

# Altamont Pass Wind Resource Area Bird Fatality Study

Alameda County Community Development Agency ■ July 2008



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# 1 Executive Summary

This report provides the Alameda County Community Development Agency and the Altamont Pass Wind Resource Area (APWRA) Scientific Review Committee with the following information:

- Summary results of the avian fatality monitoring study conducted at APWRA from October 2005 through September 2007 (Current Study);
- Parallel analysis of baseline avian fatality monitoring conducted at APWRA between March 1998 and May 2003 (Baseline Study);
- Determination of the change in mortality in the four target raptor species (golden eagle, red-tailed hawk, American kestrel, and burrowing owl) , other raptors, and all non-raptors between the Baseline and the Current study;
- Analysis of the relationship between the annual and monthly mortality in the four target raptor species and the local abundance (bird use) and behaviors of those species;
- Parallel analysis of avian mortality associated with a select overlapping set of turbines (Core Turbines) that were included in both the Baseline Study and Current Study; and
- Comparison of avian mortality associated with a subset of modern, high capacity-rated turbines (Diablo Turbines), and that associated with the remaining monitored turbines.

Table ES-1 summarizes the average annual mortality as adjusted for search effort and detection probability, and the estimated average annual total number of fatalities throughout the APWRA. Comparisons between the Baseline Study and Current Study revealed marked increases in the annual mortality rates and total fatalities of most target species and species groups examined except the golden eagle, which decreased by 35%. When the results of all target raptor species were combined, the mortality rate for the Current Study group increased 74% over baseline. This pattern of increased mortality was also evident in the comparison of mortality rates associated with Core Turbines used in both the Baseline Study and Current Study (Table ES-2). The Diablo results (Table ES-3) revealed reduced mortality of most target species and species groups for that set of turbines relative to the remainder of the study area.

Part of the observed differences in fatality levels for the four target raptor species may be a result of differences in the number of birds using the APWRA. Linear regression analysis of fatalities and bird use showed significant positive correlations for burrowing owl ( $R^2 = 0.4525$ ) and red-tailed hawk ( $R^2 = 0.5334$ ) but not for golden eagle ( $R^2 = 0.0003$ ) or American kestrel ( $R^2 = 0.0018$ ). However, the results of the burrowing owl analysis may be biased by the bird use survey protocol, which does not yield representative estimates for that species. This bias likely resulted in an underestimation of burrowing owl use and an inflation of the use/mortality correlation value.

In conclusion, this study indicates that the combined mortality rates of the four target raptor species increased between the Current and Baseline Study periods. Only the mortality rate of golden eagles appears to have decreased. The results of the Diablo analyses suggest that avian mortality could be reduced in areas where modern high-capacity turbines are deployed.

**Table ES-1. Comparison of Mortality Rates and Estimated Fatalities for the Baseline and Current Study Periods**

Species/category	Baseline 1998-2003			Current Study 2005-2007			Percent Change in mortality rates and estimated fatalities				
	Average annual mortality rate (Adjusted fatalities/MW/year)		Estimated APWRA - wide average annual fatalities	Average annual mortality rate (Adjusted fatalities/MW/year)		Estimated APWRA - wide average annual fatalities					
	Mean	Standard Deviation	Mean	0.95 LCI	0.95 UCI	Mean		0.95 LCI	0.95 UCI		
American kestrel	0.6460	1.10709	375	219	530	0.8431	0.94233	489	239	739	30.52%
Burrowing owl	0.8267	1.94103	479	183	776	2.0823	2.26210	1,208	731	1,684	151.87%
Golden eagle	0.2111	0.73421	122	31	214	0.1378	0.16096	80	-68	227	-34.69%
Red-tailed hawk	0.5369	0.71175	311	214	408	0.7915	0.52707	459	303	615	47.42%
<b>Total Target Species</b>	<b>2.2206</b>	<b>3.24068</b>	<b>1,288</b>	<b>816</b>	<b>1,760</b>	<b>3.8547</b>	<b>3.21429</b>	<b>2,236</b>	<b>1,478</b>	<b>2,994</b>	<b>73.59%</b>
Small Raptors	1.4727	2.38985	854	478	1,230	2.9254	3.01770	1,697	1,092	2,302	98.64%
Medium Raptors	0.0273	0.17922	16	-8	39	0.0378	0.10355	22	-16	60	38.19%
Large Raptors	0.9586	1.27450	556	389	723	1.3705	0.69862	795	527	1,063	42.96%
<b>Total Raptors</b>	<b>2.4586</b>	<b>3.46179</b>	<b>1,426</b>	<b>921</b>	<b>1,931</b>	<b>4.3336</b>	<b>3.45873</b>	<b>2,514</b>	<b>1,702</b>	<b>3,325</b>	<b>76.26%</b>
Small Non-Raptors	4.6107	11.97386	2,674	1,044	4,305	11.1519	8.80057	6,468	3,848	9,088	141.87%
Medium Non-Raptors	1.0763	2.05999	624	359	889	1.4091	0.90688	817	392	1,243	30.92%
Large Non-Raptors	0.2224	0.39115	129	76	182	0.3074	0.26189	178	94	263	38.24%
<b>Total Non-Raptors</b>	<b>5.9095</b>	<b>13.76548</b>	<b>3,427</b>	<b>1,573</b>	<b>5,281</b>	<b>12.8685</b>	<b>9.44552</b>	<b>7,464</b>	<b>4,484</b>	<b>10,443</b>	<b>117.76%</b>

**Table ES-2. Comparison of Mortality Rates and Estimated Fatalities at Core Turbines for the Baseline and Current Study Periods**

