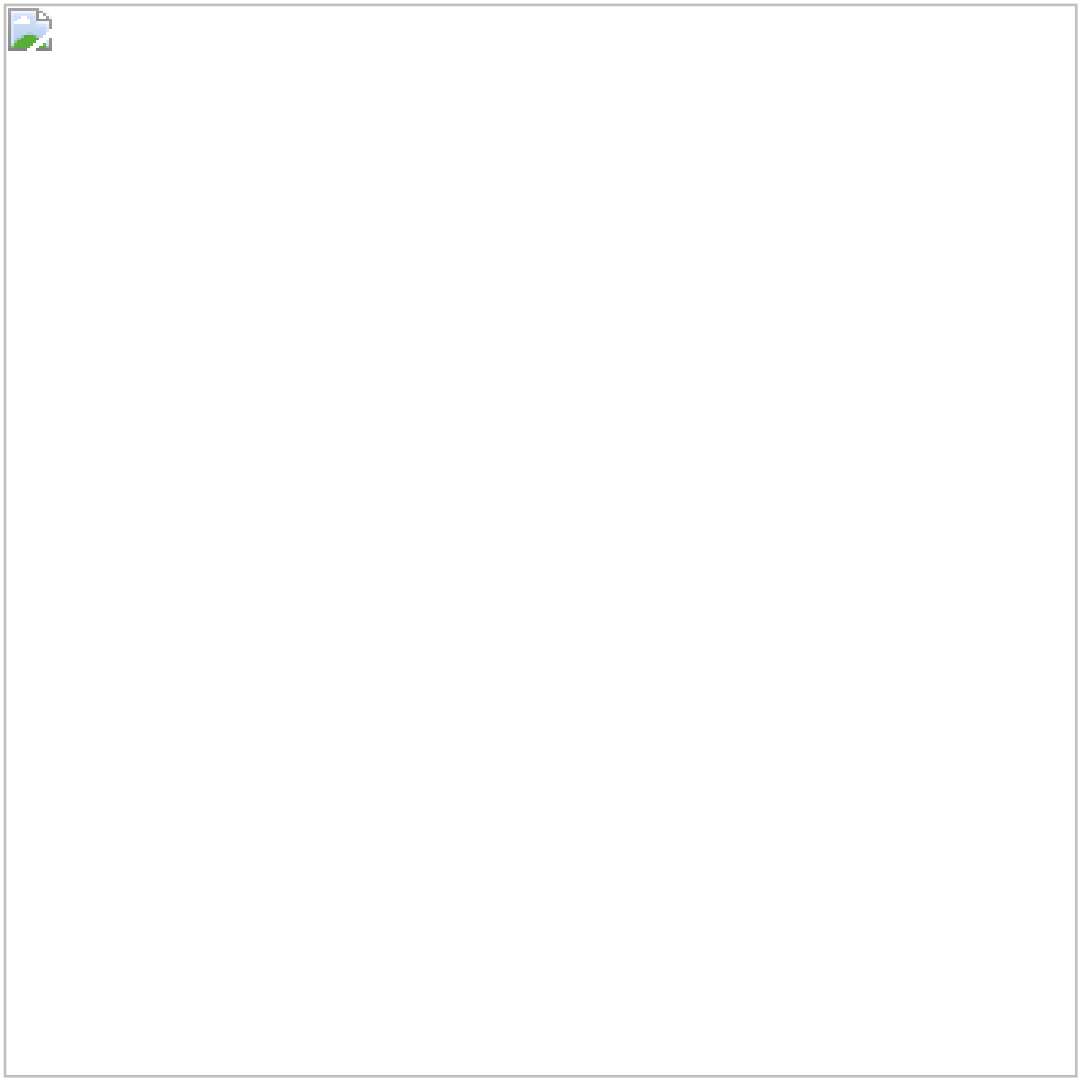

Seedbank Potential of Chinese Tallow Tree (Triadica sebifera) in a Texas Bottomland Hardwood Forest

Authors: Bennett, Andrew J., Conway, Warren C., Comer, Christopher E., Williams, Hans M., and Bosworth, Scott B.

