

2016 INVASIVE SPECIES (B/C) – TRAINING HANDOUT
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DISCLAIMER - This presentation was prepared using draft rules. There may be some changes in the final copy of the rules. The rules which will be in your Coaches Manual and Student Manuals will be the official rules.

- **BE SURE TO CHECK THE 2016 EVENT RULES** for EVENT PARAMETERS.
- **THE NATIONAL INVASIVE SPECIES LIST** may be found at www.soinc.org under B/C Event Information – Invasive Species

THE COMPETITION:

- **2016 Official National Invasive Species List** is the resource for the National Competitions.
- The taxonomic scheme is based upon the Science Olympiad – **National Invasive Species List** which follows the **USDA Invasive Species Information Format** – by type of organism and then by common names listed alphabetically -
<http://www.invasivespeciesinfo.gov/unitedstates/main.shtml> (Browse by subject for types of organisms and resource library for additional resources)
- States may have a **State Invasive Species List** for regional and state competitions so check the state website. http://www.soinc.org/state_websites
- The competition may be run as stations and/or as a PowerPoint presentation.
- Not more than 50% of the questions will require identification by common and/or scientific name.
- Each specimen will have one or more questions accompanying it on some aspect of its life history, distribution, anatomy and physiology, reproduction, habitat characteristics, ecology, diet, behavior, history, control methods, laws and regulation.
- The ecology questions may pertain to any ecological aspect of the species, including invasive behavior, habitat, niche, trophic level, or adaptive anatomy.

PROCESS SKILLS: observation, inferences, data and diagram analysis.

TRAINING MATERIALS:

- **Training Power Point** presents an overview of material in the training handout
- **Background Handout** presents introductory topic content information for the event and background about Invasive Species
- **Binder Handout** give tips for preparing the binder, learning the invasive species, and competing
- **Sample Tournament** has sample problems with key based upon the National Invasive Species List
- **Event Supervisor Guide** has event preparation tips, setup needs and scoring tips
- **Internet Resource & Training Materials** are available on the Science Olympiad website at www.soinc.org under **B/C Events-Invasive Species**
- **A Biology-Earth Science CD, Taxonomy CD (updated 2016) with new Invasive Species Materials** as well as the **Division B and Division C Test Packets** are available from SO store at www.soinc.org

PLEASE NOTE: THERE ARE NATIONAL AND STATE LAWS AND REGULATIONS CONCERNING THE COLLECTIONS AND TRANSPORT OF INVASIVE SPECIES. CHECK YOUR STATE INVASIVE SPECIES PAGE, DNR, AND/OR OTHER OFFICIALS BEFORE COLLECTING SPECIMENS.

