PROJECT PREPROPOSAL

For

Methodology for locating new precipitation stations to evaluate climate conditions for Desert Tortoise critical habitats

By

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SUMMARY

This proposal provides a method for analyzing existing precipitation data for Desert Tortoise critical habitats. The proposed work will provide maps of precipitation and estimation variance, which is used to determine the optimal location for addition precipitation stations to reduce the overall uncertainty in precipitation estimate for the critical habitats. Depending on the specified need precipitation station locations would be identified to provide the maximum reduction in estimation uncertainty of precipitation for average annual, winter (October through March)/summer (April through September) or average annual and winter/summer.

BACKGROUND

In the desert, precipitation plays a major role in evaluation of habitat and changing dynamics of desert ecosystems. Climate cycles over the last 100 years in the desert southwest are related to the pacific decadal oscillations (PDO) and El Niño and La Niña events (Schmidt and Webb, 2001). Of particular concern are reports that the southwestern United States might experience a shift from relatively wet to dry conditions during the next couple of decades (see PDO in the Press – News Items, http://topex-www.jpl.nasa.gov/science/pdo.html). These climate cycles bring deviations from long precipitation norms on a monthly and annual basis. Adequate characterization of these cycles and the current conditions in specific areas can only be determined with historical data and current data collected at precipitation stations in close proximately to the area of interest or through spatial interpolation. We are proposing an analysis of all existing and

historic precipitation stations to determine the climatic conditions that exist within the critical habitats of concern (Figure 1) and an analysis of the uncertainty associated with the interpolation. In addition, we are proposing an analysis of the spatial structure of monthly, seasonal, and yearly precipitation to optimize the selection of additional sites for precipitation stations to reduce the uncertainty in precipitation estimates for the critical habitats.

METHODS

The National Weather Service maintains a record of current and historic data for the desert southwest at the National Climatic Data Center (NCDC). A series of stations has been identified that have historically or currently exist with the study area (Figure 2). There are additional stations exist that are not part of the NCDC data set, including the Nevada Test Site, USGS, China Lake and Fort Irwin. For the analysis of precipitation within the region, all precipitation data available would be evaluated to determine the spatial structure of precipitation within the critical habitat area. Multivariate geostatistical methods of analyzing precipitation, such as kriging and cokriging (Hevesi and other, 1992a,b), provide the best first approach for analyzing precipitation distributions and optimizing the locations of addition precipitation stations. This method combines the spatial structure of precipitation with the spatial structure of topography and cross-correlates the two to provide a map of precipitation and a map of the estimation variance (or uncertainty) in the precipitation estimate. The variance maps indicate the location where the most information would be gained by adding a single precipitation gage. Additional analysis can be used to further reduce the uncertainty of the precipitation estimate by adding multiple precipitation stations. Overall estimates of uncertainty can be reduced with additional precipitation gages but each additional precipitation gage has a reduced impact on the overall uncertainty and at a certain point additional precipitation gages are not cost effective.

Optimization of a precipitation network by adding additional precipitation gages to an existing network may require a variety of solutions, depending on the precipitation estimate required. For example improving the estimation of average annual precipitation is a relatively straightforward process and can be achieve using existing techniques (Hevesi, and others, 1992a,b). Other analysis should be considered depending on the specific need of precipitation estimation. Seasonal analysis may be a more important component to ecosystem analysis. For example most plants with C3 photosynthetic pathways, such as woody vegetation, respond strongly to winter precipitation; while those with C4 photosynthetic pathways, many grasses and most chenopods, respond to summer precipitation. The habitat consideration may dictate enhancing the estimation of summer, winter or both rather than simply average annual. This proposal addresses these major choices; average annual, winter/summer, or both average annual and winter/summer. Although not specifically addressed as part of this proposal an advanced analysis could be developed to optimize network of precipitation gages for a negative PDO El Niño/La Niña climate regime, which is the most likely regime for the next 10 to 20 years.

STUDY APPROACH AND COSTS

This proposal provides three options to estimate the location of additional precipitation stations. Consultation with biological experts is required to determine which option is most viable to evaluate climate conditions most critical to Desert Tortoise habitats. A brief description of the different options and cost are presented below.

1) Average Annual—Provide an analysis of average annual precipitation for the Desert Tortoise critical habitats and determine the optimal practical location for 5 additional precipitation stations.

2) Winter/Summer—Provide an analysis of winter and summer precipitation for the Desert Tortoise critical habitats and determine the optimal practical location for 5 additional precipitation stations for winter and the 5 locations for summer.

