



Unacknowledged Potential Factors in Catastrophic Bat Die-off Arising from Coal Fly Ash Geoengineering

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Authors' contributions

This work was a joint effort between the authors that is part of an ongoing collaboration aimed at providing scientific, medical, public health implications and evidence related to aerosolized coal fly ash including its use in the near-daily, near-global covert geoengineering activity. Author JMH was primary responsible for geophysical and mineralogical considerations. Author MW was primarily responsible for medical and public health considerations. Both authors read and approved the final manuscript.

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ABSTRACT

Bats have great economic and environmental importance, including nocturnal insect control, pollination, seed dispersal and forest regeneration. Bats, however, like insects and birds are suffering a precipitous global decline due to anthropogenic causes. Deliberate air pollution in the form of undisclosed tropospheric aerosol geoengineering (TAG) has extremely damaging effects throughout the biosphere. Forensic scientific evidence implicates coal fly ash (CFA), the toxic waste product of coal-burning, as the main constituent of the jet-sprayed particulate trails seen around the world. Coal fly ash is a primary source of the ultrafine and nano-sized particulate fraction of air

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pollution that adversely impacts human and environmental health. Recently, countless exogenous magnetic pollution particles from combustion sources were found in human brains and heart tissue. Previous studies reveal that aerosolized CFA is a significant factor in the catastrophic global decline of birds and insects. Insects can accumulate aerosolized CFA on their body surfaces and/or ingest CFA particulates that insectivorous bats then consume. Bats are excellent mammalian bioindicators of environmental contaminants and it is known that their tissue contains high levels of metals and persistent organic pollutants. From a review of the literature, we show that the pollutant element ratios in bat tissue and bat guano are consistent with an origin in CFA-type air pollution. These findings suggest that CFA, including its use in covert climate engineering operations, is an unacknowledged factor in the morbidity and mortality of bats. Bats, therefore, are an important "canary in the coal mine" pointing to the urgency of halting covert climate engineering and greatly reducing ultrafine particulate air pollution.

Keywords: White-nose syndrome; aerosol particulates; coal fly ash; particulate pollution; global warming.

1. INTRODUCTION

In her 1962 seminal book *Silent Spring* [1], Rachel Carson (1907-1964) challenged the widely held, but the unrealistically-arrogant perception that humans could master nature through the use of chemicals. Her revelations of the harmful consequences of dichloro-diphenyl-trichloroethane (DDT) and other pesticides helped to spawn the modern environmental movement [2].

In less than two decades, a new and far more pervasive environmental threat arose that was orchestrated and perpetrated, not by the chemical industry, but by international governance seeking "improvement of the environment" through use of "environmental modification techniques" which refers to "any technique for changing – through the deliberate manipulation of natural processes – the dynamics, composition or structure of the Earth, including its biota, lithosphere, hydrosphere and atmosphere, or of outer space" [3], which hereafter we refer to as "geoengineering".

Rachel Carson benefitted from highly cooperative and favourable mainstream media attention, including the serialization of her book by *The New Yorker* magazine and a Columbia Broadcasting System (CBS) Reports exposé [4]. In striking contrast, the pervasive environmental geoengineering threat, for more than a decade, undertaken with increasing scope, intensity, and geographical range to become a near-daily, near-global activity, has been accompanied by concerted efforts to mislead the public [5-7] and the scientific community [8,9] and to hide the public health risks [10,11].

There is deployment-evidence of one geoengineering activity aimed at melting glacial

ice [12,13], however, the most widely observed geoengineering-evidence involves the jet-spraying of pollution particulates into the troposphere [14-17] which alter climate/weather and cause global warming [18]. Geoengineering aerial particulate trails, shown in Fig. 1, rapidly spread out, briefly appearing like cirrus clouds, before becoming a white haze in the sky [19,20]. Gravity and atmospheric convection disperse the aerial-particulates throughout the lower atmosphere, mixing with the air that biota, including humans, breathe, and ultimately settling to ground in a matter of days to weeks [21].

