



2026 Jumping Worm Workshop

Subject: Participatory Science

Jumping Worms: An Extension Perspective

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Hello, my name is Angela Gupta. I'm a University of Minnesota Extension forester, and I'll be talking to you today about jumping worms with an extension perspective. And later in the presentation, you'll hear from my colleague Hana Kim and her work related to jumping worms and extension.

I'm going to tell you mostly about a project called Jumping Worms Report Management that was conducted from 2020 to 2022. And this was a participatory science project in Minnesota. The whole objective was for volunteers to have a meaningful narrative in a Google document, and that was a journal that was submitted annually. And so, in 2020, the first year we had 15 volunteers submit an actual journal. Like a Google document in which they typed in the things that they had done related to jumping worms, and they added photos, and they told us their observations, that kind of thing. So it wasn't a form, it wasn't a survey, it was a journal.

We had 15 participants in 2020 that submitted usable journals. In 2021, we had 21 volunteers submit usable journals, and in 2022 we had 10 volunteers. And this was truly iterative learning in that it demonstrated year after year that people would try what others had done in the previous year or years, and then they would implement it, and then they would tell us about it.

So, for example, in the first year, volunteers tried lots of things. They told us about what they were doing in their home landscapes to mitigate or manage jumping worms, and then in 2021, we had volunteers that would say, hey, I tried that thing, this is what worked or didn't work, this is what I observed. And so it was the whole scientific process repeated a couple of years. And there was a hypothesis, there were trials that were run, there were observations that were made and reported, and then the information came back to me at Extension, and then I was able to summarize that information annually, send it out to volunteers, post it on our website, new people join, new people reported, and then repeat. And so we did that for 3 years.

And the goals for this project changed as a result of the project. So that iterative learning, we actually then applied that to the project itself, and we changed our objectives. So in 2020, the original and first year, the objective was to report jumping worm management. That helps us, the research community, better understand potential effective jumping worm management that can

enable future scientific research. So essentially, it was, hey, what are you guys doing out there? Can we learn from that? Anything that offers a lot of hope or promise, then maybe we can put into scientific research. That was the objective in 2020. After we went through one year of this, we realized that we needed to tweak and improve our objective

So in 2021 and 2022, the objective changed and it served a dual purpose. One, to provide emotional support to landowners impacted by jumping worms, and two, to gather data from landowners on their jumping worm management activities in order to inform future scientific research and empower others impacted by jumping worms. One of the most important outcomes of 2020 was this understanding and realization that we really had to focus more on the emotional support of our participants. And so that became the first goal. The second goal was then to gather that research about the worms themselves. And I think that is really an important and critical lesson that we've learned as a result of this work.

So back to 2020 and the outcome. There were lots of management trials that were done. This picture on the right is a picture of someone trying solarization, the idea that you can use a plastic tarp to trap in the heat of the sun to a temperature that gets the soil above that temperature, which kills jumping worms and jumping worm eggs to eradicate this small area of jumping worms and thus enable planting. And so that is one example of a management trial that was a common thing that people tried.

Then there was observations of environmental impacts. So, did the trial work? Were they able to grow plants in them? What kind of plants? Were the plants positively negatively impacted by the worms or the management? They offered recommendations for potential management research, so research that can be done in an academic setting. It became very clear that these volunteers needed an emotional support and additional resources that we did not have.

And in that first year, we had 20 volunteers, 20 of the 23 volunteers, rather, that submitted journals and now remember, this is more volunteers than we actually got good journals for, right? So some people would get in there, they'd add their name, they'd add their date, and then no subsequent information. So we didn't get full and useful journals for all of these 23 volunteers, but of those that registered for the program, 20 of them appeared to be female, 3 male based on first names. And interestingly, we did have active volunteers from Ohio and Illinois, even though the project was intended for Minnesota.

