

M56

APWRA Annual Monitoring Update & Next Steps

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CHAPTER 2. METHODS

Table 2-1. Allocation of Sampling Effort During the Baseline and Current Studies.

Study	Strings Searched	Annual Average Searches per String	Length of Study Period (Months)	Average Search Interval (days \pm SD)
Baseline (NREL)	102-150	5.8	55	68 \pm 50
Baseline (CEC)	244	2	9	99 \pm 11
Current Study	302-341	9.8	48	37 \pm 7

CHAPTER 2. METHODS

Table 2-2. Number and Percentage of Avian Fatalities by Study Period and Record Type.

Study	Survey	WRRS and Incidental (except golden eagle)	Total
Baseline	1,074 (97.6%)	41 (3.6%)	1,115
Current Study	3,351 (94.9%)	177 (5.0%)	3,528
Total	4,425 (95.3%)	218 (4.7%)	4,643

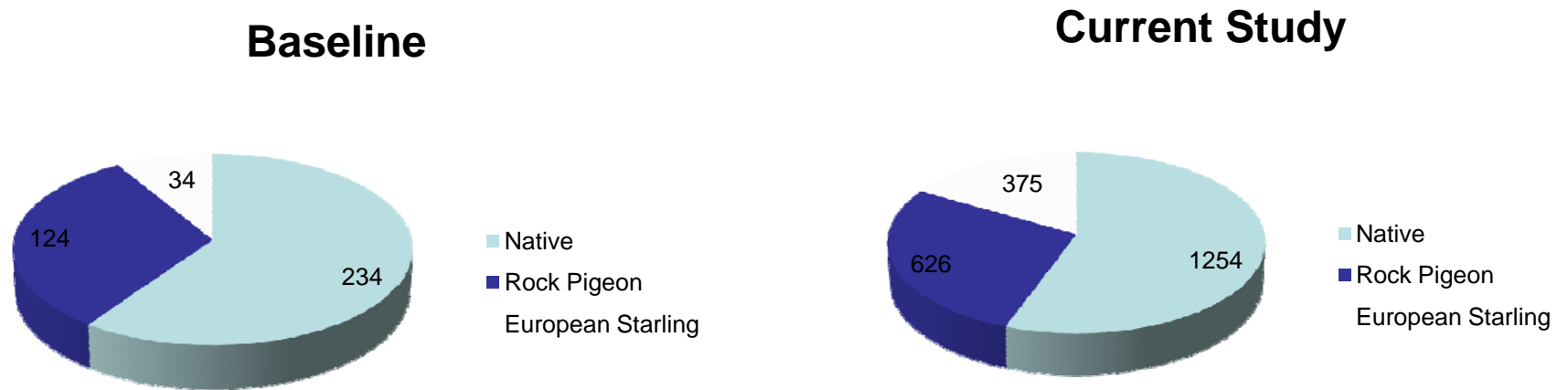
CHAPTER 2. METHODS

Table 2-3. Number and Percentage of Avian Turbine-Related Fatalities Comprised of Native and Non-Native Avian Species

Study	Native	Non-Native	Total
Baseline	824 (76.2%)	257 (23.8%)	1,081
Current Study	2,876 (65.8%)	1,492 (34.2%)	4,368
Total	3,700 (67.9%)	1,749 (32.1%)	5,449

CHAPTER 2. METHODS

Figure 2-2. Proportion of Turbine Related Non-Native Fatalities Documented in the Baseline and Current Studies.



CHAPTER 2. METHODS

Table 2-4. Number and Percentage of Native Avian Turbine-Related Fatalities Within and Beyond 125 Meters from Turbines.

Study	Within 125 Meters	Beyond 125 Meters	Total
Baseline	704 (98.1%)	14 (1.9%)	718
Current Study	3,226 (99.0%)	31 (1.0%)	3,257
Total	3,930 (98.9%)	45 (1.1%)	3,975

CHAPTER 2. METHODS

Table 2-5. Number and Percentage of Native Avian Turbine Related-Fatalities within 125 Meters Classified as Less or More than 90 Days

Study	Less than 90 days	More than 90 days	Total
Baseline	647 (74.9%)	217 (25.1%)	864
Current Study	2,790 (86.2%)	447 (13.8%)	2,558
Total	3,437 (83.8%)	664 (16.2%)	4,101

CHAPTER 3. RESULTS

Table 3-1. Number and Percentage of Native Turbine-Related Avian Fatalities For Raptors and Non-Raptors by Study.

Study	Raptor	Non-Raptor	Total
Baseline	453 (60%)	302 (40%)	755
Current Study	1,008 (45%)	1,225 (55%)	2,233
Total	1,461 (49%)	1,527 (51%)	2,988

CHAPTER 3. RESULTS

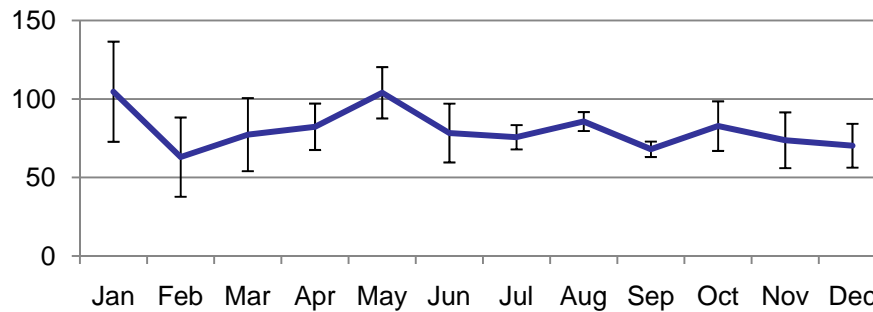
Table 3-2. Number and Percentage of Native Turbine-Related Avian Fatalities By Size Class and Study.

