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, 3rd edition (http://www.vertebrates.si.edu/msw/mswcfapp/msw/index.cfm), with the exceptions of *Myotis escalerai (*Ibáñez *et al*. 2006), *Perimyotis subflavus*, and *Parastrellus hesperus* (Hoofer *et al*. 2006).

Appendix S3. Reports of multiple bat deaths due to natural abiotic factors.

Region and Species	Date	Description	Location	Source	Case
Asia					
Unidentified, presumed pteropids	May 2010	> 400 bats dead below roost tree from heat wave with > 45 C ambient temperatures. (1 event)	Ahmedabad, Gujarat, India	Anonymous 2010c	S3-1
Unidentified, presumed pteropids	May 2010	Ca. 300 bats dead below roost tree from heat wave. (1 event)	Panchmahal, Gujarat, India	Anonymous 2010c	S3-2

Unidentified, presumed pteropodids	May 2010	"Dozen" dead bats below roost tree in heat wave. (1 event)	Sabarkantha, Gujarat, India	Anonymous 2010c	S3-3
Unidentified, presumed pteropodids	May 2015	50-60 dead bats found on ground and hanging from trees during heat wave. (1 event).	Korba, Chhattisgarh, India	Drolia 2015	S3-4
Unidentified, presumed pteropodids	May 2015	100-200 dead bats beneath trees during heat wave. (1 event)	Nalagonda, Telangana, India	Qureshi 2015	S3-5
Pteropodids	20 May 2015	"Thousands" of bats drop to the ground dead during heat wave with > 45 C ambient temperatures. (1 event)	Bhopal, Madhya Pradesh, India	Anonymous 2015	S3-6
Australia					

Pteropus sp.	Summer 1790-1791	Unusually hot weather. "An immense flight of bats driven before the wind, covered all the trees around the settlement, whence they every moment dropped dead or in a dying state, unable longer to endure the burning state of the atmosphere" "immense numbers of the large fox bat were seen hanging at the boughs of trees, and dropping into the water…during the excessive heat many dropped dead while on the wing". (1 event)	Sydney, New South Wales, Australia	Tench (1793) & Collins (1798) cited in Gergis *et al*. 2009	S3-7
Pteropus poliocephalus	1905	Mortality of unspecified numbers due to abnormally high ambient temperatures. (1 event)	Helidon, Queensland, Australia	Ratcliffe 1932; Welbergen *et al*. 2008	S3-8
Pteropus poliocephalus	1913	Mortality of unspecified numbers due to abnormally high ambient temperatures. (1 event)	Malanganee, New South Wales, Australia	Ratcliffe 1932; Welbergen *et al*. 2008	S3-9
Pteropus scapulatus	1926-1927	Drought-induced migratory stress and starvation. (> 1 event)	Queensland and New South Wales, Australia	Ratcliffe 1932	S3-10
Unspecified	1990	High mortality during wet, windy, cold weather at the end of winter when food supply was low. Over a thousand deaths reported. (1 event)	Brisbane, Queensland, Australia	Hall & Richards 2000	S3-11
Unspecified pteropodids	1991	High mortality during wet, windy, cold weather at the end of winter when food supply was low. Numbers unspecified. (1 event)	Northeastern New South Wales and southeastern Queensland, Australia	Hall & Richards 2000	S3-12

