

Supplemental Information “Multiple Mortality Events in Bats: A Global Review”, *Mammal Review* 2016, O’Shea, Cryan, Hayman, Plowright, Streicker.

We provide summaries of pertinent details regarding multiple mortality events of bats in a series of nine appendices. Appendix S10 lists all references cited in Appendices S1-S9. Events are given by region alphabetically, then chronologically within regions. The number of events entered into tallies are given in parentheses under the “Description” column. We attempted to be conservative in designating numbers of events. Unfortunately not all sources provide enough information to allow accurate judgments in each case. Generally we considered events extending over multiple years as one event per year, and events observed at more than one dispersed location as separate events. We considered events impacting more than one species of bat as separate events for each species, unless there was insufficient information on numbers per species. Events with insufficient information for each species were treated as single events. Scientific names follow Simmons (2005) in Wilson and Reeder’s (2005) *Mammal Species of the World*, 3<sup>rd</sup> edition (<http://www.vertebrates.si.edu/msw/mswcfapp/msw/index.cfm>), with the exceptions of *Myotis escalerae* (Ibáñez *et al.* 2006), *Perimyotis subflavus*, and *Parastrellus hesperus* (Hooper *et al.* 2006).

**Appendix S2.** Reports of multiple bat deaths due to biotic factors other than infectious disease.

Region and Species	Date	Description	Location	Source	Case
<i>Africa</i>					
Unspecified bats	Prior to 1925	Army ants attacking and killing young bats roosting in building roofs on multiple occasions. (1 event)	Chikala Hills, Malawi	Coudenhove 1925	S2-1
Thought to be: <i>Cloeotis percivali</i> , <i>Rhinolophus simulator</i> , <i>Hipposideros caffer</i> , <i>Nycteris thebaica</i> ,	1973	Bat hawk ( <i>Macheiramphus alcinus</i> ) observed on 6 nights captured 4-11 bats each night, one every 3 minutes; hawk averaged about 50% success on each attempt. (1 event)	Ngwerere Cave, near Lusaka, Zambia	Black <i>et al.</i> 1979	S2-2

<i>Chaerephon</i> sp., <i>Epomophorus</i> sp., <i>Hipposideros caffer</i> , <i>Laephotis angolensis</i> , <i>Myotis welwitschii</i> , <i>Neorimicia</i> or <i>Pipistrellus</i> sp., <i>Neoromicia capensis</i> , <i>Nycticeinops schlieffeni</i> , <i>Rhinolophus</i> sp., <i>Scotophilus</i> sp.,	1976	Remains of 65 bats in 28 pellets of Old World bat hawks. (1 event)	Sengwa Wild Life Research Area, Gokwe, Zimbabwe	Fenton <i>et al.</i> 1977	S2-3
<i>Chaerephon pumilus</i> , <i>Mops condylurus</i>	3-16 Mar 1992	39 bats observed taken by four species of raptors. (1 event)	Kruger National Park, South Africa	Fenton <i>et al.</i> 1994	S2-4
<i>Myotis myotis</i>	1993	Snake ( <i>Coluber hippocrepis</i> ) ingested bat, witnesses noted at least 3 snakes regularly prey on bats at grille protecting cave. (1 event)	Oujda Province, Morocco	Hammer & Arlettaz 1998	S2-5
<b>Asia</b>					
Unspecified	Ca. 1901-1911	The Indian Hobby ( <i>Falco subbuteo centralasire</i> ) is “peculiarly fond of bats. I have seen sometimes below the nests of these birds such numerous remains of bats that they must in these instances have formed the staple food of both parents	India	Baker 1917	S2-6

		and young.” Observed taking bats in moonlit sky. (1 event)			
<b>Australia</b>					
<i>Miniopterus schreibersii</i> , <i>Miniopterus australis</i>	Jul 1960-Sep 1962	Fox ( <i>Vulpes vulpes</i> ) predation on at least 472 bats based on wing remains and feces. (3 events)	Yessabah Bat Cave, Kempsey, New South Wales, Australia	Dwyer 1964	S2-8
<i>Pteropus poliocephalus</i>	1988-1993	Corpses of 61 non-volant young fallen or abandoned at roosts. (1 event)	Sydney, New South Wales, Australia	Tidemann 1999	S2-9
<i>Pteropus conspicillatus</i>	1991	“scores of dead and dying flying foxes scattered on the forest floor. Infants were clinging to paralyzed mothers” 488 counted, ca 3,000 thought died subsequently. Tick paralysis neurotoxicity (fostered by ecosystem change). (1 event)	Atherton Tablelands, North Queensland, Australia	Van Tassel 1995	S2-10
<i>Pteropus conspicillatus</i>	1998-2010	About 200 to 680 bats per year died at three camps due to tick paralysis, primarily Oct-Dec. (> 13 events)	Atherton Tablelands, Queensland, Australia	Buettner <i>et al.</i> 2013, Fox <i>et al.</i> 2008	S2-11
<i>Pteropus poliocephalus</i>	Unspecified	Large groups sometimes perish during periods of widespread or	Unspecified, Australia	Tidemann 1999	S2-12

