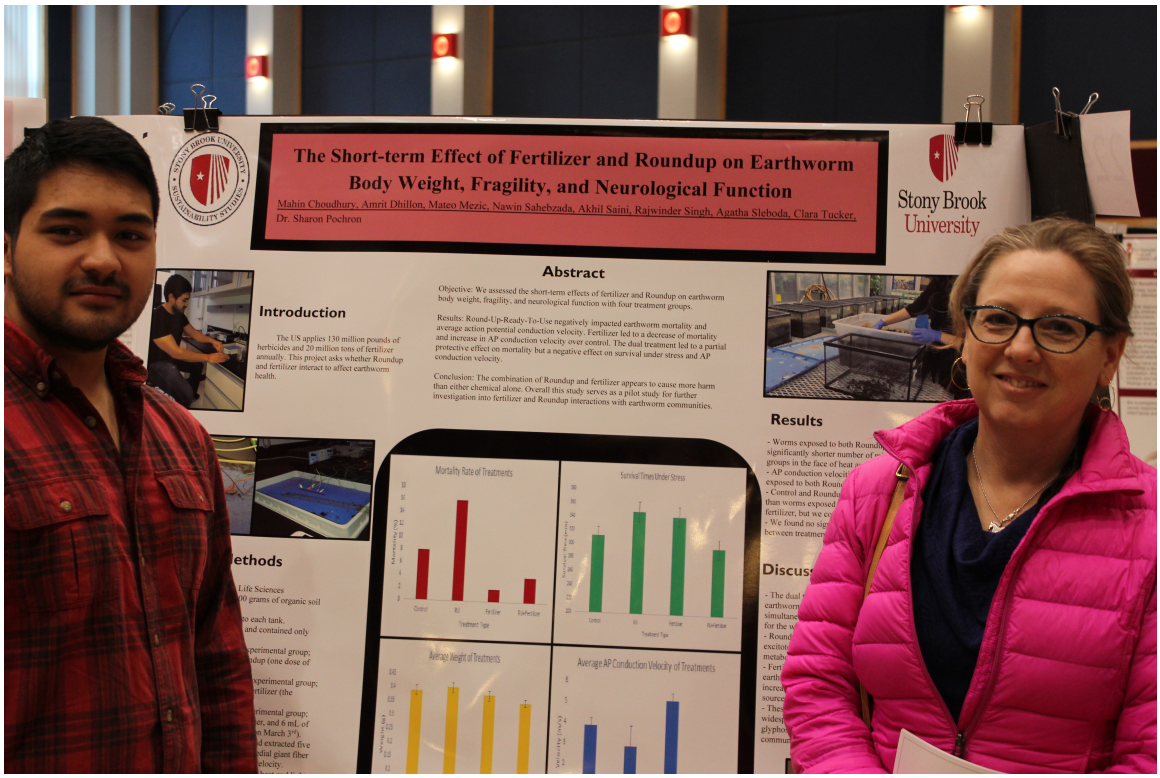
The effect of fertilizer and Roundup on earthworm body weight, fragility, and neurological function

Mahin Choudhury, Amrit Dhillon, Mateo Mezic, Nawin Sahebzada, Akhil Saini, Rajwinder Singh, Agatha Sleboda, Clara Tucker, Dr. Sharon Pochron

Mahin Choudhury completed this research in partial fulfillment of his Honor's Project.

