

APWRA Analysis of Monitoring Data

10-19-2009

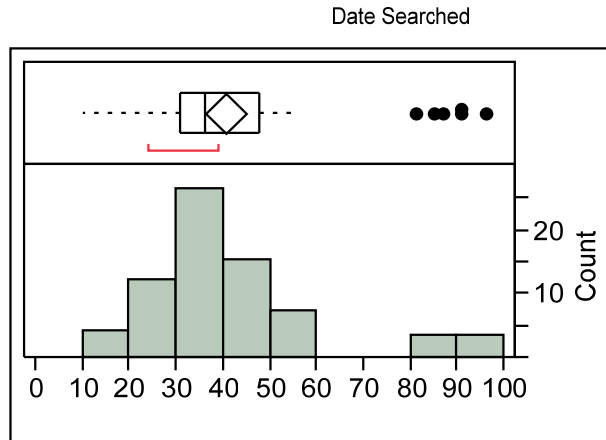
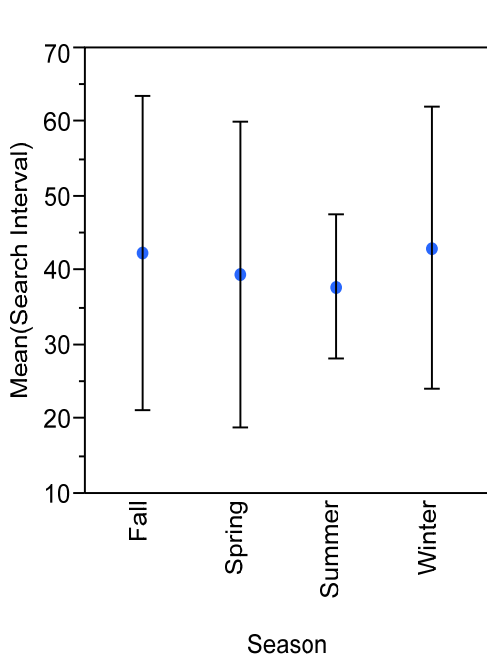
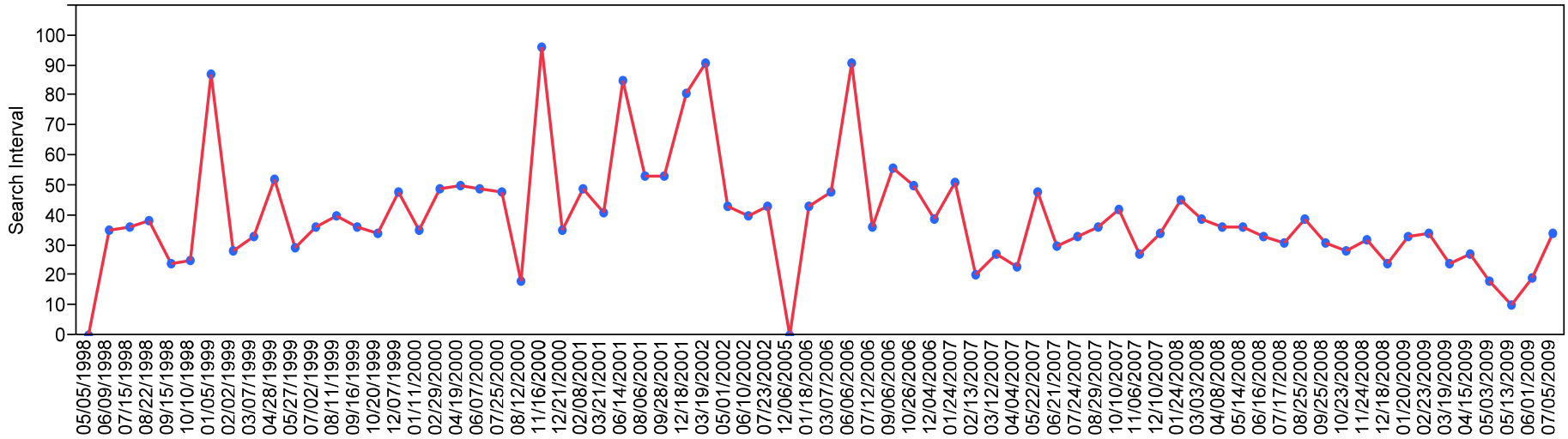
Jesse Schwartz

