

OPINION LETTER

Fear of Bats and its Consequences

Merlin D. Tuttle^{1,*}

¹Merlin Tuttle's Bat Conservation, 5000
 Mission Oaks Boulevard, 78735 Austin,
 Texas

*Corresponding author:
merlintuttle@gmail.com

DOI: <https://doi.org/10.14709/BarbJ.10.1.2017.09>

received: December, 30th 2017
 accepted: April, 27th 2018

There is a well-established body of evidence indicating that people seldom protect, and often despise, or even kill, animals they fear (Knight 2008, Johansson et al. 2011, 2016, Frank et al. 2014). This makes bats exceptionally vulnerable. Throughout history, they have been objects of fear and hostility across many cultures, arguably due to their nocturnal and elusive behavior (Kingston 2016). Also, biased media coverage has framed bats as exceptionally dangerous virus reservoirs, generating frightening headlines worldwide, that are jeopardizing decades of conservation progress (López-Baucells et al. 2017).

The rabies scare campaign of the 1970's in America illustrates the conservation implications of exaggerated disease warnings in relation to bats. In 1971 researchers, at a meeting of the American Association for the Advancement of Science, concluded that bats were rapidly disappearing, ecologically essential, and in immediate need of conservation action (Henshaw 1972). Nevertheless, progress was delayed by more than a decade due to a rash of exaggerated warnings of rabid bats. Leading newspapers and magazines published outrageous stories (e.g. Cox 1980, Okie 1979, Remsburg & Remsburg 1977) that created fear (Brass 1994) and generated substantial profits for pest control and public health industries (Gallager 1977, U.S. Environmental Protection Agency 1980, Strohm 1982, Anonymous 1984). In May 1976, the U.S. Centers for Disease Control even began distributing DDT to poison bats in buildings, greatly increasing public health risks (Barclay et al. 1980, Kunz et al. 1977, Trimarchi 1978).

Bat killing became widespread and was not limited to those living in buildings. Whole colonies of the endangered gray myotis (*Myotis grisescens*) were burned in their caves (Tuttle 1979) when health officials speculated erroneously,

and without any empirical evidence, that these bats were the source of an outbreak of rabies in foxes (Fredrickson & Thomas 1965).

By the time I founded Bat Conservation International in 1982, most Americans believed that bats were often rabid and that they would attack humans and pets. Fear was extreme. Even conservation organizations avoided bats as hopeless. Progress was impossible until rabies risks were put in perspective (Tuttle & Kern 1981). Once risks started to be understood, many Americans began building bat houses and supported conservation efforts (Tuttle 2015).

Unfortunately, in the 21st Century greatly exaggerated media stories are once again becoming common, often at the expense of easily misunderstood bats. It began with the discovery of coronaviruses in bats that were hypothesized to be ancestors of the one which caused SARS in humans (Li et al. 2005), though a bat origin for SARS remains open to question (Racey et al. 2018). Nevertheless, the hypothesis generated sensational media headlines: *New Scientist* reported (Arnold 2014), "Hordes of deadly diseases are lurking in bats and sometimes jumping to people," and went on to ask, "Can we prevent a major pandemic?" It continued with MERS. A *Science News* story (Kupferschmidt 2013) was titled, "Bat out of Hell? Egyptian tomb bat may harbor MERS virus." The early search for a source centered solely on bats, likely delaying discovery of camels as its true reservoir for humans (Chantal et al. 2016). With all the heated publicity demonizing bats, many research efforts veered toward testing hypotheses linking bats to dangerous diseases.

As in the 1970's, bats are again too often portrayed as dangerous sources of diseases without a proper analysis of the actual threat that they pose for human health. On



Fig. 1 - Millions of tourists have viewed the spectacular emergences of 1.5 million Brazilian free-tailed bats from the Ann W. Richards Congress Avenue Bridge in Austin, Texas, without harm.

August 29, 2014, scientists at a National Institutes of Health press conference, announced that the 2014 Ebola outbreak had been traced to probable transmission from a fruit bat to a two-year-old toddler in Uganda (Lewis & van der Kleut 2014), despite a lack of supporting evidence. A few months later, a team of epidemiologists visited the same site and speculated a free-tailed bat origin (Saéz et al. 2015). Subsequent research found a bat origin to be unlikely (Leendertz 2016). Nevertheless, despite countless failed attempts to document Ebola transmission from bats (Kupferschmidt 2017a) a bat origin has become widely accepted as fact.

