



# The sixth mass extinction and chemicals in the environment: our environmental deficit is now beyond nature's ability to regenerate

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Two papers about the future of the planet appeared within a month of each other (June/July 2015): *Accelerated modern human-induced species losses: Entering the sixth mass extinction* was the first (5 pages long). The 6 authors calculated the average rate of vertebrate losses over the last century and compared it with the background rate of losses. They estimated it to be up to 114 times the background rate and asserted that this rate of losses of biodiversity indicated that a sixth mass extinction is already under way. The authors described themselves variously as ecologists, field biologists, paleobiologists or population biologists, but all held two beliefs in common: that the conservation of natural ecosystems is essential to human health; but that the accelerated losses of biodiversity are a result of human activity. *Safeguarding human health in the Anthropocene epoch: Report of the Rockefeller Foundation–Lancet Commission on planetary health* was the second paper (56 pages, with 23 authors). At least 10 of the authors were associated with the Rockefeller Foundation, although only one curriculum vitae acknowledged the fact. Sarah Whitmee was seconded to the Foundation to serve as lead author of the Report and member of the Foundation's secretariat. One author worked as an environmental health scientist in the Office of the Science Adviser at the United States Environmental Protection Agency and was lead author of a recent paper *Biodiversity loss affects global disease ecology*, which made no mention of pesticides. Most of the remainder are eminent public health doctors. The Rockefeller Foundation funded the initial research on genetically modified organisms in the early 1940s and founded the science of molecular biology, a highly reductionist programme aimed at "understanding" life. The Rockefeller Foundation supports biofortification of crops: the introduction of nutrients into crops by genetic engineering techniques for the supposed benefit of third world countries. The persistent and increasing global contamination of water and air by long-acting biocides, particularly formulated glyphosate and the neonicotinoid insecticides, are toxic not only to the poor, but to the rich as well. The Rockefeller Foundation's early involvement in eugenics research and its subsequent support for depopulation are unlikely to be consummated before the sixth mass extinction.

**Keywords:** biodiversity, genetically modified organisms, human health, pesticides, water contamination

## 1. ENTERING THE SIXTH MASS EXTINCTION

Ceballos et al. [1] calculated the average rate of vertebrate losses over the last century and compared it with the background rate of losses. They estimated it to be up to 114 times the background rate, implying that a sixth extinction is already under way. Loss of biodiversity is the most urgent of the environmental problems. It is critical to ecosystem services and human health. One of the authors, Paul Ehrlich, Bing Professor of Population Studies in the Department of Biological Sciences at Stanford University and President of Stanford's Center for Conservation Biology, had warned about overpopulation since his first book, *The Population Bomb*, was published in 1968 [2]. Since then, Ehrlich has

written about this phenomenon in increasingly urgent terms [3, 4]. Here are some apposite observations taken from these two works:

- There have been increasing signs of great toxic peril for humanity and its life-support systems, with a growing threat from the release of hormone-disrupting chemicals that could even be shifting the human sex ratio and reducing sperm counts;
- Agriculture is a leading cause of losses of biodiversity and ecosystem services;
- An industrial agricultural revolution has created a technology-dependent global food system;
- *But* it has also created serious long-run vulnerabilities, especially in its dependence on stable climates, crop monocultures, industrially produced fertilizers and

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pesticides, petroleum, antibiotic feed supplements and rapid, efficient transportation;

- Farming is a principal source of global toxification, *pace* Rachel Carson;
- Soils are being degraded;
- “Growth can continue forever if it’s in service industries”, and “technological innovation will save us” are fables;
- Worship of “free” markets should be deprecated;
- Without significant pressure from the public demanding action, we fear there is little chance of changing course fast enough to forestall disaster;
- *This* will require developing mechanisms to force big corporations (including those in big agriculture and big pharma) to bear social responsibilities like the real individuals whose rights they legally want to assume;
- Adverse symptoms of exposure to synthetic chemicals are making some scientists increasingly nervous about effects on the human population;
- Elected officials and other leaders have almost no knowledge of science.

Dr Eric Chivian founded the Center for Health and the Global Environment at Harvard Medical School in 1996 “To help people understand that our health, and that of our children, depends on the health of the environment and that we must do everything we can to protect it”. He and Aaron Bernstein co-edited a book [5], including contributions from more than 100 leading biodiversity and health scientists and co-sponsored by the United Nations Development Programme, the United Nations Environment Programme, the Secretariat of the Convention on Biological Diversity and the World Conservation Union.

An editorial in *Nature* in 2014 [6] discussed the requirements for being awarded an undergraduate biology degree. Today it requires no courses in natural history, whereas in the US in 1950 it required two or more. Molecular biology, genetics, experimental biology, mathematical modelling, population biology and statistics have taken over. However, many of these fields rely on data, specimens and collections from natural history. The editors recommended that a biology diploma should not be awarded without a course in identifying organisms, learning the basic techniques for observing and recording data. Mathematical modelling tends to be used naïvely and inappropriately. For example, the chairman of the European Food Safety Authority (EFSA)’s genetically modified organisms (GMO) panel was first author of a paper in which mathematical modelling of a genetically modified (GM) herbicide-tolerant crop was used to assess its effects on an unknown lepidopteran [7]. The

14 authors failed to predict the 90% declines over 20 years of the migrant monarch butterfly on its breeding sites in the USA.<sup>1</sup> In 1999, common milkweed, the monarch’s food plant, was found in half of corn and soybean fields, but in only 8% of them a decade later. Glyphosate-tolerant GM crops are grown in the same fields each year. Once absorbed, glyphosate is translocated to the roots and therefore the milkweed does not regenerate. Another paper has shown that clothianidin, a very long-acting systemic neonicotinoid insecticide, has contributed to the decline of monarch butterflies [8].

Tewksbury et al. [9] argue that natural history is of vital importance for learning about organisms, their links to communities and ecosystems and their biotic and abiotic interactions. Examples are provided of the fundamental importance of knowledge of natural history to many disciplines: human health, food security, conservation, management and recreation and the costs of mistakes of not having that knowledge, without which absurdly elementary mistakes can be made. For example, an eminent professor of biology did not recognize the difference in life cycle between bees and bumblebees [10]; he failed to appreciate that the 85% reduction in queen bumblebees after exposure to imidacloprid would devastate their populations because only the new queen lives through the winter to start a new colony.

**Emerging pathogens as threats to animal and plant health.** Outbreaks of infectious diseases amongst species of wildlife around the world (such as amphibians, honey bees, bumblebees, fish, birds and bats) have occurred over the last 25 years (in general, the public in the US and UK has not been informed). Since the late 1990s US scientists have written in increasingly desperate tones: “In both animals and plants, an unprecedented number of fungal and fungal-like diseases have recently caused some of the most severe die-offs and extinctions ever witnessed in wild species, and are jeopardizing food security” [11] and appealed to scientists to find urgently “the elusive magic bullet” [12]. Only one paper from California dared to mention pesticides: Davidson et al. [13] reported in 2002 spatial patterns of decline for four California ranid frogs and matched the declines with the distribution of agricultural lands (based on US Geological Survey (USGS) land use maps) and key predominant wind directions (based on California Air Resources streamline wind maps). The authors highlighted that “In California, the transport and deposition of pesticides from the agriculturally intensive Central Valley to the adjacent Sierra Nevada is well documented, and pesticides have been found in the bodies of Sierra frogs.” The widespread

<sup>1</sup> [http://www.centerforfoodsafety.org/files/cfs-monarch-report\\_2-4-15\\_design\\_05341.pdf](http://www.centerforfoodsafety.org/files/cfs-monarch-report_2-4-15_design_05341.pdf)

use on agricultural crops of the systemic neonicotinoid insecticides [14] and the herbicide glyphosate,<sup>2</sup> both of which cause immune suppression, make species vulnerable to emerging infectious pathogens, driving large-scale wildlife extinctions.

**Birth defects in animals in Montana.** A recent study by Hoy et al. found alarming increases in congenital malformations in wildlife in Montana that Hoy has been documenting for the past 19 years. Similar birth defects have occurred in humans in the USA. Their graphs illustrating human disease patterns over the twelve-year period correlate remarkably well with the rate of glyphosate usage on corn, soy and wheat crops, which has increased due to “Roundup Ready” crops. While the animals’ exposure to the herbicide is through food, water and air, the authors believe that human exposure is predominantly through food, as the majority of the population does not reside near agricultural fields and forests. They conclude: “Our over-reliance on chemicals in agriculture is causing irreparable harm to all beings on this planet, including the planet herself. Most of these chemicals are known to cause illness, and they have likely been causing illnesses for many years. But until recently, the herbicides have never been sprayed directly on food crops, and never in this massive quantity. We must find another way” [15].

**Chytrid fungus has wiped out amphibian populations over five continents.** Chytrid fungus, *Batrachochytrium dendrobatidis*, has wiped out amphibian populations over five continents. A spokesman for the International Union for Conservation of Nature (IUCN) said: “The IUCN Red List currently considers 31% of the earth’s amphibians are threatened with extinction ... it’s thought that 159 species have vanished forever in recent years.” Amphibians, particularly tadpoles, are considered to be environmental indicators of indirect ecosystem effects because of their unique niche at the boundary of the aquatic–terrestrial ecosystems as well as their sensitivity to pollutants. While tadpoles feed on periphyton, adult amphibians are strictly insectivorous. Amphibians were the first group of vertebrates to be affected by the epidemics of diseases caused by uncommon pathogens. Joseph Mendelson, an amphibian taxonomist, wrote in 2011 “The reality of amphibian declines and extinctions has shifted the ecological baseline in so many ecosystems, that an entire generation of biologists is conducting their

research in a framework that has been very recently remodelled. I am a taxonomist and I have seen my career vacillate between the thrill of discovering new species and the chill of tracking extinction events—including species that I described” [16].

**Closure of wildlife research centres and opening of satellite-based global lake surveillance.** In December 2005 the UK’s Natural Environment Research Council (NERC), in response to a budget deficit, announced the closure of its wildlife research centres, with the loss of about 200 jobs.<sup>3</sup> This decision was opposed by 99% of 1,327 stakeholders. In a leaked letter to then Prime Minister Tony Blair, the junior rural affairs minister said that closure of four eco-laboratories involved in climate change research “does not make sense either scientifically or economically.” In a debate forced in the House of Lords, Lord Sainsbury of Turville, at that time Parliamentary Under Secretary of State with responsibility for science and innovation at the Department of Trade and Industry (DTI), defended the closures. He asserted that the government believed that “decisions about its scientific programme should be taken by NERC’s independent Council.”

