The Unintended Consequences of Using Glyphosate
(the main ingredient in the herbicide Roundup)

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January, 2016

Glyphosate-based herbicides are now the most commonly used herbicides in the world. They are still promoted as "safe", despite scientific evidence of their harm to health and the environment. This report describes Glyphosate's properties, including its persistence, activity and mobility, and herbicidal mechanism of action. It demonstrates how Glyphosate, Glyphosate herbicide formulations with adjuvants, and associated metabolites could contaminate and harm all facets of an ecosystem, including the soil biology and composition, water, and non-target plants, aquatic organisms, amphibians, reptiles, invertebrates, animals, and humans. It further demonstrates that using Glyphosate could increase the risk of fires, erosion, and herbicide-resistant super weeds.

I. OVERVIEW

Glyphosate was patented by Monsanto as an herbicidal agent in 1974.[1] It has become the most popular herbicide in the world since Glyphosate tolerant genetically modified (GM) crops were commercialized in the mid-1990s, together with the assumption (perpetrated by Monsanto) that the herbicide is safe for health and the environment. Agricultural use of Glyphosate in the US increased from less than 5000 to more than 80,000 metric tons/yr. between 1987 and 2007.[2] As well as being used on GM Roundup Ready crops, Glyphosate herbicides are increasingly used as desiccants on conventional grain crops to dry them before harvest, making the grains easier to harvest and store without rotting. The herbicide is also widely used on public roads, railway lines, parks, open space, forests, and other public places as well as on private home gardens. Non-agricultural use has risen steadily in the U.S., from 2270 metric tons/yr. in 1993 to 9300 metric tons/yr. in 2007.[3]

The widespread and massive application of glyphosate herbicides has resulted in extensive contamination of the environment. A comprehensive 2014 study by US Geological Survey (USGS) scientists on US water systems (including rivers, lakes, streams, lakes ponds, wetlands, precipitation, soil and sediment, soil water, ditches, drains, and groundwater) over 9 years and across 38 states found Glyphosate in 39.4%

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[1] Monsanto. "Glyphosate and Roundup Brand Herbicides." Monsanto. Available at: http://www.monsanto.com/glyphosate/pages/default.aspx

[2] Battaglin WA, Meyer MT, Kuivila KM, and Dietze JE. "Glyphosate and Its Degradation Product AMPA Occur Frequently and Widely in U.S. Soils, Surface Water, Groundwater, and Precipitation." Journal of the American Water Resources Association (JAWRA) 2014: 50, 275-290, DOI:10.111/jawr.12159 Available at: http://onlinelibrary.wiley.com/doi/10.1111/jawr.12159/abstract

[3] Sirinathsinghji E. "Widespread Glyphosate Contamination in USA." Institute of Science in Society. 2014. Available at: http://www.i-sis.org.uk/Widespread_Glyphosate_Contamination_in_US.php

of samples and its principle metabolite AMPA (aminomethylphosphonic acid) in 55% of samples.[4] [5] 70% of rain samples tested positive for Glyphosate.

Glyphosate formulations are often claimed to be safe by industry-linked sources. However, these claims are based on outdated and largely unpublished studies on the isolated ingredient glyphosate, commissioned by manufacturers in support of their application for regulatory authorization.[6] [7] In contrast, independent studies show that Glyphosate is toxic and commercial glyphosate herbicide formulations, which contain extra added ingredients (adjuvants), are more toxic than Glyphosate alone.

As demonstrated in this report, respected scientific studies show that there is a strong correlation between Glyphosate and Glyphosate formulations and serious health and environmental hazards, including disruption of hormonal systems and beneficial gut bacteria, damage to DNA, developmental and reproductive toxicity, birth defects, cancer and neurotoxicity. Glyphosate-based herbicides can harm all facets of an ecosystem, including the soil biology and composition, water, and non-target plants, aquatic organisms, amphibians, reptiles, invertebrates, animals, and humans. Glyphosate use could foster herbicide-resistant super weeds. Glyphosate is a patented desiccant (a drying agent) and could greatly increase the risk of fire. Glyphosate's effect on the soil composition could lead to greater risk of runoff and erosion. Glyphosate and its metabolites can be highly active and mobile and persist for many years in the environment, depending on conditions. Using toxic Glyphosate and Glyphosate formulations could not only harm beneficial vegetation and wildlife but could also jeopardize public health and safety.

Moreover, we support the Precautionary Principle, as described in the Marin Countywide Plan; "The Precautionary Principle carries the sense of foresight and preparation, and is the common-sense idea behind many adages: 'Be careful', 'Better safe than sorry'; 'Look before you leap'; 'First, do no harm'. Historically, many environmentally harmful activities were stopped only after they resulted in environmental degradation or serious harm to many people. The precautionary principle is an approach characterized by minimizing or eliminating potential hazards at the onset of an activity instead of the approach that determines an 'acceptable level of harm'."[8]

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[4] Battaglin WA, Meyer MT, Kuivila KM, and Dietze JE. "Glyphosate and Its Degradation Product AMPA Occur Frequently and Widely in U.S. Soils, Surface Water, Groundwater, and Precipitation." Journal of the American Water Resources Association (JAWRA) 2014: 50, 275-290, DOI:10.111/jawr.12159

[5] Sirinathsinghiji, E. "Widespread Glyphosate Contamination in USA." ISIS Report August 2014. Institute of Science in Society. 2014. Available at: http://www.i-sis.org.uk/Widespread_Glyphosate_Contamination_in_US.php

[6] European Commission Health & Consumer Protection Directorate-General. "Review report for the active substance glyphosate." 2002. Available at: http://bit.ly/HQnkFj

[7] Fagan J PhD, Antoniou M PhD, Robinson C MPhil. "GMO Myths and Truths 2nd Edition. Earth Open Source." 2014:4.1:205. Available at: http://earthopensource.org/earth-open-source-reports/gmo-myths-and-truths-2nd-edition/

[8] Marin County Community Development Agency. "Marin Countywide Plan." Marin County. 2007: Pg. 1.3-11

Therefore, in accordance with the Precautionary Principle and scientific evidence of Glyphosate's and Glyphosate formulations' harm to health and the environment, we recommend a Glyphosate-free approach to vegetation management.

II. GLYPHOSATE'S PROPERTIES AND HERBICIDAL MECHANISM OF ACTION

A. How Glyphosate Kills Plants

Besides being a broad-spectrum systemic patented herbicide, Glyphosate is also a patented mineral chelator, antibiotic, and desiccant. It disrupts plants' metabolic shikimate pathway, which starves plants of essential nutrients and weakens their immune systems. Moreover, Glyphosate's desiccating effects reduce a plant's ability to uptake water. It essentially gives the plants a condition similar to "Aids".

As a powerful antibiotic, Glyphosate also kills beneficial bacteria and other microorganisms in the soil. Beneficial organisms fix atmospheric nitrogen for plants' consumption and are necessary for healthy plant growth.[9] Without these beneficial microorganisms in the soil to compete with and suppress harmful plant soil-borne pathogens, the lethal soil-borne pathogens, such as Fusarium (**see below), take over and ultimately kill the weakened plants.[10] [11] [12]

***Fusarium is a naturally occurring soil fungus that is a plant pathogen. Fusarium invades the roots of plants and either kills the plant outright or prevents normal growth.*[13]

Moreover, if you destroy the beneficial bacteria and microorganisms in the soil, then the desired plants you replace the invasive plants with will not have the soil components they need to survive.

B. Glyphosate Can Have High Activity and Mobility

1. Glyphosate's Activity and Movement in Soil:

Depending on conditions, Glyphosate can have high activity and movement in the soil.

Glyphosate's toxicity is compounded by its persistence in the environment. Many studies show that glyphosate remains, chemically unchanged in the environment for long

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[9] Carlisle, S.M. and Trevors, J.T. "Glyphosate in the environment." Water, Air, and Soil Pollution 1988: 39:409-420.

[10] Levesque, C.A. "Effects of glyphosate on Fusarium spp.: its influence on root colonization of weeds, propagule density in the soil, and crop emergence." Can. J Microbiol. 1987: Vol 33, pp 354-360.

[11] Sanogo, S., et al. "Effects of herbicides on Fusarium solani f. sp glycines and development of sudden death syndrome in glyphosate-tolerant soybean." Phytopathology. 2000: v. 90 (N1): 57-66.

[12] Kremer, R. and Means, N. "Glyphosate and glyphosate-resistant crop interactions with rhizosphere microorganisms." European Journal of Agronomy. 2009. Available at: http://naldc.nal.usda.gov/download/35795/PDF

[13] Levesque, C.A. "Effects of glyphosate on Fusarium spp.: its influence on root colonization of weeds, propagule density in the soil, and crop emergence." Can. J Microbiol. 1987: Vol 33, pp 354-360.

periods of time. Research shows that even when glyphosate binds to soil particles, it will cyclically "desorb" or lose its attraction to soil and become active as an herbicide.[14]

A study entitled; "Hydrogen-bonding Interactions Between the Herbicide Glyphosate and Water-soluble Humic Substances" by Piccolo and Celano, has shown that glyphosate can readily desorb from soil particles in some soil types and can be highly mobile in the soil environment.[15] Four soils were used in the study. The key findings included:

- "Levels of adsorption of glyphosate varied in the different soils according to their composition. Least adsorption occurred in the soils containing lower levels of iron oxide. The clay mineral content was also found to be important. Soils containing higher levels of clay minerals adsorbed more glyphosate. However, desorption readily occurred in soil with a high clay mineral but low iron oxide content.
- Large parts of the fixed herbicide can be easily returned to the soil solution.
- The least adsorbing soils desorbed up to 80 per cent of the adsorbed herbicide and the high adsorbing soils released between 15 and 35 percent of the glyphosate adsorbed.
- In soils that are unable to bind with glyphosate long enough for microbial degradation to take place, the herbicide can be extensively mobile in the soil environment.
- Desorbed glyphosate can leach to lower soil layers.
- Glyphosate can bond with water soluble humic substances found in soil solution. Humic substances are the soil components primarily responsible for the mobility of pesticides in soil. Glyphosate can be transported with humic substances to lower soil depths."[16]

Another study entitled "Adsorption of Glyphosate on the Clay Mineral Montmorillonite" by Morilla, Undabytia and Maqueda[17], found: "Adsorption of glyphosate on clay minerals decreased in the presence of copper, due to the formation of glyphosate-copper complexes. The study concluded that in relation to glyphosate release and mobility in soil, it is necessary to take into account both the soil type and any element in the soil capable of forming complexes with glyphosate."[18]

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[14] American Bird Conservancy. "Pesticide Profile – Glyphosate." American Bird Conservancy. Available at: http://www.abcbirds.org/abcprograms/policy/toxins/profiles/glyphosate.html

[15] Piccolo, A., Celano, G. "Hydrogen-bonding interactions between the herbicide glyphosate and water-soluble humic substances." Environ. Toxicology and Chemistry. 1994: 13(11), 1737-1741.

