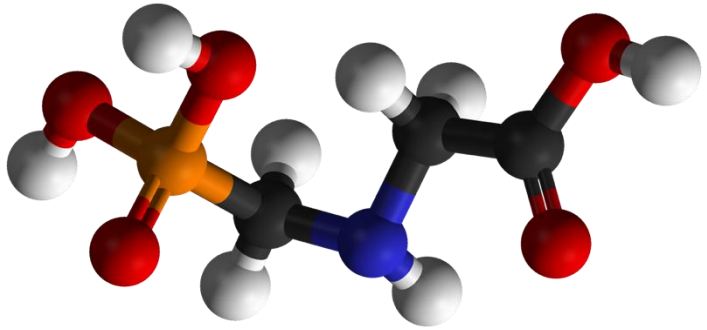


Glyphosate: Far More Toxic than We have been Led to Believe

Stephanie Seneff

MIT CSAIL

In support of Friends Of Rod Cumberland, New Brunswick

January 26, 2021

“The earth is not dying, it is being killed,
and those who are killing it have names and addresses.”

-- the late activist musician Utah Phillips.

Is Glyphosate Nontoxic?

- Glyphosate is the most used herbicide on the planet, and it is a widespread contaminant in our food supply
- Monsanto has argued that glyphosate is harmless to humans because our cells don't have the shikimate biological pathway which glyphosate disrupts in plants
- However, our gut bacteria DO have this pathway
  - We depend on them to supply us with essential amino acids produced through that pathway, and with many other nutrients such as vitamins and short chain fatty acids
- Other ingredients in Roundup greatly increase glyphosate's toxic effects
- Insidious effects of glyphosate accumulate over time
  - Most studies are too short to detect damage
- Recently, three successful lawsuits claiming that glyphosate caused non-Hodgkin's lymphoma are bringing public awareness to glyphosate's toxicity

Roundup Safety Claims Disputed*

"It is commonly believed that Roundup is among the safest pesticides. … Despite its reputation, Roundup was by far the most toxic among the herbicides and insecticides tested. This inconsistency between scientific fact and industrial claim may be attributed to huge economic interests, which have been found to falsify health risk assessments and delay health policy decisions."

*R. Mesnage et al., Biomed Research International, 2014; 2014: 179691

Many Toxic Effects of Glyphosate*

- Kills beneficial gut bacteria and allows pathogens to overgrow
  - Leads to inflammatory bowel disease and leaky gut
- Interferes with function of cytochrome P450 (CYP) enzymes in the liver
  - These enzymes serve many important roles, including making bile acids, activating vitamin D, detoxifying many toxic chemicals and breaking down prescription drugs
- Chelates (binds tightly to) important minerals like cobalt, manganese and zinc, making them unavailable to the cells
- Interferes with the synthesis of aromatic amino acids and methionine
- Depletes glutathione in the liver (important antioxidant)