Lord Sainsbury praised NERC for “*grasping the nettle*”. He said that NERC had seen a fall in contract research in recent years and the wildlife stations were not making enough money from getting private research contracts. Closure took place in March 2006. Monks Wood Experimental Station hosted BBC’s *Spring Watch*, pioneered work on DDT and other pesticides in the 1960s,<sup>4</sup> and more recently revealed how climate change is affecting wildlife, with spring arriving three weeks earlier. The research centres were also involved in assessing the impacts of GM crops on wildlife, with findings contradicting industry claims that no harm would be caused.

In 2012 NERC proudly announced its *GloboLakes* project,<sup>5</sup> “the first satellite-based global lake surveillance system, to monitor how lakes and reservoirs are being affected by environmental change.” How can one measure pesticide levels in aquatic systems, or biodiversity declines, from space?

**The Oxford Junior Dictionary (2007) deleted words connected with nature.** Twenty eight authors and poets wrote to Oxford University Press (OUP) to protest about the list of entries OUP no longer felt to be relevant to a modern-day childhood.<sup>6</sup> We, the undersigned, “are

<sup>2</sup> [http://www.fs.fed.us/foresthealth/pesticide/pdfs/seratr01\\_43\\_08\\_04.pdf](http://www.fs.fed.us/foresthealth/pesticide/pdfs/seratr01_43_08_04.pdf)

<sup>3</sup> “Anger as top wildlife research sites are axed”, Archived press release, Friends of the Earth, 13 March 2006, [http://www.foe.co.uk/resource/press\\_releases/anger\\_as\\_top\\_wildlife\\_rese\\_13032006](http://www.foe.co.uk/resource/press_releases/anger_as_top_wildlife_rese_13032006)

<sup>4</sup> Monks Wood had its own Toxic Chemicals and Wildlife research team.

<sup>5</sup> <http://www.globolakes.ac.uk/GloboLakes> will analyse 20 years of data from more than 1000 large lakes across the globe to determine ‘what controls the differential sensitivity of lakes to environmental perturbation’.

<sup>6</sup> [http://www.naturemusicpoetry.com/uploads/2/9/3/8/29384149/letter\\_to\\_oup\\_final.pdf](http://www.naturemusicpoetry.com/uploads/2/9/3/8/29384149/letter_to_oup_final.pdf)

profoundly alarmed to learn that the Oxford Junior Dictionary has systematically been stripped of many words associated with nature and the countryside. Many are highly symbolic of our cultural ties with the land, its wildlife and produce.” The deletions included: *acorn, adder, ash, beech, bluebell, buttercup, catkin, conker, cowslip, cygnet, dandelion, fern, hazel, heather, heron, ivy, kingfisher, lark, mistletoe, nectar, newt, otter, pasture and willow*. The words taking their places in the new edition included: *attachment, blog, broadband, block-graph, bullet-point, celebrity, chatroom, committee, cut-and-paste, MP3 player and voice-mail*.<sup>7</sup>

## 2. THE ROCKEFELLER FOUNDATION–LANCET COMMISSION ON PLANETARY HEALTH

This report, purportedly about safeguarding “planetary health” was posted on the website of *The Lancet* [17] on 16 July 2015. It makes the intriguing comment: “The Anthropocene has to be yet formally recognised as a new geological epoch and several dates have been put forward to mark its beginning.”

On the initiative of the egregious Bill Gates, in May 2009 some of America’s richest people met at the home of Sir Paul Nurse,<sup>8</sup> a British Nobel prize-winning biochemist and President (2003–10) of Rockefeller University in Manhattan, to discuss ways of tackling a “disastrous” environmental, social and industrial threat of overpopulation.<sup>9</sup> The meeting was hosted by David Rockefeller Jr. These same individuals have met several times since to develop “a strategy in which population growth would be tackled ...”.<sup>10</sup>

**Genetics: is it a more palatable term than eugenics?** The Rockefeller Foundation has been involved in extensive financing of eugenics research by the National Socialists (Nazis) during and after World War 2<sup>11</sup> and “were in league with some of America’s most respected scientists from such prestigious universities as Stanford, Yale, Harvard and Princeton. These academicians espoused race theory and race science, and then faked and twisted data to serve eugenics’ racist aims ... The explicit aim of the eugenics

lobby funded by wealthy elite families such as Rockefeller, Carnegie, Harriman and others since the 1920’s, has embodied what they termed ‘negative eugenics,’ the systematic killing off of undesired bloodlines”.<sup>12</sup> Nathaniel Comfort (Professor of the History of Medicine at Johns Hopkins University) asked on 16 July 2015: “Can we cure genetic diseases without slipping into eugenics?”<sup>13</sup> He continued, “Chinese scientists attempted to correct a mutation in the beta-globin gene (in a human embryo) which encodes a crucial blood protein. Mutations in this gene lead to a variety of serious blood diseases. But the experiments failed... In short, neoliberal eugenics is the same old eugenics we’ve always known. When it comes to controlling our evolution, individualism and choice point toward the same outcomes as authoritarian collectivism: a genetically stratified society resistant to social change—one that places the blame for society’s ills on individuals rather than corporations or the government.”

**The Rockefeller Foundation (RF) funded the earliest research on GMOs.** The RF funded the earliest research on GMOs in the 1940s and effectively founded the science of molecular biology. Inevitably reductionist, it is really incompatible with the complexity of life.<sup>14</sup> The RF’s 100th Anniversary Agriculture website announces:<sup>15</sup> “Since the 1970s, the techniques pioneered by the RF have been criticized for their environmental impact, for their relationship with big agribusiness, and for failing to eliminate hunger completely.” The RF also effectively ushered in the Green Revolution. Yet, it has been pointed out that “the Green Revolution was merely a chemical revolution. At no point could developing nations pay for the huge amounts of chemical fertilizers and pesticides”.<sup>16</sup>

## 3. GENETICALLY MODIFIED ORGANISMS

**Genetically engineered foods: the biggest fraud in the history of science. Governments and leading scientific institutions have systematically misrepresented the facts about GMOs and the scientific research that casts doubt on their safety.** On 4 March 2015 the organization Beyond GM facilitated the press release<sup>17</sup> of American public interest attorney Steven Druker’s new book [18].

<sup>7</sup> <http://www.theguardian.com/books/2015/feb/27/robert-macfarlane-word-hoard-rewilding-landscape>

<sup>8</sup> There was some doubt as to whether he was present or not. <http://www.theguardian.com/world/2009/may/31/new-york-billionaire-philanthropists>

<sup>9</sup> <http://www.globalresearch.ca/billionaire-club-in-bid-to-curb-overpopulation/13736>

<sup>10</sup> <http://www.prophesynewswatch.com/2014/March20/202.html>

<sup>11</sup> <http://www.sfgate.com/opinion/article/Eugenics-and-the-Nazis-the-California-2549771.php>

<sup>12</sup> <http://www.globalresearch.ca/doomsday-seed-vault-in-the-arctic-2/23503> GMO as a weapon of biological warfare?

<sup>13</sup> <http://www.thenation.com/article/can-we-cure-genetic-diseases-without-slipping-into-eugenics/>

<sup>14</sup> [http://www.i-sis.org.uk/Why\\_GMOs\\_Can\\_Never\\_be\\_Safe.php](http://www.i-sis.org.uk/Why_GMOs_Can_Never_be_Safe.php)

<sup>15</sup> <http://rockefeller100.org/exhibits/show/agriculture>

<sup>16</sup> <http://www.globalresearch.ca/doomsday-seed-vault-in-the-arctic-2/23503> Genetically Engineering a master race? The Green Revolution.

<sup>17</sup> <http://beyond-gm.org/altered-genes-twisted-truth-media-resources/>

He had previously initiated a lawsuit against the US Food and Drug Administration (FDA) that forced it to open its files on GM foods. Those files revealed that GM foods first achieved commercialization in 1992 only because the FDA:

- Covered up the extensive warnings of its own scientists about the dangers;
- Lied about the facts;
- *And* then violated federal food safety law by permitting these foods to be marketed without having been proven safe through standard testing.

He was accompanied by Dame Jane Goodall, the renowned primate expert, who has condemned deluded politicians for pushing ‘Frankenstein food.’ “The highly respected academic has endorsed a new book, which argues the companies responsible for developing genetically modified farming and food have twisted the evidence to minimise the dangers”.<sup>18</sup>

In her foreword to the book [18] she writes: “Druker has, without doubt, written one of the most important books of the last 50 years; and I shall urge everyone I know, who cares about life on earth, and the future of their children, and children’s children, to read it. It will go a long way toward dispelling the confusion and delusion that has been created regarding the genetic engineering process and the foods it creates. To me, Steven Druker is a hero. He deserves at least a Nobel Prize”.<sup>19</sup>

Druker further challenges the Royal Society of London over misleading statements made about GM foods.<sup>20</sup> *Inter alia*, in his open letter he wrote: “Because clarifying the facts about GM foods is crucial for developing an intelligent, science-based policy on the future of agriculture, and because the Royal Society has significantly contributed to the confusion that currently surrounds this issue, it is imperative that remedial action be promptly initiated. This is especially so considering that:

- The European Commission is about to approve substantial regulatory changes in regard to GM crops;
- The UK is seriously considering allowing them to be commercially planted;
- The Society and other proponents of GM foods have inculcated the widespread illusion that there is an overwhelming scientific consensus that the safety of these products has been established through rigorous testing ...”

By June 2015, he still had received no reply.

**The Royal Society of London’s “deafening silence” on GMOs.** Colin Todhunter wrote on 3 June 2015 in *The Ecologist*.<sup>21</sup> “It is now three months since Steven Druker addressed the Royal Society in his open letter. There appears to have been no response from the Royal Society—and certainly not a public one—except for a brief and deliberately insulting statement issued today: ‘The Royal Society bases its views on evidence, evidence that has been closely scrutinized by people with expert knowledge and that has stood up to that scrutiny. Personal opinions and unsubstantiated anecdotes are unhelpful to having a rational public debate on science and the use of new technologies.’” Yet the Royal Society had refused to engage in “*rational public debate*.”

Colin Todhunter reminded Sir Paul Nurse PRS of his obligations to the public: “The Royal Society is the preeminent scientific body within the UK that advises the government. It therefore has an obligation to the British public to provide a public response and ‘put the record straight’ on GMOs—not least because the current staunchly pro-GMO Cameron-led administration will likely sanction the planting of GM crops<sup>22</sup> in England within the next couple of years, and the Transatlantic Trade and Investment Partnership (TTIP) deal<sup>23</sup> could open the floodgates to GM foods appearing on the shelves of UK supermarkets.”