[16] Buffin, D., Jewell, T. "Health and environmental impacts of glyphosate." Pesticide Action Network UK. 2001:16. Available at: http://www.foe.co.uk/sites/default/files/downloads/impacts_glyphosate.pdf

[17] Morillo, E., Undabeytia T. and Maqueda C. "Adsorption of glyphosate on the clay mineral montmorillonite: Effect of Cu(II) in solution and adsorbed on the mineral." Environ. Sci. and Technol. 1997: 31(12), 3588-3592.

[18] Buffin D, Jewell T. "Health and environmental impacts of glyphosate." Pesticide Action Network UK. 2001:16. Available at: http://www.foe.co.uk/sites/default/files/downloads/impacts_glyphosate.pdf

2. Glyphosate's Activity and Mobility in Water:

During rainfall events, storm water collects pesticides, such as insecticides, herbicides and fungicides, and transports them to ditches, streams, rivers, lakes, and estuaries (called surface waters). In addition, agricultural practices and landscape maintenance that use these toxic substances can also contaminate runoff and compromise the health of watersheds.[19] Pesticides may also be washed down through soil and rock layers into underground water sources, such as aquifers (called groundwater).

Glyphosate is being detected in surface waters and groundwater wherever it is used. Glyphosate residues have been detected in surface waters across the European Union. The European Glyphosate Environmental Information Sources (EGEIS) summarized surface water monitoring from 1993-2009 for thirteen European countries. Over 50,000 samples were included. Glyphosate was found in 29% of these samples and Glyphosate's breakdown product, AMPA, was found in 50% of the samples.[20]

A 2011 study entitled; "Fate and transport of glyphosate and aminomethylphosphonic acid in surface waters of agricultural basins"[21] found that Glyphosate and AMPA were frequently detected in surface waters (at a rate of 100% in rivers) of four agricultural basins in the United States. The frequency and magnitude of detections varied across basins, and the load as a percentage of use, ranged from 0.009 to 0.86%, and could be related to three general characteristics: source strength (high application rates), rainfall resulting in overland runoff, and a flow route that does not include transport through the soil.

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[19] National Oceanic and Atmospheric Administration. "Water Quality: How Toxic Runoff Affects Pacific Salmon and Steelhead." National Oceanic and Atmospheric Administration. 2012. Available at: http://www.westcoast.fisheries.noaa.gov/publications/habitat/fact_sheets/stormwater_fact_sheet.pdf

[20] Friends of the Earth Europe. "The environmental impacts of glyphosate." Friends of the Earth Europe. 2013. Available at: https://www.foeeurope.org/sites/default/files/press_releases/foee_5_environmental_impacts_glyphosate.pdf

[21] Coupe RH, Kalkhoff SK, Capel PD and Gregoire C, 2011. "Fate and transport of glyphosate and aminomethylphosphonic acid in surface waters of agricultural basin". Pesticide Management Science, 67, doi: 10.1002/ps.2212

Summary of Data on Glyphosate in Surface Waters
Source: Friends of the Earth Europe (2013)[22]

Country	Date	Occurrence of glyphosate residues and concentrations recorded	Source
Several	2005(published)	0.5-1.0µg/l	WHO[xlv]
US	2002	36% of samples, up to 8.7µg/l	Battaglin et al[xlvi]
Canada	2002	22% of samples, up to 6.07µg/l	Humphries et al [xlvii]
France	1999-2009	99% of samples, up to 86µg/l	Villeneuve et al [xlviii]
US	2004-2008	Most rivers 100%, up to 430µg/l after a storm	Coupe et al [xlix]
Germany	1998	Found in two rivers in the Ruhr, up to 0.59µg/l	Skart et al [l]
Hungary	2010-11	Found in 2010 only, up to 0.1µg/l	Mortl et al [li]
Norway	1995-99	Up to 1µg/l	Ludvigsen et al [lii]

Glyphosate residues have also been detected at low levels in groundwater, which is used for drinking water. "The European Glyphosate Environmental Information Sources (EGEIS) summarized groundwater monitoring from over 8900 European locations between 1993 and 2009, and found a low percentage (1.3%) contaminated with glyphosate, with 270 (.07%) samples above the maximum permitted in drinking water (0.1 ug/litre).[23] Monitoring of small boreholes in four Danish counties found Glyphosate present in 8.8% of the wells analyzed, with 3.4% exceeding the drinking water maximum. In France, Glyphosate accounted for 2.9% of all samples exceeding the drinking water limit in samples of raw water destined for public supply (2000-2002). Results of monitoring in Catalonia in north east Spain between 2007 and 2010 found Glyphosate in 41% of 140 groundwater samples, with a maximum of 2.5µg/litre and an average of

[22] Friends of the Earth Europe, "The environmental impacts of glyphosate." Friends of the Earth Europe. 2013. Available at: https://www.foeeurope.org/sites/default/files/press_releases/foee_5_environmental_impacts_glyphosate.pdf

[23] Horth H., 2010. EGEIS, Monitoring results for surface and groundwater. Available at: http://www.egeis.org/documents/11%20Detection%20in%20SW%20and%20GW%20draft%20v3.pdf

0.2µg/litre[24]."[25]

A more recent 2014 study by researchers from the US Geological Survey (USGS) entitled; "Glyphosate and Its Degradation Product AMPA Occur Frequently and Widely in U.S. Soils, Surface Water, Groundwater, and Precipitation"[26] summarizes the results of 3,732 water and sediment and 1,018 quality assurance samples between 2001 and 2010 from 38 states. They found Glyphosate in 39.4% of samples (1470 out of 3732) and its metabolite AMPA (aminomethylphosphonic acid) in 55% of samples (2,052 out of 3732). Water samples included streams, groundwater, ditches and drains, rivers, soil water, lakes, ponds, wetlands, precipitation, soil and sediment, and waste water treatment plants.[27]

Other U.S. studies have also detected Glyphosate in the air and rain and in water from spring snow-melt[28]. A study from U.S. Geological Survey entitled; "Pesticides in Mississippi air and rain; A comparison between 1995 and 2007", disclosed that glyphosate was found in over 75% of air and rain samples tested in Mississippi in 2007.[29] The study revealed that involuntary exposure to the herbicide can be significant.

Another 2009 study by U.S. Geological Survey scientists entitled "Glyphosate and AMPA in U.S. streams, groundwater, precipitation and soils"[30] analyzed over 2000 water and sediment samples from locations distributed across the U.S. Glyphosate was detected

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[24] Sanchis J et al. *Determination of glyphosate in groundwater samples using an ultrasensitive immunoassay and confirmation by on-line solid-phase extraction followed by liquid chromatography coupled to tandem mass spectrometry*. Analytical and Bioanalytical Chemistry. 2012. 402 :2335-2345

[25] Friends of the Earth Europe. *The environmental impacts of glyphosate*. Friends of the Earth Europe. Friends of Earth Europe. 2013. Available at: https://www.foeeurope.org/sites/default/files/press_releases/foee_5_environmental_impacts_glyphosate.pdf

[26] Battaglin WA, Meyer MT, Kuivila KM, and Dietze JE. *Glyphosate and Its Degradation Product AMPA Occur Frequently and Widely in U.S. Soils, Surface Water, Groundwater, and Precipitation.* Journal of the American Water Resources Association (JAWRA) 2014, 50, 275-290, DOI:10.111/jawr.12159. Available at: http://onlinelibrary.wiley.com/doi/10.1111/jawr.12159/abstract

[27] Sirinathsinghiji, E. *Widespread Glyphosate Contamination in USA*. ISIS Report August 2014. Institute of Science in Society. Available at: http://www.i-sis.org.uk/Widespread_Glyphosate_Contamination_in_US.php

[28] Battaglin W.A., Rice K.C., Focazio M.J., Salmons S., and Barry R.X. *The occurrence of glyphosate, atrazine, and other pesticides in vernal pools and adjacent streams in Washington, DC, Maryland, Iowa, and Wyoming, 2005–2006.* Environmental Monitoring and Assessment. 2009. 155, 281-307.

[29] Majewski M.S., Coupe R.H., Foreman W.T., Capel P.D. *Pesticides in Mississippi air and rain: A comparison between 1995 and 2007.* Environ Toxicol Chem. 2014 Feb 19. doi: 10.1002/etc.2550.

[30] Battaglin W.A., Meyer M., Kuivila K., and Dietze J. *Glyphosate and AMPA in U.S. streams, groundwater, precipitation and soils.* Journal of the American Water Resources Association (JAWRA). Geological Society of America. 2009. Available at: http://pubs.er.usgs.gov/publication/70046159

in rain (86%), ditches and drains (71%), soil (63%), groundwater (3%), and large rivers (18%). AMPA was detected in rain (86%), soil (82%), large rivers (78%), groundwater (8%) and wetlands or vernal pools (37%).

Study results indicate that Glyphosate is more mobile and occurs more widely in the environment than was previously thought.