Species/category	Baseline 1998-2003						Current Study 2005-2007						Percent Change in mortality rates and estimated fatalities
	Average annual mortality rate (Adjusted fatalities/MW/year)			Estimated APWRA - wide average annual fatalities			Average annual mortality rate (Adjusted fatalities/MW/year)			Estimated APWRA - wide average annual fatalities			
	Mean	Standard Deviation		Mean	0.95 LCI	0.95 UCI	Mean	Standard Deviation		Mean	0.95 LCI	0.95 UCI	
American kestrel	0.5326	1.12539		308.9	25	593	1.1437	2.80493		663.4	237	1,089	114.75%
Burrowing owl	0.5987	0.99769		347.3	65	630	1.9218	2.89118		1,114.6	691	2,304	220.98%
Golden eagle	0.1337	0.42424		77.6	19	136	0.1099	0.18621		63.8	-23	151	-17.78%
Red-tailed hawk	0.6899	1.15552		400.1	228	573	0.9476	0.95119		549.6	291	808	37.35%
<b>Total Target Species</b>	<b>1.9549</b>	<b>2.42372</b>		<b>1,133.9</b>	<b>252</b>	<b>632</b>	<b>4.1230</b>	<b>4.48816</b>		<b>2,391.4</b>	<b>378</b>	<b>1,639</b>	<b>110.91%</b>
Small Raptors	1.1313	1.63799		656.2	235	1,077	3.0656	4.18815		1,778.0	4,278	2,410	170.97%
Medium Raptors	0.0000	0.00000		0.0	-4	4	0.0105	0.05150		6.1	-1	13	---
Large Raptors	1.0908	1.57176		632.6	407	858	1.3576	1.05166		787.4	449	1,126	24.47%
<b>Total Raptors</b>	<b>2.221</b>	<b>2.69224</b>		<b>1,288.8</b>	<b>759</b>	<b>1,819</b>	<b>4.4337</b>	<b>4.56249</b>		<b>2,571.6</b>	<b>1,777</b>	<b>3,366</b>	<b>99.53%</b>
Small Non-Raptors	3.1733	3.93027		1,840.5	878	2,803	10.3100	9.38947		5,979.8	4,537	7,423	224.90%
Medium Non-Raptors	1.2592	2.64863		730.4	370	1,091	1.2471	1.10074		723.3	183	1,264	-0.96%
Large Non-Raptors	0.2700	0.52575		156.6	64	249	0.4359	0.71114		252.8	114	392	61.46%
<b>Total Non-Raptors</b>	<b>4.7025</b>	<b>5.13424</b>		<b>2,727.5</b>	<b>1,615</b>	<b>3,839</b>	<b>11.9930</b>	<b>10.22755</b>		<b>6,955.9</b>	<b>5,288</b>	<b>8,624</b>	<b>155.03%</b>

**Table ES 3. Comparison of Mortality Rates and Estimated Fatalities for the Diablo and Non- Diablo Turbines in the Current Study Period**

Species/category	Non- Diablo Turbines 2005-2007				Diablo Turbines 2005-2007				Percent Change in mortality rates and estimated fatalities		
	Average annual mortality rate (Adjusted fatalities/MW/year)		Estimated APWRA - wide average annual fatalities		Average annual mortality rate (Adjusted fatalities/MW/year)		Estimated APWRA - wide average annual fatalities				
	Mean	Standard Deviation	Mean	0.95 LCI	0.95 UCI	Mean	0.95 LCI	0.95 UCI			
American kestrel	0.9785	1.07278	567.6	346	789	0.1552	0.76013	90.0	-132	312	-84.14%
Burrowing owl	2.1932	2.55305	1,272.1	507	2,037	1.4454	3.75104	838.3	74	1,603	-34.10%
Golden eagle	0.1726	0.25457	100.1	41	159	0.0000	0.00000	0.0	0	0	---
Red-tailed hawk	0.9125	0.62667	529.2	417	642	0.1236	0.22668	71.7	-40	184	-86.45%
<b>Total Target Species</b>	<b>4.2568</b>	<b>3.61589</b>	<b>2,468.9</b>	<b>1,500</b>	<b>3,438</b>	<b>1.7242</b>	<b>4.46855</b>	<b>1,000.0</b>	<b>31</b>	<b>1,969</b>	<b>-59.50%</b>
Small Raptors	3.1718	3.39053	1,839.6	904	2,775	1.6006	4.39501	928.3	-7	1,864	-49.54%
Medium Raptors	0.0422	0.12794	24.5	0	48	0.0122	0.05986	7.1	-17	31	-71.02%
Large Raptors	1.6004	0.86578	928.2	777	1,080	0.1493	0.24623	86.6	-65	240	-90.67%
<b>Total Raptors</b>	<b>4.8144</b>	<b>3.93731</b>	<b>2,792.3</b>	<b>1,790</b>	<b>3,794</b>	<b>1.7621</b>	<b>4.45674</b>	<b>1,022.0</b>	<b>20</b>	<b>2,024</b>	<b>-63.40%</b>
Small Non-Raptors	13.2087	12.96473	7,661.1	5,306	10,016	2.9132	5.21336	1,689.7	-665	4,044	-77.94%
Medium Non-Raptors	1.6285	1.13725	944.5	733	1,156	0.2967	0.53202	172.1	-40	384	-81.78%
Large Non-Raptors	0.3519	0.33412	204.1	129	278	0.1241	0.28796	72.0	-2	146	-64.75%
<b>Total Non-Raptors</b>	<b>15.1892</b>	<b>13.92650</b>	<b>8,809.7</b>	<b>6,310</b>	<b>11,309</b>	<b>3.3340</b>	<b>5.10809</b>	<b>1,933.7</b>	<b>-566</b>	<b>4,434</b>	<b>-78.05%</b>