All right, that first year, 2020, as I'm sure you all know, there was a global pandemic and lots of things went online. Our project was not stopped at all by COVID-19. Because everything could be done while social distancing at home. And frankly, many people went out in their backyards and started gardening that year. So this project, the jumping worm project, could continue unabated throughout the pandemic. But many other projects got waylaid or programs had to pivot or tweak how they did it. And one of those was the Minnesota Master Naturalist Program. So my colleagues that run the Extension Minnesota Master Naturalist Program had to move a lot of their education and their capstone courses into a virtual format. And when they did that, they

put an all call out to colleagues like myself to see if we could come up with capstone courses for their volunteer trainees that could be done virtually. And so, I put an all call out for people to consider doing jumping worm, emotional impacts literature review, so peer-reviewed literature review, and God bless them, a group of trainees selected that category, and they did a literature review on the emotional impacts of jumping worms.

It turns out there was no data on the emotional impacts of jumping worms. So we came up with nothing. We expanded the search to include the emotional impacts of invasive species. There was no data about that. And so then we expanded the search one more time to come up and ultimately we landed and stumbled upon eco-anxiety, and we realized that body of literature of which there is better information, could be applied and was indeed at least a subcategory of our volunteers were experiencing, a subcategory of eco-anxiety. So we could take that learning, apply it to the volunteers, and then proceed. So that turned out to be really critical.

So, in 2021, volunteers reported reduced jumping worm numbers. So, we actually had what you could argue, a positive jumping worm impact, so there were fewer of them, less impact to the landscape. We learned, and I'll talk more about this in the next several slides, that jumping worms cause really strong emotions. We also learned that participants' feelings changed in positive and important ways by participating in this project. So this project did not solve the question of what are scientifically recommended management approaches for jumping worms, that is still an open question that has not been resolved. But what this project did do, was it changed the feelings of the participants in positive, important ways by participating in the project.

And then we did learn that integrated pest management offers promise for reducing jumping worm numbers in home landscapes. So there's a lot of things that can be done in home landscapes responsibly that will reduce jumping worm numbers and thus make the impacts of jumping worm less bad. And so here's an example of folks trying to solarize material before removing it offsite so that like what do you do disposal kind of question. And here are people experimenting with solarization of their debris waste.

Okay, so one of the literatures that was discovered in the literature review, so peer-reviewed literature, included an addendum that was open access that was the actual survey given by these original researchers around a slightly different area, but related to emotional impacts of eco-anxiety. And we were able to take that addendum survey, tweak it and change it for jumping worms, and then give it to the volunteers. And that turned out to be really informative. So at the end of that process, having sent the survey out, the volunteers taking the survey, crunching on the data, we learned that jumping worms cause a lot of sadness, fear, panic, impatience, anger, increased negative thoughts, and tears.

And I'll just pause right there and say, the reason we explored this whole avenue was because so many people called me on the phone and cried. And as an extension forester, I did not know what to do with those heavy emotions, and it happened enough times that I realized that my

experience of dealing with people on the phone crying was a data point that needed further exploration. That's what launched the whole literature review, and then this survey. And it turns out what I was observing was true. People were very upset by these.

But we also learned in that survey that by participating in this project, participants' feelings became more positive, reducing worry, increasing confidence, increasing attention to environmental change, and their jumping worm outreach efforts. So those are pretty positive impacts, even if we haven't actually solved the jumping worm management question, we've had a lot of really positive impacts for our participants.

So also, an additional survey outcome is even when jumping worm management costs money and takes time, respondents reported a sharp increase in their efforts to manage jumping worms. And this was important because at the time, so back in 2020-2021, there was a lot of concern in the horticultural industry that once jumping worms were discovered, the people would, like, stop gardening, and they would stop buying plants and materials and all that stuff from the garden centers. And so I think there was a lot of anxiety from the horticulture industry to even address jumping worms to report them, because they were just, I think, really worried that their consumer base would decline if jumping worms are found. And our research came to the opposite conclusion. So I will admit that it was a small number, an N value for our participants, and they did tend to, as you'll hear about in future slides, be really avid gardeners. But that group actually spent a lot more time and money on their gardens after they discovered jumping worms in an effort to continue to garden, to manage their jumping worms, to figure out how to manage/to garden with jumping worms. And so it was a very interesting finding.

