

Geographic Distribution of *Coryphantha robustispina* ssp. *robustispina* (Pima Pineapple Cactus) and *Echinomastus erectocentrus* var. *erectocentrus* (Needle-spined Pineapple Cactus) within the City of Tucson HCP planning area.

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Abstract

A survey was conducted to estimate the geographic distribution and relative densities of *Coryphantha robustispina* ssp. *robustispina* and *Echinomastus erectocentrus* var. *erectocentrus* within the City of Tucson HCP Planning Area. Direct data from transects and incidental data from vehicle tracts indicated only a fair level of successful prediction for the occurrence of *C. robustispina* ssp. *robustispina* individuals. Revised polygons of potential habitat represented 46% of the total area within the Planning Area. No individuals of *C. robustispina* ssp. *robustispina* were recorded within the greater northeastern portion of the Planning Area. It was postulated that occurrences of individuals of *C. robustispina* ssp. *robustispina* are determined more by the available seed bank than by local variations in habitat. Individuals of *Echinomastus erectocentrus* var. *erectocentrus* appear restricted to the far eastern edge of the Planning Area.

Introduction:

The primary objective of this study was to estimate the geographic distribution and relative densities of *Coryphantha robustispina* ssp. *robustispina* and *Echinomastus erectocentrus* var. *erectocentrus* within the City of Tucson HCP Planning Area (13856h, 33947a, 53mi²). Although most of the planning area was known to fall within the geographic distribution of *C. robustispina* ssp. *robustispina* and a small portion within that of *E. erectocentrus* var. *erectocentrus*, little was known concerning the specific distribution and abundance of individuals of either taxon. According to the Arizona Game and Fish Heritage Data Base only four individuals of *C. robustispina* ssp. *robustispina* had been recorded within the Planning Area, even though two rather dense populations occurred adjacent to it. Recently Baker (2005) recorded an additional 66 individuals within 88.8km of vehicle transects and 96.0km of pedestrian transects, a maximum coverage of 2.7% of the total Planning Area. Coverage was based on a rather optimistic assumption that all individuals were recorded within an average of 10m either side of transects.

Methods:

Polygons of likely occurrence for *Coryphantha robustispina* ssp. *robustispina* were made based on known occurrences and with the aid of photo-orthoquads.

Known occurrences were taken from the Arizona Game and Fish Heritage Data Base and from Baker (2005). Polygons, which represented 34% to the Planning Area, were drawn based on similarity of habitat to occupied sites, including apparent density of vegetation, topographic features, and substrate color. The accuracy of the polygons was then tested by comparing 40 field survey transects within the polygons to 40 transects outside of the polygons. For most transects, an attempt was made to pair within polygon transects with outside polygon transects. Transects averaged slightly more than 1km in length with an average width, at best, of approximately 20m.

Transects began at a single point and meandered in a loop back to the point of origin. Garmin® GPS units were used to facilitate orientation and to record the actual locations (tracks) of transects. The design was intended to maximize the chance of locating populations and to record data for the comparison of plant densities across trials, but was not intended to survey for 100% of individuals within each transect.

For the estimate of distribution and abundance of *Echinomastus erectocentrus* var. *erectocentrus*, 67.7km of pedestrian transects were conducted within areas suspected to fall within the estimated overall distribution of *Echinomastus erectocentrus* var. *erectocentrus*. The estimated overall distribution of *E. erectocentrus* var. *erectocentrus* was provided to the author as an Arcview® shapefile by Clint Chiavarini of the City of Tucson.

Vehicle routes taken during the present study were also recorded as GPS tracts and all individuals of either taxon seen from the vehicle were recorded. Individuals were recorded as a GPS point (waypoint) using UTM coordinates (NAD27, zone 12). Location data for transects, vehicular tracts, and individuals were downloaded to create Arcview® shape files.