Pteropus alecto, Pteropus poliocephalus	Jan 1994	Extremely hot weather (ambient > 44º C) resulted in deaths of > 1,000 bats. (2 events)	Townsville and Ipswich, Queensland, Australia	Welbergen *et al*. 2008	S3-13
Pteropus poliocephalus	Dec 1994	Extremely hot weather (ambient > 43º C) resulted in deaths of 6,000 bats at two colonies. (2 events)	Cabramatta and Gordon, New South Wales, Australia	Welbergen *et al*. 2008	S3-14
Pteropus poliocephalus	1998	Drought-caused native food shortage resulting in ca.136 deaths of rescued bats, primarily juveniles. (1 event)	New South Wales, Australia	Markus & Hall 2004; Collins 1999	S3-15
Pteropus poliocephalus	Unspecified (late 1900s)	Unusually hot weather resulting in hyperthermia (29 bats). (1 event)	Northern Australia	Tidemann & Nelson 2011	S3-16
Pteropus alecto, Pteropus poliocephalus	Jan 2000	Hot weather (ambient > 41º C) resulted in deaths of 500 bats. (2 events)	Ipswich, Queensland, Australia	Welbergen *et al*. 2008	S3-17
Pteropus poliocephalus	2000	> 2000 adults found dead in 3-week period Aug-September when winter drought reduced food availability. (1 event)	Brisbane area, Queensland, Australia	McIlwee & Martin 2002	S3-18
Unspecified pteropodids	Unspecified	Deaths in high air temperatures > 40º C and smoke and heat from bushfires. (1 event)	Australia	Hall & Richards 2000	S3-19
Pteropus alecto, Pteropus poliocephalus	12 Jan 2002	Extremely hot weather (ambient > 42^0 C) resulted in deaths of > 3,679 bats (primarily *P. alecto*) at nine observed roosting areas. (9 events)	New South Wales, Australia	Welbergen *et al*. 2008	S3-20

Pteropus poliocephalus	Jan 2003	Extremely hot weather (ambient > 44º C) resulted in deaths of 5,000 bats. (2 events)	Cabramatta and Gordon, New South Wales, Australia	Welbergen *et al*. 2008	S3-21
Pteropus poliocephalus	Jan 2004	Extremely hot weather (ambient > 43º C) resulted in deaths of 3,000 to 8,000 bats. (1 event)	Bellingen, New South Wales, Australia	Welbergen *et al*. 2008	S3-22
Pteropus poliocephalus	Dec 2004	Extremely hot weather (ambient > 41º C) resulted in deaths of 1,000 to 5,000 bats at 2 colonies. (2 events)	Coff's Harbour, New South Wales, Australia	Welbergen *et al*. 2008	S3-23
Pteropus alecto, Pteropus poliocephalus	Dec 2005	Extremely hot weather (ambient > 41º C) resulted in deaths of 5,613 to 8,900 bats at 3 colonies. (3 events)	Queensland, New South Wales, and Victoria, Australia	Welbergen *et al*. 2008	S3-24
Pteropus poliocephalus	Jan 2006	Extremely hot weather (ambient > 42º C) resulted in deaths of 4,273 to 4,843 bats at 6 colonies. (6 events)	New South Wales, and Victoria, Australia	Welbergen *et al*. 2008	S3-25
Pteropus poliocephalus	Dec - Jan 2006-2007	Extremely hot weather (ambient > 41º C) resulted in deaths of 207 bats at 2 colonies. (2 events)	Melbourne, Victoria, Australia	Welbergen *et al*. 2008	S3-26
Miniopterus schreibersii	Dec 2006	Over 300 dead pups found, thought due to stress of cold temperatures and a preceding extreme drought. (1 event)	Bat Cave, Naracoorte Caves World Heritage Area, South Australia, Australia	Bourne & Hamilton-Smith 2007	S3-27
Pteropus sp.	Winter 2007	"Many" bats starving and dead, related to cold weather and drought. (1 event)	Southeastern Queensland, Australia	Bat Recovery Project (2007)	S3-28

