ASSESSMENT OF RELOCATION/REMOVAL OF ALTAMONT PASS WIND TURBINES RATED AS HAZARDOUS BY THE ALAMEDA COUNTY SRC

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The Alameda County Scientific Review Committee (SRC) visited the Altamont Pass Wind Resource Area (APWRA) in late November and early December 2007. During this visit, the SRC rated the level of threat to birds posed by more than 600 wind turbines (SRC Document P67). The turbines visited consisted of those identified by the Alameda County fatality monitoring team as having histories of killing one or more of four raptor species targeted by the SRC for priority consideration in formulating mitigation measures intended to reduce or offset the impacts due to collisions. These species included golden eagle, red-tailed hawk, American kestrel and burrowing owl. The SRC based its ratings on various, identified factors (SRC P67), including site characteristics such as position within saddles on ridges or where ridges intersect with each other or with larger hills, forming relatively low passes typically exploited for energy-saving travel pathways by birds.

The SRC originally recommended to Alameda County that wind turbines it rated 8 to 10 on a 10-point scale be relocated to safer places or removed altogether. However, because the companies declined to shut down all their wind turbines for four months over the winter of 2007/2008, and because the SRC is charged with recommending measures to achieve a 50% raptor reduction goal agreed upon among parties (including most of the APWRA wind companies) as part of a settlement with plaintiffs of a challenge under the California Environmental Quality Act (CEQA), the SRC recommended immediate relocation or removal of all turbines it rated 7 to 10 (SRC Document P72). The companies and Alameda County decided to relocate only wind turbines the SRC rated as 9.5 to 10 (SRC Document P78). Throughout the period when these recommendations and actions were taking place, the parties to the settlement agreement repeatedly asked about the effectiveness of the SRC's recommended wind turbine removals/relocations (e.g., Public Comments from Emre Ergas in SRC Document P78).[1] The SRC answered that assessments of the effectiveness of this mitigation measure might be possible, but it had not initiated such an assessment.

The purpose of this report was to test the effectiveness of the SRC's recommend turbine relocations/removals, as well as of the relocations that the wind companies say they initiated. My assessment was made without the benefit of knowing where wind turbines are being relocated by the wind companies, so I used two general approaches. In one approach, I assumed relocated wind turbines were to locations that averaged the same level of threat to the target raptor species as all the other turbines that were either not rated by the SRC or rated lower than the group actually or potentially relocated. In the other approach, I pretended all the turbines recommended for removal/relocation were actually removed and not relocated, and that no other

[1] Emre Ergas of FPLE asked if there are any data to prove that the ratings are correct. He also asked why the SRC recommendation for removal included ratings down to 7 and 7.5, and why removing turbines from 9.5 to 10 was not enough. Ergas said his company is hesitant to remove turbines rated lower than 9.5 because FPLE representatives lack confidence in the SRC's ratings.

wind turbines were installed in their place. The groups of rated turbines I considered were those rated 9.5 to 10, 8 to 10 and 7-10. I estimated mortality for wind turbines with and without these groups of rated turbines using data collected by the monitoring team from fall 2005 to fall 2007, and the baseline estimates were reported in Smallwood (2008).

METHODS

Field methods were described in SRC Document M21 and generally in Smallwood and Thelander (2008). Data handling was generally described in Smallwood (2008). In this case, I selected fatalities found from 1 October 2005 through October 2007, including 45 days before the first fatality search. I used only fatalities and search effort from old-generation wind turbines other than at Vasco Caves Regional Preserve, which can be extrapolated to a capacity of 547.02 MW in the APWRA. Data from Diablo Winds were not used. I also restricted fatalities to those regarded as possibly, probably and certainly caused by wind turbines.

