EFFECTS REPORTED BY PEER REVIEWED STUDIES CONCERNING EXPOSURE TO CHLOROTHALONIL, IMIDACLOPRID AND GLYPHOSATE BASED HERBICIDES FOUND ON VARIOUS ANIMALS.

Compiled by Judy Hoy
Bitterroot Wildlife Rehab Center, 2858 Pheasant Lane, Stevensville, Montana 59870, USA. E-mail: bjhoy@localnet.com

Chlorothalonil is a tetrachlorosophthalonitrile, widely used in agriculture, especially by potato, tomato, wheat and barley growers and on lawn grass and turf farms. It is most toxic when inhaled and has deleterious effects on many organisms and the environment in general (Caux et. al. 1996 and Ref. therein). Cyanide molecules, which Chlorothalonil contains, have been shown to be especially damaging to exposed prenatal animals (Soto-Blanco and Gorniak, 2004). Chlorothalonil is extremely toxic to fish and amphibians at low concentrations, as well as invertebrates, such as insects, earthworms and microorganisms (Oruc, 2010 and Ref. therein). Synergism between Chlorothalonil and Imidacloprid was found to be extremely toxic to certain kinds of bees, causing high mortality (Tome et. al. 2017). This is why there is so much concern for saving wild bees. Simultaneous exposure to other fungicides and neonicotinoids resulted in much greater damage to bees than either alone, with fungicides alone causing much less harm Tsvetkov, et. al. 2017). In laboratory studies, Chlorothalonil was found to cause loss of embryos in mammals, as well as kidney and liver damage, gene damage and cancer of the kidney (Oruc, 2010). The damage to the liver would likely interfere with an exposed animal's ability to detoxify other chemicals to which it is exposed. Thus synergy with other pesticides in the environment likely results in greater injury to the internal organs, causing serious adverse health impacts. There was likely a similar synergistic exposure in Ravalli County (RC) vertebrate species observed with multiple birth defects in 1995, immediately after the sudden massive upwind uses of the newly registered insecticide, Imidacloprid, and of Chlorothalonil, along with other fungicides for potato blight. Another consideration concerning Chlorothalonil is that its main contaminant is Hexaclorobenzene, a globally banned carcinogen.

Many studies have shown how debilitating and deadly Imidacloprid alone is to small vertebrates (Gibbons, et. al. 2015, Burke et. al. 2018, Parkinson and Gray, 2019 and references therein), resulting in severe population declines in mammals such as bats because of adverse direct and indirect effects (Mineau P and Callaghan C. 2018). Neonicotinoids were shown to damage the brains and livers of adult birds, affecting their ability to migrate (Zeid et. al. 2018), and the brains of bee larvae during development (Smith, et. al. 2020). Imidacloprid at low doses has been proven to adversely affect insects and birds (Charpentier, et. al. 2014, Abreu-Villaca and Levin, 2017, Heneberg et. al. 2020, Bishop, et. al. 2018), caused widespread declines in butterfly species (Gilburn et. al., 2015) and was the only Neonicotinoid tested that caused immobility in bumblebees (Moffat et. al. 2016). Thus, this deadly insecticide is likely the most significant cause of the severe decline in pollinators (Kenna, et. al. 2019, Laycock et. al. 2012, Woodcock et. al. 2017) as well as arachnids (Řezáč et. al. 2019, Korenko et. al. 2020) and earthworms (Dani, et. al. 2017), all being very important to the biodiversity of

the planet and the survival of humankind. Most alarmingly, recent testing has shown the urine of a high prevalence of human children contains Imidacloprid (Tao et. al. 2019) an important reason for paying attention to what wildlife is showing us with regard to birth defects, brain and nerve damage and harmful effects to other internal organs.

Additionally, a review concerning what the authors state is "interaction between nicotine and the renin-angiotensin system (RAS), one of the most important regulatory systems on autonomic, cardiovascular, and pulmonary functions in both health and disease" (Oakes et. al. 2018 and ref. therein), shows nicotine alters the homeostasis of the RAS. That resulted in adverse health issues in animals exposed to nicotine, being especially damaging to the heart and lungs. It would seem to be highly important that damaged lungs and enlarged right ventricle of the heart were two of the most common health issues observed on necropsied wild and domestic animals of all ages born with developmental malformations (Hoy et. al., 2015). Excessively applying hundreds of millions of pounds of neuro-active insecticides chemically similar to nicotine on crops specifically grown for humans and their livestock that eventually go into all ecosystems would seem to be a highly questionable practice.