Geoengineering jet-laid particulate trails are not to be confused with "contrails", which occasionally form from engine-exhaust moisture under unusually cold, humid conditions and which evaporate quickly becoming invisible gas [22]. There are, however, concerted efforts to deceive the public into falsely believing that the deliberately emplaced particulate trails are ice-crystal contrails [5,8].

Pollution particles in the troposphere are heated by solar radiation and by radiation from Earth. That heat is transferred to the atmosphere by molecular collisions, which reduces the temperature difference relative to the surface air. The reduction in adverse temperature gradient reduces atmospheric convection and concomitantly reduces convective heat loss from the surface [23-25]. The pollution-particles jet-sprayed into the troposphere cause global and/or regional warming, and cause climate chaos, disrupting natural weather patterns, potentially causing either droughts or deluges, corrupting natural habitats, harming agriculture, and poisoning the environment [19,20,26].

In a manner more fundamental than Carson [1], James E. Lovelock and Lynn Margulis [27-31] developed the Gaia theory, which in essence describes the realm of inextricable and complex interrelationships by and between the living matter of Earth and the physical states and conditions of Earth's various environments. Within the Gaia understanding, any "environmental modification", i.e. geoengineering, especially deliberately emplaced aerosol particulate pollution, is bound to have unanticipated, severe, and greater adverse consequences for life on Earth, analogous to, but far more devastating, than the pesticides disclosed by Carson [1].

Air pollution particles have devastating consequences for human health, including being the leading environmental cause of morbidity and mortality worldwide [32,33]. Air pollution particulates penetrate deep into lungs and systemic circulation, and contribute to stroke and neurodegenerative disease [34-36], heart disease [37,38], lung cancer [39], COPD [40,41], respiratory infections [42,43], and asthma [44,45].

Spherical magnetite particulates have been found in the brains of persons with dementia [35]. Recently, reactive iron magnetic particulates were found in abundance in the hearts of persons from highly polluted areas [37].

Air pollution particulates are risk factors for children having cognitive defects [46,47], for cognitive decline at all ages [48], for cognitive decline in older women [49], and Alzheimer's Dementia later in life [48].

Consistent with the Gaia theory of Lovelock and Margulis [27-31], the near-daily, near-global ongoing tropospheric particulate-emplacement is expected to have severely adverse consequences throughout the biosphere. The evidence of those severely adverse consequences is unambiguous, specifically in connection with the globally-catastrophic demise of insects [50], birds [51], forests [52], and the proliferation of harmful algae [53].

Geoengineering is an activity that poisons the planet with mercury [20], damages the ozone layer that shields life from harmful solar ultraviolet radiation [54-57], exacerbates wildfires [19], and does yet untold damage to the web of life on Earth through the disruption of habitats and food sources caused

by geoengineered climate chaos [19,58-61]. Indeed, altering global weather patterns could potentially imperil global food supplies [62].

Bats (order Chiroptera) are the most widely distributed terrestrial mammals, comprising nearly 20% of mammalian species, or about 1400 species to date. Bats have great economic importance, with ecosystem services including nocturnal insect control, pollination, seed dispersal, and forest regeneration. Bat populations are now in serious decline [63], just as are bird [64] and insect [65] populations. Data now indicate that over $\frac{1}{3}$ of bat species are threatened, with populations of an additional $\frac{1}{2}$ either unknown or declining, indicating that at least 80% of bat species now require attention and conservation efforts [63]. Here we review unacknowledged potentially major contributory factors in global catastrophic bat die-off that arise from the use and consequences of aerosolized CFA for covert weather and climate manipulation.

2. OVERVIEW OF BAT DECLINE

Global threats to bats are directly related to increasing human populations that bring extra demands for land, food, and resources leading to degradation or destruction of habitats for bats. Pressures of deforestation, development, and climate change are felt most acutely in tropical regions of the world which hold the greatest diversity of bat species [66]. Threats to bats can be ranked into categories that include invasive species, disease, energy production, biological resource use, agricultural practices, development, pollution, and climate change. For most bat species, the impact of pollution and climate change is largely unknown due to lack of sufficient study or understanding of these issues [67]. An extensive literature review reveals that no one has addressed the implications of ongoing geoengineering on bat morbidity and mortality.