*Samsel and Seneff, Entropy **2013**, *15*, 1416-1463

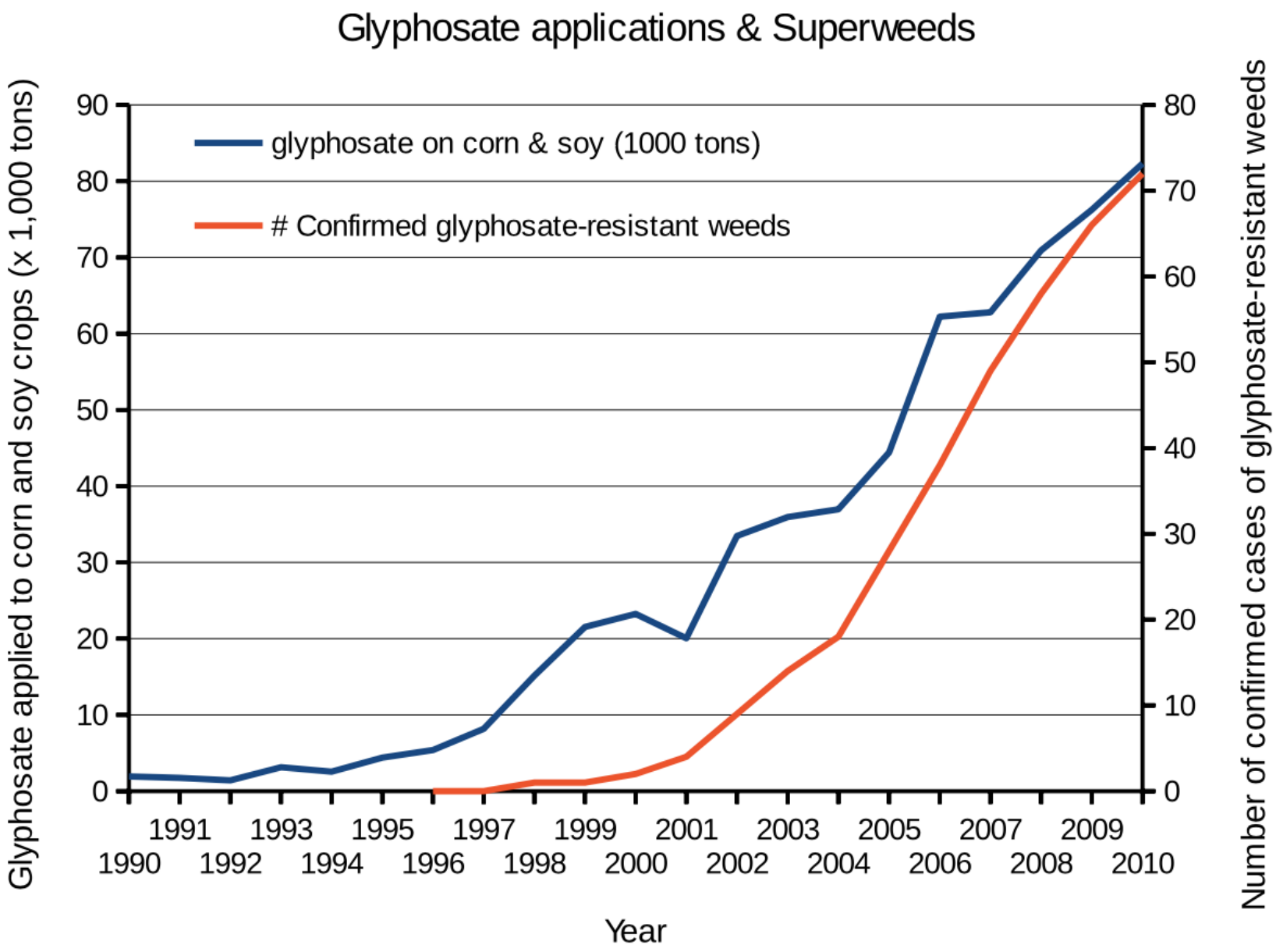


Figure 1: Glyphosate applications to corn, soy and cotton along with the advent of glyphosate-resistant weeds.

Glyphosate usage increased dramatically over time, likely because of the emergence of glyphosate-resistant weeds

*Judy Hoy et al., Poultry, Fisheries & Wildlife Sciences 2015; 3(1): 1000132.

A Veterinarian Speaks Out about Glyphosate Damage to Livestock*

Cattle herds in Saskatchewan, Canada, exposed to high glyphosate levels

- One herd:
  - Clostridia (pathogen) overgrowth
  - Large numbers of stillborns and weak calves with skeletal problems
  - Necropsies revealed large fatty livers that were mottled and friable
  - Glyphosate contamination at 448 ppb in the corn feed
- Another herd:
  - Coccidia infection in calves on a creep ration tested at 548 ppb glyphosate contamination
  - Removing feed and supplementing with iron and B vitamins reversed the problems

*Karen Briere, Oct. 19, 2017 http://www.producer.com/2017/10/glyphosate-on-feed-affects-livestock-vet/

Ib Pedersen: Pig Farmer in Europe*

- Glyphosate was found in the lungs, liver, kidney, brain, gut wall and heart of 38 malformed euthanized one-day-old Danish piglets
- Highest concentrations were in the lungs and heart

"The summary of my findings is, without a doubt, that Roundup sprayed on crops is the direct reason for the increase in fertility problems, abortions and deformities in animals and as a farmer, knowing how nature works, I quite expect that people are already affected."

