

Invasion Ecology



Week 1

Invasive species: what are they?

Week 1: Learning Outcomes

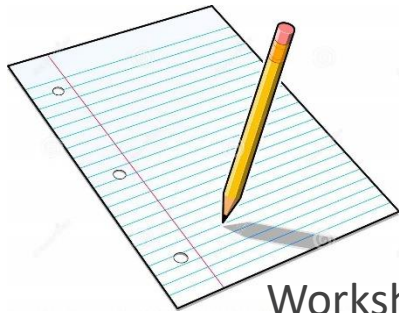
By the end of this week you will know:

- what invasive species are
- how invasive species can be introduced

By the end of this week you will be able to:

- differentiate between invasive and non-invasive species
- recognize the stage of invasion
- name at least five invasive species

Class Activities



Worksheet



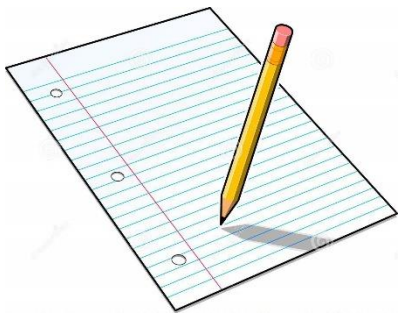
Small group discussion



All-class-discussion



In-class ungraded quizzes
using "yes/no"-cards



Invasive Species?

Worksheet Part 1. Please list the first words (associations) that come to your mind (30 sec)

Invasion Ecology: week 1

Lecture 1: worksheet

Part I. Invasive species: definition, introduction, establishment.

In the provided space below, please list the first words (associations) that come to your mind when you hear “invasive species” (30 sec)

- Please compare your lists in pairs and pick 3-5 unique associations (1-2 min)
- Please compare your lists in groups and pick 3-5 unique associations (1-2 min)
- Please compare your matches with formal definition of invasive species (2-3 min) (use 'Yes/No cards')



Invasive Species?



Please compare your guess in pairs and highlight the matches
(1-2 min)



Please compare your guess in small groups and highlight the matches
(1-2 min)

Invasive Species

“a **non-native species** whose **introduction** does or is likely to **cause** economic or environmental **harm** or harm to human, animal, or plant health”

(National Invasive Species Management Plan, 2006)



Please compare your matches with formal definition of invasive species (1 min) (use 'Yes/No cards')



Invasive Species at a Glance

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

(Entomological Society of America, published on March 2013)

Native vs. ...

Alien

Exotic

Non-indigenous

Introduced

Naturalized



Non-native

Worksheet: Part 1

Which one can be invasive?

Native vs. Non-native

a species which has been introduced 5 years ago?

20 years ago?

100 years ago?

500 years ago?

'Yes/No cards'





Quick discussion (3 min)

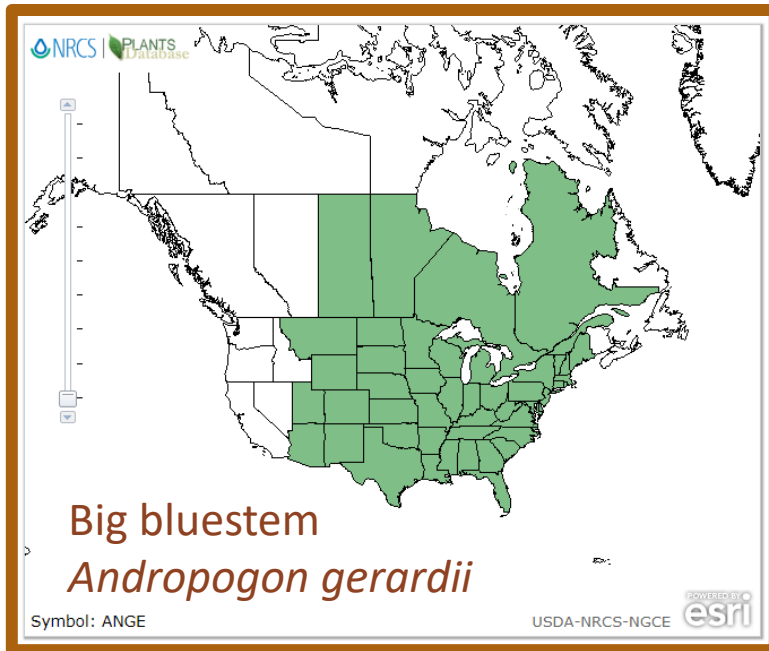


How non-native species can show up in a native community?

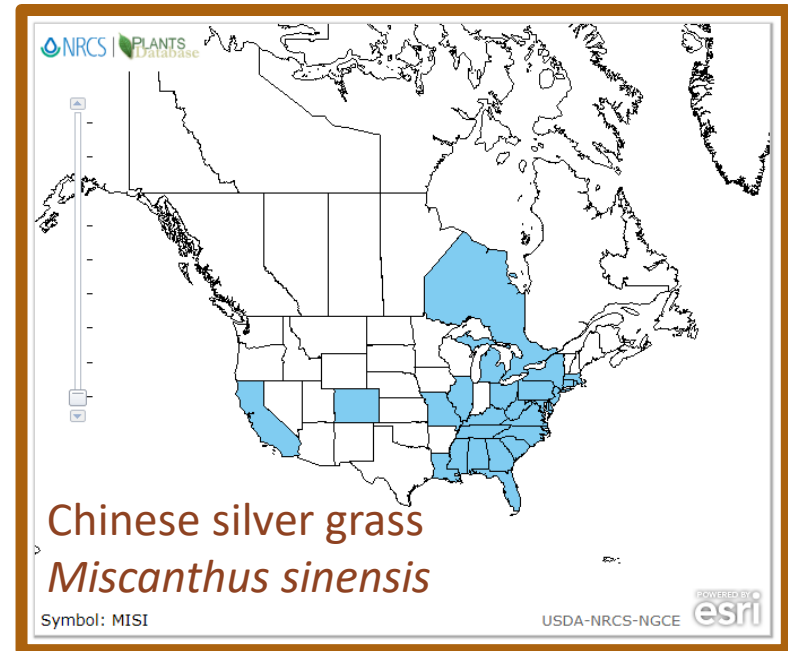
Native vs. Non-native



Before European Settlement



After European Settlement

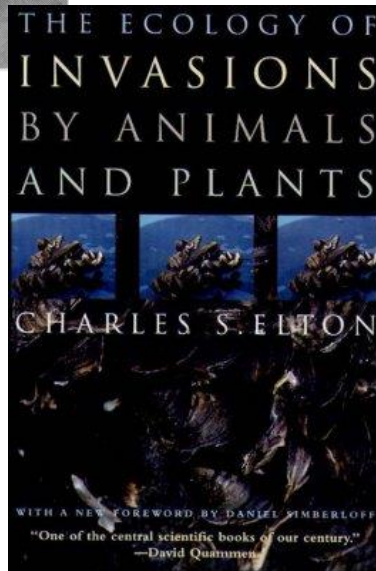
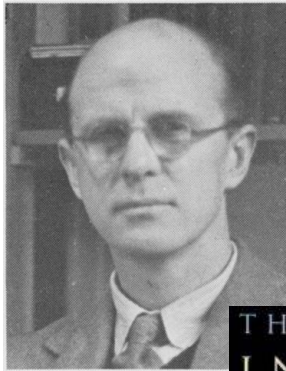


