U.S. Fish and Wildlife Service
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Desert Tortoise Science Advisory Committee Meeting
Meeting Summary
June 11-12, 2007
Las Vegas, NV

Meeting Goals and Objectives

- Refine disease management and research recommendations
- Review status and direction of range-wide monitoring, including future integration with revised recovery criteria

Attendees

Linda Allison, DTRO	Bob Williams, FWS	Bob Steidl, SAC
Roy Averill-Murray, DTRO	Kristin Berry, SAC	Richard Tracy, SAC
Kim Field, DTRO	Peter Hudson, SAC	Ken Hunter, UNR
Jody Fraser, DTRO	Katherine Ralls, SAC	Fran Sandmeier, UNR
Janet Bair, FWS	Michael Reed, SAC	Mary Brown, U. of Florida

Meeting Summary

1. Disease overview

Peter outlined the overarching knowledge and information gaps based on discussion at the last couple of SAC meetings. The most parsimonious explanation for infectious URTD in desert tortoises is that external stressors contribute to susceptibility to mycoplasmosis. We need to understand epidemics and diagnostic tests to identify spreaders (individual tortoises actively transmitting pathogens). We need a model of who is infectious and who is being exposed in a population. Debates over the historical evolution or introduction of *Mycoplasma* are not significantly important relative to the current situation. The objectives of the meeting are to review the current status of knowledge and ongoing research, develop specific management recommendations based on this knowledge, and identify research priorities to advance the state of knowledge to the point of improving management recommendations.

Ken Hunter presented results of ongoing research on the development of a polyclonal antibody-based ELISA for *Mycoplasma agassizii* and the identification of natural antibodies. In the course of developing a new ELISA for *M. agassizii*, his research group found anti-mycoplasma antibodies in plasma samples from a cohort of desert tortoises that were reared from egg to adult entirely in the laboratory where they had never been exposed to *Mycoplasma*. In most cases, the antibody titers in these animals were as high or higher than those seen in plasma samples from tortoises presumed to be infected with *M. agassizii*. Western blot analysis of plasma from these tortoises revealed the presence of antibodies to as many as 15 *M. agassizii* proteins. Some ELISA+ plasma samples from tortoises presumed to have been infected with *M. agassizii* had distinguishable Western blot patterns. These data indicate that the desert tortoise has natural antibodies to *M. agassizii* antigens and suggest that these natural antibodies may confound the identification of infected desert tortoises by ELISA. In order to confirm these results, medium controls (i.e., eliminate the possibility of cross-reaction/identification of non-*Mycoplasma*

proteins) and positive controls (i.e., comparison of results with known infected individuals) should be evaluated. Mary Brown offered to share known positive sera for the latter purpose.

Mary Brown presented an overview of the diagnostics and epidemiology of mycoplasmal URTD based on research from gopher tortoises in Florida and desert tortoises in California. URTD can be caused by *Mycoplasma agassizii* and *M. testudineum*, both infectious bacteria, as well as the non-infectious *Acholeplasma* sp. (which is generally considered commensal, rather than pathogenic) and other pathogens such as iridovirus, herpesvirus, and possibly fungal organisms. Improvements in the monoclonal *M. agassizii* ELISA have resulted in assay sensitivity of 0.98, a specificity of 0.99, and an overall 98% capacity to differentiate between cases and controls. Time-series studies of several gopher tortoise populations have revealed patterns ranging from populations free of disease; to populations experiencing increasing seroconversion, acute infection, and mortality; to populations with chronic infections. These studies have also shown low numbers of seropositive juvenile tortoises except in very high seropositive populations. Juvenile tortoises typically do not shed the disease compared to sexually mature individuals. Noticeably sick (infectious with nasal discharge) juveniles may also be more difficult to observe because they die more quickly; if so, they would pose little transmission risk due to this fact. Adult males are more likely to be ELISA+ than adult females and appear to seroconvert earlier and at smaller sizes.

2. Disease subgroup (Peter Hudson, Kristin Berry, Ken Hunter, Mary Brown, Dick Tracy, Fran Sandmeier, Kim Field, Bob Williams, Janet Bair)

The disease subgroup's discussion focused on formulating recommendations pursuant to tortoises in captivity (both in formal holding facilities and those kept as pets), head-starting and translocation programs, wild populations, and key research to implement. The group agreed that mycoplasmosis is only one of several diseases of interest, yet by continuing to build upon current knowledge of this disease a good model will be developed from which to learn about other diseases. Discussion points included the need to reduce occurrences of tortoises being released to the wild by the public; development of protocols for disease screening at holding facilities and subsequent placement of tortoises into programs to benefit recovery; monitoring and management of disease in natural populations; and development of research programs to investigate disease detection methods, natural immunity, chemotherapy and other treatments, transmission rates, demographic effects, and other key topics that will help to elucidate options for tortoise conservation. Changes in current disease protocols will be realized most immediately in captive facilities, while targeted research will help to guide future recommendations for wild populations. Annually, the status of knowledge will be assessed, and protocols and research will be adjusted accordingly. The group will continue to revise a white paper, initiated at a prior SAC meeting, which will include specific recommendations to incorporate into the recovery plan.

Action Item: Peter will edit the white paper and circulate for further comment among the SAC, Mary, and Ken.