C. Glyphosate and Its Metabolites Can Persist For Many Years In The Environment, Depending On Conditions

A number of studies have shown that, depending on conditions, Glyphosate and its metabolites can persist for many years in the environment. Nomura and Hilton (1977) reported glyphosate half-lives of **up to 22 years** in soils with pH<6 and organic matter contents of over 90 g kg^{-1}.[31] AMPA, a toxic and major metabolite of glyphosate, has also been found to be very persistent, with a half-life in soil between 119 and 958 days.[32] [33] In water, glyphosate has a long persistence in sediments.

Hun-Min Hwang and Thomas M. Young Environmental Quality Laboratory Department of Civil and Environmental Engineering, University of California, Davis prepared a report for MMWD about MMWD watershed lands entitled; "Final Report - Environmental decay of glyphosate in broom-infested Mt. Tamalpais soils and its transport through stormwater runoff and soil column infiltration". The report reached the following conclusions:

- Half-life in soil of Glyphosate and its metabolite AMPA**:**
  The half-life of glyphosate in soil was 44 days. The half-life of AMPA in soil was 46 days.
- Half-life in broom leaves that failed to drop to ground:
  Concentrations of glyphosate in broom leaves didn't exhibit significant changes over the 84 days of the study period, indicating that half-life of glyphosate is likely to be much longer than 84 days as long as the leaves remain attached to the stems and branches.

Other records of glyphosate persistence include[34] [35]:

- 249 days on Finnish agricultural soils;
- Between 259 and 296 days on eight Finnish forestry sites;
- Between one and three years on 11 Swedish forestry sites;
- 335 days on a Canadian forestry site;
- 360 days on three Canadian forestry sites;

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[31] Nomura, N.S., Hilton, H.W., *The adsorption and degradation of glyphosate in five Hawaiian sugarcane soils*. Weed Res. 1977. 17:113–121.

[32] World Health Organization (WHO). *Glyphosate. Environmental Health Criteria 159.* The International Programme on Chemical Safety (IPCS). WHO, Geneva. 1994.

[33] Buffin, D., Jewell, T. *Health and Environmental Impacts of Glyhosate*. Pesticide Action Network UK. 2001. Available at: http://www.foe.co.uk/sites/default/files/downloads/impacts_glyphosate.pdf

[34] Reviewed by Cox, C., 1995b op cit 12.

[35] Buffin, D., Jewell, T. *Health and Environmental Impacts of Glyhosate.* Pesticide Action Network UK. 2001. Available at: http://www.foe.co.uk/sites/default/files/downloads/impacts_glyphosate.pdf

- 12 to 60 days in pond water following direct application;
- Glyphosate residues in pond sediment were found 400 days after direct application;
- More than one year in studies of pond sediments in the US.

Glyphosate travels through soil, air and water. The longer Glyphosate persists in the environment, the greater the chance of cumulative impacts and exposure of non-target plants, wildlife, pets and humans to the herbicide. Residents, pets and wildlife could be exposed to Glyphosate by walking through open space and breathing in contaminated airborne dust particles. Children could be exposed while playing on a contaminated field. Children, pets and wildlife could also be exposed by drinking water from contaminated streams and ponds.

III. THE TOXIC EFFECTS OF GLYPHOSATE ON NON-TARGET PLANTS, AQUATIC ORGANISMS, AMPHIBIANS, REPTILES, INVERTEBRATES, ANIMALS, AND HUMANS

A. Glyphosate Use Would Harm Beneficial Vegetation

Glyphosate can be acutely toxic to non-target plants, including aquatic plants and algae. The effects of this toxicity on natural plant succession alters the ecology of treated areas. In most cases, the plant species diversity will decrease, and along with it, the numbers of insects, mammals and birds utilizing these areas as habitat.[36] [37]

1. Review Of How Glyphosate Kills Plants**:**

As mentioned before, besides being a broad-spectrum systemic patented herbicide, Glyphosate is also a patented mineral chelator, antibiotic, and desiccant. It disrupts plants' metabolic shikimate pathway, which starves plants of essential nutrients and weakens their immune systems. Moreover, Glyphosate's desiccating effects reduce a plant's ability to uptake water. It essentially gives the plants a condition similar to "Aids".

As a powerful antibiotic, Glyphosate also kills beneficial bacteria and other microorganisms in the soil. Beneficial organisms fix atmospheric nitrogen for plants' consumption and are necessary for healthy plant growth.[38] Without these beneficial microorganisms in the soil to compete with and suppress harmful plant soil-borne pathogens, the lethal soil-borne pathogens, such as Fusarium (**see below), take over and ultimately kill the weakened plants.[39] [40]

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[36] Santillo, D.J. et al (1989), "Response of songbirds to glyphosate-induced habitat changes on clear-cut." Journal of Wildlife Management, v. 53 no. 1, 64-71.

[37] Connor, J.F. and McMillan, L.M. (1990), "Winter utilization by moose of glyphosate-treated cutovers." Alces 26:91-103.

[38] Carlisle, S.M. and Trevors, J.T. (1988), "Glyphosate in the environment." Water, Air, and Soil Pollution 39:409-420.

[39] Levesque, C.A. (1987), "Effects of glyphosate on Fusarium spp.: its influence on root colonization of weeds, propagule density in the soil, and crop emergence." Can. J Microbiol. Vol 33, pp 354-360.

[40] Sanogo, S., et al,(2000) "Effects of herbicides on Fusarium solani f. sp glycines and development of sudden death syndrome in glyphosate-tolerant soybean." Phytopathology, v. 90 (N1): 57-66.

***Fusarium is a naturally occurring soil fungus that is a plant pathogen. Fusarium invades the roots of plants and either kills the plant outright or prevents normal growth.*[41]

Moreover, if you destroy the beneficial bacteria and microorganisms in the soil, then the desired plants you replace the invasive plants with will not have the soil components they need to survive.

2. How Glyphosate Kills Non-Target Plants:

Glyphosate doesn't just kill the targeted weeds but kills adjacent beneficial vegetation too. Glyphosate can readily desorb from soil particles in some soil types and can be highly mobile in the soil environment. Glyphosate travels from the root system of the targeted weed into the soil where it is picked up by adjacent roots of desirable plants and trees, ultimately killing them.

Don Huber PhD and Joe Holland authored an article on glyphosate and plant diseases in the European Journal of Agronomy (2009). The article demonstrates that Glyphosate predisposes plants and trees to disease and toxins. The article shows that glyphosate can increase the spread of Phytophthora (Sudden Oak Death) in oak trees (non-target species) among other plants.

Glyphosate is also a threat to non-target plants as a result of spray drift from target areas. In the US, sub-lethal doses of herbicides have been blamed for reducing winter hardiness and resistance to fungal diseases in trees.[42]

Studies of the impact of spray drift include:

- "A study of the effects of spray drift of a glyphosate formulation on British species commonly found in nature reserves. The plant species were exposed to spray drift at different distances, wind speeds and application rates (o.5 and 2.2 kg a.i./ha). Death and severe growth suppression occurred at a distance of 2-6 meters from the sprayer. Sub-lethal effects could be detected up to 20 metres away for one species, Prunella vulgaris (self heal). Some species were consistently more sensitive including Digitalis purpurea (foxglove), Centaurea nigra (hard head), Prunella vulgaris (self heal) and Lychnis flos-cuculi (ragged robin). Epinasty (more rapid growth of the upper side of an organ causing for example curling in a leaf) was the most frequent symptom of damage[43]…
- A study looked at species typical to UK woodland margins, hedgerows and field margins. The plant communities were exposed to glyphosate and other herbicides each year for at least three years. The effects of sub-lethal doses were measured on species yield, flowering performance, seed production, seed variability and invasion of new species. All species showed some effects within

[41] Levesque, C.A. (1987), "Effects of glyphosate on Fusarium spp.: its influence on root colonization of weeds, propagule density in the soil, and crop emergence." Can. J Microbiol. Vol 33, pp 354-360.

[42] ENDS Report 193, February 1991.

[43] Marrs R.H., Williams, C.T., Frost, A.J. and Plant, R.A. 1989. Assessment of the effects of herbicide spray drift on a range of plant species of conservation interest. Environ. Pollut 59(1), 71-86. Cited in WHO, 1994 op cit 7.

an eight-metre zone[44]…

- A UK Forestry Commission study into the decline of hedgerow ash found that 19 percent of hedgerow ash showed symptoms of dieback. Trees in rural areas were more badly affected than urban trees. In rural areas, dieback was strongly associated with arable land. The Forestry Commission believes that hormone and glyphosate herbicides commonly affect hedgerow trees and may in part be responsible for the dieback in ash.[45„ 46]

B. Toxic Effects of Glyphosate on Aquatic Organisms

Glyphosate can contaminate surface water either directly as a result of aquatic weed control or indirectly when glyphosate bound to soil particles is washed into rivers, streams, lakes and estuaries[47].

Studies show that peak herbicide concentrations tend to occur during the first runoff after herbicide application and that herbicide flushes can occur during runoff for several weeks to months following application.

When herbicides enter our waterways via stormwater runoff, they can cause a variety of adverse effects to aquatic species. In addition to directly impacting salmon and steelhead, the toxics can harm or kill the aquatic insects that salmon eat. Pollution risks vary depending on the particular chemical, the amount transported in stormwater, and environmental persistence.[48]

Studies with fish show that glyphosate can be moderately toxic alone, but when combined with the surfactant normally found in commercial products, the toxicity is greater.[49] [50] Glyphosate and commercially formulated products containing POEA (Polyoxyethylenetallowamine) surfactant are toxic to fish and to some aquatic

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[44] Marrs, R.H. and Frost, A.J., 1997. A microcosm approach to the detection of the effects of herbicide spray drift in plant communities. J. of Environ.

[45] Forestry Commission. Bulletin 93, Ash dieback. HMSO. London. (Reported in: ENDS Report 193, February 1991.)

