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Dr. Catherine Darst
Assistant Field Supervisor
US Fish and Wildlife Service
Ventura Fish & Wildlife Office
2493 Portola Road, Suite B
Ventura CA 93003

Dear Dr. Darst and Members of the USFWS,

I have examined the draft recovery plan for the Santa Barbara County Distinct Population Segment (DPS) of the California Tiger Salamander (CTS; *Ambystoma californiense*) and am impressed by the thoroughness of the plan as presented. My biggest concerns regarding the implementation for the plan is that this DPS occurs in a part of California that is home to some of the highest real estate values in the nation. I think because the salamander can co-occur with cattle and with grazing activities (as indicated in the report), it might be possible to convince private land owners (at least those that own cattle and graze on their lands) to assist with conservation activities. The USFWS and all other agencies involved in the implementation of this plan will have a large job before them convincing private land owners to join the quest to save populations of endangered amphibians in Santa Barbara County. Work on the borderlands in Arizona (regarding fire ecology) might be informative to the particular case in California involving the Santa Barbara DPS of the CTS. I attach the first page of a Google scholar search on the subject as an attachment to provide example references on the subject.

The one thing missing from the plan was any sort of "action" to engineer the remaining environments to make them suitable for the Santa Barbara DPS of the CTS. I think that given this taxon is a pond-breeding species that relies on burrows, environments that can be "preserved" can probably be engineered as well to ensure survival of the Santa Barbara DPS. Digging/refurbishing ponds is a lot easier than creating streams! If historic records exist for the county; known locations of prior ponds could direct efforts at locating sites to engineer/create breeding ponds that could be used by the Santa Barbara DPS salamanders. Additionally if rodenticide reduces the number of burrows in upland habitats, drilling appropriate sized holes in the environment might be another way to engineer landscape for the species (see Shoo et al. 2011: Shoo, L.P., D.H. Olson, S.K. McMenamin, K.A. Murray, M. Van Sluys, M.A. Donnelly, D. Stratford, J. Terhiuvo, A. Merino-Viteri, S.M. Hebert, P.J. Bishop, P.S. Corn, L. Dovey, R.A. Griffiths, K. Lowe, M. Mahony, H. McCallum, J.D. Shuker, C. Simpkins, L.F. Skerratt, S.E. Williams, and J-M. Hero. 2011. Engineering a future for amphibians under climate change. Journal of Applied Ecology. 48:487-492). Given the fact that most of the land is private, agencies need to think about mitigation activities that might positively help this threatened population segment by providing breeding and retreat sites.

Engineering underpasses for salamanders where vehicular-strike mortality is high is another example of how we can mitigate some threats for endangered species through human engineering of the environment. Regulation of the bait industry also jumps to mind as an action that can be taken immediately. Given that animals move through different environments at different costs, woody plants could be planted between ponds and upland sites to reduce the cost of movement between ponds and burrow sites (see page I-5 and Wang et al. 2009).

Table 1 on page I-4 and the figures in Appendix D were probably the most critical data presentations in the document that helped guide my assessment of the plan. Three of the metapopulations (East Santa Maria, East Los Alamos and Santa Rita Valley) are vulnerable because they have so few breeding ponds. I have no idea how the current drought is affecting the ponds in this region, but anything fewer than 10 ponds seems to leave these particular metapopulations vulnerable to blinking out if the drought cycle is extended or worsens in its severity. The East Santa Maria metapopulation seems to live in the highest human impact zone (Figure 3) and while you may wish to save them all, if funds prohibit such action, this metapopulation might be one to "drop" to save the others that have more ponds available to the animals. The Eastern Santa Maria metapopulation is the northern-most metapopulation, but the West Los Alamos, East Lost Alamos and Santa Rita Area metapopulations have representation from the eastern side of the DPS distribution so while losing the northeastern metapopulation may be difficult, it might be the "cut to take" if one has to take a cut.

The agency has obtained input from Dr. H. Bradley Shaffer and his former and current students, and that is extremely useful for preservation of the Santa Barbara County DPS of the CTS. Dr. Shaffer is the recognized expert on the California Tiger Salamander, and his work with population genetics and its applications are useful for work with this DPS to ensure its recovery. The use of population genetic tools is increasingly popular in conservation and Brad Shaffer is a leader in the field. Hopefully all the agencies and academics can come together to provide the expertise required to save these metapopulations.

Because the loss and destruction of habitat is the most pressing threat to the Santa Barbara County DPS, the USFWS should partner with all NGOs and other agencies to work towards the acquisition of lands that are not in private ownership to secure a future for these metapopulations. This task is complicated by high real estate prices but I think that land purchase combined with buy in from the local land owners can help conserve the Santa Barbara DPS.

The agencies responsible for this endangered species must institute a monitoring program so that we can change our lack of knowledge: "We do not have data on the population size or trends of the Santa Barbara County DPS of the California tiger Salamander due to its cryptic life history strategies". If you use the genetic approach to estimate population size, it will take 30 to 50 tail clips/pond and that will help everyone know the status of this population because until we do, we cannot determine if the recovery plan has been successful. Many pond breeding amphibians exhibit the type of "random fluctuations" noted for the CTS and examples from pond systems provided counter arguments for early reports of amphibian decline. We know pond-breeding amphibians are variable through time and long lifespans allow mature adults to "bet hedge" and delay reproduction in difficult conditions. A monitoring program will also provide data that will allow one to measure dispersal distances and movement patterns for the Santa Barbara DPS so that you will know if these salamanders act like other DPS units. Advances in GPS technology

can allow for the use of spatial information on pond location to estimate the location of upland habitats that might be used by the local salamanders.