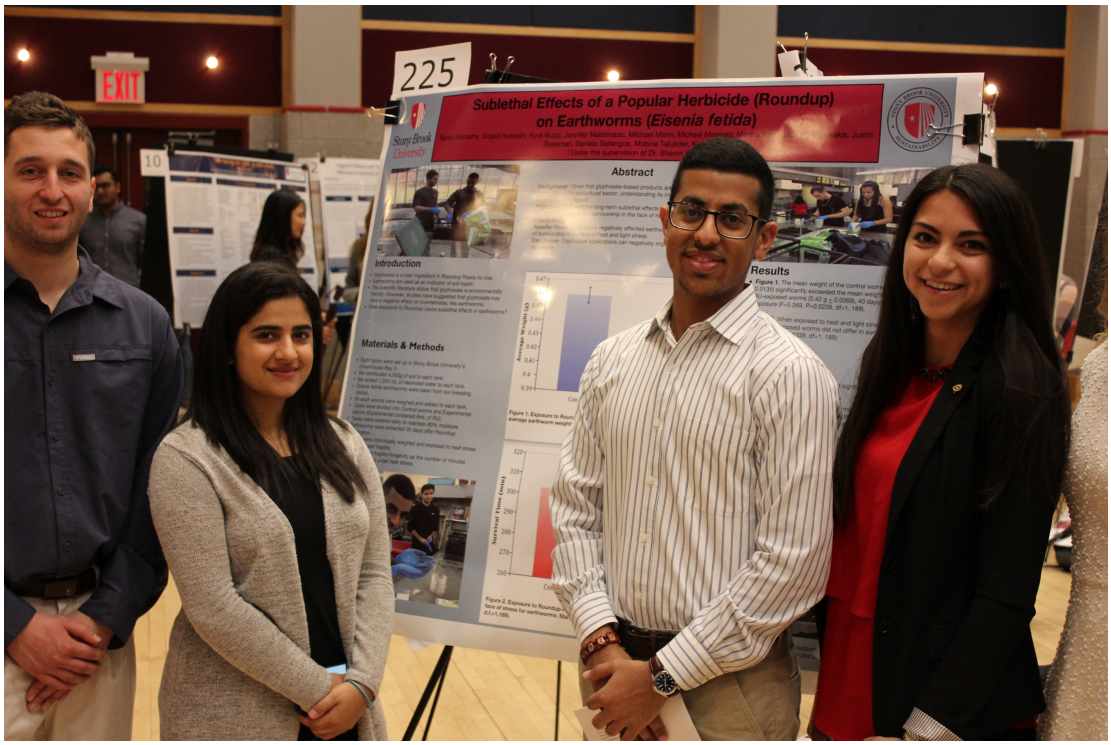
The US applies 130 million pounds of herbicides and 20 million tons of fertilizer to the soil annually. The interaction between these two chemicals and how it impacts *Eisenia fetida*, a bioindicator of soil health, remains unstudied. We tested the short-term effects of fertilizer and Roundup on earthworm body weight, fragility, and neurological function with four treatment groups: a control, a group that received only fertilizer, a group that received only Roundup, and a group that received fertilizer and Roundup. After 28 days, we extracted five worms from each treatment to test the medial giant fiber activity for action potential propagation velocity. We extracted the remaining worms to look for differences in average mortality, body weight, and survivorship in the face of heat and light stress. We found that neither mortality nor body weight differed significantly across treatments. Earthworms exposed to both fertilizer and Roundup together survived for significantly fewer minutes than worms exposed to either contaminant alone. The treatment group with both fertilizer and Roundup had slower action potential propagation speed than the other treatments.



Sublethal Effects of a Popular Herbicide (Roundup) on Earthworms (*Eisenia fetida*)

Sarah Habashy, Sajjad Hussaini, Kyra Illuzzi, Jennifer Maldonado, Michael Mann, Alex Mardon, Michael Moawad, Marina Nasr, Jackie Nikakis, Justin Roseman, Akhil Saini, Daniella Sallangos, Mobina Talukder, Katherine Tsui, Sharon Pochron

Glyphosate was first introduced as an herbicide product to farmers in 1974. Glyphosate is the active ingredient in the herbicide Round Up, While the lethality of Roundup (RU) on earthworms has been examined, its sublethal effects are not well understood. We studied the effect of a particular chemical formulation, Ready Roundup, on earthworm health, specifically earthworm body weight and survivorship under stressful conditions (heat stress). We set up eight tanks containing 30 earthworms and 4.5 kilos of outdoor soil in each tank. We contaminated four tanks with 6mL of Roundup Ready-To-Use solution and left four tanks untreated. After 35 days of exposure, we recorded earthworm body weight and placed each worm into its own Petri dish. We then placed the Petri dishes in a heated (90°F) and well lit environment. The worms were monitored at 5-minute intervals and the time of deaths were recorded in order to quantify survivorship at the completion of the study. We found that average weight of worms exposed to RU showed a significant decrease in average body weight. After exposure to heat stress, the time of deaths between both groups did not differ. When exposed to RU, *Eisenia fetida* display evidence for some predicted sublethal effects, but it remains challenging to project our findings more generally to other common worm species.