Pteropus sp.	2012	"many hundreds of bats and other wildlife were killed or wounded" by a major hail storm. (1 event)	Mount Ommaney, Queensland, Australia	Wade 2012	S3-29
Pteropus poliocephalus, Pteropus alecto, others unspecified	Jan 2014	At least 100,000 bats in more than 25 colonies died during record hot spell. (25 events)	Primarily Queensland, Australia	Murphy 2014, Saunders 2014	S3-30
Pteropus sp.	Nov 2014	Deaths of 5,000 bats at Casino and 2,000 bats at Richmond Valley reported during extreme hot spell. (2 events)	Casino and Richmond Valley, New South Wales, Australia	Godfrey 2014	S3-31
Islands					
Pteropus niger	1960	Cyclone Carol appeared to reduce the population by an order of magnitude. (1 event)	Reunion, Mauritius	Cheke & Dahl 1981	S3-32
Brachyphylla cavernarum	Prior to 1977	"During a year of severe drought, both infant and mother mortality was very high with some roosts being abandoned presumably due to the stench of dead and rotting bats." (1 event)	St. Croix, U.S. Virgin Islands	Nellis & Ehle 1977	S3-33
Pteropus seychellensis	Apr 1977	"Many" bats reportedly sucked up and burned in updraft of a vent on volcano. (1 event)	Grande Comore, Comoros Islands	Cheke & Dahl 1981	S3-34
Pteropus rodricensis	1979	Typhoon Celine II decreased numbers from 151 to 70. (1 event)	Rodriquez Island	Cheke & Dahl 1981; Carroll 1984 cited in Pierson & Rainey 1992	S3-35
Mormopterus acetabulosus	1980	Cave flooded after Cyclone Hyacinthe, ca. 3,000 bats found dead on cave floor. (1 event)	Reunion, Mauritius	Cheke & Dahl 1981	S3-36
Pteropus rayneri Pteropus tonganus	1986	Cyclone Namu destroyed some forests, also stripped remaining	Malaita, Solomon Islands	Flannery 1989	S3-37

		trees of leaves and fruit, leading to starvation of "hundreds". (2 events)			
Stenoderma rufum	1989	Hurricane Hugo in 1989 and Hurricane Georges in 1994 resulted in decreased abundance and reduced reproduction for several years afterward. No carcasses seen. (0 event)	Luquillo Experimental Forest, Puerto Rico	Gannon & Willig 1994	S3-38
Pteropus tonganus, Pteropus samoensis	1990, 1991	Hurricane Ofa and Hurricane Val caused bat starvation, with "Hundreds, perhaps thousands" of flying foxes killed, many exposed and killed for recreation or food by local people. (4 events)	Tutuila, American Samoa	Daschback 1990; Craig & Syron, 1992; Craig *et al*. 1994; Pierson *et al*. 1996a	S3-39
Mormoops blainevillei, Monophyllus redmani, Erophylla sezekorni	1998	Abnormally high number of skulls (56) found at Culebrones Cave along with declines in abundance after Hurricane Georges. (1 event)	Culebrones Cave, Puerto Rico	Rodriguez-Duran 2009	S3-40
Pteropus tonganus	2001	"Large numbers of flying foxes were seen floating in the water of a sheltered lagoon immediately after Cyclone Waka passed over (S. Campbell *pers. comm.*), but dead bats were not reported from other areas until several weeks later." Clarified as 40-50 dead bats by Wiles and Brooke (2009). (1 event)	Vava'u, Tonga	McConkey *et al*. 2004, Wiles & Brooke 2009	S3-41
North America					