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RESEARCH NOTE

Seedbank Potential of Chinese Tallow Tree (*Triadica sebifera*) in a Texas Bottomland Hardwood Forest

Andrew J. Bennett[1,4]
[1]Arthur Temple College of Forestry and Agriculture
Stephen F. Austin State University
419 E. College St.
Nacogdoches, TX, 75962

Warren C. Conway[2]
Christopher E. Comer[1]
Hans M. Williams[1]
Scott B. Bosworth[3]

[2]Department of Natural Resources Management, Texas Tech University
Mail Stop 2125
Lubbock, TX 79409-2125, USA

[3]Texas Parks and Wildlife Department
Old Sabine Bottom Wildlife Management Area
21187 CR 4106
Lindale, TX, 75771

[4] Corresponding author:
abennett409@gmail.com (281) 727-6737

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ABSTRACT: Chinese tallow tree (*Triadica sebifera*) is arguably one of the most deleterious exotic invasive plants in the southern United States, where it alters ecosystem structure and function, especially near the Gulf Coast. Chinese tallow continues to expand into riparian floodplain forests, which likely facilitate regional invasion by dispersing seeds during seasonal flooding and providing corridors of favorable habitat. We attempted to estimate existing Chinese tallow soil seedbank presence and density in a bottomland hardwood forest located at Old Sabine Bottom Wildlife Management Area (OSBWMA) in northeastern Texas, where heavy infestation has not occurred to date, though mature seed-bearing trees are present regionally. No Chinese tallow seeds were detected across the study area, despite the occurrence of mature, seed-bearing plants on adjacent properties. Based on this lack of detected seeds, combined with the lack of observed Chinese tallow plants at OSBWMA, it appears the species continues to occur at low densities within apparently suitable habitats in northeastern Texas, perhaps reflecting a lack of en masse water-mediated dispersal into the region due to its upstream location in relation to heavily infested areas further south.

Index terms: bottomland hardwood forest, Chinese tallow tree, invasive species, seed bank, *Triadica sebifera*

INTRODUCTION

Chinese tallow (*Triadica sebifera* (L.) Small; Euphorbiaceae) is a deciduous tree native to subtropical and warm-temperate portions of eastern Asia (Howes 1949) that has become a noxious invasive species in the southern United States since its introduction in the 1700s (Bruce et al. 1997; McCormick 2005). The species has become increasingly abundant in forested ecosystems, especially riparian floodplain forests (Conner et al. 2002; Tan et al. 2010; Howard 2012), where its long-term ecological impacts are less understood. Furthermore, as Chinese tallow continues to spread north and west from areas of greater density in coastal Texas (Gan et al. 2009; Oswalt 2010; Wang et al. 2011), riparian forests are hypothesized to act as corridors of dispersal out of the region by furnishing favorable moist habitats and seasonal flooding capable of dispersing seeds (Wang et al. 2011).

Chinese tallow is highly fecund, producing seeds as soon as three years after germination (McCormick 2005). Floodwaters are thought to be a major dispersal mechanism of seeds (hydrochory) in periodically flooded habitats (Jubinsky and Anderson 1996), although avian dispersal (ornithochory) is also important and accomplished by a wide variety of bird species (Conway et al. 2002; Renne et al. 2002) in both uplands and bottomlands (Renne et al. 2000). The seeds may remain viable for seven years in storage (Bruce et al. 1997) and large, persistent soil seedbanks often complicate control efforts (Jubinksy and Anderson 1996). Their germination is suppressed by burial under litter and stimulated by increased temperature fluctuations that can result from soil disturbance or canopy removal (Nijjer et al. 2002; Donahue et al. 2004; Donahue et al. 2006). For example, seedbanks have been implicated in the proliferation of Chinese tallow following both natural and artificial canopy disturbances in forests where no individuals had been observed previously (Conner et al. 2002; Williams et al. 2002).