Colonial bats are tempting research subjects because they are exceptionally easy to capture and sample quickly in large numbers. Probably for this reason, the study upon which the scariest, recent headlines was based (Anthony et al. 2017) sampled nearly twice as many bats as rodents, shrews and non-human primates combined and did not even include carnivores or ungulates. Omitted groups also support deadly viruses (Marcella 2009, Foufopoulos 2001). However, they would take far longer to capture and sample. Potentially even greater bias resulted from sampling less than half the world's bat families, the largest, widest spread, and most colonial ones. Species from remaining families were assumed to support equal viral diversity, although no empirical evidence was provided. Finally, a large proportion of viral fragments detected in bats came from feces, potentially indicating that bats fed on infected arthropods (Moratelli & Calisher 2015). Finding a wide variety of new viruses in one of the most varied and widely distributed groups of mammals is not surprising, especially given the

exceptional search effort (Enriquez & Gullans 2015). When new viruses are discovered in bats, they are often reported to be closely related to ones that are dangerous. This can be misleading, as harmless viruses are sometimes closely related to deadly ones (Miranda & Miranda 2011). Also, even among recently emphasized coronaviruses, most appear to be innocuous, so finding more in bats is not necessarily indicative of risk (Moratelli & Calisher 2015).

In a rush to judgement, the historic rarity of viral spillover from bats to humans has been largely overlooked (Fig. 1). We have a long history of co-association. If bats were as dangerous as postulated, why has it been impossible to document major disease outbreaks among the millions of African, Asian and Pacific Islanders who eat them? Why have there been no significant disease outbreaks in cities of Africa, Australia, and the United States where millions of bats live in close association with people? How is it that I and hundreds of other bat researchers remain in good health despite lifetimes of close contact, sometimes surrounded by millions of bats in caves? Like veterinarians, we are vaccinated against rabies, because we are sometimes bitten in self-defense by the animals we handle. However, throughout most of our careers we have not been protected against any of the other deadly diseases for which bats are now speculated to serve as reservoirs.

The sensational coverage found in both scientific publications and media is hindering bat conservation worldwide. Recently misleading reports include: *Science*, "Bats really do harbor more dangerous viruses than other species" (Kupferschmidt 2017b); *Nature*, "Bats are global

reservoir for deadly coronaviruses” (Maxmen 2017); *Time* magazine, “Bats are the number one carriers of disease” (Sifferlin 2017); *The Wall Street Journal*, “Where will the next pandemic come from? Likely from bats” (McKay 2017). *National Public Radio* in the U.S., “Bats are arguably among the most dangerous animals in the world” (Doucleff 2017). Such headlines can greatly magnify social risk perception (López-Baucells et al. 2017), potentially leading to persecution of bats, destruction of roosting sites and extermination campaigns.

Historically, the world’s greatest zoonotic pandemics have not come from bats. Currently, H7N9 bird influenza (Imai et al. 2017, Subbarao 2017, Su et al. 2017), and drug-resistant microbes (Spellberg et al. 2008, Lammie & Hughes 2016), pose significant threats but are gaining far less research or media attention. It is time to focus more on known threats, and less on speculation about possibilities not yet verified.