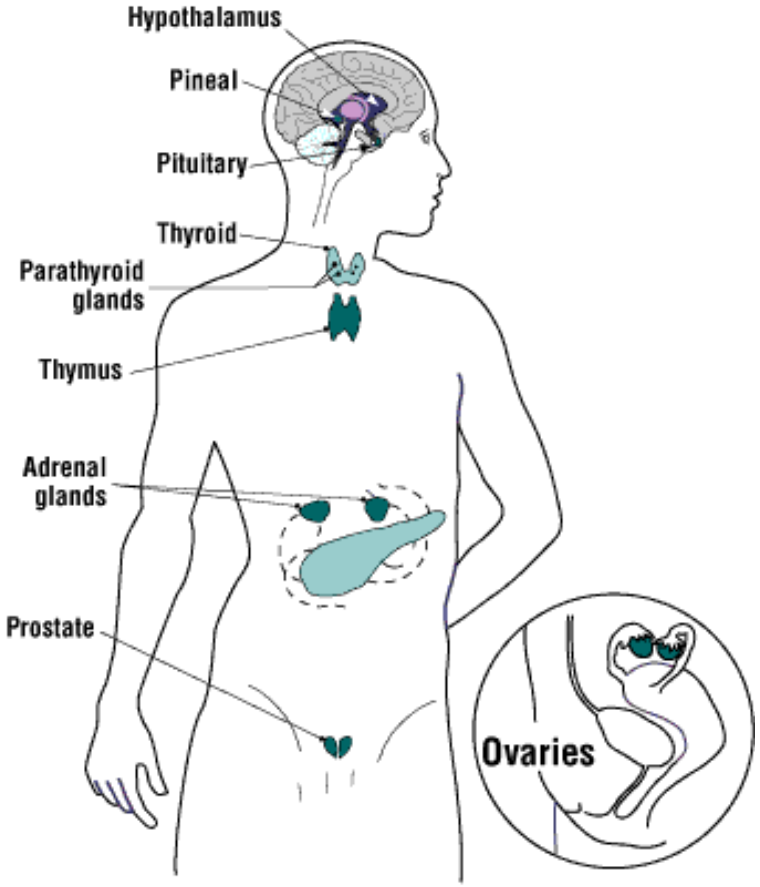
"Glyphosate is everywhere."

-- Ib Pedersen

* M Kruger et al. Detection of Glyphosate in Malformed Piglets J Environ Anal Toxicol 2014, 4:5

Glyphosate is an Endocrine Disruptor*

- Glyphosate at parts per trillion triggers estrogen-sensitive breast cancer cells to proliferate
- Glyphosate increases expression levels of estrogen and progesterone receptors
- Glyphosate-based herbicides disrupt the hypothalamic-pituitary-thyroid (HPT) axis
- Glyphosate alters circulating levels of hormones
  - Diminished serum progesterone and elevated serum estrogen in exposed mice
- Glyphosate induced hypothyroidism in female Wistar rats
- Glyphosate-based formulations altered reproductive developmental parameters in animal models
- Glyphosate induced malformation in zebrafish embryos



*Juan P. Muñoz et al. Chemosphere October 19, 2020 [Epub ahead of print]

Poultry, Fisheries & Wildlife Sciences

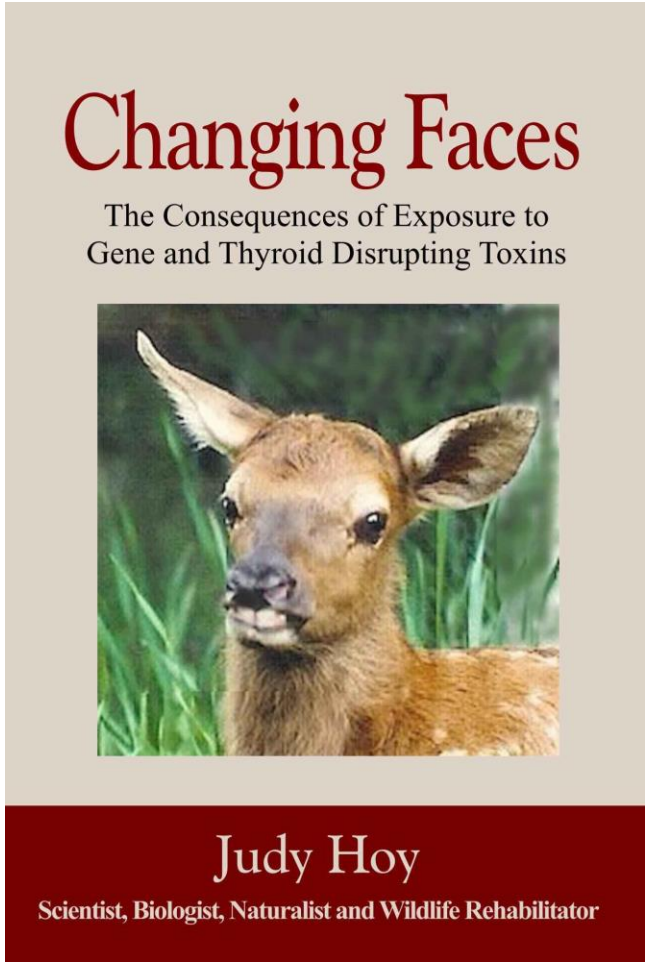
Hoy et al., Poult Fish Wildl Sci 2015, 3:1
http://dx.doi.org/10.4172/2375-446X.1000132

