Questions Concerning California Condors and Development of Wind Energy Facilities, November 2011

Developed by the California Condor Wind Energy Work Group

Questions identified as viable research opportunities are identified with bold text. Research on California condors should only be conducted with proper State and Federal permits, as appropriate, and coordination with the California Condor Recovery Office and the California Condor Wind Energy Work Group is strongly recommended.

Biological Questions

1. What are the areas of lower probability for condor occurrence? What are the habitat characteristics (vegetation, wind, topography) of these areas?

   Modeling effort currently underway by U.S. Geological Survey, peer reviewed report deliverable to Bureau of Land Management and U.S. Fish and Wildlife Service by December 2012.

2. **What constitutes condor roosting habitat? Can this be determined by habitat modeling and projected throughout the range?**

3. **What constitutes condor nesting habitat? Can this be determined by habitat modeling and projected throughout the range?**

Interaction Questions

4. **Do condors exhibit any changes in behavior or flight pattern in proximity to wind turbines? Do condors appear to approach or avoid wind facilities, and does the number of turbines make a difference?**

5. **Does the wake effect created by turbines have an impact on condor flight behavior?**

6. Do stationary turbines pose a collision risk to condors? How does the number of turbines on the landscape influence this potential risk?

7. **What buffer is needed to avoid disturbing condors from a roost or feeding event, considering elements such as noise, weather conditions, and length and type of disturbance (e.g. construction, helicopter use, project operation)?**

8. **What disturbance buffer is needed to prevent condors from abandoning a roost or feeding area, considering elements such as noise and length of disturbance (e.g. construction, helicopter use, project operation)?**

9. **What disturbance buffer is needed to avoid disrupting nesting (i.e., stressing individual, flushing, altering incubation, altering feeding) activities, considering**

elements such as noise, weather conditions, and length of disturbance (e.g. construction, helicopter use, project operation)?

10. **What disturbance buffer is needed to prevent condors from abandoning a nest location, considering elements such as noise and length of disturbance (e.g. construction, helicopter use, project operation)?**

11. **What are the proper protocols for helicopter use and flight in vicinity of condors to avoid prompting changes in behavior?**

12. **Does the increase of human access associated with the wind facility affect the abundance of native or non-native food for condors?**

Land Management Questions

13. **Is managing the foraging base effective in deterring condor use at the project level?**

14. **Can we successfully manage carcass removal on wind facility sites?**

Industry/Technology Questions

15. Can sodar and lidar replace meteorological towers for data collection? What additional studies/tests are needed to ensure the feasibility of these replacements?

16. **Are flight diverters effective in preventing collision for condors? What frequency of marking is necessary on guy wires and/or met towers to prevent collision? Are diverters effective in all weather conditions? Are perch excluders effective for condors?**[1]

17. What is the feasibility of placing gen-tie lines underground? What length of gen-tie makes undergrounding the line cost prohibitive?

18. Is it feasible to cover non-insulated wires on a wind project site to reduce electrocution of condors? Is a visual stimulus needed as well to prevent condors from perching on towers or areas of risk?

19. What kinds of machine coolants are available that are verified to be non-toxic to condors? How can maintenance practices reduce the events where condors are exposed to ethylene glycol?

[1] Research on utility infrastructure and work by the Avian Power Line Interaction Committee has concluded that marked lines are more effective than unmarked lines for reducing collision.

20. Is there a turbine design that would reduce likelihood of mortality?

21. **Is there a visual or auditory deterrent that could be deployed to provoke avoidance behavior and prevent condors from entering the risk zone (i.e., area with potential for electrocution or collision)?**

22. Could a GPS transmitter be designed that provided a smaller detection error (i.e. 5 meters error vs. 50 meters) and a more refined altitudinal component (i.e. height above ground vs. height above sea level)?

23. Can a GPS unit be designed and fitted to a condor that collects data on a more frequent basis than the currently used GPS units? Could the units be designed to provide "real time" locations?

24. **Is there reliable means to detect condors in the vicinity of wind farms? Can a system be developed to detect condors early enough that collisions with operating turbines could be avoided by curtailing turbines? How does topography influence what is needed to detect condors?**

25. **Can a radar system reliably differentiate California condors from other soaring raptors at all angles and profiles? Which band of radar is most successful at detecting and differentiating condors? Does the appropriate system vary depending on topography? How many radar systems are needed to address features such as mountain shadows and the complex topography found in the Tehachapi Wind Resource Area or other mountain areas? Can the VHF units worn by condors enhance the ability of radar to detect the individual?**

26. If curtailment is the selected avoidance measure, how frequently can various turbines (i.e., different manufacturers) tolerate shutdowns? Outside of the manufacturer warranty, can turbines actually be expected to tolerate frequent shutdowns to avoid condors if a project is developed in a location that may require frequent curtailment?