The First Permanent European Settlements in North America

Country	Name of Settlement	Present-Day Location	Year First Settled
Spain	St. Augustine	Florida	1565
England	Jamestown	Virginia	1607
France	Quebec	Canada	1608
Holland	New Amsterdam	New York	1624
Sweden	New Sweden	New Jersey	1638

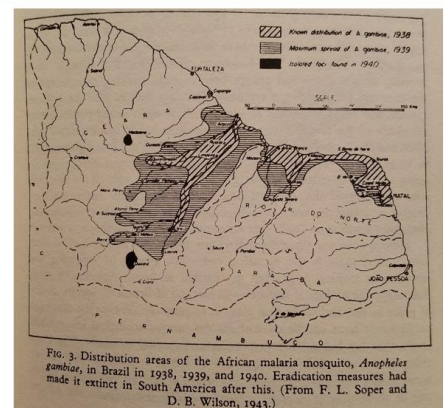


Charles Elton (1900-1991)



Part II. Charles Elton (1958): *The ecology of invasions by animals and plants.*

“...About 1929, a few African mosquitoes accidentally reached the north-east corner of Brazil, having probably been carried from Dakar on a fast French destroyer. They managed to get ashore and founded a small colony in a marsh near the coast—the Mosquito Fathers as it were. At first not much attention was paid to them, though there was a pretty sharp outbreak of malaria in the local town, during which practically every person was infected. For the next few years the insects spread rather quietly along the coastal region, until at a spot about 200 miles farther on explosive malaria blazed up and continued in 1938 and 1939, by which time the mosquitoes were found to have moved a further 200 miles inland up the Jaguaribe River valley. It was one of the worst epidemics that Brazil had ever known, hundreds of thousands of people were ill, some twenty thousand are believed to have died, and the life of the countryside was partially paralysed..”



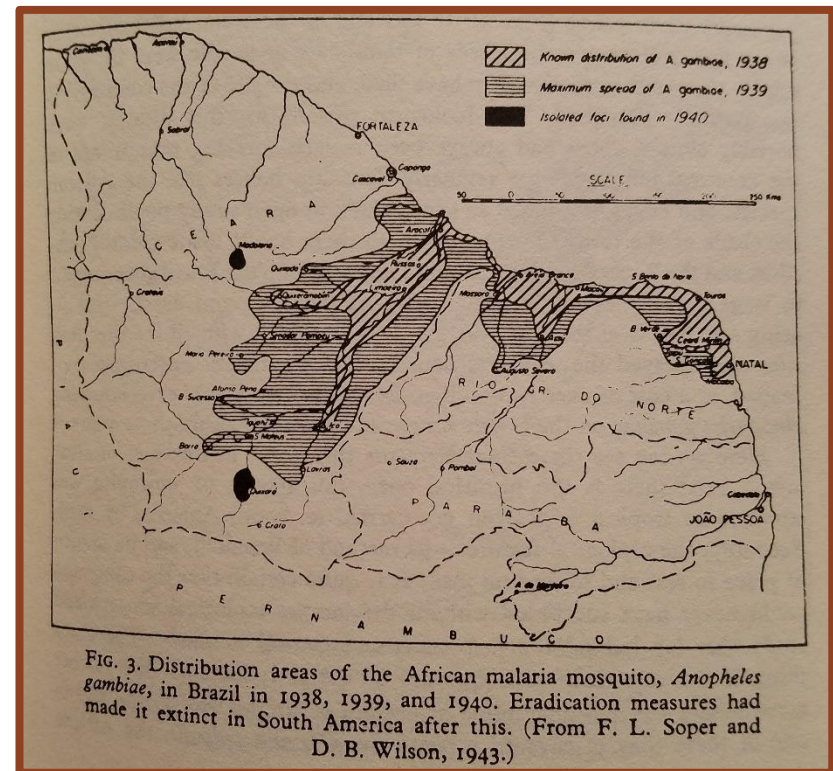
Worksheet. Part II.

Elton (1958): *The ecology of invasions by animals and plants*

Worksheet. Part II.

- Was it intentional introduction? Yes/No
- Were these mosquitoes invasive species? Yes/No

- Non-native
- Caused harm





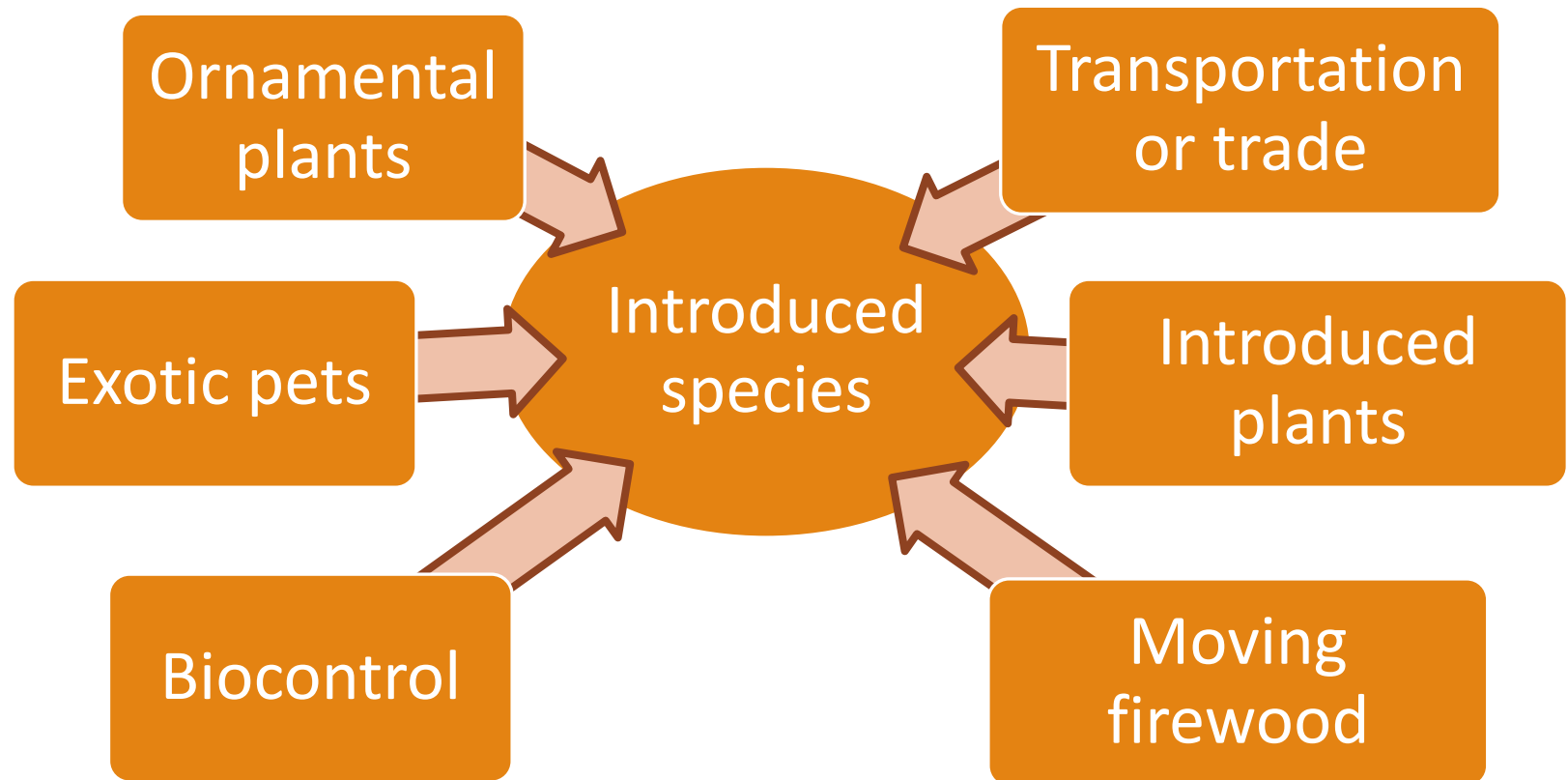
Quick Review

- Are all the non-native species invasive? (Yes/No)
- Do all the introduced species cause harm to native communities? (Yes/No)

