur here; silver-haired bat, big brown bat, long-legged myotis, northern long-eared myotis and western long-eared myotis (Fournier 1997, Nagorsen and Brigham 1993, Parker et al. 1997, van Zyll de Jong 1985, and Wilkinson et al. 1995).
2. Continue wing banding and tissue sampling in collaboration with AK and BC bat researchers to help determine migration routes and hibernacula of YT bats.
3. Document bat habitat associations, including natural and man-made roosting sites of maternal colonies and males, foraging sites, flyways and hibernacula.

4. Construct a library of recorded bat calls and computer-generated analyses of vocalizations for behavioural studies and bat identification.

Materials and Methods

Many of the materials and methods described below are discussed in detail in Kunz (1988). The research protocol closely followed the standardized inventory methodologies for bats in BC (Garcia and Barclay 1997).

Visual Detection

A night vision scope (ITT, Model 160, Roanoke, VA) was used to view bat activity at roosts and foraging sites in poor light conditions, especially later in the field season. Otherwise bats were often visible in the long twilight hours after sunset in summer. Civil twilight varies from about 2.5 hours in length (both before sunrise and after sunset) with no official darkness near the summer solstice (in the southern Yukon) to about 0.5 hours in length in mid September, giving about 10 hours of darkness. Morning twilight is generally the coldest part of the day, occasionally freezing in late August, and frequently freezing by mid-September.

Electronic Detection

A bat detector (Anabat II, Titley Electronics, Ballina, NSW, Australia) was used to detect ultrasound produced by bats. The ultrasound was transformed by the detector to an audible output and recorded by a cassette tape recorder (Model CTR-96, Genexxa [Radio Shack], InterTAN, Barrie, ON). This system was used remotely with a delay switch (Anabat II delay switch, Titley Electronics, Ballina, NSW, Australia), which stores the detected call in a memory buffer while it triggers the tape recorder to start running. When the recorder is running at normal speed, the call is downloaded, thus avoiding data loss. The delay switch also produces a time stamp and calibration frequency at the end of each call sequence.

The taped bat calls were processed by a zero-crossing analysis interface module (Anabat V ZCAIM, Titley Electronics, Ballina, NSW, Australia) and downloaded to a PC computer for analysis. De Oliveira (1998) describes the Anabat system. Bat calls were recorded and analyzed using Anabat software version 5.7i for DOS (Chris Corben) and Analyze version 2.0 for Windows (Simon Jolly).

Capture

Bats were captured using 4-shelved nylon mist nets (Models A26N-2, 2.1m x 12.8m, and CH6, 2.6 x 6m, Avinet, Dryden, NY) set on 2.7m poles (Model 10536C, Avinet, Dryden, NY), 0.5m above ground. A harp trap, with an area of $1m^2$ (Palmeirim and Rodruigues 1993) was placed in the flyway adjacent to bat roosts in the roof of a cabin.

Handling

Captured bats were placed in cloth holding bags and held until the end of the trapping session. They were aged, sexed, assessed for reproductive condition, weighed (Avinet scale S30, 30g x 0.2g), and forearm length was measured.

A numbered aluminum split-ring band was attached with finger pressure to the forearm (5.5 x 0.38mm with anodized colours, Lambournes, Ltd., Birmingham, UK) to identify recaptures locally and at hibernacula suspected to be in coastal AK. Bands for males were red with blue reflective tape and bands for females, gold with yellow reflective tape. A plagiopatagium (wing membrane) sample was taken with a 2mm diameter leather punch (Osborne, model 153 w/#1 screw tube, Oregon Leather Co., Portland, OR) and placed in a 1.8ml cryotube vial (NUNC, Denmark) filled with 70% ethanol. The membrane sample provides DNA for polymerase chain reaction based analyses. Samples were sent to the Alaska Frozen Tissue Collection, University of Alaska, Fairbanks, for genetic studies of migration patterns. The banding and tissue sampling were done in collaboration with Stephen Lewis, Ph.D. candidate, University of Alaska,

Fairbanks, who is studying bats in southeast AK, and Tony Fischbach, U.S. Fish and Wildlife Service, Anchorage, AK.

Study Sites

Live-capture was attempted at Wolf Lake in June but abandoned due to nighttime waterfowl flights. It was attempted unsuccessfully at the Wolf Creek subdivision. All live-captured specimens were obtained from an unoccupied cabin in the Judas Creek subdivision on Marsh Lake. Several areas were remotely sampled for bat calls, including the Yukon River between Carmacks and Dawson City, Wolf Lake, the Nisutlin River, the Whitehorse area, the Tutshi uplands near Log Cabin, BC, and Tagish Lake, BC.

