



Invasive Species Curriculum

Developed by the Northwest Michigan Invasive Species Network (2017)

Grades 6-12

With an emphasis on northwest Lower Michigan, the Northwest Michigan Invasive Species Network (ISN) works to manage terrestrial invasive plants and provides educational resources to those living in the region. A healthy habitat is critical to the survival of wildlife, and invasive species greatly alter the ecosystems where they are introduced – either intentionally or unintentionally. Additionally, the impact to our economy from prevention and management is in the billions of dollars while our own enjoyment of Michigan’s natural resources is threatened. Education is a crucial step in the process to successfully manage invasive species. ISN’s goal is to provide the resources necessary to incorporate an invasive species’ curriculum into your own lesson plans, providing students in grades 6-12 with an understanding of this issue and how it seriously affects the environment where they live.

About the Curriculum

It is important for students to understand the impacts of invasive species and the issues affecting their own community. This subject intertwines with broader environmental topics and will contribute to a greater understanding of natural resource and habitat health.

How to use the Curriculum

This curriculum has been developed for students in grades 6-12 and can be applied in one or two class periods. Multiple activities are provided to allow for flexibility, and all material can be modified for younger students or adjusted for time allotment.

ISN has provided all of the information necessary for educators to take the reins and teach about the topic of invasive plants. However, ISN staff are always available as additional resources and can also serve as visiting educators within the counties of Benzie, Grand Traverse, Leelanau, and Manistee.

*PowerPoint presentation, handouts, games, and other information can be obtained directly from ISN or downloaded on www.habitatmatters.org, under “Resources”.



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CURRICULUM OVERVIEW

- A. Introduction to Invasive Species (classroom)**– use complex questioning (beyond “yes” and “no” answers) to determine the students’ existing knowledge
- What is an invasive species?
 - Are you familiar with any invasive species (plant or animal)?
 - How do invasive species affect the environment?
 - What are some ways invasive species are spread? How did our existing invasive species populations get here?

- B. Expanding Upon Invasive Species (classroom)** – 30 minutes

*Powerpoint presentation provided by ISN

Students will learn about the importance of habitat and how invasive species affect our region’s ecology. They will learn about the invasives’ relationship with native plants, how an invasive species is defined, and how they are introduced from other parts of the world. Students will be provided with examples of local invasive plant species and learn some ways they can help prevent their spread.

- C. Optional Activities**

- **“It’s an Invasion” Game** (large classroom space or outside) – 25 minutes

*Suitable for younger ages

Students will play this fun game that encourages critical thinking and assists with the understanding of how invasive species can crowd out native species and change their environment.

- **Invasive Species Hike** (at school or nearby natural area) – 30 - 60 minutes

Students will see first-hand how invasive species threaten their region and the native plants sharing that environment. Students will stop along the way, taking part in several observational activities, encouraging them to take a close look at the plants and animals inhabiting an area. Additionally, students will try to spot invasive species that were introduced in the classroom.

- **Town Hall Meeting** (classroom) – 45 - 60 minutes

Students will take part in a role-playing exercise to better understand the process of making invasive species-related decisions as a community. They will be provided with a scenario and use their designated roles to hold a discussion and determine the best management plan for that situation.

*Each of the activities is described on the following pages.



ACTIVITIES

It's an Invasion!¹

This game is a fun way for students to start to think and learn about how invasive species can crowd out native species and damage their new environments. The activity works best if you have a group larger than 15 students.

MATERIALS:

Invasive species and native plant cards (Laminated versions are available directly from ISN. PDF is also available for free download on ISN's website.)

BACKGROUND BASICS:

Scientists call animals that are unwanted and out of their natural habitat "pests," while plants that are out of place are called "weeds." Invasive species are plants and animals that are worse than native pests or weeds because they have traveled, or been moved, to new places that are so far out of their native habitat that they have no predators. (That is, nothing in their new homes keeps their population under control by eating them.) The "Invasive Species Cards" list several invasive species along with information about where they came from, how they arrived in Michigan or the Great Lakes and why they're a problem.

For the sake of simplicity, this game doesn't match an invasive species to the native species it threatens. The game is designed to demonstrate how an invasive species can throw a natural environment out of whack, and to encourage students to start thinking about the relationships between native and invasive species.

