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Previously Unacknowledged Potential Factors in Catastrophic Bee and Insect 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 MW was primarily responsible for the entomological data. Author JMH was primary responsible for mineralogical and geophysical considerations. Both authors read and approved the final manuscript.

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ABSTRACT

Aims: We investigate previously unacknowledged potentially major contributory factors in global catastrophic bee and insect die-off that arise from the use of aerosolized coal fly ash (CFA) for covert weather and climate manipulation. We also present forensic evidence that CFA is the primary material used in atmospheric aerosol geoengineering operations.
Methods: We conducted extensive literature research and additionally utilized inductively coupled plasma mass spectrometry.
Results: The primary components of CFA, silicon, aluminum, and iron, consisting in part of magnetite (Fe_3O_4), all have important potential toxicities to insects. Many of the trace elements in CFA are injurious to insects; several of them (e.g., arsenic, mercury, and cadmium) are used as

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insecticides. Toxic particulates and heavy metals in CFA contaminate air, water, and soil and thus impact the entire biosphere. Components of CFA, including aluminum extractable in a chemically-mobile form, have been shown to adversely affect insects in terrestrial, aquatic, and aerial environments. Both the primary and trace elements in CFA have been found on, in, and around insects and the plants they feed on in polluted regions around the world. Magnetite from CFA may potentially disrupt insect magnetoreception. Chlorine and certain other constituents of aerosolized CFA potentially destroy atmospheric ozone thus exposing insects to elevated mutagenicity and lethality levels of UV-B and UV-C solar radiation.

Conclusions: It is necessary to expose and halt atmospheric aerosol geoengineering to prevent further gross contamination of the biosphere. As insect populations decline, bird populations will decline, and ultimately so will animal populations, including humans. The gradual return of insects when the aerial spraying is stopped will be the best evidence that aerosolized CFA is, in fact, a leading cause of the current drastic decline in insect population and diversity.

Keywords: Insect die-off; biodiversity; geoengineering; coal fly ash; aluminum toxicity; colony collapse; magnetite.

1. INTRODUCTION

There is public awareness and concern [1] about the population decline of the Western honey bee, *Apis mellifera*, the principal agricultural pollinator worldwide [2]. Bumble bee populations (*Bombus* sp.), secondary but nevertheless important pollinators, are also in decline in North America and Europe [3-5]. Evans et al. [6] investigated 61 quantified variables, such as pesticide levels and pathogen loads in *Apis mellifera* and reported: "no single measure emerged as a most-likely cause of colony collapse disorder". As noted by Watanabe [7] there is “no smoking gun.”

A recent study documented the alarming decline, 75% reduction, in insect populations (biomass) in protected areas of Germany just over the past three decades [8]. This dramatic loss of insect abundance and diversity has profound ramifications for the world-wide food web and ecosystems. In that study, neither climate change nor land use could be linked to this frightening decrease in insects, although agricultural practices and pesticide use could not be excluded as contributing factors. Like Western honey bee decline, there is no readily identifiable cause, no ‘smoking gun’.

Biodiversity declines have been reported elsewhere in other species. For example, Brooks et al. [9] in the UK reported over a 15 year period that three-quarters of the carabid beetle species investigated had declined substantially. Similar declines were reported for British common macro-moths [10] and butterflies [11]. In the last 40 years, there has been a 45% decline in invertebrates, a decline that includes all of the major insect Orders [12]. No readily identifiable cause of these declines has emerged.

These investigations clearly implicate a large-scale cause of insect die-off, and point to an urgent need to discover the actual underlying cause(s) of this insect decline. However, it is presumed that deliberately aerosolized coal fly ash (CFA), a global and toxic by-product of coal combustion, potentially represents a major contributor to the worldwide die-off of insects.

