

Volume 9, Issue 4

News of Environmental and Resource Management Issues and Events from throughout New Jersey

Geoengineering is Not a Solution to Global Warming

Alan Robock, Distinguished Professor, Department of Environmental Sciences, Rutgers University

Global warming is one of the most important problems facing humanity, and will have serious impacts in New Jersey. We are already seeing stronger storms, rising sea levels, and more frequent flooding, heat waves, and drought, and as Earth's temperature continues to rise, we can only expect these and other impacts to continue and get worse. Global warming is being caused by particles and gases, particularly carbon dioxide and methane, that we are pumping into the atmosphere as we drive our cars, generate electricity, raise our food, heat and cool our homes, and make cement. Unlike trash and sewage, we currently use the atmosphere as a dump for these gases and particles and pay no fees.

Clearly, the solution to the global warming problem is mitigation (reduction of the emissions of the gases and particles that cause global warming). We can do this by using energy more efficiently and switching to green sources, particularly solar and wind energy. A fee on carbon emissions will produce fewer emissions and stimulate new technology to make reduced emissions easier. We will also need to adapt to impacts that are already occurring, such as raising buildings that are now close to sea level. But in the last decade, an idea has gathered steam as an additional way to address global warming. It is commonly called "geoengineering," but more correctly called "climate engineering" or "climate intervention." Geoengineering is defined as "deliberate large-scale manipulation of the planetary environment to

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Seafood Safety and Recommendations

Douglas Zemeckis, Rutgers Cooperative Extension, Ocean, Atlantic, and Monmouth Counties

The August 2018 issue of the Green Knight spotlighted the "Fish Smart, Eat Smart NJ" program led by the New Jersey Department of Environmental Protection (<u>www.state.nj.us/dep/dsr/njmainfish.htm</u>). This program does a great job at helping to decide what is the right fish for you to eat with a focus on species caught in NJ waters, including freshwater and marine species, and local waterbody advisories.

The New Jersey Agriculture Experiment Station's (NJAES) Seafood Safety website includes links to resources from other programs that provide additional seafood recommendations (<u>njaes.rutgers.edu/</u> <u>seafoodsafety/</u>).

One of these resources is the National Oceanic and Atmospheric Administration's (NOAA) FishWatch program (www.fishwatch.gov/), which includes federally managed species and helps people to make smart seafood choices based on facts about sustainability through an improved understanding of how U.S. seafood is responsibly harvested and grown, and by providing up-to-date information about the status of our resources. Users of the NOAA FishWatch website can type in the name of a species of interest to be presented with information to help make seafood choices, including the status of the population, the fishing mortality rate on this species, potential habitat impacts from fishing activities to capture the selected species, potential bycatch issues, nutrition facts, and recipe options. Check out their website and search for some of your favorite species and explore some new species, too!

The NJAES Seafood Safety website also includes links to resources from other organizations who provide seafood recommendations, such as the United States Environmental Protection Agency, the United States Food and Drug Administration, and the Food and Agriculture Organization of the United Nations.

Check out these helpful resources and feel confident in your next seafood selections!



Photo Credit: NOAA FishWatch (<u>www.fishwatch.gov/</u>)





Sea How High: Interactive Game Educates about Sea Level Rise

Judith Burr, Rutgers Environmental Steward

Are oceans really rising? Could your favorite beach disappear? Would drinking water become salty? Globally, who'll have to migrate?

Burlington County Rutgers Environmental Stewards Judy Burr and Linda Gaffney set out to increase public knowledge about sea level rise. Partnering with the Jacques Cousteau National Estuarine Research Reserve in Tuckerton, they designed and fabricated "Sea How High", an interactive game. The game highlights the causes, effects, responses to and solutions surrounding both micro and macro issues of accelerating sea level rise. Players select challenge cards by rolling a die, with correct answers moving a slider downward across the poster image of a flooded house, to 'save' it. Interaction with www.njfloodmapper.org; video demos of glacial melt, thermal expansion and greenhouse gases; and a flooded model landscape augment the physical game kit.