PROCEDURE:

Before class:

Make and cut apart enough copies of the Native Species Cards that each player can have one. Depending on the size of your group, make and cut apart a copy of one or more Invasive Species Cards.

During class:

1. Have the students sit or stand in a circle where they can hear you. Read aloud or paraphrase to the group, the following information.

Today we're going to play a game called "It's an Invasion!" It's a matching game in which most of you will be trying to match pairs of Native Species Cards while another player – the "invader" with an Invasive Species Card – is trying to break up and crowd out the native species. In a few minutes I'm going to give each of you one Native Species Card. There are an even number of each card, and your job will be to find one person whose card matches yours. When I give you the signal, I want you to "shuffle the cards," that is,



*move around the room/play space without letting anyone else see your card. When you're well-shuffled, I'll tell you to freeze. Then when I give you the next signal, you'll have to show your card to the person next to you **without talking**. If that person has the exact same card as you, you've matched and survive! The two of you can move to the side of the room. If you match with another native plant but it's not the same species, nothing happens. If you show your card to someone with an Invasive Species Card, you'll have to sit down without making a match. (You can have a dramatic death but try not to give away who the invader is.) The invader can then move on to do the same thing to other native species card holders. When all of the species are matched or have been crowded out by the invader, the game is over. Remember, no talking!*

2. Now give each player a Native Species Card. Be sure to hand out an even number of copies of each card. Secretly give one player an Invasive Species Card (there should be no matches for this card). Depending on the size of your group, you may want to give out more than one Invasive Species Card (they can be different species).
3. Remind the students not to show their cards while they're "shuffling the cards" around the room and that there's no talking while they're playing the game. Give them a signal to begin playing. As they move around the room, you may need to remind the students to sit down if they've been "crowded out" by the person who has the Invasive Species Card.
4. The game is over when all the Native Species Card pairs have been matched or crowded out by the holder of the Invasive Species Card.
5. If the students are having fun with the game and you have time, you may want to collect the cards at the end of the round and repeat the process, making sure that a new person holds the Invasive Species Card in each round.
6. After the group is done playing the game, have them return to a circle and sit with their native species partner from the final round they played. Ask for volunteers to share information about their native species, including where it is found in Michigan or the Great Lakes and what species is threatening it. Next, ask the player or players who held Invasive Species Cards to talk about their species, including what part of the world it is native to, how it arrived in Michigan or the Great Lakes, and why it's a problem in its new environment.

TALKING IT OVER:

Now ask the group the following questions:

- Do you think it was easier to be a player with a Native Species Card or an Invasive Species Card? Why?



- What do you think would happen if there were more players with Invasive Species Cards in the game
- What happens when real native species are crowded out of their habitat by invasive species?
- Can you name one species we haven't talked about that has invaded Michigan or the Great Lakes and what affect its presence has had on its new habitat? *(For example, the emerald ash borer has invaded southeastern and central Michigan and killed millions of ash trees. The invasion of the zebra mussel in the Great Lakes has forced utilities such as water departments to spend millions of dollars to scrape the mussels off water intake pipes.)*

It's An Invasion! Game Notes

- When printing the cards, note that we've had some issues with the front and back alignment of the cards, depending on the printer. Be sure to do a test print before printing en masse.
- The MSU curriculum for "It's an Invasion" is certainly a good starting point. We've had luck with the following adaptations. We've also received many good pointers from teachers about adapting the game to suit their age groups when teaching them how to use the game.
 - Run through the game three times. The first time, do not introduce any invasive species. This allows you to develop a baseline for how the game models a healthy ecosystem. Then, introduce one invasive species for the second round, and, for the third round, several species (depending on the group's size). This allows the group to observe the impacts of multiple invasive species in a given ecosystem.
 - Since the game cards indicate habitat, you may set rules such that the invasive plant may only replace plants that occupy the same habitat space.
- Without structure, the invasive student may run at the other students. Setting rules like "plants don't run" will help. Model procedure for sharing cards ("1, 2, 3 reveal") will keep things orderly.
- Give students a goal when viewing the native plants during the first round without invasives. Consider having the students select one plant to research afterwards.

Examples:

 - Write down all plants that occupy the same habitat space as your plant.
 - Which plant is your favorite, and why?

Invasive Species Hike

Taking students on a hike encourages them to take a close look at the ecology directly in front of them. Students will use their observational skills and senses to identify healthy ecosystems and potential invaders, taking notes along the way and sharing them with their classmates.

