Sampling Burrowing Owls Across the Altamont Pass Wind Resource Area

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The Alameda County Scientific Review Committee (SRC) identified the need for focused study on burrowing owls in the Altamont Pass Wind Resource Area (APWRA) (SRC doc P90). The needs were to estimate the distribution and abundance of burrowing owls across the APWRA and to further understand the behaviors of burrowing owls that might lead to their frequent deaths nearby wind turbines. Since the SRC generated the earlier burrowing owl study proposal (P90), the need for distribution and abundance data has increased because repowering projects are under planning and environmental review. These data are needed for careful siting of new turbines to minimize burrowing owl impacts.

The APWRA encompasses about 16,500 hectares (ha). An area of this size would require many biologists to census the burrowing owl population. A more efficient approach would be to sample the area, mapping all the active burrowing owl burrows within each sampled area. So long as the samples are representative of the environmental variation in the APWRA, and so long as the cumulative area of the sampling plots is large enough, the mapped burrowing owl burrows within the sampling plots could inform predictive models of burrowing owl burrow locations. Sufficiently accurate predictive models could then be extrapolated throughout the non-sampled areas to guide wind turbine siting during repowering.

The goal of the burrowing owl study proposed herein is to inform repowering of where burrowing owls are most likely to reside in highest abundance and in moderate abundance, so that wind turbines can be sited to maximize their distances from high abundance areas. Trade-offs will be required, however, because siting will also have to consider collision risks to golden eagles, red-tailed hawks, and American kestrels. Also, there may be other considerations, such as sites that may be favored by burrowing owls for nocturnal foraging. The objectives of the study are to estimate (1) nest density; (2) spatial distribution of burrowing owl populations across the APWRA; and (3) quantify use and availability of specific landscape features and slope attributes across the APWRA. The ongoing ad-hoc recording of burrowing owl burrows during fatality searches could also contribute to objective 2.

METHODS

The following terminology will be used for describing the steps to select and build survey plots. *Sub-watersheds* are slopes bounded by ridge crests and ridge lines that drain rainfall into a stream until the stream reaches a node with another stream. Multiple sub-watersheds form a watershed. *Prominent ridge crests* and *prominent valley bottoms* are the major ridge crests and valley bottoms of the local area, and are represented in GIS as line features. The areas between prominent ridge crests can include additional ridge crests at lower elevations, as well as additional streambeds that are at higher elevations than the prominent valley bottom. Wind *turbine fields* are groups of turbines with common ownership, turbine model, and similar geography. *Turbine field polygons* are groups of sub-watersheds that intersect with the turbines composing turbine fields.

We first delineated watershed boundaries in the APWRA, then sub-watershed boundaries. We also divided sub-watershed polygons by lines representing prominent valley bottoms, which were actually major streambeds. The resulting polygons represented portions of watersheds between stream intersection nodes, as well as slopes on each side of prominent streambeds Polygons smaller than 1 ha were aggregated with adjacent polygons, as most of these small polygons were GIS slivers resulting from earlier geoprocessing steps. We overlaid a map of wind turbines representing conditions during 2002-2006, and we intersected our 952 sub-watershed polygons with these turbine locations.

Wind turbines were grouped into wind turbine fields based on ownership, turbine model, and geography. We used the old-generation turbine locations to represent the Buena Vista project because they covered all of the original project area, including the lower slopes to the east. We aggregated the Diablo Winds project with the Difwind project because the turbines of these projects were interspersed. We also aggregated the turbine field representing the Altech, Viking and TaxVest projects with the turbine field representing the Venture project because both of these fields were very small and we wished to prevent over-sampling in areas represented by small turbine fields. In the end, we identified 19 wind turbine fields, and we intersected these with sub-watershed polygons to identify turbine field polygons. The 19 turbine field polygons covered 10,796 ha, averaging 11 ha per sub-watershed polygon (range 1-90). Gaps of non-intersected sub-watershed polygons also resulted from our approach, but some of these were likely caused by lack of wind leases, which could also mean that we would be less likely to gain access to the properties to survey for burrowing owls. Other small gaps were probably inconsequential to our sampling plot development process.