Results

A total of 92 newly recorded individuals of *Coryphantha robustispina* ssp. *robustispina* documented during the course of the present study (Table 1). Thirty five individuals were recorded along transects, 19 along vehicle tracts, and 38 along pedestrian routes primarily associated with *Echinomastus* surveys. Of the 35 individuals recorded along transects, 30 (86%) occurred within predicted habitat, the remainder five (14%) occurring outside of predicted habitat. Similarly, of the 19 individuals recorded along vehicle routes, 16 (84%) occurred within predicted habitat and three (16%) occurred outside. A greater percentage (37%) of individuals recorded along other pedestrian routes occurred outside of predicted habitat. All individuals with the exception of two (360m, 660m) were within 300m of predicted habitat.

Density of individuals along transects was one in 5.1h. GPS tracts recorded a total of 88.6km for the 40 transects. Using the assumption of an average effective transect width of 20m, the number of hectares surveyed was $88.6\text{km} \times 1000\text{m}/\text{km} \times 20\text{m} \div 10000\text{m}^2/\text{h} = 177.2\text{h}$. Seven individuals were recorded along the estimated 35.7km of previously unsurveyed vehicle routes of the present study. The remaining twelve of the 19 individuals were recorded along routes traveled in an April 2005 survey (Baker 2005). Using an assumption that the effective survey width was 10m on

either side of the road, the density of individuals along new vehicle routes was one in 10.2h. According to unpublished data from the Heritage Data Management System, AZ Game and Fish Department, Phoenix, AZ, the average density for individuals of the taxon is one in 1.6ha (4a).

Table 1. Numbers of individuals of <i>Coryphantha robustispina</i> ssp. <i>robustispina</i> recorded during present study within transects, along vehicle routes and other pedestrian routes. Total individuals 92.					
No. inds. along transects		No. inds. along vehicle tracts		No. inds. along other pedestrian routes	
predicted	not predicted	predicted	not predicted	predicted	not predicted
30(86%)	5(14%)	16(84%)	3(16%)	24(63%)	14(37%)

Eight individuals of *Echinomastus erectocentrus* var. *erectocentrus* were recorded within an area of approximately 2h at the far eastern edge of the Planning Area.

Discussion and conclusions

Direct data from transects and incidental data from vehicle tracts indicated a fair level of prediction for *Coryphantha robustispina* ssp. *robustispina* habitat. Incidental records of *C. robustispina* ssp. *robustispina* along *Echinomastus* transects indicated a poor level of prediction in the southeastern portion of the Planning Area. Inversely, no individuals were recorded within polygons of potential habitat in the greater northeastern area, an area where no individuals were recorded in April 2005 (Baker 2005). Based on data from the new surveys, an additional 1763h of polygons were added to the original 4682h of potential habitat. The revised total (6356h) represents 46% of the total area within the Planning Area (Fig. 1).

These data suggest that, within small geographic areas, habit of greater potential can be successfully defined but that defining areas of occurrence is more difficult and that the likelihood of occurrence increases dramatically near other occurrences. For this reason, areas representing a radius of 500m are presented in Fig. 1. The 500m radius is arbitrary and is given solely for heuristic and planning purposes. Perhaps the most important inference is that occurrences of individuals are determined much more by the available seed bank than by differences in values of habitat parameters. Within areas of known occurrence, it can be assumed that individuals are absent, or the potential of occurrence is extremely low, only in areas of dense vegetation along streams. Inversely, it appears that, in spite of apparently suitable habitat, there are probably no significant populations of individuals within the greater northeastern portion of the Planning Area.

Individuals of *Echinomastus erectocentrus* var. *erectocentrus* are apparently restricted to the far eastern edge of the Planning Area (Fig. 2). Populations of *E. erectocentrus* var. *erectocentrus* generally occur in aggregations and thus the chance of a single individual occurring in the larger survey area to the southeast is small. In

any case, any such occurrence would be insignificant with respect to the conservation biology of the taxon. With respect to the far eastern edge, surveys were not intended to cover the possible habitat at a rate of 100% and, thus, additional individuals are likely. Although the habitat beyond the recorded individuals did not appear suitable, there remains the possibility of suitable habitat within a few hundred meters.

Literature cited

Baker, M. 2005. Geographic distribution and DNA analysis of *Coryphantha robustispina* ssp. *robustispina*, part 1: geographic distribution. Report to the Arizona Department of Game and Fish, Phoenix, Arizona.