Results and Discussion

Public Interest in Bats

There was a high level of demand by the public for information on bats. The following is a summary of public interest in the past year:

1. Yukon Bird Club talk, March 5, Whitehorse Public Library.
2. Lecture to 'Principles and Practices of Heritage Interpretation' course (Yukon College), May 14, Chadburn Lake.
3. Presentation to City of Whitehorse's Fireweed day camp leaders, June 17.
4. Walks in the Woods Program presentation, sponsored by the Department of Renewable Resources, August 5, Chadburn Lake, Whitehorse.
5. School talk, Selkirk Street School, Nov. 2.
6. CBC replayed the radio interview from the 1997 Nature Appreciation Series talk, sponsored by the Yukon Conservation Society, at Chadburn Lake.
7. The Yukon News reprinted the article on bats written for the Environment Canada's "Your Yukon" series by Claire Eamer.
8. In response to the media coverage and referrals from the Department of Renewable Resources I received several phone calls on issues of health

concerns, the exclusion of bats from buildings, bat house construction, and bat sightings.

9. I have an ongoing dialogue with the City of Whitehorse on the issue of conserving the bat colony at Chadburn Lake. The colony is well located for interpretive talks and research. The City has excluded the bats from the interior of the cabin (they are still residing in the louvered air vents that have outside access only). Suitable bat houses have not yet been provided as a replacement as promised by the City.

Live-capture

Twenty-four bats were captured from the Marsh Lake cabin, including 16 adults (3M:13F) and 8 juveniles (2M:6F) (Table 1). All were identified as little brown myotis (*Myotis lucifugus*) and were banded. Tissue samples were obtained from 21.

The total number of bats occupying the cabin is estimated at 50 or more. Bats were found roosting in various south-facing locations, including the eaves of a gable roof and eaves of the main roof. There is probably more than one colony occupying this cabin; a maternity colony in the warmest habitat of the gable roof, with other bats, mainly males, scattered elsewhere.

Bat Call Analysis

The remote detection and recording of bat echolocation calls is summarized in Table 2. Sixteen sites were surveyed over 53 nights, and over 300 calls were recorded. Bats were more common and ubiquitous than previously thought. They were found adjacent or near still-water aquatic habitats throughout the southern YT and northwestern BC.

Bat calls have been used to compare bat activity between areas or among habitats (e.g., Hayes and Adam 1996), to determine activity type, such as search, approach and feeding buzz (e.g., Brigham et al. 1997, Crampton and Barclay 1996), and to identify species (e.g., Fenton and Bell 1981, Fenton et al. 1983).

The assessment of foraging activity remains subjective and varies between observer and method of analysis (Weller et al. 1998). I attempted to estimate feeding activity as indicated by distinctive "buzzes" which indicate either approach or feeding as differentiated from searching or commuting (Table 2). Although a subjective technique, it may be useful for comparing foraging activity among sites.

Species identification is likewise wrought with controversy and problems due to the variability of calls within species and the extensive overlap of the calls of species such as *Myotis* spp. I did not attempt to analyze calls (e.g., discriminant analysis of attributes such as pulse shape, pulse duration, pulse interval, inter-pulse interval, call frequency, mean, maximum and minimum frequencies, etc.) other than to visually assess time-frequency displays for comparison with known *Myotis lucifugus* calls. At the present time I could not identify other species, however I will maintain all recorded calls in a library for future use as our experience with northern bat species improves.

Although man-made roosts are easier to detect, natural roosts have been found, and bats were found in several locations where man-made structures were either absent or not inhabited by bats. Bats probably roost in south facing rock crevices in cliffs bordering Wolf Creek, near the Mary Lake.

Miscellaneous Observations

A bat specimen obtained in 1997 (97-17; Slough 1998) was identified as *Myotis lucifugus* (D. Nagorsen, pers. commun.) and is held in the research collection of the Royal British Columbia Museum (catalogue no. RBCM 29863).

The following observations were made at the Chadburn Lake Cabin:

- May 14, no bats observed. Centre of lake frozen with 2-5 m open water along shoreline.

- May 27, 10 bats roosting in louvered vents, following exclusion from the interior of the cabin. No ice on lake.
- June 15, 3 bats in vents.
- July 2, 2 bats in vents.
- August 5, 6 bats in vents.