Study	Small	Medium	Large	Total
Baseline	304 (41%)	89 (12%)	362 (48%)	755
Current Study	1,013 (46%)	330 (15%)	890 (48%)	2,233
Total	1,317 (44%)	419 (14%)	1,252 (40%)	2,988

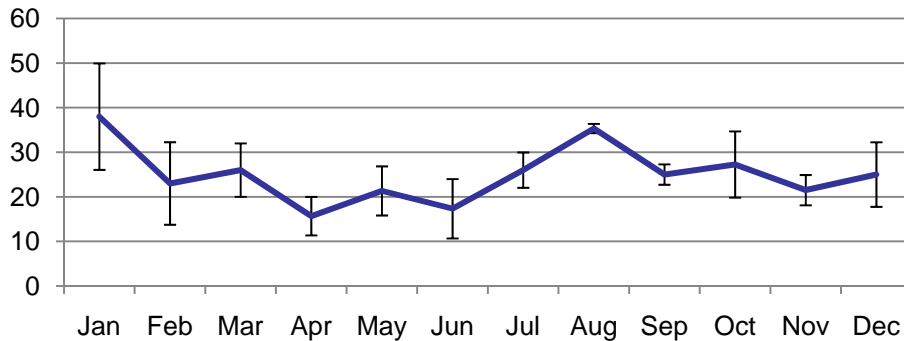
CHAPTER 3. RESULTS

Figure 3-1. Average Number of Turbine-Related Avian Fatalities per Month for All Birds, Raptors, and Non-Raptors During the Current Study.

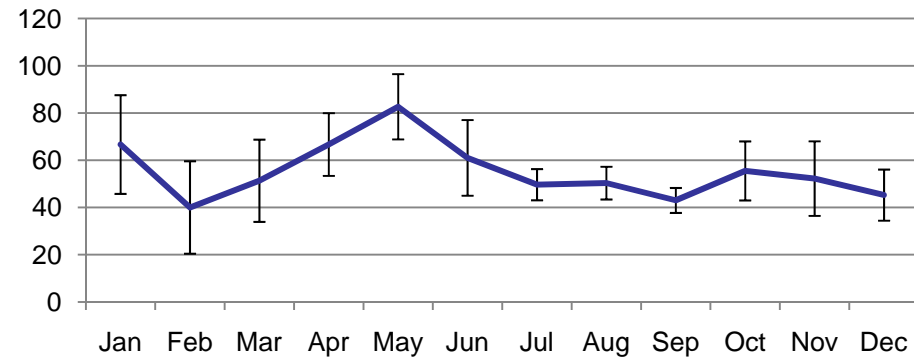
All Birds



Raptors



Non-Raptors

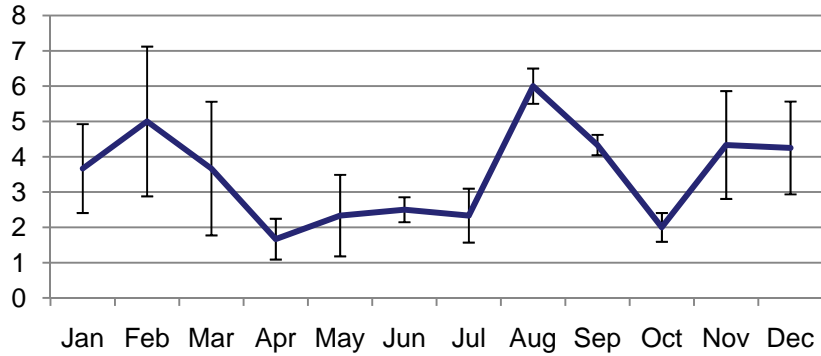


Fatalities Detected

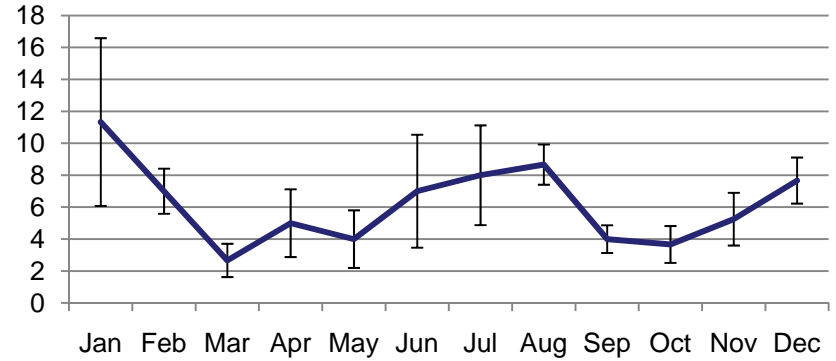
	Baseline	Current Study	Ratio C/B
American Kestrel	10±2	32±11	3.2
Burrowing Owl	14±5	53±22	3.8
Golden Eagle	8±2	22±8	2.8
Red Tailed Hawk	38±11	83±17	2.2
Average Focal Species	70	190	3.0
Small Raptors	24±6	84±32	3.5
Medium Raptors	2±0.5	10±2	5.0
Large Raptors	64±16	161±41	2.5
Average Total Raptors	90	255	3.7
Small Non-Raptors	49±12	260±82	5.3
Medium Non-Raptors	52±16	230±77	4.4
Large Non-Raptors	8±4	63±24	7.9
Average Non Raptors	109	323	5.9