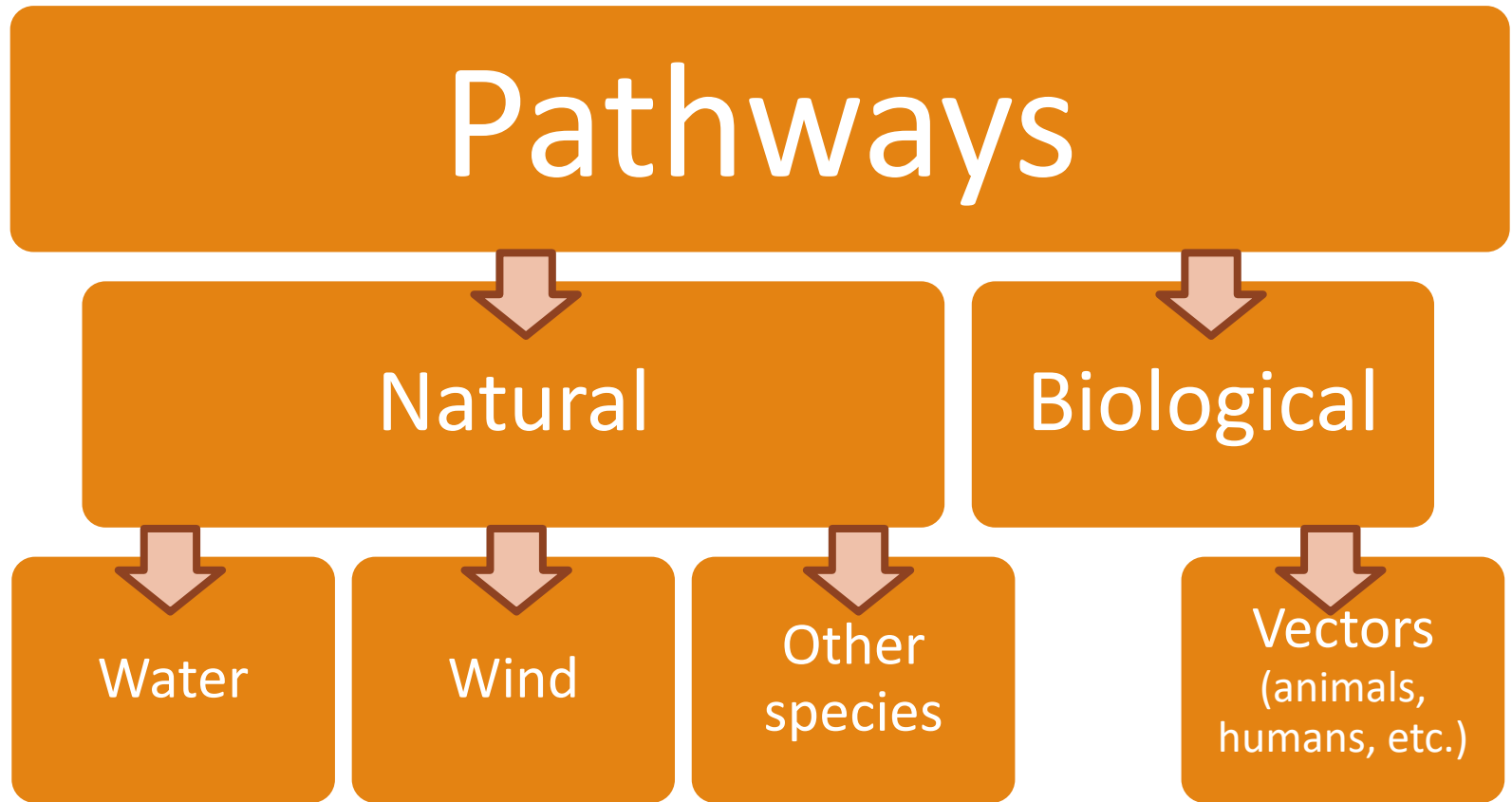
Modes of Introduction

Deliberate

Accidental



Spread From the Point of Introduction





Quick Review

- Are all the introductions deliberate? (Yes/No)
- Is spreading introduced species by native vector species a natural pathway? (Yes/No)

Invasive Species: Common Characteristics

- Fast growth
- Rapid reproduction
- High dispersal ability
- High phenotypic plasticity
- High ecological tolerance
- Generalists
- Pioneer species



Gypsy moth larva



Quick discussion (3 min)



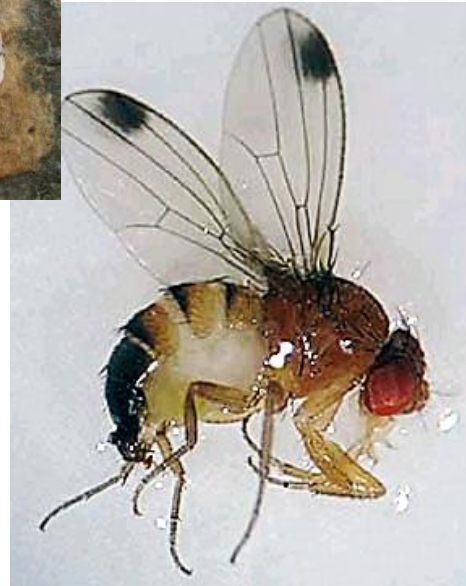
What about natural enemies and introduced prey species?

Narrowing down the focus: Invasive Insects

➤ Gypsy moth



➤ Spotted Wing Drosophila



➤ Emerald Ash Borer



➤ Sirex Woodwasp

Lepidoptera: Gypsy moth

- Native to Europe
- It was introduced into Massachusetts in 1869
- It did not spread rapidly in the eastern United States until the late 1960's
- In Maryland:
 - The first gypsy moth appeared in 1959
 - The first egg mass was discovered in 1971
 - The first extensive defoliation occurred in 1981
- Oaks are preferred host trees



Coleoptera: Emerald Ash Borer

- Native to Asia; likely arrived in the US in packing material
- It was first detected near Detroit, Michigan, in 2002
- Since then it has killed more than 100 million ash trees in the US
- In 2003 it was detected in a nursery in Prince George's County
- It escaped quarantine zones in Prince George's County and by 2015 it had arrived in Baltimore



- The total population of ash the entire metropolitan area surrounding Baltimore exceeds 6 million trees (Maryland Department of Natural Resources)
- According to estimates by USDA the loss of ash trees in Baltimore could exceed \$200 million dollars.

