Jumping Worm MN & WI Community of Practice Group, Every other month, first Thursday, 3pm, Krischiklab organizes

Next meeting, August 1st, 2024, 3pm
Julie M Semrow is inviting you to a scheduled Zoom meeting.

Topic: JW COP Meeting
Time: This is a recurring meeting Meet anytime

Join Zoom Meeting
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Meeting ID: 938 7928 2284
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Second meeting:
June 6th, 3pm, online Zoom meeting
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Purpose of the meeting:

1. Sharing our varied experiences with jumping worms (JW) as well as other worms
    a. What has worked best for keeping worms
    b. What have been the methods of others researching using worms
    c. What specifically to avoid when trying to raise your own worm colony
    d. Seeing if anyone had a written protocol for taking care of worms
2. Bringing together resources we've found
    a. Where to get enough worms if we can't source enough locally
        i. Worms4Earth.com was the one source we found to purchase from that seemed to be reliable, turned out it may not work out - may be the wrong worms, too hot of conditions to be able to ship them from Southern US until fall

ii. Maryam proposed collecting worms for us and sending them from Vermont

b. The best food and bedding materials because we want a colony with quality worms for bioassays and qPCR

i. Reaffirmed that organic material seems to be their preferred food source - Lee mentions that maple leaves and basswood leaves (Linden) are the best (highest calcium, lowest carbon-nitrogen ratio (C:N)), but for the Krischik Lab experiment, we want to be able to buy products commercially rather than collect them so it's easier to recreate our procedure

ii. We still want to try the worm food from Worms4Earth even if we don't end up using his worms

iii. Austin Worm Lab also seems rather reputable and they offer worm food iv. Maryam has used Millet and it has had good results; she cooked it slightly, but didn't allow it to get too mushy - need it to maintain its shape v. Jenna plans to use Purina Chicken Scratch as food since it has a little grit, but is still small enough for JW to be able to consume

vi. Josef and Lee emphasize the importance of gritty materials as part of the JW diet because it helps them digest their food quicker, such as fine to medium grain sand, can't be too coarse (0.1-0.5mm)

vii. Erin and Jenna mentioned that they experienced JW eating fresh, green leaves in the absence of other food sources

1. This caused us to wonder if they could survive off a diet of fresh leafy greens, Lee suggests that dark green, thin leafy greens would be the best if we try this
2. Lee also mentioned that he noticed that Lumbricidae ate other dried-up leaves throughout summer, but left oak leaves largely alone until August

viii. Mulch and mushroom compost would likely be the two best materials for bedding

ix. We plan to use 25-gallon totes for our worm colonies; don't want it to be complicated so we're avoiding the two-tier system if we can

1. Plan to use styrofoam peanuts in the bin and to turn over the bin about once a week to keep anything from going sour or collecting too much moisture

x. Will use temperature and moisture probes to discern the most appropriate conditions

xi. How to effectively seal in JW so they can't escape from their containers - one strategy would be to use Insect Barrier on the edges of the bin so its completely sealed off

xii. Erin and Jenna have used a peat-based mix without fertilizer, though it does have perlite, but they said that it worked great - Promix BX 1. Not the best to use peat/peat moss

xiii. We're thinking that potting mix is not as good for the worms as was

previously thought

c. All the different possible treatments we want to try to manage populations of JW - in general, mostly focusing on adult JW at the moment, cocoons may end up being a whole other pest to tackle
    i. Erin's, Jenna's, and Nate's projects with different experiments
    ii. Lee emphasized mustard drenches, have been found to be successful in bringing JW to the soil surface in past studies[1]
    iii. Possibly using an already FDA-approved product that isn't yet labeled for controlling JW populations that actually turns out to be effective for this use - like Castaway 1-0-0, which is tea seed meal
    iv. Could test Biochar as a material to kill adult JW

3. Talked to Laura, the Terrestrial Invasive Species Coordinator with the Minnesota DNR
    a. What conversations have they been having with people?
    b. What is their expectation on July 1st when the species is officially listed as a Prohibited Regulated Species?
    c. Do they have suggestions for people dealing with JW?
    d. Also gave us suggestions for how to responsibly conduct research with JW 4. Also asked Laura about how other states classify levels of invasiveness and if there was a federal, US-wide standard