		extended food shortages. (1 event)			
<b>Europe</b>					
<i>Barbastella barbastellus</i> , <i>Eptesicus serotinus</i> , <i>Rhinolophus ferrumequinum</i> , <i>Rhinolophus hipposideros</i> , <i>Myotis bechsteinii</i> , <i>Myotis brandtii</i> , <i>Myotis daubentonii</i> , <i>Myotis mystacinus</i> , <i>Myotis nattereri</i> , <i>Nyctalus leisleri</i> , <i>Nyctalus noctula</i> , <i>Pipistrellus pipistrellus</i> , <i>Plecotus auritus</i> , <i>Plecotus austriacus</i>	1968-1972, 1981-84	Total impact on all species of bats by 15 species of birds estimated at 201,415 bats per year. (~9 events)	British Isles	Speakman 1991	S2-13
<i>Rhinolophus ferrumequinum</i> , <i>Rhinolophus hipposideros</i> , <i>Plecotus auritus</i>	Prior to 1988	One house cat ate 22 bats in a few hours. (1 event)	Europe or UK	Stebbings 1988	S2-14
<i>Myotis daubentonii</i>	Prior to 1988	One domestic cat caught and killed over 70 bats within a few weeks. (1 event)	Europe or UK	Stebbings 1988	S2-15
<i>Plecotus auritus</i> , <i>Pipistrellus</i> spp., Unidentified species	1997 (summer)	30 cases of bats killed by domestic cats recorded in a survey of households with cats. Extrapolation from sample suggests about 170,000 bats could be killed by cats in Britain during summer. See	Britain	Woods <i>et al.</i> 2003	S2-16

		reference for discussion of biases. (1 event)			
<i>Hypsugo savii</i>	2009 (summer)	1 cat killed 12 bats. (1 event)	Rome, Italy	Ancillotto <i>et al.</i> 2013	S2-67
<i>Pipistrellus kuhlii</i>	2009-2011 (summers)	1 cat killed 47 bats at a roost in 3 year period. (3 events)	Cassino, Italy	Ancillotto <i>et al.</i> 2013	S2-66
<b>Islands</b>					
<i>Phyllonycteris poeyi</i>	1954-1955	Forty-one Cuban boas ( <i>Epicrates angulifer</i> ) collected stalking bats at cave entrance; three constricting or swallowing bats, digestive tracts of two others with three and nine bats each. (1 event)	Las Villas Province, Cuba	Hardy 1957	S2-17
<i>Rhinolophus cornutus</i>	1967	Remains of 11 bats in feces of weasels ( <i>Mustela sibirica</i> ). (1 event)	Komoriana Cave, Yamaguchi Prefecture, Japan	Kuramoto <i>et al.</i> 1969	S2-7
<i>Pteronotus quadridens</i>	1981-1983	6-9 merlins ( <i>Falco columbanus</i> ) preyed on emerging bats each evening for six months each winter. At least 2.8 bats/day taken by each falcon, with most easily observed falcon taking 5.1 bats/day. Annual estimates of	Cucaracha Cave, Puerto Rico	Rodriguez-Duran & Lewis 1985	S2-18