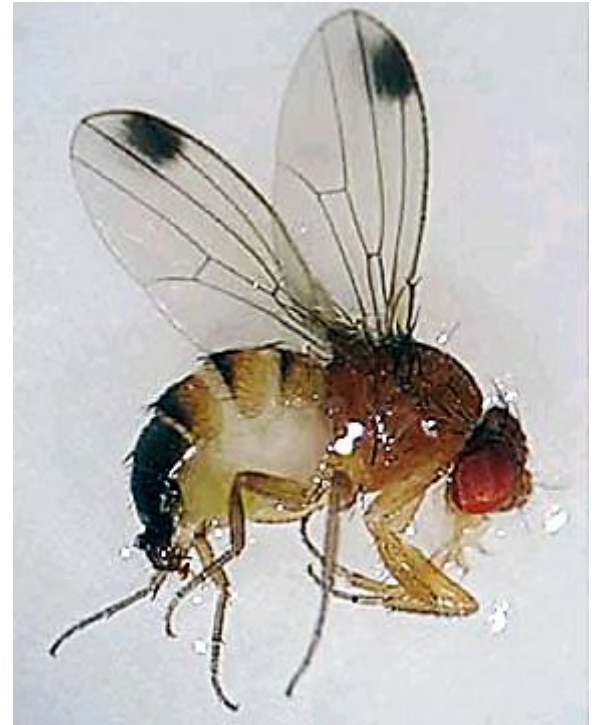
Hymenoptera: Sirex Woodwasp

- Native To: Eurasia
- First detected in New York in 2004
- Accidentally introduced through imported wood products
- One of the top 10 most serious forest insect pests worldwide
- Primarily attacks pine species



Diptera: Spotted Wing Drosophila

- Native to Asia
 - It was first reported in 1916 in mainland Japan
 - Several decades later it was detected in Europe, North America, and South America
- In the USA it was first detected in Hawaii around 1980
 - Its mainland invasion started in California in 2008
 - By 2012, damage from *D. suzukii* was reported in 35 states, as well as in Canada
- Attacks a wide variety of soft-skinned fruits and berries (raspberry, blueberry, cherry, etc.)



Spotted Wing Drosophila: control



Spotted Wing Drosophila: control



Hemiptera: Spotted Lanternfly

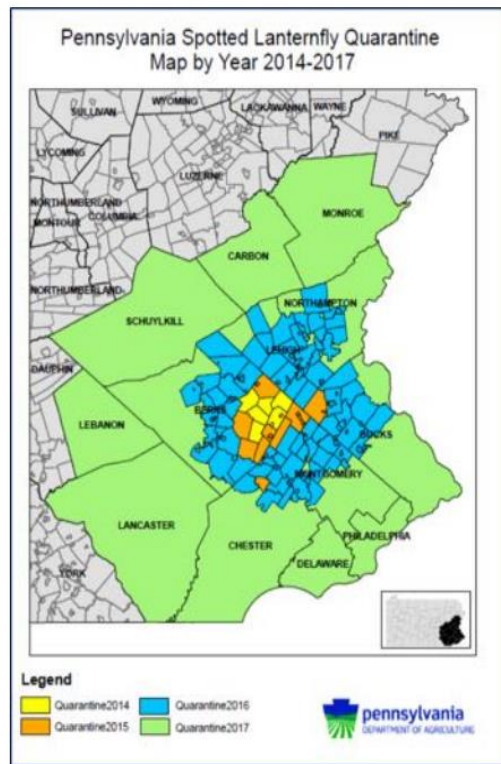
- An emerging highly invasive insect pest
- Native to China
- Invaded Korea in 2004
- Detected in Berks County, PA in 2014

- It has rapidly spread to 13 counties in PA
- Fall 2017: detected in New York and Delaware
- January 2018: detected in Virginia
- Maryland: October 2018



Where is spotted lanternfly in the US and how fast will it spread?

Invasion process



Pennsylvania – Berks (2014) now in 13 counties, established

Delaware – New Castle (2017), established

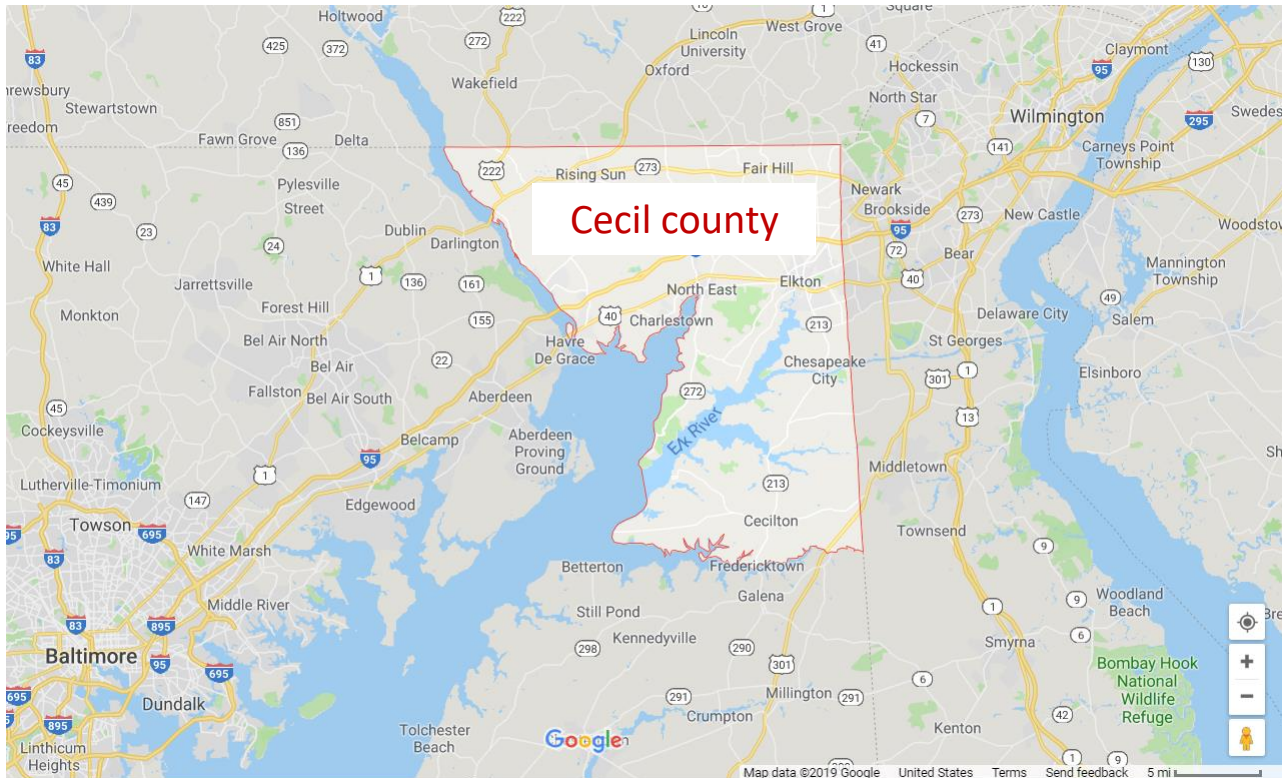
New Jersey – Hunterdon, Mercer and Warren Counties (2018) established

New York – Albany, Suffolk and Yates (2018)

Virginia - Frederick County (2018), established

Massachusetts (2019)

Spotted Lanternfly in Maryland!