A global review of multiple mortality events (MME's) in bats reveals that before the year 2000, persecution and intentional killing by humans caused the greatest proportion of MME's in bats. Intentional killing of bats occurred in South America for vampire bat control, in Asia and Australia for fruit depredation control, and in Africa and Asia for human food. Historically, abiotic and biotic causes and accidents were also responsible for bat mortality. However, there



Fig. 1. From [23]. Geoengineering particulate trails with photographers' permission. Clockwise from upper left: Soddy-Daisy, Tennessee, USA (David Tulis); Reiat, Switzerland (Rogerio Camboim SA); Warrington, Cheshire, UK (Catherine Singleton); Alderney, UK looking toward France (Neil Howard); Luxembourg (Paul Berg); New York, New York, USA (Mementosis)

was a major shift in MME's in bats around the year 2000 – when mortality from industrial wind-power facilities and emerging diseases like white-nose syndrome became important causes of MME's. The majority of reported MME's continue to be anthropogenic in origin, with an expected sharp increase in bat mortality from pollution and climate change, e.g. heatwaves, storms, flooding, and drought [68], which to a great extent are consequences of ongoing tropospheric geoengineering that causes global warming and weather-chaos [23,26]. For example, mass die-offs of pteropodid bats like the Australian flying foxes due to temperature extremes over 42°C have now been documented [69].

Although bats are ecologically diverse, with a range of species specializing in feeding on fruit,

nectar, blood, fish and even small mammals – the large majority of bats are insectivorous. The drastic global decline in insect populations portends a sharp reduction in food supply for most bats [65]. This reduction in insect biomass at ground level leads to less availability and quality of insects in the aerosphere, resulting in higher search efforts and increased energy expenditure by bats. This is particularly true in modern industrialized countries, where insect biomass is sharply decreasing and it may become critical for open-space foraging bats.

Particulate pollution from all sources, including geoengineering, is principally responsible for global warming and climate change [18,24, 25,70]. Global climate is likely to change the phenology, intensity, and directions of large-scale insect migration patterns, with potentially

serious consequences for bats as insect consumers [71]. Climate change alters the emergence patterns of bats, the timing of which must be balanced among predation risk, competition, and foraging opportunities [72]. Widespread use of insecticides and insect-resistant crops contributes to both to decreased insect abundance and chemical poisoning of bats [63]. Our work suggests that most of the remaining insects have been contaminated by toxic elements contained in CFA, the toxic waste product of coal-burning which is widely utilized in environmental modification, weather modification, and climate engineering [50].

3. AIR POLLUTION – CFA

When coal is burned, the heavy ash settles beneath the burner, while the light ash, called CFA, condenses and accumulates in the hot gases above the burner, producing the characteristic spherical shape of CFA particles that result from the surface tension of the melt [73].

Coal fly ash is a cheap and abundant waste product that requires little additional processing for use in undisclosed tropospheric aerosol geoengineering operations. Forensic scientific evidence implicates aerosolized CFA as the main constituent of the jet-sprayed particulate trails now observed on a near-daily, near-global basis [26].

Coal fly ash particulate pollution in the troposphere mixes with the air we all breathe and is toxic to nearly all biota, including humans [74]. We have shown that aerosolized CFA, evidenced as used for covert geoengineering operations [20,26,52], is an unacknowledged factor in the catastrophic global die-off of trees [52], insects [50] and birds [51], as well as in the proliferation of harmful algae [53].

CFA is a primary source of ultrafine and nano-sized (<0.1 μm) air pollution particles that affect human and environmental health [75]. Emissions of CFA from Western power plants, unlike many in China and India, are reduced by the use of electrostatic precipitators or filters, but the collection efficiency of these technologies is lowest for ultrafine and nanoparticles [76]. The primary elements in CFA are oxides of silicon, aluminium, iron, and calcium, with lesser amounts of magnesium, sulfur, sodium, chlorine, and potassium. Trace elements in CFA include arsenic, barium, cadmium, chromium, lead,

mercury, nickel, selenium, strontium, titanium, and the radionuclides uranium, thorium and their daughter products. CFA contains unconsumed carbon (soot) and small amounts of polycyclic hydrocarbons [77,78].