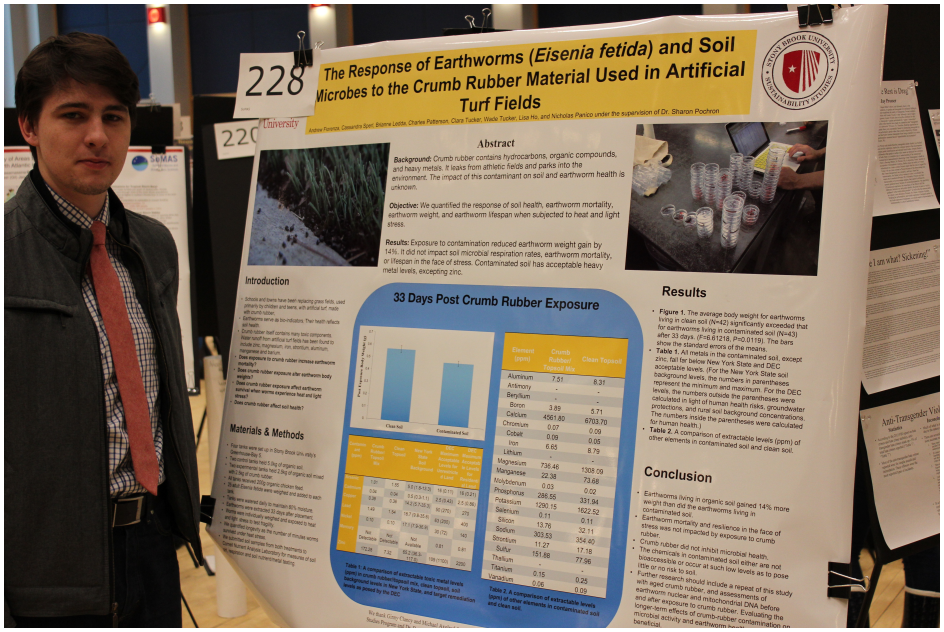


The response of earthworms (*Eisenia fetida*) and soil microbes to the crumb rubber material used in artificial turf fields

Clara Tucker, Charles Patterson, Nick Panico, Sharon Pochron

This paper has been published in *Chemosphere.* Charlie Patterson and Clara Tucker are in the Honors College. Nick Panico is a University Scholar.

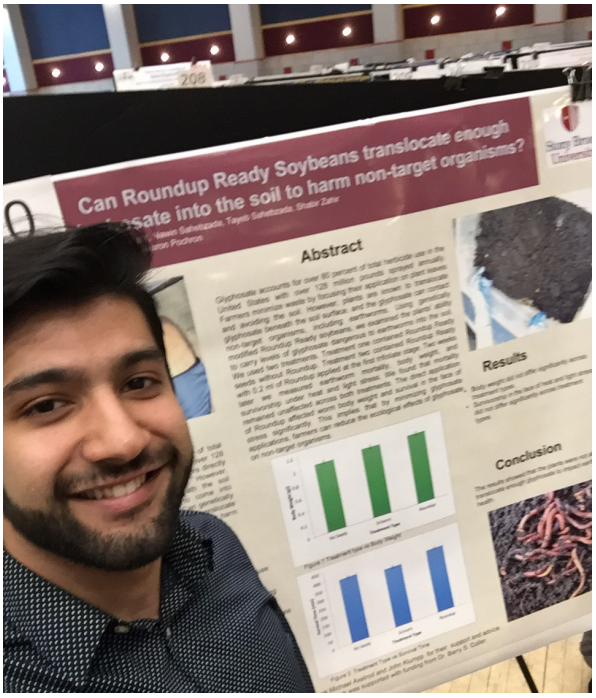
Municipalities have been replacing grass fields with artificial turf, which uses crumb rubber infill made from recycled tires. Crumb rubber contains hydrocarbons, organic compounds, and heavy metals. Water runoff from crumb rubber fields contains heavy metals. These components can damage the environment. We contaminated topsoil with new crumb rubber and measured its impact on earthworms and soil microbes. Specifically, we compared soil microbe activity and earthworm health, survivorship, and longevity in heat and light stress under two soil regimes: clean topsoil and clean topsoil contaminated with crumb rubber. We then characterized levels of metals, nutrients, and micronutrients of both soil treatments and compared those to published New York soil background levels and to levels set by the New York State Department of Environmental Conservation (DEC) as remediation goals. We found that: 1) contaminated soil did not inhibit microbial respiration rates, 2) earthworm survivorship was not impacted by exposure to contaminated soil, 3) earthworms' ability to cope with heat and light stress remained unchanged after living in contaminated soil, but 4) earthworms living in contaminated soil gained 14% less body weight than did earthworms living in uncontaminated soil. We also found that, with the exception of zinc, heavy metals in our contaminated soil did not exceed the background levels found throughout New York State or the remediation targets set by the DEC.



Can Roundup Ready soybeans translocate enough glyphosate into the soil to harm non-target organism?

