

Distribution, Dispersal and Ecology of *Sphenoclea zeylanica* (Sphenocleaceae) in North America



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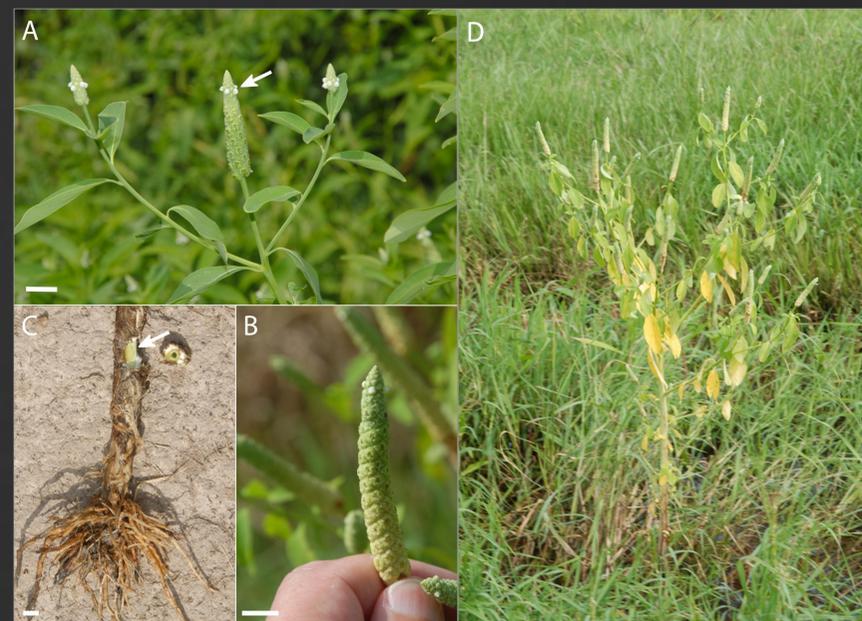
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Introduction

Sphenoclea zeylanica Gaertn. (gooseweed) is native to the Eastern Hemisphere. It is a major pest of rice (*Oryza sativa* L.) and is now distributed widely in tropical, subtropical, and warm temperate regions around the world, inhabiting seasonal wetlands, ditches, stream banks, pond margins, and rice fields (Holm et al 1977). Our purpose is (1) to elucidate the introduction and dispersal of *S. zeylanica* in North America, (2) to explore the relationship between the expansion of rice agriculture and the dispersal and current distribution of *S. zeylanica*, and (3) to describe its habitats and phenology.



Sphenoclea zeylanica: A. Inflorescence habit; flowers (arrow). B. Spike. C. Plant base, showing stem c.s. and portion of stem with spongy cortex removed (arrow). D. Plant habit. Scale bars = 1 cm. Chambers County, Texas (A); Acadia Parish, Louisiana (B-D).

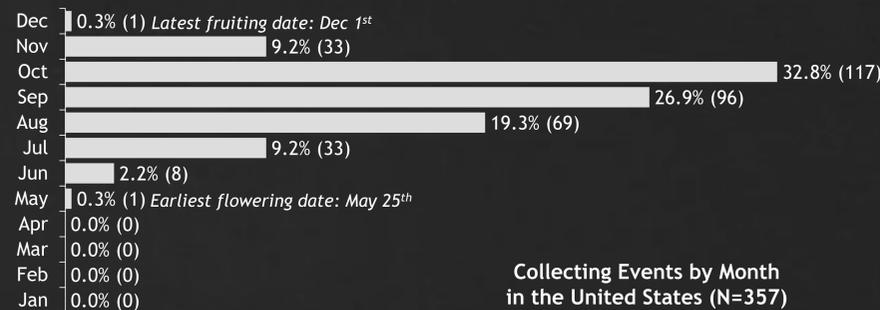
Materials and Methods

More than 600 voucher specimens were examined from the following herbaria: APCR, AUA, BAYLU, BRIT, CLEMS, ECON, FLAS, FSU, GA, GH, HEND, LAF, LAMU, LL, LSU, LSUS, MCN, MISS, MMNS, MO, NCSC, NLU*, NO, NY, ODU, OKL, SAT, SMU, STAR*, TAES, TEX, TROY, UNA, US, USCH, USMS, VDB, VSC (*virtual loan). Morphometric data were taken from specimens to describe the species, and geographical, habitat, and phenological data were transcribed from labels. Field observations, photographs, and additional voucher specimens were made in Louisiana and Texas during summer 2012.

To discern patterns of dispersal, specimen label data were used to map county distributions at 25 year intervals. Data on annual rice production by U.S. county, obtained from USDA (2013), were used to investigate the relationship between distributional and dispersal patterns of *S. zeylanica* and the expansion of rice agriculture.

Acknowledgements. Anne Bradburn (NO) provided assistance interpreting Hale's specimen and granted permission to use a photograph of it. Wendy Zomlefer (GA) made helpful suggestions on a draft of this poster. Imaging of historical specimens was supported by the National Science Foundation (DBI 1054366, R. Carter, PI). The Valdosta State University (VSU) Foundation supported travel for field work, and the VSU Faculty Development Fund and Biology Department supported travel to ASB 2013 in Charleston, WV.