Of the wind turbines that are searched by the monitoring team, I added the SRC ratings as an attribute in the data set that characterizes wind turbines. I then selected groups of wind turbines and fatalities based on ranges of SRC ratings, or more accurately I omitted wind turbines and fatalities from new estimates of mortality when the turbines were within the selected range of ratings:

$$M = \text{deaths / MW / year},$$
$$M_{\text{-}9.5\text{-}10} = \text{deaths / MW}_{\text{-}9.5\text{-}10} \text{ / year},$$
$$M_{\text{-}8\text{-}10} = \text{deaths / MW}_{\text{-}8\text{-}10} \text{ / year},$$
$$M_{\text{-}7\text{-}10} = \text{deaths / MW}_{\text{-}7\text{-}10} \text{ / year},$$

where M was mortality based on all searched wind turbines and all found fatalities, $M_{\text{-}9.5\text{-}10}$ was mortality based on all searched turbines and all found fatalities other than the wind turbines rated 9.5 to 10 and their associated fatalities, $M_{\text{-}8\text{-}10}$ was mortality based on all searched turbines and all found fatalities other than the wind turbines rated 8 to 10 and their associated fatalities, and $M_{\text{-}7\text{-}10}$ was mortality based on all searched turbines and all found fatalities other than the wind turbines rated 7 to 10 and their associated fatalities. For the turbine relocation scenario, the mortality estimates were extrapolated to the comparable capacity of 547.02 MW. For the turbine removal scenario, the mortality estimates were extrapolated to: the comparable capacity of 539.84 MW to account for the removal of turbines rated 9.5-10, the comparable capacity of 520.23 MW to account for the removal of turbines rated 8-10, and the comparable capacity of 504.36 MW to account for the removal of turbines rated 7-10. Of the comparable capacity, the turbines rated 9.5-10 compose 1.3%, those rated 8-10 compose 4.9%, and those rated 7-10 compose 7.8%.

All of the mortality estimates were adjusted for scavenger removal rates and searcher detection errors that appeared in App. 1 of Smallwood (2007) for an average search interval of 41 days during the period of fatality monitoring between fall 2005 and fall 2007. My estimates of APWRA-wide changes in mortality due to relocations or removals were based on the assumption that the SRC equitably rated wind turbines between searched and unsearched turbines. The SRC tried to allocate ratings equitably, but it remains unknown whether this was achieved. In my

opinion, the SRC's ratings were most likely reasonably equitable. My estimated changes in mortality were also based on my assumption that the existing fatality data I used would be consistent with future patterns of fatalities, i.e., left unchanged in operating status, the rated turbines would continue to kill birds at relatively similar rates compared to other turbines.

RESULTS

Among target raptor species, the SRC's ratings performed best for golden eagles, followed by red-tailed hawks and American kestrels (Tables 1 and 2, Figure 1). By relocating turbines rated 9.5 and 10, I projected golden eagle mortality to decline 25%, assuming the relocations are to places no more hazardous than the average hazard level of all other wind turbines (Table 1; Figure 1, top left graph). Relocating turbines rated 8-10 is projected to achieve a 34% reduction in golden eagle mortality, though nothing appears to be gained for golden eagles by relocating turbines rated 7 and 7.5. Instead, relocating turbines rated 7 and 7.5 should further reduce mortality of red-tailed hawks and American kestrels.

Removing the highly rated turbines, rather than relocating them, should further reduce mortality of golden eagles, red-tailed hawks, and American kestrels (Table 2, Figure 1, top right graph). I projected that removing turbines rated 7 to 10 could reduce golden eagle mortality 39%, red-tailed hawk mortality 29%, and American kestrel mortality 24%. These reductions could be achieved at the cost of 7.6% of the APWRA's permitted operating capacity.

The ratings performed miserably for burrowing owls. Among all scenarios of relocation and removal of turbines with high ratings, burrowing owl mortality either did not change or increased. Because burrowing owl mortality was estimated to be so much greater than for the other three target raptor species, the combined reductions in target raptor mortality are projected much lower than for Golden eagle, red-tailed hawk, or American kestrel alone (Tables 1 and 2; Figure 1, bottom graphs). Essentially, the high mortality of burrowing owls combined with the ineffectiveness of the SRC ratings for this species overwhelmed the mortality reduction estimates of the other species and resulted in relatively poorer performance of the ratings applied to the combined target species.