MATERIALS:

Clipboards/other hard writing surface, notebook/paper, and writing utensil

BACKGROUND BASICS:

An invasive species hike can be short or long, and the location can be in your schoolyard or at a nearby natural area – it's entirely up to you, as the educator. You often do not have to travel far to have an ideal location to make observations. Regardless of the location, students will be encouraged to pay attention to their surrounding environment and make observations at pre-determined locations. Taking notes and then sharing those ideas with their classmates allows for more thoughtful insights and can be used to answer follow-up questions later.

PROCEDURE:

Before Class:

Visit the location where you would like to do your invasive species hike. Identify invasive species along the route that the students may or may not be familiar with. Look for areas that are good examples of a healthy ecosystem – locations with higher biodiversity, both plant and animal. Also select a spot that is impacted by many invasive species. Having a variety of locations to choose from on your hike will allow students to make greater comparisons while observing the landscape in front of them.

During Class:

1. Hand out clipboards to all students or make sure they have something hard to write on, such as a notebook. If using a clipboard, ensure students also have blank paper for writing down observations and a writing utensil.
2. Go over the hiking rules with your students. Remind them to be respectful of any wildlife (and they will see more!) by keeping their voices down. Encourage them to stay on the designated trail to minimize human impact.
3. Begin the hike at the head of the group and walk to your first pre-selected location. Have students stand back-to-back with a partner so that they are each looking out at opposite sides of the trail. (There will be lines of partners going down the trail.) Tell your students that they will each have 90 seconds to make as many observations as possible.



- i. Have them take notes as they observe their environment.
 - ii. Silence is encouraged. Students should be able to use most of their senses beyond just sight.
 - iii. Remind them to look down at their feet and up at the sky – look for animals and plant life that may not be directly in front of them.
4. After the 90 seconds, tell your students to turn around and face their partner, sharing some of the things they saw. As an entire class, ask for some examples of observations and what assumptions can be made about the environment you are standing in. Is it healthy? Was there a lot of biodiversity? Did anyone spot an invasive species? What would happen if an invasive species was introduced? Etc.
5. Continue to the other pre-selected sites along your hike and repeat the above exercise at each location. Students should work with a different partner each time. Ask the students to begin comparing their observations to ones made earlier and identify what habitats appeared to be the healthiest and why.

TALKING IT OVER:

Now ask the group the following questions (or create your own):

- What were the differences seen between the various locations where we stopped and made observations? What were some similarities?
- How does biodiversity determine the health of an ecosystem? How do invasive species affect biodiversity?
- What role do native plants serve in the ecosystem?
- Do you think any invasive species can be beneficial – did you see any signs of this?

Town Hall Meeting²

This “Town Hall Meeting” engages students in a thought-provoking experience where they will discuss the issue of invasive species in a formal community setting.

MATERIALS:

No additional items are necessary for this activity. Note-taking materials may be beneficial when acting out the provided scenario.

BACKGROUND BASICS:

Invasive species is a subject that is often discussed among community members – many times within a formal setting, such as a town hall meeting. There are a wide range of opinions on this subject, and it is important to evaluate all viewpoints when making decisions regarding plant management.

After viewing the introductory PowerPoint (pg. 3 – available for download on ISN’s website), students will have the background information necessary to have a meaningful “meeting”. They will be introduced to the concept of native and invasive species and understand the importance of natural habitat. They will also understand that there are diverse plant-insect relationships that connect to a broad food web.

PROCEDURE:

1. Explain to the students that they will be given roles and will be holding a “Town Hall” meeting in those roles. There will be a Mayor, Lawyer, and Secretary running the meeting. The Mayor will take a vote at the end of the session to decide what should be done. The Lawyer will make sure things stay honest and orderly. The Secretary (most likely the instructor) will take down meeting minutes.
2. Assign remaining students roles from the list on page 10.
3. The facilitator (instructor, additional aide, or ISN staff member) will explain the issue at hand (scenario, page 11), and the Mayor will open the floor to public comment. The teacher should function in a mediator role and ensure the students all get a chance to voice their opinions.
4. If no students put forth a comment, the Facilitator may ask everyone to state what they think should be done about the situation and their concerns.
5. After reading “Part 2” of the scenario, have characters come up with several options that could solve the issue. Create a list of options that can be voted on.
6. After a lengthy discussion, let students (still in character) vote to choose from the options. Make sure the Secretary records votes and the final decision.
7. Tally votes. Which option won? Why?