3. Research-brainstorming subgroup (Katherine Ralls, Michael Reed, Bob Steidl, Linda Allison, Roy Averill-Murray, Jody Fraser)

This subgroup noted that the threats diagram in the recovery plan assessment has outlived its heuristic value and offers little guidance in determining or choosing between management options for desert tortoise recovery. As mentioned at previous meetings, one recommendation to improve our understanding of the effects of various threats on desert tortoise populations is to

model the threats network with path analysis or similar methods and identify critical nodes. At the same time, applied research is needed to identify the effects of individual or suites of threats and remedial management actions. Exotic, invasive plant eradication should be a particular area of emphasis. More generally, we need better quantification of threats across the landscape. Remote sensing or other GIS analysis would be beneficial to track changes in absolute habitat loss through urbanization or habitat degradation by fires. With a landscape perspective, we can correlate patterns of threats over time with patterns in tortoise demography or distribution. Studying most individual threats/management actions in isolation from other possible threats/actions is unfeasible. However, we need to identify topics that can be studied experimentally. For example, research on demographic study areas can be targeted to specific suites of threats and management, such as that involving OHVs or roads.

4. Status and direction of range-wide monitoring

Linda presented an overview of the range-wide monitoring program, focusing on several particular areas, as described below.

Counting tortoises—Emphasis needs to be placed on issues in bias resulting from crew technique (e.g., variability between crews in P_a) and location of transects (e.g., the need to stratify within the current strata or propose alternative monitoring in these areas).

Precision—Power considerations discussed in the 1996 white paper by Anderson and Burnham, which initially outlined a distance-sampling monitoring program for the desert tortoise, focused on detecting trends as low as 1% per year over 25 years. Dick commented that the 1994 Recovery Plan identified a “normal” population growth rate of 0.5% annually, while an average rate of 1% per year might be achieved under reasonably favorable conditions. However, if reasonable precision can be achieved, power is expected to drop off slowly if sampling is reduced to every second or third year, assuming firm baselines at both ends of the time series. Additional work is needed to confirm the ability to achieve necessary precision.

G_0 is an important driver of variance in density estimates. We need to limit the time over which a G_0 estimate is applied so that variance is minimized. In 2007 this was accomplished with a new transect schedule that completed all transects in the neighborhood of a G_0 site (or cluster of sites) in a short period of time. Separate estimates of G_0 will be applied to each site/cluster of sites, instead of rolling them all into a global estimate. Another topic in G_0 was the relevance of the "visibility" index from monitoring telemetered tortoises to the LDS technique for detecting. Especially with less searching off the line, the current LDS technique probably wouldn't detect many of the in-burrow or in-vegetation tortoises that are detected with transmitters. Bringing these two techniques together will be necessary and may involve refining the description of "visible" beyond yes/no to up to 5 levels of visibility. Kathy noted that much work on estimating accurate G_0 in marine mammals has been done.

The contribution to density variance from the detection curve is so small that Bob Steidl proposed we consider analysis alternatives outside of those available within program DISTANCE. We still need to model detection, but the curve has little variation. This is a possibility to consider for the future and might include alternatives such as those used for the breeding bird survey and other large-scale monitoring strategies.

Measuring other variables—The potential of the range-wide monitoring program to collect other data identified as important by the SAC was also discussed. If such information is important, we should generate calls for proposals to address particular topics, with written proposals and evaluation of merits. The group discussed pitfalls of less formal data collection, such as data that are collected but not "owned" by a researcher for publication, and quick ideas that miss some issues. An example in the latter case was description of invasive plants, which was implemented in a wet year (2005) and is now discovered to be not comparable as collected in a dry year (2007). Relative to the potential to move toward a biennial or triennial population sampling schedule, as mentioned above, “off years” could be used to collect range-wide, landscape-level data on threats (see item #3, above), to inventory or ground truth the habitat model in areas not included in the population monitoring program (see below), and/or to monitor habitat relative to the habitat-based recovery criteria (see below).

5. Reaffirm recovery criteria

The committee started discussion of recovery criteria by deciding to "loosen up" descriptions so that occupancy estimation would not be the only method of estimating lambda, but line distance sampling would also be potentially useful. Given the mission of DOD and less certainty about long-term land use compatible with tortoise recovery, the committee discussed the value of monitoring tortoise populations on DOD lands. It was agreed that those populations should still be included in the range-wide monitoring program because they may contribute to recovery of surrounding/adjacent populations. It would be easy to estimate trends in recovery criteria parameters with and without DOD lands/populations, depending on any changes in land-use status.

When discussing the criteria for habitat quantity and quality, the group maintained that all areas that *could* include tortoises should be monitored. Vagaries of the habitat model should not be included, so the group discussed the need for inventory monitoring to refine the concept of potential habitat by ground-truthing beyond the model. This monitoring might not be built on distance sampling, but might instead be designed in conjunction with introduction of occupancy estimation. We also would have to decide what areas identified by the model would not be worth traveling to. Bob Steidl mentioned developing a set of rules by which exploring validity of unsampled but potential habitat is considered. For example, Neyman indicator to assess cost-benefit of including potential areas in the inventory could factor the distance from occupied habitat and the size of the potential parcel. Also, habitat monitoring would need to be done less frequently than monitoring tortoise populations.

Action Item: Bob Steidl will edit the recovery criteria and rationale/conceptual foundations.

Open Forum

An open forum was held from 5-7pm on June 11. Five stakeholders/interested parties attended, representing Clark County, the Off-Road Business Association, and QuadState County Government Coalition. The group discussed a variety of topics, especially progress on disease recommendations and range-wide monitoring.

Next meeting

The next meeting is scheduled for **September 14** in Las Vegas with the Desert Tortoise Management Oversight Group. The meeting will focus on discussing the draft recovery plan, which will be distributed to the SAC, managers, and stakeholders for advance review.