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Table 1 Bat Live-capture Summary, Marsh Lake Yukon, 1998

Date	Specimen No.	Species[1]	Sex[2]	Age[3]	Mass (g)	Forearm length (mm)	Band No.	AF No.[4]	Comments
Jul 30	98-1	MYLU	F	A	-	37	2949	20714	Parous
Jul 30	98-2	MYLU	F	J	7.2	38	2948	20715	
Jul 30	98-3	MYLU	F	J	5.9	37	2902	-	
Jul 30	98-4	MYLU	M	A	-	38	2903	20716	
Jul 30	98-5	MYLU	F	J	8.0	38	2904	20717	
Jul 30	98-6	MYLU	F	A	8.4	40	2905	20718	Parous
Jul 30	98-7	MYLU	M	J	7.0	38	1963	20719	
Jul 30	98-8	MYLU	F	A	8.0	39	2906	-	Parous
Jul 30	98-9	MYLU	F	A	8.4	39	2907	20720	Parous
Jul 30	98-10	MYLU	F	A	9.6	39	2908	-	Parous
Jul 30	98-11	MYLU	F	A	8.0	38	2909	20721	Parous
Jul 30	98-12	MYLU	F	A	9.2	39	2950	20722	Parous
Jul 30	98-13	MYLU	F	J	8.4	38	2910	20723	
Jul 30	98-14	MYLU	F	A	7.4	38	2911	20724	Nulliparous, recent trauma to abdomen (dried blood), torn wing membrane
Jul 30	98-15	MYLU	M	J	6.0	35	1964	20725	
Aug 1	98-16	MYLU	F	J	6.2	39	2912	20726	

Aug 1	98-17	MYLU	M	A	6.2	39	1965	20727	
Aug 1	98-18	MYLU	F	J	8.0	37	2913	20728	
Aug 1	98-19	MYLU	F	A	8.0	38	2914	20729	Parous
Aug 1	98-20	MYLU	F	A	9.0	38	2915	20730	Parous, several white lesions and one puncture on wings
Aug 1	98-21	MYLU	F	A	7.8	38	2917	20731	Parous
Aug 1	98-22	MYLU	F	A	7.3	38	2918	20732	Parous
Aug 2	98-23	MYLU	F	A	6.4	38	2919	20733	Nulliparous
Aug 2	98-24	MYLU	M	A	6.0	39	1966	20734	

[1] MYLU = *Myotis lucifugus*

[2] M = Male, F = Female

[3] A = Adult, J = Juvenile

[4] Alaska frozen tissue collection number

Table 2 Bat Echolocation Call Surveys, Yukon and Northwestern B.C., 1998.

Date	Location	Lat., Long.	Habitat	No. of Calls (Foraging buzzes)	Time of Calls	Comments
May 28	Mary Lake	60°35'N, 134°57'W	Large beaver pond	4	00:29-00:34	00:38 end of tape.
May 29	Marsh Lake	60°27'N, 134°16'W	Cabin near lakeshore	Numerous	11:40-end of tape	03:25 end of tape. Juvenile isolation calls in roost 11:40-00:21 and 03:03 to end of tape.
May 30	Wolf Creek subdiv.	60°36'N, 134°58'W	Open aspen bluff	0		Terminated at 03:17 due to rain.
May 31	Wolf Creek	60°35'N, 134°58'W	Granite cliff near creek	2	01:28-02:00	
Jun 2	Wolf Creek subdiv.	60°36'N, 134°58'W	Open aspen bluff	1	03:49	
Jun 3	Wolf Creek subdiv.	60°36'N, 134°58'W	Open aspen bluff	0		
Jun 6	Wolf Lake	60°36'N, 131°36'W	Creek mouth	3	00:49-02:52	
Jun 7	Wolf Lake	60°36'N, 131°36'W	Creek mouth	0		Mist netting to 01:00, no bats detected.
Jun 8	Wolf Lake	60°35'N, 131°36'W	Creek meadow 1 km from lake	0		
Jun 9	Wolf Lake	60°36'N, 131°36'W	Creek mouth	2	00:57-01:28	
Jun 11	Wolf Creek subdiv.	60°36'N, 134°58'W	Open aspen bluff	0		
Jun 12	Wolf Creek subdiv.	60°36'N, 134°58'W	Open aspen bluff	0		
Jun 15	Chadburn Lake	60°39'N, 134°58'W	Protected bay	34 (1)	00:39-03:02	
Jun 18	Marsh Lake	60°27'N, 134°16'W	Marsh near lake	125 (36)	00:57-end of tape	00:38 end of tape.
Jun 23	Wolf Creek subdiv.	60°36'N, 134°58'W	Open aspen bluff	1	02:57	
Jun 24	Mary Lake	60°35'N, 134°57'W	Large beaver pond	1	02:18	
Jun 25	Wolf Creek	60°36'N,	Open aspen	3	01:02-	