The other one that I think is absolutely critical for the people listening to this presentation is that as communicators of scientific research, of jumping worm information, we must manage the stories and actions we talk about because those, the way in which we talk about jumping worms can cause anxiety, mourning, anger, hopelessness, and motivation. So the first 4 are pretty negative feelings, anxiety, mourning, anger, and hopelessness. Hopelessness often does not get us what we want. We want people to feel that there is hope and that they can make a difference. And we want people to be motivated. So we need to figure out how we can accurately and appropriately communicate about jumping worms that empowers these positive emotions to make change and not to give up or to further their anxiety or further their mourning or further their anger. Certainly, we don't want to further feelings of hopelessness.

The respondents for our survey the median age was 57.5 years. They were predominantly white at 92% and 88% were female.

So I think this is a really important chart to realize. So it's that same data in a numerical format. So here are the top. This is organized in moderate to well, and that was how these words describes the feelings that were evoked in a story that they were prompted to remember about jumping worms. And so you can see that these words, anxiety, 76% said that the story that they thought about related to jumping worms evoked anxiety, feelings of anxiety. 65% evoked

feelings of mourning, 56% anger, 55% hopeless, so over half of the participants had these words associated with their feelings around jumping worms, and then 50%, so fully half, found some motivation, and that's the part I think we want to tap into most and figure out how we can help people through these totally legitimate feelings without evoking them further. And there are certainly ways we can do that, and I'll show some examples in a moment.

So this crying, again, I think it can be really important, so I was experiencing people on the phone crying to me. That is not like a scientifically reported data point, right? That's a lived experience. But it turned out it was that tip of the iceberg that really did require further exploration. And so I'm glad I followed that tip and we explored it with our Master Naturalist trainees. So you can see 57% of respondents reported negative thoughts about jumping worms and 19% reported crying about jumping worms. That was the end value of 15. So you can see these negative thoughts, you can see crying and heightened sensitivity to jumping worms, and then fewer with altered breathing and ringing of the ears, and these are metrics that are used related to some emotional changes, and so they were included in that survey.

All right. So as a result of those findings in 2021, emotional additions were added to Extensions engagement as a result of that survey. And so there's three things that we really identified, and then three ways we offered to help folks. So when you dove into the emotions, and I did some work trying to figure out what exactly within that large realm of eco-anxiety was maybe evoked most by these jumping worms, and feelings of solastalgia emerged.

So, solastalgia is the feelings of remorse for a landscape that no longer exists. So, a common example of this is if you grew up on a farm, you have lots of lovely memories of your childhood on this farm, and you go back to visit your farm, and you realize it's been turned into a housing development or a parking lot. And now you're going to feel this remorse, this loss for a landscape that no longer exists. And I think many of the gardeners were viewing their now gardens with jumping worms as a lost landscape, when they can never get back and they could never enjoy as they had before, and so they were experiencing solastalgia. I don't actually think that is what has to happen in a landscape when a landscape gets jumping worms, so we'll talk about that a little bit. But those were the feelings that they were experiencing.

So another particular emotion that I think was present within the volunteers was many of them garden as a point of serious leisure. So it's a thing that they take seriously, it's a hobby that they love, and they have pride in their hobby. Not all that many were actually master gardeners, but they were all involved in the gardening community, or many of them, or they were just really proud of this landscape they had created. And then they had to work through the emotional experience of likely having directly or indirectly brought in these jumping worms, so this tremendously negative invasive species that they couldn't do anything about, right? There's no way to eradicate them once they're there. And then those invasive species, which they inadvertently brought in, none of them knew they were bringing in jumping worms, none of

them, very few of them had ever heard of jumping worms until they were identified in their landscape.