Detections per Month

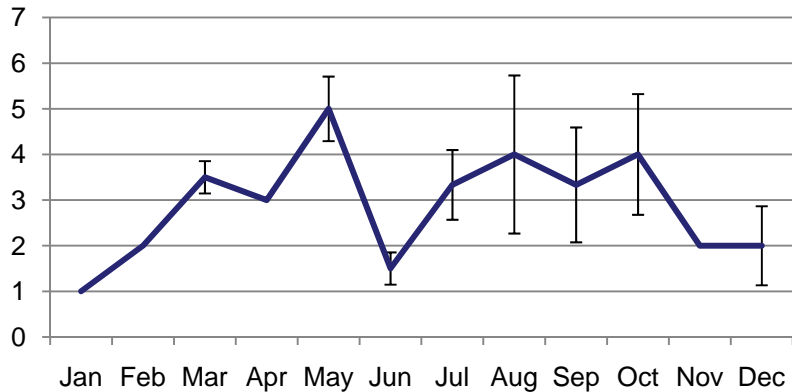
American Kestrel



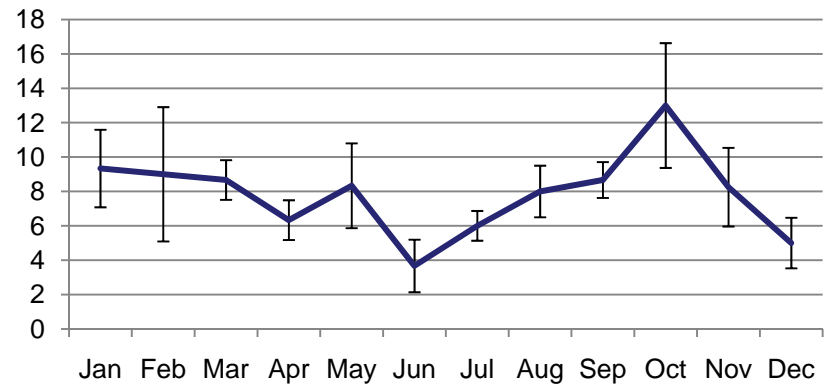
Burrowing Owl



Golden Eagle



Red Tailed Hawk



CHAPTER 3. RESULTS

Table 3-7. Percentage of Unadjusted Mortality during the Winter Period (Nov-Feb) Based on Backdate Using the Common Strings Dataset.

Study	American Kestrel	Burrowing Owl	Red-tailed Hawk	Golden Eagle
Baseline	50	43	47	29
Current Study	41	44	33	20

CHAPTER 3. RESULTS

Table 3-8. Percentage of Unadjusted Mortality during the Winter Period (Nov-Feb) Based on Discovery Date Using the Common Strings Dataset (note: change to all string dataset).

Bird Year	American Kestrel	Burrowing Owl	Red-tailed Hawk	Golden Eagle
2005	0	100	23	0
2006	25	44	32	33
2007	23	41	29	17
2008	36	56	23	17

Operating Groups of the APWRA

Operating Group	Company	ProjectSite	TurbineManufacturer	Maximum Turbines	Turbine Size (kw)	Nameplate Capacity (MW)
OP-15	AES SeaWest	Altech I	Enertech	144	40	5.76
OP-20	AES SeaWest	ESI (Johnson)	Enertech	26	60	1.56
OP-23	AES SeaWest	Santa Clara	Vestas	202	95	19.19
OP-18	AES SeaWest	Swamp (TV 11 & 12)	Micon	12	65	0.78
OP-16	AES SeaWest	Taxvest (AC/GB)	Micon	183	65	11.895
OP-22	AES SeaWest	Venture Winds	Polenko	12	100	1.2
OP-21	AES SeaWest	Venture Winds	Windmatic	26	65	1.69
OP-17	AES SeaWest	Viking '83	Micon	26	65	1.69
OP-08	Altamont Power	Altamont Power	Danwin	25	110	2.75
OP-10	Altamont Power	Altamont Power	Flowind	150	150	22.5
OP-09	Altamont Power	Altamont Power	Flowind	19	250	4.75
OP-13	Altamont Winds	EIF Altamont	Kenetech	100	100	10
OP-14	Altamont Winds	WEG	250KW	20	250	5
OP-11	Altamont Winds	WPP 87	Kenetech	500	100	50
OP-12	Altamont Winds	WPP 88	Kenetech	300	100	30
OP-29	Babcock & Brown	Tres Vaqueros	Howden	85	330	28.05
OP-30	Babcock & Brown	Tres Vaqueros	Howden	1	750	0.75
OP-32	enXco	Buena Vista	Danwin	14	160	2.24
OP-33	enXco	Buena Vista	Mitsubishi	38	1000	38
OP-31	enXco	Buena Vista	Nordtank	60	150	9
OP-37	enXco	Buena Vista	Windmaster	5	50	0.25
OP-36	enXco	Buena Vista	Windmaster	76	200	15.2
OP-35	enXco	Buena Vista	Windmaster	20	250	5
OP-24	enXco	Difwind 7	Bonus	200	120	24
OP-26	enXco	Difwind 9	Bonus	25	120	3
OP-25	enXco	Difwind 9	Bonus	100	150	15
OP-27a	enXco	Patterson Pass	Bonus	211	65	13.715
OP-27b	enXco	Patterson Pass	Nordtank	125	65	8.125
OP-28	enXco	WPP 89	Kenetech	117	100	11.7
OP-07	NextEra	Diablo	V-47	31	660	20.46
OP-01	NextEra	GRP	Kenetech	1491	100	149.1
OP-02	NextEra	GRP	KVS	41	400	16.4
OP-03	NextEra	WPP 90	Kenetech	150	100	15
OP-04	NextEra	WPP 91	Kenetech	163	100	16.3
OP-05	NextEra	WPP 91-2	Kenetech	279	100	27.9
OP-06	NextEra	WPP 92	Kenetech	300	100	30
OP-38	Wintec	Northwind	Nordtank	186	65	12.09

Monitored Capacity by Operating Group

Operating Group	1998	1999	2000	2001	2002	2005	2006	2007	2008
OP-01		6.6	6.6	6.6	86.1	40.4	55.7	55.7	55.7
OP-02		6.4	6.4	6.4	8	14.8	14.8	14.8	14.8
OP-03		1.8	1.8	1.8	15.1	15.4	19	19	19
OP-04		9.6	6.5	9.6	1.1	2.1	3.2	3.2	3.2
OP-05		5.2	5.2	5.2	17.2	4.4	18	18	18
OP-06					24.7	5	10.2	10.2	10.2
OP-07						20.46	20.46	20.46	20.46
OP-08	2.09	1.32	0.44	0.33					
OP-09	4.75	4.75							
OP-10	17.55	14.4							
OP-11		9.6	9.6	9.6	15.2	14	18.1	18.1	18.1
OP-12		2.2	2.2	2.2	22.6	10.3	19.9	19.9	19.9
OP-13		7.4	7.4	7		4	5.2	5.2	5.2
OP-14					5	5	5	5	5
OP-15			5.76	5.76		5.76	5.76	5.76	5.76
OP-16			11.895	11.895		11.895	11.895	11.895	11.895
OP-17			1.69	1.69		1.69	1.69	1.69	1.69
OP-18			0.78	0.78		0.78	0.78	0.78	0.78
OP-20			1.56	1.56					
OP-21			1.625	1.625		1.625	1.625	1.625	1.625
OP-22			1.265	1.265		1.265	1.265	1.265	1.265
OP-23	19.19	19.19	19.19	19.19		12.255	12.255	12.255	12.255
OP-24	24.06	24.06	23.34	23.34		13.2	14.64	14.64	14.64
OP-25	15.36	15.36	15.36	15.36		6.45	6.45	6.45	6.45
OP-26	2.64	2.64	2.64	2.64		2.64	2.64	2.64	2.64
OP-27a					13.975	14.3	14.3	14.3	14.3
OP-27b					7.54	7.54	7.54	7.54	7.54
OP-28					13.3	4.5	4.5	4.5	4.5
OP-29					24.75	24.75	13.2	13.2	13.2
OP-30					1.41	1.41	1.41	1.41	1.41
OP-31					11.74				
OP-32					0.8				
OP-38					8.385				
Grand Total	85.64	130.52	131.245	133.835	276.9	245.92	289.51	289.51	289.51