[46] Buffin D, Jewell T. Health and environmental impacts of glyphosate. 2001: 16. Pesticide Action Network UK. Available at: http://www.foe.co.uk/sites/default/files/downloads/impacts_glyphosate.pdf

[47] World Health Organisation (WHO), 1994. Glyphosate. Environmental Health Criteria 159. The International Programme on Chemical Safety (IPCS). WHO, Geneva.

[48] National Oceanic and Atmospheric Administration, 2012. Water Quality: How Toxic Runoff Affects Pacific Salmon and Steelhead. National Oceanic and Atmospheric Administration. Available at: http://www.westcoast.fisheries.noaa.gov/publications/habitat/fact_sheets/stormwater_fact_sheet.pdf

[49] Folmar, L.C. et al (1979) "Toxicity of the herbicide glyphosate and several of its formulations to fish and aquatic invertebrates." Archives of Environmental Contamination and Toxicology, v 8, 269-278.

[50] Austin, A.P., et al (1991), "Impact of an organophosphate herbicide (glyphosate) on periphyton communities developed in experimental streams." Bulletin of Environmental Contamination and Toxicology, v. 47, 29-35.

invertebrates[51] [52]. POEA is about 30 times more toxic to fish than glyphosate[53].

The toxicity of glyphosate increases with higher temperatures in fish; one study found that the toxicity of glyphosate doubled in bluegill and in rainbow trout test subjects when the temperature of the water was increased from 45 to 63 degrees F.[54] [55]

The thesis entitled; "Neurotoxicity of pesticides to salmon: Physiology to Ethology" by Keith Bryan Tierney with the Simon Fraser University Biological Sciences Department[56], demonstrates that pesticides routinely found in the environment can adversely affect neurological systems in salmon. When the nervous system is affected, it impairs environmental information about food, predators, mates, siblings or environmental conditions.

The major focus of Tierney's studies is on the impairment of the relatively exposed olfactory sensory neurons (OSNs), since their functionality is critical to several indispensable behaviors. The responses of OSNs to various behaviorally-relevant odorants were impaired following exposure to several pesticide classes, including triazine (e.g. atrazine), carbamate (e.g. IPBC), organophosphorus (e.g. dimethoate), and phenylurea (e.g. linuron) pesticides, as well as a pesticide formulation (i.e. Roundup). In many cases, within minutes of exposure to environmentally realistic (part per billion) concentrations, impairments of greater than 50% in OSN responses were noted.

In an exposure, the uptake and distribution of pesticides and their metabolites have capacity to alter the neurological system. Clearly, the impairment of this system translates to a genuine survival challenge.

C. Toxic Effects of Glyphosate on Amphibians

Vernal pools are sensitive environments that provide critical habitats for many species, including amphibians. In 2005 and 2006, water samples were collected from vernal pools and adjacent flowing waters in parks in Iowa, Washington, D.C., and Maryland, prior to and just after the local use of glyphosate (Battaglin et al. 2008)[57]. At each site

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[51] World Health Organisation (WHO), 1994. Glyphosate. Environmental Health Criteria 159. The International Programme on Chemical Safety (IPCS). WHO, Geneva.

[52] Cox, C., 1995b. Glyphosate, Part 2: Human Exposure and Ecological Effects. J. Pesticide Reform 15 (4), 14-20.

[53] Servizi, J.A., Gordan, R.W. and Martens, D.W., 1987. Acute toxicity of Garlon 4 and Roundup herbicides to salmon, Daphnia and trout. Bull. Environ. Contam. Toxicol. 33, 355-361. Cited in Cox, C. 1995b op cit 12.

[54] Folmar, L.C. et al (1979) "Toxicity of the herbicide glyphosate and several of its formulations to fish and aquatic invertebrates." Archives of Environmental Contamination and Toxicology, v 8, 269-278.

[55] Austin, A.P., et al (1991), "Impact of an organophosphate herbicide (glyphosate) on periphyton communities developed in experimental streams." Bulletin of Environmental Contamination and Toxicology, v. 47, 29-35.

[56] Tierney, K., 2007. Neurotoxicity of pesticides to salmon: Physiology to ethology. Simon Fraser University. Available at: http://summit.sfu.ca/item/8281

[57] Battaglin, W. A., K. C. Rice, M. J. Focazio, S. Salmons, and R. X. Barry.

there was a treatment pool (with adjacent glyphosate use), a control pool (with no glyphosate use nearby), and a flowing stream (with multiple potential glyphosate sources). In addition, a park in Wyoming was a study control with no reported glyphosate use nearby. Results indicate that vernal pools and adjacent streams can be contaminated by the use of herbicides within parks to control weeds in cropped areas or to kill noxious or nonindigenous plants. Contamination also originates from pesticide use occurring outside park boundaries (Battaglin et al. 2008)[58]. Glyphosate was detected in 31 of 76 samples with a maximum concentration of 328 µg/L, measured in a sample collected from a vernal pool in Rock Creek Park, Washington, D.C. That sample was collected seven days after glyphosate was applied by backpack sprayer in the area near the site to control lesser celandine (Ranunculus ficaria) and one day after approximately 3 cm of rain fell at the site.

Deleterious effects on the development and survival of amphibians have been observed at various levels of exposure to commercial glyphosate formulations, in some cases at concentrations of 1,000 µg/L or less (Cauble and Wagner 2005[59]; Edginton et al. 2004[60]; Howe et al. 2004[61]; Relyea 2005[62]; Dinehart et al. 2009[63]). Most of these studies indicate that commercial glyphosate formulations are more toxic than pure glyphosate due to the effects of the surfactants used (Howe et al. 2004[64]: Bringolf et al. 2007[65]).

2009. The occurrence of glyphosate, atrazine, and other pesticides in vernal pools and adjacent streams in Washington, D.C., Maryland, Iowa, and Wyoming, 2005-200. Environmental Monitoring and Assessment 155:281-307

[58] Battaglin, W. A., K. C. Rice, M. J. Focazio, S. Salmons, and R. X. Barry.
2009. The occurrence of glyphosate, atrazine, and other pesticides in vernal pools and adjacent streams in Washington, D.C., Maryland, Iowa, and Wyoming, 2005-200. Environmental Monitoring and Assessment 155:281-307

[59] Cauble, K., and R. S. Wagner. 2005. Sublethal effects of herbicide glyphosate on amphibian metamorphosis and development. Bulletin of Environmental Contamination and Toxicology 75:429–435.

[60] Edginton, A. N., P. M. Sheridan, G. R. Stephenson, D. G. Thompson, and
H. J. Boermans. 2004. Comparative effects of pH and Vision® on two life stages of four anuran amphibian species. Environmental Toxicology and Chemistry 23(4):815–822

[61] Howe, C. M., M. Berrill, B. D. Pauli, C. C. Helbing, K. Werry, and N.
Veldhoen. 2004. Toxicity of glyphosate-based pesticides to four North
American frog species. Environmental Toxicology and Chemistry 23(8):1928–1934.

[62] Relyea, R. A. 2005. The lethal impacts of Roundup® and predatory stress on six species of North American tadpoles. Archives of Environmental Contaminant Toxicology 48:351–357.

[63] Dinehart, S. K., L. M. Smith, S. T. McMurry, T. A. Anderson, P. N. Smith, and D. A. Haukos. 2009. Toxicity of a glufosinate- and several glyphosate-based herbicides to juvenile amphibians from the Southern High Plains, USA. Science of the Total Environment 407:1065–1071.

[64] Howe, C. M., M. Berrill, B. D. Pauli, C. C. Helbing, K. Werry, and N.
Veldhoen. 2004. Toxicity of glyphosate-based pesticides to four North
American frog species. Environmental Toxicology and Chemistry
23(8):1928–1934.

[65] Bringolf, R. B., W. G. Cope, S. Mosher, M. C. Barnhart, and D. Shea. 2007. Acute and chronic toxicity of glyphosate compounds to glochidia and juveniles of Lampsilis siliquoidea (Unionidae). Environmental Toxicology and Chemistry 26(10):2094–2100.

For example, a University of Pittsburgh study by Dr. Rick Relyea entitled; “The Impact of Insecticides and Herbicides on the Biodiversity and Productivity of Aquatic Communities”[66] examined the impact of four globally common pesticides, including Roundup, on the biodiversity of aquatic communities containing algae and 25 species of animals. The study revealed that the application of Roundup, at a concentration equivalent to direct overspray on a wetland (3.8 mg glyphosate/L), resulted in a 22% reduction in species richness of all animal taxa in the communities. Moreover, Roundup completely eliminated two species of tadpoles and nearly exterminated a third species, resulting in a 70% decline in the species richness of tadpoles.

The toxic effect of Glyphosate on amphibians could increase the risk of West Nile Virus: Research has shown that Glyphosate kills tadpoles and frogs. Since these amphibians eat mosquito larvae, use of Glyphosate, due its harm to the amphibians, could significantly increase the risk of West Nile Virus. [67]

D. Toxic Effects of Glyphosate on Reptiles and Potential Increase in the Risk of Lyme Disease

According to Jacob Leone ND reporting to the Marin Health Council on March 25, 2014, Lyme disease is endemic to California and Marin County. Regarding epidemiology, he reported that there is greater incidence of Lyme disease in Marin County than HIV or Breast Cancer.