	subdiv.	134°58'W	bluff		03:07	
Jun 26	Wolf Creek subdiv.	60°36'N, 134°58'W	Open aspen bluff	5	00:52-02:56	
Jun 27	Wolf Creek	60°35'N, 134°58'W	Granite cliff near creek	7 (2)	01:08-02:57	1 call sequence ~35 sec., could indicate several bats feeding or nearby roost in rock crevice.
Jun 29	Deep Bay, Tagish Lake	59°38'N, 134°17'W	Lakeshore near marsh	12	00:38-03:05	
Jun 30	Wolf Creek subdiv.	60°36'N, 134°58'W	Open aspen bluff	13 (1)	01:04-02:55	
Jul 1	Wolf Creek subdiv.	60°36'N, 134°58'W	Open aspen bluff	1	01:21	
Jul 4	Yukon R.	60°34'N, 134°33'W	Lewes R. Marsh	1	02:43	
Jul 5	Wolf Creek area	60°35'N, 134°58'W	Pond 1 km from creek	1	02:57	
Jul 6	Cowley Creek	60°36'N, 134°55'W	Sedge meadows	0		
Jul 10	Yukon R, Minto Landing	62°35'N, 136°53'W	Grasslands near riverbank	0		
Jul 11	Yukon River	62°49'N, 137°34'W	Island in river	0		
Jul 21	Wolf Creek subdiv.	60°36'N, 134°58'W	Open aspen bluff	9 (1)	00:18-03:38	
Jul 23	Wolf Creek subdiv.	60°36'N, 134°58'W	Open aspen bluff	3	00:18-00:27	Mist mist netting to 01:00.
Jul 30, Aug 1-2	Marsh Lake	60°27'N, 134°16'W	Cabin near lakeshore	Numerous	Emergence at 11:06, 11:01, 11:00	Recordings made of live-captured and released *Myotis lucifugus*.
Aug 9	Graham Inlet, Tagish Lake	59°38'N, 134°11'W	Creek mouth in Bay	26 (1)	11:16-03:20	
Aug 10	Graham Inlet, Tagish Lake	59°36'N, 134°12'W	Pond 1 km from lake	1	11:14	Battery failure after 11:14.

Aug 11	Graham Inlet, Tagish Lake	59°36'N, 134°12'W	Pond 1 km from lake	3	10:53-00:47	Bob Wilson has "4 or 5" bats living in cabin at Taku Landing, Graham Inlet.
Aug 18	Tutshi uplands	59°49'N, 134°56'W	Pond	5	10:47-03:05	Battery failure after 03:05.
Aug 25	Tutshi uplands	59°46'N, 134°56'W	Pond	6 (1)	10:19-11:01	
Aug 26	Tutshi uplands	59°46'N, 134°56'W	Pond	6	10:02-02:25	
Aug 27	Tutshi uplands	59°46'N, 134°56'W	Pond	2	10:41-05:21	
Sep 3	Nisutlin River	60°55'N, 132°57'W	Riverbank	0		
Sep 4	Nisutlin River	60°44'N, 132°55'W	Slough	1	10:14	
Sep 5	Nisutlin River	60°36'N, 132°44'W	Slough	3 (1)	10:11-11:21	
Sep 8	Wolf Creek subdiv.	60°36'N, 134°58'W	Open aspen bluff	0		
Sep 11	Wolf Creek subdiv.	60°36'N, 134°58'W	Open aspen bluff	3	09:07-00:40	
Sep 13	Mary Lake	60°35'N, 134°57'W	Large beaver pond	1	01:57	
Sep 14	Mary Lake	60°35'N, 134°57'W	Large beaver pond	2	09:16-09:18	
Sep 15	Mary Lake	60°35'N, 134°57'W	Large beaver pond	0		
Sep 16	Mary Lake	60°35'N, 134°57'W	Large beaver pond	2	?	Tape speed/battery problem.
Sep 17	Mary Lake	60°35'N, 134°57'W	Large beaver pond	5	09:25-?	Tape speed/battery problem.
Sep 18	Mary Lake	60°35'N, 134°57'W	Large beaver pond	0		
Sep 20	Mary Lake	60°35'N, 134°57'W	Large beaver pond	5	10:02-05:49	
Sep 21	Mary Lake	60°35'N, 134°57'W	Large beaver pond	10 (1)	09:41-03:25	
Sep 22	Mary Lake	60°35'N, 134°57'W	Large beaver pond	0		