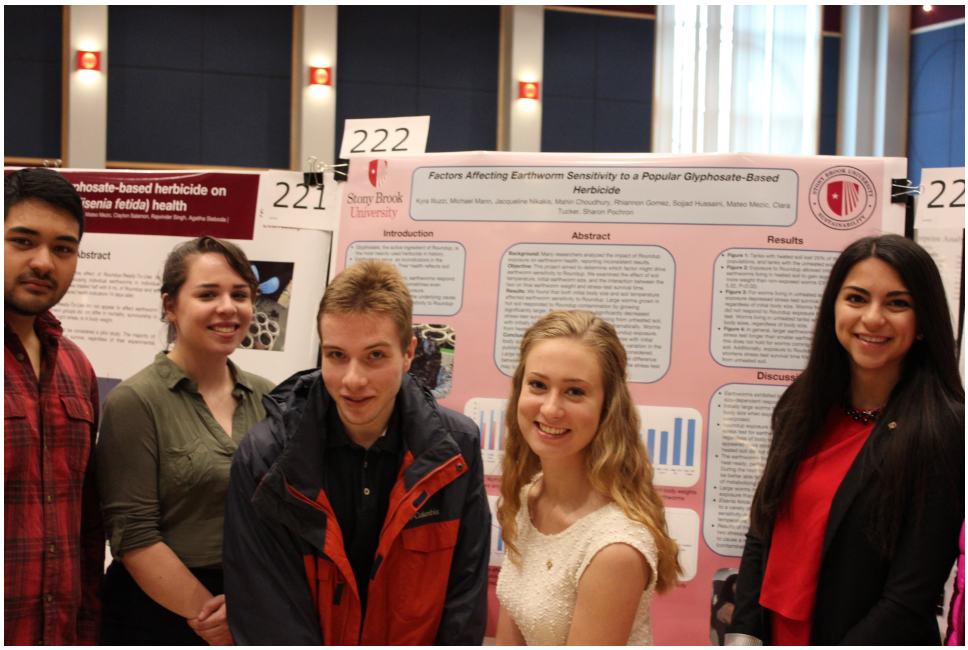
Mahin Choudary, Amrit Dillion, Serafina Margomo, Alex Mardon, Matteo Mezic, Feisal Sahebzada, Nawin Sahebzada, Roman Sahebzada, Tayeb Sahebzada, Rajwinder Singh, Agatha Sleboda, Akhil Saini, Shabir Zahir, Sharon Pochron

Glyphosate accounts for over 80 percent of total herbicide use in the United States with over 128 million pounds sprayed annually. Farmers minimize waste by focusing their application on plant leaves and avoiding the soil. However, plants are known to translocate glyphosate beneath the soil surface, and the glyphosate can contact non-target organisms, including earthworms. Using genetically modified Roundup Ready soybeans, we examined the plants' ability to carry levels of glyphosate dangerous to earthworms into the soil. We used two treatments. Treatment one contained Roundup Ready seeds without Roundup. Treatment two contained Roundup Ready with 0.2 ml of Roundup applied at the first trifoliate stage. Two weeks later we measured earthworm mortality, body weight, and survivorship under heat and light stress. We found that mortality remained unaffected across both treatments. The direct application of Roundup affected worm body weight and survival in the face of stress significantly. This implies that by minimizing glyphosate applications, farmers can reduce the ecological effects of glyphosate on non-target organisms.



Factors Affecting Earthworm Sensitivity to a Popular Glyphosate-Based Herbicide
Mahin Choudhury, Rhiannon Gomez, Sojjad Hussaini, Kyra Illuzzi, Michael Mann, Mateo Mezic, Jaqueline Nikakis, Clara Tucker, Sharon Pochron

Many farmers use glyphosate-based herbicides such as Roundup to increase harvest yield. These herbicides affect non-target organism, including red wiggler earthworms, *Eisenia fetida*, an organism designated by the EU, OECD, ISO and FAO as an indicator species. Many researchers have analyzed the effects of Roundup and glyphosate on earthworm health, finding inconsistent results. Some studies show that glyphosate has a negative effect, others find no effect, and still others find a positive effect. We've found the same sort of inconsistencies in our own lab. This project aimed to determine which factor might drive earthworm sensitivity to Roundup. Taking cues from the literature and our own work, we examined the effect of soil temperature, initial earthworm size, and the interaction between the two on final earthworm weight after a month of exposure to contamination. We also examined the effect of those variables on earthworm survival in a stressful environment. We used eight tanks to establish a 2 x 3 factorial design using initial worm size, soil temperature, and Roundup contamination as the three factors. After 28 days of exposure, we recorded earthworm body weight (g) and length of survivorship under stress (min). We found that both initial body size and soil temperature affected earthworm sensitivity to Roundup. Large worms grown in hot soil responded to Roundup contamination by growing significantly larger. Regardless of initial body size, earthworms living in unheated soil lived significantly shorter in the face of stress, with Roundup-exposed worms surviving for the shortest number of minutes overall. This study shows that earthworm sensitivity to Roundup varies with factors such as initial body size and soil temperature. This may explain the variation in the published literature, where neither factor is generally reported or controlled.