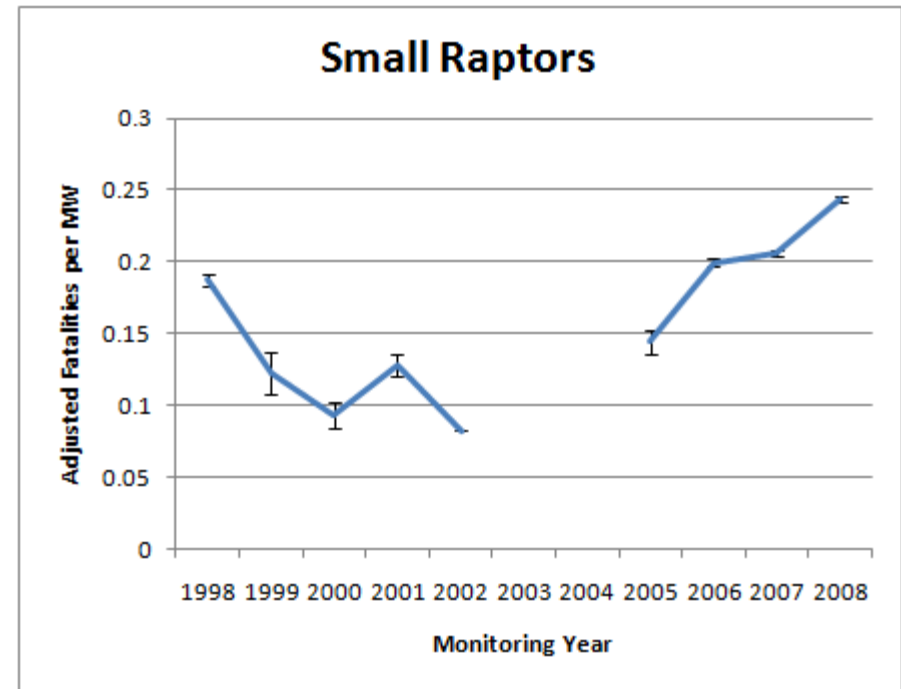
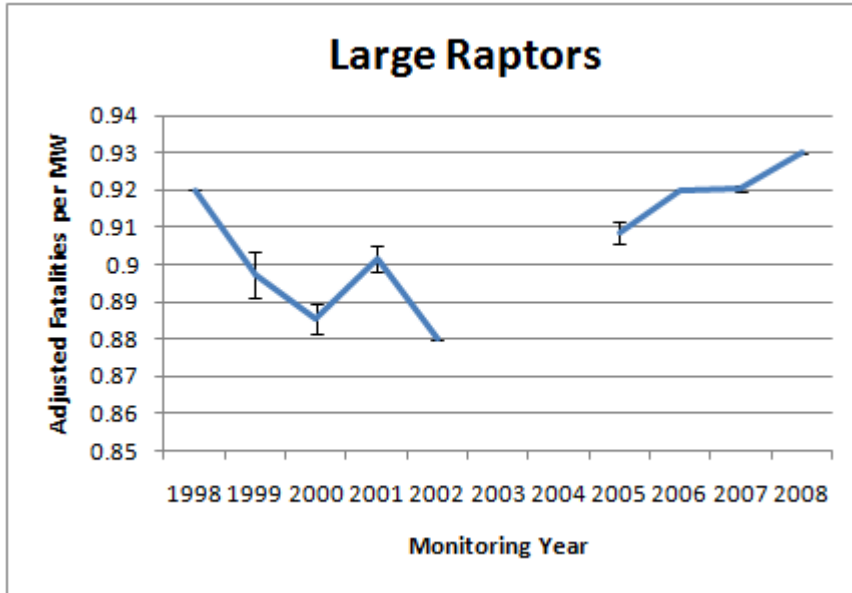
Search Interval by Operating Group

Operating Group	1998	1999	2000	2001	2002	2005	2006	2007	2008
OP-01		50.0	196.2	47.0	98.4	48.7	36.3	35.1	30.0
OP-02		53.5	195.0	51.0	95.3	47.4	36.7	35.0	30.0
OP-03		54.0	181.0	57.0	101.5	50.3	35.7	35.0	29.9
OP-04		52.5	188.6	106.0	104.0	51.6	35.2	35.0	29.8
OP-05		93.0	178.4	55.4	95.5	49.3	37.2	34.7	30.0
OP-06					110.7	47.8	36.8	35.2	29.8
OP-07						33.6	36.0	32.5	30.0
OP-08	36.6	54.0	366.5	58.0					
OP-09	40.0	54.3							
OP-10	38.7	64.8							
OP-11		48.4	191.4	55.7	99.9	53.2	38.1	34.9	29.6
OP-12		38.0	181.0	58.0	100.7	48.7	35.9	35.0	29.7
OP-13		53.0	181.2	57.0		52.0	35.6	34.6	30.0
OP-14					90.0	50.7	35.7	35.3	30.0
OP-15			73.9	56.1		55.9	34.7	35.0	29.6
OP-16			69.2	50.5		55.7	35.8	34.3	30.0
OP-17			84.4	62.8		56.0	36.0	35.0	30.0
OP-18			77.3	56.7		56.0	35.0	35.0	30.0
OP-20			98.8	46.0					
OP-21			106.5	52.0		49.0	37.0	35.0	30.0
OP-22			102.0	54.0		49.0	37.0	35.0	30.0
OP-23	39.1	80.0	57.2	59.2		47.3	37.0	34.4	29.9
OP-24	39.8	89.5	62.6	59.2		50.8	36.7	35.0	30.0
OP-25	40.8	74.2	57.8	59.3		52.4	38.3	36.4	29.9
OP-26	39.3	162.2	56.2	59.0		53.0	36.0	35.5	30.0
OP-27a					91.0	52.4	35.6	34.5	29.8
OP-27b					86.2	52.6	35.3	34.6	30.0
OP-28					105.3	47.7	37.0	35.3	30.0
OP-29					110.9	48.3	36.3	34.5	30.2
OP-30					118.0	51.0	38.0	34.0	30.0
OP-31					109.9				
OP-32					111.0				
OP-38					108.3				
Grand Average	39.4	76.4	97.9	58.0	99.0	50.5	36.2	34.8	29.9