Although Sir Paul’s presidency of Rockefeller University terminated in 2010, “after he assumes the Royal Society presidency, Nurse will maintain a laboratory on the Rockefeller campus and will have an ongoing relationship with the university”.<sup>24</sup> As noted, the Rockefeller Foundation did the earliest research on GMOs. Is that why Sir Paul was unable even to discuss GMOs with Steven Druker “in rational public debate”? Did he acknowledge that the “Rockefeller Foundation’s molecular biology and their genetics work was consciously based on that fundamental scientific error, reductionism” [19, (p. 156; *Food is Power*)]? In fact the whole process was fraudulent. “Neither the RF, nor the scientists it funded, nor the GMO agribusiness they worked with, had any apparent interest in examining the risk” [19]. As has been pointed out [20], “In order to survive, the organism needs to engage in natural genetic modification in real time, an

<sup>18</sup> <http://www.dailymail.co.uk/news/article-2979645/Senior-academic-condemns-deluded-supporters-GM-food-anti-science-ignoring-evidence-dangers.html>

<sup>19</sup> [http://beyond-gm.org/wp-content/uploads/2015/03/AGTT\\_FOREWORD.pdf](http://beyond-gm.org/wp-content/uploads/2015/03/AGTT_FOREWORD.pdf)

<sup>20</sup> [http://beyond-gm.org/wp-content/uploads/2015/03/DRUKER\\_OPEN-LETTER-TO-THE-ROYAL-SOCIETY\\_Final.pdf](http://beyond-gm.org/wp-content/uploads/2015/03/DRUKER_OPEN-LETTER-TO-THE-ROYAL-SOCIETY_Final.pdf)

<sup>21</sup> [http://www.theecologist.org/blogs\\_and\\_comments/commentators/2893487/gmos\\_the\\_royal\\_societys\\_deafening\\_silence.html](http://www.theecologist.org/blogs_and_comments/commentators/2893487/gmos_the_royal_societys_deafening_silence.html)

<sup>22</sup> <http://www.globalresearch.ca/britain-is-set-to-open-the-door-to-cancerous-gmo/5452390>

<sup>23</sup> <http://www.globalresearch.ca/the-transatlantic-trade-and-investment-partnership-ttip-and-the-corporate-hijack-of-europe/5390817>

<sup>24</sup> <http://newswire.rockefeller.edu/2010/04/23/paul-nurse-to-resign-as-rockefeller-president-to-become-president-of-royal-society-of-london-in-december/>

exquisitely precise molecular dance of life with RNA and DNA responding to and participating in ‘downstream’ biological functions. Artificial genetic modification, in contrast, is crude, imprecise, and interferes with the natural process.”

In April 2004 the author of that paper, Dr Mae-Wan Ho, was interviewed by Anastasia Stephens of the *Evening Standard*:<sup>25</sup>

AS “Doesn’t genetic modification follow what nature does already—the evolutionary principle of genetic selection?”

MWH “No, GM breaks all the rules of evolution, it short circuits evolution altogether. It bypasses reproduction, creates new genes and gene combinations that have never existed, and is not restricted by the usual barriers between species.”

Is that why the President of the Royal Society, Sir Paul Nurse, refused to reply to Steve Druker’s challenge about GMOs? Was he sent to London by the Rockefeller Foundation to support the UK Government in their attempt to bring in GM crops?

**The UK Government and the GM industry: colluding to promote GM crops and foods, undermine consumer choice and ignore environmental harm.** A briefing published by Genewatch UK in May 2014<sup>26</sup> summarizes information collected using requests under the Freedom of Information Act and the Environmental Information Regulations (known as FoIs). It demonstrates close coöperation between the GM industry and the UK Government, including a joint strategy to promote GM crops and foods in the press and media. The documents:

- Reveal how foreign multinational GM companies are running the government’s public relations (PR) strategy on GM crops by controlling how public and private money will be invested in research;
- Show that taxpayers’ money is being spent on PR for the GM industry rather than delivering better food and farming;
- Suggest close coöperation with GM soya importers to pressure retailers to allow meat and dairy suppliers to use Monsanto’s “Roundup Ready” GM soya for animal feed and hinder consumers from accessing GM-free fed meat and dairy products;

- Highlight the extent to which the GM industry’s rôle in government policy is being kept hidden from the public.

#### 4. GLYPHOSATE

**Scientists in the RF–Lancet Commission failed to mention glyphosate and other pesticides.** According to their report [17] the key drivers of ecosystem change in the last 60 years have been: “Increases in the amounts of nitrogen and phosphorus entering the environment through agricultural fertiliser run-off and soil erosion.” In its *Synthesis of the UK National Ecosystem Assessment*, the Department for Environment, Food and Rural Affairs (Defra)’s statement in 2011 was almost identical:<sup>27</sup> “Major increases in fertiliser use, particularly nitrogen and phosphorus, have adversely affected aquatic ecosystems through run-off.” What about pesticides?

The report [17] failed to mention the serious threats of exposure to the most widespread chemicals in the global environment, glyphosate (an endocrine disruptor) and the systemic neonicotinoid insecticides. Neither of them is routinely measured in the environment by governments; however, there is plenty of evidence that these biocidal chemicals are ubiquitous in humans and the environment.

**Glyphosate is an antibiotic. Four different patents have been granted for glyphosate in the US:**

- As a chelator of heavy metals and a wetting agent in 1964,<sup>28</sup>
- As a herbicide in 1969;<sup>29</sup>
- As both an antibiotic in 2010,<sup>30</sup>
- *And* as an antiprotozoal agent in 2010.<sup>30,31</sup>

That glyphosate is an antibiotic has been confirmed experimentally [21]. Increasingly common chemicals used in agriculture, domestic gardens and public places can induce a multiple antibiotic resistance phenotype in potential pathogens. The effect occurs upon simultaneous exposure to antibiotics and is faster than the lethal effect of antibiotics. The magnitude of the induced response may undermine antibiotic therapy and substantially increase the probability of spontaneous mutation to higher levels of resistance.

**A class action lawsuit has been taken out against Monsanto for false advertising.**<sup>32</sup> Remarkably, Monsanto has misled everyone, including the EFSA and the UK Chemicals Regulation Directorate. On its label, it is claimed that the Monsanto glyphosate formulation “Roundup”

<sup>25</sup> <http://www.i-sis.org.uk/GMmyths.php>

<sup>26</sup> [http://www.genewatch.org/uploads/f03c6d66a9b354535738483c1c3d49e4/FoI\\_summary\\_May14.pdf](http://www.genewatch.org/uploads/f03c6d66a9b354535738483c1c3d49e4/FoI_summary_May14.pdf)

<sup>27</sup> [file:///C:/Users/Rosemary/Downloads/uk\\_nea\\_synthesis\\_report.pdf](file:///C:/Users/Rosemary/Downloads/uk_nea_synthesis_report.pdf)

<sup>28</sup> <http://www.google.com/patents/US3160632>

<sup>29</sup> <http://www.google.com/patents/US3455675>

<sup>30</sup> <http://www.google.com/patents/US7771736>

<sup>31</sup> <http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO1&Sect2=HITOFF&d=PALL&p=1&u=%2Fnethtml%2FPTO%2Fsrchnum.htm&r=1&f=G&l=50&s1=7771736.PN.&OS=PN/7771736&RS=PN/7771736>

<sup>32</sup> <http://www.monsantoclassaction.org/>

doesn't affect humans and pets because they don't have the shikimate (EPSP) pathway that plants have.<sup>33</sup> This is, however, a false statement. Glyphosate not only affects plants, but humans and animals as well. The pesticides industry and its regulators are ignorant of human physiology. Humans and animals absorb nutrients through billions of microbes in their gut (the microbiome). These microbes *do* possess the enzyme pathway that is targeted by "Roundup". It is further pointed out in the lawsuit that there are many human and animal health problems associated with the disruption of our intestinal microbes: "Because it kills off our gut bacteria, glyphosate is linked to stomach and bowel problems, indigestion, ulcers, colitis, gluten intolerance, sleeplessness, lethargy, depression, Crohn's Disease, coeliac disease, allergies, obesity, diabetes, infertility, liver disease, renal failure, autism, Alzheimer's and endocrine disruption, and the World Health Organization (WHO) recently announced glyphosate is 'probably carcinogenic'."

A similar lawsuit has been announced by lawyers in New York.<sup>34</sup>

Although it is often claimed that glyphosate is not metabolized and does not bio-accumulate but is excreted unchanged in the urine, this appears to be at variance with the facts. Residues are found in the organs of animals, human urine and human breast milk; glyphosate residues in organs and tissues as different as lungs, liver, kidney, brain, gut wall and heart of malformed euthanized one-day-old Danish piglets ( $n = 38$ ) were identified using an enzyme-linked immunosorbent assay (ELISA); all organs or tissues had glyphosate, at various concentrations [22].

Urine tests were carried out on 182 volunteers from cities in 18 countries in Europe to measure glyphosate and aminomethylphosphonic acid (AMPA, a metabolite of glyphosate). On average, 44% and 36% of the urine samples analysed were found to contain quantifiable levels of glyphosate and AMPA, respectively.<sup>35</sup> Zen Honeycutt of the organization Moms Across America and Sustainable Pulse commissioned analyses of breast milk for glyphosate: "The levels found in the breast milk testing of  $76 \mu\text{g L}^{-1}$  to  $166 \mu\text{g/L}$  are 760 to 1600 times higher than the European drinking water directive allows for individual pesticides.<sup>36</sup> They are, however, less than the  $700 \mu\text{g L}^{-1}$  maximum contaminant level (MCL) for glyphosate in the USA, which was decided upon by the USA Environmental Protection Agency (EPA) based on

the now seemingly false premise that glyphosate was not bio-accumulative."