3) Average Annual and Winter/Summer—Provide an analysis of average annual precipitation, winter and summer the Desert Tortoise critical habitats and determine the optimal practical location for 5 additional precipitation stations for average annual, winter and summer precipitation (this includes both options 1 and 2).

Personnel	Average Annual	Winter/Summer	Average Annual and Winter/Summer
Project Chief	2 weeks	4 weeks	5 weeks
Modeler	2 weeks	4 weeks	5 weeks
Data Analyst	4 weeks	8 weeks	9 weeks

Option	Personnel	Misc. expenses	Total
1)	$23,478	$500	$23,978
2)	$46,915	$500	$47,415
3)	$56,601	$500	$57,101

REFERENCES

Hevesi, J.A., Istok, J.D., and Flint, A.L., 1992a, Precipitation estimation in mountainous terrain using multivariate geostatistics: 1. Structural Analysis: Journal of Applied Meteorology, 31(7) 661-676.

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Schmidt, K.M. and Webb, R.H., 2001, Researchers consider U.S. Southwest's Response to warmer, drier conditions, *Eos*, Transactions, American Geophysical Union, Vol. 82 No. 41, October 9, 2001, Pages 475, 478.

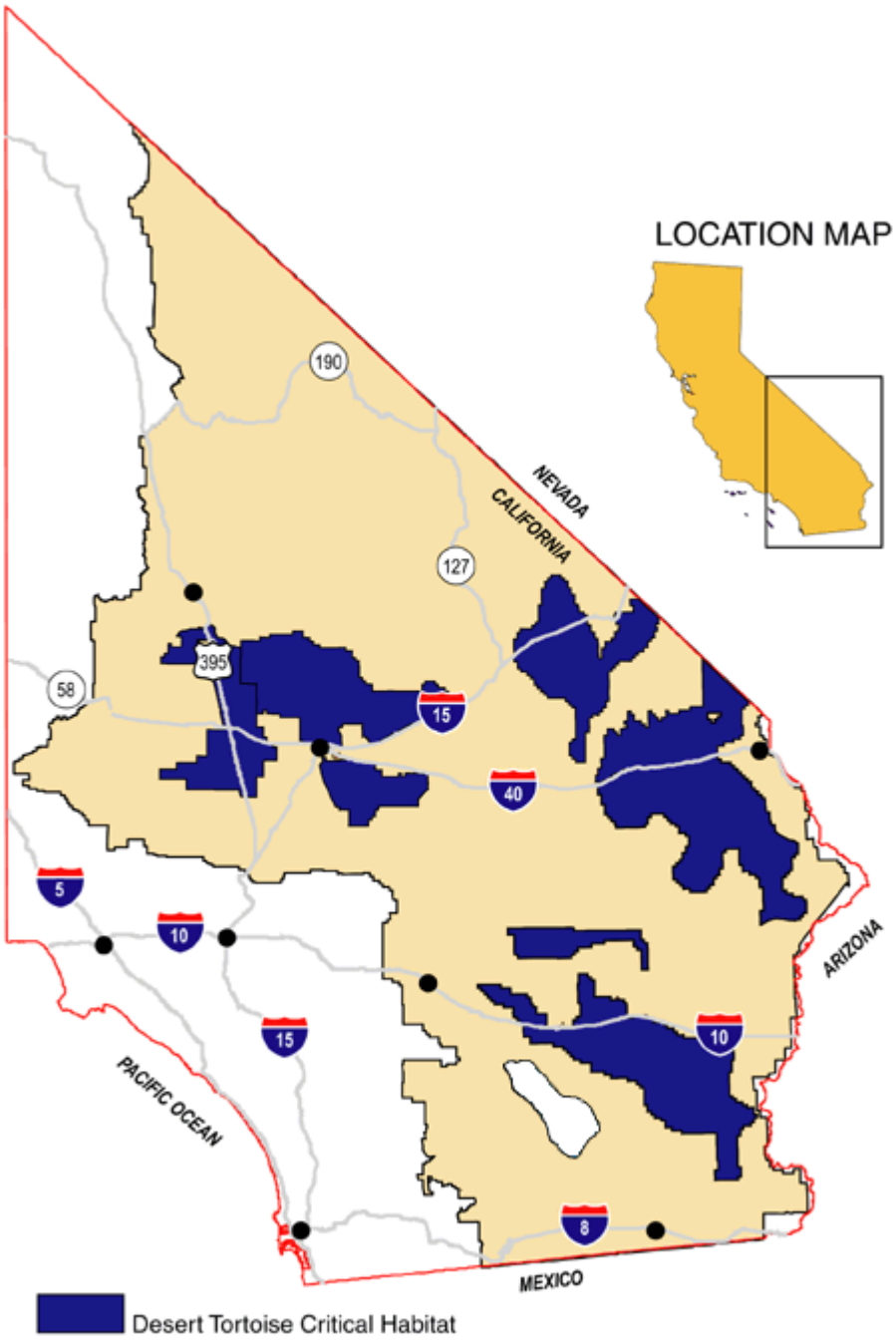

Figure 1 Location of Desert Tortoise critical habitat in southern California.

