

AQUATIC INVASIVE SPECIES

Quantifying Pathways of Nonindigenous Aquatic Species

Final Report

In 1999, President Clinton signed an executive order calling for establishment of a National Management Plan for Invasive Species. This plan, published in 2001, calls for quantification of the various pathways by which nonindigenous nuisance species (NIS) enter or are distributed within the US. While the importance of ballast water as a pathway of NIS introductions into aquatic systems is well established, the importance of other pathways has not been quantified. Some of these pathways--live bait, pet, water garden, and biological supply trades--are widely thought to be increasingly important. This project will examine the relative importance of these different pathways through 1) quantification of organisms for sale by these industries in the southern Lake Michigan region; 2) identification of those species that are most likely to establish in the Great Lakes and connecting waterways; and 3) collaboration with local and national industry leaders in production of educational materials for them and their customers, and voluntary codes of industry conduct that will reduce the future risk of spreading NIS via these pathways. Collaboration with these industries will reduce the introduction and spread of NIS in the short term, and lay the groundwork for more effective and efficient future regulations, should they be necessary.

Major Goals and Objectives

- To determine the importance of the trades in live bait, pets, water gardens, and biological supplies as pathways for the introduction of nonindigenous freshwater species.
- To estimate the ecological and economic risks associated with given species in trade.
- To reduce the numbers of high risk species in trade and to reduce the likelihood of release of organisms by customers.

Summary of Progress

In the few months since funding started, we purchased over 100 plant species and numerous animal species from pet, bait, water garden and biological supplies vendors. These specimens have been preserved and identified. We have thus far concentrated our sampling efforts mostly on plants, and will thus concentrate more on animals in our next field season (summer 2003). We have therefore made substantial progress on Goal 1 listed above.

We have begun risk assessments of plants found in trade using two existing procedures: the Western Australia Weed Risk Assessment (WRA) and the US Aquatic Plant Health Inspection Service (APHIS) WRA. The former was chosen because it is a prominent quantitative method, and the latter because it is the current US qualitative method. Known nuisance plants have been used to determine how accurate the WRA's are, and a limited number of species of unknown nuisance status have been assessed. Because neither WRA has proved satisfactory, we plan to construct our own WRA that will be specific to aquatic plants in the upper midwest, and also potentially applicable to the US generally. This WRA will consider both economic and ecological risks involved in allowing various plant species in trade. Thus, we have made substantial progress on Goal 2 listed above.

Goal 3 will be addressed in year 2 as originally planned.

Accomplishment/Benefits

Our progress in the first few months of funding has laid the groundwork on which we will build our outreach efforts to industry. We plan to combine our proposed local and national advisory committees because that

seems most efficient given what we've learned about the industries under study. We are making plans to convene this committee at Notre Dame in Jan/Feb 2003, and hence begin our outreach efforts to reduce the environmental risk of species in trade.

Keywords

Alien species, bait, biological supply, Lake Michigan, nonindigenous species, pathway, pet risk assessment, vector, water garden.

Narrative Report

Our overall goals are to identify the live aquatic species that are in trade in the southern basin of Lake Michigan, identify what environmental and economic risks these species pose, and to design guidelines and materials that could be use lower these risks. Over the period of funding we will achieve this by purchasing and identifying plants and animals from all relevant pathways and conducting quantitative risk assessments for each species. We will create lists of species likely to become nuisances if released and species that are considered safe. Using these lists, and knowledge we gain about the industry from interactions with vendors, we will write and distribute pamphlets, guidelines, and possibly software that will lower the risks posed by live aquatic organisms in trade. Over summer, 2002, we sampled plants and animals from the pet, water garden, bait and biological supplies trades. In this first field season, we concentrated on plants, and thus mostly purchased from pet, aquarium and water garden vendors. Prior to the sampling, we investigated the trades, and organized our sampling by locating vendors and identifying the species that we believe are most likely to survive in the upper midwest. When purchasing samples, we concentrated on these species.

From our purchases we have identified more than 100 species of plants that are available for purchase or delivery from web vendors in the upper midwest. Our main conclusions from this part of the work are:

" Many known nuisance species are readily available, including Eurasian water milfoil (*Myriophyllum spicatum*) and *Egeria* (*Egeria densa*).

" Approximately 40% of purchased plant samples were given wrong scientific names by the vendors, and some were given undescribed Linnaean names. Many more were only identified with ambiguous common names.