Within each turbine field polygon, we randomly selected 1 sub-watershed polygon using a stratified random number generator in Statistica 10.0 (Stat Soft, Inc. 2011). This polygon was the starting point for building a burrowing owl sampling plot by aggregating adjacent sub-watershed polygons until the total areas were between 40 and 100 ha in each turbine field polygon. We used decision rules to build the sampling plots from the randomly selected starting polygon:

(1) The next and subsequent sub-watershed polygons to add must have been located within the boundary of the turbine field polygon;

(2) If adding an adjacent sub-watershed polygon would extend the survey plot across a prominent valley bottom line, then that polygon would be selected next, else the adjacent sub-watershed polygon closest to the nearest prominent valley bottom line would be added next; and,

(3) If the most recently added sub-watershed polygon presented an opportunity to cross a prominent valley bottom line with the next sub-watershed polygon addition, then that polygon would be added next, else another sub-watershed polygon adjacent to the original

starting polygon would be added next, so long as it was closer than any other candidate sub-watershed polygon to the nearest prominent valley bottom line.

These decision rules treated the randomly selected starting polygons as pivotal for building burrowing owl sampling plots, while also favoring the selection of slopes facing each other across a shared major streambed. Favoring opposite slopes in the selection process helped to equalize the incidence of aspect (i.e., slope orientation) among the survey plots. Even though the available evidence indicates that burrowing owls do not select nest sites based on aspect (Smallwood et al. 2010), we intend to test anew all hypotheses of how burrowing owl nest sites relate to slope attributes as we extend our model development to include the entire APWRA. We did not see any possibility for our selection rules to introduce bias regarding slope, elevation, or proportions of upper versus lower slopes. Once built, the sampling plots reasonably represented the east-west and north-south extents of the APWRA and covered about 1,140 ha (Figure 1).

We also repeated our process for selecting and constructing sampling plots to ensure that alternative plots are available, in case one or more of the original plots are not. However, we did not construct additional plots in two small turbine field groups on the east side of the APWRA, because these field groups lacked sufficient space to justify another plot. If time and budget allows, we will survey the plots developed in our second round.

Before field surveys commence, we will use digital elevation models of the APWRA to identify all of the ground areas that are visible from roadside vantage points, as well as all the ground that is hidden from view. The hidden ground would be surveyed from off-road vantage points and by foot. This way, all of the surface area within each sampling plot would be searched.

Locating active burrowing owl burrows will be done in the morning and evening hours, using binoculars from a parked vehicle at roadside vantages. It is anticipated that one vantage will be needed per 15 ha, so about 3 to 7 per sampling plot. As noted above, ground surface areas hidden from roadside vantages will be surveyed by foot. Each sampling area would be surveyed at least twice during the period April through June. Active burrows will be noted on hand-held maps, then mapped by GPS during mid-day hours after all the burrows have been noted on maps.

RESULTS

We identified a sampling pool of 10,796 ha among the 953 GIS subwatershed polygons that intersected with wind turbine locations. From these we randomly selected one subwatershed polygon per field group, and developed 19 survey plots using decision rules starting with the random selection (Figure 1). We delineated 1,169 ha of burrowing owl survey area, averaging 62 ha per field group.

After our second round of randomly selecting and developing survey plots, we delineated 17 survey plots totaling 914 ha, averaging 54 ha per plot (Figure 1).

Selected plots will be visited in random order to prevent temporal bias in characterizing burrowing owl distribution, although we do not anticipate such bias.