An article entitled; “Lizard, Tick, Lyme Disease Study Yields Surprise” by David Perlman stated; "The tiny black-legged ticks, abundant throughout the woods of Northern California, carry microbes that can cause Lyme disease in humans they bite. The common Western Fence Lizards eat those ticks by the millions. Wherever the lizards abound, the population of disease- carrying ticks would be low. That's what scientists have believed. And the smaller the tick population, the lower the risk of Lyme disease. Fewer lizards should result in more of the dangerous ticks. Western fence lizards carry a protein in their blood that kills the Borrelia bacteria, which cause Lyme disease. When the ticks feed on the lizards' blood, the protein cleanses their bodies of the bacteria, so their annoying bites no longer pose a Lyme disease risk."[68]

“In 1998 it was discovered that when a Western black-legged tick feeds on a Western fence lizard, the Lyme disease causing bacteria, *Borrelia Borgdorferi*, is killed. The tick lives but its blood is cleansed of the *Borrelia* bacteria, so its next bite becomes more of a nuisance than a threat to one's health.” “In areas with Western Fence Lizards, about 5% of ticks carry the disease, while in other areas 50% of ticks harbor the disease.”[69]

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[66] Relyea, R. 2005. The Impact of Insecticides and Herbicides on the Biodiversity and Productivity of Aquatic Communities. Ecological Society of America. 15(2):618-627. Available at: http://whyy.org/91FM/ybyg/relyea2005.pdf

[67] Richard A. Relyea, PhD. Ecological Applications, vol.15, No.2, 2005

[68] Perlman, D., Feb. 22, 2011. Lizard, Tick, Lyme Disease Study Yields Surprise. SF Gate

[69] Website of Hastings, a biological Field Station of the University of California. Available at: http://www.hastingsreserve.org/

A study on the impact of glyphosate formulations with POEA on the New Zealand Common Skink, a type of lizard, found that skinks sprayed with glyphosate plus POEA selected warmer microclimates and had slower sprint speeds, which can result in lower survival rates.[70] Selecting hotter microclimates can lead to dehydration and greater predation rates, as skinks are more likely to be basking in exposed areas. Sprint speed is an important predictor of lizard health and survival as lizards with slow sprint speeds find it harder to capture prey and escape predators.[71] Based on the study's findings, New Zealand's Department of Conservation expressed concern about the use of glyphosate formulations containing POEA in areas that are inhabited by rare or threatened lizard species.[72]

Although the study did not specifically examine the impact of glyphosate formulations with POEA on the Western Fence Lizard, it is reasonable to expect that the formulations could have a similar adverse impact on the Western Fence Lizard as they did on the New Zealand Common Skink. If so, then the use of Glyphosate formulations could reduce Western Fence Lizards populations and thereby increase the percent of ticks that harbor Lyme disease.

E. Toxic Effects of Glyphosate on Invertebrates

Studies have shown that glyphosate can have both a direct toxic effect and an indirect impact due to habitat change or destruction on invertebrates.

1. Direct and Indirect Toxic Effects of Glyphosate on Forest-Dwelling Invertebrates:

Below are two studies that demonstrate a direct toxic effect and indirect effect due to habitat change on forest-dwelling invertebrates:

- "A laboratory study found that Roundup exposure caused a decrease in the survival and a decrease in body weight of woodlice[73]."[74]
- "In the US, a three-year study found that herbivorous insects and ground invertebrates were significantly reduced up to three years after treatment with Roundup in a four-to-five-year-old clear-cut planted with spruce seedlings. The vegetation did not recover over the study period and the authors concluded that the effects on the forest organisms were mainly due to habitat change[75]."[76]

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[70] Carpenter, J. K., 2013. Evaluating the effect of glyphosate formulations on the New Zealand common skink (Oligosoma polychroma) (Honours thesis). Victoria University of Wellington, Wellington.

[71] Miles, D. B., 2004. The race goes to the swift: fitness consequences of variation in sprint performance in juvenile lizards. Evolutionary Ecology Research, 6(1), 63- 75.

[72] Carpenter, J. The effect of glyphosate herbicides on lizards. New Zealand Department of Conservation – Te Papa Atawbai. Available at: http://www.ecogecko.co.nz/documents/glyphosate%20lizards.pdf

[73] Mohamed, A.I. et al, 1992. Effects of pesticides on the survival, growth and oxygen consumption of Hemilepistus reaumuri. Trop. Zool. 5, 145-153. Cited in Cox 1995b (Reference 12).

[74] Buffin, D., Jewell, T., Health and environmental impacts of glyphosate. 2001: 19. Pesticide Action Network UK. Available at: http://www.foe.co.uk/sites/default/files/downloads/impacts_glyphosate.pdf

[75] 172. Cited in WHO, 1994 op cit 7.

2. Indirect Toxic Effects of Glyphosate on Monarch Butterflies:
Glyphosate's indirect effect on invertebrates due to habitat destruction is also exemplified by the decline of Monarch butterfly numbers.[77] A 2011 study led by Isabel Ramirez at Universidad Nacional Autonoma found that Monarch butterfly migration abundance had been declining over the previous 17 years due to extreme weather conditions, over-logging of the Monarch's migratory destination in Mexico and herbicidal destruction (via glyphosate use) of their breeding grounds in the US. The larvae of this species feed almost exclusively on milkweed plants, making abundance of Monarch butterflies critically dependent on milkweed availability. Yet, milkweed is being destroyed by glyphosate treatment of GM crops. Studies assessing milkweed population in Iowa recorded a 90% and 79% loss between 1999-2009 and 2000-2009 respectively. The authors speculate that with such widespread glyphosate usage, milkweed may almost completely disappear from croplands altogether, resulting in a further decline of Monarch butterflies.[78]

3. Direct Toxic Effects of Glyphosate on Honeybees:
A 2014 Study entitled; "Effects of field-realistic doses of Glyphosate on honeybee appetitive behavior"[79] shows that Glyphosate can disrupt learning behaviors in honeybees and severely impair long-term colony performance. The scientists who conducted the study used field-realistic levels of glyphosate, similar to what honeybees may encounter on a farm growing GMOs. They found that learning behavior (elemental learning and non-elemental associative learning) and short-term memory retention decreased significantly compared with control groups. Since the bees don't die immediately when exposed to glyphosate, they bring the chemical back to the hive, where larvae come into contact with it. The scientists speculate that "successful forager bees could become a source of constant inflow of nectar with Glyphosate traces that could then be distributed among nest-mates, stored in the hive and have long-term negative consequences on colony performance."[80]

F. Toxic Effects Of Glyphosate On Animals And Humans
In March 2015, the International Agency for Research on Cancer (IARC), part of the World Health Organization (WHO), determined that glyphosate is probably carcinogenic

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[76] Buffin, D., Jewell, T., Health and environmental impacts of glyphosate. 2001:19. Pesticide Action Network UK. Available at: http://www.foe.co.uk/sites/default/files/downloads/impacts_glyphosate.pdf

[77] Sirinathsinghji, E. ISIS Report 19/09/11: Glyphosate and Monarch Butterfly Decline. Institute of Science in Society. 2011. Available at: http://www.i-sis.org.uk/Glyphosate_and_Monarch_Butterfly_Decline.php

[78] Sirinathsinghji, E. ISIS Report 19/09/11: Glyphosate and Monarch Butterfly Decline. Institute of Science in Society. 2011. Available at: http://www.i-sis.org.uk/Glyphosate_and_Monarch_Butterfly_Decline.php

[79] Herbert LT, Vazquez DE, Arenas A, Farina WM. 2014. Effects of field-realistic doses of glyphosate on honeybee appetitive behavior. The Company of Biologists Ltd. Available at: http://www.ncbi.nlm.nih.gov/pubmed/25063858

[80] Herbert LT, Vazquez DE, Arenas A, Farina WM. 2014. Effects of field-realistic doses of glyphosate on honeybee appetitive behavior. The Company of Biologists Ltd. Available at: http://www.ncbi.nlm.nih.gov/pubmed/25063858

to humans and therefore classified the herbicide as a Group 2A carcinogen.[81] [82]

Based on that classification and pursuant to state law, the state Office of Environmental Health Hazard Assessment (OEHHA) has issued a notice of intent to list Glyphosate and several other chemical insecticides and pesticides as chemicals "known to the state" to cause cancer under the Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65).

According to the report "GMO Myths and Truths – Edition 2" by genetic engineers John Fagan, PhD, Michael Antoniou, PhD, and Claire Robinson, MPhil; "Toxic effects of glyphosate and Roundup include disruption of hormonal systems and beneficial gut bacteria, damage to DNA, developmental and reproductive toxicity, birth defects, cancer, and neurotoxicity."[83]

"Roundup and other glyphosate herbicide formulations have never been tested or assessed for long-term safety for regulatory purposes. Only glyphosate alone was tested. Even the industry tests on glyphosate alone revealed toxic effects, including malformations[84]."[85]

Based on outdated and unpublished studies on the isolated ingredient glyphosate, commissioned by manufacturers in support of their application for regulatory authorization[86], the GMO and Pesticide industry authors claim that glyphosate and glyphosate herbicide formulations are non-toxic to animals and humans because glyphosate's sole mechanism of toxicity is the shikimate biochemical pathway, which plants have but animals lack.[87] This is false, as glyphosate also affects other pathways

[81] Bunge, J., Health Agency Says Widely Used Herbicide Likely Carcinogenic. Wall Street Journal. 2015. Available at: http://www.wsj.com/articles/health-agency-says-widely-used-herbicide-likely-carcinogenic-1426885547

[82] American Cancer Society, Known and Probable Human Carcinogens. American Cancer Society. 2015. Available at: http://www.cancer.org/cancer/cancercauses/othercarcinogens/generalinformationaboutcarcinogens/known-and-probable-human-carcinogens

[83] Fagan J PhD, Antoniou M PhD, Robinson C MPhil. GMO Myths and Truths 2nd Edition. Earth Open Source. 2014:4.1:205. Available at: http://earthopensource.org/earth-open-source-reports/gmo-myths-and-truths-2nd-edition/

[84] Antoniou M, Habib MEM, Howard CV, et al. Teratogenic effects of glyphosate-based herbicides: Divergence of regulatory decisions from scientific evidence. J Env Anal Toxicol. 2012;S4:006. doi:10.4172/2161-0525.S4-006.

[85] Fagan J PhD, Antoniou M PhD, Robinson C MPhil. GMO Myths and Truths 2nd Edition. Earth Open Source. 2014:4.1:205. Available at: http://earthopensource.org/earth-open-source-reports/gmo-myths-and-truths-2nd-edition/

[86] European Commission Health & Consumer Protection Directorate-General. Review report for the active substance glyphosate. 2002.