Research Article Open Access

The High Cost of Pesticides: Human and Animal Diseases

Judy Hoy[1], Nancy Swanson[2] and Stephanie Seneff[3]*

- The first author, Judy Hoy, runs a wildlife rehabilitation center in the Bitterroot Valley in Western Montana
- She has been tracking the dwindling numbers and decreasing health status of wildlife there for decades
- Dr. Nancy Swanson and I collaborated with her to compare health issues of the animals with those of humans in the United States



Newborn white-tailed deer have severely damaged thymuses*

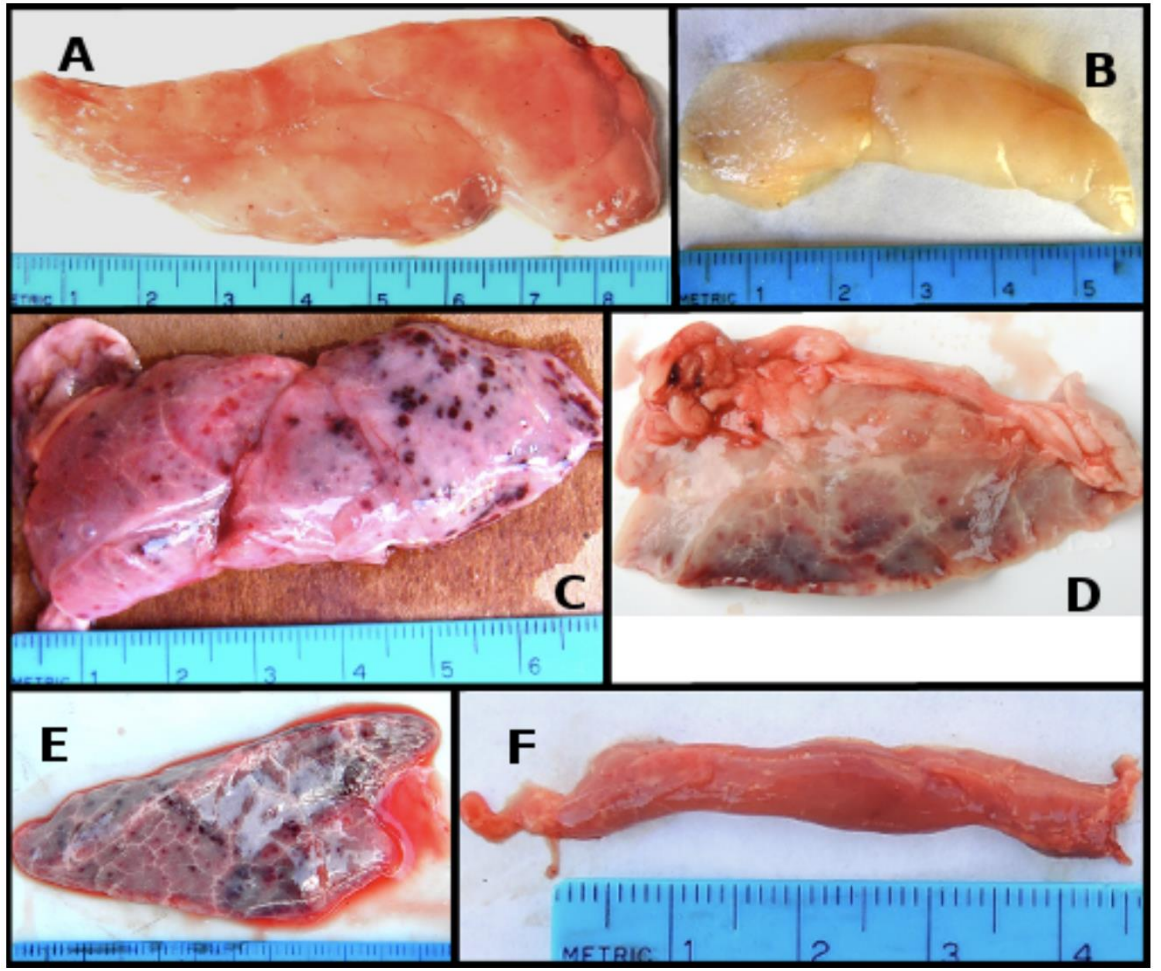