Given the potential importance of bottomland forests as corridors of dispersal of Chinese tallow into newly invaded areas and the occurrence of soil seedbanks as precursors to large increases in Chinese tallow abundance, we sought to quantify seedbank densities of Chinese tallow during concurrent botanical surveys (Bennett 2013) in a bottomland hardwood forest near the species' current northwestern limit in eastern Texas.

METHODS

Study Area

This research was conducted at Texas Parks and Wildlife Department's Old Sabine Bottom Wildlife Management Area (OSBWMA), Smith County, Texas (32°35'24", -95°20'38"), a 2300-ha tract bordering the upper Sabine River in northeastern Texas. Quaternary floodplain soils at OSBWMA are dominated by very firm, medium-acid

clays, while adjacent Pleistocene terraces consist of various friable, acidic silt loams and fine sandy loams (Hatherly 1993). The site contains numerous flats, low ridges, and sloughs which support 50–70 year old second-growth bottomland hardwood forest dominated by willow oak (*Quercus phellos* L.), water oak (*Q. nigra* L.), cedar elm (*Ulmus crassifolia* Nutt.), overcup oak (*Q. lyrata* Walt.), and green ash (*Fraxinus pennsylvanica* Marsh.) (Bennett 2013). Flood-stage water levels in the Sabine channel are often reached for brief periods nearly annually in winter and spring, leaving sloughs and low basins flooded for months, often well into the growing season.

Chinese tallow remains rare at OSBWMA (Bennett 2013), despite the presence of apparently suitable habitats similar to those in bottomland hardwood forests throughout eastern Texas. Only a handful of seedlings and no mature plants have been observed anywhere at OSBMWA by staff biologists in the last eight years (Scott Bosworth, pers. comm.), with similar reports from upstream conservation sites (Cliff Sunda, independent forestry consultant, pers. comm., March 2014). However, mature plants do occur immediately downstream of OSBWMA in disturbed habitats at the Little Sandy National Wildlife Refuge (LSNWR), Wood County, Texas (32°34'57", -95°14'24") (Andrew Bennett, pers. obs.). In 2011, a short but intense 100-year drought affected the region resulting in extensive mortality of canopy trees at OSBWMA and nearby forests, raising concerns for a sudden increase in Chinese tallow germination and establishment if seedbanks were present.

Field Methods

Two soil cores were collected at each of 466 sampling points within a systematic 100-m by 200-m grid coinciding with simultaneous vegetation sampling in summer 2011 and 2012 (Figure 1). The study area encompassed approximately 1000 ha representing a cross-section of the Sabine River floodplain, from riverfront to floodplain-upland interface. Each core was collected by inserting a 3.8-cm diameter PVC pipe to a depth of 10 cm below mineral soil surface (Schneider and Sharitz 1986), yielding an individual core volume of 113.4 cm^3, not including collected leaf litter. Cores were combined for each point and air dried until processed. Upon drying, most cores required mechanical separation, which was accomplished by gently crumbling samples by hand with a mallet, taking care not to destroy any plant material present. Samples were then sorted using a US #10 mesh sieve (~4 mm openings) suitable for retaining Chinese tallow seeds, which average 7–8 mm in diameter (McCormick 2005).