**Many independent scientists have measured glyphosate in the environment.** In 2011, the USGS published the first report on the ambient levels of glyphosate, the most widely used herbicide in the United States, and its major degradation product, AMPA, in air and rain in Mississippi and Iowa in two growing seasons [23]. In 2013, scientists in Argentina did the same. "Agricultural production is fundamentally based on a technological package that combines no-till and glyphosate in the cultivation of transgenic crops. Transgenic crops (soybean, maize and cotton) occupy 23 million hectares. This means that glyphosate is the most employed herbicide in the country, where 180–200 million liters are applied every year" [24]. Another report from the USGS "The most comprehensive research to date on environmental glyphosate levels exposes the widespread contamination of soil and water in the US, as well as its water treatment system. Looking at a wide range of geographical locations, researchers from the USGS: analysed 3,732 water and sediment samples and 1,081 quality assurance samples collected between 2001 and 2010 from 38 states in the US and the District of Columbia. They found glyphosate in 39.4% of samples (1470 out of 3732) and its metabolite AMPA in 55% of samples. They concluded that glyphosate and its degradation product AMPA occur frequently and widely in US soils, surface water, groundwater, and precipitation" [25]. No wonder the WHO IARC (International Agency for Research on Cancer)'s recent assessment of glyphosate being a 2A carcinogen (probably carcinogenic in humans) is unwelcome news for the agrochemical industry [26].

In South Wales, "Roundup" sprayed on Japanese knotweed from April to August has caused rapid declines of biodiversity in our nature reserve<sup>37</sup> and in the surrounding areas since 2010. Glyphosate was present in river and tap water at concentrations of the order of that found in a study in 2013, which showed that breast cancer cell proliferation is accelerated by glyphosate in extremely low concentrations: "The present study used pure glyphosate substance at log intervals from  $10^{-12}$  to  $10^{-6}$  M. These concentrations are in a crucial range that correlate to the potential biological levels at ppt to ppb which have been reported in epidemiological studies" [27]. In the UK, according to the Cancer Research UK

<sup>33</sup> <http://www.examiner.com/article/monsanto-sued-los-angeles-county-for-false-advertising>

<sup>34</sup> <http://www.aboutlawsuits.com/roundup-class-action-lawsuit-85070/>

<sup>35</sup> <http://www.foeurope.org/weed-killer-glyphosate-found-human-urine-across-Europe-130613>

<sup>36</sup> [http://www.momsacrossamerica.com/glyphosate\\_testing\\_results](http://www.momsacrossamerica.com/glyphosate_testing_results)

<sup>37</sup> [http://www.i-sis.org.uk/How\\_Roundup\\_Poisoned\\_My\\_Nature\\_Reserve.php](http://www.i-sis.org.uk/How_Roundup_Poisoned_My_Nature_Reserve.php)

website, the incidence of breast cancer almost doubled between 1975 and 2011.<sup>38</sup> The Chemicals Regulation Directorate refused our appeal to instruct the local council and their contractors, Complete Weed Control, to stop spraying “Roundup” because Japanese knotweed had developed resistance and become a superweed.

**A biological desert: Correlation of loss of biodiversity with glyphosate levels on an Iowa farm.**

The state of Iowa was just one area in which the USGS reported widespread contamination with glyphosate. Grundy County, Iowa was where Craig Childs spent a long weekend in a monoculture of GM “Roundup Ready” corn looking for wildlife [28]. “In this cornfield, I had come to a different kind of planetary evolution. I listened and heard nothing, no bird, no click of an insect ... Mr Owen was the farmer who had given us permission to backpack across his cornfields. He grew a combination of DuPont and Monsanto stock. We were in DuPont now. It didn’t look any different to me.” In contrast, “Yet, 100 years ago, these same fields, these prairies, were home to 300 species of plants, 60 mammals, 300 birds, hundreds and hundreds of insects. This soil was the richest, the loamiest in the state. And now, in these patches, there is almost literally nothing but one kind of living thing. We’ve erased everything else. There’s something strange about a farm that intentionally creates a biological desert to produce food for one species: us. It’s efficient, yes. But it’s so efficient that the ants are missing, the bees are missing, and even the birds stay away. Something’s not right here. Our cornfields are too quiet”.<sup>39</sup>

**Loss of biodiversity also correlated with systemic neonicotinoids in streams in the USA.**

Widespread occurrence of neonicotinoid insecticides in streams in a high corn- and soybean-producing region in the USA was reported and chemicals were persistent [29]. Pulses of elevated neonicotinoid insecticide concentrations were associated with rainfall events during and shortly after crop planting, which is consistent with the spring flushing of herbicides that has been documented in Midwestern US streams. The insecticides also were detected prior to their first use during the growing season, persisting from use during previous growing seasons. Based on correlations between loss of butterflies and moths and increases in agricultural pesticides over the same years, the chief of the Wildlife Refuges decided to ban the use of GMOs and neonicotinoids from the refuges by January 2016.<sup>40</sup>

**The UK Environment Agency refused to measure neonicotinoids or glyphosate in water. Where levels have been measured, disturbing, cumulative damage to the ecosystem has been reported.**

Dr Henk Tennekes was the first independent researcher to recognize the extreme toxicity of low levels of systemic neonicotinoid insecticides [30, 31]. They cause a virtually irreversible blockage of postsynaptic nicotinic acetylcholine receptors (nAChRs) in the central nervous system of insects. He found the damage is cumulative, and with more exposure more receptors are blocked. He proposed that there may be no safe level of exposure. The Dutch water boards had been measuring imidacloprid since 2004 and found there was major contamination of Dutch surface water, particularly in the western part of the country. Imidacloprid is stable to breakdown in water and at neutral pH has a half-life of 355 days. Tennekes reported declines in invertebrates and insect-dependent birds in Holland and throughout Europe. In December 2010, I wrote to UK ministers, civil servants and NGOs and later to regulatory agencies around the world with this information. Replies were suspiciously identical: “There is no evidence that they are harmful to honey bees, if correctly used”. Not one of the Chemicals Regulation Directorate, the European Commission, the US EPA or the Australian Pesticides and Veterinary Medicines Authority (APVMA) has mentioned water contamination. The UK Environment Agency refused to measure neonicotinoids or glyphosate in water. Where levels have been measured, disturbing damage to the ecosystem has been reported.

It has been shown that macrofauna abundance drops sharply between 13 and 67 ng L<sup>-1</sup> of imidacloprid [32]. The team combined 8 years of monitoring data on imidacloprid in surface water and 8 years of monitoring data on macrofauna abundance. The water quality standards applied in the Netherlands to achieve ecological protection are not met in many parts of the country, and especially in agricultural areas with greenhouses and crops like bulbs, where concentrations up to hundreds of µg L<sup>-1</sup> imidacloprid are being found in the surface water. “We are risking far too much to combat a few insect pests that might threaten agriculture,” said Dr Jeroen van der Sluijs, the senior member of the team based at Utrecht University. “This substance should be phased out internationally as soon as possible. The pollution was so bad in some places that the ditch water in fields

<sup>38</sup> <http://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/breast-cancer/incidence-invasive#heading-Two>

<sup>39</sup> <http://www.npr.org/blogs/kruhwich/2012/11/29/166156242/cornstalks-everywhere-but-nothing-else-not-even-a-bee>

<sup>40</sup> [http://www.centerforfoodsafety.org/files/agricultural-practices-in-wildlife-management\\_20849.pdf](http://www.centerforfoodsafety.org/files/agricultural-practices-in-wildlife-management_20849.pdf)



could have been used as an effective pesticide” he said. “As well as killing mayflies, midges and molluscs, the pollution could have a knock-on effect on birds such as swallows that rely on flying insects for food,” he added.<sup>41</sup> Half the 20 000 tonnes of the imidacloprid produced each year is not affected by the EU ban, because it is used not to treat crops, but to combat fleas and other pests in cattle, dogs and cats; much of it ends up in surface water. Examples given in ref. 33 demonstrate evidence of the negative impacts of systemic insecticides on decomposition, nutrient cycling, soil respiration and invertebrate populations valued by humans. Invertebrates, particularly earthworms which are important for soil processes, wild and domestic insect pollinators which are important for plant and crop production, and several freshwater taxa which are involved in aquatic nutrient cycling, were all found to be highly susceptible to lethal and sublethal effects of neonicotinoids at environmentally relevant concentrations. Environment Canada has shown that clothianidin was the most persistent neonicotinoid residue and was present in wetlands in agricultural fields as a result of either snowmelt run-off or other transport mechanisms. Clothianidin residues occurred primarily near fields where canola had been seeded the previous year, because it is very long acting.<sup>42</sup> Neonicotinoid insecticides have, furthermore, come under scrutiny for their potential unintended effects on non-target organisms. Residues of clothianidin and thiamethoxam were detected during and after planting maize, outside the fields and in conservation areas. They may move off target by wind erosion of contaminated soil [34].

Another study sampled water in 136 wetlands in spring 2012, summer 2012, fall 2012 and spring 2013 [35]. Prior to seeding, 36% of wetlands contained at least one neonicotinoid, 62% in summer 2012, 16% in fall, but increased to 91% spring 2013 after ice-off. Wetlands situated in barley, canola and oat fields consistently contained higher mean concentrations of neonicotinoids than grasslands. Distribution maps indicate neonicotinoid use is increasing and becoming more widespread with concerns for environmental loading. The reported concentrations of neonicotinoids in surface waters from 29 studies in 9 countries worldwide in tandem with published data on their acute and chronic toxicity to 49 species of aquatic insects and crustaceans spanning 12 invertebrate orders is synthesized to indicate the current state of knowledge [36]. Strong evidence exists that waterborne neonicotinoid exposures are frequent and

long-term; levels are  $0.13 \mu\text{g L}^{-1}$  (geometric mean) and  $0.63 \mu\text{g L}^{-1}$  (maximum). Overall, neonicotinoids can exert adverse effects on survival, growth, emergence, mobility and behaviour of many sensitive aquatic invertebrate taxa at concentrations at or below  $1 \mu\text{g L}^{-1}$  under acute exposure, and  $0.1 \mu\text{g L}^{-1}$  for chronic exposure. There is a wide range of sensitivities of aquatic invertebrates to neonicotinoids. *Daphnia magna*, the standard test species, appears to be very tolerant. However the orders Ephemeroptera (mayfly), Trichoptera (caddis fly) and Diptera (midge) appear to be the most sensitive species, of the order of 10 000–100 000 times more sensitive than *D. magna*. These three species are critical for supporting numerous aquatic and terrestrial food webs. Developed to replace organophosphate and carbamate insecticides, neonicotinoids are structurally similar to nicotine. The three main neonicotinoid insecticides, imidacloprid, clothianidin and thiamethoxam, are being re-evaluated by Health Canada’s Pest Management Regulatory Agency (PMRA). The Canadian interim water quality guideline for imidacloprid is  $0.23 \mu\text{g L}^{-1}$  but there is currently insufficient use, fate and toxicological information available to establish guidelines for clothianidin and thiamethoxam. Based on concentrations of neonicotinoids reported in surface waters in Canada and globally, there is potential for aquatic invertebrates to be negatively impacted by neonicotinoids [37]. The current methods for measuring neonicotinoids are inadequate for trace measurements and passive sampling methods are unavailable [38]; the authors describe a multiresidue analytical method for neonicotinoids in water. The limits of quantitation were in the range 0.6–1.0 ng for all compounds. Residues of five compounds were found in a survey around Sydney. The American Bird Conservancy even found neonicotinoids in Congress cafeteria food!<sup>43</sup> In two rounds of testing—the first in January and the second in May of 2015—nearly all Congressional cafeteria food tested positive for one or more neonicotinoid insecticide residues. Sixty out of a total of 66 food samples, or 91%, tested positive for the chemicals. Forty-seven (or 71%) of the foods had two or more neonicotinoids.