- October 2018: first confirmed spotted lanternfly in Maryland!

Spotted Lanternfly:

Host plants and plant damage

Sap-feeder

Over 70 host plants:

- **Apple**
- Plum
- Cherry
- Peach
- Apricot
- **Grape**
- Pine
- Tree of heaven (preferred tree host)
- and many many others....

Consumes
phloem sap

Create a sugary
substance (honeydew)



Spotted Lanternfly: Modes of Dispersal

- One of the most aggressive leaf-hopping pest in Mid-Atlantic region
- Very high potential to breed and increase its population size
- It can be spread long distances by any material (including manmade material) containing egg masses:

- ❖ trunked tree
- ❖ stones
- ❖ vehicles
- ❖ yard furniture
- ❖ farm equipment, etc.

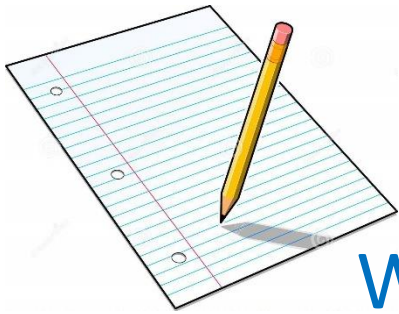




Quick discussion (3 min)



Do you recall any invasive species you might read about?



Worksheet Part 3. Species introduction

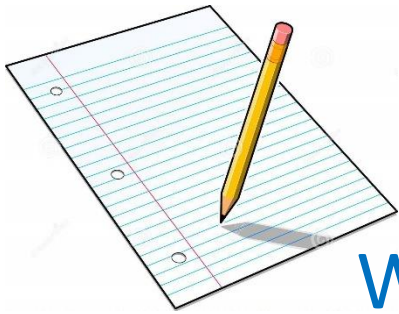


Jumping worm

““ Most earthworms in the northeast are considered exotic. They were introduced to North America in the 18th and 19th centuries from Europe and Asia through the trade of horticultural materials. Native plants in the northeast evolved without the presence of earthworms, and Northeastern forests have a characteristically thick layer of leaf litter and organic matter. Many native plants require this organic layer for their seeds to germinate. When jumping worms consume the upper organic layer of the soil, native plants slowly disappear and invasive species take their place. As the forest floor structure changes, other species suffer too, such as ground nesting birds, amphibians, and invertebrates.” (UNH extension, 2018)



Please read the description for your assigned species and answer the questions



Worksheet Part 4. Modes of introduction



Please add one more deliberate and one more accidental mode of introduction.





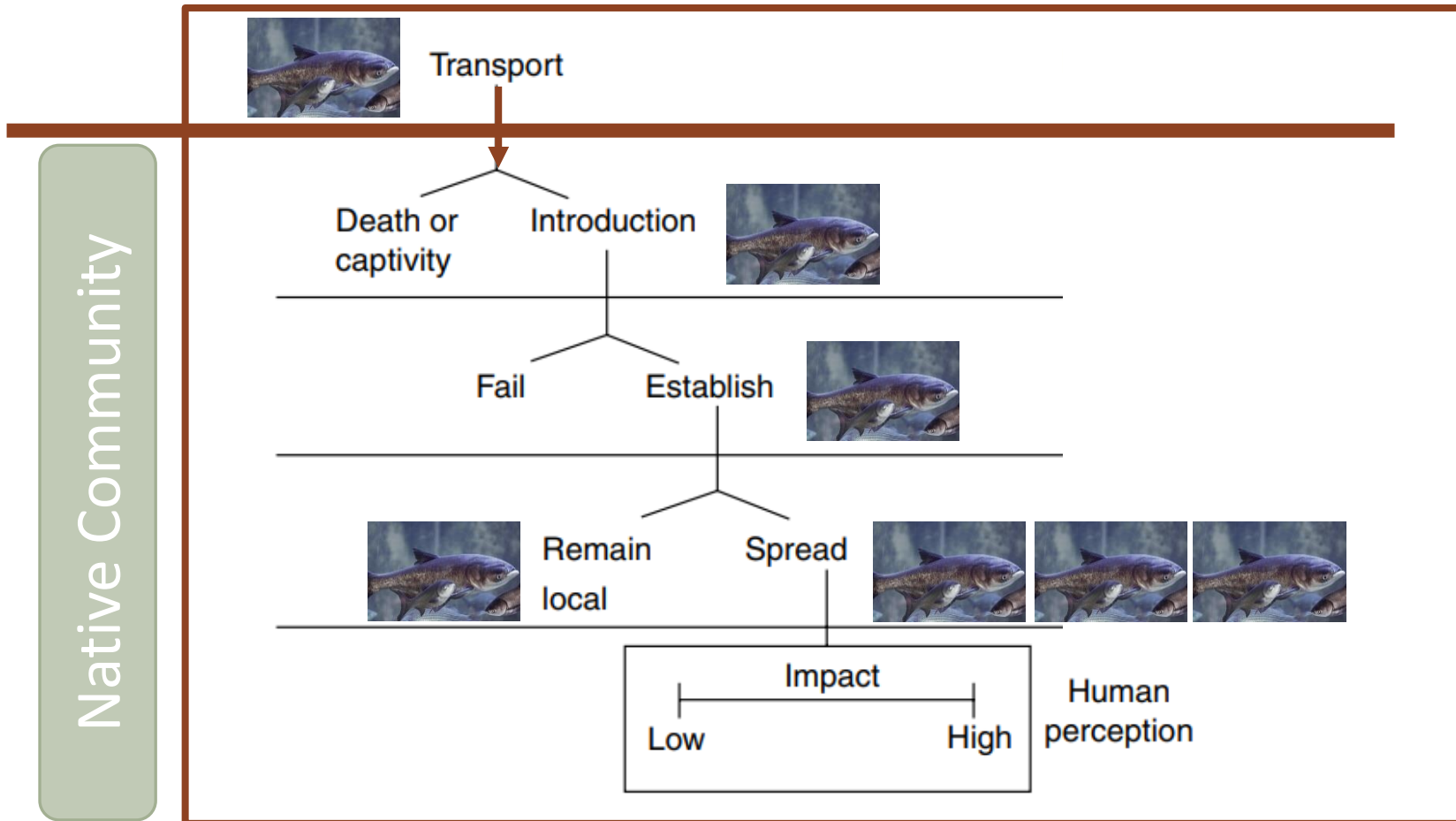
Quick Review

- Do all the introduced species become invasive? **Yes/No**
- Do invasive species cause only economic problems? **Yes/No**
- Are invasive insects typically specialists? **Yes/No**
- Do invasive insects usually lack natural enemies? **Yes/No**
- Are high reproduction and high dispersal typical characteristics of invasive insects? **Yes/No**