		3,100-4,700 bats taken each winter, about 1.5 % of estimated population in cave. (3 events)			
<i>Artibeus jamaicensis</i> , <i>Ariteus flavescens</i> , <i>Erophylla sezekorni</i> , <i>Monophyllus redmani</i> , <i>Eptesicus fuscus lynni</i>	1985 and prior	Remains of 52 bats found in pellets of barn owls, <i>Tyto alba</i> (period of deposition unknown). (1 event)	Jackson's Bay, Clarendon Parish, Jamaica	McFarlane & Garret 1989	S2-19
<i>Pteropus sp.</i>	1986	Remains of 11 fruit bats documented at a peregrine falcon ( <i>Falco peregrinus</i> ) eyrie in rain forest during "one collection period" of unspecified length. (1 event)	Fiji Islands	White <i>et al.</i> 1988	S2-20
<i>Phyllonycteris poeyi</i> , <i>Phyllops falcatus</i> , <i>Artibeus jamaicensis</i>	Mar 1994	Remains of 21 individual bats found in regurgitated pellets of Stygian owls ( <i>Asio stygius</i> ). (1 event)	La Guira, Cuba	Kirkconnell <i>et al.</i> 1999	S2-22
<i>Erophylla sezekorni</i> , <i>Brachyphylla cavernarum</i>	1994-1995	From 4 to 21 Puerto Rican Boas ( <i>Epicrates inornatus</i> ) aggregated at caves with dense bat colonies, with 1-10 snakes at entrances; on one night 4 boas captured 7 bats. Timing of activity and prey selection indicated smaller bats were ignored. (2 events)	Cueva de los Culebrones and other caves, Puerto Rico	Rodriguez- Duran 1996	S2-23

<i>Brachyphylla cavernarum</i> , <i>Erophylla bombifrons</i> , <i>Mormoops blainvillei</i> , <i>Monophyllus redmani</i> , <i>Pteronotus quadridens</i>	2006-2007	Cats preyed each night on 5 of 6 species known to use the cave, not in proportion to abundance; 16 different cats observed. Remains of 161 bats examined, about half were adults. (5 events)	Culebrones Cave, Puerto Rico	Rodriguez-Duran <i>et al.</i> 2010	S2-24
<i>Mystacina tuberculata</i>	2010	One feral cat killed at least 102 bats at two roost trees in 7 days. (1 event)	Central North Island, New Zealand	Scrimgeour <i>et al.</i> 2012	S2-25
<b>North America</b>					
<i>Myotis</i> sp.	1892	>12 bats (probably <i>M. lucifugus</i> , according to Lyon 1925) impaled on burrs on clump of burdock plants ( <i>Arctium</i> sp.). (1 event)	Rock Island Arsenal, Illinois, USA	Lyon 1925	S2-26
<i>Tadarida brasiliensis</i>	Prior to 1925	“Chicken snake” (probably <i>Pantherophis obsoleta</i> ) with 14 bats in gut. (1 event)	Texas, USA	Campbell 1925	S2-27
<i>Tadarida brasiliensis</i>	1938	Six peregrine falcons ( <i>Falco peregrinus</i> ) observed preying on bats at evening emergence and morning returns to cave, predation said to take place daily for years. (1 event)	Ney Cave, Medina County, Texas	Stager 1941	S2-28
<i>Tadarida brasiliensis</i>	1943	Peregrine falcons ( <i>Falco peregrinus</i> ), American sparrow hawks ( <i>Falco sparverius</i> ), red-tailed hawks ( <i>Buteo</i>	Carlsbad Caverns, New Mexico	Constantine 1948	S2-29

		<i>jamaicensis</i> ), and Great horned owls ( <i>Bubo virginianus</i> ) observed killing and eating bats during exits and entrances at cave mouth. (1 event)			
<i>Eptesicus fuscus</i>	1949, 1950	“considerable number” of bat skins and wings found under screech owl ( <i>Otus asio</i> ) roost at mouth of hibernaculum, owl also observed feeding on a bat. (2 events)	St. Paul, Minnesota, USA	Beer 1953	S2-30
<i>Myotis sp.</i>	1950	Three mink ( <i>Mustela vison</i> ) captured at a hibernaculum with remains of “several” bats in their stomachs, thought to feed “heavily” upon hibernating bats in winter. (1 event)	Carter Caves, Carter County, Kentucky, USA	Goodpaster & Hoffmeister 1950	S2-31
<i>Tadarida brasiliensis</i>	1950	Numerous observations of peregrine falcons ( <i>Falco peregrinus</i> ) successfully attacking bats on the wing. (1 event)	Ney Cave, Medina County, Texas	Sprunt 1951	S2-32
<i>Myotis velifer</i> , <i>Tadarida brasiliensis</i>	1952	Scat of a raccoon ( <i>Procyon lotor</i> ) with remains of 14 <i>M. velifer</i> , that of another full of <i>T. brasiliensis</i> hair. (1 event)	Double Entrance S Cave, Kansas	Twente 1955	S2-33



