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FIRST ACOUSTIC RECORDS OF THE BRAZILIAN FREE-TAILED BAT (*TADARIDA BRASILIENSIS*) IN BRITISH COLUMBIA

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ABSTRACT—We report here the 1st evidence of the Brazilian Free-tailed Bat (*Tadarida brasiliensis*) in Canada. Historic distribution records of this species in the Pacific Northwest region of North America include southern Oregon and southern Idaho, but not British Columbia. During 2014–2016 we conducted bat acoustic surveys in Canada on Salt Spring Island, British Columbia, sampling 1342 detector-nights. We recorded multiple bat-call sequences during 2016 showing pulse and sequence attributes consistent with those of the Brazilian Free-tailed Bat, and we recorded 2 such call sequences in 2015. Calls were detected from May until September, suggesting summer residency by adults, rather than stray post-natal dispersals from the south. The Brazilian Free-tailed Bat is a fast long-distance flyer, and acoustic surveys outside of its historic range may benefit from surveillance for this species.

Key words: acoustic, bats, Brazilian Free-tailed Bat, British Columbia, Canada, echolocation, Salt Spring Island, *Tadarida brasiliensis*

The geographic range of the Brazilian Free-tailed Bat (*Tadarida brasiliensis*) in western North America extends as far north as southern Oregon (Verts and Carraway 1998), southern Idaho (Rita Dixon, Idaho Department of Fish and Game, pers. comm.), and southeastern South Dakota (Genoways and others 2000). The species, however, has not previously been recorded in Canada. This report describes unique call sequences characteristic of this bat species detected on Salt Spring Island, British Columbia.

The Brazilian Free-tailed Bat is a fast flyer capable of long-duration flights. Adaptations include wings of high aspect ratio, short aerodynamic fur, gliding behavior, and primary flight muscles with only fast oxidative fibers (Wilkins 1989). Flight speed exceeds all other bat species tested and may exceed that of the fastest birds (McCracken and others 2016).

Salt Spring Island is located 50 km west of Washington State (Fig. 1) and within 1 km of Vancouver Island to the west. Salt Spring Island is 190 km^2 in area, with 78% forest cover, 17% anthropogenic land use including cultivation, and less than 2% wetland (Madrone Environmental Services Ltd. 2008).

Prior to 2014, bat surveys on Salt Spring Island were sporadic. The Royal British Columbia Museum holds a specimen of the California Myotis (*Myotis californicus*; catalog number 013254) collected 6 June 1984 and specimens of the Little Brown Myotis (*M. lucifugus*; catalog numbers 015284 through 015290) collected 13 July 1985. Mist netting in 1991 captured the Little Brown Myotis and Yuma Myotis (*M. yumanensis*) on 9 May and Californiа Myotis on 1 July (Firman and others 1993). Mist netting by one of the authors (CL) on 18 and 28 July 2013 captured the California Myotis, Yuma Myotis, and Keen's/Long-eared Myotis (*M. keenii* / *M. evotis*). Short acoustic surveys by the authors 2009–2013 detected, in addition to the above species, the Big Brown Bat (*Eptesicus fuscus*), Hoary Bat (*Lasiurus cinereus*), and Silver-haired Bat (*Lasionycteris noctivagans*).

Beginning in 2014, we began long-term passive acoustic monitoring to document bat biodiversity, species distributions, and activity levels in anticipation of wetland restoration projects at the Salt Spring Island Conservancy's Blackburn Lake Nature Reserve. Bat detectors were also deployed at other lakes and at private properties on Salt Spring Island. Bat detectors used were 2 Anabat Express, 2 Anabat SD2 (Titley Scientific, Columbia, MO, USA), and 2 SM4BAT (1 FS and 1 ZC, Wildlife Acoustics, Inc, Maynard, MA, USA). During 2014–2016, we sampled 725 calendar nights (1342 detector nights) (Table 1).

The 2014–2016 acoustic surveys detected all of the species found prior to 2014 as well as the Townsend's Big-eared Bat (*Corynorhinus townsendii*). Dead specimens of this species and the Big Brown Bat, California Myotis, and Long-eared Myotis were also observed during this period.