Search Interval by Operating Group

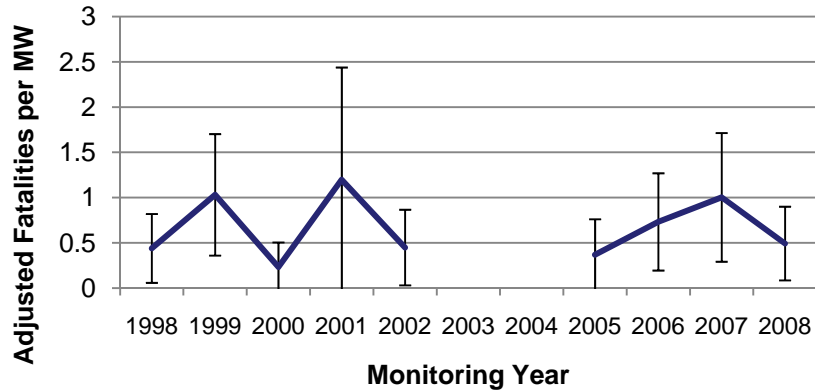
Operating Group	1998	1999	2000	2001	2002	2005	2006	2007	2008
OP-01		50.0	196.2	47.0	98.4	48.7	36.3	35.1	30.0
OP-02		53.5	195.0	51.0	95.3	47.4	36.7	35.0	30.0
OP-03		54.0	181.0	57.0	101.5	50.3	35.7	35.0	29.9
OP-04		52.5	188.6	106.0	104.0	51.6	35.2	35.0	29.8
OP-05		93.0	178.4	55.4	95.5	49.3	37.2	34.7	30.0
OP-06					110.7	47.8	36.8	35.2	29.8
OP-07						33.6	36.0	32.5	30.0
OP-08	36.6	54.0	366.5	58.0					
OP-09	40.0	54.3							
OP-10	38.7	64.8							
OP-11		48.4	191.4	55.7	99.9	53.2	38.1	34.9	29.6
OP-12		38.0	181.0	58.0	100.7	48.7	35.9	35.0	29.7
OP-13		53.0	181.2	57.0		52.0	35.6	34.6	30.0
OP-14					90.0	50.7	35.7	35.3	30.0
OP-15			73.9	56.1		55.9	34.7	35.0	29.6
OP-16			69.2	50.5		55.7	35.8	34.3	30.0
OP-17			84.4	62.8		56.0	36.0	35.0	30.0
OP-18			77.3	56.7		56.0	35.0	35.0	30.0
OP-20			98.8	46.0					
OP-21			106.5	52.0		49.0	37.0	35.0	30.0
OP-22			102.0	54.0		49.0	37.0	35.0	30.0
OP-23	39.1	80.0	57.2	59.2		47.3	37.0	34.4	29.9
OP-24	39.8	89.5	62.6	59.2		50.8	36.7	35.0	30.0
OP-25	40.8	74.2	57.8	59.3		52.4	38.3	36.4	29.9
OP-26	39.3	162.2	56.2	59.0		53.0	36.0	35.5	30.0
OP-27a					91.0	52.4	35.6	34.5	29.8
OP-27b					86.2	52.6	35.3	34.6	30.0
OP-28					105.3	47.7	37.0	35.3	30.0
OP-29					110.9	48.3	36.3	34.5	30.2
OP-30					118.0	51.0	38.0	34.0	30.0
OP-31					109.9				
OP-32					111.0				
OP-38					108.3				
Grand Average	39.4	76.4	97.9	58.0	99.0	50.5	36.2	34.8	29.9

Mean \pm 1/2 SD Detection Probability as a Function of Search Interval and Searcher Efficiency Estimates (Smallwood, 2007)