ROLES:

- **Mayor** – Will make a final decision at the end of the meeting.
- **Lawyer** – Can confer with the Mayor and ensures no illegal activity is occurring.
- **Township Planner** – In charge of approving landscape designs (and which species to plant).
- **Farmer #1** – Supportive of native buffers because research shows an increase in quantity and quality of fruit.
- **Farmer #2** – Doesn't care about invasive species because it doesn't affect them.
- **Farmer #3**– Actively trying to rid land of invasive species.
- **Organic Farmer #1**– Supportive of removing invasive species as they are not beneficial to any other insects apart from bees.
- **Organic Farmer #2** – Supportive of removal but not with chemicals
- **Local Expert from an Environmental Agency** – Provides a second round of information (a co-facilitator or instructor).
- **Agriculture Specialist** – Wants to make sure that those involved are following regulations on herbicides and pesticide use (limiting use).
- **Bee Keeper (could have 2)** – Supportive of some invasive plants as they provide good nectar and pollen for bees. (Bee populations are rapidly declining.)
- **Restaurant Owner** - #1 seller is "Honey Chicken" dish with local honey serving as the star ingredient.
- **Permaculturist** – There is no such thing as a bad plant – therefore, invasive plants are not an issue.
- **Fisherman** – Concerned about treatment and chemicals entering the river and lakes.
- **Hunter** – Worried about invasive species taking over because deer do not forage on most of them.
- **Land Developer** – building next to location in question and concerned about spread of knapweed.
- **General Citizen** – Loves the outdoors and is an avid birder. Has worked to create a habitat in his backyard.
- **General Citizen** – Loves grass and big lawns. Hates bugs, and the idea of non-native plants supporting few/no insects sounds appealing.
- **General Citizen** – Lives on the river. Has had to put a lot of time and money into erosion control.
- **General Citizen** – Parent of 2 children and lives next to the area being discussed.

SCENARIO - “Response to Invasion – Managing Spotted Knapweed”³

Part 1: Introduction to Spotted Knapweed

The United States Forest Service (USFS) has found a large spotted knapweed infestation in our community in a park close to downtown – it is frequently accessed by community members. Spotted knapweed is an invasive plant that is native to southeastern Europe. It has been known to invade intact native plant communities such as dry prairies, oak-pine barrens, and open dunes. The presence of spotted knapweed can reduce native plant diversity because it releases chemicals into the soil that harms other plants. This impacts wildlife and ecosystem functions. Spotted knapweed is toxic to horses, if consumed, and in rare cases can lead to rashes on both horses and humans if they touch the plant. Spotted knapweed does provide an important source of nectar and pollen for honeybees. (It is often called “Star Thistle”.) However, it is not known to be extremely beneficial to other insects. Spotted knapweed seeds cannot blow more than a few meters from the plant, so they rely on animals, people, or vehicles to carry their seeds longer distances. **The USFS would like to know how the community plans to proceed regarding this issue.**

If students are having a hard time engaging in dialogue, the following questions may be used to help foster some response:

- *Do you think the spotted knapweed needs to be controlled? Why?*
- *Who does spotted knapweed affect the most?*
- *What do you think should be done to control spotted knapweed from spreading?*

Part 2: Control Methods (This information should be provided by the “Local Expert from an Environmental Agency)

There are several control methods that can be used (and have already been used elsewhere). They include:

- Prevention – Remove early colonizing individuals by pulling or spot-spraying with an herbicide
- Cultural – Mowing is an effective method of controlling spotted knapweed if it is done before the knapweed has had a chance to produce seed. Prescribed burning is effective for adult plants. Grazing with sheep and goats has been shown to reduce knapweed, but can also limit the establishment of native plant species.
- Chemical – Several herbicides are available to control spotted knapweed.
- Biological – Five insect species have been introduced into Michigan for biological control of spotted knapweed including seedhead flies and flower weevils. Progress has been slow.

If students are having a hard time engaging in dialogue, the following questions may be used to help foster some response:

- *With new information about methods of control, has your opinion changed?*
- *Do you want to fully eliminate spotted knapweed, or would you rather develop a way to better control the invasive plant? How long do you think that would take?*



TALKING IT OVER:

Allow students to step out of character and reflect on the meeting.