In 2016, we recorded call sequences on at least 30 calendar nights that we attribute to the Brazilian Free-tailed Bat. These were 1st record-

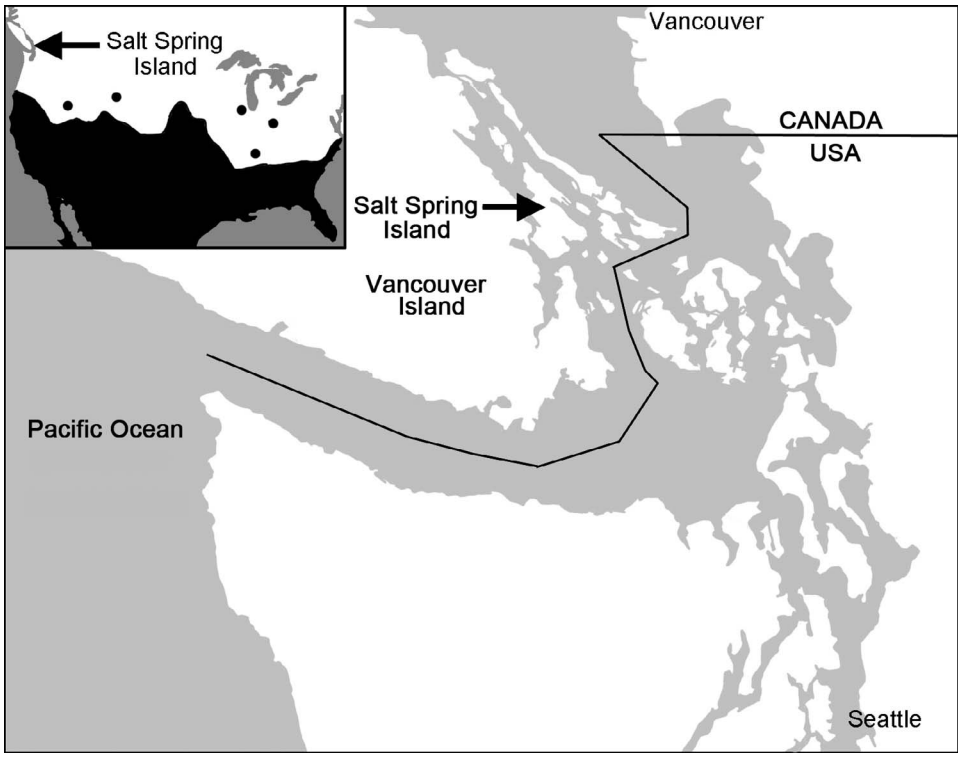

FIGURE 1. Salt Spring Island, British Columbia, and inset of North America showing in black the geographic range of the Brazilian Free-tailed Bat (after Armstrong 2008 and Genoways and others 2000).

ed on 25 May 2016 at restored wetlands on the Blackburn Lake Nature Reserve (UTM: Zone 10 U, 464397 m E, 5407595 m N, WGS84), and subsequently in the vicinity of Ford Lake (UTM: Zone 10 U, 465283 m E, 5405099 m N, WGS84), Roberts Lake (UTM: Zone 10 U, 462036 m E, 5409034 m N, WGS84), and Maxwell Lake (UTM: Zone 10 U, 460433 m, E 5407804 m N, WGS84). These wetlands lie in the Coastal Douglas-fir biogeoclimatic zone, which has a mild Mediterranean-type climate. The last evidence of this bat species in 2016 was recorded on 15 September. During 2015 only 2 call sequences were detected on Salt Spring Island, one on 6 June and one on 27 June. Although calls were detected on at least 30 calendar nights in 2016, it was rare to record more than a few clear diagnostic call sequences in a single night, and all calls were recorded within a 3-km geographic radius. Acoustic voucher files have been archived at the Figshare digital scientific data repository (https://dx.doi.org/10.6084/m9.figshare.4522931.v1).