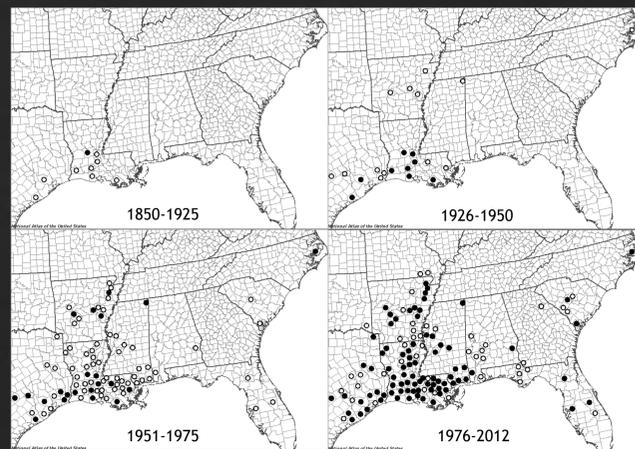
Results



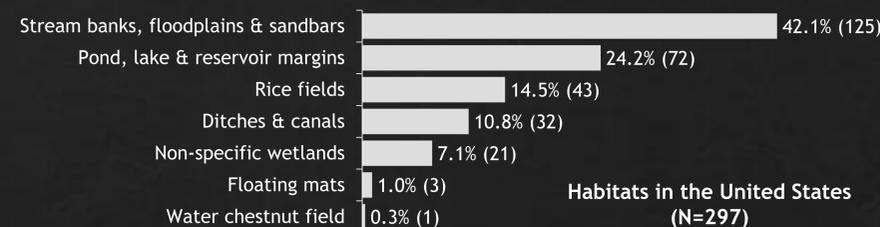
Our data indicate *S. zeylanica* has been in the United States since the mid-1800s; the earliest records are from Louisiana where it was most likely introduced as a contaminant of rice seed. We document the distribution and dispersal of *S. zeylanica* in the United States over the past 150 years, from Louisiana westward into southeastern Texas, northward through Arkansas and into southeastern Missouri, then sporadically eastward into Florida, Georgia and the Carolinas. Its dispersal pattern in the Mid-South appears to be correlated to some extent with rice agriculture.



Earliest herbarium specimen of *Sphenoclea zeylanica* from the United States: Rapides Parish, Louisiana, ca. 1850, J. Hale s.n. (NO).



Range expansion in *Sphenoclea zeylanica* after 1850: symbols represent earliest herbarium voucher from county or parish; closed circles show records at start of period, open circles show records added during period.

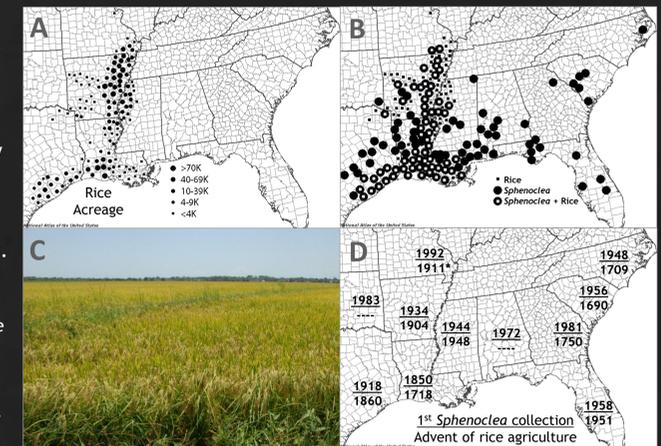


Discussion

The earliest record of *S. zeylanica* in the United States was cited as 1898 (Rossati 1986). Our research revealed specimens at NO and US (probable duplicates at GH, NY), collected in Rapides Parish, Louisiana, by Dr. Josiah Hale. These undated specimens were in Hale's possession before he died in 1856, and, although many of Hale's specimens at NO lack dates, they were most likely collected 1840-1845 (A. Bradburn, pers. comm.; Ewan 1977). Thus, the date of initial detection of *S. zeylanica* in the U.S. is now known to be about 50 years earlier than previously thought.

Rice agriculture was first established in the American Colonies in 1690 in South Carolina and soon spread to Georgia and North Carolina (Smith 1985; Carney 2002); however, the earliest herbarium records of *S. zeylanica* from the Eastern Seaboard date to the mid-1900s. The possibility that *S. zeylanica* was introduced there during the Colonial Period and went undetected is unlikely given (1) the absence of vouchers despite the early history of botanical exploration and (2) the absence of any reference to it by Elliott (1821-1824) in his early flora of South Carolina and Georgia that included 16 citations of plants associated with rice agriculture.

Rice agriculture and *Sphenoclea zeylanica*:
 A. Mean annual rice acreage by county, per USDA statistics 1954-2011. B. Distribution by county of rice agriculture and *S. zeylanica*. C. Habitat, rice field, Chambers County, Texas. D. Advent by state of *S. zeylanica* and rice agriculture (*pre-1973 acreage only 3-6K/yr; Anon. 2004, Babineaux 1967, Carney 2002, Dethloff 2013, Gates 2005, Green 1953, Miller et al. 2008, Smith 1985).



It is likely *S. zeylanica* was introduced as a contaminant of rice seed well before its detection in the mid-1800s. It is now well established in the southeastern United States. Its dispersal is related, at least in part, to the postbellum expansion of rice agriculture in the Mid-South, and its occurrence in a variety of wetland habitats implicates other dispersal agents, e.g., waterfowl, human activities such as dredging and road construction.

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