[87] European Commission Health & Consumer Protection Directorate-General. Review report for the active substance glyphosate. 2002.

that are present in animals and humans.[88]

"Glyphosate and Roundup have been found to interfere with the retinoic acid signaling pathway, which affects gene expression in animals and humans. When disrupted, it can result in the development of malformations. Glyphosate and Roundup negatively affect gut bacteria that are vital to the healthy functioning of the immune system. Glyphosate is a chelator of essential nutrient metals, making them unavailable to the plant and therefore to the consumer. Glyphosate and Roundup are endocrine Disruptors, an effect that can lead to multiple health problems during development and adult life.

The endocrine disruptive effects are most worrying, as they manifest at very low doses and can lead to ill health when exposure takes place over long periods of time."[89]

Study findings regarding the endocrine-disruptive effect of glyphosate and its commercial formulations include the following:

- "Glyphosate herbicide altered hormone levels in female catfish and decreased egg viability. The study concluded that the herbicide is harmful to catfish reproduction. Roundup disrupted production of the steroid hormone progesterone in mouse cells. Glyphosate herbicide was a potent EDC in rats, causing disturbances in reproductive development after exposure during puberty.[90]

- In an in vitro experiment in human cells, glyphosate herbicides prevented the action of androgens, the masculinizing hormones, at levels up to 800 times lower than glyphosate residue levels allowed in some GM crops used for animal feed in the USA. DNA damage was found in human cells treated with glyphosate herbicides at these levels. Glyphosate herbicides disrupted the action and formation of estrogens, the feminizing hormones. The first toxic effects were found at the low dose of 5 ppm and the first endocrine disruption at 0.5 ppm – 800 times less than the 400 ppm level authorized for some animal feeds.[91]

- Roundup herbicide at environmentally relevant exposure levels (down to 0.00023% glyphosate dilution of the commercial formulation) caused the dysregulation of large numbers of genes in human breast cancer cells grown in the laboratory in vitro. Of the 1,550 genes analyzed, expression of 680 was either increased or decreased. Roundup was able to replace and work synergistically

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88 Fagan J PhD, Antoniou M PhD, Robinson C MPhil. GMO Myths and Truths 2nd Edition. Earth Open Source. 2014:4.1:205. Available at: http://earthopensource.org/earth-open-source-reports/gmo-myths-and-truths-2nd-edition/

89 Fagan J PhD, Antoniou M PhD, Robinson C MPhil. GMO Myths and Truths 2nd Edition. Earth Open Source. 2014:4.1:215. Available at: http://earthopensource.org/earth-open-source-reports/gmo-myths-and-truths-2nd-edition/

90 Romano RM, Romano MA, Bernardi MM, Furtado PV, Oliveira CA. Prepubertal exposure to commercial formulation of the herbicide Glyphosate alters testosterone levels and testicular morphology. Arch Toxicol. 2010;84:309-317.

91 Gasnier C, Dumont C, Benachour N, Clair E, Chagnon MC, Séralini GE. Glyphosate-based herbicides are toxic and endocrine disruptors in human cell lines. Toxicology. 2009;262:184-91. doi:10.1016/j.tox.2009.06.006.

with estrogen, which is required for growth of the breast cancer cells. This demonstrates the strong potential endocrine disruptive potential of glyphosate in this hormonal system. The authors commented, "There remains an unclear pattern of very complex events following exposure of human cells to low levels of glyphosate, but events surrounding the altered levels of expression of only three genes... out of the entire battery tested, are both complicated and potentially damaging to adult and fetal cells."[92]

- Glyphosate alone increased the proliferation of estrogen-dependent breast cancer cells by estrogenic mechanisms in vitro.[93]

- An in vivo study of Roundup administered to rats in drinking water diluted to 50 ng/L glyphosate equivalence – half of the level permitted in drinking water in the EU[94] and 14,000 times lower than that permitted in drinking water in the USA[95] – resulted in severe organ damage and a trend of increased incidence of mammary tumours in female animals over a 2-year period of exposure.[96] This type of non-linear endocrine disruptive effect of glyphosate and Roundup is not taken into account in safety evaluations, resulting in exposures to the public that could lead to severe illness and reproductive and developmental problems."[97]

G. Glyphosate Herbicide Formulations With Added Adjuvants Are More Toxic Than Glyphosate Alone

According to the report "GMO Myths and Truths – Edition 2" by genetic engineers John Fagan, PhD, Michael Antoniou, PhD, and Claire Robinson, MPhil; "Commercial glyphosate herbicide formulations contain extra added ingredients (adjuvants) and are more toxic than glyphosate alone."[98] "The added ingredients (adjuvants) are toxic[99] and

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[92] Hokanson R, Fudge R, Chowdhary R, Busbee D. Alteration of estrogen-regulated gene expression in human cells induced by the agricultural and horticultural herbicide glyphosate. Hum Exp Toxicol. 2007;26:747-52. doi:10.1177/0960327107083453.

[93] Thongprakaisang S, Thiantanawat A, Rangkadilok N, Suriyo T, Satayavivad J. Glyphosate induces human breast cancer cells growth via estrogen receptors. Food Chem Toxicol. 2013. doi:10.1016/j.fct.2013.05.057.

[94] Council of the European Union. Council directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption. Off J Eur Communities. 1998. Available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do? uri=OJ:L:1998:330:0032:0054:EN:PDF.

[95] US Environmental Protection Agency (EPA). Basic information about glyphosate in drinking water. 2014. Available at: http://water.epa.gov/drink/contaminants/basicinformation/glyphosate.cfm#four.

[96] Séralini GE, Clair E, Mesnage R, et al. [RETRACTED:] Long term toxicity of a Roundup herbicide and a Roundup- tolerant genetically modified maize. Food Chem Toxicol. 2012;50:4221-4231.

[97] Fagan J PhD, Antoniou M PhD, Robinson C MPhil. GMO Myths and Truths 2nd Edition. Earth Open Source. 2014:4.1:215. Available at: http://earthopensource.org/earth-open-source-reports/gmo-myths-and-truths-2nd-edition/

[98] Fagan J PhD, Antoniou M PhD, Robinson C MPhil. GMO Myths and Truths 2nd Edition. Earth Open Source. 2014:4.1:205. Available at: http://earthopensource.org/earth-open-source-reports/gmo-myths-and-truths-2nd-edition/

[99] Bradberry SM, Proudfoot AT, Vale JA. Glyphosate poisoning. Toxicol Rev. 2004;23:159–

increase the toxicity of glyphosate by enabling it to penetrate plant and animal cells more easily, making it more bioavailable.[100] [101] [102],[103]

"In an in vitro study, eight out of nine major pesticides tested in vitro in their complete formulations, including Roundup, were up to 1,000 times more toxic to human cells than their isolated active ingredients. This increased toxicity of the complete formulation compared with the active ingredient alone was found to be a general principle of pesticide toxicology.[104],[105]

In June 2009, Scientific American published an article by Crystal Gammon and Environmental Health News entitled; "Weed-Whacking Herbicide Proves Deadly to Human Cells". The article is about a 2008 research study by Nora Benachour and Gilles-Eric Seralini, molecular biologists at University of Caen, France, entitled; "*Glyphosate Formulations Induce Apoptosis and Necrosis in Human Umbilical, Embryonic, and Placental Cells*"[106]. Benachour and Seralini "found that Roundup's inert ingredients amplified the toxic effect on human cells—even at concentrations much more diluted than those used on farms and lawns."[107]

POEA (polyethoxylated tallowamine) is a surfactant, or detergent, derived from animal fat. It is added to Roundup and other herbicides to help them penetrate plants' surfaces, making the weed killers more effective.

According to Crystal Gammon, "Researchers Benachour and Seralini tested four different Roundup formulations, all containing POEA and glyphosate at concentrations

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167.

[100] Benachour N, Séralini GE. Glyphosate formulations induce apoptosis and necrosis in human umbilical, embryonic, and placental cells. Chem Res Toxicol. 2009;22:97–105. doi:10.1021/tx800218n.

[101] Haefs R, Schmitz-Eiberger M, Mainx HG, Mittelstaedt W, Noga G. Studies on a new group of biodegradable surfactants for glyphosate. Pest Manag Sci. 2002;58:825-33. doi:10.1002/ps.539.

[102] Richard S, Moslemi S, Sipahutar H, Benachour N, Seralini GE. Differential effects of glyphosate and Roundup on human placental cells and aromatase. Env Health Perspect. 2005;113:716-20.

[103] Fagan J PhD, Antoniou M PhD, Robinson C MPhil. GMO Myths and Truths 2nd Edition. Earth Open Source. 2014:4.1:206. Available at: http://earthopensource.org/earth-open-source-reports/gmo-myths-and-truths-2nd-edition/

[104] Mesnage R, Defarge N, de Vendomois JS, Séralini GE. Major pesticides are more toxic to human cells than their declared active principles. BioMed Res Int. 2014;2014. doi:10.1155/2014/179691.

