

Tucson's lost wetland plant species: where are they now?

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INTRODUCTION

By some estimates, up to 90% of riparian vegetation in the deserts of the U.S. Southwest has been transformed in the last two centuries by factors including erosion, land use, hydrological change, and species invasions (Dahl 1990). The river valleys of the Tucson Basin in southern Arizona were once home to rich riparian ecosystems. Nearly 400 plant species were documented in these bottomlands in the period 1855-1920 (Mauz 2006). One-third of those were plants usually or always allied with wetland habitats (Reed 1988). Near the close of the nineteenth century, channel erosion on the Santa Cruz River and Rillito Creek initiated a cycle that, combined with ongoing hydrological manipulation and urban growth, destroyed these bottomland vegetation communities and contributed to local species extirpation. These losses not only had consequences for regional wetland species geography, but constitute an imperative for conservation of populations elsewhere that serve as ecosystem and genetic resources.

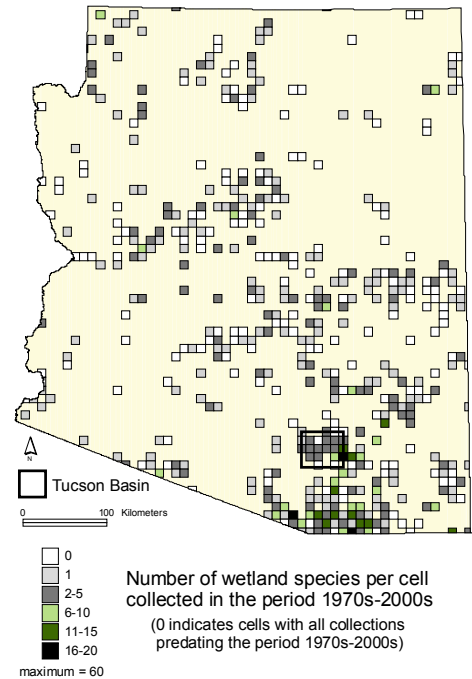
OBJECTIVES

This study aimed to identify the landscapes in which plant species that once grew in the Tucson Basin have been found in Arizona, and to reveal gaps in voucher-based documentation of species presence in these environments.

DATA & METHODS

Database records were extracted for specimens at the University of Arizona Herbarium (ARIZ) of the 60 obligate wetland vascular plant species found historically in the Tucson Basin. Duplicate records were eliminated, and geolocation was evaluated (corrected when necessary) in a digital topographic map environment for 2173 qualifying records. Plant species presence and number of species were tabulated for 10-km x 10-km cells across Arizona for the period 1900-2005.

Analyses of vertical distributions were based upon the elevation of the cell center associated with each record, derived from a 10-m digital elevation model (dataset: USGS National Elevation Dataset, gisdata.usgs.gov/ned, 2002). Geographic distribution was summarized by the sub-regional watershed (Seaber et al. 1987) associated with the cell center (dataset: USGS Hydrologic Unit Boundaries, National Atlas, nationalatlas.gov/metadata/hucs00m020.faq.html, 2005). Local ecological association was summarized by biotic community (Brown and Lowe 1980) associated with the cell center (dataset: Biotic Communities of the Southwest, Nature Conservancy of Arizona, www.azconservation.org/blp.htm, 2004).



FINDINGS

Tucson's 60 historic obligate wetland plant species have been documented in 16% of the 3096 10-km x 10-km grid cells in Arizona over the period of record. Species were collected in from 1 to 109 cells each, yet 57% of them were found in fewer than 20 cells. These species were collected up to 14 times per cell, but 77% of species-cell associations are the result of just one collection in the span of 105 years. The highest values of cell-level species richness were in the southeastern part of the state. For the period 1970-2005, richness ranged from 1 to 19 species per cell (see figure above). Herbarium collections for the period 1970-2005 failed to document five species in Arizona that had been collected prior to this era.

Species in this analysis have been collected at elevations often significantly higher, on average (95% c.i. for the mean = 1250-1362 m), than the formerly rich bottomlands of the Tucson Basin (650-950 m). This pattern reflects, in particular, species occurrences in the semi-desert grasslands and Madrean mountain ranges of southeastern Arizona, and in the drainages of the Mogollon Rim in central Arizona – regions that experience lower high temperatures and greater rainfall than the low deserts or the Colorado Plateau.

Collection locations of obligate wetland plant species are associated with major drainages, headwaters, and isolated oases, and are represented disproportionately across the major watersheds in the state. Specimens were collected in more cells than would be expected in the Salt River and Middle Gila River watersheds, and fewer than would be expected in the watersheds of the Colorado River and the Upper and Lower Gila River. Similarly, although specimens for these species are represented from all of the major biotic communities in Arizona, collection locations are more often associated with montane forest, chaparral, upland Sonoran Desert, and semidesert grassland than would be expected for the state.

DISCUSSION

It is well known that herbarium collections reflect the accumulated effort of many individuals over time, and stem from a range of field activities (Ponder et al. 2001), as well as variation in collection activity over time (Prather et al. 2004). At a minimum, the findings of this study reflect a combination of the spatiotemporal pattern of wetland plant collection in Arizona during the twentieth century, and the geographic ranges of the plant species analyzed. Just over half of the specimens considered here were collected in the last 35 years. Importantly, the patterns illustrated here for 10-km x 10-km cells are temporally aggregated, and it is the case that for any narrower slice of time (a decade or a year, for example) there are few records for any of these species across the state.

Several partial or comprehensive local floristic inventories have been published for riparian and wetland ecosystems in Arizona in the last 35 years. In most cases, voucher specimens were prepared as part of these efforts, although it is possible that ARIZ does not hold complete sets for work conducted by investigators from other institutions. Published lists for these environments might supply additional detail regarding plant species presence, however voucher specimens are the most reliable means for evaluating plant identity long after the field studies have been completed (Goldblatt et al. 1992). While statewide collections are substantial and invaluable records of wetland biodiversity, in no way do they constitute a 'snapshot' of species presence in Arizona. Temporal and spatial limitations have indicated a clear analytical need for more systematic, and current, sampling – and vouchering – of wetland plant species in the state, as well as in neighboring regions.

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