You know, they weren't taking mitigation efforts. That was all very, very new at this time back in 2020. And so then they had to, like, many of them took ownership of this grave accidental introduction, and that really caused them to think twice like were they really good gardeners or were they like posing as good gardeners, and then that was influencing their sense of self-esteem. So, if they weren't good gardeners, then maybe they weren't, like, good people. And all of that, I don't think is true, right? Like, they have to give themselves grace, they didn't mean to do it, they were trying to do the right thing. This just happened. But those were the emotions that they were experiencing. So we can't just shove them under the rug. I think it's important to talk about them.

The other thing was disenfranchised grief. And so the shorthand for this is, many people were reporting they'd go to the greenhouse nursery, they would look to buy some plants or some mulch or some soil, and they would ask the nursery employees, like, what are you doing to mitigate the impacts of jumping worms, or to reduce the spread of jumping worms? And they would get the crazy lady look, like, what are you talking about? And that then just evoked all these negative feelings, because they were going through the stages of grief as they worried they were losing their beloved landscape, and then they were going, they were asking these totally reasonable questions, and again, at the time, lots of horticultural industry folks did not really know or understand jumping worms. There weren't a lot of mitigation or management efforts happening.

And then they were just, you know, the floor staff was just giving him the crazy lady look. And so the world at large did not know how to meaningfully engage with this, this grief that they were feeling. That's called disenfranchised grief. We do not have rituals to culturally to work through this type of grief. For what it's worth, the most common example of disenfranchised grief where the literature is most robust is, like, if you have a family member or close friend that's a drug addict, and you might tell your other friends or your family about that person and your community doesn't know how to respond to that. We're good at responding, or we're better at responding to the death of a loved one but not to some of these other things and so just if that's helpful, it's a different example of disenfranchised grief. But I am quite convinced that the volunteers were experiencing disenfranchised grief based on the experiences and results of the survey.

So there are some things that we can do to help people through those emotions, right? So I think it's important to name them, to recognize them, to say they're real and that people are experiencing them. But we can create rituals. So that can help people just work through their eco-anxiety, including their anxiety around jumping worms. So, for example, in every presentation I give, I didn't do it today, maybe I should have, I have people stand up and do a box breathing exercise. So, as a whole group, we breathe slowly in a box breathing exercise, and that

is a very easy way to reduce anxiety, to reduce your blood pressure. To kind of bring you back to a centered place.

In all of our messaging now within Extension Forestry, we try to offer audiences hope and agency. The hope that the future can be good, and the power and the motivation to go out there and make it better. The agency to do something. You can make it better, here's how. And then I constantly remind people that nature based, there are plenty of human health benefits for being in nature. So whether you're getting rid of jumping worms, whether you're putting down a different kind of mulch, whether you are planting new plants that are likely to do better in the presence of jumping worms, or weeding; you're out in nature, and that is good for the mind, body, and soul.

Also, images can matter. So I was a participant in this project, and I have had jumping worms for over a decade now, and you can see that in 2020 I was trying a couple of different things, mustard powder and coco mulch in this little area in my landscape. And jump ahead six years. And it's not the same plants, like, those are annuals up there, but you can see that exact same area is now a flourishing pollinator habitat. So the point here is that there are lots of things that you can do in order to make your landscape beautiful and lovely. It might be different, but it isn't lost. And there's plenty, there's a lot of hope and agency for a lovely future and landscape. And so I think these are ways in which we can frame the actions of what we want people to take.

Okay, so some final project results. Almost all volunteers reported a reduction in jumping worms. Jumping worms cause strong emotions. We know that with confidence now. Feelings change in positive and important ways when people actively manage and mitigate jumping worms on their landscape, and creative integrated pest management offers promise for jumping worm reductions in home landscapes. So again, there are lots of things that you can do to make a jumping worm life miserable, to reduce population numbers. I think of this as hazing the worms at my property, but it turns out I can do lots of things that make them uncomfortable, and then that enables my landscape to thrive.

So, there is a fairly lengthy online report. You can get access to it. It's totally available on the University of Minnesota Extension's website. It's like 18 pages long, I think, and it's organized in these categories. So management trials, volunteers did lots of things, and so what we do is we say what they did a little bit about how they did it, and what kind of outcomes they saw. So management trials, there were lots of cultural trials, so think solarization, mechanical and biological. So did they pull them out? Did they try to attract birds to do that, soil amendments, did they put down any types of things like mulch, or did they use appropriately fertilizers, and did any of those have any impacts on worms? So that is all documented.