When coal is burned, primarily by electric utilities, the heavy ash settles, while the light ash, CFA, formed in the gases above the burner, would exit smokestacks if not trapped and sequestered as required by modern regulations. Coal fly ash is one of the largest industrial waste-product streams throughout the world. Disposal of CFA is problematic; it is often simply dumped into surface impoundments or placed into landfills which cause concerns for ground water contamination and environmental pollution [13,14]. However, in many countries including the United States, a significant percentage of coal fly ash is recycled into the structural fill and such products as concrete [15]. Coal fly ash is also utilized in soil additives and fertilizer [16].

Reports are available to show that CFA is consistent with its use as the primary material aerosolized for covert, jet-emplaced climate manipulation operations (Fig. 1) [17,18]. CFA forms as particles ranging from <0.1 μm to 50 μm in width and therefore requires little further processing for use as a climate-altering aerosol. Sprayed into the atmosphere, these particles reflect some sunlight, but they also absorb energy which is transferred to the atmosphere via molecular collisions. The particles also block

Fig. 1. Jet-emplaced weather/climate manipulation particulate trails. (Photographers with permission) Clockwise from upper left: Karnak, Eqypt (author JMH); London, England (Ian Baldwin); Geneva, Switzerland (Beatrice Wright); Chattanooga, TN, USA (David Tulis); San Diego, CA, USA (author JMH); Jaipur, India (author JMH)

heat from leaving Earth's surface. The aerosolized particles inhibit rainfall by keeping water droplets from coalescing to fall as rain; the effect is to cause drought, but eventually, the atmosphere becomes so burdened with moisture that storms occur with rain falling in deluges. This covert aerial spraying worsens global warming and totally disrupts natural weather patterns [19].

In the present investigation, efforts are made to describe and provide evidence that aerosolized CFA yields toxic elements that contaminate the environment and potentially become major contributors of insect die-offs. These include, specifically the consequences of toxins extractions from CFA into rainwater, and the effects of CFA particulate-components on insect viability. Further, the harmful consequences of enhanced UV-B and UV-C solar radiation that concomitantly arise from atmospheric ozone reduction by aerosolized CFA are discussed.

2. METHODS

In the face of the obvious aerial particulate spraying, there is, however, a concerted effort to deceive the public and the scientific community of its existence and its adverse consequences on human and environmental health [20]. For the following reasons, CFA is a likely material for use in global-scale geoengineering operations: (1) It is a major industrial waste product; (2) It is produced in the size needed without much additional processing; and, (3) Its production facilities are in place, out of sight, and utilize railroad transport.

The methods for demonstrating that the aerosolized particulates are consistent with CFA are twofold: (1) Showing that the relative amounts of elements dissolved in rainwater are similar the relative amounts of elements of CFA extracted into water during laboratory leach studies [21]; and, (2) Showing that the relative amounts of elements brought down by snow, in a manner analogous to the technique of co-precipitation [17], are similar to the relative amounts of elements found in CFA [21]. Measurements, previously published and newly presented here, are by inductively coupled plasma mass spectrometry.

3. RESULTS AND DISCUSSION

Since at least the beginning of the 21st century and even before, numerous citizens from around the world have witnessed aerial spraying of particulate trails across the sky [22]. Without reliable information available about chemical composition and potential health-risks of the aerosol substance being sprayed, concerned citizens took post-spraying rainwater samples to commercial laboratories for analyses. Typically, only aluminum analysis was requested; sometimes barium was also requested and, occasionally, strontium as well. When the aerial spraying became an obvious near-daily activity in San Diego (USA), one of us (JMH) began a series of investigations to ascertain the composition of the aerosolized particles. Standard protocols for certified laboratory water analyses require filtration to remove particulate matter before measurements; thus it is evident that the rainwater had leached those three elements from some readily leachable particulate matter before it fell to the ground.