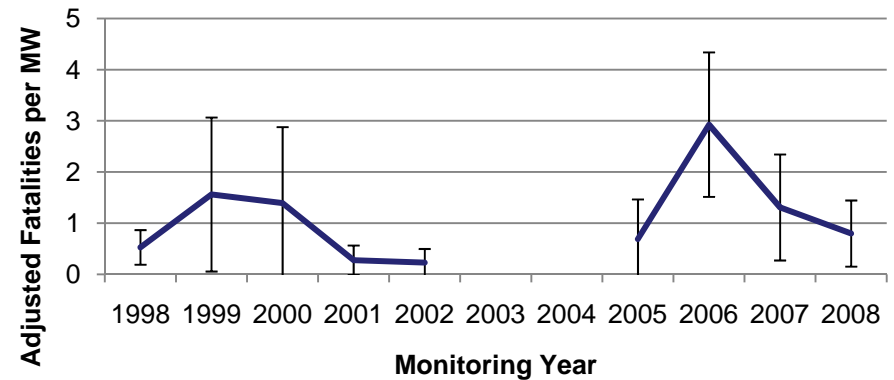


Adjusted Rates for Focal Species

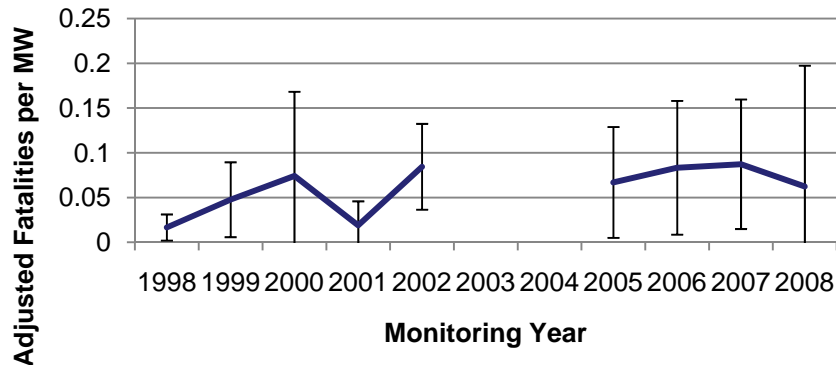
American Kestrel



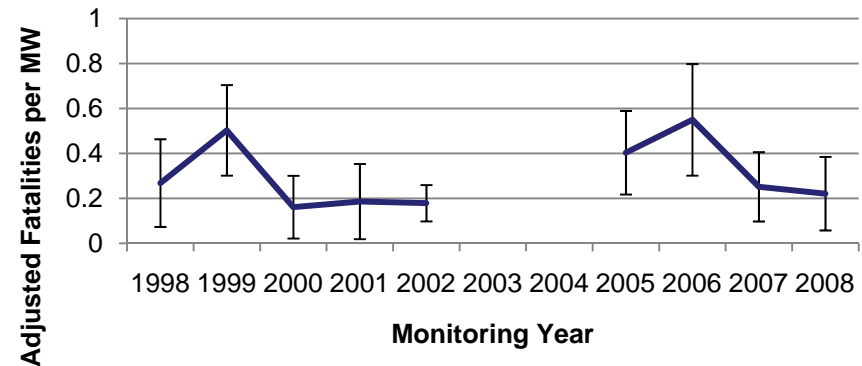
Burrowing Owl



Golden Eagle



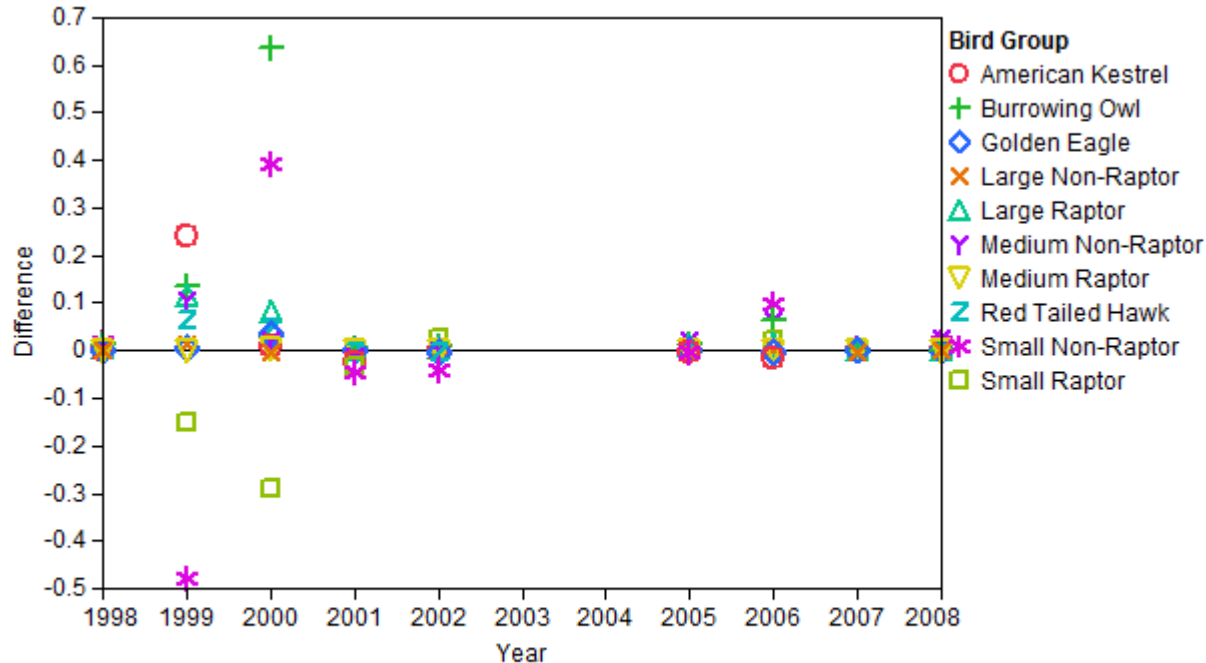
Red Tailed Hawk



Coverage

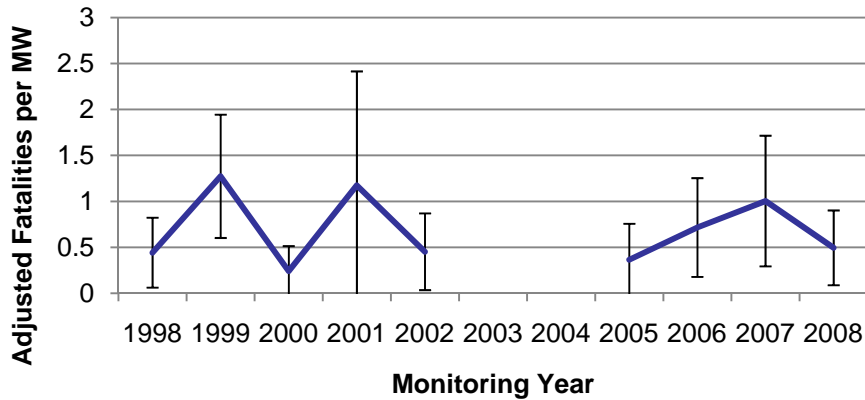
Op Group	1998	1999	2000	2001	2002	2005	2006	2007	2008
OP-01		79%	21%	89%	27%	90%	87%	100%	100%
OP-02		81%	21%	89%	26%	92%	100%	100%	100%
OP-03		89%	23%	89%	28%	91%	95%	100%	100%
OP-04		66%	22%	84%	28%	91%	92%	100%	100%
OP-05		83%	21%	88%	26%	89%	72%	100%	100%
OP-06					30%	93%	83%	100%	100%
OP-07						100%	100%	100%	100%
OP-08	83%	26%	44%	71%					
OP-09	95%	28%							
OP-10	91%	34%							
OP-11		74%	21%	88%	27%	93%	83%	100%	99%
OP-12		85%	21%	92%	28%	91%	80%	100%	98%
OP-13		78%	20%	92%		92%	90%	100%	100%
OP-14					25%	92%	100%	100%	100%
OP-15			65%	82%		96%	100%	100%	100%
OP-16			62%	81%		94%	100%	100%	100%
OP-17			74%	83%		97%	100%	100%	100%
OP-18			67%	81%		97%	100%	100%	100%
OP-20			61%	86%					
OP-21			62%	86%		96%	100%	100%	100%
OP-22			59%	86%		96%	100%	100%	100%
OP-23	90%	97%	92%	81%		93%	100%	100%	100%
OP-24	95%	76%	86%	74%		92%	96%	100%	98%
OP-25	97%	81%	92%	81%		91%	99%	97%	91%
OP-26	93%	23%	90%	81%		95%	100%	100%	100%
OP-27a					25%	88%	100%	100%	99%
OP-27b					24%	89%	100%	100%	96%
OP-28					29%	93%	100%	100%	100%
OP-29					30%	66%	95%	100%	100%
OP-30					32%	88%	100%	100%	100%
OP-31					30%				
OP-32					30%				
OP-38					30%				