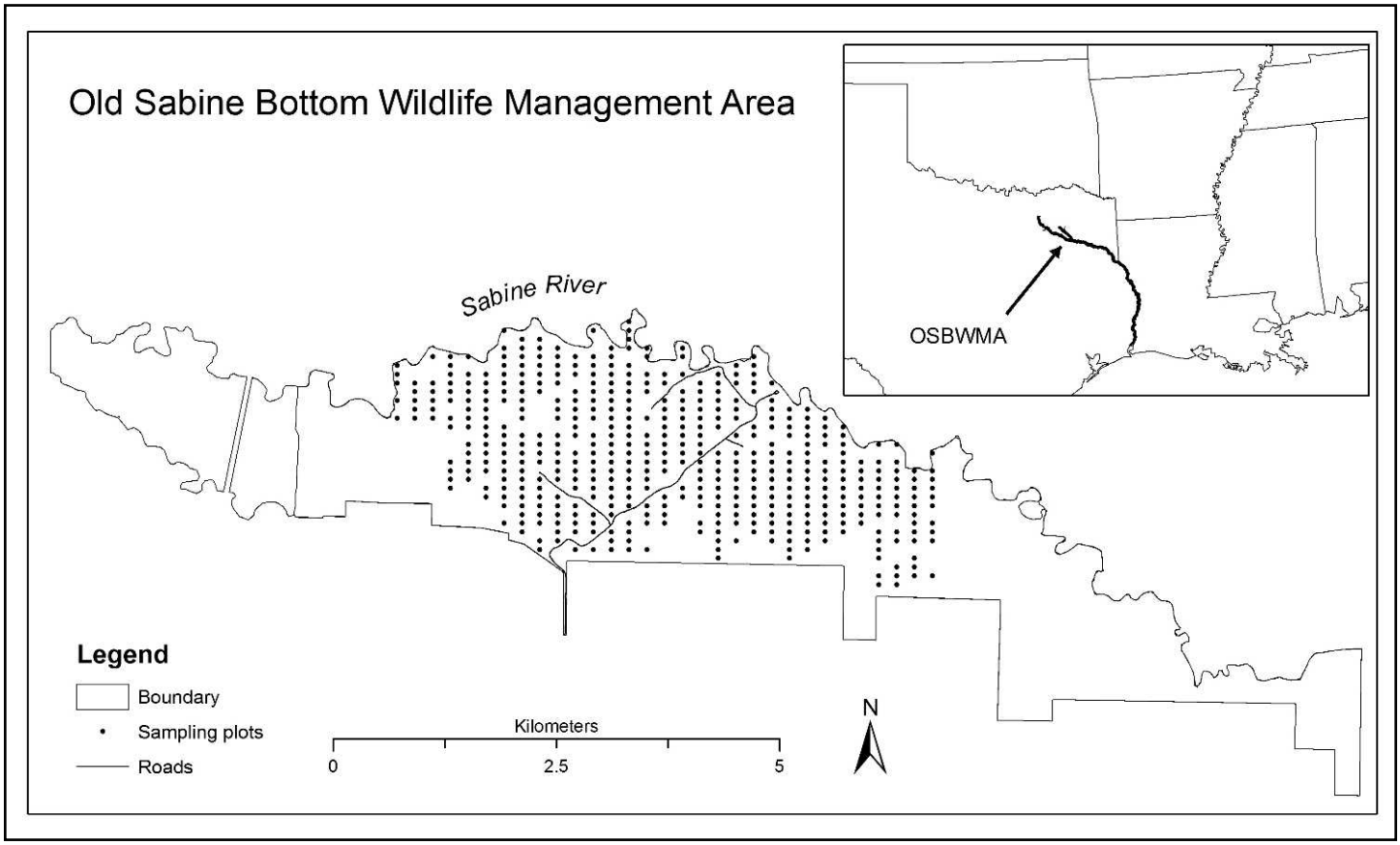

Figure 1. Study site and sampling plot locations in the Old Sabine Bottom Wildlife Management Area, Texas, during 2011–2012.

RESULTS

A total of 832 soil cores were collected, yielding a pooled sample volume of approximately 0.1 m^3. No Chinese tallow seeds were discovered within soil samples. Few other large seeds were found (such as acorns or hickory nuts), although these species generally do not form perennial seedbanks.

DISCUSSION

Our results suggest Chinese tallow has developed little or no seedbank at OSBWMA, supplementing field observations of the near absence of vegetative plants. The occasional discovery of seedlings, including one observed during simultaneous vegetation sampling in 2012, indicates some Chinese tallow seed input does occur at OSBWMA. No other published studies have attempted to quantify seedbank densities of Chinese tallow in bottomland forest, which complicates comparison. However, invaded bottomland forests elsewhere in eastern Texas often contain extensive stands of Chinese tallow seedlings, demonstrating the density with which seed deposition may occur in invaded forests.