They did a nice job, many of them, some of them, of reporting the environmental impact. So to garden plants, did they notice that garden plants were thriving or decreasing as a result of jumping worms? They also looked at different woodland specific mechanical and biological managements, like could they draw in raccoons to really eat a lot of the worms. Plant impacts for jumping worms. So the outcomes are divided into garden plants and native plants, but again, it

talks about those plants that appear to do well and those plants that appear to do negatively in the presence of jumping worms.

So this can help a gardener prioritize what plants they might want to invest in that are likely to do well in the presence of jumping worms, and what plants there might need to really work really hard to keep on the landscape or to recognize that those plants are unlikely to thrive, and so to try something else. And then there was a lot of soil and weather information, particularly when it was too dry or too wet around irrigations, that kind of thing. So all of that you can look up and see.

And then we did some significant improvements to our Extension website as a result of this project. So, as with all invasive species, there's information about identification, habitat regulations (they are, jumping worms, are now regulated in Minnesota, they weren't during this project) and how to report.

We also talk a lot more about controlling, including the emotions of the humans, and that's actually the piece that I get the most gratitude for. When people take the extra time to email me about jumping worm management information on our website, it's almost always related to the emotional component.

We also included more management, so there are things that you can do. What are those things? Prevention, and that has gotten a lot better as I think the industry has kind of moved through their steps and they do more prevention and management, certainly more education. What are surveillance tools and how can you do disposal? Because those are really critical questions. There's a frequently asked questions section, plant sale recommendations. So early on in our experience in Minnesota, a lot of counties or plant gardening groups decided not to host plant sales because they were so worried and anxious about the possibility inadvertently moving and spreading jumping worms. But the problems with that are several, including this is a really important social event for those groups, and it is commonly their largest or only money making activity for the year. And so when those groups canceled their plant sales, it meant they had no money to operate for the rest of the year.

And that was devastating on a couple of different levels. So we worked really hard to offer recommendations for plant sales on how they can most responsibly go ahead and have those plant sales and really significantly mitigate their risk of spreading jumping worms. They can also be really great tools for education and community engagement around jumping worms.

And so there are also many linked resources. So this is public, right? It's the University of Minnesota Extension website. You all can go there and check it out. But these were significant changes and improvements as a result of this Jumping Worm project. And I strongly recommend, if you're going to do outreach, that you think about some of these categories in your own work.

And so, with that, I am going to turn off my audio and my video and turn it over to my colleague, Hana Kim. Thanks so much for listening.

Hi, everyone. I'm Hana Kim. I'm an Extension Educator with the University of Minnesota Extension, and today I'll be talking a little bit about a research project which is led by the University of Minnesota, where participatory science plays a big role in the research.

So, jumping worm-induced soil erosion is the title of the research project, which is funded by the Minnesota Invasive Terrestrial Plants and Pest Center, supported by the Environment and Natural Resources Trust Fund. Our research team is led by Kyungsoo Yoo, Lee Frelich, Angie Gupta, Nate Lund, and Erin Buchholz. The research team is doing a lot with this project, but the main portion I'll be talking about today is the collection of soil movement data in worm-infested forests in Minnesota.

So we have sites set up in both jumping worm-infested areas as well as European earthworm infested sites to act as a comparison there. But the goal of this portion is to quantify the rate of soil erosion over an extended period of time in our Minnesota forests and assess the risk there, which, of course, will better inform us on the impacts that jumping worms are having in our forests

So we're incorporating participatory science in a couple of ways. And so the first is crowdsourcing more information about jumping worms in Minnesota. We're doing this by putting all calls out there through social media and utilizing our extension programs, newsletters, tabling and presentations, and just asking Minnesotans. So one, know what to look for, know how to identify jumping worms, and know what makes them different from the other worms that they may be familiar with, such as night crawlers. Know what the crumbly soil looks like, and just actually keep an eye out for them while they're out enjoying our forests and our green spaces and natural areas.