I think that the threats to the Santa Barbara DPS of the CTS most critical are the continued modification of remaining habitat, disease spread, lack of organizational protection for the species, and probably other human-caused stressors. These factors certainly act synergistically and we are now beginning to conduct studies that examine more than single factor drivers, but those data are now only beginning to accumulate. The habitat loss problem (Factor A) is made worse by the cost of property in the region. The best approach is partnership with land owners through outreach and perhaps the Federal, State, and County governmental agencies can work together to provide conservation easements to private landowners for their conservation efforts on behalf of the Santa Barbara DPS of the CTS.

The recovery plan provides detailed information on the main drivers of loss (pages I-9 to I-20). I do not believe Factor B (Overutilization as a threat) is going to make or break the success of the recovery plan but scientific research on the species could be facilitated by offering grants to to focus on certain aspects of research you wish to accomplish as part of the "adaptive management" strategy you will employ to implement the plan (e.g., monitoring, occupancy sampling). The fact that most of the sites are in relatively remote regions means that human-salamander conflict is unlikely and research might help with outreach and communication about the animals to the local community.

Disease is an unknown factor for endangered species but makes those involved with management attentive because disease spread could undo years of careful conservation planning and activity. As part of the monitoring efforts, animals can be swabbed following standard protocols to keep tabs on disease status. Our work in the tropics showed that Bd incidence varied as a function of environmental temperatures and that during cool months, incidence increased. If disease dynamics are affected by changing climate, then it is hard to predict if warm and dry conditions would be beneficial overall (those conditions are not conducive to the Bd fungus). If Bsal leaves Europe and is introduced into the United States through the pet trade, the Santa Barbara DPS of the CTS will face new challenges. In addition to fungal diseases, amphibians are affected by viruses and other disease-causing agents. Montioring activities will help keep track of the health status of the metapopulations during the implementation of the plan.

Predation on eggs and early life stages could be a threat to these endangered metapopulations, but interactions with "released bait" animals (Midwestern *Ambystoma*) is probably a bigger threat to the Santa Barbara DPS of the CTS. Controlling exotic animals is a nightmare from an agency standpoint but any actions at the local, state, and federal levels that prohibit movement of non-native mole salamanders would be a good starting point to prevent hybridization. Occupancy studies of all ponds in the range of the Santa Barbara DPS of the CTS would be worthwhile; such studies could focus on the salamanders and other species and would help agencies gauge the threat from these biotic agents. Research on field populations is essential for the success of the implementation of the recovery plan.

As far as Factor D (regulatory mechanisms), that is difficult for me as an amphibian biologist to assess. The various actors in government change and mandates from agencies can change

quickly leaving research on target species lacking. Hopefully the fact that the agencies are working to try and ensure recovery and delisting is a sign that there is a commitment to fulfill the needs of this endangered amphibian in California.

Part of Factor E (other anthropogenic drivers) can be managed through construction of underpasses in areas where vehicle-caused mortality is high. Perhaps "adopt a road" type campaigns could be initiated by local NGOs that are interested in the Santa Barbara DPS of the CTS to help finance the modifications required to give amphibians a passageway under the road. Contaminants are always an issue in areas with intensive agriculture and monitoring studies should also incorporate samples of water and air for contaminants known to affect amphibians. Our studies in Costa Rica revealed few ecotoxicological data for tropical species and few data are available for any amphibian species because the EPA considers fish in estimations of toxicological threats for the most part; there is ample room for research in this arena. Drought and climate change are real threats for this DPS because there is no way, a priori, to predict how long the current drought cycle will last. Almost all climate change models predict that local weather will change and become increasingly difficult to predict. For species that depend on ponds lasting at least 60 days, unpredictable weather may be problematic. If rainfall is the trigger that stimulates reproduction in the Santa Barbara DPS of the CPS, then sufficient rain must fall to ensure that embryos can complete their arc of metamorphic change before ponds dry. I think the metapopulations with fewer than 10 ponds are most vulnerable to climatic/weather changes. Any measures that can increase pond and retreat availability should be considered for all six metapopulations, especially the three with the fewest ponds.

In the recovery strategy (page II-1) it states: "We think that recovery of this species could be achieved through the conservation of remaining aquatic and upland habitat that provides connectivity, reduces fragmentation, and sufficiently buffers against encroaching development." Where are these sites and is there a prioritization for land acquisition? The University of California has an outreach unit and you might be able to partner with them to get assistance/advice/examples of successful partnerships with local private landowners to effect change for conservation. These offices have skilled people that are effective and they might be an effective partner that could assist with this recovery plan implementation.

The plan includes appropriate set points to determine when recovery has occurred, and hopefully these efforts will bear fruit in the time predicted for success. It will require partnerships with private landholders and that could present the strongest challenges to success. I would recommend starting a school program in Santa Barbara County that introduces children to the Santa Barbara DPS of the CTS and have the curriculum start early and repeat during their time in school. This sort of "conservation in the classroom" project has been remarkably successful in Guanacaste, Costa Rica. School children begin visiting the park during primary school and become advocates for park issues as they learn about how important the intact ecosystem is for biodiversity. Partnerships with education experts will be fruitful in developing a curriculum that would increase knowledge of this interesting animal and increase local knowledge of the conservation issues.

It would be a shame to lose tiger salamanders from the Santa Barbara wildlands. The recovery plan is an expensive plan, but we have seen great successes in California – the California Condor, sea otters, elephant seals that were also expensive plans. I hope that the recovery plan for the Santa Barbara County DPS of the CTS is successful. Thanks for the opportunity to examine the plan.

Sincerely,

Maureen A. Donnelly
Associate Dean for Graduate Studies
Professor of Biological Sciences