" Almost all purchased plants arrived with associated live organisms, such as snails and other plants (esp. duckweed). These unordered organisms may pose independent invasion risks.

" Some species can't be identified beyond family or genus because of inadequate specimens (esp. a lack of flowers) or a lack of appropriate taxonomic literature. The latter problem is mainly a factor for plants native to non-English speaking regions of the world, or places for which species keys have not been produced.

Using known invaders we have tested two risk assessment models: the Western Australia Weed Risk Assessment (WRA) and the US APHIS WRA. The former procedure was chosen because it is the most prominent WRA currently available, it represents a newer quantitative style of risk assessments, and it has been shown to be very accurate in some cases. The APHIS WRA was chosen because it is the current procedure used in the US to determine whether an aquatic plant species should be restricted from trade. The Western Australia WRA correctly predicted all weed species, but misclassified some known non-weeds. Thus, it is too risk averse. The APHIS WRA incorrectly identified some known weeds, and would thus have accepted into trade plants now known to be nuisance species. We believe that the Western Australia WRA has the most potential as a model for an aquatic plant WRA for the upper midwest, and plan to modify that framework to this end. If possible, we will make the model easily adaptable to consider the whole US. While the APHIS WRA was quite accurate, it is hampered by the qualitative nature of the questions and subsequent predictions. This makes it highly likely that different users would get different answers, and any predictions are thus difficult to interpret.

We have arranged to send most of the animals collected this summer to taxonomic experts for identification. When these identifications are returned, we will conduct risk assessments on those species. During the next sampling season we will concentrate on a more complete survey of animals in trade.

Lay Summary

Our goal is to determine how the trade in live aquatic plants and animals may be contributing to the introduction and spread of invasive alien species in the southern basin of Lake Michigan. To accomplish this we are buying and identifying those species that we believe may be capable of surviving in the area. These species come from the bait, pet, water garden and biological supplies trades. We have thus far concentrated on plants. Collections have shown that many species already known to be invasive are readily available for purchase, that many species are misidentified by vendors, and that most plants come with other plant and animal contaminants (e.g. snails) which may themselves pose invasion risks. We have also identified some plants in trade that are not yet nuisance species, but that may become such.

International Implications

Because organisms released in the Great Lakes region can be expected to spread to Canadian waters, our results will have implications for Canada also.

Partnerships

We anticipate that the first meeting of our project Advisory Committee will result in some very effective partnerships with the industries that are under study.

Publications

Keller R., C. Van Loon, and D. M. Lodge. "Coming To A Pond Near You: Live Aquatic Plant Trade As An Invasion Pathway", poster to be presented at the Janet Meakin Poor Research Symposium on Invasive Plants, Chicago, 28-30 Oct 2002.

Undergraduates / Graduates

Reuben Keller is a PhD candidate currently supported by this project. Christine Van Loon is an undergraduate who was supported by this project over the summer sampling season.

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Research Information

- **Principal Investigator:** David Lodge
- **Initiation Date:** March 1, 1998
- **Completion Date:** February 28, 2001
- **Affiliation:** University of Notre Dame

Contacts

[Tomas Höök \(../staff/hook.html\)](#)

Associate Director of Research

765-496-6799

thook@purdue.edu (<mailto:thook@purdue.edu>)

Carolyn Foley (../staff/foley.html)

Assistant Research Coordinator

765-494-3601

[cfoley@purdue.edu \(mailto:cfoley@purdue.edu\)](mailto:cfoley@purdue.edu)**Pat Charlebois (../projects/staff/charlebois.html)**

Aquatic Invasive Species Coordinator

847-242-6441

[charlebo@illinois.edu \(mailto:charlebo@illinois.edu\)](mailto:charlebo@illinois.edu)**Sarah Zack (staff/zack.html)**

Aquatic Invasive Species Specialist

847-242-6440

[szack@illinois.edu \(mailto:szack@illinois.edu\)](mailto:szack@illinois.edu)**Danielle Hilbrich (staff/hilbrich.html)**

Aquatic Invasive Species Assistant

847-242-6442

[hilbrich@illinois.edu \(mailto:hilbrich@illinois.edu\)](mailto:hilbrich@illinois.edu)

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Illinois-Indiana Sea Grant
Purdue University
195 Marsteller Street
West Lafayette, IN 47907-2033
765-496-6009
iisg@purdue.edu ([mailto:iisg@purdue.edu?subject=IISG Inquiry](mailto:iisg@purdue.edu?subject=IISG%20Inquiry))



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