Physical game kits were placed in three locations: Tuckerton Seaport Museum, JC NERR field events and Burlington County RES intern-run events. Summer 2018 field trials involved 42 players and trained seven game instructors, with both adult and youth players expressing enjoyment in participation. A written survey yielded the following:

- 36% learned 'quite a bit'
- 59% learned 'a few things'
- 96% gave examples of new knowledge directly from the game
- 96% think a 'connection exists between sea level rise and people's actions'
- 64% will alter a personal activity to lower carbon emissions as a result of playing the game



Multiple Choice Question

From 1900-2000, sea level around the globe rose an average of 8.4". How much did the sea rise from Sandy Hook to Cape May? a. 12" b. 8.4" c. 16"

C9





Photo credit: Zane Clark, The Mt. Laurel Sun (www.mtlaurelsun.com)

Answer: c – 16 inches

Details: Sea rise measures

et. al, "Sea-level Rise in New Jersey" fact sheet, Rutgers Dept. of Earth and Planetary Sciences, Institute of Marine and Coastal Sciences.

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Sea How High... continued

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• 100% of those changing a personal activity will adopt a strategy given in the game

So, how would you do as a player? Here's a peek at the challenge cards you might draw: What are NJ's Blue Acres? How fast is a football field's size of salt marsh being submerged in the Mississippi Delta – once a month, once a week or once an hour? How many tons of emitted carbon can you save annually, just by washing your laundry in cool water, instead of hot? And, can you eat a fiber log or tour an oyster castle?

Because interest in the game was quickly shown by multiple organizations, including Rutgers Climate Institute and NOAA, a downloadable version, including a tracking device to identify and survey users, will become available this November via the JC NERR website, <u>www.jcnerr.org</u>. "Sea How High's" developers hope you and your audiences will enjoy this engaging and informative challenge!

Sample challenge cards.

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2nd Annual Watershed Conference

Pat Rector, County Agent II, Rutgers Cooperative Extension

The 2nd Annual Watershed Conference was held at the Watershed Institute on November 2, 2018 from 9:00 AM to 4:00 PM and about burst the seams of this LEED certified building with participants from watershed associations from across the state, along with a few governmental, non-governmental, academic and private representatives.. Registered attendees of 90 people were joined by quite a few more, creating a vibrant, watershed based community focused on watershed solutions, networking, and collaboration.

Jim Waltman, Executive Director of the Watershed Institute provided the Welcome and Introductions. The keynote speaker was Michele Putnam, Assistant Commissioner for Water Resource Management at the New Jersey Department of Environmental Protection. She discussed how listening, science, and the law will be hallmarks of this NJDEP administration. Public participation will be crucial and drinking water is and will continue to be their highest priority. Ms. Putnam thanked the many water-

Figure 1. Watershed Institute Building. Photo https://thewatershed.org/green-infrastructurecertification-dec-6-7/

Figure 2. Jim Waltman, Executive Director, Watershed Institute. Photo courtesy of Pam Podger, Watershed Institute.

shed associations who are conducting water monitoring, monitoring that is critical to NJDEP's decision making processes.

Sessions included groundwater discussions, using drones to monitor river restoration, legislative issues including Green Amendments and Stormwater Utilities, implementation of Total Maximum Daily Loads, and using social media to best effect in your watershed.

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2nd Annual Watershed Conference... continued

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Many of the attendees were representatives of the New Jersey Council of Watershed Associations.

More information on the conference can be found at <u>thewatershed.org/new-jersey-watershed</u>-<u>conference-advances-knowledge-on-clean-water/</u>

Attendees at the 2nd Annual Watershed Conference, November 2, 2018. Photo courtesy of Pam Podger, Watershed Institute.

Michele Putnam, Assistant Commissioner for Water Resource Management, New Jersey Department of Environmental Protection (NJDEP). Photo courtesy of Pam Podger, Watershed Institute.

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U.S. Geological Survey StreamStats Site Offers Easy Watershed Delineation and Statistics

Sal Mangiafico, Rutgers Cooperative Extension

The U.S. Geological Survey StreamStats site offers users the ability to delineate the area draining to any point, and report useful statistics for the identified watershed such as the drainage area, forest cover, urban cover, population density, and flow statistics.