4. BAT CONTAMINATION BY EXPOSURE TO CFA

There are several ways bats may be exposed to the toxins of aerosolized CFA. Nano-particulates of CFA can directly enter bat bodies through respiration or trans-dermally as they can in humans [36,39,40]. Additionally, the metals of CFA can be partially extracted by water [79], including extraction by body-moisture *in vivo* or by atmospheric moisture that ultimately can contaminate bats' drinking-water sources. Moreover and perhaps most significantly, insects can accumulate aerosolized CFA on their body surfaces and/or ingest CFA particulates [80-83] that insectivorous bats then consume.

Evidence indicates that bat activity and population diversity are affected by air pollution. Higher bat flight activity and higher bat population diversity are found at less disturbed and polluted forest areas compared to urban areas with heavy industrial pollution [84]. The increasingly large amounts of combustion-type pollution particles released into the atmosphere appear to harm the specialized respiratory organs and high metabolism of foraging bats [71].

Bat navigation is dominated by echolocation, but other modalities, including an iron/magnetic sensory system, are essential to the bat's familiarity with the terrain [85]. Recent evidence supports the contention that bats use magnetite (Fe_3O_4) particles located in their heads for sensing and orientation in the Earth's magnetic field [86]. Countless combustion-derived exogenous magnetic pollution particles have been found in brains of humans with dementia that match the spherical magnetite nanoparticles in CFA [35,36]. Presumably, exposure to exogenous magnetite nano-particles from CFA-type air pollution can impair the bat's magnetic sense and navigation.

Metal contamination is an important environmental stressor that has been implicated as a factor in the global decline of bats. Traditionally cited anthropogenic sources of metal pollutants include combustion-type air pollution, industrial run-off, and contaminated food and water sources [87]. The year-after-year,

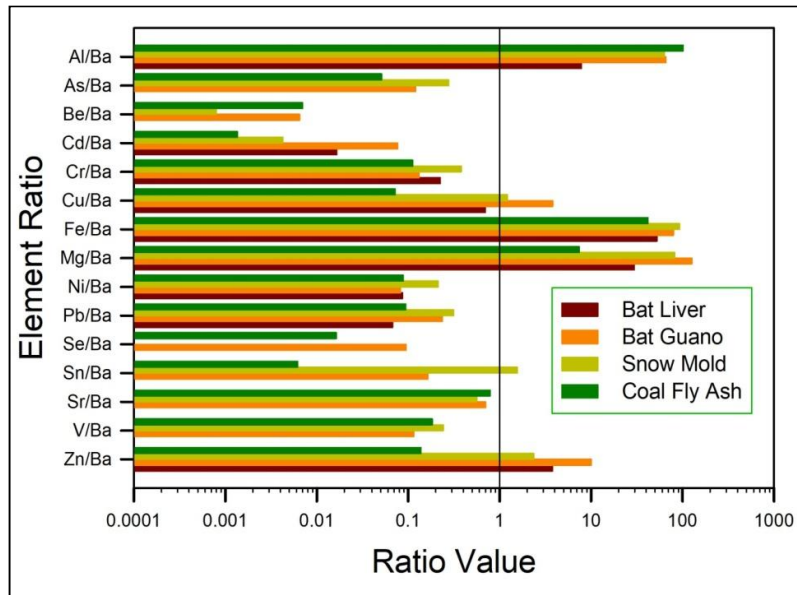


Fig. 2. Average metallic composition of insectivorous male bat livers expressed as ratios for comparison with corresponding ratios from average bat guano, snow mould and CFA samples

near-daily, near-global atmospheric pollution for geoengineering environmental modification, evidenced as CFA, must now be seen as a major factor in the global decline of bats.