Many independent scientists have demonstrated that the neonicotinoid insecticides have effects on the mammalian brain, particularly that of the foetus. In 2000, Tomiwaza et al. showed that neonicotinoids acted on mammalian nicotinic acetylcholine receptors as well as those of insects, but considered that the selective nature of its binding (i.e. less affinity than in insects) made it safe

<sup>41</sup> <http://www.theguardian.com/environment/2013/may/01/study-links-insecticide-invertebrate-die-off>

<sup>42</sup> [http://www.traceorganic.com/2013/presentations/JBailey%202013\\_WCTOW.pdf](http://www.traceorganic.com/2013/presentations/JBailey%202013_WCTOW.pdf)

<sup>43</sup> [http://abcbirds.org/wp-content/uploads/2015/07/CongressionalDiningHallReport\\_July2015.pdf](http://abcbirds.org/wp-content/uploads/2015/07/CongressionalDiningHallReport_July2015.pdf) (see p. 8).

for human exposure [39]. However, they are long-acting and are now widespread in the environment. Clothianidin, for example, has a half-life in soil of up to 1386 days so it accumulates in the soil, yet farmers apply neonicotinoids blindly the following year. Li et al. obtained preparations of human neonicotinoid acetylcholine receptors and found that both chemicals had effects on human receptors, but imidacloprid more so than clothianidin [40]. Abou-Donia et al. showed that gestational exposure to a single large, nonlethal dose of imidacloprid in rats caused significant neurobehavioral deficits and an increased expression of glial fibrillary acidic protein in several brain regions of the offspring on postnatal day 30, corresponding to human early adolescent age. These changes may have long-term adverse effects in the offspring [41]. Kimura-Kuroda et al. found nicotine-like effects of the neonicotinoid insecticides acetamiprid and imidacloprid on the cerebellar neurons of neonatal rats [42]. Tennekes and Sánchez-Bayo demonstrated that chemicals binding irreversibly to specific receptors (neonicotinoids, genotoxic carcinogens and some metals) will produce toxic effects in a time-dependent manner, no matter how low the level of exposure [43]. Neonicotinoid insecticides cause damage to the central nervous system of insects that is virtually irreversible and cumulative. There is apparently no safe level of exposure; even minute quantities can have severe effects in the long term. During pregnancy, when the foetal brain is the size of an insect, exposure to neonicotinoids may cause similar neurological defects.

The American Bird Conservancy also produced a report on neonicotinoids and birds.<sup>44</sup> In April 2013 I sent this document to the chairman of the UK Environment Agency (EA) asking him to read it and instruct the EA to measure neonicotinoids and glyphosate in water, but he declined. Some of the salient findings of the report are: “The environmental persistence of the neonicotinoids, their propensity for runoff and for groundwater infiltration, and their cumulative and largely irreversible mode of action in invertebrates raise environmental concerns that go well beyond bees. A single corn kernel coated with a neonicotinoid can kill a songbird. Even a tiny grain of wheat or canola treated with the oldest neonicotinoid, imidacloprid, can poison a bird” (p. 3); “This suggests that we should be looking at possible links between neonicotinoid insecticides and birds, not on a farm scale, but in the context of whole watersheds and regions. Impacts from the neonicotinoids may very well

be further afield than the arable area on which they are used, and many of those impacts may be mediated through the aquatic environment” (p. 8); and “It is clear that we are witnessing contamination of the aquatic environment at levels that will affect aquatic food chains. This has a clear potential to affect consumers of those aquatic resources, be they birds, fish or amphibians” (p. 64).

**The Rockefeller–Lancet Report [17]’s only reference to potential loss of pollinators by neonicotinoid insecticides was to the one from the Oxford Martin Commission, endorsing Syngenta studies [10].** The first author, Prof. Charles Godfray, was also lead author of *The Future of Food and Farming* report (2011)<sup>45</sup> (coöperation with Syngenta on genetically engineered (GE) wheat was discussed on p. 88 of the report).

“The experiments (on bees) described in paras. 38 and 39 are true field experiments in the sense that the treatments involve the normal use of neonicotinoids, though only the Pilling et al. [44] study was successfully concluded and found no effects of neonicotinoids but with limited statistical power to detect differences” [10]. That study [44] was conducted by Syngenta scientists using a Syngenta product, thiamethoxam. Another was a Defra study by Thompson et al.,<sup>46</sup> commissioned by Syngenta, in which the controls were contaminated by a third neonicotinoid. Professor Godfray seems to have little knowledge of the life cycle of bumblebees. He remarked that the Whitehorn study on bumblebees [45] showed “reductions in growth rate and queen production” [10], without appreciating that an 85% reduction in queens would be devastating to bumblebees, since it is only the queen that survives the winter to start a new colony.

## 6. BIOFORTIFICATION OF FOOD

The Rockefeller Foundation contributed to the scandalous Golden Rice Project, financially supporting biofortification of rice research and development at the University of Ghent, from which institution de Steur et al. wrote in 2015 [46]: “This month marks the 15th anniversary of the publication of pro-vitamin A–enriched ‘Golden Rice’. As the crop still awaits regulatory approval, its developers have little reason to celebrate. Golden Rice is not alone in facing a political and regulatory blockade. Several other biofortified transgenic crops also await authorization.” They were not the only ones to express anger. The former UK Environment

<sup>44</sup> [http://abcbirds.org/wp-content/uploads/2015/05/Neonic\\_FINAL.pdf](http://abcbirds.org/wp-content/uploads/2015/05/Neonic_FINAL.pdf)

<sup>45</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/288329/11-546-future-of-food-and-farming-report.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/288329/11-546-future-of-food-and-farming-report.pdf)

<sup>46</sup> <http://fera.co.uk/ccss/documents/defraBumbleBeeReportPS2371V4a.pdf>

Secretary Owen Paterson opined: “Opponents of the development of a type of genetically modified (GM) rice enriched with vitamin A are wicked. It’s just disgusting that little children are allowed to go blind and die because of a hang-up by a small number of people about this technology”.<sup>47</sup> He had been sadly misled about the availability of “golden rice”. The paper reporting on its purported efficacy [47] has been retracted.

The Institute of Science in Society (ISiS) sardonically remarked “This ‘golden rice’, not yet available, is already worth its weight in diamonds.<sup>48</sup> Many have commented on the absurdity of offering “golden rice” as the cure for vitamin A deficiency when there are plenty of alternative, much cheaper sources of vitamin A or pro-vitamin A, such as green vegetables and unpolished rice, which would, moreover, be rich in other essential vitamins and minerals. “Golden rice” was illegally trialled on children by scientists in Tufts University without the knowledge of the Chinese Government.<sup>49</sup>

A detailed audit on the project by ISiS<sup>50</sup> uncovered fundamental deficiencies from the scientific and social rationale to the science and technology involved. It was being promoted “to salvage a morally as well as financially bankrupt agricultural biotech industry”.<sup>51</sup> The authors of the paper [47] filed an injunction to stop the retraction, but it was denied.<sup>52</sup> Adrian Dubock, executive secretary of the “Golden Rice Humanitarian Board”, based in Switzerland, says that a wealthy philanthropist—whose name he declined to share—offered to bankroll lead author Tang’s lawsuit, remarking, “My understanding is that this person is very troubled by socially important issues that affect the disadvantaged”.<sup>53</sup>

**Biofortification with zinc.** A modelling study of the global threat of increasing carbon dioxide levels on zinc in third world countries appeared in *The Lancet Global Health* on the same day as the RF–Lancet paper [48]. The study was funded by the Bill and Melinda Gates Foundation. The author, Samuel Myers, who appears to be associated with the RF, concluded: “Such interventions might include zinc supplementation, fortification of staple foods with additional zinc, the application of zinc-containing fertilisers to crops, and the development and introduction of biofortified crop strains such as rice and wheat.”

**“And yet, global health has mainly improved as these changes have gathered pace.”** This second sentence of the RF–Lancet Commission Report is untrue, at least for the UK and US. Between 1990 and 2010, Britain and the US have slipped down the scale of health compared with other wealthy nations and the patterns of disease are remarkably similar. In the US: “However, morbidity and chronic disability now account for nearly half of the US health burden, and improvements in population health in the United States have not kept pace with advances in population health in other wealthy nations”.<sup>54</sup> In the UK: “The performance of the UK in terms of premature mortality is persistently and significantly below the mean of EU15+ and requires additional concerted action... premature mortality from several major causes such as cardiovascular disease and cancers ... in terms of premature mortality worsening ranks are most notable for men and women aged 20–54 years.” Increases in Alzheimer’s disease, breast cancer, oesophageal cancer, congenital anomalies “and a growing burden of disability, particularly from mental disorders” are all acknowledged.<sup>55</sup>

**Increase in total neurological deaths (TND) in the US.** An alarming paper compared the rates for TNDs in the US with those from 20 Western countries [49]. The diseases were divided into two categories: Alzheimer’s and other dementias, and diverse neurological diseases such as Parkinson’s, motor neurone disease, neuromuscular diseases, Creutzfeldt-Jakob disease (CJD) and new variant CJD. Age ranges were 55–74 and 75+ and males were separated from females. TND deaths in males aged 55–74 in the US increased by 82% to 627 pm (per million) compared with the average in the 20 countries of 2% to 503 pm. TND deaths in females aged 55–74 in the USA increased by 48% to 560 pm. The USA rate of TND deaths in the 75+ group in males increased from 3336 pm to 12271 pm, a more than twofold (368%) rise over the period. The USA rate for females 75+ rose from 3206 pm to 21253 pm, a more than five-fold (663%) increase. This was the largest increase of all countries under review. In the over 75’s group, TND rates ranged from the highest in Finland (24797 pm), to the lowest in Greece at (1479 pm). The TND average rates for age 75+ for 20 countries

<sup>47</sup> <http://www.bbc.co.uk/news/uk-politics-24515938>

<sup>48</sup> <http://www.i-sis.org.uk/rice.php>

<sup>49</sup> <http://www.i-sis.org.uk/SPUCTGM.php>

<sup>50</sup> Ho MW. The ‘Golden Rice’ – An Exercise in How Not to Do Science. TWN Biotechnology and Biosafety Series No. 6, Third World Network, Penang, 2002. <http://www.i-sis.org.uk/onlinestore/books.php#276>

<sup>51</sup> <http://www.i-sis.org.uk/goldenRiceScandal.php>

<sup>52</sup> [http://www.nature.com/news/the-week-in-science-31-july-6-august-2015-1.18120?WT.ec\\_id=NATURE-20150806&spMailingID=49256879&spUserID=MTg5MTg3OTcxMTES1&spJobID=740835078&spReportId=NzQwODM1Mdc4S0](http://www.nature.com/news/the-week-in-science-31-july-6-august-2015-1.18120?WT.ec_id=NATURE-20150806&spMailingID=49256879&spUserID=MTg5MTg3OTcxMTES1&spJobID=740835078&spReportId=NzQwODM1Mdc4S0)

<sup>53</sup> <http://news.sciencemag.org/asiapacific/2014/07/researcher-sues-block-retraction-golden-rice-paper>

<sup>54</sup> <http://www.ncbi.nlm.nih.gov/pubmed/23842577>.