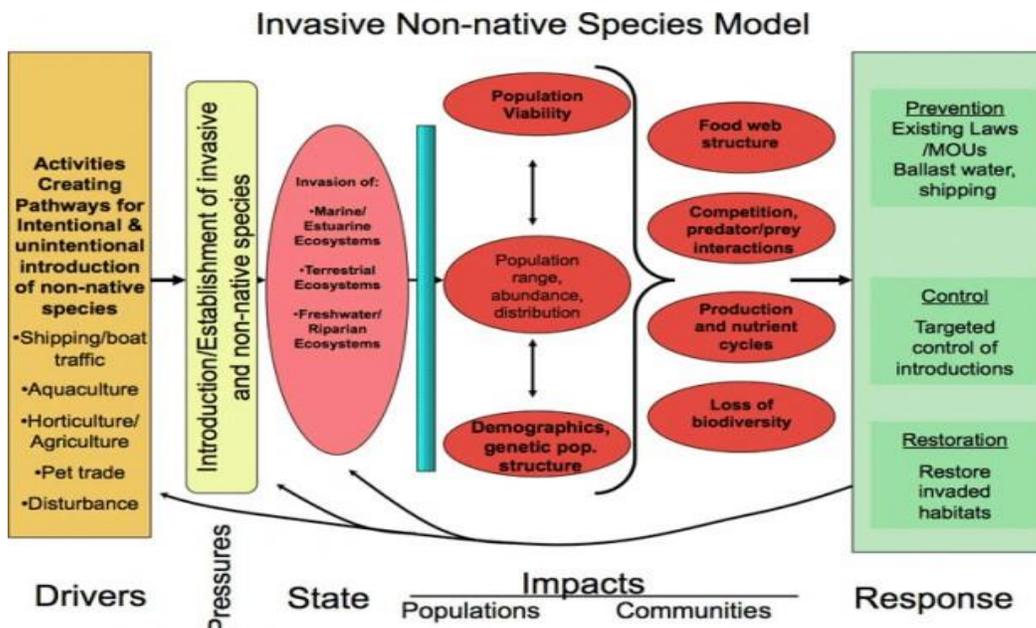
BACKGROUND INFORMATION ABOUT INVASIVE SPECIES

Terminology

- **Native or indigenous** – a species found within its natural range
- **Non-native (introduced, alien, exotic, non-indigenous)** – a species living outside its native distribution range which has arrived there by human activity either deliberate or accidental.
 - *Note:* non-native, introduced, exotic, non-indigenous and alien are often used interchangeably.
- **Feral (released pets, livestock and game animals)** – an animal living in the wild but descended from domesticated individuals
- **Human commensal or subsidized (out of control natives)** - native species that benefit from our land use (disturbance)
- **Invasive species** - species that spread subsequent to establishment usually at some cost.
US legal definition - an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.

Non-Native Species– Causes for introduction

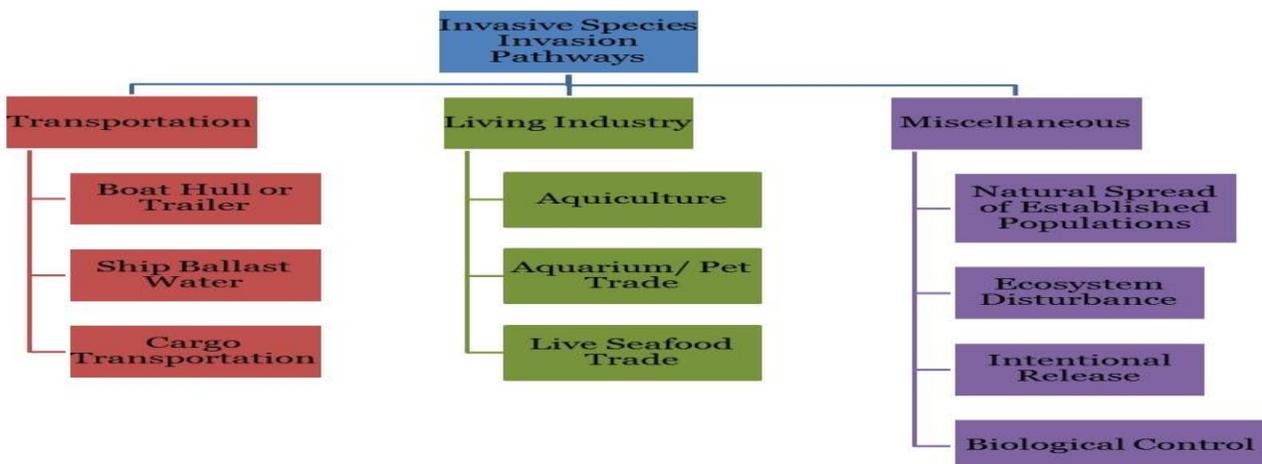
- **Natural Range Extensions**
- **Introduced as a result of human activity** – estimated 50,000 exotic species released in US every year – globalization has increased individual and commercial long distance travel and trade resulting in the altering of important waterways. Non-native species are introduced as a result and some species become invasive species.
- **10% Rule** –EPA estimates that only 10% of introduced species survive and of these, only 10% become invasive As a general rule, only 10% of introduced exotics will live at all due to wrong climate, food availability and other factors; of the 10% that live, only 10% will actually breed and become invasive. However, with a large number of introduced species, a small percent can represent large numbers of invasive species. 6,500 established invasive species in U.S. -USGS
- **Invasive Species** – when non-native species cause harm
 - change habitats and alter ecosystems
 - crowd out or replace native species – 42% of threatened or endanger species from invasive species
 - cause loss of diversity, loss of habitat, loss of food for other organisms
 - damage human activity - \$137 billion/year to the US economy – agriculture, forestry, fisheries and other human activities