Bats are excellent bio-indicators for metal pollution because of their longevity, their high trophic level, and their frequent association with man. The elemental composition of bat guano reflects the undigested portion of ingested prey and can provide clues as to the source of the pollution [88]. Fig. 2 shows the similarity of average metallic element compositions determined from male insectivorous bat livers and bat guano with corresponding average element ratios of laboratory CFA [79] and aerosolized CFA that was trapped by snowflakes, brought down, subsequently released upon partial melting and re-trapped on underlying snow mould [51,52]. Not all element ratios were determined in each of the four data sources. For the 9 instances of element ratios from all four data sources, at a 95% confidence interval, each individual data-source value was not significantly different, as determined statistically using the student t-test.

Metals in bats tend to accumulate in internal organs including the liver and kidney. The effect of multiple pollutants including metals in bats and their interaction with other environmental stressors remains largely unexplored [88]. Documented effects of heavy metals in bats

include hepatopathy, DNA damage, hemochromatosis, and neurological disease. Eleven metals: arsenic, cadmium, cobalt, chromium, copper, mercury, manganese, nickel, lead, tin, and thallium (all trace elements in CFA) are known to be potentially toxic to mammals including bats [89]. Cadmium, lead, and mercury are among the most commonly reported elements associated with toxicity in bats [90].

Mercury contamination of the environment is one of the consequences of aerosolized CFA used for geoengineering [20]. Mercury is one of the elemental contaminants of California pacific coastal fog [91,92]. Other elemental contaminants of California pacific coastal fog were found to be consistent with CFA contamination [52]. Recent investigations of a limited number of species demonstrated that pacific coastal biota had significantly greater mercury content than comparable species from inland areas not exposed to the coastal fog [93]. Although bats were not included in that study, they should be for future investigations.

Bats are important bio-indicators for environmental contaminants other than metals. A wide range of contaminants of emerging concern was found in the tissue of bats from the northeastern United States, with the suggestion that these contaminants of emerging concern have the potential to affect physiological function in bats, including hibernation, immune function,

and response to white-nose syndrome [94]. High concentrations of persistent organic pollutants, including polychlorinated biphenyls, polybrominated diphenyl ethers, polybrominated biphenyls and organochlorine pesticides were found in the fatty tissue of little brown bats (*Myotis lucifugus*) with white-nose syndrome in New York [95]. Significant levels of both trace metals (e.g. Ag, Cd, Co, Hg, Pb, Se, V, and Zn) and organochlorine contaminants were measured in carcasses of southern bent-wing bats (*Miniopterus* sp.) in southeastern Australia [96]. Note that CFA contains significant amounts of persistent organic pollutants, including polycyclic aromatic hydrocarbons and polychlorinated biphenyls [77,78].

5. WHITE NOSE SYNDROME IN BATS

White-nose syndrome (WNS) is a newly emerged disease that potentially threatens all temperate bat species. White-nose syndrome is caused by the pathogenic fungus *Pseudogymnoascus destructans* and it has decimated the populations of several hibernating North American bats. First discovered in 2006 in New York State, WNS spread rapidly across the eastern U.S. and has caused population collapses of certain bats; e.g. it is predicted to lead to the regional extinction of the little brown bat (*Myotis lucifugus*), previously one of the most common bats in North America [97]. White-nose is a cold-loving fungus that grows on the exposed skin surfaces (including snout, ears, and wing membranes) of affected bats during hibernation. Disease manifestations of White Nose include depletion of fat reserves, dehydration, premature arousal from hibernation, and ulcerated and necrotic wing lesions.

Bat metabolism and the animal's immune response are reduced during hibernation. Further immune suppression may result from other causes including chemical/heavy metal contamination. As bats are known to harbour high levels of chemical toxins, further studies are needed to assess the impact of this toxicity on the bat's immune system [98]. During arousal from hibernation, the sudden reversal of immune suppression associated with euthermia can lead to a paradoxical worsening of the white-nose fungal infection, so-called immune reconstitution inflammatory syndrome [99].