By expressing data as ratios to some common element, such as barium, provides a means to eliminate the consequences of various amounts of dilution. Comparison of those analytical results, expressed as ratios relative to barium, to corresponding experimental water-leach analyses of a likely aerosolized-substance, coal fly ash (CFA), provided the first scientific evidence that CFA is the main particulate-pollutant substance used for ongoing tropospheric geoengineering [23].

To understand the chemical process involved, consider by analogy the hypothetical example of finely powdered tea leaves being sprayed into the troposphere. Atmospheric moisture would "brew" the tea, extract tannin and other chemicals, which would come down as rain, with chemical signatures of tea; the rain would be tea, albeit very weak tea. Coal fly ash (CFA) forms principally by condensation in the hot combustion gases in the flue above the combustion chamber of coal-powered electric utilities in circumstances, unlike those typically encountered in nature, and consists of a disequilibrium assemblage of typically anhydrous matter [24]. Water is capable of quickly extracting numerous toxic elements from CFA [21]. When CFA is sprayed into the troposphere, atmospheric water extracts numerous toxic elements by leaching, which are brought down dissolved in rainwater and provide a chemical signature of the CFA. The more elements measured in rainwater, the more precise and unique the signature becomes. This is a significant signature as common windblown sands and soils are not readily and quickly leached by rainwater.

Fig. 2. shows a comparison of rainwater analyses with ranges of CFA laboratory leach data. Except for the Bangor, Maine (USA) data, the remainder of the data has been published and is reproduced with permission [18]. Dilution is a variable factor that can be compensated in analytical comparisons by using ratios. Dilution, however, in many instances causes the less abundant elements to be below the detection limits for commercial analytical laboratories. The Bangor, Maine (USA) data, shown in Fig. 2. is particularly significant as the dilution factor was low and important trace element analyses as requested were able to be determined.

Fig. 3. reproduced with permission from [18], shows analyses of aerosolized particulates brought down by snow, the residue from evaporation and the residue trapped upon underlying snow mold as the snow melted, compared with the range of corresponding CFA analyses. This figure and Fig. 2. demonstrate the range of toxic elements that contaminate the environment consistent with CFA being the main aerosolize particulates used in climate manipulation.

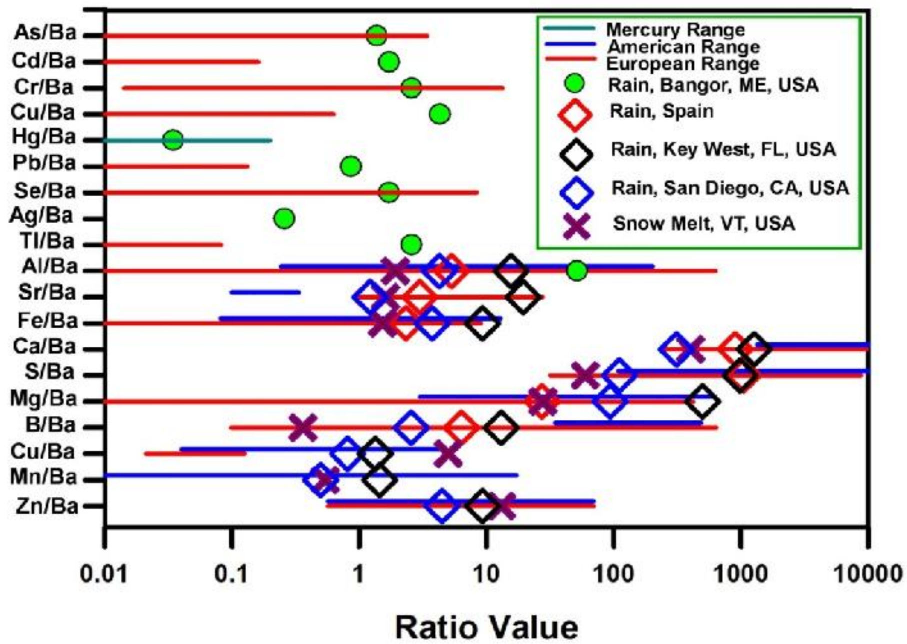

Fig. 2. Element ratios measured in filtered post-spraying rainwater and snow from [18] with permission and with new rainwater data from 2011 in Bangor, ME, USA, courtesy of Russ Tanner

The elemental composition of CFA is variable, dependent upon the compositions of the parent coals and the coal-burner dynamics. In Figs. 2 and 3, the ranges of CFA elemental compositions of European CFA samples are indicated by red lines, the ranges of American CFA elemental compositions by blue lines.