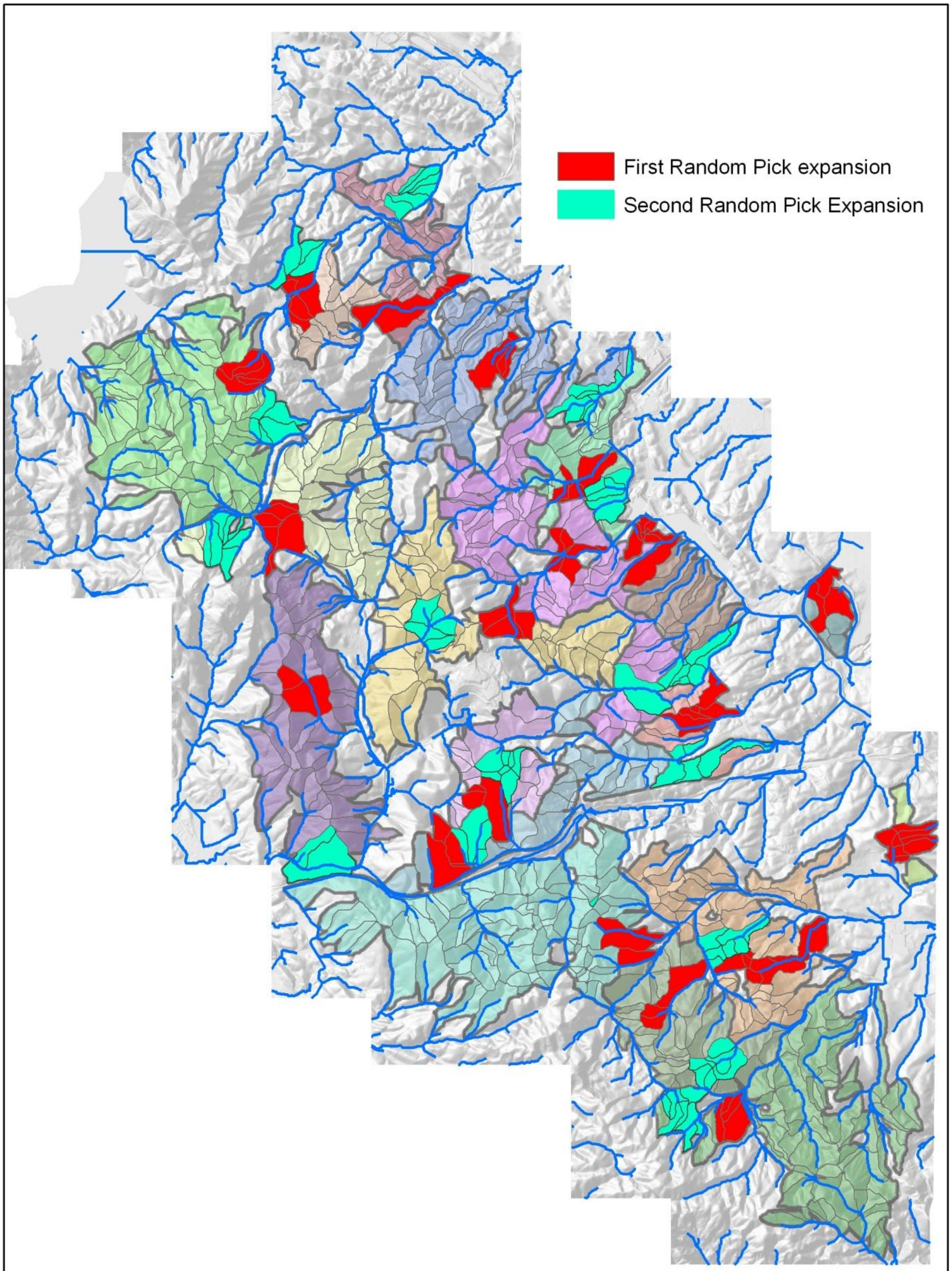

Figure 1. Burrowing owl sampling plots (red for first round and turquoise for second round) were selected and built using decision rules, one plot per wind turbine field group (various colors other than red, turquoise, and gray).