<sup>55</sup> <http://www.ncbi.nlm.nih.gov/pubmed/23668584> UK health performance: findings of the Global Burden of Disease Study 2010.

increased by 185% with a doubling of rates in 17 countries. It should be noted that in every country female rates rose more than male rates over the years 1989–2010. These diverse neurological diseases are identical to those described by Samsel & Seneff [50].

**Overweight and obesity in mid-life: Evidence from the 1970 British Cohort Study.**<sup>56</sup> The Centre for Longitudinal Studies based at the Institute of Education University of London published their latest report on 9 November 2013. Their key findings of the cohort at age 42 were that:

- The generation born in 1970 is considerably more likely to be overweight or obese than those born 12 years earlier were at the same age;
- Men born in 1970 are far more likely to be overweight than women.

It may be no coincidence that UK farmers have been spraying glyphosate on crops pre-harvest since 1980,<sup>57</sup> and countries with the biggest obesity problem are the US and the UK. The ministerial meeting in Paris in 2010 shows England's projected obesity rates rising in parallel with those of the USA;<sup>58</sup> it is predicted that by 2020, 75% of the US population, 69% in England and 65% of the Australian population will be overweight (p. 6). Australia is now growing commercial GM "Roundup Ready" crops.

## 7. THE PROBLEM OF OVERPOPULATION

**Is there a depopulation agenda?** Dr Betty Martini, US physician and campaigner against Monsanto's aspartame,<sup>59</sup> demanded why she hadn't had a reply to her complaints about its extreme toxicity.<sup>60</sup> Aspartame was originally shown by the FDA to cause brain tumours, epilepsy and neurotoxic effects. For the first time, Michael Delaney, a member of the FDA, admitted that the US has a depopulation agenda.<sup>61</sup>

It has been suggested that plans are now under way to depopulate the planet's 6–7 milliard people to a more manageable level of between 500–2000 million by the following means:<sup>62</sup>

- unsustainable/exploitative international development,

which leads to massive hunger, starvation and famine worldwide;

- the fomentation of war, hatred and military procurements leading to millions of deaths worldwide;
- the poisoning and contamination of the planet's food and water supplies;
- the creation and spread of infectious diseases leading to global pandemic, plague and pestilence on an unprecedented scale.

It has been remarked "Considering the amount of genetically modified foods that are being forcefully pumped onto our grocery store shelves, the chemicals that are put into our cosmetics and clothes, the chem-trails being sprayed from the skies above our homes, and the harmful toxins mixed into vaccines, one can only consider the idea that someone is trying to cause harm to the public. Recently, the US National Cancer Agency was exposed for manipulating cancer statistics, stating that there has been a decrease in the number of cancer cases over the past decades when in fact cancer cases have significantly increased over the years".<sup>63, 64</sup> Monsanto CEO Hugh Grant declared that genetically modified foods are good for poor people who can't afford organic;<sup>65</sup> "Opponents of GM who want to block genetically modified foods are guilty of 'elitism' that's fanned by social media and fail to consider the needs of the rest of the world".<sup>66</sup>

## 8. THREATS TO BIODIVERSITY

Near the small Arctic village of Longyearbyen on Spitsbergen, a "doomsday seed vault" is being built inside a mountain. It will contain a bank of up to 3 million different varieties of seeds from around the entire world, collected with the aim of conserving crop diversity for the future. The project is being funded by, *inter alia*, Bill Gates, the Rockefeller Foundation, Monsanto, the Syngenta Foundation and the Government of Norway [19].<sup>67</sup> Despite the laudable aim, the seed bank is misconceived: diversity cannot be boxed up and conserved in a container, no matter how secure it may be, and this

<sup>56</sup> Overweight and obesity in mid-life: Evidence from the 1970 British Cohort Study at age 42.

<sup>57</sup> <http://www.hgca.com/media/185527/is02-pre-harvest-glyphosate-application-to-wheat-and-barley.pdf>

<sup>58</sup> Healthy Choices OECD Health Ministerial Meeting, Paris, 7–8 October 2010, <http://www.oecd.org/health/ministerial/46098333.pdf>

<sup>59</sup> Dr Betty Martini, a physician who has repeatedly called for the FDA to ban aspartame, the sweetener in children's drinks has a website: <http://www.mpwhi.com/>

<sup>60</sup> [http://www.mpwhi.com/peer\\_reviewed\\_research.htm](http://www.mpwhi.com/peer_reviewed_research.htm)

<sup>61</sup> [http://www.mpwhi.com/fda\\_says\\_so\\_what.htm](http://www.mpwhi.com/fda_says_so_what.htm)

<sup>62</sup> <http://rense.com/general64/pordc.htm>

<sup>63</sup> <http://www.thesleuthjournal.com/the-global-depopulation-agenda-being-played-out/>

<sup>64</sup> <http://www.preventcancer.com/losing/nci/manipulates.htm>

<sup>65</sup> <http://2paragraphs.com/2013/05/monsanto-ceo-says-gmo-food-good-for-poor-people/>

<sup>66</sup> <http://www.bloomberg.com/news/2013-05-15/monsanto-sees-elitism-in-social-media-fanned-opposition.html>

<sup>67</sup> <http://www.globalresearch.ca/doomsday-seed-vault-in-the-arctic-2/23503> Why now Svalbard?

corresponds to the practical experience of farmers, especially those in developing countries, which nowadays contain the greatest variety of plants.<sup>68</sup> Indeed, since the environment, including pests and diseases, is always changing, crops are continually adapting in response and the “frozen diversity” of the seeds will likely make them completely unsuitable for the prevailing conditions whenever they are ultimately released, not least since global warming is likely to bring considerable, and unpredictable, changes to the environment.

As noted above, an analysis from the USGS in 2014 “concluded that glyphosate and its degradation product AMPA occur frequently and widely in US soils, surface water, groundwater, and precipitation” [25]; presumably the WHO IARC recent assessment of glyphosate being a 2A carcinogen (probably carcinogenic in humans) [26] is unwelcome news for the Rockefeller Foundation *and* the agrochemical industry. The latter has created a toxic environment from which no one can escape. The devastating effects of these silent killers in our water do not distinguish between farmers or city dwellers, the global élite or the poor they are trying to eliminate, between media moguls or their reporters, between Monsanto executives, senators, presidents, lords or prime ministers. The recent episodes of extreme weather and severe flooding caused by climate change will spread the chemicals even further.

The so-called “global élite” appear to be inadvertently poisoning themselves and their children, along with everyone else. They may be able to survive by eating organic food, but they cannot evade the pollution of water, soil and air by genotoxic and teratogenic herbicides and insecticides and the loss of biodiversity.

The US Congress, while voting for the DARK (“Deny Americans the Right to Know”) Act on behalf of Monsanto, is unknowingly eating food contaminated by neonicotinoid insecticides.<sup>69</sup>

If they are currently voting for GM food not to be labelled, how will they themselves know what food contains GM and glyphosate? “A bill pending before the US Senate would not just deny consumers the right to know whether their food contains GMOs, it could also strip states of their right to limit or regulate the use of dangerous herbicide chemicals widely sprayed over fields of GM crops. The bill in question, which passed a vote in the House of Representatives of July 22, is formally known as H.R. 1599, the Safe and Accurate

Food Labeling Act, but has come to be known by organic and natural foods advocates as the DARK Act”—because, far from ensuring accurate food labelling, the bill is actually designed to prevent the implementation of mandatory GMO labelling laws.<sup>70</sup>

The human race has, apparently, learned nothing since *Silent Spring* [51]. The global pesticides industry has been allowed to dominate the regulatory agencies. They have created chemicals of mass destruction that can no longer be controlled. Furthermore, successive British governments have allowed themselves to be persuaded that only a chemical-based agricultural system can feed the world. Fifty three years ago Rachel Carson’s description of systemic pesticides was correct; nothing has changed apart from the fact that the industry has devised more potent and longer-acting biocides and has incorporated them into the global food supply. As she wrote: “The world of systemic insecticides is a weird world, surpassing the imaginings of the brothers Grimm. It is a world where the enchanted forest of the fairy tales has become a poisonous forest. It is a world where a flea bites a dog and dies... where a bee may carry poisonous nectar back to its hive and presently produce poisonous honey” [51].

Humans need invertebrates; without them they cannot survive. Prof E.O. Wilson, the eminent field entomologist from Harvard University, who in his book *Naturalist* [52] has documented massive global declines of ant colonies at the hand of man, ominously predicted that: “The one process now going on that will take millions of years to correct is the loss of genetic and species diversity by the destruction of natural habitats. This is the folly our descendants are least likely to forgive us.” He may have been too sanguine. Humans also need biodiversity of ecosystems to prevent mass extinction. Let us recall the statement quoted right at the beginning: “The average rate of vertebrate species loss over the last century is up to 114 times higher than the background rate. These estimates reveal an exceptionally rapid loss of biodiversity over the last few centuries, indicating that a sixth mass extinction is already under way” [1].