The aerosolized CFA mixes with the air we breathe and settles to Earth, hence the need for near-daily spraying. Consequently, CFA employed for climate manipulation/intervention grossly contaminates the biosphere with particulate toxic CFA and with toxins extracted from the CFA into rainwater [17,18,22].

The main elements in CFA are oxides of silicon, aluminum, iron, and calcium, with lesser amounts of magnesium, sulfur, sodium and potassium. Primary components of CFA are alumino-silicates and an iron-bearing (magnetic) fraction that contains magnetite, Fe_3O_4. Coal fly ash is principally composed of spherical particles, including alumino-silicate and magnetite spherules [24]. The spherical configurations are due to surface tension of the melts during condensation and agglomeration in the hot gas above the coal burner [18]. Among the many trace elements originally present in coal that occur in CFA include arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), chromium (Cr), lead (Pb), manganese (Mn), mercury (Hg), nickel (Ni), phosphorus (P), selenium (Se), strontium (Sr), thallium (Tl), titanium (Ti), vanadium (V), and zinc (Zn). Small amounts of organic material and even the radionuclides uranium (U), thorium (Th) and their radioactive daughter products are found in CFA [21,25].

Early studies of the adverse effects of air pollution on insects focused on volatile emissions including fluoride-containing gases, sulfur (SO_2), nitrogen oxides, and ozone [26]. It is now recognized that sustained exposure to particulate matter (PM) in air pollution is a major global cause of morbidity and mortality [27]. Coal fly ash is one of the main sources of anthropogenic particulate matter pollution on a world-wide basis [28]. Tropospheric aerosol geoengineering (TAG) operations, increasing in scope and intensity in recent years, represent a deliberate form of CFA-PM air pollution that also contaminates soil and water. This kind of particulate pollution can affect insects through respiration, ingestion, and direct contact. The particulate material in CFA, including metals and metalloids, are difficult for organisms to regulate, and are toxic to arthropods in various concentrations and by different modes of action [29].