And then also we're asking them to report jumping worms that they find, whether it is in these forests or it's in their home landscapes and gardens. And we have found in the past that there's a correlation between our social media posts and increased reports to EDDMapS, which is fantastic. You can see that this is a map that I pulled from EDDMapS this year and the reports are primarily concentrated around the Twin Cities here, but having more reports from the public provides us with more information about where jumping worms are in the States, and where they're densely located as well. They're also densely located in Rochester down there, so I'll be talking a little bit more about our research sites, and they are around these highly concentrated areas in the metro and in Rochester.

Having these reports also points us to potential areas where jumping worms are spreading, too. So from these verified reports, our team is able to go into EDDMapS and look around those areas for nearby parks and forests and other green spaces where jumping worms might be present, because we know that they're nearby in a neighborhood or in a backyard. And we actually have found a couple of our research sites by doing this through these all calls, social media and crowdsourcing. We've also gotten direct emails and direct calls from the public saying that they know of potential sites as well, which has been super helpful for this research project.

And the second main way that participatory science is contributing to this research is by having awesome volunteers out there in the field, and they go and collect data collection or data erosion measurements. And so this year we have 8 fantastic volunteers. They are across 10 research areas within six parks, again, around the Twin Cities metro and Rochester. And to just give you a better idea of what they're doing out there, here is how the field sites are set up. So on the left, you'll see these little dots, and each one of those dots is a soil pin. On the far right there, that is what the individual soil pins look like. You can even see a jumping worm right next to it, and if you look a little closer, you can see that crumbly soil. But the soil pins only stick out about a couple inches from the ground. So each one of these areas that we see on the left there, that is considered a transect.

You'll also see in the middle picture, that is one transect that we are setting up. So for each area that a single volunteer will go to has three transects. So three basically rows of soil pins.

And so, what the volunteers go out and do first, in the beginning of the season, they are trained, they are given the materials, and we make sure that they are confident in their role. But they'll go out either by themselves or some of our volunteers also bring a friend or a family member along with them. And they will start off by taking photos of the transects, and then they'll go ahead and collect the soil movement data using a caliper, which you can see on the right there. They'll do that for all 36 pins. And then they are recording the data, then they'll go home and upload the data into our folders. And you can also see if you're curious, each soil pin is marked with paint for the spot that they should go back and take that measurement from so there's consistency over the summer into the fall.

But that's pretty much it. Each session, on average takes the volunteers about 1 hour, and it doesn't require a ton of materials. It's just their phone, the caliper, which is pictured, the washer, which is pictured, and then the data sheet, pencil and a clipboard. And so they can go ahead, move on with their day after they upload it, and then they'll come back in 2 weeks. So they do it biweekly. Again, this is throughout the summer into the fall.

This year, we also added an additional role, which is digitizing the data. So on the left, this is what the volunteers will upload. It's either a scan or a photo of the data sheet with the recorded measurements from the day. Then this new role is going in and taking those numbers and putting them into our digital system. So that way it's easier for our team to actually utilize and analyze.

So just an overall picture of how participatory science has contributed to this research, is it's given us a better understanding of the density and distribution of jumping worms in our state, as well as pointing us to potential research sites, and in general, just giving us an idea of where jumping worms might be spreading to. Our volunteers out in the field have doubled our monitoring capacity across more sites, and overall has allowed the research team to do more and focus on other parts of this project as well.

So per season, our volunteers are clocking just about 100 hours of data collection as an estimate, not including the travel time to and from the sites. Also not including the time it takes to digitize the data. So shout out to our awesome volunteers and everyone that we've mentioned today.

And this research is still ongoing, but from the team's findings last year, our analysis indicated that the net soil erosion across our monitored plots was statistically significant. And so we'll have more about that once the project is wrapped up and once it's published, but thank you for listening today, and if you have any questions for Angie and I, please feel free to reach out. Our emails are listed here.



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