The service can be accessed at: streamstats.usgs.gov/ss/

The site is relatively easy to use, but there are few points in the process that aren't entirely intuitive. The following steps may be useful:

Step 1

Zoom into Zoom level 8, and find the place of interest

Step 2

Select New Jersey data

Screenshot from the StreamStats website. The blue marker was placed at the Deepwater Canal near Salem, NJ. The yellow area indicates the watershed that drains to this point.

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U.S. Geological Survey StreamStats... continued

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Step 3

Zoom into Zoom level 15

Click on the Delineate button

Choose a point on a blue pixelated line. This will be the lowest point of the sub-watershed you are choosing. The software will determine area that drains to this point. Click on Continue

Scenarios Step 1

Click e.g. on Monthly Flow Statistics under Regression Based Scenarios

Choose Basin Characteristics of interest

Click on Continue

(Wait)

Build a report Step 1

Click Continue

Step 4

(Wait)

Step 5

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	64.8	square mile
APRAVPRE	Mean April Precipitation	3.71	inches
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	20.2	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	3.97	feet per mi
FOREST	Percentage of area covered by forest	10.9	percent
JUNAVPRE	Mean June Precipitation	3.78	inches
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	18.1	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	5.23	percent
PERMSSUR	Area-weighted average soil permeability from NRCS SSURGO database	5.83	inches per hour
POPDENS	Basin Population Density	297	persons per square mile

Statistics for the watershed area of the Salem River draining to Deepwater Canal.

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US Forest Service Reports: Cities and Communities in the U.S. Losing 36 Million Trees a Year

Sal Mangiafico, Rutgers Cooperative Extension

In recently published research, the U.S. Forest Service reported that forest cover in U.S. urban and community areas declined 0.7 percent between 2009 and 2014. This change represents 36 million trees or 175,000 acres per year. (USDA–USFS, 2018).

The study was conducted using aerial photographs, and was conducted in all 50 states and the District of Columbia.

The study also found an 0.6 percent increase in impervious cover in urban and community areas.

New Jersey

Results for New Jersey, noted a decrease in tree cover in urban and community areas from 48.4 to 47.8 %, for a change of 0.6 % in 5 years, or 0.12 % per year, from 2008 to 2013.

This was a statistically significant change that corresponds to 2590 acres per year.

Impervious cover in New Jersey's urban and community areas increased from 24.0 to 24.3 % over the same years. This corresponded to 1290 acres per year. This change was reported as not statistically significant.

References

[USDA–USFS] USDA–U.S. Forest Service Northern Research Station. 2018. Cities and Communities in the U.S. Losing 36 Million Trees a Year. <u>www.nrs.fs.fed.us/news/release/cities-communities-losing-tree-cover/</u>.

Nowak, D.J., Greenfield, E.J. 2018. Declining urban and community tree cover in the United States. Urban Forestry & Urban Greening. <u>www.fs.fed.us/nrs/pubs/jrnl/2018/nrs_2018_nowak_005.pdf</u>.

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Geoengineering is Not a Solution to Global Warming... continued

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counteract anthropogenic climate change" (Shepherd et al., 2009).

Geoengineering is a proposal and is not currently being employed. Proposed schemes come in two flavors, carbon dioxide reduction (CDR; taking the gas which causes global warming, CO_2 , out of the atmosphere), and radiation management (RM; injecting particles into the stratosphere to mimic a volcanic eruption or adding particles to low marine clouds, both of which would reflect more sunlight to space; or artificially thinning cirrus cloud cover to increasing outgoing heat radiation). While CDR technology currently exists, it is very expensive and there are not facilities to do it on a large scale. It presents very different engineering, scientific, governance, and ethical issues than RM. Here I will focus on the most studied proposed scheme for geoengineering, artificial creation of a stratospheric aerosol cloud, and will use the term "geoengineering" to refer to that scheme. This is the scheme I research. Parts are condensed from Robock (2016a) and Robock (2016b), which contain more detailed discussion.