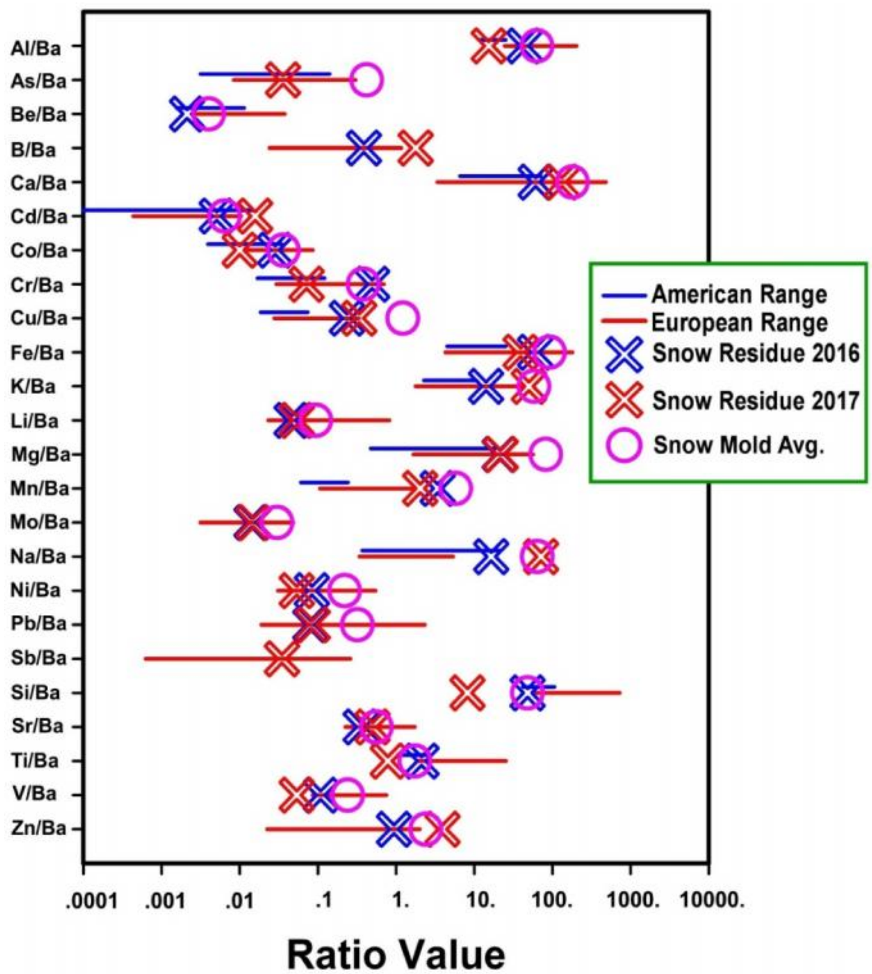

Fig. 3. Element ratios measured in post-spraying snow residue after evaporation and in snow mold found beneath melting snow, from [18] with permission

Pollution caused by CFA can affect insects by bottom-up (e.g. soil or host plant quality) or top-down (e.g. direct contact or effects on predators or pathogens). A comprehensive review showed the fitness of insect herbivores was usually impacted by bottom-up factors. Fewer studies have been carried out by top-down factors, but it has been shown that air pollution does affect insect population dynamics by differential effects on herbivores and their natural predators [30]. Pollutants often bioaccumulate in predatory insects. Airborne pollution particles coat leaves and plants, affecting plant chemistry, photosynthesis, and thereby nutrition for herbivores. Contamination of soil allows for plant uptake of many elements that in turn are consumed by herbivores [31]. Coal fly ash added to fertilizer or soil can lead to potentially toxic accumulations of elements including arsenic [32].

The primary component elements of CFA, Si, Al, and Fe all have toxic effects upon insects. Deposition of Si in plant tissue provides a barrier against insect probing, feeding, and penetration into plant tissue [33]. Silicon-bearing components remove the waxy coat of insects that preserves moisture, thus killing them by desiccation [34].

Moisture is capable of extracting aluminum from CFA in a chemically-mobile form [21]. Aluminum is usually not found in the natural world in chemically-mobile form thus there is an absence of defense mechanisms; aluminum is a non-essential metal with no biologic function. Aluminum is found in insecticides like aluminum phosphide, a highly toxic material used for grain preservation. Aluminum has been found to be toxic (causing deformities) in caddisfly larvae, with an enhanced effect in acid conditions [35].

In-vitro studies show aluminum toxicity in *Drosophila* flies [36]. Ingested aluminum is detrimental to foraging and other behaviors in bees [37].

As in other organisms, insects must balance opposing properties of ionic iron, that of an essential nutrient and a potent toxin. Iron must be acquired as a catalyst for oxidative metabolism, but it must be tightly regulated to avoid destructive oxidative reactions [38]. Ionic iron is one of the most reactive of all atmospheric pollutants. A biological effect common to many ambient air pollution particles is the disruption of iron homeostasis in cells and tissues [39]. Iron is known to play a catalytic role in the generation of oxygen free radicals in vitro. Houseflies fed ferrous chloride in their drinking water had shortened life spans with evidence of oxidative stress [40]. Iron accumulates in insects causing lipid peroxidation and eliciting an antioxidant response [41].