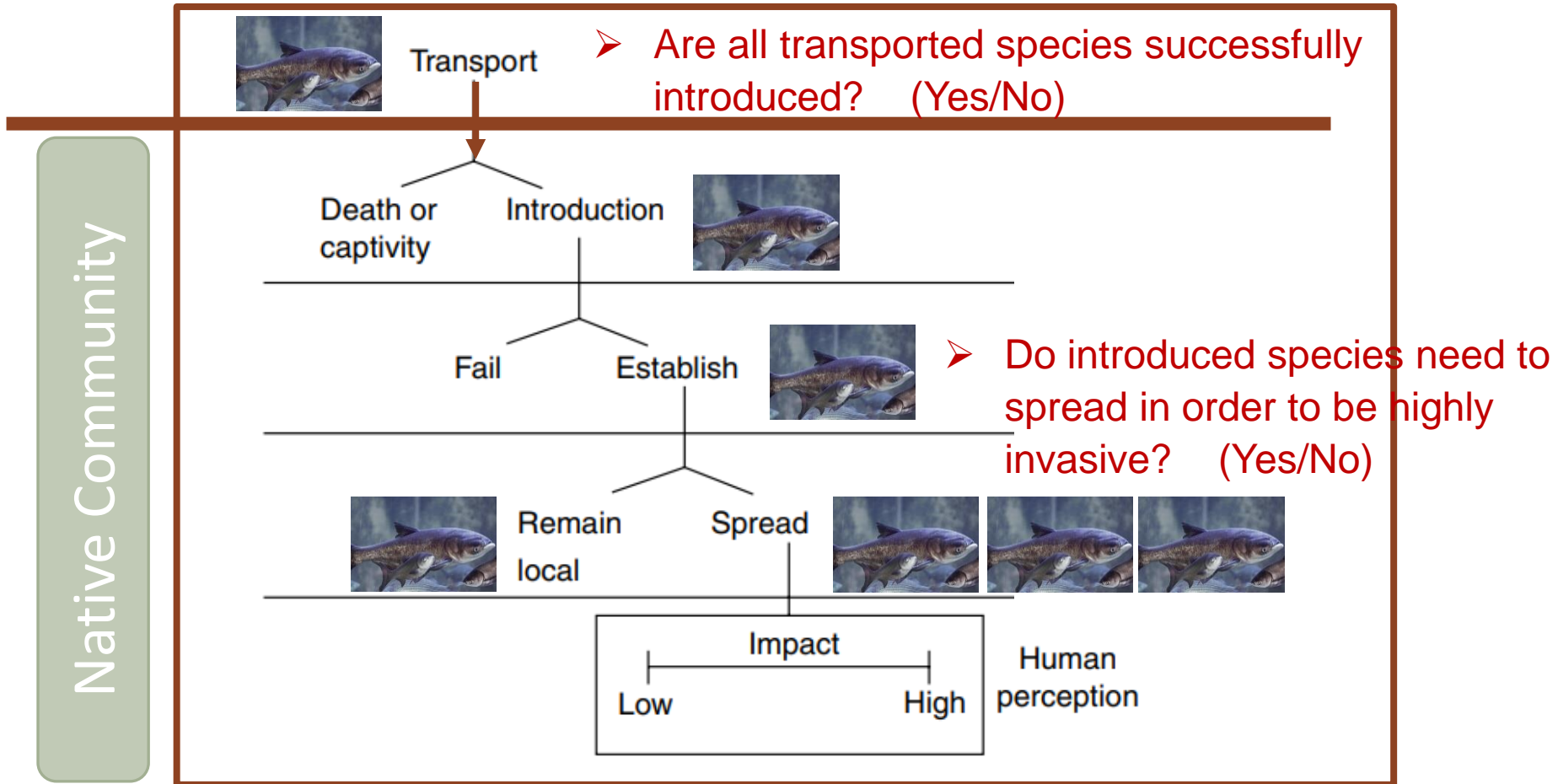
Discussion

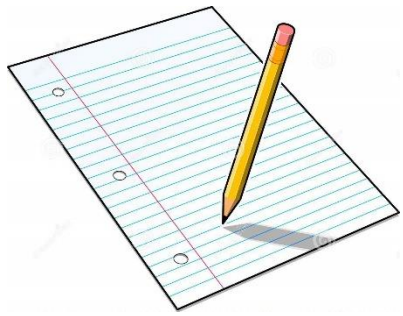
What do you see?





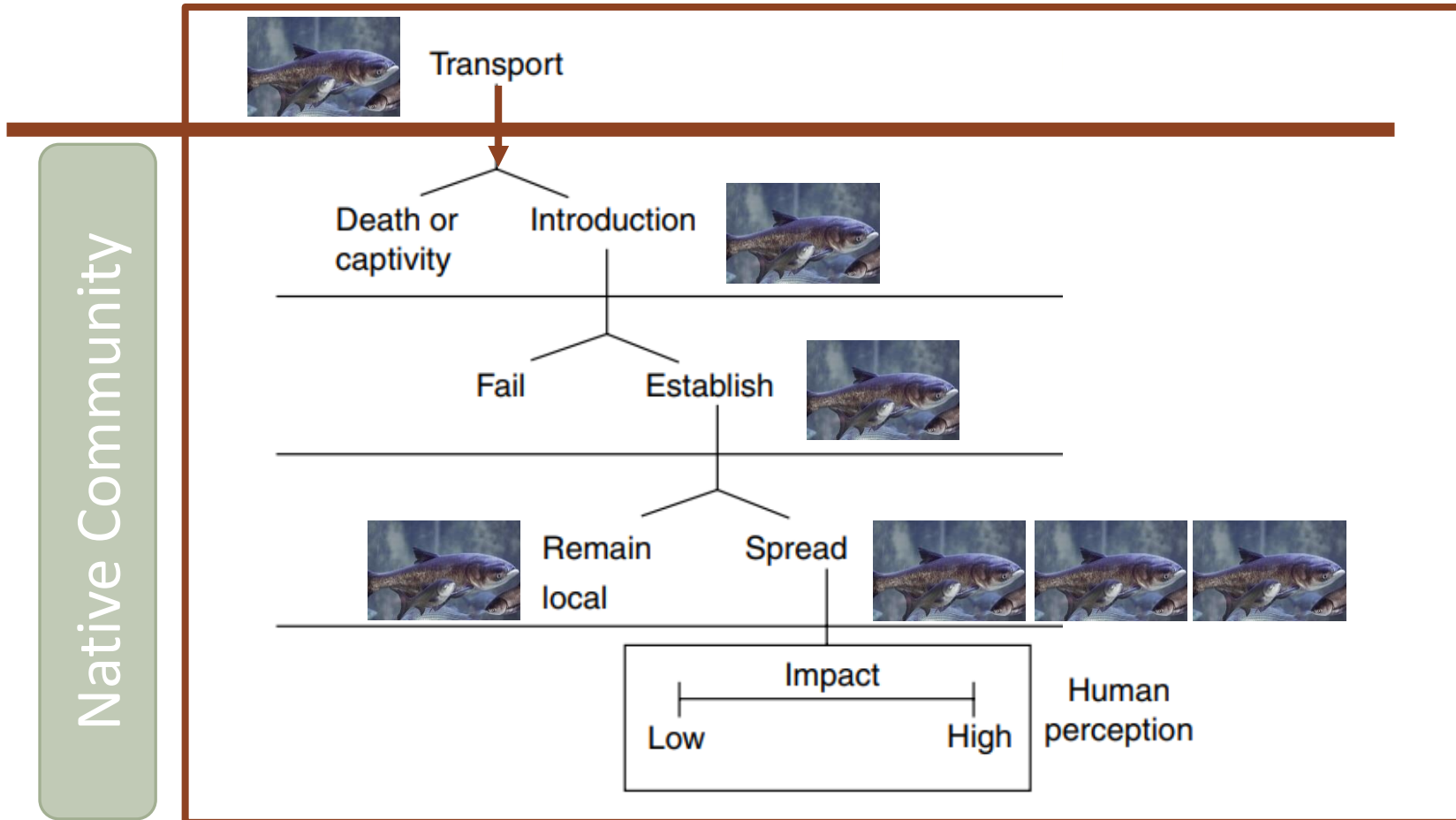
What does it mean?