TABLE 1. Bat acoustic sampling on Salt Spring Island, 2014–2016.

Year	Calendar nights	Detector nights	Sampling period
2014	30	30	21 July–21 September
2015	331	543	19 January–31 December
2016	364	769	1 January–1 December

Full-spectrum bat calls were viewed using Kaleidoscope software version 3.1.7 (2016), and acoustic measurements were obtained from zero-crossings spectrograms on the same software. We measured the highest frequency (F_{max}), lowest frequency (F_{min}), pulse interval, and pulse duration from a sample of zero-cross search-phase calls (pulses) and compared these to measurements reported in the literature. Calls that we recorded and attributed to the Brazilian Free-tailed Bat were narrow-bandwidth search-phase calls (Fig. 2, Table 2), mostly between 20 and 25 kHz. Many calls had a frequency upswing into the call and a frequency down-

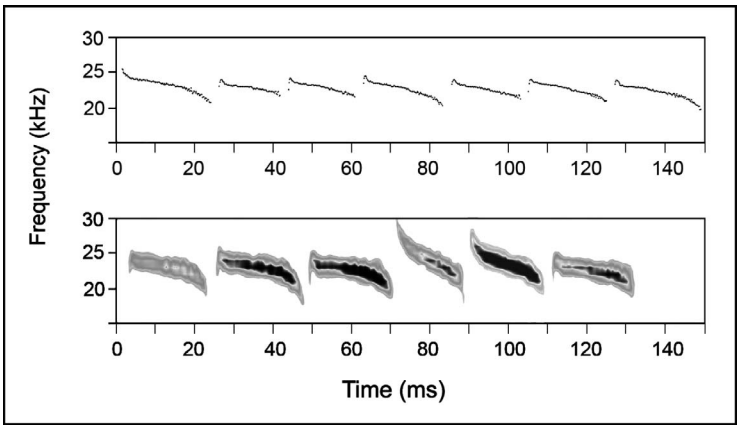

FIGURE 2. Two different bat call sequences from the Blackburn Lake Nature Reserve, Salt Spring Island, British Columbia, recorded on an SM4BAT FS detector 29 July 2016, and viewed in compressed mode (time between calls removed). Upper = zero-crossing spectrogram. Lower = power spectrogram.

swing out of the call (Fig. 3). The latter 2 features have been reported as "diagnostic" for the Brazilian Free-tailed Bat (Humboldt State University Bat Lab 2011) and are illustrated in Figure 2a of Gillam and McCracken (2007), Figure 2a of Schwartz and others (2007), and Figure 2 of Jung and others (2014a).

The call measurements we documented were consistent with values reported by other authors who analyzed full spectrum calls from Brazilian Free-tailed Bats that were visually identified. Jung and others (2014a) listed a mean start frequency of 27.6 ± 3.0 kHz (mean ± standard deviation) and mean end frequency of 24.4 ± 1.3 kHz measured from 48 calls. Gillam and McCracken (2007) recorded calls from 16 locations that included 1 set of 44 sequences with a mean F_{min} of 20.9 ± 0.9 kHz and a mean F_{max} of 30.0 ± 2.0 kHz. Our recorded calls were a mean F_{min} of 21.67 ± 1.03 kHz and a mean F_{max} of 24.67 ± 1.68 kHz. Our mean F_{max} may be lower than that of other authors because we measured only call sequences least likely to overlap with those of the Silver-haired Bat.

TABLE 2. Descriptive statistics of search-phase echolocation pulses in 10 call sequences from this study measured from zero-crossing spectrograms.