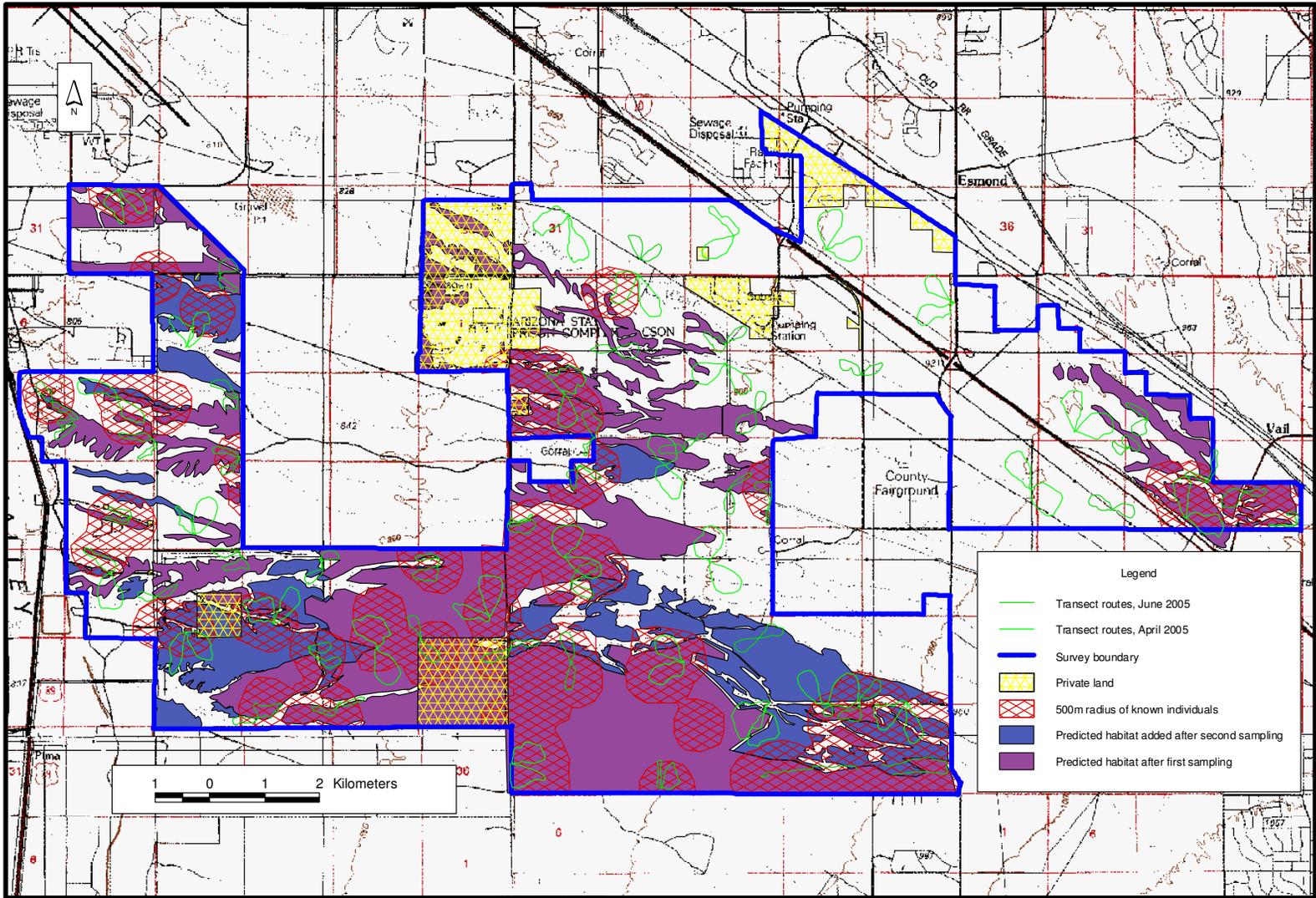


Figure 1. Original and revised polygons of predicted occurrence for *Coryphantha robustispina ssp. robustispina*, transect tracts, and areas within 500m of recorded individuals.