There is currently more direct evidence of pollution damage to insects from the main components of CFA. Exley et al. [42] reported that Bumble bee pupae from both urban and rural areas were found to be heavily contaminated with aluminum. This aluminum content was higher than levels considered harmful to humans and was associated with smaller Bumble bee pupae. High levels of aluminum and other elements found in coal fly ash (Cd, Co, Cr, Cu, Mn, Se, Sr, Ti and V) have been measured in honey bees from polluted areas [43,44]. High levels of aluminum, iron and multiple other trace elements including As, Pb, and Ba have been detected in bee pollen collected from polluted areas [45-47]. Bee pollen is a mixture of flower pollen, the bee's own secretions, and some nectar. It can be assumed that bees acquire significant amounts of metals and metalloid pollution from a "bottom-up" mechanism by ingestion of contaminated plant products and drinking water sources. In the case of bee pollen this material is brought back to the hive on the insects' legs and is one of their primary nutrition sources [45].

In addition to bees, other insects have been evaluated as bioindicators of heavy metal pollution, including those trace elements in CFA. In Pakistan, significant levels of Cd, Cu, Cr, Zn, and Ni were detected in a *libellulid* dragonfly, an *acridid* grasshopper, and a *nymphalid* butterfly. The highest levels of these elements were found near polluted industrial areas, and the lowest values (but still present) at a site far from industrial activity [48]. Accumulation of Cd, Co, Cu, Fe, Mn, Ni, and Pb were documented in grasshoppers (Orthoptera, Acrididae) that were collected near a copper mine in Bulgaria. Cadmium and lead were heavily concentrated in grasshoppers at the most contaminated sites [49]. Concentrations of Pb>Cd>Hg were found in food plants and grasshoppers collected from a mountain grassland 1200 m above sea level in Greece, suggesting an anthropogenic source of pollution transported in the atmosphere [50].

As bioindicators of pollution, honey bees are also used as samplers of airborne particulate matter. As reported by Negri et al. [51], honey bees foraging in polluted areas collect many inorganic pollution particles, mostly concentrated in the forewings, the head area, and back legs. These anthropogenic particles, ranging from 500 nm to 10 um in diameter, display a sub-spherical morphology and have been characterized by EDX as either Fe-rich particles or alumino-silicates. Lead and barium (both found in CFA) were also detected adhering to the body of the honey bee [51].

Coal fly ash Is a rich source of nanoparticle-sized pollution. Nano and bio-nanoparticles are increasingly being studied and employed for insect control. Aluminum, silicon, zinc, and titanium nanoparticles (all components of CFA) are being developed for crop pest management [52]. For example, nano-alumina dust can be engineered through modified synthesis to target different insect species [53]. Chemically fabricated nano-iron is being developed as an effective pesticide. It has been shown that iron and iron oxide nanoparticles are highly toxic to *Culex quinquefasciatus*, the Southern House Mosquito [54].

Recently spherical magnetite pollution nanoparticles like those in CFA, and distinct from biogenic magnetite particles, were found abundance in the brain tissue of humans with dementia [55]. Many insects (e.g. bees, ants, termites) contain biogenic magnetite and employ it for magnetoreception [56-58]. Honey bees, for example, use magnetite-based magnet oreception to detect the Earth's magnetic field by means of magnetoreceptor iron granules located in their abdomen [57]. It is therefore likely that exogenous magnetic pollution particles can disrupt these functions.

Magnetic measurements of deposited atmospheric dust serve as an additional parameter in assessing environmental pollution. Samples of this particulate atmospheric pollution contain magnetite of spherical shape, consistent with particles in the magnetic-magnetite fraction of coal fly ash [59]. Both biogenic and exogenous magnetite particles are known to be exquisitely sensitive to external electromagnetic fields [60]. Insects are continually exposed to radio-frequency electromagnetic fields at different frequencies. The range of frequencies used in wireless communication systems will soon increase from 6 GHz to 120 GHz (5G). It has now been reported that insects absorb radiofrequency electromagnetic power as a function of frequency from 2 GHz to 120 GHz [61]. There is growing evidence that exposure to cell phone radiation induces stress, and can produce both behavioral and biochemical changes in worker honey bees [62].