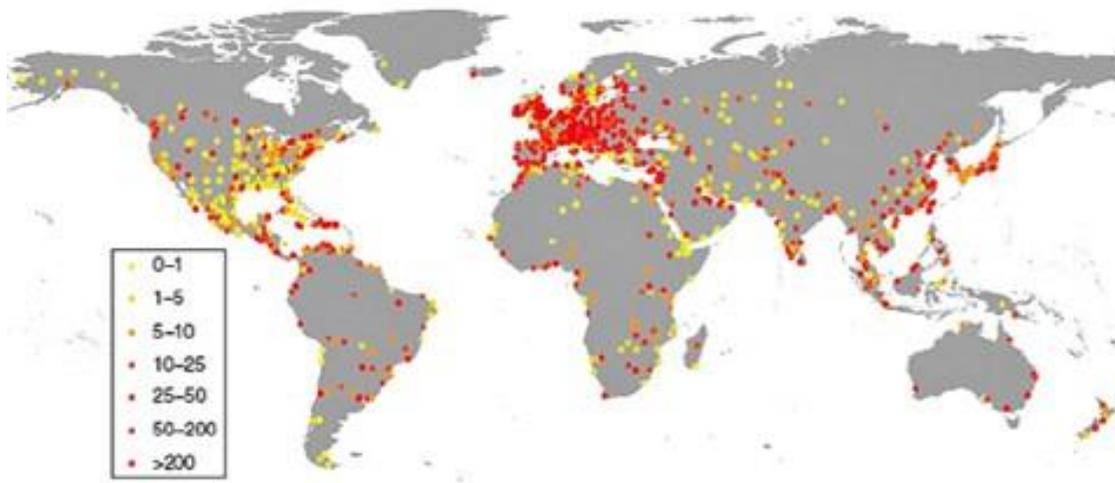
Vectors or Modes for Invasion into Ecosystems

- **Intentional Release**- Release of Target Species into the Environment
 - Economic Purposes – nutria
 - Plants for Agriculture
 - Plants for Forestry
 - Plants for Soil Improvements - fire suppression, erosion control
 - Aesthetic reasons – honeysuckle, purple loosestrife
 - Ornamental Plants
 - Cultural Purposes – starlings, Asian Shore crabs
 - Birds and Mammals for Hunting
 - Misguided Environmental Projects – Kudzu, Multiflora rose
 - Biological Control
 - Released Pets and Pet Trade
 - Naturalization societies
 - Shakespeare fans – plan to release all birds mentioned in works of Shakespeare – 12 birds released including European Starling
 - Domestic animals
 - Release of lab animals or plants – by science teachers and researchers

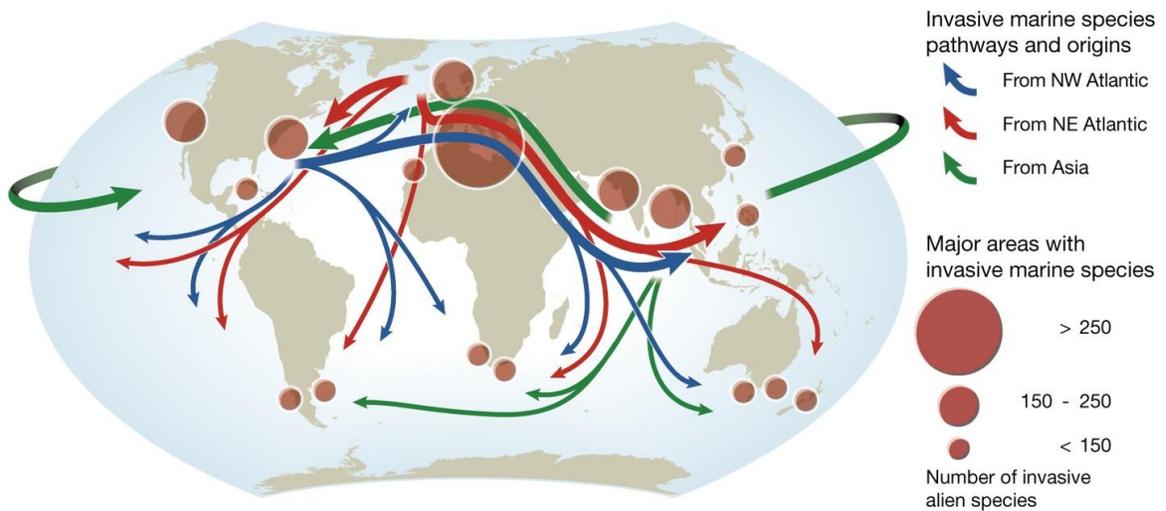
- **Accidental Releases** - Release of Non-Target Species
 - Ballast water in ships (Green crab, Zebra Mussel, Comb Jellyfish)
 - Canals – as St. Lawrence River and Great Lakes system
 - Timber – unprocessed wood
 - Accident release of organisms – gypsy moth, “Killer” African bees
 - Contaminants of Seed Stock
 - Fruit Shipments
 - Transfer in packing material (European Green Crab to CA, Horned Asian Beetle)
 - By-pass natural barriers
 - Cars and Planes
 - Tourists, Luggage
 - Hitchhikers with Packing Material, Cargo
 - Contaminants or Hitchhikers with Produce
 - Contaminants or Hitchhikers with Ornamental Plants
 - Contaminants or Hitchhikers with Aquaculture