[105] Fagan J PhD, Antoniou M PhD, Robinson C MPhil. GMO Myths and Truths 2nd Edition. Earth Open Source. 2014:4.1:206-207. Available at: http://earthopensource.org/earth-open-source-reports/gmo-myths-and-truths-2nd-edition/

[106] Benachour, N. Seralini, G. Glyphosate Formulations Induce Apoptosis and Necrosis in Human Ubilical, Embryonic, and Placental Cells. 2008. American Chemical Society. Journal Chemical Research in Toxicology (Jan. 2009). Available at: http://pubs.acs.org/doi/abs/10.1021/tx800218n

[107] Gammon, C. Environmental Health News. 2009. Weed-Whacking Herbicide Proves Deadly to Human Cells. Scientific American. Available at: http://www.scientificamerican.com/article/weed-whacking-herbicide-p/

below the recommended lawn and agricultural dose. They also tested POEA and glyphosate separately to determine which caused more damage to embryonic, placental and umbilical cord cells."[108]

Seralini's team studied multiple concentrations of Roundup, which "ranged from the typical agricultural or lawn dose down to concentrations 100,000 times more dilute than the products sold on shelves. The researchers saw cell damage at all concentrations."[109]

Benachour and Seralini demonstrated that "Glyphosate, POEA and all four Roundup formulations damaged all three cell types (embryonic, placental and umbilical cord cells). Umbilical cord cells were especially sensitive to POEA. Glyphosate became more harmful when combined with POEA, and POEA alone was more deadly to cells than glyphosate." – a finding the researchers call "astonishing."[110]

"This clearly confirms that the inert ingredients in Roundup formulations are not inert," wrote Benachour and Seralini, "Moreover, the proprietary mixtures available on the market could cause cell damage and even death at the residual levels found on Roundup-treated crops, such as soybeans, alfalfa and corn, or lawns and gardens."[111]

Similarly, the study entitled; "*Differential Effects of Glyphosate and Roundup on Human Placental Cells and Aromatase"* by Sophie Richard, Safa Moslemi, and Gilles-Eric Seralini (June 2005) noted that: "Surprisingly, Roundup is always more toxic than its active ingredient (glyphosate)"… and that "…the presence of Roundup adjuvants enhances glyphosate bioavailability and/or bioaccumulation."[112]

In conclusion, adjuvants have been proven to be extremely toxic by themselves and to dramatically amplify the toxicity of the main active ingredient of an herbicide. Complete herbicide formulations are up to 1000 times the toxicity of their isolated active ingredients.

H. Children Are Particularly Vulnerable to Pesticides, including Glyphosate
According to the article by Pesticide Action Network North America entitled; "A

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[108] Gammon, C. Environmental Health News. 2009. Weed-Whacking Herbicide Proves Deadly to Human Cells. Scientific American. Available at: http://www.scientificamerican.com/article/weed-whacking-herbicide-p/

[109] Gammon, C. 2009. Weed killer kills human cells. Study intensifies debate over 'inert' ingredients. Environmental Health News. Available at: http://www.environmentalhealthnews.org/ehs/news/roundup-weed-killer-is-toxic-to-human-cells.-study-intensifies-debate-over-inert-ingredients

[110] Gammon, C. Environmental Health News. 2009. Weed-Whacking Herbicide Proves Deadly to Human Cells. Scientific American. Available at: http://www.scientificamerican.com/article/weed-whacking-herbicide-p/

[111] Gammon, C. Environmental Health News. 2009. Weed-Whacking Herbicide Proves Deadly to Human Cells. Scientific American. Available at: http://www.scientificamerican.com/article/weed-whacking-herbicide-p/

[112] Richard S, Moslemi S, Sipahutar H, Benachour N, Seralini GE. Differential effects of glyphosate and Roundup on human placental cells and aromatase. Env Health Perspect. 2005;113:716-20. Available at: http://www.ncbi.nlm.nih.gov/pubmed/15929894

Generation In Jeopardy"[113], pesticides are undermining our children's health and intelligence. Children are particularly vulnerable because of the following well-documented pesticide exposure pathways:

1. "In their first six months of life, children take in roughly 15 times more water than the average adult per pound of body weight.[114] Children also inhale more air. Up to around age 12, a child's breathing rate is roughly twice that of an adult, which means a child will inhale roughly double the dose of a pesticide in the air from spray drift or household use."[115] [116]

2. "Exposure to pesticides occurs largely through touching, inhaling or ingesting. For each of these routes, children are much more likely to absorb what they come into contact with than adults. The skin of infants and young children, for example, is particularly permeable, and the skin surface area relative to body weight is much greater in children than adults.[117] The lung surface area relative to rate of breathing is also higher among children,[118] and absorption levels in the gastrointestinal tract are also greater (especially for alkaline pesticides), as adult levels of gastric acid are not reached until a child is about two years old."[119] [120]

3. "As noted above, the brain and nervous system are especially vulnerable during fetal development and for the first six months of life. During this period the blood-brain barrier, which provides the adult nervous system some protection from toxic substances, is not yet fully developed."[121] [122]

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[113] Schafer, K. Marquez, E. 2012. A Generation in Jeopardy – How pesticides are undermining our children's health & intelligence. Pesticide Action Network North America

[114] Landrigan, P.J., L. Claudio, S.B. Markowitz, G.S. Berkowitz, B.L. Brenner, H. Romero, et al. "Pesticides and Inner-City Children: Exposures, Risks, and Prevention." Environ Health Persp. June 1999. 107 Suppl 3.: 431-437.

[115] Miller, M.D., M.A. Marty, A. Arcus, J. Brown, D. Morry and M. Sandy. "Differences Between Children and Adults: Implications for Risk Assessment at California EPA." International Journal of Toxicology. October 2002 21(5): 403-418.

[116] Schafer, K. Marquez, E. 2012. A Generation in Jeopardy – How pesticides are undermining our children's health & intelligence. Pesticide Action Network North America

[117] Miller, M.D., M.A. Marty, A. Arcus, J. Brown, D. Morry and M. Sandy. "Differences Between Children and Adults: Implications for Risk Assessment at California EPA." International Journal of Toxicology. October 2002 21(5): 403-418.

[118] Bennet, W.D. and K.L. Zeman. "Effect of Body Size on Breathing Pattern and Fine-particle Deposition in Children." Journal of Applied Physiology. Sept 2004 97(3): 821-826.

[119] Louis, G.B., United Nations Environment Programme, International Laour Organisation, World Health Organization, Inter-Organization Programme for the Sound Management of Chemicals, and International Program on Chemical Safety. "Principles for evaluating health risks in children associated with exposure to chemicals." 2006. Available at: http://site.ebrary.com/id/10214527.

[120] Schafer, K. Marquez, E. 2012. A Generation in Jeopardy – How pesticides are undermining our children's health & intelligence. Pesticide Action Network North America

[121] Schwenk, M., U. Gundert-Remy, G. Heinemeyer, K. Olejniczak, R. Stahlmann, W. Kaufmann, et al. "Children as a Sensitive Subgroup and Their Role in Regulatory Toxicology: DGPT Workshop Report." Archives of Toxicology. Jan 2003 77(1): 2-6. Louis et al. 2006, op. cit.

4. "Finally, young bodies are less equipped to process and excrete harmful chemicals as the liver and kidneys—the body's primary detoxifying organs—are not yet fully developed. Levels of enzymes that help the body process chemicals are also not yet at full strength."[123] [124]

These findings mean that children, as well as a subpopulation of adults, are much more likely to have adverse health effects from pesticide exposure. Policies should account for this variability and should protect all, including the most vulnerable.

I. The Amount Of Glyphosate Used When Sponge Dabbing The Herbicide Is Equal To Or Greater Than The Amount Used When Spraying The Substance

A number of vegetation managers assume that sponge dabbing Glyphosate on a weed is less toxic than spraying the substance. However, this supposition is incorrect. According to Dr. Don Huber (Emeritus Professor of Plant Pathology at Purdue University) and Bob Streit (Crop, Seed, Technology and Soil remediation Consultant), sponge dabbing typically uses a much higher concentration of Glyphosate than spraying. Therefore, when sponge dabbing weeds, the total amount of Glyphosate used would be about the same as spraying BUT the amount entering the soil at a particular site would be much greater!

IV. GLYPHOSATE INCREASES THE RISK OF FIRE, RUNOFF & EROSION, AND HERBICIDE-RESISTANT SUPER WEEDS

A. Glyphosate Is A Patented Desiccant And Could Greatly Increase The Risk Of Fire

Glyphosate is a patented desiccant. Its desiccating effects reduce a plant's ability to uptake water. As already mentioned, glyphosate has non-target impacts. Glyphosate use could lead to Sudden Oak Death (see below), Oak Wilt, and a host of Scorch Diseases in which plants can no longer absorb sufficient water and thereby become very flammable. More dry and dead non-target vegetation increases the risk of fire.

Don Huber PhD and Joe Holland authored an article on glyphosate and plant diseases in the European Journal of Agronomy (2009). The article demonstrates that Glyphosate predisposes plants and trees to disease and toxins. In Maryland parks, glyphosate was found to have a very deleterious effect on Red Oaks. The article shows that glyphosate can increase the spread of Phytophthora (Sudden Oak Death) in oak trees among other plants.

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[122] Schafer, K. Marquez, E. 2012. A Generation in Jeopardy – How pesticides are undermining our children's health & intelligence. Pesticide Action Network North America

[123] Furlong, C.E., N. Holland, R. Richter, A. Bradman, A. Ho and B. Eskenazi. "PON! Status of Farmworker Mothers and Children as a Predictor of Organophosphate Sensitivity." Pharmacogenetics and Genomics. March 2006 16(3): 183–190.

[124] Schafer, K. Marquez, E. 2012. A Generation in Jeopardy – How pesticides are undermining our children's health & intelligence. Pesticide Action Network North America

B. Glyphosate Changes The Soil Composition And Could Increase Runoff & Erosion

The New York Times article by Stephanie Strom entitled; "Misgivings About How A Weed Killer Affects The Soil"[125] explains the negative effects glyphosate has on soil, effects that include compaction and resultant increased run-off.

Biotech crops, such as Roundup Ready crops, are genetically engineered to withstand Glyphosate-based herbicides. The use of Glyphosate has grown exponentially, along with biotech crops. Pervasive use of Glyphosate has caused the rise of superweeds, which are more resistant to the herbicide. To fight them, farmers sometimes have to spray the toxic herbicide two to three times during the growing season.

Strom interviewed a number of farmers who are rethinking their methods. Dennis Von Arb, a farmer in Iowa, stated; "Anything you put on the land affects the chemistry and biology of the land, and that's a powerful pesticide (Glyphosate)." Mike Verhoef, another farmer in Iowa, said he switched to biotech corn and soybeans on his 330 acres and almost immediately problems occurred. He noticed that his soil was becoming harder and more compact, requiring a bigger tractor and more gas to pull the same equipment across it. As a result, Verhoef switched back to growing conventional crops again.