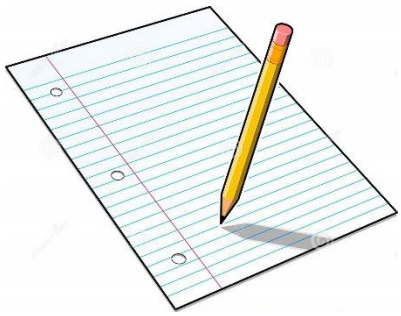




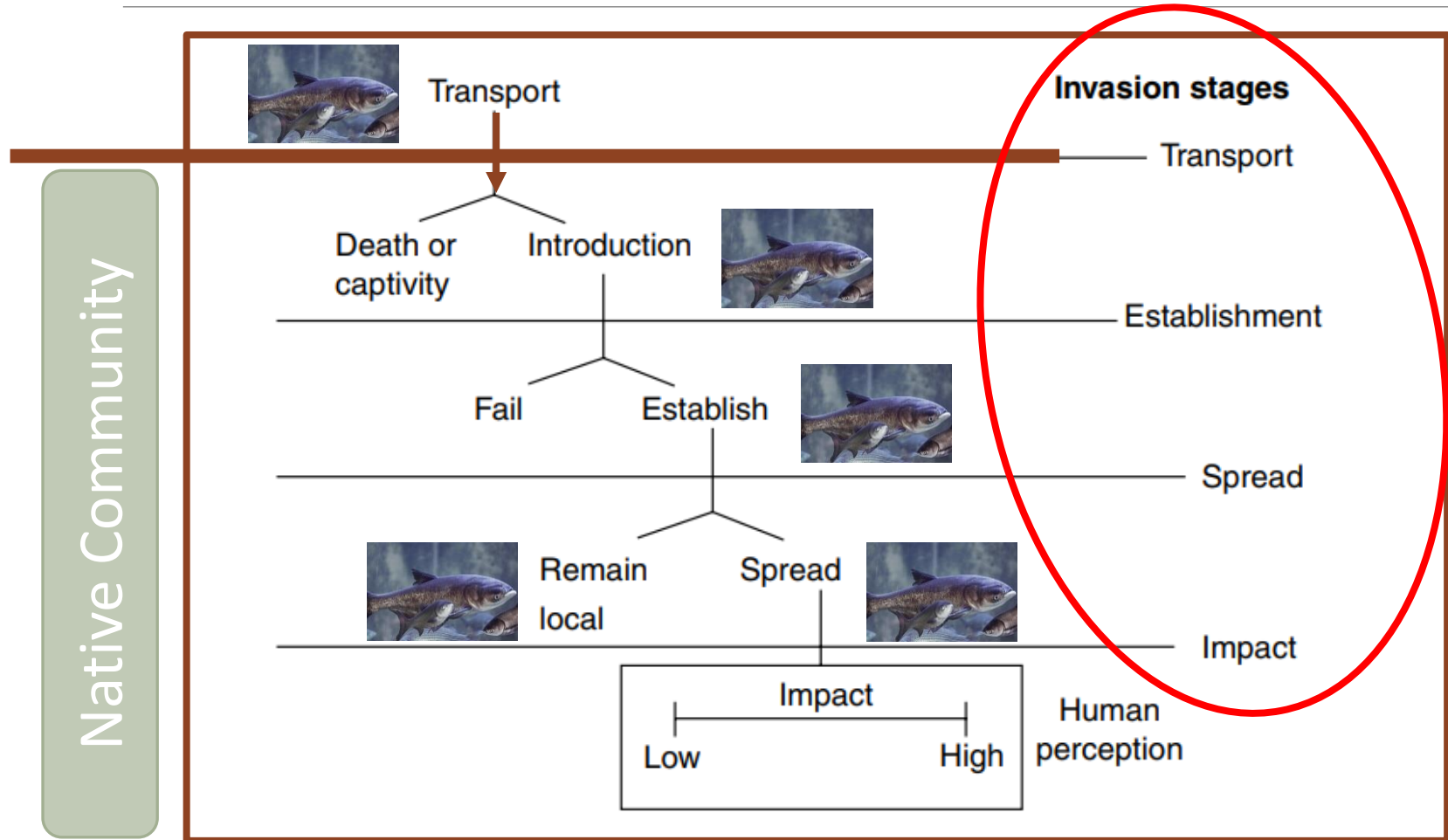
Worksheet Part 5.

Title for this scheme?