DISCUSSION

The SRC's ratings of wind turbines for threat levels to birds were potentially more effective than any mitigation measure proposed or implemented in the APWRA to date. By removing wind turbines rated 7 to 10, or 7.6% of the APWRA's permitted capacity, I projected that there could be a 39% reduction in golden eagle mortality, a 29% reduction in red-tailed hawk mortality, and a 24% reduction in American kestrel mortality. The only other proposed mitigation measure that approached these estimates of mortality reduction was the four-month winter shutdown. I projected mortality reductions due to a 4-month winter shutdown of 25% for golden eagle, 35% for red-tailed hawk, 42% for American kestrel, 33% for burrowing owl, and 34% for the combined four target raptor species (SRC Document S19). The winter shutdown would perform better than the SRC's turbine ratings for red-tailed hawk, but especially for American kestrel and burrowing owl, although it should be remembered that the winter shutdown would give up about 16% of the APWRA's annual power generation whereas the removal of turbines rated 7 to 10

would give up only 7.6%. By both removing turbines rated 7 to 10 *and* shutting down the remaining turbines during the winter, the wind companies could achieve the 50% mortality reduction goal within the year of implementation.

However, the Avian Protection Program is now more than halfway complete, so less than half of the program period is available to achieve its mortality reduction goal. Whatever reduction that is achieved over the last 16 months of the Program will be averaged with 0% reduction of mortality achieved over at least nearly half the initial portion of the Program (SRC Document P41), making it very unlikely the Program's goal will be achieved. I realize that some believe that the 50% reduction target could be measured over a small period during the latter portion of the Avian Protection Program, but I will point out that it was always the intent of the settling parties and the initial intent of the SRC to assess the Program's effectiveness over the entire 34 months of the Program (SRC Documents P43). Furthermore the high imprecision of the estimates from short periods of fatality monitoring argue against relying on estimates made over a year or less to assess the effectiveness of the Program (SRC Document P44).

For the most part, the SRC's ratings performed very well when checked against the fatality data, but performed miserably for burrowing owls. It appears the SRC developed a good eye for situations that are risky to golden eagles, red-tailed hawks, and American kestrels, but entirely missed the risky situations for burrowing owls. The projected increases in mortality of burrowing owls were likely caused by simulating the relocation or removal of wind turbines that are not very hazardous to burrowing owls while leaving in operation the turbines that are hazardous. This resulted in a relatively unchanged number of burrowing owl fatalities being divided by a reduced number of MW in the denominator of the mortality metric. A clear result of this test of the SRC's ratings is the pressing need for focused research on patterns of burrowing owl mortality in the APWRA. Until the fatality mechanisms are much better understood for burrowing owls, the 50% mortality reduction goal for raptors in the Avian Protection Program cannot be achieved based on any of the currently recommended mitigation measures.

Also, whereas the SRC's ratings performed well for 3 of the target raptor species, for all raptors as a group and for all birds as a group, the SRC's recommended measure of relocating or removing turbines rated 7 to 10 would show little improvement. Species vary widely in their behaviors, utilization rates of the APWRA, and probably in their collision mechanisms. Removing or relocating turbines will likely not perform nearly as well as seasonal shutdown of all turbines for all raptors as a group and for all birds as a group.

REFERENCES

M21_(Formerly R36) Wildlife Monitoring at Altamont Pass, Winter 05-Early Fall 06, Preliminary Draft Results.
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P44_Smallwood: Effects of Monitoring Duration and Inter-Annual Variability on Precision of Wind-Turbine Causes mortality Estimates in the Altamont Pass Wind Resource Area, California, 26 July 2007

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P68_Turbine List for SRC Selection of Dangerous Wind Turbines 12/7/07

P69_SRC Hazardous Rating Scale 12/18/07

P70 SRC Hazardous Turbine Relocation Guidelines

P76_Smallwood_Comparison of mortality estimates in the Altamont Pass Wind Resource Area. http://www.altamontsrc.org/alt_doc/p76_mortality_estimates_apwra_2005_07.pdf

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Table 1. Adjusted mortality estimates and changes in mortality due to *relocating* old-generation wind turbines that were rated by the SRC for high hazard to target raptor species in the APWRA, excluding turbines in Vasco Caves Regional Preserve.

