RESEARCH ARTICLE

A Novel, Web-based, Ecosystem Mapping Tool Using Expert Opinion

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Natural Areas Journal 29:281–292

ABSTRACT: Regional distribution and abundance data for invasive plant species are urgently needed for management planning, modeling of invasion risks and impacts, and communicating the scope of the problem. Yet, regional distribution data are rare in the United States. Here, we present a web-based mapping tool designed for efficient collection of expert opinion of invasive species abundance. We use this approach to generate distribution maps of three prominent invasive plants in the southeastern United States: (1) Chinese/European privet (*Ligustrum sinense/vulgare*), (2) kudzu (*Pueraria montana*), and (3) cogongrass (*Imperata cylindrica*). We validated the maps for internal consistency, based on multiple submissions for the same location, and with two other independent data sources: the U.S. Forest Service's Forest Inventory and Analysis plots (FIA) (for privet) and point-location data gathered from various sources (for all three species). Percent cover data were collected for each species across 30% of the Southeast U.S. The web-based mapping system yielded high participation rates (187 users). Internal consistency was 69% for Chinese/European privet, 72% for kudzu, and 88% for cogongrass. For Chinese/European privet, percent cover accuracy was 64% relative to the U.S. Forest Service FIA data. A web-based mapping system is an effective means of collecting regional distributional data from a broad but loose network of experts. Regional abundance maps complement point presence data typically used in invasive plant management. Regional distribution maps are useful for cross-jurisdictional management of invasive species, biogeographical research, and attracting support for containment and restoration programs.

Index Terms: biogeography, Google Maps, invasive plant, regional land cover, species distribution

INTRODUCTION

Non-native invasive plants increasingly threaten native ecosystems by altering ecosystem processes and reducing biological diversity. Invasive species are recognized as a major component of global change (e.g., Vitousek et al. 1996; Millennium Ecosystem Assessment 2005). Their impact on ecosystems is significant and alarming: almost half of the United States species listed under the Endangered Species Act are threatened by competition with invasive species (Wilcove et al. 1998) while, globally, invasive species are a major threat to 30% of birds, 11% of amphibians, and 8% of mammals on the IUCN Red List of Threatened Species (Baillie et al. 2004). Invasive species frequently affect ecosystem function by altering fire regimes and water availability (Vitousek 1990; D'Antonio and Vitousek 1992; Busch and Smith 1993; Zavaleta 2000). Further, they impair local economies by reducing commercial forest and agricultural yields, decreasing rangeland productivity, and requiring expensive control efforts (Vitousek et al. 1996; DiTomaso 2000; Mack et al. 2000). Economic losses associated with non-native invasive species total nearly $120 billion annually in the United States alone (Pimentel et al. 2000; Pimentel et al. 2005).

Critical to measuring, monitoring, and controlling the damage caused by non-native invasive plants are data on their distribution and abundance. In the United States, distribution data are usually sparse, patchy, or non-existent. In the Southeast United States in particular, the need for invasive plant distribution data has led to multi-state partnerships with a focus on mapping (Bowen 2007). However, agencies or individuals are often knowledgeable about invasive species distributions, but lack the resources or infrastructure to collate and synthesize that knowledge. The resulting lack of a "big picture," especially in the form of regional-scale maps, inhibits monitoring, management, and research. Using the Southeast United States as a focal region, we present a new, interactive, web-based method for gathering, collating, and synthesizing data from numerous local experts to produce large-scale maps of the distribution and abundance of invasive plants. This approach not only assembles existing data but identifies knowledge gaps of species distributions and abundance. Our technique for generating distribution and abundance maps has the advantages of being inexpensive, user-friendly, and flexible. It can be readily adapted for use with other species and locales.

The Southeast United States suffers from the ecological and economic effects of nearly 450 species of non-native invasive plants (Miller et al. 2004). These invasive