5. Maine is also going to be coming out with a classification change for JW this month 6. What are the differences between JW and other types of worms - European earthworms or Red Wigglers?
    a. Could we generalize management strategies that work on other types of earthworms to also manage JW?
    b. Also need to consider that JW from the Southern US may not be the same species that we experience in Minnesota
        i. In Ohio, Lee mentioned that *Amynthas gracilis* are more prevalently invasive in lawns, whereas we don't see any JW in lawns here, we see them more in forest ecosystems

Worm Species of Most Prevalence So Far
Family: Megascolecidae, Lumbricidae
Genus: *Amynthas*, *Metaphire*, *Lumbricus*, *Eisenia*
Species: *agrestis*, *gracilis*, *tokioensis*, *hilgendorfi* *terrestris*, *rubellus*, *fetida*

Jumping Worm Colony Logistics
On Worms4Earth, the owner, Jeff, does not mention what species Alabama Jumpers are, meaning it's likely that he, one, doesn't know what species he has for sure, and two, may not have just one species. On top of this, as Erin pointed out during the meeting, his pictures seem like they could be stock images that don't show very well the physical characteristics of the worms he has, such as the clitellum and the number of segments from the clitellum to the tip of the head which would

make it very easy to tell if he has *Amynthas*, the genus we're working with, as they have a pale clitellum that is not raised and completely encircles their body and at least around 12 segments from the clitellum to the tip of the worm's head/mouth. While talking with Jeff, he also mentioned that the worms live and reproduce year-round, which Maryam said is not a characteristic of JW as they die off in the fall regardless of environmental conditions, another

fact that causes us to believe that Jeff does not have true *Amynthas* "Jumping" worms. Due to these realizations, Maryam offered to send us worms from Vermont if we do have trouble finding enough JW locally, which would allow us to know at least the genus for sure, if not the species**. Maryam also noted that there are ways to ID juvenile worms, the majority of what we see when we go to look for JW right now, but that it's not nearly as easy to identify juveniles as it is to identify adults.** The physical characteristics of *Amynthas agrestis*, *A. tokioensis*, *A. gracilis*, and *Metaphire hilgendorfi*, the two genera and 4 species we've found in the US, overlap considerably, making the identification of the species nearly impossible without assessing internal morphology, bioassays, and qPCR testing.[5]

Using the experiences of the others in the group and the experiences they draw in from outside the group will be helpful in determining the type of colony we set up and what materials we test out to get the healthiest, most reproductive worms we can. In order to find this information out, we intend to have multiple colonies with different collections of worms (from the UMN St. Paul campus, from the Minnesota Landscape Arboretum, and either a collection from Vermont or from another online source if we're able to find them), different types of bedding materials (coconut coir, mushroom compost, mulch, soil, peat-based substrate (Pro-Mix BX), and possibly potting mix), and different sources of food (sand, formulated worm grain feed, chicken scratch, millet, dark leafy greens, and possibly dried leaves or other brown organic matter (like peanut shells)). For ease of replication, we hope to use materials that are widely, commercially available instead of location-specific sourced materials. We also hope to simplify the more popular two-tiered worm farming system by using 25-gallon storage bins/totes with styrofoam packing peanuts on the bottom layer to improve aeration and turning the bin over completely about once a week to prevent too much build-up of moisture in the bottom or any souring of materials.

As of this meeting, no one we've talked to has come up with a written protocol for raising JW in an enclosed habitat, so that will also be something we hope to do if we find a consistently successful method of keeping a colony. We also hope to be able to keep our worms year-round though Maryam mentions that she's found it's not best to keep them for too long. We hope to begin determining what causes JW to die off in the fall, whether it's a natural phenological trait or caused by another factor. JW don't die directly after laying cocoons and can lay many, many cocoons before they do eventually die. Josef brought up that he had conversed with an Australian researcher who had worked in Japan for a number of years and reported finding *A. agrestis* under snow piles in their native range, suggesting that they can survive quite cold temperatures and that a drop in temperature may not be the only reason JW die off in the fall.