Thermal (coal-fired) power plants (TPP's) have a long history of adverse environmental impacts due to their emissions of particulate matter, organic, and inorganic pollutants. Honey bees from apiaries foraging near TPP's accumulate high quantities of the primary (Al/Fe) constituents and trace elements (e.g. Cr, Ba, Cu, Li, and Ni) found in coal fly ash compared to bees from apiaries in rural areas [63]. Declines in honey bee populations due to pesticides have been studied, but the role of soil-borne pollutants on honey bee survival wasn't examined until recently. In regard to the soil-borne pollutant, selenium (Se), pollen collected by bees from plants growing in coal fly ash from TPP's contained 14 mg Se per kg [64]. In an urban but less polluted area of Poland, honey bee foragers collected from stationary hives contained 7.03 mg of Se per kg [65]. It was later shown that selenium in excessive amounts adversely affects honey bee behavior and survival. Bees foraging on nectar containing high levels of selenium (particularly selenate) suffer direct toxicity and population reduction from this soil-borne pollutant [66].

Coal fly ash itself has been used as a pesticide, with activity against many types of insects [16]. Many of the trace elements in CFA are quite toxic to insects. Before the development of organic/synthetic pesticides, inorganic chemicals and elements including arsenic, mercury, cadmium and boron were used as insecticides. Arsenic, cadmium, mercury and lead have no useful function in living organisms and may be toxic at any dose [67]. An insect model used to assess mercury toxicity found that mercury induces oxidative stress in insects just as it does it in vertebrates [68]. Cadmium chloride ($CdCl_2$), mercuric chloride ($HgCl_2$), and methymercuric chloride (MeHgCl) all produced marked toxicity including cell death in *Aedes albopictus* (mosquito) cells with MeHgCl>$HgCl_2$>$CdCl_2$ [69]. We have shown that climate manipulation using aerosolized coal fly ash is likely a previously undisclosed and world-wide source of mercury contamination in the biosphere [18].

Contamination of water in lakes, rivers, and other bodies of water by chemical pollutants is one of the most important threats to all wildlife including insects. Toxic elements of CFA readily leach into water where they concentrate in aquatic plants and insects. Selenium, one such element, is an essential trace nutrient, but it is toxic in higher amounts. The development and survival of insect herbivores can be affected by even low to moderate concentrations of selenium acquired from pollution in plants [70]. Elevated levels of copper, zinc, iron, manganese, lead, cobalt, and cadmium have been detected in water and aquatic insect body samples from polluted sites [71]. These pollutants have been shown to cause both oxidative stress and genotoxicity (e.g. chromosomal breaks/damage) in aquatic infections. Even small amounts of heavy metals can change the physiochemical characteristics of water and dramatically affect the metabolism of insects [71].

Another major contributor to the world-wide insect die-off is the thus-far widely unacknowledged but independently confirmed elevated level of short-wave ultraviolet UV-B and UV-C radiation penetrating to earth's surface [72-75]. We have proposed that this increase in deadly UV-B and UV-C radiation is partially caused by geoengineering utilizing CFA, which places ozone depleting chemicals (e.g. chlorine) high into the atmosphere [75]. The mutagenicity and lethality action spectra of sunlight exhibits two maxima, both in the UV-B and UV-C region [76]. Insects are very sensitive to changes in UV-B irradiance, and solar UV-B has a large direct and indirect (plant mediated) effect on arthropods [77]. It was recently shown that UV-B influences and disrupts the metamorphosis of insects [78]. UV-C radiation (100-290 nm) is well-known to be lethal to insects [79].