- How did you feel about being a character other than yourself? Was it difficult to have an opinion that may have differed from your own? How did that affect your decision-making process?
- What do you think of the decision that was reached?
- Can you think of any other potential invasive species scenarios where an entire community would need to gather and discuss a resolution?
- How should a community move forward after a management goal has been reached?

TEACHER RESOURCES

LOCAL INVASIVE SPECIES (From ISN's "Top 20 Least Wanted Species" List)



Common buckthorn
(*Rhamnus cathartica*)
Photo: Gary Fewless



Glossy buckthorn
(*Frangula alnus*)
Photo: Mark Lindsay



Honeysuckles
(*Lonicera spp.*)
Photo: Frankenstoen



Japanese barberry
(*Berberis thunbergii*)
Photos: David Mindell (Plantwise) & Eric Haber



Autumn olive
(*Elaeagnus umbellata*)
Photo: Leslie J. Mehroff (UCONN)



Multiflora rose
(*Rosa multiflora*)

Photo: Leslie J. Mehroff (UCONN)



Oriental bittersweet
(*Celastrus orbiculatus*)

Photo: Steve Conaway



Baby's breath

(*Gypsophila paniculata*)

Photo: Shaun Howard (TNC)



Bull thistle

(*Cirsium vulgare*)

Photo: ISN



Canada thistle

(*Cirsium arvense*)

Photo: ISN



European swamp thistle

(*Cirsium palustre*)

Photo: Mark Lindsay



Dame's rocket

(*Hesperis matronalis*)

Photo: Rob Routledge



Japanese knotweed

(*Polygonum cuspidatum*)

Photo: Wikipedia



Leafy spurge

(*Euphorbia esula*)

Photo: E. Czarapata



Blue lyme grass
(Leymus arenarius)
Photo: Kristian Peters



Narrow-leaved cat-tail
(Typha angustifolia)
Photos: Rebekah Wallace & CapeMayWildlife.com



Phragmites
(Phragmites australis)
Photo: Jill Fejszes



Garlic mustard
(Alliaria petiolata)
Photo: Chris Evans



Purple loosestrife
(Lythrum salicaria)
Photo: John D. Byrd



Reed Canary Grass
(Phalaris arundinacea)
Photo: Michael Shepherd



Wild Parsnip
(Pastinaca sativa)
Photo: Leslie J. Mehroff



INVASIVE SPECIES ECOLOGY

What is an invasive species?

An invasive species is a non-native species that harms people, the economy, and/or the environment.

The Invasive Species Network uses “Habitat Matters” as its message when educating the broader public about this issue in northwest Michigan. Invasive Species are introduced to a healthy ecosystem, changing the entire structure of an area. Habitat matters for:

- **People** – We live in this region for a reason – it’s beautiful! A habitat with diverse plant and animal life provides broader recreational opportunities and a higher level of enjoyment when venturing outdoors.
- **Northwest Michigan** – The economy thrives off what this region has to offer. Ecotourism and logging in particular have the potential to be greatly affected by the introduction of invasive species. Entire ecosystems can be changed by the introduction of a single plant species.
- **Wildlife** – Simply put, wildlife cannot exist without habitat. At a broader level, we also rely on wildlife for a variety of reasons including using pollinators to grow agricultural products, hunting, and birdwatching, for example.

Expanding upon the above messaging, it is important to not only inform students about the implications of invasive species, but also stress the importance of retaining a healthy ecosystem that is full of native plants. Nearly all invasive plants follow the same path – they are introduced into a new area and with the absence of natural predators and with high seed production, they quickly takeover native plant populations. These native plants play host to thousands of insect species, many of whom rely on just one or several species (i.e. Monarch butterfly caterpillars will only consume milkweed species.) If those species are diminished in an area, the insect populations (often pollinators) are lowered – affecting the foundation of the entire food web.

THE ARRIVAL AND SPREAD OF INVASIVE SPECIES

How do they get here?

Invasive species arrive from other countries via a variety of different portals. Some are introduced intentionally while others are brought to new areas purely by accident.

- **Imported accidentally** – Some species, such as invasive phragmites, were brought over hundreds of years ago without any intention for the plant to have an alternative use. Harbored in ship ballasts or travelling as “hitch-hikers”, these plants were unintentionally released and then quickly adapted to their new environment.