The difficulty we've had in finding a reputable supplier for JW has pushed us to think of alternatives if we can't source enough JW locally. We considered using Red Wigglers (typically the species *Eisenia fetida*) as a backup if we didn't have enough JW for our colonies. If this is

the choice we make, we'd have to identify the differences between the two different genera, though it may seem that generalizing among different earthworm families Megascolecidae and Lumbricidae may be rather easy.[2] Bernard et. al. (2009) writes about earthworms quite generically, being able to describe their distributions and behaviors rather specifically without breaking down into specific families or genera (though they do describe them separately as well) and mentions that *E. fetida* and *A. agrestis* both used similar sources for food and responded similarly to liming of soil. Another study[4] found that the biggest differences between *L. rubellus*

and *A. hilgendorfi* are that the *Amynthas* had a more flexible diet and that it accrued biomass more rapidly than *Lumbricus* (it also mentions that *Eisenia fetida* grows at a rate more similar to *Lumbricus*, more slowly than *Amynthas*). Lastly, as another article[3] mentions, while *E. Fetida* are epigeic, *Amynthas* species are epi-endogeic, meaning they primarily live in different horizons of soil, but are very close to each other.

Input from the Minnesota DNR

An important concern among the industry, including greenhouses, nurseries, arboretums, and even homeowners was the lack of management precautions in place as the Minnesota DNR had decided to list JW as a "Prohibited invasive species". In our previous meeting, the group had discussed what this designation meant, and what unintended effects it might have. There was a lot of concern that introducing this restriction before we have well-informed measures to take if you do come across JW on your property or within your business would cause unnecessary fear. We also worried that this would cause people who would otherwise reach out for advice, scared of what consequences they might face, making them less likely to reach out at all, inadvertently worsening our JW problem rather than reducing it.

This month, we had the opportunity to talk with Laura Van Riper, the Terrestrial Invasive Species Coordinator with the Minnesota DNR to help minimize some of these worries that we've felt ourselves or experienced from others. The main point Laura wished to emphasize was that, while this decision may feel like the introduction of a "quarantine", the DNR is adamant about not using this term specifically and that it won't be a "light switch" on July 1st. The "prohibited invasive species" classification will prohibit the transport and sale of JW, hopefully slowing the spread of the species further throughout Minnesota and to neighboring states, but will not require nurseries, greenhouses, arboretums, or other plant-centric businesses to quarantine or close if they do find themselves with JW. On top of this, the DNR is more interested in working with people and helping people deal with this issue than shutting people or businesses down - which is not something they're looking to do at all.

The decision from the DNR to classify JW is more to increase awareness and knowledge about JW, their characteristics, spread, and effects on our environment. The DNR is aware and understands that there aren't very good management practices in place at the moment and, more than anything, wants to make sure people are educated about JW because the more educated and knowledgeable people are about this invasive species, the more careful and well-informed people are, and the better chance we have in dealing with JW.

The Minnesota DNR has been involved in an ongoing conversation will the Minnesota Nursery

and Landscape Association (MNLA) in an effort to make the most well-informed decision possible in a time where much is left unknown. Laura also wanted to emphasize that MNLA has a set of best practices when it comes to JW that may help businesses and homeowners in the coming months as they may encounter JW on their own properties; and to report sightings of JW (and other invasive pests) on iNaturalist or EDDMapS. iNaturalist reports have to have enough "seconds" for them to be imported into EDDMapS, but both platforms should have the most current distributions and reports of JW. The Minnesota Department of Agriculture (MDA) also has a Report a Pest website - with a link to their own mobile app - where you can report sightings of JW.

Looking into other states, I found that most don't have levels of classifications for terrestrial invertebrates and if they find that an invasive pest species needs to be regulated, they'll just introduce a new quarantine, but not necessarily classify or categorize each pest. This causes some confusion as it's easy to look between Minnesota and Wisconsin as they operate very similarly with very involved DNR agencies; however, other states employ different agencies to frontline regulations of invasive species. The National Plant Board consolidates all of the regulations of different states for invasive plants, animals, insects, and even plant diseases, but not one state has updated their regulations document to include JW. While it's likely that we will start seeing updates that include this species, a handful of the documents on the NPB website haven't been updated in 5+ years, making it difficult to gauge the level of invasiveness in other states. Another website, Pest Tracker, funded mainly by the USDA and some other national agencies, is also yet to include a listing for JW among their 606 other pest entries.

Our Goals

Considering our current knowledge and understanding of JW and the growing concern of invasion due to JW, our research is most likely going to be mainly focused on finding a way to treat for JW while maintaining biodiversity. In their native range, JW aren't considered to be an invasive species which could be due to enough competition from other species in their native range that aren't present in the US, such as the upwards of 300 other *Amynthas* species that are documented in China,[6] or it could be due to the compost tea that is used abroad. In other countries, a popular, widely used practice for the management of invasive pests is compost tea, and while it is effective, it's not currently an option for consumers in the US due to the fact that it isn't FDA-approved because the main ingredient is unknown. Taking this information into account, the next best step would be to determine if there are any FDA-approved products that, while they may be labeled for other uses, may also be effective at diminishing JW populations.