REFERENCES

- ANONYMOUS. (1984). Fraudulent bat control outlawed. *BATS Magazine* 1(2): 2-3.
- ANTHONY, S.J., JOHNSON, C.K., GREIG, D.J., KRAMER, S., CHE, X., WELLS, H., HICKS, A.L., JOLY, D.O., WOLFE, N.D., DASZAK, P., KARESH, W., LIPKIN, W.I., MORSE, S.S., CONSORTIUM, P., MAZET, J.A.K. & GOLDSTEIN, T. (2017). Global patterns in coronavirus diversity. *Virus Evolution* 3(1): 1 January 2017, vex012. <https://doi.org/10.1093/ve/vex012>
- ARNOLD, C. (2014, February 5). Reservoir bats: Spreading contagion on night’s wings. *New Scientist*.
- BARCLAY, R.M.R., THOMAS, D.H. & FENTON, M.B. (1980). Comparison of methods used for controlling bats in buildings. *The Journal of Wildlife Management* 44(2): 502-506. <https://doi.org/10.2307/3807989>
- BRASS, D.A. (1994). Rabies in bats: natural history and public health implications. ed.: Livia Press, Ridgefield, Connecticut, USA. 335 pp.
- CHANTAL, B.E.M., STALIN, V., KOOPMANS, M.P. & HAAGMANS, B.L. (2016). Cross host transmission in the emergence of MERS coronavirus. *Current Opinion in Virology* 16: 55-62. <https://doi.org/10.1016/j.coviro.2016.01.004>
- COX, C. (1980). The nightmare house. *Family Circle* 93: 64-94.
- DOUCLEFF, M. (2017, February 14). Why killer viruses are on the rise. *National Public Radio* [Audio Podcast].
- ENRIQUEZ, J. & GULLANS, S. (2015). *Evolving Ourselves: How Unnatural Selection and Nonrandom Mutation are Changing Life on Earth*. ed.: Penguin Group, New York, USA. 384 pp.
- FRANK, J., JOHANSSON, M. & FLYKT, A. (2015). Public attitude towards the implementation of management actions aimed at reducing human fear of brown bears and wolves. *Wildlife Biology* 21(3): 122-130. <https://doi.org/10.2981/wlb.13116>
- FREDRICKSON, L.E. & THOMAS, L. (1965). Relationship of fox rabies to caves. *Public Health Reports* 80(6): 495-500.
- GALLAGER, J. (1977, February 16). Bats’ fate hangs on destroying sinister myths. *Chicago Tribune* 15-17 pp.
- HENSHAW, R.E. (1972). Cave bats: their ecology, physiology, behavior and future survival. *Bulletin of the National Speleological Society* 34(2): 31-32.
- HIGGINSON, A.D. & MUNAFO, M.R. (2016). Current incentives for scientists lead to underpowered studies with erroneous conclusions. *PLoS Biology* 14(11): e2000995. <https://doi.org/10.1371/journal.pbio.2000995>
- IMAI, M., WATANABE, T., KISO, M., NAKAJIMA, N., YAMAYOSHI, S., IWATSUKI-HORIMOTO, K., HATTA, M., YAMADA, S., ITO, M., SAKAI-TAGAWA, Y., SHIRAKURA, M., TAKASHITA, E., FUJISAKI, S., MCBRIDE, R., THOMPSON, A.J., TAKAHASHI, K., MAEMURA, T., MITAKE, H., CHIBA, S., ZHONG, G., FAN S., OISHI, K., YASUHARA, A., TAKADA, K., NAKAO, T., FUKUYAMA, S., YAMASHITA, M., LOPES, T.J.S., NEUMANN, G., ODAGIRI, T., WATANABE, S., SHU, Y., PAULSON, J.C., HASEGAWA, H. & KAWAOKA, Y. (2017). A highly pathogenic avian H7N9 influenza virus isolated from a human is lethal in some ferrets infected via respiratory droplets. *Cell Host & Microbe* 22(5): 615–626. <https://doi.org/10.1016/j.chom.2017.09.008>
- JOHANSSON, M., SJÖSTRÖM, M., KARLSSON, J. & BRÄNNLUND, R. (2011). Is human fear affecting public willingness to pay for the management and conservation of large carnivores? *Society & Natural Resources* 25(6): 610-620. <https://doi.org/10.1080/08941920.2011.622734>
- JOHANSSON, M., FERREIRA, I.A., STØEN, O., FRANK, J. & FLYKT, A. (2016). Targeting human fear of large carnivores - Many ideas but few known effects. *Biological Conservation* 201: 261-269. <https://doi.org/10.1016/j.biocon.2016.07.010>
- KINGSTON, T. (2016). Cute, creepy, or crispy - how values, attitudes, and norms shape human behaviour toward bats. In: *Bats in the Anthropocene: Conservation of Bats in a Changing World* (Voigt, C., Kingston, T.). ed.: Springer International Publishing, Berlin, Germany. 571–595 pp. https://doi.org/10.1007/978-3-319-25220-9_18
- KNIGHT, A.J. (2008). “Bats, snakes and spiders, Oh my!” How aesthetic and negativistic attitudes, and other concepts predict support for species protection. *Journal of Environmental Psychology* 28(1): 94-103. <https://doi.org/10.1016/j.jenvp.2007.10.001>