Parameter	*n*	Mean ± standard deviation (range)
Minimum frequency (kHz)	126	21.67 ± 1.03 (19.4–24.5)
Maximum frequency (kHz)	126	24.67 ± 1.68 (21.0–30.0)
Bandwidth (kHz)	126	3.00 ± 1.17 (−0.34–6.9)
Pulse interval (ms)	118	426.6 ± 163.8 (139–1012)
Pulse duration (ms)	104	15.7 ± 3.3 (9.0–23.0)

Although guano DNA or bat specimens are desirable for identification of a bat species, acoustic evidence may be informative when other evidence is unavailable and when the calls are "unambiguous" (Jung and others 2014b). On Salt Spring Island, the 3 species with calls most similar to those of the Brazilian Free-tailed bat are the Silver-haired Bat, the Big Brown Bat, and the Hoary Bat. The Silver-haired Bat can produce flat and narrow bandwidth calls, but with an

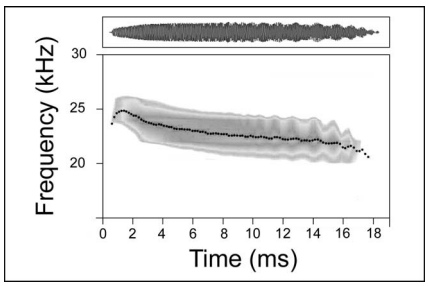

FIGURE 3. Enlargement of a single bat call showing oscillogram (top) and spectrogram (bottom). The latter shows a full spectrum recording (grey shade) made by an SM4BAT FS detector, with zero-crossing overlay (black line). Note the initial upsweep into the call and downsweep out of the call, features reported to be diagnostic of the Brazilian Free-tailed Bat (Humboldt State University Bat Lab 2011).

F_{max} typically above 25 kHz (Betts 1998; Humboldt State University Bat Lab 2011).

Narrowband calls of the Big Brown Bat may show an initial frequency downswing (Surlykke and Moss 2000), are unlikely to be flat, and unlikely to have an F_{max} below 25 kHz (Humboldt State University Bat Lab 2011). Social calls of the Big Brown Bat are likely to have much smaller pulse intervals than those we measured (Gadziola and others 2012; Wright and others 2014). Calls of the Hoary Bat in the 20+ kHz range tend to be steeper (Barclay 1986) and lack the frequency downswing observed in our sample (Humboldt State University Bat Lab 2011). Our call sequences were also identified as Brazilian Free-tailed Bats through independent visual examination of 28 acoustic files by bat acoustic experts (Chris Corben and William E Rainey, pers. comm.).

The date when Brazilian Free-tailed Bats may have first appeared on Salt Spring Island is uncertain. Although multiple detections occurred during 2016, during 2015 only 2 call sequences were detected. There is no prior evidence of this bat on the island.

The proximity of Salt Spring Island to the closest known US locations of the Brazilian Free-tailed Bat, southern Oregon and southern Idaho, is 700 and 800 km respectively. These distances are well within the measured 1800+ km flight capacity of this species. Although Brazilian Free-tailed Bats that breed in Oregon are non-migratory, the documented northern late- summer dispersal distance of a Brazilian Free-tailed Bat is 640 km (Genoways and others 2000), which could facilitate a rapid, stepwise range extension. Alternatively, British Columbia specimens (and those in Idaho) may have originated as spring migrants derived from known migratory populations such as those in Nevada and Colorado (Russell and others 2005). Genoways and others (2000) characterize the Brazilian Free-tailed Bat as highly mobile, having a fluid geographic distribution, and easily capable of occupying reproductive "pioneering" zones and (mostly non-reproductive) "exploring" zones. These new habitats relieve intraspecific competition in the natal range. The detection of volant bats in British Columbia as early as May excludes the explanation that the bats are only occasional stray postnatal (late-summer) dispersals from southern populations. It is possible that local reproductive colonies may exist in British Columbia, and in 2016 three acoustic records were reported from Metro Vancouver (St. Clair and others 2016). The British Columbia records reported here accentuate the need to include the Brazilian Free-tailed Bat as a candidate species in acoustic surveys throughout the Pacific Northwest.

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Literature Cited

Armstrong K. 2008. Brazilian free-tailed bat (*Tadarida brasiliensis*). Mammalian Species 4:1–6. Department of Wildlife and Fisheries, Mississippi State University, MS 39762.

