To: Jena Sudds, local councillor, for Kanata, City of Ottawa; Lise Guevremont, Ottawa Land Use and Natural Systems; Dr. Nick Stowe, Senior Planner, City of Ottawa; Residents of Kanata:

19 November 2019
From: Scientists Concerned and Informed on the Environment Speak Out

It has been brought to our attention that the area of Ottawa known as North Kanata has just completed a four-year program of nuisance mosquito control which employed a "biological toxin" called BT toxin, which was dumped and sprayed on wetlands thoughout the area over the past four years. This program is being considered for renewal for a further period.

During the initial trial, the contractor did their own comparitive tests with adjacent areas to demonstrate that the toxin was, in fact, reducing the number of mosquitoes relative to these non-treated areas. At the least, some of these activities included independent citizen varification, but to the best of our knowledge the siting of comparitive tests was at the discretion of the contractor.

Futhermore, there was a study, paid for by the residents of Kanata and coordinated by the city and the proponents, and carried out by a graduate student from the University of Ottawa, which primarily studied the impacts of the spraying program on closely related insects which were important to the environment as part of the food chain but not a threat to humans either as disease vectors or nuisance bites.

Medlock and Snow (2008), in a review study of natural predators and parasites of British mosquitoes notes both the importance of prey species and the relative difficulty of quantitatively assessing direct effects. They review a number of studies, noting in their conclusions:

"It is important that any measures to control mosquitoes take into account the need to maintain natural predators and their habitats. Removal of predators from habitats could exacerbate a mosquito nuisance biting problem."

However, in the local Kanata case, **no study was undertaken** of the impact of the spraying program on mosquito predators. Natural predators of mosquitos include bats, birds (primarily members of the swallow family), dragonflies, empididae, and amphibians; and for the lavae, many species of small fish, copepods, dragon fly nymphs, water-bugs, and even larvae of alternate mosquito species (Benelli, et al, 2016) . Benelli (2016) also notes that: "The potential of anurans (particularly frogs and toads) for mosquito control has been barely investigated".

Since **no baseline data was obtained** on the prevalence or health of these natural predator species prior to the spraying program, there is no way, post program, to determine if there was a negative impact. During the discussions prior to the initial program, this issue was raised by Dr. Bob Abell with both Dr. Nick Stow and with then Councillor Marianne Wilkinson, but no action was taken by the City in this regard. Non-quantitative observation by the author suggests that the population of both swallows and dragonflies is drastically down in the area, and the mosquito problem is actually worse both in number and duration than in previous years. This has been reflected by others on local Facebook groups.

It has become clear though recent discussions that no study of higher predators was undertaken because City planners accepted as a given that (1) the role of predators in mosquito control is minimal; (2) that the mode of action of BTi is fully understood, highly selective, and has no effect on non-target species; and (3) that approval by regulatory agencies is rigorous, based on the best science, and serves as adequate assurance of safety.

Pesticides have been in vogue for approximately 70 years. Every pesticide that has come to market carries, at the time, the same statements from the proponent, that (a) they are perfectly "safe" if used as directed and (b) that they will not cause adverse effects for non-target species. Over time these same claims were made for DDT, 2-4D, glyphosate (round up), chlorpyrifos, and neonicotinoids – and all have been found over the long term to have unintended consequences ranging from thinning of the shells of birds eggs to massive losses of pollinators, to cancers in humans, and birth deformities in amphibians herbivores, and birds. It should be noted that:

- all of these pesticides have been at one time accepted and approved by regulatory agencies;
- environmental impacts of pesticides can take a very long time to manifest;
- short term toxicology studies are seldom useful predictors of long-term low-dosage effects;
- different agencies, different states, and different countries are often not in accord;
- there is clear evidence in court records that there has been colusion between some regulatory agencies and pesticide proponents that led to understating the risks of pesticides, including herbicides.

In that same period of 70 years, there has been a precipitous decline in birds in North America – particulary in insectivores (birds whose primary diet is insects) – in amphibians, and in bats.

Many causes have been identified for these declines. Of course environmental stresses are multiplicative, reducing the ability of a species to survive by making them more susceptible to disease, sensitive to enviromental contaminants, infertile, and increasing the probability of infant death. In that situation, attibuting the decline to a single cause is unwise. There are, however, certain primary causes that appear to contribute in a major way to such declines. Most experts attribute habitat loss, agricultural intensification, and pesticide use as primary determinants.