Species/group	Mean mortality per string, deaths/MW/year	Percent change in mortality after relocating turbines rated:		
		9.5-10	8-10	7-10
Turkey vulture	0.0184	1	-5	-4
Golden eagle	0.1201	-25	-34	-33
Red-tailed hawk	0.6976	-12	-18	-23
Ferruginous hawk	0.0013	1	2	20
Swainson's hawk	0.0010	1	2	3
Red-shouldered hawk	0.0006	1	2	3
Buteo spp.	0.0311	1	2	-2
Northern harrier	0.0062	15	-41	-30
White-tailed kite	0.0007	1	7	8
Hawk spp.	0.0018	9	-100	-100
Raptor spp.	0.0043	1	2	3
Large raptor spp.	0.0025	-39	-32	-14
Prairie falcon	0.0025	1	-51	-47
Great horned owl	0.0594	-1	0	2
Barn owl	0.2578	-6	-11	-17
American kestrel	0.8189	1	-12	-18
Burrowing owl	1.9451	16	11	7
Great blue heron	0.0014	1	2	3
Great egret	0.0525	1	2	3
Sandhill crane	0.0028	1	8	15
Wild turkey	0.0017	1	2	3
Medium non-raptor spp.	0.1551	1	3	2
Mallard	0.1248	2	6	1
Gull spp.	0.1175	3	1	5
Duck spp.	0.0182	1	2	10
Common raven	0.1659	-1	3	-15
California gull	0.0119	1	53	-100
American crow	0.0569	1	0	3
Large non-raptor spp.	0.0738	1	2	3
Black-necked stilt	0.0429	1	2	3
Killdeer	0.0118	1	2	8
White-throated swift	0.0548	5	-8	-7
Western tanager	0.0041	1	2	3
Tree swallow	0.0043	1	2	3
Cliff swallow	0.0152	1	2	3
American pipit	0.0061	7	8	10
Bluebird spp.	0.0952	1	2	3
House wren	0.0088	1	2	3
Mountain bluebird	0.0632	5	8	2

Rock wren	0.0167	1	8	15
Swainson's thrush	0.0157	1	2	3
Western meadowlark	3.2026	3	1	-3
Loggerhead shrike	0.3320	3	-3	-2
Sparrow spp.	0.0146	1	2	3
Lincoln sparrow	0.0055	1	2	29
Northern flicker	0.0286	1	2	3
Hammond's flycatcher	0.0055	1	2	29
Mourning dove	0.5790	2	9	8
Dove spp.	0.0665	2	4	6
Say's phoebe	0.0210	1	2	3
Brown-headed cowbird	0.0537	1	2	3
Blackbird spp.	0.3931	-11	-13	-11
Northern mockingbird	0.0174	43	56	70
Brewer's blackbird	0.3618	-6	-29	-35
Horned lark	0.5429	0	2	4
Cockatiel	0.0228	1	2	3
Red-winged blackbird	0.2608	1	2	-18
Rock pigeon	1.4928	-1	0	-2
European starling	3.4411	-6	-6	-5
Small non-raptor	0.6243	2	-1	-1
Unidentified bird spp.	0.3010	1	1	2
Bats	0.0877	1	2	7
Target raptors	3.5817	6	-2	-6
All raptors	3.9692	5	-3	-7
All birds	9.7926	3	0	-4

Table 2. Adjusted mortality estimates and changes in mortality due to *removing* old-generation wind turbines that were rated by the SRC for high hazard to target raptor species in the APWRA, excluding turbines in Vasco Caves Regional Preserve.