- **Imported for gardens** – Importing/exporting plants is an enormous trade throughout the entire world and the United States imports an incredible number of ornamentals, trees, shrubs, and grasses – many of which are classified as invasive species. In fact, more than half of ISN’s “Top 20 Least Wanted Species” are invasive garden plants. On top of that, many of them are still being sold in nurseries and used by landscapers. Buckthorn species, Japanese barberry, Oriental bittersweet, and baby’s breath are just a handful of examples. Once introduced to a landscape, they easily escape cultivation and spread into nearby natural areas, wreaking havoc on the native plant-based ecosystem.
- **Planted to manage soil erosion** – In some cases, invasive species are introduced on purpose and with good intentions before their long-term effects are entirely known. Autumn olive is a perfect example. Introduced as early as 1830 as an ornamental, it truly began to take-over in the late twentieth century when Soil and Water Conservation Districts encouraged landowners to plant it as a solution to soil erosion and to serve as wind breaks. Unfortunately, it also spreads like wildfire and thousands of berries (consumed by birds) are easily spread. Now entire landscapes are dominated by large autumn olive shrubs.
- **Imported for food and medicine** – There are a handful of invasive species that were introduced for food and medicine, garlic mustard being one of them. As alternative food and medicinal options were discovered, these plants were allowed to escape cultivation and spread easily.

WAYS TO TAKE ACTION!

When teaching about invasive species, you can emphasize that there are ways to get involved, even when students are young. Small actions can make a significant difference when it comes to the prevention and management of invasive species.

- **Report invasive species** – The first step in management is identifying where the plant populations exist. If students are comfortable with species identification, they can use the Midwest Invasive Species Information Network (MISIN) to report invasives. MISIN is not only a great tool in this capacity but it is also a fantastic learning opportunity. Plant profiles for nearly all species are available, and students can learn about the origin of invasive species and best management practices. (www.misin.msu.edu)
- **Stop the spread** – Invasive species can be easily spread by getting caught in the tread of our shoes when hiking, on our pet’s fur, and in the tires of bikes and other vehicles. It’s simple to take five minutes after a hike to brush out the bottom of your boots or the tires of your bike before moving out of a natural area. This can prevent the movement of seeds to another location. Additionally, when designing your landscape, don’t plant invasive ornamentals! By choosing native plants (or non-native/non-invasive species), ecosystems automatically benefit. Not only will harmful plants not be introduced but you are boosting the habitat for existing insects and other wildlife.
- **Spread the word** – Encourage students to tell others about what they have learned! Word of mouth and continuing education is critical to invasive species management.



Spreading awareness of this issue plays a huge role in the long-term success of identifying existing invasive species populations and preventing the introduction of new ones.

- **Get involved** – ISN and many of its regional partners host numerous volunteer events where the public is welcome and encouraged to participate. Students (and entire classes) can join us at an event to gain hands-on management experience and to see how landscapes have been affected by invasive species – and how helping to manage the population is benefiting the ecosystem.



CITATIONS

1. **It's an Invasion** – Adapted from Michigan State University Extension.
2. **Town Hall Meeting** – The following “Next Generation Science Standards” are met:
 - a. **5th Grade**
 - i. 5-ESS3-1, Students who demonstrate understanding can obtain and combine information about ways individual communities use science ideas to protect Earth’s resources and environment.
 - b. **Middle School**
 - i. MS-LS2-1, Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in and ecosystem.
 - ii. MS-LS2-2, Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems
 - iii. MS-LS2-5, Evaluate competing design solutions of maintaining biodiversity and ecosystem services.
 - iv. MS-LS4-4, Construct an explanation based on evidence that describes how genetic variations of traits in a population increases some individuals’ probability of surviving and reproducing in a specific environment.
 - v. MS-ESS3-3, Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
3. **Response to Invasion – Managing Spotted Knapweed** (Town Hall Meeting), adapted from:
 - a. “National Center For Case Study Teaching In Science: Response To Invasion: Managing Spotted Knapweed” By Anastasia P. Maines Department Of Ecology & Evolutionary Biology, University Of Colorado At Boulder, Boulder, CO and “Biology and Management of Spotted Knapweed in Michigan” By Brendan Carson and Douglas Landis Department of Entomology, Michigan State University, East Lansing Michigan 49924



**NORTHWEST MICHIGAN
INVASIVE SPECIES NETWORK**

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