On the other hand, biodiversity is increasing where we do not want it—within our bodies in the form of cancers. At a meeting on 15 July 2015 in London between the Soil Association and a scientific panel<sup>71</sup> that included Prof. Christopher Portier, one of the co-authors of the IARC report that determined glyphosate’s status as a probable carcinogen [26], he reiterated IARC’s full

<sup>68</sup> <http://www.theguardian.com/science/2015/may/20/the-doomsday-vault-seeds-save-post-apocalyptic-world>

<sup>69</sup> [http://abcbirds.org/wp-content/uploads/2015/07/CongressionalDiningHallReport\\_July2015.pdf](http://abcbirds.org/wp-content/uploads/2015/07/CongressionalDiningHallReport_July2015.pdf) (see p. 15).

<sup>70</sup> <http://www.globalresearch.ca/dark-act-would-cause-americas-crop-fields-to-be-saturated-with-cancer-causing-glyphosate-monsanto-roundup/5467889>

<sup>71</sup> <http://www.soilassociation.org/news/newsstory/articleid/8110/soil-association-calls-for-ban-on-glyphosate-the-world-s-most-widely-sold-weedkiller>

conclusions,<sup>72</sup> starkly asserting that: “glyphosate is definitely genotoxic. There is no doubt in my mind.” At that same meeting, Dr Robin Mesnage of the Department of Medical and Molecular Genetics at King’s College London, revealed new data analysis showing “Roundup”, the most common brand of glyphosate-based herbicides, is a thousand times more toxic than glyphosate alone, due to the inclusion of other toxic chemicals in its formulation [53].

Also at the meeting, Claire Robinson, an editor at GMWatch.org provided an international perspective looking at moves by other countries to ban glyphosate. She noted that: outside the United Kingdom, the reaction to the WHO IARC report had been dramatic; some retailers in Switzerland and Germany having removed glyphosate products and France has committed to do so by 2018; indeed some German states are calling for an EU-wide ban. She further reported that the Danish Working Environment Authority has declared it as a carcinogen and El Salvador and Sri Lanka have banned it and the Colombia government has banned aerial spraying on coca crops. All this is encouraging news. The UK position is, in fact, anomalous. Peter Melchett, Soil Association policy director remarked: “If glyphosate ends up in bread it’s impossible for people to avoid it, unless they are eating organic. On the other hand, farmers could easily choose not to use glyphosate as a spray on wheat crops just before they are harvested. This is why the Soil Association is calling for the immediate ending of the use of glyphosate sprays on wheat destined for use in bread”.<sup>73</sup>

## 9. SUBSTANTIALEQUIVALENCE

In 1992, the United States Food and Drug administration (FDA) declared GMOs to be “substantially equivalent” to non-GMOs.<sup>74</sup> In practical terms, this means that GMOs do not have to be tested at all. The concept of “substantial equivalence” is nebulous and scientifically indefensible.

Thomas Bøhn has shown that glyphosate-tolerant GM soybeans from Iowa are not “substantially equivalent” to non-GM or organic soya. They contain high residues of glyphosate and AMPA (mean 3.3 and 5.7 mg kg<sup>-1</sup>, respectively), low protein, low levels of zinc and a higher total saturated fat and total omega-6 fatty acids [54]. In a commentary on the paper Bøhn pointed out that extreme levels of “Roundup” in food have become the industry norm:<sup>75</sup> “Roundup Ready GM-soy accumulates residues

of glyphosate and AMPA and GM soy also differs markedly in nutritional composition compared with soybeans from other agricultural practices. Organic soybean samples also showed a more healthy nutritional profile (e.g. higher in protein and lower in saturated fatty acids) than both industrial conventional and GM soybeans. Lack of data on pesticide residues in major crop plants constitutes a serious knowledge gap with potential consequences for human and animal health. How is the public to trust a risk assessment system that has overlooked the most obvious risk factor for herbicide-tolerant GM crops, i.e. high residue levels of herbicides, for nearly 20 years?” If it were due to lack of understanding, it would be bad; if it were the result of the producer’s power to influence the risk assessment system, it would be worse. Did the industry know that GM soya was deficient in zinc? Is that why Myers suggested that biofortification with zinc might be necessary for poor countries with problems from carbon dioxide increases [48]?

The rise of systems biology may provide a welcome antidote to the reductionism of molecular biology. Systems biology aims to understand the complexity of the whole organism as a system, rather than just studying its parts in a reductionist manner. It recognizes that genetic modification may affect emergent properties of the whole system [55]. Dr Shiva Ayyadurai designed “Cytosolve” as a new systems biology method and used it to integrate 6497 *in vitro* and *in vivo* laboratory experiments from 184 scientific institutions across 23 countries. One of the findings was a dramatic depletion of glutathione in the GM product (glutathione is an antioxidant necessary for cellular detoxification).

Dr Ayyadurai suggests that the presence of formaldehyde and depletion of glutathione are likely to be critical criteria for distinguishing the GMO from its non-GM counterpart. *A propos* formaldehyde, Dr Ray Seidler, a former EPA senior scientist, has noted: “Formaldehyde is a known class 1 carcinogen. Its elevated presence in soybeans caused by a common genetic engineering event is alarming and deserves immediate attention and action from the FDA and the Obama administration. Soy is widely grown and consumed in the US, including by infants fed baby food products, with 94% of soy grown here being genetically engineered.”<sup>76</sup> Unfortunately the

<sup>72</sup> [monographs.iarc.fr/ENG/Monographs/vol112/mono112-02.pdf](http://monographs.iarc.fr/ENG/Monographs/vol112/mono112-02.pdf)

<sup>73</sup> [www.soilassociation.org/notinourbread](http://www.soilassociation.org/notinourbread)

<sup>74</sup> <http://www.fas.org/biosecurity/education/dualuse-agriculture/2.-agricultural-biotechnology/us-regulation-of-genetically-engineered-crops.html>

<sup>75</sup> <http://www.independentsciencenews.org/news/how-extreme-levels-of-roundup-in-food-became-the-industry-norm/>

<sup>76</sup> <http://www.prnewswire.com/news-releases/systems-biology-group-international-center-for-integrative-systems-gmo-soy-accumulates-formaldehyde—disrupts-plant-metabolism-suggests-peer-reviewed-study-calling-for-21st-century-safety-standards-300112959.html>

degree of elevation was not given, making it difficult to assess the significance.

Be that as it may, the current criteria for assessing “equivalence” considers only basic nutritional and superficial characteristics such as taste, sight, smell and touch for declaring GMOs safe for human consumption, allowing them to be fast-tracked to market without independent scientific testing.

If formaldehyde and glutathione were also criteria, then the GMO could surely not be deemed “equivalent” to its non-GMO counterpart. This finding calls into question the FDA’s food safety standards for the entire country.<sup>77</sup>

## 10. CONCLUSION

The persistent and increasing global contamination of water and air with long-acting biocides, particularly formulated glyphosate and the neonicotinoid insecticides, are toxic not only to the poor, but to the rich as well. The consequent depopulation is, therefore, unlikely to be achieved before the sixth mass extinction.

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## REFERENCES

1. Ceballos, G., Ehrlich, P.R., Barnosky, A.D., Garcia, A., Pringle, R. M. & Palmer, T.M. Accelerated modern human-induced species losses: Entering the sixth mass extinction. *Sci. Adv.* **1** (2015) 1–5.

2. Ehrlich, P. R. *The Population Bomb*. New York: Buccaneer Books (1968).
3. Ehrlich, P.R. The Millenium Alliance for Humanity and Biosphere (MAHB), the culture gap, and some really inconvenient truths. *PLoS Biol.* **8** (2010) e1000330.
4. Ehrlich, P.R. & Ehrlich, A.H. Can a collapse of global civilization be avoided? *Proc. R. Soc.* **B 280** (2013) 20122845.
5. Chivian, E. & Bernstein, A. (eds). *Sustaining Life. How Human Health Depends On Biodiversity*. Oxford: Oxford University Press (2008).
6. Editorial. Natural decline. Few biology degrees still feature natural history. Is the naturalist a species in crisis? *Nature* **508** (2014) 7–8.
7. Perry, J.N., Devos, Y., Arpaia, S., Bartsch, D., Ehlert, C., Gathmann, A., Hails, R.S., Hendriksen, N.B., Kiss, J., Messean, A., Mestdagh, S., Neemann, G., Nuti, M., Sweet, J.B. & Tebbe, C.C. Estimating the effects of Cry1F *Bt*-maize pollen on non-target Lepidoptera using a mathematical model of exposure. *J. Appl. Ecol.* **49** (2012) 29–37.
8. Pecenka, J.R. & Lundgren, J.G. Non-target effects of clothianidin on monarch butterflies. *Sci. Nat.* **102** (2015) 19–22.
9. Tewksbury, J.J., Anderson, J.G.T., Bakker, J.D., Billo, T.J., Dunwiddie, P.W., Groom, M.J., Hampton, S.E., Herman, S.G., Levey, D.J., Machnicki, N.J., Martinez Del Rio, C., Power, M.E., Rowell, K., Salomon, A.K., Stacey, L., Trombulak, S.C. & Wheeler, T.A. Natural history’s place in science and society. *BioScience* **64** (2014) 300–310.
10. Godfray, H.C.J., Blacquière, T., Field, L.M., Hails, R.S., Petrokofsky, G., Potts, S.G., Raine, N.E., Vanbergen, A.J. & McLean, A.R. 2014 A restatement of the natural science evidence base concerning neonicotinoid insecticides and insect pollinators. *Proc. R. Soc.* **B 281** (2014) 2014055819.
11. Cardinale, B.J., Duffy, J.E., Gonzalez, A., Hooper, D.U., Perrings, C., Venail, P., Narwani, A., Mace, G.M., Tilman, D., Wardle, D.A., Kinzig, A.P., Daily, G.C., Loreau, M., Grace, J.B., Larigauderie, D.S., Srivastava, D.S. & Naeem, S. Biodiversity loss and its impact on humanity. *Nature* **486** (2012) 59–67.
12. Fisher, M.C., Henk, D.A., Briggs, C.J., Brownstein, L.C., Madoff, L.C., McCraw, S.L. & Gurr, S.J. Emerging fungal threats to animal, plant and ecosystem health. *Nature* **484** (2012) 186–194.
13. Davidson, C., Shaffer, H.B. & Jennings, M.R. Spatial tests of the pesticide drift, habitat destruction, UV-B, and climate-change hypotheses for California amphibian declines. *Conservation Biology* **16** (2002) 1588–1601.
14. Mason, R., Tennekes, H., Sánchez-Bayo, F. & Jepsen, P.U. Immune suppression by neonicotinoid insecticides at the root of global wildlife declines. *J. Environ. Immunol. Toxicol.* **1** (2013) 3–12.
15. Hoy, J., Swanson, N. & Seneff, S. The high cost of pesticides: human and animal diseases. *Poult. Fish Wildl. Sci.* **3** (2015) 132–150.
16. Mendelson, J.R. Shifted baselines, forensic taxonomy, and Rabbs’ fringe-limbed trees frog: the changing role of biologists in an era of amphibian declines and extinctions. *Herpetol. Rev.* **42** (2011) 21–25.