<i>Tadarida brasiliensis</i>	1953	Six owl (probably <i>Tyto alba</i> ) pellets with remains of 11 bats. (1 event)	Woods County, Oklahoma	Twente 1954	S2-34
<i>Myotis austroriparius</i>	1953-1955	Unidentified owl discarded wings of 42 bats eaten at cave entrance. (1 event)	Florida	Rice 1957	S2-35
<i>Tadarida brasiliensis</i>	1954	Raccoon ( <i>Procyon lotor</i> ): accumulated fecal material with skins and bones of bats; some scats with remains of 5-10 bats each. Some may have been scavenged. (1 event)	Bracken Cave, Texas, USA	Eads <i>et al.</i> 1955	S2-36
<i>Tadarida brasiliensis</i>	Ca. 1956	Eight species of raptors feeding on emerging or returning bats. Cooper's hawks ( <i>Accipiter cooperii</i> ), observed taking up to 6 bats/evening each. One great horned owl ( <i>Bubo virginianus</i> ) took 27 bats in one hour. (2 events)	Carlsbad Caverns, New Mexico, USA	Baker 1962	S2-37
<i>Tadarida brasiliensis</i>	Jul-Oct 1962	Remains of 46 bats found in 23 great-horned owl ( <i>Bubo virginianus</i> ) pellets near a roost. (1 event)	Greer County, Oklahoma, USA	Taylor 1964	S2-38
<i>Tadarida brasiliensis</i>	1963	21 banded volant young found as remains in 41 great horned	Major County, Oklahoma, USA	Perry & Rogers 1964	S2-39

		owl ( <i>Bubo virginianus</i> ) pellets at cave entrance. (1 event)			
<i>Eptesicus fuscus</i>	1965	Long-tailed weasel ( <i>Mustela frenata</i> ) observed killing up to 14 adult and young bats at a nursery colony. (1 event)	Hamilton County, Indiana	Mumford 1969	S2-40
<i>Eptesicus fuscus</i>	Ca. 1968-1970	Barn owl ( <i>Bubo virginianus</i> ) pellets with remains of 27 bats (half were young of year), or 13.5 % of prey items. (1 event)	Russel County, Kansas, U.S.A.	Kunz 1974	S2-41
<i>Myotis lucifugus</i>	Prior to 1969	Domestic cat perched on roof at roost each evening capturing bats at emergence. (1 event)	New York	Barbour & Davis 1969	S2-42
<i>Myotis grisescens</i>	Jan 1970	“discarded wings indicated that thousands more had fallen prey to opportunistic raccoons” (some could have been scavenged). (1 event)	Hubbard’s Cave, Tennessee, USA	Tuttle 1985	S2-43
<i>Antrozous pallidus</i>	1976	Great horned owl ( <i>Bubo virginianus</i> ) pellets with 10 skulls of pallid bats, mostly young of the year. (1 event)	Verde Valley, Arizona, USA	O’Shea & Vaughan 1977	S2-44
<i>Tadarida brasiliensis</i>	1976-1979	Great horned owl pair ( <i>Bubo virginianus</i> ) roosted at cave	Major County, Oklahoma, USA	Caire & Ports 1981	S2-45

		entrance and often killed and ate emerging bats. (1 event)			
<i>Parastrellus hesperus</i>	1977-1978	Bats made up half (56) of 112 non-insect prey of Mississippi kites ( <i>Ictinia mississippiensis</i> ), but 2% of total prey items. (2 events)	Near Gila River and tributaries, Arizona, USA	Glinski & Ohmart 1983	S2-46
<i>Myotis</i> sp., <i>Lasiurus cinereus</i>	Aug 1985	Over 1,000 dead bats floating with dead ducks in pond with blue-green algal bloom (blue-green algae neurotoxin identified). (2 events)	Steele Lake, Alberta, Canada	Pybus <i>et al.</i> 1986	S2-47
<i>Lasionycteris noctivagans</i> , <i>Eptesicus fuscus</i> , <i>Lasiurus borealis</i>	1989	Five peregrine falcons ( <i>Falco peregrinus</i> ) observed killing at least 28 bats on 3 mornings when migrating bats failed to reach shoreline before dawn. (1 event)	Lake Michigan, Illinois, USA	Byre 1990	S2-48
<i>Tadarida brasiliensis</i>	Apr 1989	One pair of burrowing owls ( <i>Athene cunicularia</i> ) observed for 2 weeks and 18 pellets collected had remains of 20 bats. (1 event)	Bakersfield, California, USA	Hoetker & Gobalet 1999	S2-49
<i>Artibeus jamaicensis</i> , <i>Artibeus</i> sp., Unidentified bats	1994-1995	Twelve bats were 7% of 181 prey items of crane hawks ( <i>Geranospiza caerulescens</i> ). (1 event)	Tikal National Park, Guatemala	Sutter <i>et al.</i> 2001	S2-50