Species/group	Mean mortality per string, deaths/MW/year	Percent change in mortality after relocating turbines rated:		
		9.5-10	8-10	7-10
Turkey vulture	0.0184	0	-10	-11
Golden eagle	0.1201	-26	-37	-39
Red-tailed hawk	0.6976	-13	-22	-29
Ferruginous hawk	0.0013	0	-3	10
Swainson's hawk	0.0010	0	-3	-5
Red-shouldered hawk	0.0006	0	-3	-5
Buteo spp.	0.0311	0	-3	-9
Northern harrier	0.0062	13	-44	-36
White-tailed kite	0.0007	0	1	-1
Hawk spp.	0.0018	8	-100	-100
Raptor spp.	0.0043	0	-3	-5
Large raptor spp.	0.0025	-40	-36	-21
Prairie falcon	0.0025	0	-53	-51
Great horned owl	0.0594	-2	-5	-6
Barn owl	0.2578	-7	-15	-24
American kestrel	0.8189	-1	-17	-24
Burrowing owl	1.9451	15	5	-2
Great blue heron	0.0014	0	-3	-5
Great egret	0.0525	0	-3	-5
Sandhill crane	0.0028	0	2	6
Wild turkey	0.0017	0	-3	-5
Medium non-raptor spp.	0.1551	0	-2	-6
Mallard	0.1248	0	1	-7
Gull spp.	0.1175	1	-4	-3
Duck spp.	0.0182	0	-3	1
Common raven	0.1659	-2	-2	-21
California gull	0.0119	0	45	-100
American crow	0.0569	0	-5	-5
Large non-raptor spp.	0.0738	-1	-3	-5
Black-necked stilt	0.0429	0	-3	-5
Killdeer	0.0118	0	-3	-1
White-throated swift	0.0548	4	-12	-14
Western tanager	0.0041	0	-3	-5
Tree swallow	0.0043	0	-3	-5
Cliff swallow	0.0152	0	-3	-5
American pipit	0.0061	6	3	1
Bluebird spp.	0.0952	0	-3	-5
House wren	0.0088	0	-3	-5
Mountain bluebird	0.0632	3	2	-6

Rock wren	0.0167	0	2	6
Swainson's thrush	0.0157	0	-3	-5
Western meadowlark	3.2026	2	-4	-10
Loggerhead shrike	0.3320	1	-8	-10
Sparrow spp.	0.0146	0	-3	-5
Lincoln sparrow	0.0055	0	-3	19
Northern flicker	0.0286	0	-3	-5
Hammond's flycatcher	0.0055	0	-3	19
Mourning dove	0.5790	1	4	0
Dove spp.	0.0665	1	-1	-3
Say's phoebe	0.0210	0	-3	-5
Brown-headed cowbird	0.0537	0	-3	-5
Blackbird spp.	0.3931	-12	-17	-18
Northern mockingbird	0.0174	41	48	57
Brewer's blackbird	0.3618	-8	-32	-40
Horned lark	0.5429	-1	-3	-4
Cockatiel	0.0228	0	-3	-5
Red-winged blackbird	0.2608	0	-3	-24
Rock pigeon	1.4928	-2	-5	-9
European starling	3.4411	-7	-11	-13
Small non-raptor	0.6243	1	-6	-9
Unidentified bird spp.	0.3010	0	-4	-6
Bats	0.0877	0	-3	-2
Target raptors	3.5817	4	-7	-13
All raptors	3.9692	3	-7	-14
All birds	9.7926	2	-5	-11