<sup>77</sup><https://www.organicconsumers.org/news/gmo-soy-accumulates-formaldehyde-disrupts-plant-metabolism-suggests-peer-reviewed-study>

17. The Rockefeller Foundation–Lancet Commission. *Safeguarding Human Health in the Anthropocene Epoch: Report of The Rockefeller Foundation–Lancet Commission on Planetary Health*. *The Lancet* (2015) (online: 56 pp.).
18. Druker, S.M. *Altered Genes, Twisted Truth. How the Venture to Genetically Engineer Our Food Has Subverted Science, Corrupted Government, and Systematically Deceived the Public*. Salt Lake City: Clear River Press (2015).
19. Engdahl, F.W. *Seeds of Destruction: The Hidden Agenda of Genetic Manipulation*. Montreal: Global Research (2007).
20. Ho, M.-W. The new genetics and natural versus artificial genetic manipulation. *Entropy* **15** (2013) 4748–4781.
21. Kurenbach, B., Marjoshi, D., Amáñile-Cuevas, C.T., Ferguson, G.C., Godsoe, W., Gibson, P. & Heinemann, J.A. Sublethal exposure to commercial formulations of the herbicides Dicamba, 2,4-dichloro-phenoxyacetic acid, and glyphosate cause changes in antibiotic susceptibility in *Escherichia coli* and *Salmonella enterica* serovar typhimurium. *J. Am. Soc. Microbiol.* **6** (2015) 1–9.
22. Krüger, M., Schrödl, W., Pedersen, I. & Shehata, A.W. Detection of glyphosate in malformed piglets. *J. Environ. Anal. Toxicol.* **4** (2015) 230–231.
23. Chang, F.-C., Simcik, M. F. & Capel, P. D. Occurrence and fate of the herbicide glyphosate and its degradate aminomethylphosphonic acid in the atmosphere. *Environ. Toxicol. Chem.* **30** (2011) 548–555.
24. Aparicio, V.C., Geronimo, E.D., Marino, D., Primost, J., Carriquiriborde, P. & Costa, J.L. Environmental fate of glyphosate and aminomethylphosphonic acid in surface waters and soil of agricultural basins. *Chemosphere* **93** (2013) 1866–1873.
25. Battaglin, W.A., Meyer, M.T., Kuivila, K.M. & Dietze, J.E. Glyphosate and its degradation product AMPA occur frequently and widely in U.S. soils, surface water, groundwater, and precipitation. *J. Am. Water Resources Assn* **50** (2014) 275–290.
26. Guyton, K.Z., Loomis, D., Grosse, Y., El Ghissassi, F., Benbrahim-Tallaa, L., Guha, N., Scoccianti, C., Mattock, H. & Straif, K. on behalf of the International Agency for Research on Cancer (IARC) Monograph Working Group. Carcinogenicity of tetrachlorvinphos, parathion, malathion, diazinon, and glyphosate. *The Lancet Oncology* **16** (2015) 490–491.
27. Thongprakaisang, S., Thiantanawat, A., Rangkadilok, N., Suriyo, T. & Satayavivad, J. Glyphosate induces human breast cancer cells growth via estrogen receptors. *Food Chem. Toxicol.* **59** (2013) 129–136.
28. Childs, C. *Apocalyptic Planet. Field Guide to the Future of the Earth*, ch. 6, Species Vanish, p. 187. New York: Vintage Books (2013).
29. Hladik, M.L., Kolpin, D.W. & Kuivila, K.M. Widespread occurrence of neonicotinoid insecticides in streams in a high corn and soybean producing region, USA. *Environ. Pollution* **193** (2014) 189–196.
30. Tennekes, H.A. The significance of the Druckrey–Küpfmüller equation for risk assessment—the toxicity of neonicotinoid insecticides to arthropods is reinforced by exposure time. *Toxicology* **276** (2010) 1–4.
31. Tennekes, H.A. *The Systemic Insecticides: a Disaster in the Making* (2010).
32. Van Dijk, T.C., Van Staaldin, M.A. & Van der Sluijs, J.P. Macro-invertebrate decline in surface water polluted with imidacloprid. *PLoS ONE* **8** (2013) e62374.
33. Chagnon, M., Kreutzweiser, D., Mitchell, E.A.D., Morrissey, C.A., Noome, D.A. & Van der Sluijs, J.P. Risks of large-scale use of systemic insecticides to ecosystem functioning and services. *Environ. Sci. Pollution Res.* **22** (2014) 119–134.
34. Schaafsma, A., Limay-Rios, V., Baute, T., Smith, J. & Xue, Y. Neonicotinoid insecticide residues in surface water and soil associated with commercial maize (corn) fields in southwestern Ontario. *PLoS ONE* **10** (2015) e0118139.
35. Main, A.R., Headley, J.V., Peru, K. M., Michel, N.L., Cessna, A.J. & Morrissey, C.A. Widespread use and frequent detection of neonicotinoid insecticides in wetlands of Canada's prairie pothole region. *PLoS ONE* **9** (2014) e92821.
36. Morrissey, C.A., Mineau, P., Devries, J.H., Sánchez-Bayo, F., Liess, M., Cavallaro, M.C. & Liber, K. Neonicotinoid contamination of global surface waters and associated risk to aquatic invertebrates: A review. *Environ. Intl* **74** (2015) 291–303.
37. Andreson, J.C., Dubetz, C. & Palace, V.P. Neonicotinoids in the Canadian aquatic environment: a literature review on current use products with a focus on fate, exposure, and biological effects. *Sci. Total Environ.* **505** (2015) 409–422.
38. Sánchez-Bayo, F. & Hyne, R.V. Detection and analysis of neonicotinoids in river waters—development of a passive sampler for three commonly used insecticides. *Chemosphere* **99** (2014) 143–151.
39. Tomizawa, M., Lee, D.L. & Casida, J.E. Neonicotinoid insecticides: molecular features conferring selectivity for insect versus mammalian nicotinic receptors. *J. Agric. Food Chem.* **48** (2000) 6016–6024.
40. Li, P., Ann, J. & Akk, G. Activation and modulation of human  $\alpha 4\beta 2$  nicotinic acetylcholine receptors by the neonicotinoids clothianidin and imidacloprid. *J. Neurosci. Res.* **89** (2011) 1295–1301.
41. Abou-Donia, M.B., Goldstein, L.B., Bullman, S., Tul, T., Khan, W.A., Dechkovskaia, A.M. & Abdel-Rahman, A.A. Imidacloprid induces neurobehavioral deficits and increases expression of glial fibrillary acidic protein in the motor cortex and hippocampus in offspring rats following *in utero* exposure. *J. Toxicol. Environ. Health A* **71** (2008) 119–130.
42. Kimura-Kuroda, J., Komuta, Y., Kuroda, Y., Hayashi, M. & Kawano, H. Nicotine-like effects of the neonicotinoid insecticides acetamiprid and imidacloprid on cerebellar neurons from neonatal rats. *PLoS One* **7** (2012) e32432.
43. Tennekes, H.A. & Sánchez-Bayo, F. Time-dependent toxicity of neonicotinoids and other toxicants: implications for a new approach to risk assessment. *J. Environ. Anal. Toxicol.* (2011) S4:001.
44. Pilling, E., Campbell, P., Coulson, M., Ruddle, N. & Tornier, I. A four-year field program investigating long-term effects of repeated exposure of honey bee colonies to flowering crops treated with thiamethoxam. *PLoS ONE* **8** (2013) e77193.
45. Whitehorn, P.R., O'Connor, S., Wackers, F.L. & Goulson, D. Neonicotinoid pesticide reduces bumble bee colony growth and queen production. *Science* **336** (2012) 351–352.
46. de Steur, H., Blancquaert, D., Strobbe, S., Lambert, W., Gellynck, X. & Van Der Straeten, D. Status and market potential of transgenic biofortified crops. *Nature Biotechnol.* **33** (2015) 25–29.



47. Tang, G., Hu, Y., Yin, S.-a., Wang, Y., Dallal, G.E., Grusak, M.A. & Russell, R.M.  $\beta$ -Carotene in Golden Rice is as good as  $\beta$ -carotene in oil at providing vitamin A to children. (Retracted). *Am. J. Clin. Nutr.* **96** (2012) 658–664.
48. Myers, S.S., Wessells, K.R., Kloog, I., Zanobetti, A. & Schwartz, J. Effect of increased concentrations of atmospheric carbon dioxide on the global threat of zinc deficiency: a modelling study. *The Lancet Global Health.* (2015) 7 pp.
49. Pritchard, C. & Rosenorn-Lanng, E. Neurological deaths of American adults (55–74) and the over 75's by sex compared with 20 Western countries 1989-2010: Cause for concern. *Surg. Neurol. Int.* **6** (2015) 123–135.
50. Samsel, A. & Seneff, S. Glyphosate pathways to modern diseases III: Manganese, neurological diseases, and associated pathologies. *Surg. Neurol. Int.* **6** (2015) 45–71.
51. Rachel Carson. *Silent Spring*. Boston, Mass.: Houghton Mifflin (1962).
52. Wilson, E.O. *Naturalist: New Edition for a New Generation*. Washington, DC: Island Press (2006).
53. Mesnage, R., Defarge, N., Spiroux de Vendomois, J. & Seralini, G.-E. Major pesticides are more toxic to human cells than their declared active principles. *Biomed. Res. Int.* **2014** (2014) 179691.
54. Bohn, T., Cuhra, M., Traavik, T., Sanden, M., Fagan, J. & Primicerio, R. Compositional differences in soybeans on the market: Glyphosate accumulates in Roundup Ready GM soybeans. *Food Chem.* **153** (2014) 207–213.
55. Ayyadurai, V.A.S. & Deonikar, P. Do GMOs accumulate formaldehyde and disrupt molecular systems equilibria? Systems biology may provide answers. *Agricultural Sci.* **6** (2015) 630–662.