It took until March 20, 2019, 25 years after Imidacloprid was registered for use, for a study to be done using white-tailed deer as the study animal, which clearly showed Imidacloprid's significant adverse effects on large mammals (Berheim et. al. 2019). This ground breaking study published in Nature showed that the higher the level of Imidacloprid was in the spleens of the does and fawns, the more likely they were to die. Alarmingly, much higher levels of Imidacloprid were found in many of the collected spleens tested from 367 hunter-killed and accident-killed deer than was given to any group of deliberately exposed deer in the study. Also, fawns with congenital defects, most commonly underdeveloped facial bones and reproductive malformations, had higher levels of Imidacloprid in their spleen than the normal fawns. The authors stated, "as Imidacloprid increased in the spleen, fawn survival, thyroxine levels, jawbone lengths, body weight, and organ weights decreased" and "behavioral observations indicated that Imidacloprid levels in spleens were negatively correlated with activity levels in both does and fawns."

These findings correlate well with the decreased activity levels and poor survival rates that Dr. Bruce Smith and colleagues found on their second cohort of elk calves in 1997, 1998 and 1999. Millions of pounds of Imidacloprid, millions of new pounds of Roundup on Roundup Ready crops and over a million pounds of Chlorothalonil were being used during those second three years of the study. The study began in 1990 near Jackson, Wyoming, four years prior to the excessive use of Chlorothalonil and new extensive use of Imidacloprid in the states upwind of Wyoming where the elk calf study took place. (Smith et. al. 2006). In the first three years, it took only 12 days for the elk calves to get up and join the nursery herd. In the second three years it took over 4 times that at an average 49 days. It was extremely unfortunate that the elk calves were not examined for birth defects such as underbite in both time periods.

Regarding glyphosate based herbicides (GBH), Roundup's main ingredient, glyphosate, chelates the minerals animals need for survival and disrupts or kills the gut microbes, causing starvation and damaging the animals' immune systems making them more susceptible to parasites and diseases (Samsel and Seneff, 2013, Motta et.al. 2018). The use of GBH increased in the United States from 7.7 million pounds in 1990 to 70.9 million pounds in 2000, in the next 5 years to 132.3 million pounds and then nearly doubling again to 249.9 million pounds by 2014 (Benbrook, 2016).

A recent alarming study showed that glyphosate at a very low short-term exposure in gestating female rats resulted in transgenerational effects (Kubsad, et. al. 2019). The directly exposed FO generation and offspring, F1 generation, had negligible impacts. However, the study authors found dramatic increases in pathologies in the F2 (grand-offspring) and F3 (great-grand offspring). They state, "The transgenerational pathologies observed include prostate disease, obesity, kidney disease, ovarian disease, and parturition (birth) abnormalities." They also suggest "the generational toxicology of glyphosate needs to be considered in the disease etiology of future generations." There have been many generations of animals since the first were exposed to glyphosate in the 1970s, with subsequent exposure continuous and constantly escalating. Thus, the generational toxicology and transgenerational effects of glyphosate should be of utmost concern for all animals. There have been many generations of wild ruminants since the reproductive malformations and other birth defects began in spring of 1995. This should be very concerning to wildlife managers.

In a study of both birds and amphibians, embryonic exposure to GBH disrupted the development of the head, eyes and brain by impairing retinoic acid signaling (Paganelli, et. al. 2010). In a study using Japanese quail (*Coturnix japonica*), embryonic development was poorer in the eggs of the quail exposed to GBH with normal development at 76%. The controls had an 89% with normal development. In addition, the embryonic brain tissue from the exposed group expressed 20% higher lipid damage and females had delayed plumage development. The GBH residues were present in eggs, muscles, and liver (Ruuskanen, et. al., 2020). Another recent study using chicken (*Gallus gallus*) eggs injected with either glyphosate or Roundup found a decrease in hatchability of 66%, with oxidative stress in the hatchlings from treated eggs. The weight of the liver and kidneys were increased and the serum protein profiles were significantly affected as well as the serum concentrations of triglyceride (Fathi, et. al., 2019). Both studies showed glyphosate and GBH caused a significant increase in eggs failing to hatch and measurable damage to chicks that did hatch. Thus widespread exposure to GBH products is likely contributing to current declining bird populations. Failure to thrive, sudden death from respiratory failure and developmental defects, including underdeveloped upper facial bones, eye sockets, eyes, upper bill and feathers were the most often reported issues on young birds received for care in Montana between 1995 and 2019.