- KUNZ, T.H., ANTHONY, E.L.P. & RUMAGE III, W.T. (1977). Mortality of little brown bats following multiple pesticide applications. *Journal of Wildlife Management* 41(3): 476-483. <https://doi.org/10.2307/3800519>
- KUPFERSCHMIDT, K. (2013, August 22). Bat out of Hell? Egyptian tomb bat may harbor MERS virus. *Science News*.
- KUPFERSCHMIDT, K. (2017a, June 1). Hunting for Ebola among the bats of the Congo. *Science News*.
- KUPFERSCHMIDT, K. (2017b, June 21). Bats really do harbor more dangerous viruses than other species. *Science News*.
- LAMMIE, S.L. & HUGHES, J.M. (2016). Antimicrobial resistance, food safety, and one health: The need for convergence. *Annual Review of Food Science and Technology* 7: 287-312. <https://doi.org/10.1146/annurev-food-041715-033251>
- LEENDERTZ, S.A.J. (2016). Testing new hypotheses regarding Ebolavirus reservoirs. *Viruses* 8(2): 30. <https://doi.org/10.3390/v8020030>
- LI, W., SHI, Z., YU, M., REN, W., SMITH, C., EPSTEIN, J.H., WANG, H., CRAMERI, G., HU, Z., ZHANG, H., ZHANG, J., MCEACHERN, J., FIELD, H., DASZAK, P., EATON, B.T., ZHANG, S. & WANG, L. (2005). Bats are natural reservoirs of SARS-like coronaviruses. *Science* 310(5748): 676-679. <https://doi.org/10.1126/science.1118391>
- LÓPEZ-BAUCELLS, A., ROCHA, R. & FERNANDEZ-LLAMAZARES, A. (2018). When bats go viral: negative framings in virological research imperil bat conservation. *Mammal Review* 48(1): 62-66. <https://doi.org/10.1111/mam.12110>
- MCKAY, B. (2017, June 21). Where will the next pandemic come from? Likely from bats. *The Wall Street Journal*.
- MAXMEN, A. (2017, June 13). Bats are global reservoir for deadly coronaviruses. *Nature News*.
- MIRANDA, M.E.G. & MIRANDA, N.L.J. (2011). *Reston ebolavirus* in humans and animals in the Philippines: A Review. *Journal of Infectious Diseases* 204(3) Supplementary: 757-760. <https://doi.org/10.1093/infdis/jir296>
- MORATELLI, R. & CALISHER, C.H. (2015). Bats and zoonotic viruses: Can we confidently link bats with emerging deadly viruses? *Memórias do Instituto Oswaldo Cruz Rio de Janeiro* 110(1): 1-22. <https://doi.org/10.1590/0074-02760150048>
- OKIE, S. (1979, September 20). Warning: sick bird may be a rabid bat. *The Washington Post*.
- RACEY, P.A., FENTON, B., MUBAREKA, S., SIMMONS, N. & TUTTLE, M. (2018). Don't misrepresent link between bats and SARS. *Nature Correspondence* 553(281): 281.
- REMSBURG, C. & REMSBURG, B. (1977). Three years of terror. *Good Housekeeping* 184: 83-134.
- SAÉZ, A.M., WEISS, S., NOWAK, K., LAPEYRE, V., ZIMMERMANN, F., DÜX, A., KÜHL, H.S., KABA, M., REGNAUT, S., MERKEL, K., SACHSE, A., THIESEN, U., VILLÁNYI, L., BOESCH, C., DABROWSKI, P.W., RADONIĆ, A., NITSCHKE, A., LEENDERTZ, S.A.J., PETTERSON, S., BECKER, S., KRÄHLING, V., COUACY-HYMAN, E., AKOUA-KOFFI, C., WEBER, N., SCHAADÉ, L., FAHR, J., BORCHERT, M., GOGARTEN, J.F., CALVIGNAC-SPENCER, S. & LEENDERTZ, F.H. (2014). Investigating the zoonotic origin of the West African Ebola epidemic. *EMBO Molecular Medicine* 7(1): 17-23. <https://doi.org/10.15252/emmm.201404792>
- SIFFERLIN, A. (2017, June 22). Bats are the number one carriers of disease. *Time Health*.
- SPELLBERG, B., GUIDOS, R., GILBERT, D., BRADLEY, J., BOUCHER, H.W., SCHELD, W.M., BARTLETT, J.G. & EDWARDS, JR. (2008). The epidemic of antibiotic-resistant infections: A call to action for the medical community from the Infectious Diseases Society of America. *Clinical Infectious Diseases* 46(2): 155-164. <https://doi.org/10.1086/524891>
- STROHM, B. (1982). Most facts about bats are myths. *National Wildlife Magazine* 20: 35-39.
- SUBBARAO, K. (2017). Avian influenza H7N9 viruses: a rare second warning. *Cell Research* 28(2018): 1-2. <https://doi.org/10.1038/cr.2017.154>
- SU, S., GU, M., LIU, D., CUI, J., GAO, G.F., ZHOU, J. & LIU, X. (2017). Epidemiology, evolution, and pathogenesis of H7N9 influenza viruses in five epidemic waves since 2013 in China. *Trends in Microbiology* 25(9):713-728. <https://doi.org/10.1016/j.tim.2017.06.008>
- TRIMARCHI, C.V. (1978). Rabies in insectivorous temperate-zone bats. *Bat Research News* 19:7-12.
- TUTTLE, M.D. (1979). Status, causes of decline, and management of endangered gray bats. *The Journal of Wildlife Management* 43(1): 1-17. <https://doi.org/10.2307/3800631>
- TUTTLE, M.D. (2015). *The secret lives of bats*. Houghton Mifflin Harcourt Publishing, New York, USA. 288 pp.
- TUTTLE, M.D. (2017). Give bats a break. *Issues in Science and Technology* 33(3): 41-50.
- TUTTLE, M. & KERN, S.J. (1981). Bats and public health. *Contributions in Biology and Geology* 48: 1-11.
- U.S. ENVIRONMENTAL PROTECTION AGENCY, Region 5, in the matter of Bradley Exterminating Co., Richfield, Minn. (1980) Docket no. I.F. & R.V.-604-c, Marvin E. Jones, Admin. Law Judge. May 8, 1980.