Spiller and Dettmers (2019), examine this in detail. With specific reference to swallows, and the work of Twining (2016, 2018), Imlay (2017), and Morrissey (2015) they note: "...results would suggest that changes in the availability of high-quality prey could be more important for aerial insectivore populations than overall insect abundance." In the discussion they specifically reference the importance of "... high quality aquatic insects ..." as a better predictor of breeding success than overall insect abundance. They go on to discuss extensively contamination of available food with insecticides, noting:

> "Contaminants can bioaccumulate in insects exposed to pesticides or polluted aquatic systems, and these contaminants can be transported up the food web to insectivorous birds."

BT toxin, of course, is perfectly safe — according to the proponents. BT toxin is produced by certain soil bacteria – Bacillus thuringiensis. Bacillus thuringiensis is a member of the **Bacillus cereus** group of bacteria, which includes Bacillus anthracis (cause of anthrax), and Bacillus cereus, "a probably ubiquitous soil bacterium and an opportunistic pathogen that is a common cause of food poisoning." (Helgason, et al, 2000)

BT toxins, of which there are many variants, including Bacillus thuringiensis serotype israelensis — the BTi specifically used in the Kanata area — appears to work on insects by creating what are termed Cry (crystal) proteins. These proteins effectively destroy the gut of the insect, leading to its rapid death. The overall safety and specificity of BT toxin is predicated upon the specifics of the mechanism and postulated unique proteins in the insect gut.

However, various researchers have questioned this exact claim of specificity which is critical to the assumption of safety. Much of the scientific work in this area has been prompted by the introduction of BT-expressing plants through genetic engineering. However, such research has

substantially greater impact in that it calls into question both the specificity and the mechanism by which Cry proteins act.

Hilbeck and Otto (2015), attempt to summarize the current state of knowledge re both specificity, and proposed action mode. With respect to specificity, they note that most early studies were centered around the single economic parameter "quick kill", and that only 17% of Cry toxins have ever been tested with species from more than one or two orders.

"Yet, even for the most tested lepidopteran-active Cry1 toxins, only a little more than one third has ever been experimentally tested outside of that order."

They go on to note that:

- "the old definition of order-specifity of Bt-toxins ... may no longer be regarded as a functional concept ...
- "...sub-lethal effects such as growth inhibition, changes in developmental time or other parameters which may affect fitness can be expected to occur at far lower effect-doses than those inducing a “quick kill.”

In examinining the recent literature on the action mode of Cry toxins, they note that:
"... the modes of action of Cry toxins are far from conclusive to date ... that co-factors which naturally occur in the environment impact the efficacy and specificity of Cry toxins which may help explaining some of the effects of Cry toxins on non-target organismes reported in the literature."

"... it is clear that the claim of no reported adverse effects of single Cry toxins on cross-order non-target organisms is not supported by the scientific evidence in the scientific literature. In fact, there is an increasing body of evidence suggesting significant effects of Cry toxins far beyond the originally postulated primary taxa of herbivorous target pest organism are possible.

Other authors have undertaken studies into the potential impact of Cry proteins on the health of mamals, including haematoxicity, and effects on the immune system. Such studies were not a part of the early focus on the "single economic parameter".

To characterize all of this work as "junk science" and attribute it to a vendetta against specific agribiz companies is myopic in the extreme.

What is quite clear is that all three of the basic assumptions held by the City in undertaking this mosquito control approach are questionable:

(1) the role of predators in mosquito control **is** significant, and in the words of Medlock and Snow (2008), "***Removal of predators from habitats could exacerbate a mosquito nuisance biting problem.***"
(2) the mode of action of BTi is **far from** fully understood, is not as highly selective as formerly believed, and has the potential to effect non-target species; Hilbeck and Otto (2015)
(3) approval by regulatory agencies is not necessarily based on the best science, can be corrupted or slanted by commercial concerns, and seldom serves as adequate assurance of safety.

Given these concerns expressed clearly in the scientific literature, we, the undersigned advise that the current mosquito program not be renewed, and that alternate control methods and adaptations not involving pesticides be employed.

The city respondent to an earlier draft of this paper, took umbrage with the use of the term

"controls" with respect to the following section. While we would argue that controls are generally understood to be any actions taken to reduce bites, we have organized the following under the term "control" with the explicit meaning of reduction in numbers of biting insects, and "adaptations" with the explicit meaning of ways to alleviate the nuisance and potential health impact of bites.