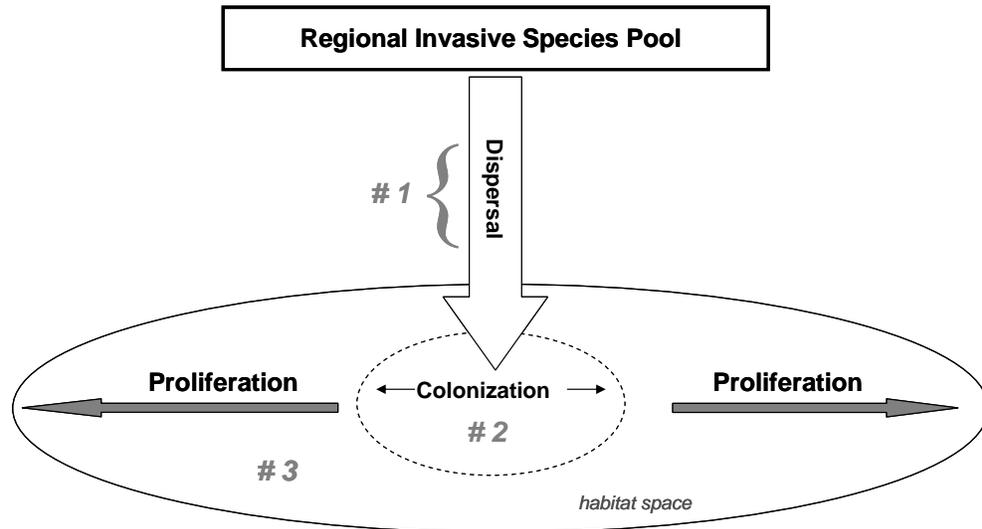
Tracking the Invasive Species – the Origin of Invasive Species



Climate and Environment – the time of year and the climate are major factors in the establishment success of an invading species. It needs a suitable climate as temperature and water needs, resources for growth and reproduction as food, no diseases or predators and lack of competitors throughout the year.



Invasion Process



1. The first process is *dispersal*, which is the arrival of a propagule on a site.
2. The *colonization* process occurs when the species establishes and maintains a minimum viable population. The colonization process is often associated with a “lag” phase in the invasion wherein the population level is small and, thus, the invasion is potentially manageable.
3. During the *proliferation* process, the invasive species passes through a “log” phase of exponential increase in population number. In some cases, the proliferation phase results in the invasive species transforming from a series of small colonies into a site-dominating monoculture. Once the proliferation stage of the invasion is complete, the structure, composition, and functioning of the native ecosystem is significantly impacted and the management of a post-proliferation invasive species is difficult and sometimes impossible.

Common Characteristics for Most Invasive Species

- *No natural predators*, so nothing to hold the population down.
- Usually *very prolific*, reproducing very rapidly
- Short time to maturity and reproduction
- Ability to live in diverse environments
- To be associated with human activities and environmental disturbances
- General diet and habitat requirements
- High abundance
- Small body size
- Social/ gregarious
- Increased competitive ability – they outcompete native species.
- Pre-adapted to disturbed environments
- Have *characteristics that exclude* native species from a habitat
- The area of the world in which the species evolved (mainland species tend to have a higher invasion potential than island species).
- Successful invader somewhere else in the world. .