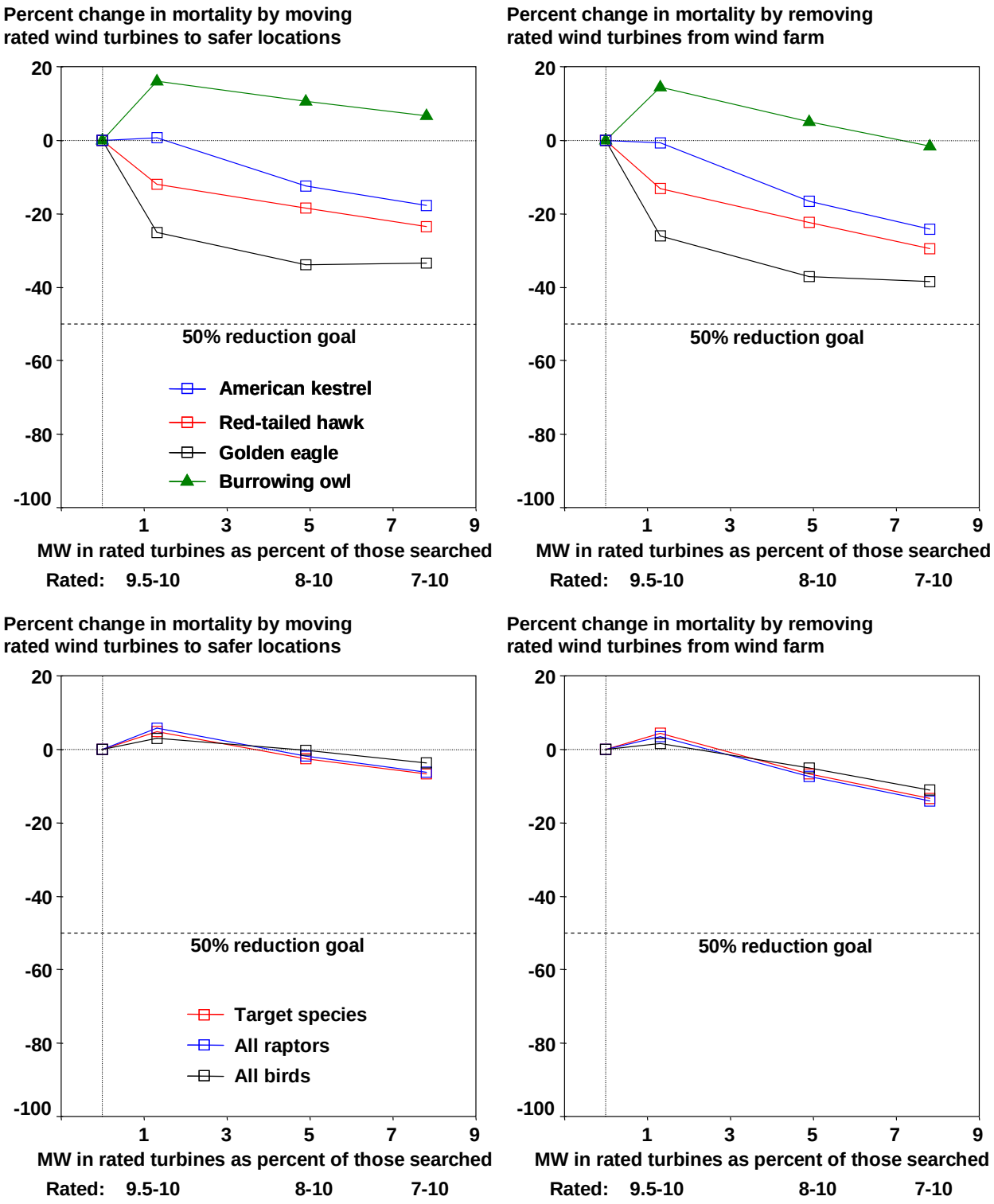

Figure 1. Changes in mortality estimates among old-generation wind turbines if the wind turbines the SRC rated as highly hazardous were relocated (left graphs) or removed (right graphs). As a percentage of the APWRA's permitted capacity, wind turbines rated 9.5-10 compose 1.2%, those rated 8-10 compose 4.6%, and those rated 7-10 compose 7.4%, assuming the ratings were equitably applied between searched and unsearched turbines.