Barclay RM. 1986. The echolocation calls of Hoary (*Lasiurus cinereus*) and Silver-haired (*Lasionycteris noctivagans*) Bats as adaptations for long-versus short-range foraging strategies and the consequences for prey selection. Canadian Journal of Zoology 64:2700–2705.

Betts BJ. 1998. Effects of interindividual variation in echolocation calls on identification of Big Brown and Silver-haired Bats. The Journal of Wildlife Management 62:1003–1010.

Firman M, Getty M, Barclay RMR. 1992. Status of Keen's Long-eared Myotis in British Columbia. Wildlife Working Report No. WR59. Victoria, BC: Wildlife Branch, Ministry of Environment, Lands and Parks. 22p.

Gadziola MA, Grimsley JM, Faure PA, Wenstrup JJ. 2012. Social vocalizations of Big Brown Bats vary with behavioral context. PLoS ONE 7:e44550. doi10.1371/ journal.pone.0044550.

Genoways HH, Freeman PW, Grell C. 2000. Extralimital records of the Mexican Free-Tailed Bat (*Tadarida brasiliensis mexicana*) in the central United States and their biological significance. Transactions of the Nebraska Academy of Sciences 26:85–96.

Gillam EH, McCracken GF. 2007. Variability in the echolocation of *Tadarida brasiliensis*: Effects of geography and local acoustic environment. Animal Behaviour 74:277–286.

Humboldt State University Bat Lab. 2011. Echolocation call characteristics of western US bats. http://www.sonobat.com/download/WesternUS_Acoustic_Table_Mar2011.pdf.

Jung K, Molinari J, Kalko EK. 2014a. Driving factors for the evolution of species-specific echolocation call design in new world free-tailed bats (Molossi-

dae). PloS ONE 9: e85279. doi:10.1371/journal.pone.0085279.

Jung TS, Blejwas KM, Lausen CL, Wilson JM, Olson LE. 2014b. Concluding remarks: What do we need to know about bats in northwestern North America? Northwestern Naturalist 95:318–330.

Madrone Environmental Services Ltd. 2008. Terrestrial ecosystem mapping of Saltspring Island. Duncan, BC: Madrone Environmental Services Ltd. 103 p. http://a100.gov.bc.ca/appsdata/acat/documents/r15273/06.0449SSITEMReportFinal_1223598357983_8e248a8d30d9e7e5b40626e34f0e8207820b65a12b9b.zip.

McCracken GF, Safi K, Kunz TH, Dechmann DK, Swartz SM, Wikelski, M. 2016. Airplane tracking documents the fastest flight speeds recorded for bats. Royal Society Open Science DOI:10.1098/rsos.160398.

Russell AL, Medellin RA, McCracken GF. 2005. Genetic variation and migration in the Mexican Free-tailed Bat (*Tadarida brasiliensis mexicana*). Molecular Ecology 14:2207–2222.

Schwartz C, Tessler J, Keller H, Vanzant M, Ezell S, Smotherman M. 2007. The tiny difference between foraging and communication buzzes uttered by the Mexican Free-tailed Bat, *Tadarida brasiliensis*. Journal of Comparative Physiology A 193:853–863.

St. Clair C, Palmer C, Martinez F. 2016. Vancouver Fraser Port Authority species at risk inventory 2016, Little Brown Bat. Vancouver Fraser Port Authority report prepared by Hemmera, 4730 Kingsway, Burnaby BC, V5H 0C6. 18p.

Surlykke A, Moss CF. 2000. Echolocation behavior of Big Brown Bats, *Eptesicus fuscus*, in the field and the laboratory. The Journal of the Acoustical Society of America 108:2419–2429.

Verts BJ, Carraway LN. 1998. Land mammals of Oregon. University of California Press. 668 p.

Wilkins KT. 1989. *Tadarida brasiliensis*. Mammalian Species 331:1–10. American Society of Mammalogists.

Wright GS, Chiu C, Xian W, Wilkinson GS, Moss CF. 2014. Social calls predict foraging success in Big Brown Bats. Current Biology 24:885–889.

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