In order to start testing out what products will be most effective at reducing JW populations, we need populations of JW to test on, meaning we would need to grow colonies of our own worms. Even more, the healthier our colonies of worms, the more accurate our results will end up being once we do begin conducting experiments on our colonies, and when we conduct genetic testing - such as qPCR testing - and bioassays, we want to have healthy worms to conduct these tests on.

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States where jumping worms are recognized as invasive:

- Minnesota
- Wisconsin
- New York
- California
- Missouri
- Nebraska
- Texas
- Vermont
- Connecticut
- Nebraska
- New Hampshire
- North Carolina
- Michigan
- Maine
- Ohio

States with jumping worm regulatory issues:

State	Link to website	Regulatory status	Species
New York	Cornell Cooperative Extension New York Codes, Rules, and Regulations - Prohibited and Regulated Invasive Species	Prohibited	*Amynthas* and *Metaphire* (all species)
Vermont	Vermont Invasives	Not regulated by DNR, but recognized	*Amynthas* (all species)
Wisconsin	Wisconsin DNR	Restricted since September 2009	*Amynthas* (all species)

Minnesota	Minnesota DNR	Unlisted currently, but will be prohibited beginning July 1st, 2024	*Amynthas* (all species) (*Metaphire* will also be prohibited)
Illinois	U of I Extension	Listed as a non-native/invasive species Gardening and jumping worms in northern Illinois	*Amynthas* (all species)
Indiana	Purdue Extension	nonregulated/listed Not on DNR website for invasive species	*Amynthas*/not specified
Iowa	Iowa DNR	Present, but not regulated by DNR	*Amynthas* (all species)
Kansas	K-State Research and Extension	Present, but not regulated by DNR	*Amynthas* (all species)
Missouri	Missouri Department of Conservation	Recognized as invasive species	*Amynthas* and *Metaphire* (all species)

Nebraska	Nebraska Extension in Lancaster County Nebraska Invasive Species Program	Recognized as invasive species	*Amynthas* and Metaphire (all species)
Oklahoma	OSU Extension	Not regulated	*Amynthas*/not specified

Texas	Texas Invasive Species Institute	Recognized as invasive	*Amynthas* (all species)
California	University of California Agriculture and Natural Resources	Listed as A-rated pest by CDFA	*Amynthas agrestis*
Connecticut	Connecticut Department of Energy & Environmental Protection	Recognized as invasive	Megascolecidae family - *Amynthas agrestis*, *Amynthas tokioensis* and *Metaphire hilgendorfi*
New Hampshire	NHBugs	Recognized as invasive	*Amynthas*/not specified
North Carolina	NC State Extension	Recognized as invasive	*Amynthas* (all species)
Michigan	Michigan Invasive Species	Recognized as invasive	*Amynthas agrestis*, *Amynthas tokioensis* and *Metaphire hilgendorfi*
Maine	Maine Department of Agriculture, Conservation, and Forestry	Recognized as invasive	*Amynthas* (all species)
Ohio	Butler Soil and Water Conservation District OSU Extension	Recognized as invasive	*Amynthas* (all species)
Delaware	Delaware Invasive Species Council	Recognized as invasive	Focus mainly on *Amynthas agrestis*, but includes all

			species of *Amynthas*

Louisiana, Kentucky, Tennessee - present, but not recognized by gov/university (only by popular media)

*While JW haven't been documented in Canada, there is a page from the Invasive Species Centre based out of Ontario explaining why they're invasive including *Amynthas*, *Metaphire*, and *Pheretima* genera.

- This page also links out to a description of JW published in CABI

Classifications for nonnative species in Minnesota:
Prohibited invasive species: It's a misdemeanor to possess, import, purchase, transport, or introduce these species unless you have appropriate permitting.
Regulated and unlisted invasive species: It is legal to possess, buy, or transport, but these species can't be released into or "free-living" in public waters or public land. **Unregulated nonnative species:** These species are not subject to regulation under Minnesota Invasive Species Statutes, but may be regulated in other ways (hunting regulations). **Unlisted nonnative species:** Unlisted nonnative species are those that are not prohibited, regulated, or unregulated.

Minnesota DNR Prohibited and Regulated Invasive Species Permit Information webpage, links to the prohibited invasive species permit application.