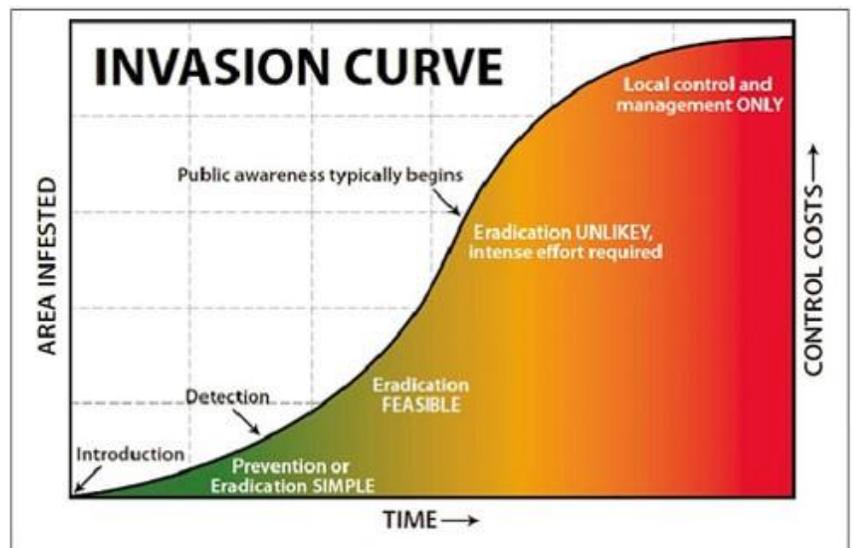


Threats because of Invasive Species

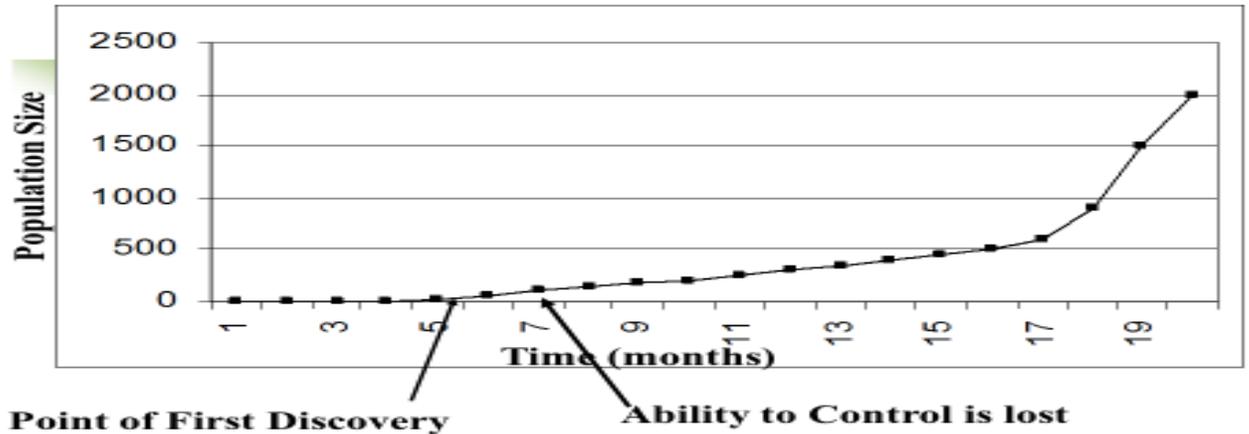
- Causing disease
- Acting as predators or parasites
- Acting as competitors
- Altering habitats
- Hybridizing with local species - If an invasive species is much more abundant than a native relative, they may hybridize so often that the invaders genes "flood" the native species, such that no individuals contain the entire genotype of the native species, thus effectively driving the native species to extinction
- Major threat to biodiversity
 - Second only to habitat destruction as a threat to biodiversity
 - Almost half of the endangered species in the US are at risk because of invasive species
 - Introduced species are a greater threat to native biodiversity than pollution, harvest and disease combined
 - Zebra mussels were accidentally brought to the United States from Russia in the ballast of ships. They alter aquatic habitats by filtering large amounts of water, thus reducing densities of planktonic organisms and settling in dense masses over vast areas. At least thirty freshwater mussel species are threatened with extinction by competition from the zebra mussel.
- Invasive predators may greatly reduce the population of native species or cause them to become endangered/extinct because the native prey have no defenses against the invasive predator.
- Invasive species can cause disease to other species as the Asian chestnut blight fungus the almost eliminated the American chestnut from the Eastern US forests in the first half of the 20th Century harming the ecosystem and the organisms dependent on the chestnut for survival.
- Invasive species can cause human disease as the AIDs virus and West Nile virus
- **Invasion Meltdown** - invading species interact with one another to generate a problem where either species alone would be harmless

Control of Invasive Species – Key factors for the success of the control

- Catching the infestation EARLY, before population numbers get out of hand.
- Whether or not the invasive organism is mobile within the environment.
- How rapidly the invasive can reproduce.
 - Does it reproduce in more than one way?
 - Does it need certain conditions?
- How vulnerable the invasive is to control.
 - IS it tolerant to pesticides?
 - Will it re-grow if burned?