Strom also noted; "Dirt in two fields around Alton where biotech corn was being grown was hard and compact. Prying corn stalks from the soil with a shovel was difficult, and when the plants finally came up, the roots were trapped in a chunk of dirt. In comparison, conventional corn in adjacent fields could be tugged from the ground by hand, and dirt with the consistency of coffee grounds fell off the corn plants' knobby roots."

"Because glyphosate moves into the soil from the plant, it seems to affect the rhizosphere, the ecology around the root zone, which in turn can affect plant health", said Robert Kremer Ph. D., Professor of Soil Microbiology at University of Missouri and recently retired USDA scientist, who has studied the impact of Glyphosate on soybeans for more than a decade and has warned of the herbicide's negative impact on soil health.[126]

Compaction of soil affects the water-holding capacity of the soil and reduces the infiltration rate, which further accelerates erosion by increasing the risk of water run-off.[127] [128]

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[125] Strom S. 2013. Misgivings About How Weed Killer Affects The Soil. New York Times. Available at: http://www.nytimes.com/2013/09/20/business/misgivings-about-how-a-weed-killer-affects-the-soil.html

[126] Strom S. 2013. Misgivings About How Weed Killer Affects The Soil. New York Times. Available at: http://www.nytimes.com/2013/09/20/business/misgivings-about-how-a-weed-killer-affects-the-soil.html

[127] Glyphosate.eu. 2013 The problem of soil erosion in Europe. Available at: http://www.glyphosate.eu/problem-soil-erosion-europe

[128] European Soil Data Centre. 2009. Water erosion and compaction. European Soil Data Centre. Available at: http://esdac.jrc.ec.europa.eu/projects/SOCO/FactSheets/ENFactSheet-02.pdf

C. Glyphosate-Resistant Super Weeds

Consistent with herbicides used in the past, weeds resistant to glyphosate are causing huge agronomic and ecological concerns as farmers are forced to abandon whole fields of crops.[129]

The spread of glyphosate-resistant weeds is increasing dramatically. Since the commercialism of Roundup Ready Crops in 1996, resistant weed species have been emerging at a rate of 1 per year. Glyphosate-resistance was first documented in ryegrass in 1996 in Australia. Up until 2003, 5 resistant populations had been documented worldwide. Since 2007, there has been a 5-fold increase in the spread of resistant weeds. In 2010, world-wide coverage was estimated to have reached 120 million hectares and US coverage was estimated at 4.5 million hectares, with 13 different species in 73 different locations.[130]

The super weeds' mechanisms for resistance include reduced glyphosate uptake, and/or mutations in the EPSPS gene that make it less susceptible to inhibition by the herbicide.

Resistant weed species listed by the WeedScience database include: Palmer Amaranth, Common Waterhemp, Common Ragweed, Giant Ragweed, Ripgut Brome, Australian Fingergrass, Hairy Fleaben, Horseweed, Sumatran Fleabane, Sourgrass, Julnglerice, Goosegrass, Kochia, Tropical Sprangletop, Italian Ryegrass, Perennial Ryegrass, Rigid Ryegrass, Ragweed Parthenium, Buckhorn Plantain, Annual Bluegrass, Johnsongrass, Gramilla mansa and Liverseedgrass.[131]

Glyphosate-resistant weeds are not restricted to areas near fields of crops. Resistance can occur in any location where multiple rounds of herbicide treatments are applied, including forests, open spaces, and parks. Resistant common Waterhemp was first documented in fields in Missouri, US, in 2004, after 6 consecutive years of growing Roundup Ready soybeans.[132] Similarly, during a 2014 lecture in Marin County, Bob Streit (Crop, Seed, Technology and Soil remediation Consultant) stated that herbicide-resistant super weeds could develop after multiple consecutive years of using glyphosate-based herbicides on weeds in the Marin Municipal Water District Watershed.

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[129] Ho, M. ISIS Report 01/02/10: GM Crops Facing Meltdown in the USA. Institute of Science in Society. 2010. Available at: http://www.i-sis.org.uk/GMCropsFacingMeltdown.php

[130] Sirinathsinghji, E. ISIS Report 28/11/11: Monsanto Defeated by Roundup Resistant Weeds. Institute of Science in Society. 2011. Available at: http://www.i-sis.org.uk/Monsanto_defeated_by_herbicide_resistant_superweeds.php

[131] Ho M., Sirinathsinghji E. Why Glyphosate Should be Banned – A Review of Its Hazards to Health and the Environment. Institute of Science in Society. 2012; 5.1 Available at: http://permaculturenews.org/2012/11/01/why-glyphosate-should-be-banned-a-review-of-its-hazards-to-health-and-the-environment/

[132] Ho M., Sirinathsinghji E. Why Glyphosate Should be Banned – A Review of Its Hazards to Health and the Environment. Institute of Science in Society. 2012: 5.1 Available at: http://permaculturenews.org/2012/11/01/why-glyphosate-should-be-banned-a-review-of-its-hazards-to-health-and-the-environment/

V. COUNTRIES AND LOCAL JURISDICTIONS THAT HAVE BANNED GLYPHOSATE

The following Countries and local jurisdictions have banned glyphosate:

A. Netherlands

In 2014, the Dutch Parliament voted to ban glyphosate herbicides for non-commercial use in the Netherlands, starting the end of 2015.[133]

B. Sri Lanka

In May 2015, Sri Lanka's president, Maithripala Sirisena, announced that the import of glyphosate would no longer be allowed in the country. Sri Lanka had already banned the sale of glyphosate herbicides in March of 2014, but the decision was overturned in May 2014 after a review. The new ban by President Sirisena (elected in January 2015 after the overturn of the previous ban) is expected to stand. The ban is largely due to the association of Glyphosate use with rising rates of chronic kidney disease (CKD) throughout the Sri Lankan Farming community. CKD has affected 15% of people working in the northern part of Sri lanka, of which 400,000 patients, and 20,000 deaths are related to Monsanto's chemicals.[134]

C. Bermuda

In May 2015, Bermuda Minister of Health, Jeanne Atherden, announced that, effective immediately, any importation of Glyphosate/Roundup has been suspended, pending the continuing assessment of the emerging research.[135] The suspension was made shortly after the International Agency for Research on Cancer (IARC), the cancer agency of the World Health Organization (WHO), identified Glyphosate to probably be carcinogenic to humans and classified the herbicide as a Group 2A carcinogen.

D. France

In June 2015, French Ecology Minister Segolene Royal announced a ban on the sale of Glyphosate in garden centers throughout France.[136] The ban was enacted three months after the World Health Organization's classification of Glyphosate as being probably carcinogenic to humans.

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133 Lilley, J. "Netherlands Bans Monsanto's Roundup to Protect Citizens from Carcinogenic Glyphosate". Global Research. May 2015. Available at: http://www.globalresearch.ca/netherlands-bans-monsantos-roundup-to-protect-citizens-from-carcinogenic-glyphosate/5451552

134 Sarich, C. "Sri Lanka's Newly Elected President Bans Glyphosate (Monsanto Roundup) – Deadly Chronic Kidney Disease Increased 5-Fold". Global Research. May 2015. Available at: http://www.globalresearch.ca/sri-lankas-newly-elected-president-bans-glyphosate-monsanto-roundup-deadly-chronic-kidney-disease-increased-5-fold/5451936

135 Sarich, C. "Bermuda Suspends Glyphosate-Ridden Monsanto Roundup Indefinitely". Natural Society. May 2015. Available at: http://www.globalresearch.ca/bermuda-suspends-glyphosate-ridden-monsanto-roundup-indefinitely/5449207

136 Schlanger, Z. "France Bans Sales of Monsanto's Roundup in Garden Centers, 3 Months After U.N. Calls It 'Probable Carcinogen' ". Newsweek. June 2015. Available at: http://www.newsweek.com/france-bans-sale-monsantos-roundup-garden-centers-after-un-names-it-probable-343311

E. Town of Fairfax, California
In April 2001, the Town of Fairfax banned the use of pesticides, including Glyphosate, on town property.

F. City of Belvedere, California
In August 2005, the City Government of Belvedere resolved that the City shall only permit the application of pesticides to City-owned sites, which, if used on or around food crops, would allow such crops to carry the label "organic", pursuant to the U.S. Government National Organic Program for food production. The resolution was established in order to protect people and pets who use the recreation areas from the dangers of certain pesticides (including Glyphosate) and certain fertilizing chemicals.

G. City of Sausalito, California
In 2014, the City of Sausalito City Council voted for a moratorium on the use of Roundup and Surflan, pending a review of need and alternatives, on city parks, playgrounds, and open space.

H. City of Richmond, California
In February 2015, the City Council of Richmond California unanimously voted to enact a 12-month ban on all toxic pesticides, including Glyphosate.

I. Marin Municipal Water District
In July 2015, the Marin Municipal Water District (MMWD) Board of Directors voted to continue a ban on the use of pesticides, including Glyphosate, in the MMWD watershed.

J. School Districts in Marin County
The Reed School District in Tiburon, California, the Larkspur-Corte Madera School District in Corte Madera, California, and the Mill Valley School District in Mill Valley, California have banned the use of pesticides, including Glyphosate, on school grounds.

The above list of bans on Glyphosate and other pesticides not only reveals governments' concerns about the potential harm that the toxic herbicide(s) can cause, but also demonstrates their ability to manage vegetation without the use of Glyphosate and other pesticides.

VI. CONCLUSION

Using Glyphosate herbicides could not only harm beneficial vegetation and wildlife but could also jeopardize public health and safety. This risk is unnecessary and unacceptable.

In accordance with the Marin County Precautionary Principle, which requires "the selection of the alternative that presents the least potential threat to human health and the natural systems", we recommend a Glyphosate-free approach to vegetation management.