Figure 14: Newborn white-tailed deer thymus conditions. A and B. Normal thymus color and shape. C and D. Thymus with red spots throughout. E. Odd shaped, mostly red thymus. F. Undersized thymus, red throughout.

*Judy Hoy et al., Poultry, Fisheries & Wildlife Sciences 2015; 3(1): 1000132.

Some Correlations between Human Diseases and Glyphosate*

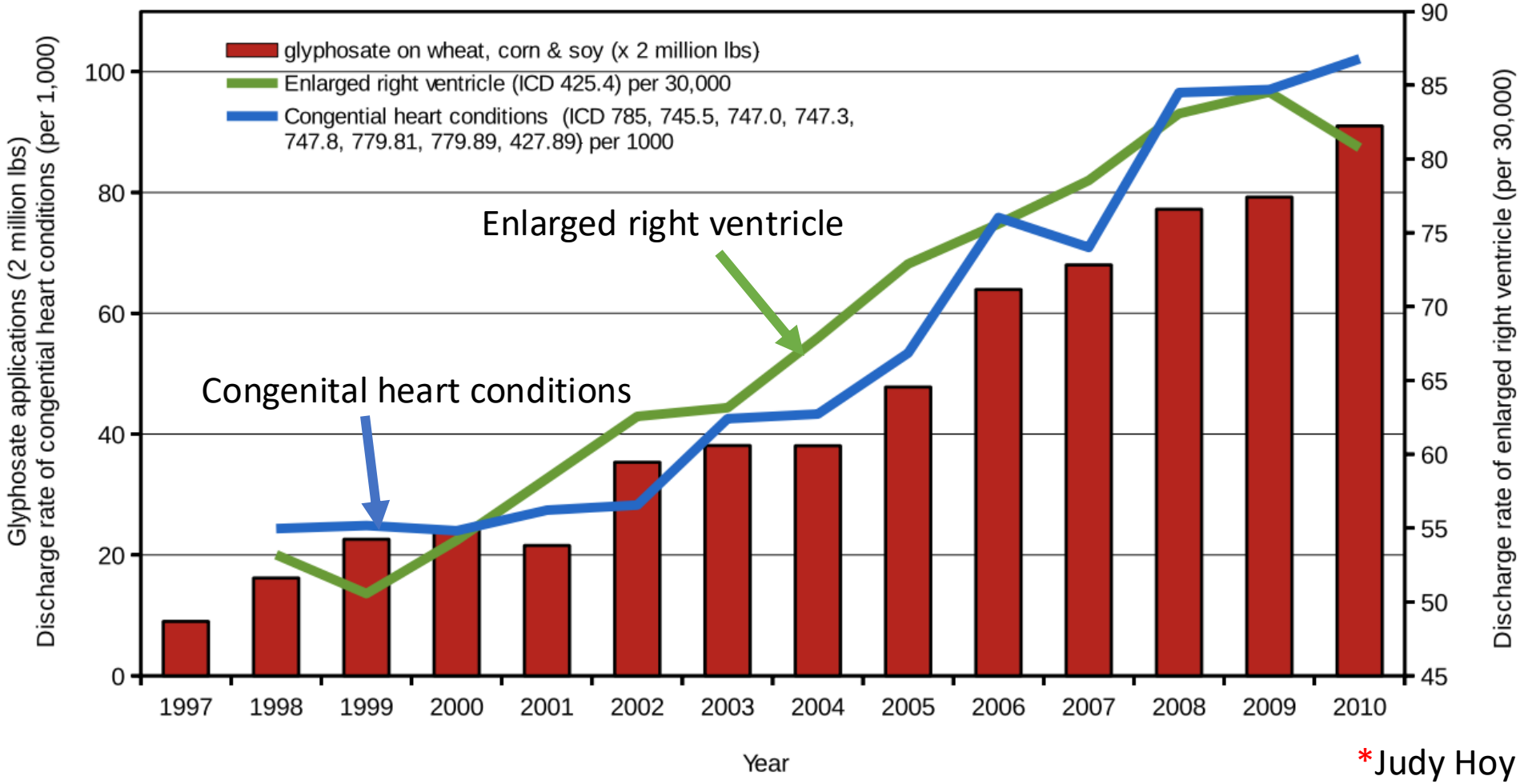
- Compared US government data on glyphosate usage and on human disease patterns over time from the 1998-2010 hospital discharge data
- Found striking correlations between the rise in glyphosate usage and multiple health issues in newborn babies:

