PIMA PINEAPPLE CACTUS RECOMMENDED SURVEY PROTOCOL
3 TIER SURVEY METHODS
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To survey for Pima pineapple cactus (PPC) a specific area should be delineated using clear and accessible boundaries to serve as a perimeter from which to establish belt transects across identified potential habitat. Transects shall be placed across the area by determining the shortest distance between the perimeter boundaries. Coverage or passes ran across each transect can be ran in any direction to achieve the above distance requirement. The number of people conducting the survey can vary. However, a single person should be responsible for covering approximately 4 to 6m, except persons on the edge who shall cover approximately 2m. Each lateral boundary of an entire transect can be marked with pin flags or flagging. One edge person can distribute flags of flagging to designate a transect boundary and the other edge person can pick up the previous transect's flags or flagging (Reichenbacher 1990, Roller 1996).

Therefore, if 5 people ran a transect it would be 16 – 24 m in width.

3 X 4 = 12 m	3 X 6 = 18 m
2 X 2 = 4 m	2 X 3 = 6 m
16 m	24 m

Typically, one transect coverage or passage with a crew of 5 people, surveying for 5 hours a day have covered 160 acres or 65 ha in 2 days; repeating each transect would take 4 days.

The particular methodology described above has been used to cover 100% of an area. However, it is highly unlikely that all individuals are found running one coverage or passage across a transect. During a PPC salvage project directed to relocate cacti from a private residential land development; the standard search was conducted by repeating coverage or passages across transects. The objective was to completely remove all PPC from the land area. Repeated searches were run from varied directions to search at different light angles. After the third search we were still finding up to 100% as many plants as were found initially. No individual PPC were found on the seventh search.

Preliminary surveys document PPC as not occupying drainage bottoms or steep slopes (Philips et al. 1981, Mills 1991, Ecosphere Environmental Services Inc. 1992). Drainage bottoms comprised of sandy soils or steep, rocky slopes greater than 10% do not have to be surveyed. The delineation of specific land areas which do not appear to be potential habitat can be determined with the assistance of the U.S. Fish and Wildlife Service.

PPC are well camouflaged within their micro-habitat and general habitat characteristics vary across the taxon's range. The thorough, 50 m^2 surveys found no young individuals and very few older, dying adults in dense Lehmann lovegrass (*Eragrostis lehmanniana*)

stands which were comprised of >70% foliar coverage. PPC generally occupy open patches, on the tops of alluvial bajadas with <10% slope in moderately deep, sandy loam soils which are often defined as the white-house sandy loam series of the Sonoran desertscrub and desert grassland vegetation types. Healthier PPC populations supporting higher densities, reproduction and greater plant vigor have been characterized in plant communities comprised of mid-sized mesquite trees, half-shrubs, native bunch grasses and scattered succulent species. To increase the probability of effectively finding all PPC within a given area, we recommend repeating the coverage or passages across a transect until 25% of total number of individuals found on the first coverage or passage are surveyed within the healthier PPC habitat described above.

Upon finding an individual a casual search of the local area which involves approximately a 20 m radius area around it should be conducted to find additional PPC. Sub-adults or small individuals representing younger age classes of PPC should be intensively searched, due to the level of difficulty finding these size classes. Therefore, a random sample of 10 to 20% of the total number of surveyed individuals should be taken to thoroughly search, at ground level, a 50 m^2 area around adults for seedlings.

In summary the three tier survey protocol for PPC entails three general parts which are all defined above:

1) General short distance transects which entail repeated coverage or passages,
2) Local area searches associated with all surveyed individuals, and
3) Intensive searches within 50 m^2 random sample of individuals.

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