Table 1 presents a brief instructional overview of toxic effects from CFA constituents.

Table 1. Brief instructional overview of toxic effects from constituents of Coal Fly Ash (CFA)

Primary components of Coal Fly Ash (CFA):
Silicon (Si) – Deposition in plants creates a barrier for insect feeding/probing, and penetration into plant tissue. Silicon-bearing components remove/destroy waxy coat of insects causing desiccation.
Aluminum (Al) – CFA is the chief source of chemically-mobile aluminum. Aluminum, which has no biological function in insects, is used in insecticides (Al-phosphide). Aluminum toxicities include deformities and adverse changes in behavior/foraging (bees). Anthropogenic CFA aluminosilicate particles ‘coat’ insects including bees.
Iron (Fe) – Ionic iron is one of most reactive atmospheric pollutants. Biologically, iron excess causes oxidative stress and lipid peroxidation. Magnetite (Fe_3O_4) pollution particles ‘coat’ insects, and are exquisitely sensitive to external electromagnetic fields; they may interfere with magnetoreception in insects.
Nanoparticles (abundant in CFA) – Nanoparticles in CFA are reasonably assumed to be detrimental to insects as chemically fabricated Al, Si, and Fe nanoparticles are being developed for insect control.
Trace elements in Coal Fly Ash (CFA):
Arsenic (As), cadmium (Cd), mercury (Hg), and boron (B) have been used as insecticides. Arsenic, cadmium, mercury, and lead (Pb) have no known useful function in living organisms and may be toxic at any dose.
Selenium (Se) has been shown to concentrate in plants grown in CFA and accumulate with toxicity in insects (e.g. bees) foraging/feeding on those plants. Selenium in excess has been shown to be toxic to many organisms in the aquatic environment, including insects.

4. CONCLUSION

Coal fly ash, including its use in covert (undisclosed) climate engineering operations, is a previously unrecognized prime suspect in the world-wide decline of insects. CFA is a global source of pollution known to be toxic to insects that contaminates air, water, and soil. In fact, we suggest that of the many threats to insects, i.e, habitat loss/degradation, pesticides, foreign species and disease, atmospheric geoengineering, especially utilizing CFA, may well be not only the most dire, but the most neglected and unrecognized cause of the catastrophic loss of insects on a world-wide basis. Previously published data and updated in this study are consistent with CFA being the main undisclosed particulate aerosol used in tropospheric geoengineering. Coal fly ash adversely affects insects in aerial, terrestrial, and aquatic environments. Coal fly ash is implicated in the dramatic decline of insects because its primary components (alumino-silicates and iron) and multiple trace elements, are found in, on, and around insects collected in polluted areas from around the world. It is imperative to confirm and expand these findings and look for the “fingerprint” of CFA in rainwater, insects, and their surroundings in areas far removed from industrial sites but impacted by CFA aerosol spraying. Atmospheric geoengineering using CFA likely contributes the increasing irradiance by UV-B and UV-C radiation which is deadly to insects.

To date there has been no statistically significant cause ascertained to account for the demise of insects [1-12]. The precautionary principle, which is proposed as a new guideline in environmental decision making [80], consists of four central components: (1) taking preventive action in the face of uncertainty; (2) shifting the burden of proof to the proponents of an activity (in this case the aerial particulate spraying); (3) exploring a wide range of alternatives to possibly harmful actions; and, (4) increasing public participation in decision making, which in the matter of wide-spread insect demise should rightly include scientists. In this spirit we have disclosed potential primary, yet previously unacknowledged, causes of the catastrophic decline of insects. It is necessary to expose and halt atmospheric aerosol geoengineering to prevent further gross contamination of the biosphere. The gradual return of insects when the aerial spraying is stopped will be the best evidence that aerosolized CFA is in fact a leading cause of the current drastic decline in insect population and diversity.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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