Also with regard to birth defects, GBH products and the main additive polyethoxylated alkylamines (POEA) were found to disrupt the functions of immature mouse Sertoli cell line (TM4)(Vanlaeys, et. al. 2018). They stated, "Our results show that formulations of glyphosate-based herbicides induce TM4 mitochondrial dysfunction, disruption of cell

detoxification systems, lipid droplet accumulation and mortality at sub-agricultural doses." and "As Sertoli cells are essential for testicular development and normal onset of spermatogenesis, disturbance of their function by glyphosate-based herbicides could contribute to disruption of reproductive function demonstrated in mammals exposed to these pesticides at a prepubertal stage of development." This strongly suggests that widespread exposure to GBH products is likely at least partly responsible for the serious male reproductive malformations on many wild mammals, including ruminants, rodents, raccoon, canines, and others, with ruminants and rodents having the highest prevalence. All of those are supposed to be protected by MDFWP.

WHAT WILL HAPPEN TO LIVING ORGANISMS IF WE CONTINUE TO IGNORE THE ABOVE ADDRESSED STUDIES AND THOUSANDS MORE LIKE THEM?

We desperately need to get immediate attention to bees, especially those that are becoming endangered. This recent data is extremely concerning. Europe's bumblebee populations fell by 17% from 2000 to 2014, and in North America, the population dropped by 46% in the same time period. That is 3.3% per year here in North America. There have been 6 more years of bumblebee population losses since 2014 so we likely have now lost at least 65.8%. Thus, if we don't stop killing them immediately in about 9 or 10 years we will have no bumblebees at all.

What is extremely concerning and scary, Andrew Barron says, "Bees hold our ecologies together. If they disappeared, goes an apocryphal quote often attributed to Albert Einstein, "man would only have four years of life left." Andrew is a neuroethologist who studies how nervous systems generate natural behavior in animals. If Einstein was correct, and he almost always was, that will leave people in North America only about 15 more years, possibly less depending on how fast the bees and other insects decline and then go extinct. Hopefully, the people and all the officials in charge of protecting wildlife will wake up and will immediately put an end to this unbelievably insane rush to humankind's own extinction.

Many invertebrate species, including some insects have to have insects as food, as do arachnids, and most vertebrates, including fish, amphibians, reptiles, most birds (at least as hatchlings), and most small and many large mammals. Without insects, almost all other animals will starve. Immediately banning the pesticides (herbicides, insecticides and fungicides) that are the main killers of invertebrates and of vertebrates is good for bees, other insects and especially for humans. After all, bees are invertebrates and people are vertebrates.

The first thing that must be done immediately is to ban the pesticides that are killing nearly all vertebrates and invertebrates. Also consider that those same pesticides are killing vital native plants and without insects, most flowering plants will go extinct. If we keep using the pesticides addressed in the above listed studies that are killing insects and other animals, especially pollinators, at the present rate and if Einstein was even close to

being correct about the effects of just the bees going extinct, all animals on Earth will be extinct in 20 to 30 years. What the declining human populations will do to each other and anything else that is edible is not a nice image.

Our federal agencies who are supposed to protect the humans, their livestock and all native wildlife, are presently promoting even more excessive use of pesticides, not less, in addition to the use of new more deadly pesticides. The federal agencies have removed nearly all restrictions on the use of thousands of toxins in the last three years, resulting in faster declines in insects and other animals. Even so, life on Earth might have a few more years than Einstein's calculations give it. It would seem to be extremely important not to waste any time at all for the sake of your children, grandchildren and great grandchildren and all the other life on the planet, which they will need to survive.

CHLOROTHALONIL AND IMIDACLOPRID STUDIES AND SYNERGY STUDIES

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A FEW OF THOUSANDS OF ROUNDUP/GLYPHOSATE BASED HERBICIDES STUDIES ON ANIMALS, INCLUDING WILDLIFE.

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