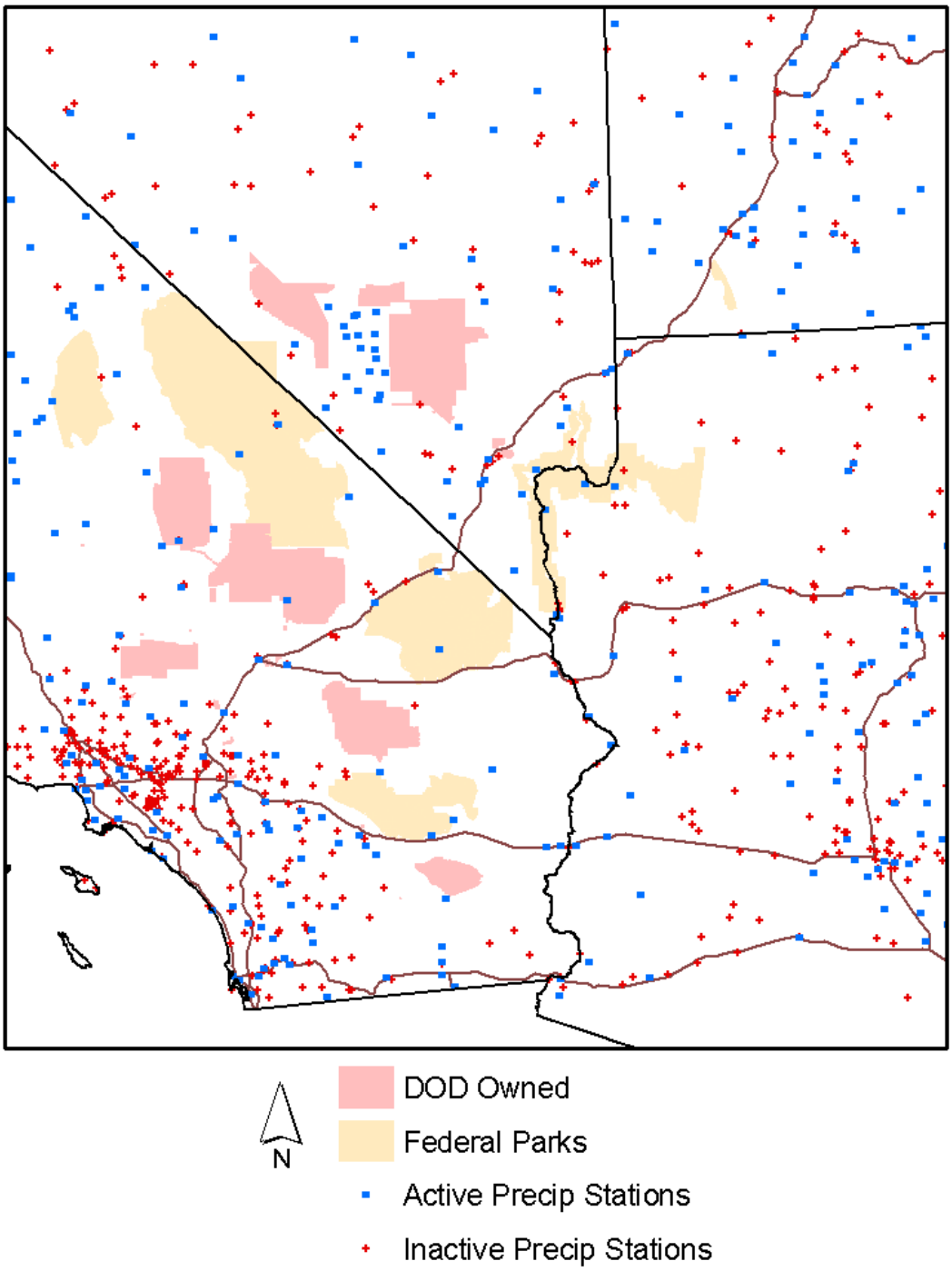

Figure 2. Location of historical or current precipitation stations in proximity to the Desert Tortoise critical habitat.