REPORT

Title: Evaluation of invasive aquatic species in Texas

Project Number: 2013TX461B

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Abstract

Research on invasive aquatic species in Texas, funded through the USGS and the W.G. Mills Memorial Endowment, began June of 2012 and concluded May of 2014. The time frame for this report is March 1, 2013 through February 28, 2014. The focus of this research was to evaluate aquatic invasive species in the state of Texas. Upon speaking with representatives from the Texas Parks and Wildlife Department and the Lady Bird Johnson Wildflower Center, it was determined that a risk assessment tool for aquatic invasive plants, tailored to the state of Texas would be beneficial as inhibiting the introduction of new, potentially invasive species is the most successful method for preventing serious infestations. An invasion model was also developed to simulate the invasion and management of invasive species within a reservoir in Texas. The risk assessment serves as a useful predictor of future potential invasive plant species, as well as prioritizing existing invasive aquatic plants for management purposes, and is applicable to policy makers in determining which species to prohibit, as well as for managers deciding which species deserve the highest priority in management and control efforts. The invasion model is a case study model, simulating the infestation and management of hydrilla at Lake Conroe, and serves as an example of future modeling work that could be done to model the spread of an invasive species after introduction, and a tool to model potential management techniques.

Problem and Research Objectives

Determining which non-native aquatic plants have the greatest potential to invade a new area, and prohibiting those species prior to their introduction, is the key to preventing future serious infestations. The vast majority of non-native plants, either aquatic or terrestrial, are intentionally introduced to an area for purposes such as food crops, ornamental gardening, or as novelties. Once established in captivity, many plants are accidentally or intentionally released into the environment. The majority do not pose a serious threat of infestation, however a select number can quickly become well established and cause severe damage to both the ecosystem and the economy. Each year, millions of dollars are spent in an attempt to control these invaders in the United States. Additionally, invasive plants cause a multitude of negative impacts, such as reduced biodiversity, increased transportation costs, changes water chemistry, and decreased land values. Weed Risk Assessments, tools for determining the invasive potential of a plant species, have been developed and are currently being used around the world to screen non-native plant species and identify those which are likely to be invasive and should be excluded. Most notably, a risk assessment was developed for Australia in 1999 as a biosecurity tool, which is referred to as the Weed Risk Assessment or WRA. The Australian system is regarded as a highly

accurate tool for screening non-native terrestrial plants prior to their introduction. This model has been widely adapted to screen for both terrestrial and aquatic plants in a number of other countries including New Zealand, Chile, and the United States, as well as individual states in the US such as California and Hawaii.

A tool specifically tailored to the unique ecosystems of Texas has not yet been developed, however. Texas is a major hub in the aquatic plants trade and has conditions, like a temperate climate, which are favorable for plant invasions. In fact, one of the most common sources of aquatic ornamental plants is internet sale, and Texas is home to some of the largest retailers in the country. So, developing and implementing an effective risk assessment tool is imperative to reducing future invasions. This study reviewed the models that are currently available, the New Zealand and United States models in particular, and adapted them to develop a tool that accurately identifies those aquatic species which should be prohibited from entering the state of Texas, while recognizing those which should be safe to import. The new tool will be comprised of two models: a questionnaire-style risk assessment which will give each plant an invasiveness score, and an invasion model which simulates aquatic invasive plant growth and potential management techniques.

Materials/Methodology

The research began with assessing existing risk assessments models that have been developed and are currently in use, specifically the New Zealand Weed Risk Model (AWRA) and the United States Weed Risk Assessment (USAqWRA). The models are questionnaire-style assessments with a number of weighted questions which address various aspects of plant ecology, reproductive abilities, potential environmental and economic impacts, and history of invasion in other areas, among others. Questions include temperature tolerance, resistance to management, and aesthetic value. Upon completion of the questionnaire, each plant is given a score of invasiveness potential; the higher the score, the more likely the plant is to become invasive.

The risk assessment developed for Texas, the Texas Aquatic Plant Risk Assessment or TX APRA, is similar to these previous models, however minor changes were made so that the parameters accurately reflect conditions in Texas. To test for model accuracy, 100 plants which are known to have been previously introduced into Texas ranging from major invaders, to minor invaders, to non-invaders were scored to ensure that the model can correctly distinguish between the three categories.