Alternate control mechanisms include traps, methods attacking the reproductive capacity of mosquitos by male sterilzation, and even hi-tech laser perimeter guards that use lasers to selectively shoot mosquitos out of the air. This latter technology was originally developed at the Lawrence Livermore Lab in the 1980. More recent work has been done, with the patent rights owned by Intellectual Ventures in California. Given Kanata's prominence as a tech centre, this should be explored.

A second method of control would be to reduce the causes of the problem — largely self-inflicted by lax or ineffective land control and land use requirement within and by the City. This included allowing the clear cutting of large areas in North Kanata, in the absence of an agreed water management plan. Clearcutting and beaver dam destruction contribute to wet-lands issues, loss of predator species of all types, and to excessive flooding in the Carp River watershed – the most quoted source for the epidemic of flood-water mosquitoes in the past year.

An active program to provide appropriate habitat and programs to enhance the recovery of predator species, including predatory fish, and **to monitor such species on a regular basis** is recommended, as is improved regulatory oversight of development. This might involve breeding programs as well as habitat upgrades including dealing appropriately with watershed issues.

At the level of individual properties and local residents, there are many adaptations (controlling bites, not populations of insects) which include plants that deter mosquitos or whose scents disrupt their ability to locate prey, clothing protection when outdoors, repellents, use of screened enclosures, and area mosquito traps, of which there are many on the market. An active program to both educate residents and encourge such adaptations would be beneficial.

Signed,

Robert A. Abell, Ph.D., B.Ed. B.Sc.

Document prepared by Dr. Bob Abell, Ph.D. Science Education, B.Ed., B.Sc., Kanata resident and founding member, Scientists Concerned and Informed on the Environment Speak Out.

Scientists Concerned and Informed on the Environment Speak Out is a closed group of approximately 60 international members, all with minimum B.Sc. and diverse skill sets as specialties. It was set up as a multidisciplinary group to discuss complex ecosystem issues.
Scieso members who have responded to date to support this position.

Emmanuel G. Moutondo, M.Sc.
Emmanuel is Operations Manager, Africa Global Vision (AGV), and spent 8 years as a staff member of UNEP's Division of Environmental Law and Policy in Nairobi.

Judy Hoy, B.Sc.
Judy is biologist, wildlife rehabber, and author residing in Stevensville, Montana. Judy has spent 23 years in wildlife rehabilation, documenting and writing extensively on birth deformities in wildlife, including potential pesticide interactions.

David Loubser, M.Sc., B.Sc.

David is Managing Director at Ecosystem Services Ltd., Wellington & Wairarapa, New Zealand. David has over 30 years experience in the Environmental and Environmental Information arena in Africa, New Zealand, the Pacific and the Middle East.

Ila France Porcher, B.Sc.
Ila is a published ethologist and "Shark Behaviour Specialist Advisor" at Shark Research Institute. Her focus is on the behaviour of wild animals and marine life. A resident of B.C., most of Ila's shark studies came from her direct experience swimming with wild sharks in Tahiti.

Paul Renaud, B.Sc.
Paul is an Executive Advisor, and former Ottawa resident. Paul has been very active in the past on local environmental issues, including the South March Highlands.

Venkatasamy Ramakrishna, Ph.D., M.Sc. B.Sc.
Ven is Director and Consultant at Enviro Solutions Ltd., Mauritius. His field of study at the Masters and Ph.D. level was in natural sciences - environmental biology and microbiology. He is active at the international level in the area of environmental law.

Stephanie Seneff, Ph.D.
Stephanie is a Senior Research Scientist at the MIT Computer Science and Artificial Intelligence Laboratory. She has worked (with others) on extensive analysis of the relationship between chemical pesticide exposure and a wide range of chronic diseases.

Yomi Taiwo, Ph.D.
Yomi is a chemist in Sustainable (Green) entrepreneurship development / Food QC&A / Energy at Moshood Abiola Polytechnic, Nigeria

Sarel Van Der Merwe, M.Sc.
Sarel is a wildlife and biodiversity specialist, and for 20 years Chairman of the African Lion Working Group.

Dr. Michael White, President Hakono Hararanga Inc, Tongareva Atoll, Oceania. Dr. White has a Ph.D. in Marine Zoology, and a Masters in Marine Environmental Protection. He is Principal Investigator for Sea Turtles in the Cook Islands.

Other Signators
Sheryl McCumsey, formerly with Pesticide Free Alberta. Sheryl was a medical lab technologist for 13 years, and has spent most of the last five years studying pesticide issues and related research.