Geoengineering is currently impossible. The technology does not exist, and there are serious questions as to whether it would be possible to create a cloud in the stratosphere that would have the desired effects. We can inves-

Figure 1. Proposed methods of stratospheric aerosol injection. A mountain top location would require less energy for lofting to stratosphere. Drawing by Brian West. (Figure 1 from Robock et al., 2009)

tigate the impacts of a geoengineering by using analogs, in particular volcanic eruptions, which can teach us about some of the resulting benefits and risks. We can also use climate models, computer simulations that calculate the climate response to different geoengineering scenarios. These are the same models that we use for weather forecasting and global warming climate simulations. They are validated with simulations of past climate, in particular the response to volcanic eruptions.

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Table 1. Risks or concerns and benefits of stratospheric geoengineering, from Robock (2016a). Please also see Robock (2008) for explanations of most items. The effects that are observed after volcanic eruptions are indicated by an asterisk (*).

Benefits	Risks or Concerns
1. Reduce surface air temperatures*, which could reduce or reverse negative im-	Physical and biological climate system
pacts of global warming, including floods, droughts, stronger storms, sea	1. Drought in Africa and Asia*
ice melting*, and sea level rise*	2. Perturb ecology with more diffuse radiation*
	3. Ozone depletion*
	4. Continued ocean acidification
	5. May not stop ice sheets from melting
2. Increase plant productivity*	6. Impacts on tropospheric chemistry
3. Increase terrestrial CO ₂ sink*	7. Rapid warming if stopped*
4. Beautiful red and yellow sunsets*	Human impacts
5. Unexpected benefits	8. Less solar electricity generation*
6. Prospect of implementation could in- crease drive for mitigation	9. Degrade passive solar heating
	10. Effects on airplanes flying in stratosphere*
	11. Effects on electrical properties of atmosphere
	12. Affect satellite remote sensing*
	13. Degrade terrestrial optical astronomy*
	14. More sunburn
	15. Environmental impact of implementation

Table 1... continued.

Risks or Concerns
Esthetics
16. Whiter skies*
17. Affect stargazing*
Unknowns
18. Human error during implementation
19. Unexpected consequences
Governance
20. Cannot stop effects quickly
21. Commercial control
22. Whose hand on the thermostat?
23. Societal disruption, conflict between countries
24. Conflicts with current treaties
25. Moral hazard – the prospect of it working could re- duce drive for mitigation
Ethics
26. Military use of technology
27. Moral authority – do we have the right to do this?

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If there were a way to continuously inject sulfur dioxide into the lower stratosphere, it would create a permanent cloud of sulfuric acid droplets there, producing global cooling, stopping melting of the ice caps, and increasing the uptake of CO_2 by plants. A comparison of different proposed injection schemes, using airplanes, balloons, and artillery (Figure 1), shows that putting sulfur gases into the stratosphere would be inexpensive. But there are at least 27 reasons why stratospheric geoengineering may be a bad idea (Table 1). These include disruption of the Asian and African summer monsoons, reducing precipitation to the food supply for billions of people; ozone depletion; no more blue skies; reduction of solar power; and rapid global warming if it stops. Furthermore, there are concerns about commercial or military control, and serious degradation of terrestrial astronomy and satellite remote sensing.

The audacious idea of actually controlling Earth's climate brings up a number of ethical and governance issues. The fundamental question is that of where to set the planet's thermostat. Who would decide how to carry out geoengineering? What values would be used to decide? For whose benefit would this decision be made? For those controlling the geoengineering? For the entire planet, however defined? For the benefit of those most at risk? For only humans, or taking into account the rest of the natural biosphere? These decisions are in the realms of politics and power, and are different from testable scientific hypotheses, but scientific evaluations of the benefits, risks, and uncertainties of various proposals should, in an ideal world, inform decisions about implementation of geoengineering.

Ethical and governance decisions about geoengineering need to differentiate between research and actual implementation. As for research, there have been many recent recommendations that geoengineering research be enhanced, such as from the U.S. National Academy of Sciences (McNutt, 2015) and the American Geophysical Union (2018). But is such research ethical? Does it lead to a slippery slope toward geoengineering deployment? Does it take resources away from other more useful pursuits? Is it yet another way for developed countries to continue to run the world to benefit themselves? Does the knowledge that this research is ongoing present a "moral hazard," and reduce whatever political drive there is toward mitigation, since it will be seen as an easier solution to global warming? Does indoor geoengineering research (in a laboratory or a computer, with no emissions to the environment) have different ethical issues from outdoor research (in which sulfur is emitted into the stratosphere to test potential technology and its impacts)? Would the existence of the technology enable hasty, politically-driven decisions to deploy? Are weapons being developed in the guise of understanding the science of geoengineering, which was a strong motivation for past research on weather and climate modification? Or would it be unethical not to investigate a technology that may prevent widespread dangerous impacts on climate associated with global warming? Would it be unethical not to be able to provide policymakers in the near future with detailed information about the benefits and risks of various