Difference in Adjusted Fatalities per MW by Year: Weighted Average minus Average

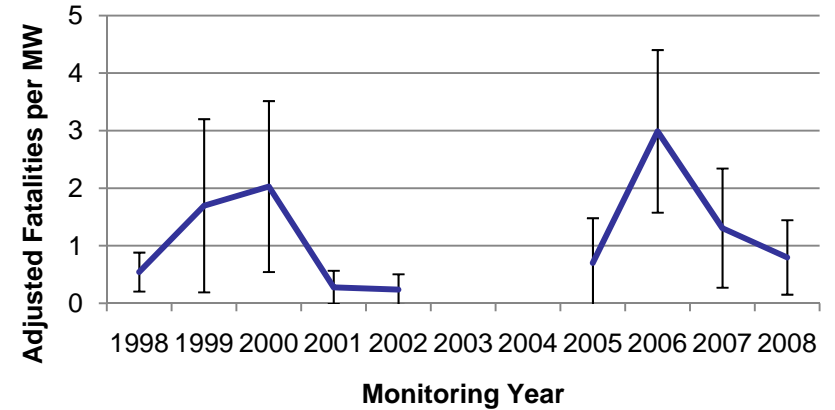


Weighted Adjusted Rates for Focal Species

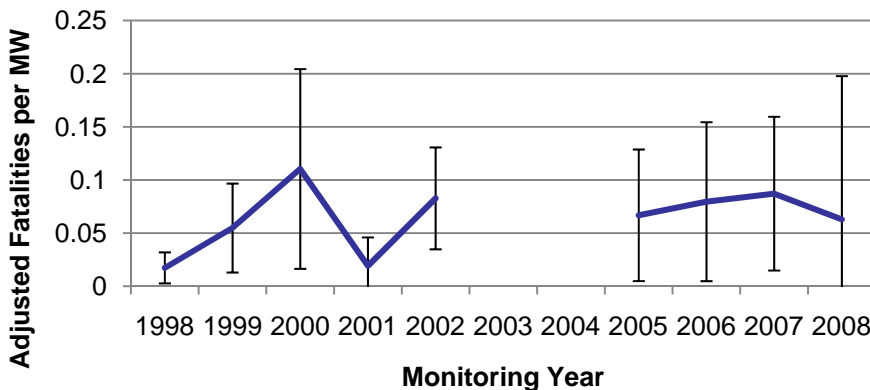
American Kestrel



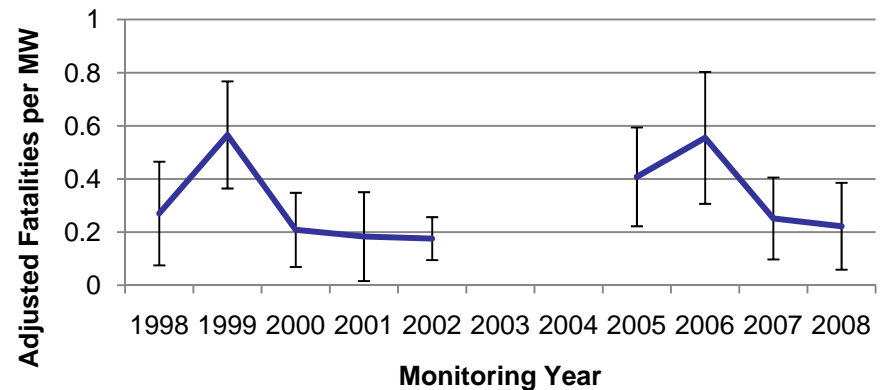
Burrowing Owl



Golden Eagle

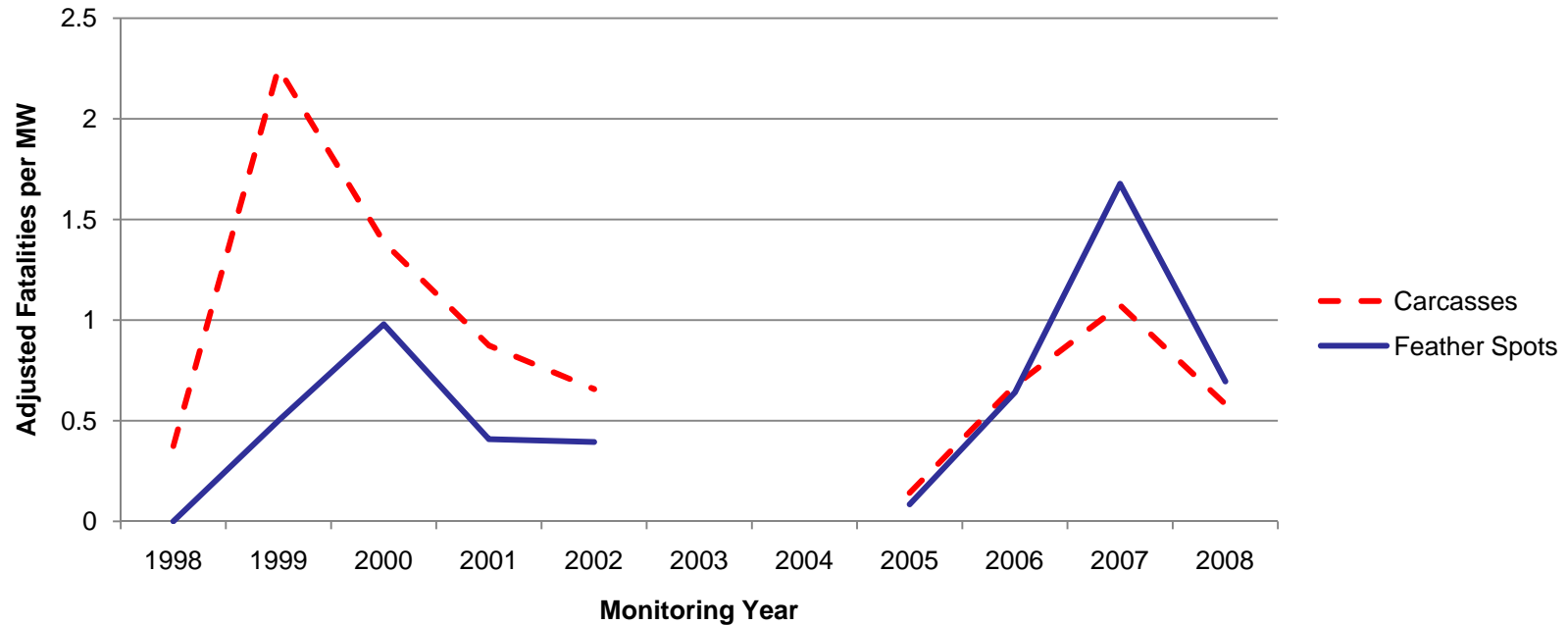


Red Tailed Hawk



Annual Small Raptor Adjusted Fatality Rate by Fatality Type

Adjusted Small Raptors per MW



Installed Capacity

Row Labels	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
OP-01	140.1	140.7	138.6	135.8	140.7	131.7	127.9	114.9	111.2	107.5	101.3	97.8
OP-02	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4
OP-03	15	15	15	15	15	12.6	13.4	12.8	11.9	11.1	9	8.4
OP-04	16.3	16.3	16.3	16.3	19.9	17.2	17.3	18.1	20.1	16.6	16.2	13.1
OP-05	26.1	26.1	26.1	26.1	26	22.2	22.4	22.1	21.1	19.8	17.8	17
OP-06	28.9	28.9	28.9	28.9	28.8	25.7	26.9	26.1	25	23.2	20.1	19.4
OP-07	0	0	0	0	0	0	0	20.46	20.46	20.46	20.46	20.46
OP-08	2.42	2.09	1.54	1.21	1.21	1.21	1.21	1.21	1.21	1.21	0	0
OP-09	3.25	3.25	3.25	2.5	0.75	2.5	2.5	0	0	0	0	0
OP-10	15.3	14.55	11.4	10.2	10.2	10.2	10.2	0	0	0	0	0
OP-11	50	47.2	46.3	46.3	45.5	44.8	45.1	45.5	47.5	46.7	45	43.7
OP-12	30	28	27.7	27.6	27.6	27.2	27.8	28	29.3	29.2	29	28.4
OP-13	10	9	9	8.9	9.2	9	8.9	8.9	9.5	9.5	9.4	9.2
OP-14	5	5	5	5	5	5	5	5	5	5	5	5
OP-15	5.76	5.76	5.76	5.76	5.76	5.76	5.76	5.76	5.72	5.72	5.72	5.44
OP-16	11.895	11.895	11.895	11.895	11.895	11.895	11.57	11.57	11.57	11.44	11.31	11.31