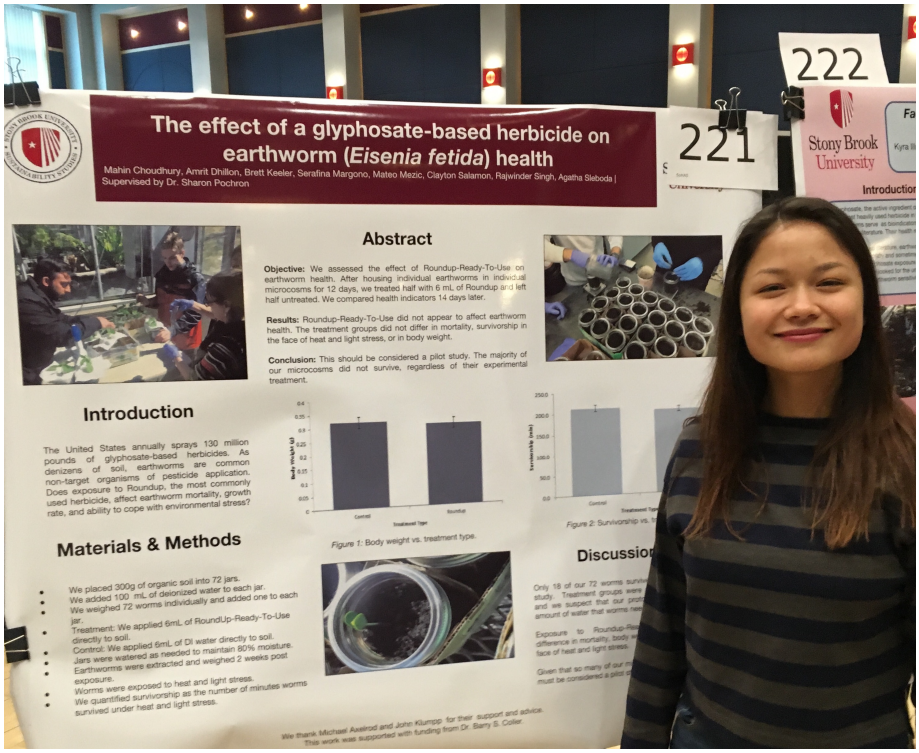
The effect of a plant-translocated herbicide on earthworm health

Mahin Choudhury, Amrit Dhillon, Brett Keeler, Serafina Margono, Mateo Mezic, Clayton Salamon, Rajwinder Singh, Agatha Sleboda Dr. Sharon Pochron

This work was supported with funding from Dr. Barry S. Coller.

Sustainability Studies Earthworm Ecotoxicology Lab

The US annually sprays 130 million pounds of glyphosate-based herbicides such as Roundup. Farmers attempt to minimize their use of glyphosate by directly injecting the leaves of their crops, but plants are known to translocate glyphosate beneath the soil surface. The effects of plant-translocated glyphosate on earthworms and microorganisms remain unstudied. We tested the translocative properties of conventional soybean plants by using three treatment groups. The control contained no soybeans or Roundup. We sprayed Roundup on Group A during the first trifoliate stage, and we applied Roundup directly on the soil in Group B, which contained no soybean seed. Fourteen days later we measured earthworm mortality, body weight, and survivorship through heat stress. We found that mortality did not differ amongst the three groups. Worms with higher body weight lived longer under heat stress, but treatment type did not significantly affect body weight. Group A exhibited higher survivorship in the face of stress compared to Group B.



Human and Animal Traffic through Ashley Schiff Park Preserve on Stony Brook University Campus

Research by: Andrew Clay, Rebecca Glayzer, Harrison Watters, Sharon Pochron

Continuing ongoing research, this study was conducted to estimate the daily amount of human and animal traffic through the Ashley Schiff Park Preserve on Stony Brook University campus. Utilizing four Simon's Whitetail motion-activated cameras with infrared night-vision, we collected time-stamped pictures capturing anything that entered the park at the four hiking trail entrances. At these locations, human entrance into the park was recorded in regard to group size and activity (walking, biking, running). Two additional cameras were set up deeper into the woods to collect more pictures of Whitetail Deer (*Odocoileus virginianus*) after past results predicted the park could be a refuge for deer populations. Increased park usage was found to occur during the spring and fall semesters, and a decline in use during the campus winter and summer intersessions. This study into the patterns and values of visitors into the park preserve may serve well as a reference for park management and future studies.