Part two of the tool is an invasion model which shows predicted rates of growth and spread of non-native plants over time. The invasion model developed for this research is a case study model, simulating the invasion and subsequent management of hydrilla within Lake Conroe, a man-made reservoir in East Texas. Lake Conroe was chosen as because the hydrilla infestation at Lake Conroe is a very well documented event with a multitude of readily available data. Annual average temperatures, day length, water depth, and hydrilla growth and senescence rates were all used in the model. Management techniques like manual removal, herbicide application, bio-control, were also incorporated, and the control technique's effectiveness can be predicted.

Principal Findings

Results from analysis of the risk assessment test data show that the risk assessment can correctly distinguish between major invaders, minor invaders, and non-invaders with an extremely high level of accuracy. Preliminary staticall analysis using multivariate analysis of variance (MANOVA) results in a 100% correct prediction rate. The invasion model accurately simulates the invasion of hydrilla in Lake Conroe and subsequent management efforts, according to data collected from the actual hydrilla invasion at Lake Conroe (Klussmann et al. 1988, Chilton et al. 2008).

Significance

Implementing an accurate risk assessment tool in the state of Texas will be highly useful to policy makers, and could serve as a useful aid in determining which aquatic plant species to exclude from entry into the state. Prevention through prohibition is the most effective way of ensuring that new, potentially devastating invasive species do not enter our state's waters. With this tool, policy makers will be able to accurately determine those species which have a potential to be highly invasive and should be prohibited, while still allowing entrance of species which likely do not pose a serious threat of invasion.

The TX APRA will also benefit managers and those working to control and manage existing invasive species. The invasion model will allow managers to model various control techniques and determine what the most effective course of action will be. An invasion model to predict growth and spread of aquatic plants has not been developed with any of the previous risk assessments and could be highly useful in aiding managers when deciding the best plan of action for controlling existing aquatic invasive plants, or as an educational tool to demonstrate the consequences of aquatic invasive species. Modeling control efforts prior to testing them in the field could prove very cost effective, as time spent in the field and money spent on control efforts could be saved by narrowing down the best plan of action.

References Cited (if needed)

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Chilton, E.W., Webb, M.A., and Ott Jr., R.A. 2008. Hydrilla Management in Lake Conroe, Texas: A Case History. American Fisheries Society Symposium. 62,247-257.

Clayton, J.S., Champion, P.D. 2006. Risk Assessment Method for Submerged Weeds In New Zealand Hydroelectric Lakes. Hydrobiologia 570: 103–188.

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Pimentel, D., Lach, L., Zuniga, R. Morrison, D. 2000. Environmental and Economic Costs of Nonindigenous Species in the United States. BioScience 50, 53-65.

PUBLICATION

Water Resources Research Institute Reports

Edgerton, Elizabeth A. 2014. USGS Annual Report: Evaluation of invasive aquatic species in Texas. Texas Water Resources Institute, Texas A&M University. College Station, TX. 1-5.

Conference Proceedings

Edgerton, Elizabeth; Lucas Gregory; Michael Masser; William Grant; Allen Knutson. 2013. *Developing a Risk Assessment Tool for Identifying Potential Aquatic Invasive Plants in Texas* in Aquatic Plant Management Society's Abstract's Review.

Edgerton, Elizabeth; Lucas Gregory; Michael Masser; William Grant; Allen Knutson. 2014. *Aquatic Invasive Plant Management: Using modeling to PredictExisting Infestations and Prioritize Existing Infestations in Texas* in Texas Invasive Plant & Pest Council's Abstract's Review.

NOTABLE AWARDS AND ACHIEVEMENTS

2nd Place; Student Poster Competition at the Aquatic Plant Management Society Annual Conference, San Antonio, TX, July 16, 2013. $200.

1st Place; Oral Student Presentation at the Texas Invasive Plant & Pest Conference, Port Aransas, TX, February 27, 2014. $500.

Won $150 travel grant to attend the Texas Invasive Plant & Pest Council's Conference, February 2014.

Received assistance from the Aquatic Plan Management Society in January; serve as student director on the society's board of directors and they paid flight, hotel and meals for planning the meeting held in January 2014.