OP-17	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69
OP-18	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.715
OP-19	0	0	0	0	0	0	0	0	0	0	0	0
OP-20	1.56	1.56	1.56	1.56	1.56	1.56	1.56	0	0	0	0	0
OP-21	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.495	1.495	1.495	1.495	1.43
OP-22	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.1	1.1
OP-23	19	19	19	19	19	19	19	18.81	18.335	18.335	18.335	18.335
OP-24	24	24	24	24	24	24	24	24	24	24	23.28	21.96
OP-25	15	15	15	15	15	15	15	15	15	15	15	12.6
OP-26	3	3	3	3	3	3	3	3	3	3	3	3
OP-27a	13.715	13.715	13.715	13.715	13.715	13.715	13.715	13.715	13.715	13.715	13.715	13.715
OP-27b	8.125	8.125	8.125	8.125	8.125	8.125	8.125	8.125	8.125	8.125	8.125	8.125
OP-28	11.7	11.7	11.7	11.7	11.6	11.6	11.6	10.9	9.7	9.4	6.6	5.9
OP-29	27.39	27.39	26.07	26.07	26.07	24.75	24.75	24.09	24.09	23.1	21.78	15.18
OP-30	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
OP-31	0	0	3.3	9	9	9	9	9	9	0	0	0
OP-32	0	0	0.32	2.24	2.24	2.24	2.24	2.24	2.24	0	0	0
OP-33	0	0	0	0	0	0	0	0	0	38	38	38
OP-34	4.5	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	0	0	0
OP-35	7.5	0	0	0	0	0	0	0	0	0	0	0
OP-36	25.8	0	0	0	0	0	0	0	0	0	0	0
OP-37	0.25	0	0	0	0	0	0	0	0	0	0	0
OP-38	12.09	12.09	12.09	12.09	12.09	12.09	12.09	12.09	12.09	12.09	12.09	12.09

Next Steps

- Turbines and Removals – Op Group Installed Capacity
- Complete Fatality Type Analysis
- Expansions – Installed & Address
- Winter Shutdown Analysis

- 2009-2010 Data Input & QA/QC
- Quarterly Report Services