ICFI

Outline

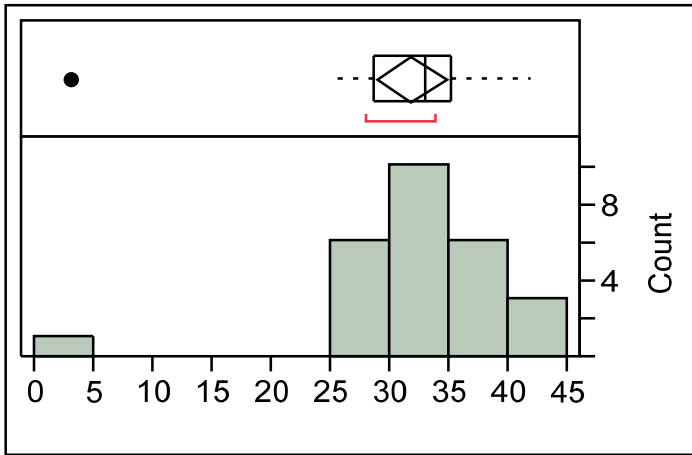
- String characteristics
- Operational Capacity
- Baseline & current fatalities
 - Rich string poor string
 - Fatality types
 - Adjusted fatalities
 - APRWA wide expansions
- Shut-Down Analysis
- Diablo Winds Comparisons

String 63

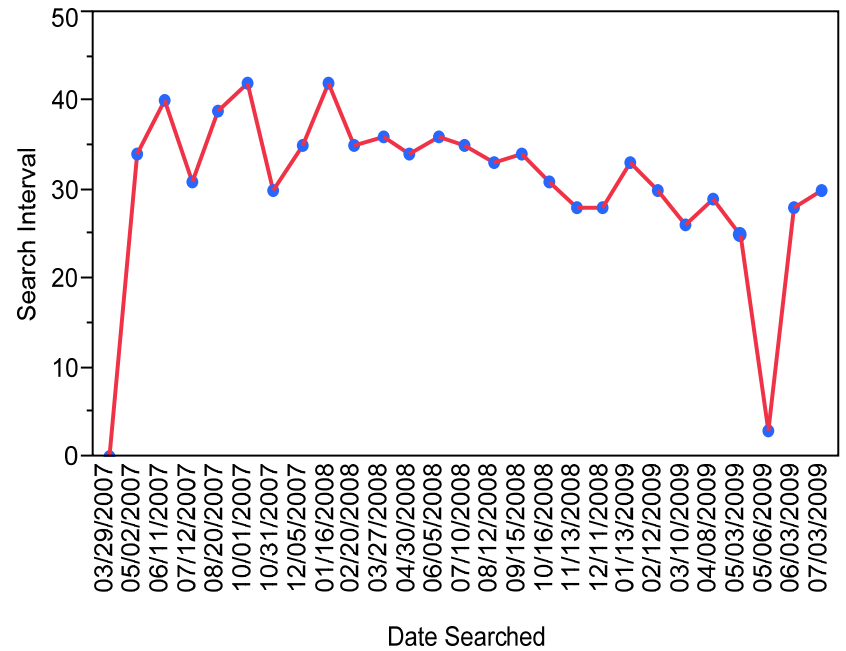
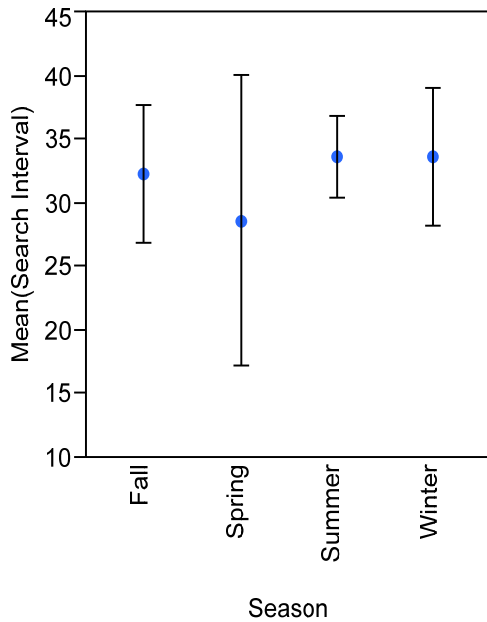