Chinese tallow appears to remain regionally rare, despite being pervasive in virtually all riparian systems located south and east of OSBWMA, including downstream portions of the Sabine River. The occurrence of Chinese tallow in isolated populations within the region indicates regional climate and soils are suitable for establishment and growth, and its invasion is likely not limited by habitat availability in these bottomland forests, but rather by limited seed input. The continued low density of surrounding residential development, a historically important source of Chinese tallow where it is planted intentionally, may have spared the upper Sabine floodplain from early invasion. The upstream position of OSBWMA and other local bottomland sites in relation to heavily invaded forests downstream likely continues to limit en masse dispersal of Chinese tallow seeds by floodwaters from those populations; although to date, hydrochory in Chinese tallow remains unquantified.

Other dispersal mechanisms such as ornithochory may be more important contributors to the spread of Chinese tallow within this region. Birds are heavy consumers of Chinese tallow seeds in the southeastern United States, and are efficient local dispersal vectors, increasing seed deposition and germination in favorable habitats (Renne et al. 2000). Moreover, numerous bird species across diverse assemblages utilize Chinese tallow seeds (Conway et al. 2002), an indication of a generalized dispersal syndrome, which likely contributes to the invasiveness of Chinese tallow (Renne et al. 2002). Where Chinese tallow is a recent arrival and occurs at low densities, birds may be especially efficient at dispersing seeds from existing reproductive individuals by seeking out these focal seed sources (Renne et al. 2002). However, due to their relatively limited movements, birds do not likely hold great influence on regional rates of dispersal of Chinese tallow in comparison to potential long-distance dispersal mechanisms like floodwaters (Renne et al. 2002).

The long-term impacts of Chinese tallow invasion in bottomland forests remain somewhat speculative; however, they may prove to be far reaching. For example, Chinese tallow appears to outcompete important native tree species through superior growth or heavy seed production, suggesting major shifts in species composition in the future (Jones and McLeod 1990; Wall and Darwin 1999; Denslow and Battaglia 2002). Because few arthropods directly utilize Chinese tallow in the southeastern United States (Barrow and Renne 2001; Hartley et al. 2010), heavily invaded forests are hypothesized to contain reduced arthropod populations, potentially impacting food availability to breeding and migrating birds (Barrow and Renne 2001). Considering the relative lack of information regarding the nature of Chinese tallow seedbanks in natural settings (potential density, lifespan, distribution), as well as the dispersal mechanisms that may influence these characteristics, the continued monitoring of Chinese tallow establishment and proliferation in previously uninvaded habitats, including the development of soil seedbanks, should remain a research focus.

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Andrew Bennett is a recent graduate with an MS in Forestry and Wildlife Management from Stephen F. Austin State University. His principle career interests include botany and plant ecology.

Warren Conway is currently the Bricker Endowed Chair in Wildlife Management at Texas Tech University, but was a Professor of Wildlife Management at SFASU during this research. He received his BS from the University of Rhode Island, and his MS and PhD from Texas Tech University. Primarily a wildlife ecologist, he has maintained a consistent research focus on exotic invasive plant ecology, control, and management since 1995.

Christopher Comer is an Associate Professor of Wildlife Management at SFASU who received his MS from the Pennsylvania State University and PhD from the University of Georgia. His recent research projects focus on bottomland forest management for non-game wildlife and urban wildlife population dynamics.

Hans Williams serves as Associate Dean and Professor of Forestry at SFASU. He completed his MS in Forestry at Clemson University and PhD at Auburn University and currently specializes in wetland forest delineation, restoration, and functional assessment and physiological response of trees to environmental stresses.

Scott B. Bosworth is a Natural Resource Specialist at the Old Sabine Bottom Wildlife Management Area with the Texas Parks

and Wildlife Department. Scott earned a BS in Biology from Sam Houston State University and an MS in Wildlife and Fisheries Management from West Virginia University. His current research interests include bottomland hardwood forest ecology and management.

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