As noted above, the Gaia theory, developed by James E. Lovelock and Lynn Margulis [27-31], in essence, describes the realm of inextricable and

complex interrelationships by and between the living matter of Earth and the physical states and conditions of Earth's various environments. Upsetting that delicate balance may have unforeseen consequences. For example, we have shown that the addition of iron to the marine environment can shift the global plankton balance favouring harmful over beneficial algae [53]. White Nose Syndrome seems to have emerged and proliferated at the same time that aerial particulate geoengineering accelerated in range, scope, and intensity, suggesting the possibility that causal relationships might be discovered.

6. IRON TOXICITY IN BATS

Among the metals detected in bat tissues like liver and kidney, iron is usually found at very high levels [88]. Iron is an essential element for mammals and other living creatures but it is one that requires strict balance. Iron imbalance, or altered iron homeostasis, results from excessive or misplaced reactive iron in the body, promoting a wide variety of diseases [100].

Captive Egyptian fruit bats (*Rousettus aegyptiacus*) frequently develop iron storage disease associated with increased infection rates and cancer, including hepatocellular carcinoma [101]. There is recent evidence that environmental pollutants (including persistent organic pollutants and metals) disrupt iron homeostasis, producing adverse biological effects [102].

Detection of fungal iron-gathering siderophores on the wings of bats with WNS suggests that these molecules play a role in infection and/or tissue invasion [103]. In mammals, iron-rich brown fat has a limited distribution in the body and is involved in thermoregulatory processes. In hibernating bats, thermogenesis by brown fat is necessary for both arousal and maintenance of hibernation [104].

It was recently discovered that the ferritin heavy-heart (FHH) chain component of ferritin (the main iron storage protein) acts as a master regulator of organismal iron homeostasis, coupling nutritional iron supply to redox homeostasis, energy expenditure, and thermoregulation [105]. Bats rely on brown adipose tissue for energy, and feeding on highly contaminated insect prey is likely to change the fatty acid profile in this particular bat tissue, with effects on mitochondrial functioning, torpor, and energy usage [106].

Further verification of the data from our review of CFA-type pollutants in bats should be obtained from bat samples in various habitats from widely separated geographical areas. Living bats do not need to be sacrificed for these studies. Tissue for element sampling can be obtained from bats killed in mass mortality events. Guano samples tend to contain the same heavy metals detected in analyzed bat tissue [88]. The fur is another non-invasive proxy that can be used to monitor metal contamination in bats. Furthermore, fur analyses are capable of yielding data on the recent, long term, and chronic metal exposure [107].

7. CONCLUSION

Air pollution is the leading environmental cause of disease and death in the human population. Deliberate air pollution in the form of “covert” tropospheric aerosol geoengineering produces damaging effects throughout the biosphere. Jet-sprayed particulate trails bear the clear footprint of CFA, the highly toxic waste product of coal burning. Coal fly ash, including its use in climate engineering operations, has contributed to the catastrophic global loss of trees, insects, birds and other living things. The recent finding of countless exogenous, spherical, magnetic nanoparticles in the brain and hearts of persons living in highly polluted areas provides definite evidence of the near-universal exposure of humans to the combustion products of fossil fuels, including CFA.

Bats have great economic and environmental importance, including nocturnal insect control, pollination, seed dispersal, and forest regeneration. Bats, however, are suffering a precipitous global decline due to multiple anthropogenic causes. Bats are extremely important mammalian bio-indicators of environmental contamination. They are exposed to environmental contaminants from food and water sources as well as air pollution. Bats are known to have high levels of heavy metals and persistent organic pollutants in their tissue. This work suggests that element ratios in bat tissue and bat guano are consistent with their origin in CFA. These findings provide yet another ominous sign that CFA, including its use in climate engineering, poses a dire threat to the entire web of life on Earth.

Immediate steps that must be taken include (1) a halt to global “hidden in plain sight” tropospheric aerosol geoengineering, (2) the

reduction of harmful combustion-type nanoparticle emissions and (3) the development of international programs to quantify, monitor, and regulate ultrafine particulate air pollution. Bats are an important “canary in the coal mine” telling us these steps constitute a moral imperative if we and our children are to have a viable future.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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