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geoengineering proposals so that they can make informed decisions about implementation? Would it be unethical not to develop the technology to carry out geoengineering, both so that the costs and efficacy can be determined (maybe it will prove impossible or much too expensive or dangerous), and to have the designs available so that it could be rapidly implemented if needed?

Certainly if the research itself were dangerous, directly harming the environment, this would bring up ethical concerns. Is it ethical to create additional pollution just for the purpose of scientific experiments? There have been no such outdoor experiments in the stratosphere. To test whether there were a climate response or whether existing sulfuric acid cloud droplets would grow in response to additional emissions would require very large emissions, essentially implementation of geoengineering, and would therefore be unethical. But what about flights to spray a little sulfur dioxide or other sulfur species and then observe how particles would grow or the response of ozone? Although no such governance now exists, any such outdoor experiments need to be evaluated by an organization, like a United Nations commission, independent from the researchers, that evaluates an environmental impact statement from the researchers and determines that the environmental impact would be negligible, as is done now for emissions from the surface. Additional monitoring capabilities would be needed. There would also need to be enforcement of the limits of the original experiment, so that it would not be possible to emit a little more, or over a larger area or for a longer time than in the initial plans, should the experimenters be tempted to expand the experiment in light of inconclusive results.

To make decisions about ethics requires a declaration of values, unlike in the physical sciences, where nature follows well-accepted laws, such as conservation of energy. The above conclusions are based on the following principles: 1) Curiosity-driven indoor research cannot and should not be regulated, if it is not dangerous; 2) Emissions to the atmosphere, even for scientific purposes, should be prohibited if they are dangerous; and 3) The idea of geoengineering is not a secret, and whatever results from it will need to be governed the same way as all other dangerous human inventions, such as ozone-depleting substances and nuclear weapons.

The conclusions are therefore, "in light of continuing global warming and dangerous impacts on humanity, indoor geoengineering research is ethical and is needed to provide information to policymakers and society so that we can make informed decisions in the future to deal with climate change. This research needs to be not just on the technical aspects, such as climate change and impacts on agriculture and water resources, but also on historical precedents, governance, and equity issues. Outdoor geoengineering research, however, is not ethical unless subject to governance that protects society from potential environmental dangers....Perhaps, in the future the benefits of geoengineering will outweigh the risks, considering the risks of doing nothing. Only with geoengineering research will we be able to make those judgments." (Robock, 2012)

Eventual decisions about deployment will need to consider the relative benefits and risks, which will be deter-

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mined by research. All these potential benefits and risks (Table 1) will need to be quantified. Because some can never be quantified, I am very skeptical that geoengineering will ever be deployed. Of course, in the real world, decisions are made without full knowledge, and sometimes under pressure from extraordinary events. Much more research in stratospheric geoengineering, conducted transparently and published openly, is needed so that future policy decisions are as informed as possible.

Even at this late date, a global push to rapid decarbonization, by imposing a carbon tax, will stimulate renewable energy, and allow solar, wind, and newly developed energy sources to allow civilization to prosper without using the atmosphere as a sewer for CO₂. Adaptation will reduce some of the negative impacts of global warming. Geoengineering does not now appear to be a panacea, and research in geoengineering should be in addition to strong efforts toward mitigation, and not a substitute. In fact, geoengineering may soon prove to be so unattractive that research results will strengthen the push toward mitigation.

Acknowledgments

I thank Brian West for drawing Figure 1. Supported by U.S. National Science Foundation grant AGS-1617844.

For those with questions about the reality of global warming or chemtrails:

https://skepticalscience.com/ : Explaining climate change science and rebutting global warming misinformation

<u>http://contrailscience.com/</u> : The science and pseudoscience of contrails and chemtrails

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******* NEWS AND UPCOMING EVENTS *******

Rutgers Environmental Stewards Program: Registration is open

Classes begin in early 2019.