Control of Invasives



Control Methods – Control vs. Eradication – Much of control relies on the ability to lower the population before the size has grown beyond our ability to handle it. It may not always be in the best interest to completely eradicate a population. Economic and environmental damage play a role in deciding to eradicate an invasive. Past a certain point, eradication may be virtually impossible. Close monitoring of critical habitats may be necessary.

- **Prevention** – keeping potential invaders out or preventing the spread of invasive species - Aquatic prevention measures – as to prevent the spread of zebra mussels include
 - Never dump bait buckets!!
 - Before leaving site, inspect gear, boats and trailers for exotics
 - Empty all water before leaving site
 - Rinse your boat and equipment with high pressure hot water, especially if moored for more than a day
 - Let equipment dry for several days (does not work for species with resting eggs)
- **Eradicating potential invaders soon after invasion**
- **No action.** This alternative may be chosen if the pest numbers are low enough that they don't interfere with management goals
- **Physical (manual & mechanical)**
 - Mechanical or physical control methods involve using barriers, traps, or physical removal to prevent or reduce pest problems.
 - Tactics may include baited or pheromone traps to capture insects, or cultivation or mowing for weed control.
- **Cultural – Ecosystem Management**
 - Cultural practices are a manipulation of the habitat environment to increase pest mortality or reduce rates of pest increase and damage.
 - There are many different cultural practices that can help to reduce pest impact such as selection of pest resistant varieties of crops, mulching, addition of beneficial insect habitat, or other habitat alterations.
- **Biological** - Biological control is the deliberate use of the pest's natural enemies - predators, parasites, and pathogens - to reduce the pest population below damage levels.

- **Chemical**
 - Use of pesticides in a way that complements rather than hinders other elements in the strategy and which also limits negative environmental effects
 - It is important to understand the life cycle of a pest so that the pesticide can be applied when the pest is at its most vulnerable – the aim is to achieve maximum effect at **minimum levels of pesticide**.
 - A broad spectrum pesticide kills ALL of the related pests. This generally bad because beneficial plants and animals are killed as well.
 - A targeted or NARROW SPECTRUM pesticide is much better for the environment because the beneficial organisms are not harmed.
- **Integrated Pest Management** – Uses a combination of methods – OFTEN MOST EFFECTIVE
According to the [EPA](#), there are **four general steps** to **Integrated Pest Management**:
 - **Set Action Thresholds:** Seeing one bug shouldn't necessarily set off a massive pesticide spraying program. Instead, IPM encourages people to set some kind of threshold for taking action. Only after a certain number of pests are seen for a certain length of time should steps be taken to control their populations.
 - Zero tolerance for pests, then, is not the goal of IPM, and farmers should realistically expect the loss of some crops to pests. In the case of agriculture, economics will usually determine how action thresholds are set; in other settings, health issues may be the primary factor that establishes action thresholds.
 - **Monitor and Identify Pests:** Tolerating the presence of some pests isn't the same as ignoring them, and IPM encourages people to keep a watchful eye on areas where pests may become a problem.
 - If pests are seen, it's also important to identify them accurately so that any pest-management procedures are targeted to the pests that are present, while allowing beneficial organisms to live.
 - **Prevention:** Perhaps the most common-sense method of [pest control](#) is to prevent them in the first place. Inside a home, this would mean sealing holes and other gaps in floorboards, window screens and other places, and eliminating sources of food or water that pests rely on.
 - Mosquitoes, for example, need standing water to breed, so getting rid of any sources of standing water is an easy way to control mosquito populations.
 - Farmers can use the same principle to prevent agricultural pests. Rotating between different field crops, changing irrigation practices to use less water, choosing pest-resistant varieties of crops, and planting pest-free rootstock will prevent pests from infesting farmland.
 - **Control:** If it's determined that pest control action is needed, there are a number of alternatives available.
 - The least risky control methods -- hand-picking, screening, trapping, weeding or tilling the soil -- are used first in IPM. Some biological methods, like spraying pheromones, using biological insecticides, or introducing sterile males into a pest population, are also available in many cases.
 - As a last resort, synthetic pesticides are used in IPM, and even then their use is limited. Ideally, pests will be targeted with as much precision as possible, and pesticides will be used at the correct time in the pest's life cycle, e.g., before eggs have hatched. Only when all else fails is broadcast spraying of broad-spectrum, non-specific pesticides used in IPM.