• head and face anomalies	R=0.95
• blood disorders	R=0.92
• skin disorders	R=0.96
• metabolic disorders	R=0.95
• genitourinary disorders	R=0.96
• congenital heart conditions	R=0.98
• lung problems	R=0.95

R is the correlation coefficient characterizing how similar the two curves are. 1.0 is the highest value it can take, representing a perfect match.

*Judy Hoy et al., Poultry, Fisheries & Wildlife Sciences 2015; 3(1): 1000132.

Congenital heart conditions (newborns) and Enlarged right ventricle (adults)*



*Judy Hoy et al., Poultry, Fisheries & Wildlife Sciences 2015; 3(1): 1000132.

Cardiovasc Toxicol (2015) 15:117–126
DOI 10.1007/s12012-014-9282-y

Glyphosate-Based Herbicides Potently Affect Cardiovascular System in Mammals: Review of the Literature

Steeve Gress · Sandrine Lemoine · Gilles-Eric Séralini · Paolo Emilio Puddu

Is Glyphosate Causing an Epidemic in Fatty Liver Disease?

- Worldwide epidemic in fatty liver disease today*
- "Multiomics reveal non-alcoholic fatty liver disease in rats following chronic exposure to an ultra-low dose of Roundup herbicide"**
- Glyphosate correlated with fatty liver disease in humans***

Non-Alcoholic Fatty Liver Disease (NAFLD)

Hunterdon Gastroenterology Associates
Medical Experts in the Treatment of Digestive Diseases

* Chris Estes et al. Hepatology 2018; 67(1): 123-133.
** Robin Mesnage et al. Sci Rep 2017; 7: 39328.
*** PJ Mills et al. Clinical Gastroenterology and Hepatology 2020;18(3):741-743.

Effect of Glyphosate on Water Flea Embryos*

- Water fleas are near the bottom of the aquatic food chain
- Tadpoles, salamanders, newts, aquatic insects and many types of small fish feed on water fleas
- When water fleas are exposed to concentrations of Roundup and glyphosate well below the approved regulatory threshold, they suffered from:
  - Embryonic developmental failure
  - Systemic inflammation
  - Collagen degradation
  - Impaired wound healing
  - Disrupted gut microbes
- The animals that eat the water fleas pick up glyphosate from their food
- Effects on water fleas propagate up the food chain

*Suppa et al. Microbiome (2020) 8:170.