Tadarida brasiliensis	Dec 29, 1930	Forty or more bats frozen in unusual ice condition formed over a pond used for drinking. (1 event)	Mojave Desert, California, USA	Campbell 1931	S3-42
Myotis lucifugus	Oct 29, 1936	Hundreds found dead or dying in the streets, thought to be due to exhaustion of migration during cold front. (1 event)	Black River Falls, Wisconsin, USA	Zimmerman 1937	S3-43
Myotis sodalis	Uncertain, perhaps 1937	Estimated as many as 300,000 Indiana bats had died from a single flood based on deposition of bones. (1 event)	Bat Cave, Edmonson County, Kentucky, USA	Hall 1962; U.S. Fish & Wildlife Service 2007	S3-44
Eptesicus fuscus	11 Nov 1940	>100 found dead in snow at entrance of hibernacula blocked by snow drifts following a severe winter storm. (1 event)	Nicollet County, Minnesota, USA	Rysgaard 1941, 1942	S3-45
Myotis lucifugus, Myotis sodalis	Nov 1950	Flood drowned about 90% of hibernating colonies of 5,000 *M. lucifugus* and 500 *M. sodalis*. (2 events)	Aitkin Cave, Pennsylvania	Mohr 1972a, Griffin 1953	S3-46
Eptesicus fuscus, Myotis lucifugus, Myotis sodalis, Perimyotis subflavus	Mar 1964	Severe flooding of cave used as a hibernaculum. (3 events)	Wind Cave, Kentucky, USA	DeBlase *et al*. 1965	S3-47
Tadarida brasiliensis	Summer 1967	"couldn't see the surface of the guano for the carcasses of the bats" during drought. (1 event)	Carlsbad Caverns, New Mexico, USA	Gosnell 1977	S3-48
Myotis grisescens	Jan 1970	Some 10,000 bats lay dead, killed by flood. (1 event)	Hubbard's Cave, Tennessee, USA	Tuttle 1985	S3-49
Tadarida brasiliensis	Prior to 1977	"Several hundred bats dashed to the ground in one small area" due to a severe rainstorm. (1 event)	Carlsbad Caverns, New Mexico, USA	Gosnell 1977	S3-50

Myotis sodalis	1977	Carcasses of 200 apparently frozen to death in hibernaculum. (1 event)	Twin Domes Cave, Harrison County, Indiana	Richter et al. 1993	S3-51
Myotis sodalis	Late 1950s	"Numerous dead bats have been found under their roost in Bat Cave, Shannon Co., Missouri during or after unusually long, cold winter storms." (1 event)	Bat Cave, Shannon County, Missouri, USA	Humphrey 1978, U.S. Fish & Wildlife Service 2007	S3-52
Myotis sodalis	ca. 1986	“large numbers of dead bats beneath hibernating clusters… apparently frozen to death as the result of particularly cold temperatures”. (1 event)	Bat Cave, Shannon County Missouri	U.S. Fish & Wildlife Service 2007	S3-53
Myotis austroriparius	1989	6,500 carcasses found awash at cave following flooding from a summer downpour. (1 event)	Florida, USA	Gore & Hovis 1994	S3-54
Myotis austroriparius	1990	Flooding of cave by nearby river resulted in an estimated 50,000 deaths. (1 event)	Apalachicola River, Florida, USA	Gore & Hovis 1994	S3-55
Myotis austroriparius	1994	Flooding at Snead’s Cave, Florida reported to result in 85,000 deaths. (1 event)	Snead’s Cave, Jackson County, Florida, USA	Whitaker & Hamilton 1998	S3-56

Myotis sodalis	1996	Flooding apparent cause of several hundred carcasses found in fresh mud at lower level of cave. (1 event)	Batwing Cave, Crawford County Indiana, USA	Brack et al. 2005	S3-57
Myotis sp.	Mar 1997	Flooding of hibernaculum resulted in deaths of at least 10 bats. (1 event)	Binkley Cave, Harrison County, Indiana, USA	Brack et al. 2005	S3-58
Myotis lucifugus	Jun-Jul 2004	50 dead bats, emaciated: weather conditions suspect. (1 event)	Winnebago County, Illinois, USA	U.S. Geological Survey 2015c	S3-59
Eptesicus fuscus *Myotis sp.*	Jan 2005	Flooding of hibernaculum resulted in deaths of at least 25 bats. (2 events)	Mitchell Crushed Stone Quarry Cave, Lawrence County, Indiana USA	Brack et al. 2005	S3-60
Tadarida brasiliensis	Jan 2011	600 dead bats, cold exposure suspected (1 event)	Travis County, Texas, USA	U.S. Geological Survey 2015c	S3-61