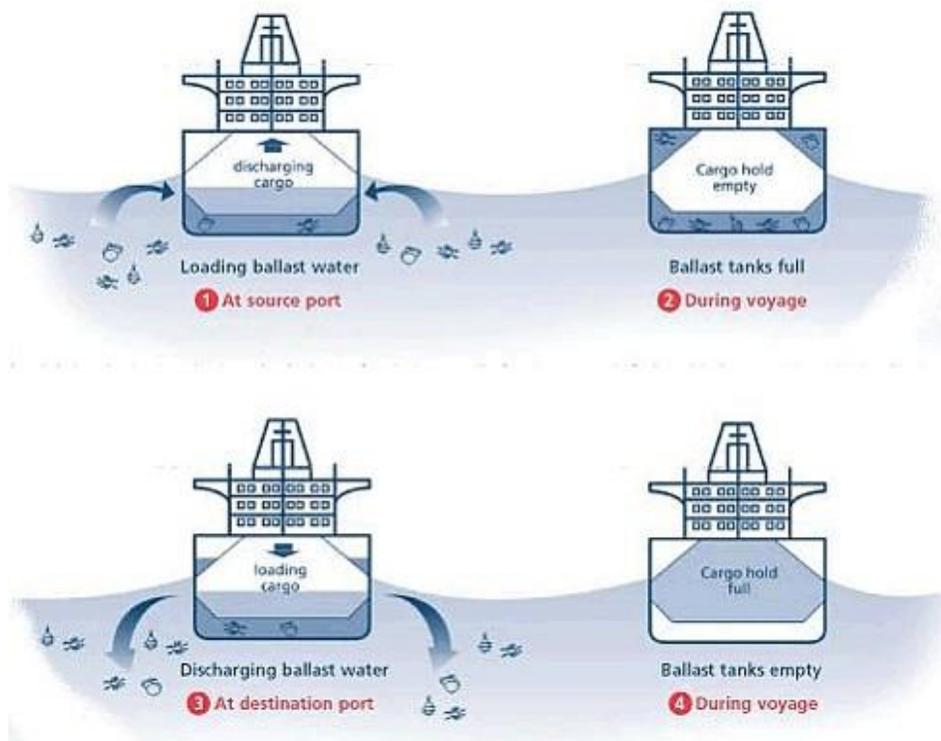
Control Methods – likely side effects

- **Biological** – control species can become invasive
- **Chemical** – may kill native species
- **Physical** – may miss removing some of the invasive species
- **Prevention** – apathy and lack of awareness

Federal Laws, Policies and Regulations

NISA

- The National Invasive Species Act (NISA) was passed in 1996 amending the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990. The 1990 Act established the [ANS Species Task Force](#) to coordinate nationwide ANS activities. The ANS Task Force is co-chaired by the Service’s Assistant Director for Fisheries and Habitat Conservation and the Undersecretary of Commerce/NOAA. NISA furthered ANS activities by calling for ballast water regulations, the development of State management plans and regional panels to combat the spread of ANS, and additional ANS outreach and research.
- One important national piece of aquatic invasive species legislation is the **National Invasive Species Act**, mentioned in Chapter 2 (for a summary of NISA, visit www.nemw.org/nisa_summary.htm). The act expired in 2002, so Congress must authorize NAISA (a revised version of NISA) for its provisions to continue (for more information on NISA, visit: www.nemw.org/search/naisa). Much of this act dealt with national ballast water management. A great deal of national and international focus has been placed on ballast water because of its implication in numerous aquatic invasive species introductions worldwide. The U.S. Coast Guard is responsible for regulating ballast water management. Visit the Coast Guard Office of Operating and Environmental Standards web site for information on regulations and links to specific ballast water programs. www.uscg.mil/hq/g-m/mso/ans.htm



Executive Order 13112

- In 1999, President Clinton signed [Executive Order 13112](#) on Invasive Species. This Order established a National Invasive Species Council, which helps coordinate activities of existing federal agencies that address terrestrial and aquatic invasive species. It also directed Federal agencies to conduct, as appropriate, activities related to invasive species prevention; early detection, rapid response, and control; monitoring; restoration, research; and education. The Order also directed Federal agencies to not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States unless the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions.