Epigenetic transgenerational toxicology through germline alterations by glyphosate*,**

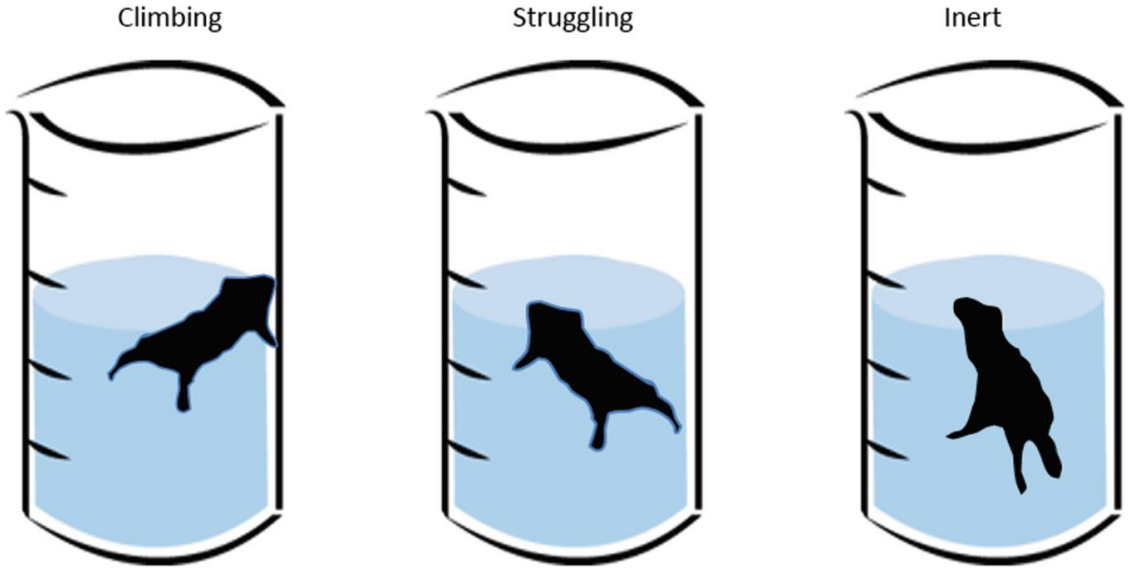
- Pregnant rats were exposed to glyphosate at half the No Observable Adverse Effect Level (NOAEL) from day 8 to day 14 of gestation (timed to match germ cell epigenetic programming)
- Offspring were bred to produce pups (F1), grandpups (F2) and great-grandpups (F3)
- Exposed rats showed no symptoms
- F1 generation were mostly fine
- F2 and especially F3 generations suffered from many diseases, including mammary tumors, delayed or early puberty, premature birth abnormalities, prostate disease, kidney disease, and obesity.

*Millissia Ben Maamar et al. Epigenetics 2020 Dec 9;1-18.

**Deepika Kubsad et al. Scientific Reports 2019; 9:6372.

“Developmental exposure to glyphosate-based herbicide and depressive-like behavior in adult offspring: Implication of glutamate excitotoxicity and oxidative stress”*

- Mother rats were exposed to glyphosate while pregnant and for fifteen days following birth of the offspring.
- The offspring suffered from glutamate excitotoxicity in their brains persistently even after exposure was terminated.
- When the offspring were 60 days old, they showed signs of depression in a forced swimming test.



*Daiane Cattani et al., Toxicology 2017; 387: 67-80.

Glyphosate at Low Levels Damaged Mouse Neurons in Vitro*

"Our findings demonstrated that the permissible concentrations of glyphosate in drinking water recognized by environmental protection authorities are capable of inducing neurotoxicity in the developing nervous system."

"Our findings signify the need to review the safety standards established by environmental protection agencies concerning safe glyphosate concentrations in drinking water."

*Muhammad Irfan Masood et al., Environmental Pollution 270 (2021) 116179.

Summary

- Glyphosate is the most used herbicide on the planet due in part to its falsely perceived nontoxicity
- Many diseases and conditions are rising in prevalence in step with the rise in glyphosate usage on core crops
  - In some cases, a direct link has been found in both humans and animal studies
- Much evidence has accumulated that glyphosate is an endocrine disruptor, causing developmental issues, hormone imbalances and cancer
- Recently, many new papers have appeared showing glyphosate toxic effects at exposure levels below regulatory limits and transgenerational effects
- We need to set a global goal of reducing the need for glyphosate in agriculture and in the forest industry

*“Children today are sicker than they were a generation ago. From childhood cancers to autism, birth defects and asthma, a wide range of childhood diseases and disorders are on the rise. Our assessment of the latest science leaves little room for doubt: pesticides are one key driver of this sobering trend.”**

*A Generation in Jeopardy
http://www.panna.org/sites/default/files/KidsHealthReportOct2012.pdf