<i>Tadarida brasiliensis</i>	Summer 1997	Observed red-tailed hawks ( <i>Buteo jamaicensis</i> ) and peregrine falcons capture 237 bats entering or emerging from a large colony in a cave. Estimated that these predators killed >2,150 bats or <0.02 % of the colony. (2 events)	Frio Cave, Uvalde County, Texas	Lee & Kuo 2001	S2-51
<i>Myotis lucifugus</i>	May 2008	10 dead bats, predation and emaciation. (1 event)	Sargents Purchase, New Hampshire, USA	U.S. Geological Survey 2015c	S2-52
<i>Myotis lucifugus</i>	Jun-Jul 2008	40 dead bats, emaciation: starvation suspect. (1 event)	Blue River, Wisconsin, USA	U.S. Geological Survey 2015c	S2-53
<i>Myotis lucifugus</i>	Jun-Jul 2010	30 dead bats, predation. (1 event)	Jefferson County, Idaho, USA	U.S. Geological Survey 2015c	S2-54
<i>Eptesicus fuscus</i>	Jun-Jul 2010	12 dead bats, predation. (1 event)	Holcombe, Wisconsin, USA	U.S. Geological Survey 2015c	S2-55
<i>Myotis septentrionalis</i> , <i>Myotis lucifugus</i>	Jul 2010	12 carcasses, predation. (1 event)	Cumberland Gap Historic Park, Virginia USA	U.S. Geological Survey 2015c	S2-56
<i>Eptesicus fuscus</i>	Jul 2011	12 dead, predation. (1 event)	Four Mile Township, Iowa, USA	U.S. Geological Survey 2015c	S2-57
<i>Myotis ciliolabrum</i>	Jul-Aug 2011	50 dead, starvation. (1 event)	Ramon Cave, Idaho, USA	U.S. Geological Survey 2015c	S2-58
<i>Corynorhinus townsendii</i>	Jun 2012	11 dead bats, emaciated, starvation suspected. (1 event)	Channel Islands National Park,	U.S. Geological Survey 2015c	S2-59

			California, USA		
<i>Tadarida brasiliensis</i>	Mar 2014	123 dead bats, emaciation, starvation suspected. (1 event)	Milano, Texas, USA	U.S. Geological Survey 2015c	S2-60
<b>South America</b>					
Unspecified	1960	Daily observations of a peregrine falcon ( <i>Falco peregrinus</i> ) preying on bats emerging from a roost at dusk. (1 event)	Rio De Janiero, Brazil	Sick 1961	S2-61
<i>Saccopteryx bilineata</i> , <i>Phyllostomus discolor</i> <i>Glossophaga soricina</i> , <i>Carollia perspicillata</i> , <i>Uroderma</i> sp., <i>Chiroderma villosum</i> , <i>Artibeus cinereus</i> , <i>Artibeus jamaicensis</i> , <i>Lasiurus borealis</i> , <i>Lasiurus ega</i> , <i>Eumops auripendulus</i> , <i>Eumops glaucinus</i> , <i>Molossus molossus</i> , <i>Molossus pretiosus</i>	1981	Remains of 27 bats found in pellets of one pair of black and white owls ( <i>Ciccaba nigrolineata</i> ) monitored for 38 days. (1 event)	Portuguesa State, Venezuela	Ibanez <i>et al.</i> 1992	S2-62
Undetermined, suspect <i>Molossus</i> sp.	Jan-Mar 1981	Observed a peregrine falcon take at least 19 bats at dusk on six nights and one dawn. (1 event)	Paramaribo, Suriname	Pierson & Donahue 1983	S2-63
<i>Glossophaga longirostris</i>	Jun 1987-Jan 1988	Eleven dead bats found in regurgitated barn owl ( <i>Tyto alba</i> ) pellets. (1 event)	Curacao	Debrot <i>et al.</i> 2001	S2-21

<i>Molossus molossus</i>	Feb-Jul 1994	Pellets collected at roosts of a breeding pair of bat falcons ( <i>Falco rufigularis</i> ) had remains of 30 bats. (1 event)	Guanare, Venezuela		S2-64
<i>Sturnira</i> sp., <i>Eptesicus</i> sp., <i>Lasiurus</i> sp., <i>Myotis</i> sp., <i>Molossops</i> sp., <i>Molossus</i> sp.	May 1998, May 1999	Observed remains of 444 bats in pellets at nest of barn owls. (5 events)	Beni, Bolivia	Vargas et al. 2002	S2-65