The Lacey Act

- Also important are federal regulations that define “prohibited” species and establish rules restricting their movement. **The Lacey Act** establishes a list of injurious species, as well as penalties for importing or shipping them (for more information, visit: invasives.fws.gov/Index.LacetAct.html).
- The [Lacey Act](#) (pdf) is a law that dates back to 1900 and is one of the oldest wildlife-related laws on the books. Under the Lacey Act, the Secretary of the Interior is authorized to regulate the importation and transport of species, including offspring and eggs, determined to be injurious to the health and welfare of humans, the interests of agriculture, horticulture or forestry, and the welfare and survival of wildlife resources of the U.S. Wild mammals, wild birds, fish, mollusks, crustaceans, amphibians, and reptiles are the only organisms that can be added to the injurious wildlife list.
- Species listed as injurious may not be **imported** or **transported** between States, the District of Columbia, the Commonwealth of Puerto Rico, or any territory or possession of the U.S. by any means without a permit issued by the Service. Permits may be granted for the importation or transportation of live specimens of injurious wildlife and their offspring or eggs for bona fide scientific, medical, educational, or zoological purposes.
- An injurious wildlife listing would not prohibit intrastate transport or possession of that species within a State, where those activities are not prohibited by the State.
- A current list of Injurious Wildlife Species and information on Injurious wildlife species under evaluation can be found by visiting our [Injurious Wildlife](#) page.

The Federal Noxious Weed list

- includes some aquatic species, like hydrilla, as well as a number of terrestrial species. To view the complete list and associated regulations, visit the Animal and Plant Health Inspection Service (APHIS) web site (www.aphis.usda.gov/ppq/weeds). Species listed under both acts cannot be moved into or through the United States without a permit.

Other Agencies' Laws Regulating Invasive Species

- Other agencies besides the USFWS have laws restricting the importation or possession of certain wildlife and plant species. Here are links:
- [USDA APHIS](#)
- [CDC](#)

NATIONAL CAMPAIGNS, INITIATIVES, AND PLANS

“**Stop Aquatic Hitchhikers**” - National Public Awareness Campaign and website encourages recreational users to become part of the solution in stopping the transport and spread of these harmful invasive species.

<http://www.protectyourwaters.net/>

“**Habitattitude**” - National Public Awareness Campaign and website encourages aquarium hobbyists, backyard pond owners, water gardeners and others who are concerned about aquatic resource conservation to properly dispose of unwanted plants and animals while promoting responsible consumer behaviors

<http://www.habitattitude.net/>

100th Meridian Initiative

<http://100thmeridian.org/>

- A cooperative effort between local, state, provincial, regional and federal agencies to prevent the westward spread of zebra/quagga mussels and other aquatic nuisance species in North America. lead by the U.S. Fish and Wildlife Service
- The goals of this Initiative are to 1) prevent the spread of zebra mussels and other aquatic nuisance species in the 100th meridian jurisdictions and west and 2) monitor and control zebra mussels and other aquatic nuisance species if detected in these areas.



Quagga-Zebra Mussel Action Plan for Western U.S. Waters

http://www.fws.gov/fisheries/ans/Quagga_Zebra_Mussel_Action_Plan_Projects.pdf

State Laws and Regulations

- Many states have laws and regulations that are designed to prevent the spread of Invasive Species.
<http://www.invasivespeciesinfo.gov/laws/statelaws.shtml>
- On the State Laws link – click on your state to see the state resources
- Check on your State website and State agency website for state guidelines
www.naisn.org/documents/compendium%20for%20website_links.pdf
- Check with local authorities or cooperative extensive service.
- Many states have Invasive Species agencies that guide the state efforts to control and prevent the spread of invasive species. – They will also have a list of your state invasive species as well as important specie information.

Be sure you know your state regulations before attempting to collect and preserve invasive species - *Check with your State Science Olympiad Website and State Agencies.*

<http://www.invasivespeciesinfo.gov/resources/lists4states.shtml>

<http://www.invasivespeciesinfo.gov/resources/orgstate.shtml>

www.naisn.org/documents/compendium%20for%20website_links.pdf

<http://www.fws.gov/offices/statelinks.html>

- **If you are not sure, use photos.**