Atlantic, Essex, Middlesex, and Somerset Counties. Participants do not have to be county residents to attend the classes.

The program costs \$250.

Stewards start out in the classroom once a week with topics including climate change, soil health, energy conservation, water resource protection, invasive species management, land use policy, wildlife ecology, protecting pollinators, and native/invasive species, among others. Optional field trips to environmentallysignificant sites around the state are included as part of the program. The program introduces non-scientists to the science underlying key environmental issues in the Garden State. Leading researchers from Rutgers are joined by government and non-profit representatives to share their knowledge with the Stewards and help them make a difference in their own communities.

To register:

http://envirostewards.rutgers.edu/countyprograms/

A Rutgers Environmental Steward is a volunteer that is trained in the important environmental issues affecting New Jersey and works to help solve local environmental problems.

Stewards attend weekly classes and are taught by leading researchers from Rutgers, government, and the non-profit sector. Fieldtrips to environmentally significant sites are included. Stewards complete a 60 hour internship of their choosing to become certified. Topics include climate change, soil health, alternative energy, water quality, habitat conservation, pollinator protection, environmental policy and more!

Anyone can become an Environmental Steward! You do not need an environmental degree. You simply need a passion for the environment, a desire to learn, and a willingness to volunteer to create positive change in your community. The program fee is \$250. Classes start in early 2019 in Essex, Middlesex, Somerset, and Atlantic counties. Start times and locations vary. To register or learn more visit envirostewards.rutgers.edu.

******* NEWS AND UPCOMING EVENTS *******

Rutgers Environmental Stewards Public Facebook Page is Live

Visit Rutgers Environmental Stewards on Facebook:

www.facebook.com/RutgersEnvironmentalStewards/

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Green Knight newsletter

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DOUGLAS H. FISHER Secretary

New Jersey Agricultural

Talking Points - Spotted Lanternfly and NJ Christmas Trees

Much has been made in the media over the past week about the impact of the spotted lanternfly on Christmas trees. It's important to provide some additional clarity for families looking forward to visiting one of New Jersey's more than 70 Christmas tree farms this holiday season that might be concerned about the impact of this invasive pest.

Q: Will buying a choose-and-cut Christmas tree mean I might bring the Spotted Lanternfly into my home?

Very unlikely. To date, the spotted lanternfly has not been detected on any Christmas tree grown in New Jersey, nor are traditional Christmas tree varieties a known favored host of the lanternfly. Additionally, and out of an abundance of caution, family owned Christmas tree farms across the state are taking every precaution to further mitigate the risk, inspecting their trees regularly not only now, but in the lead-up to the holiday season.

Q: In the off chance that a spotted lanternfly and/or its egg mass comes into my home, is there any risk to me or my family?

Simply put, no. This is a nuisance pest, plain and simple. It poses no risk whatsoever to you or your family or your pets. It has the potential to do economic harm to New Jersey's agriculture and horticulture industries if it spreads within the state, and that is why the Department of Agriculture is underway with a comprehensive eradication plan to limit the risk.

Q: What would happen if one of the flies or its egg mass came into my home?

As noted, there is limited risk of this happening. If on the off-chance you do encounter a lanternfly or an egg mass, simply eradicate it as you would any other unwanted pest.

Q: Should this have any impact on my holiday plans?

Absolutely not. New Jersey's Christmas tree farmers are ready to welcome you to their operations from Sussex to Cape May County over the coming weeks. There is truly no holiday experience quite like choosing a one-of-a-kind Christmas tree. Now more than ever, we would encourage you to "Keep it Real" by supporting New Jersey's Christmas tree farmers. To find a choose-and-cut operation near you, visit https://njchristmastrees.org/.

******* NEWS AND UPCOMING EVENTS *******

New Jersey Nursery and Landscape Association release spotted lanternfly videos in English and Spanish

"Be on the lookout for the Spotted Lanternfly"

English:

https://www.youtube.com/watch?v=UI0gIA9oTsg

Spanish:

https://www.youtube.com/watch?v=u5gYf7yHBXQ

Green Knight newsletter

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