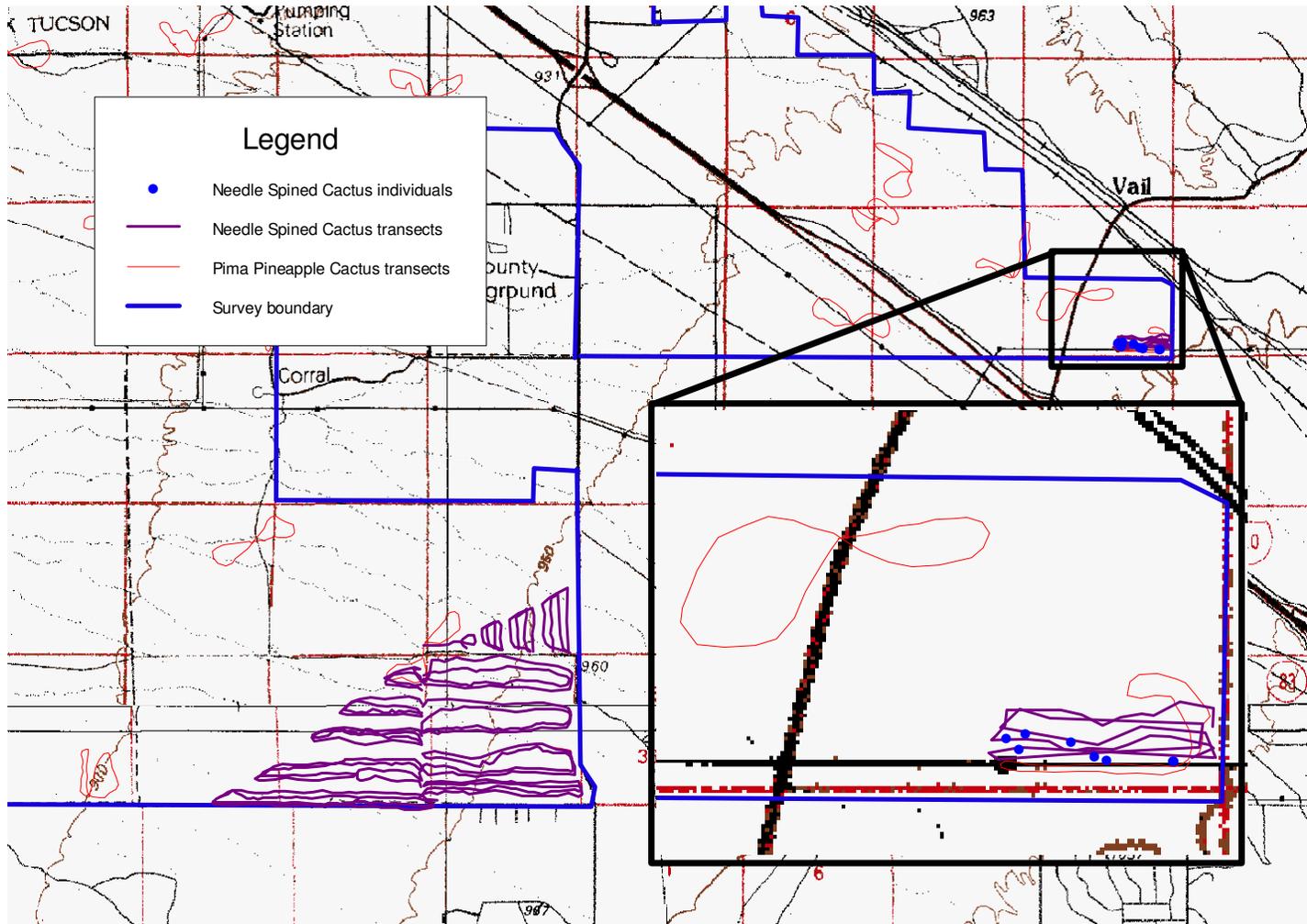


Figure 2. Locations of survey transects for and individuals of *Echinomastus erectocentrus* var. *erectocentrus* within the planning area.