Invasion stages

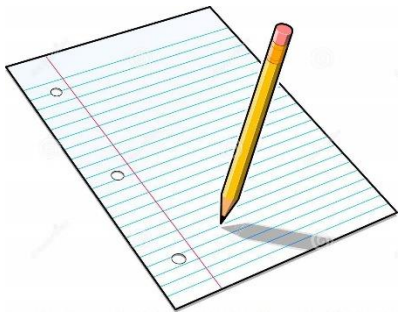




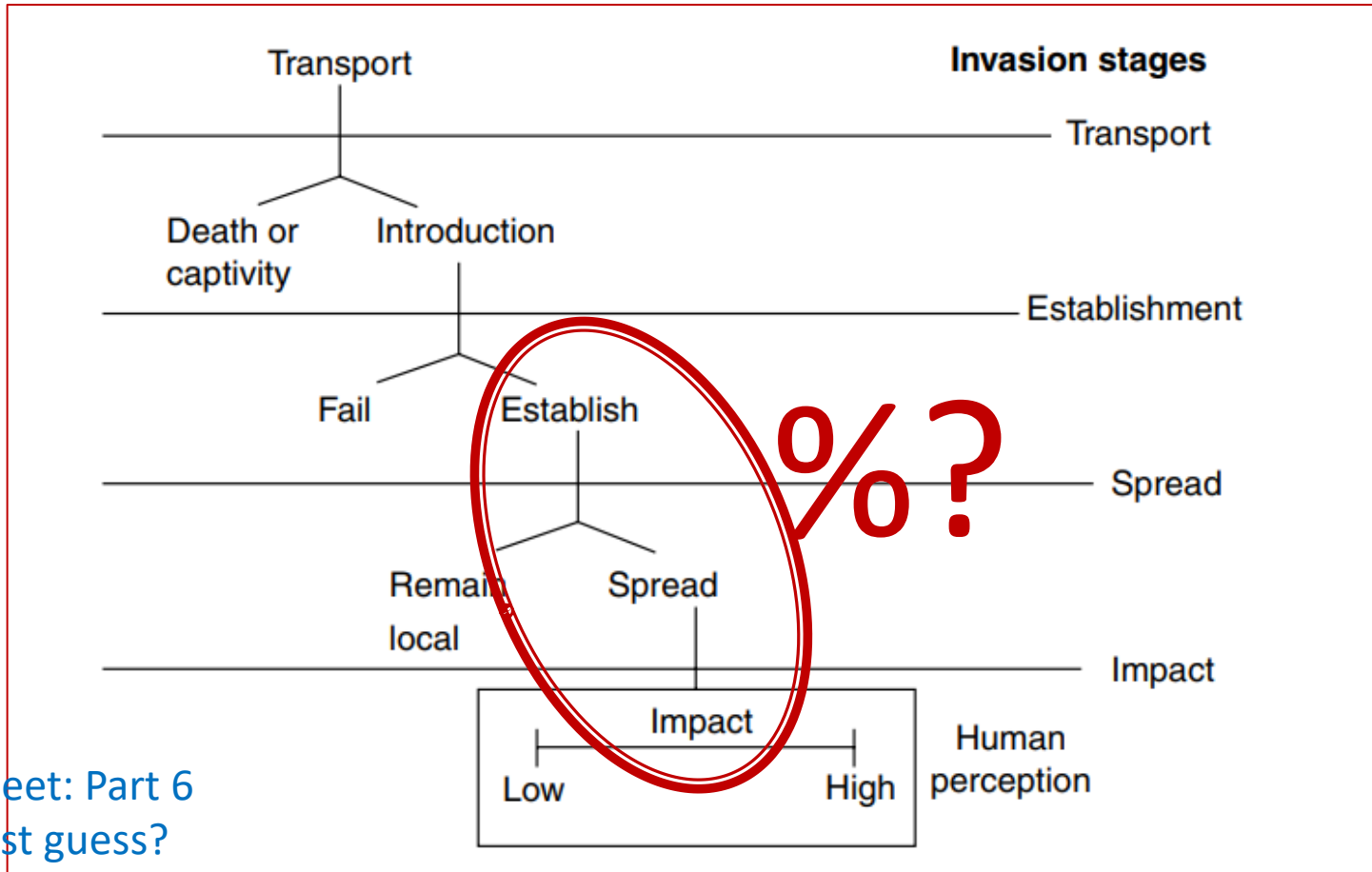
Quick discussion (3 min)



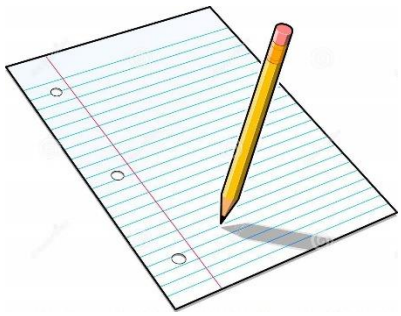
Can you think of any other possible stage of species invasion?



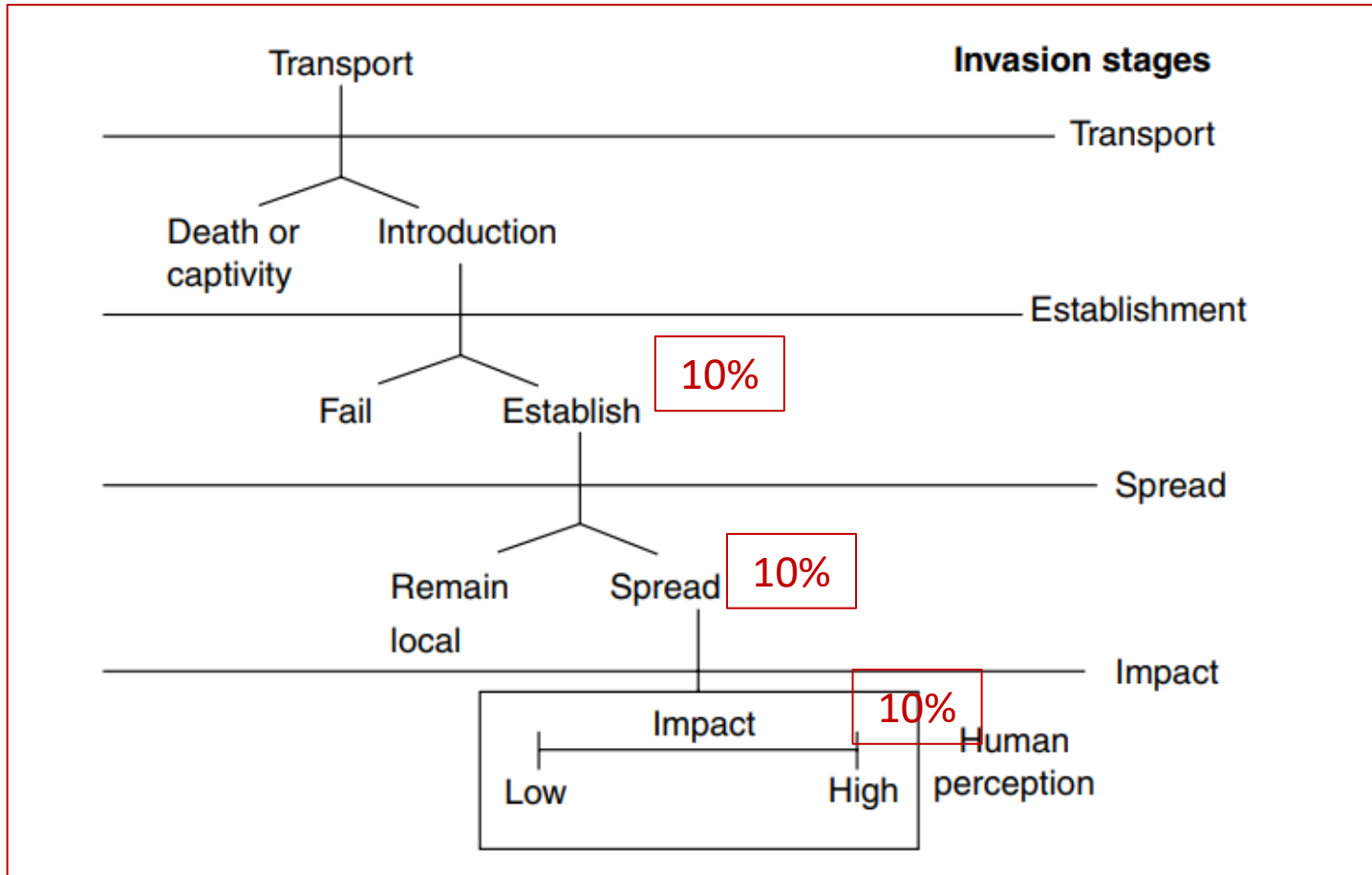
Invasion stages



Worksheet: Part 6
Your best guess?



Invasion stages





Quick Review

- Do all the stages of invasions occur for a single introduced species?
Yes/No
- Do all the invasive species have a high impact on ecosystems? Yes/No

The End

Please name at least one
invasive species



Image credits and resources

USDA

Maryland Cooperative Extension

<https://www.nhbs.com/the-ecology-of-invasions-by-animals-and-plants-book>

<http://www.socialstudiesforkids.com>

<https://oceanservice.noaa.gov>

<https://www.ecori.org/natural-resources/2015/6/23/gypsy-moth-caterpillars-take-ri-by-storm>

Louis-Michel Nageleisen, Département de la Santé des Forêts, Bugwood.org

<http://bugoftheweek.com/blog/2017/4/29/good-bye-ash-trees-of-the-potomac-emerald-ash-borer-eab-iagrilus-planipennisi>