Mean	40.671429
Std Dev	17.694445
Std Err Mean	2.1148907
Upper 95% Mean	44.89052
Lower 95% Mean	36.452337
N	70

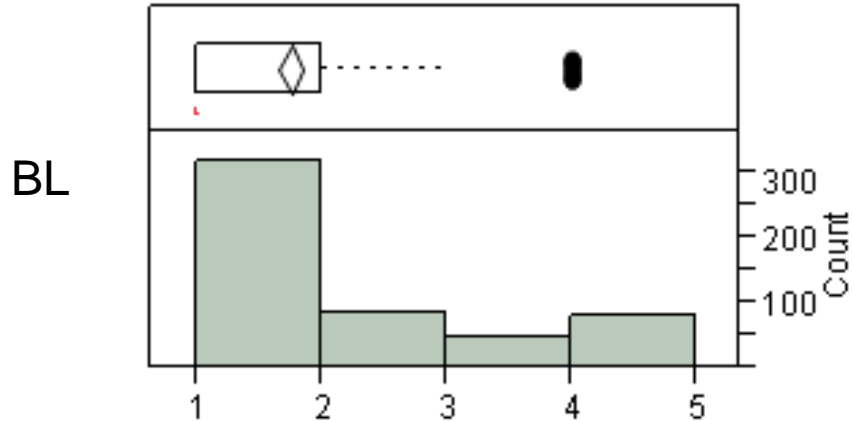
String 618



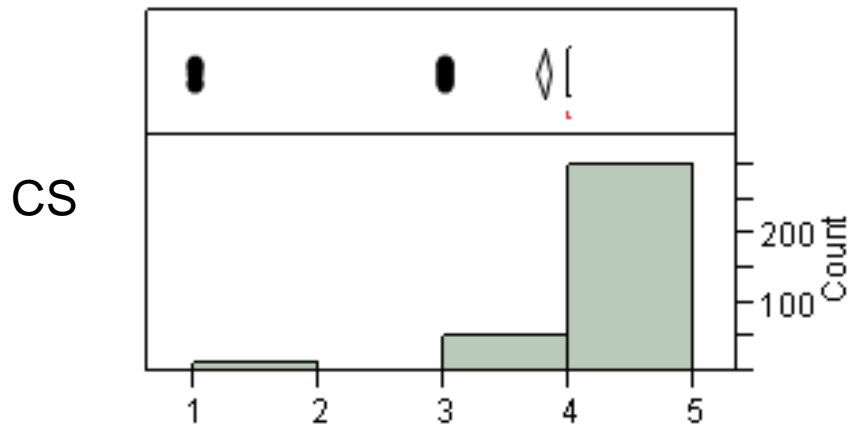
Mean	31.807692
Std Dev	7.4351556
Std Err Mean	1.458154
Upper 95% Mean	34.810817
Lower 95% Mean	28.804568
N	26



Years Monitored by String

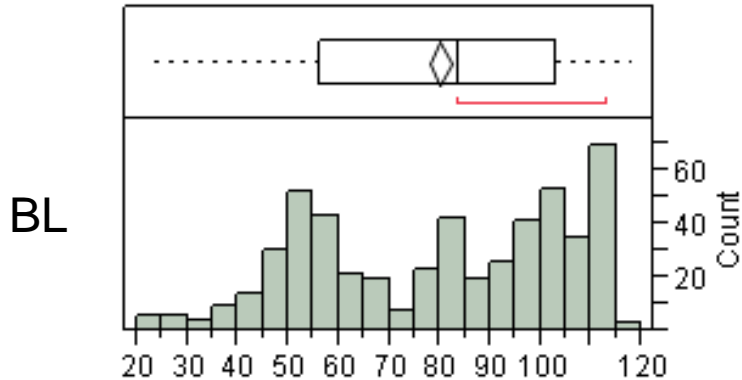


Mean	1.76494
Std Dev	1.11446
Std Err Mean	0.04974
Upper 95% Mean	1.86266
Lower 95% Mean	1.66721
N	502

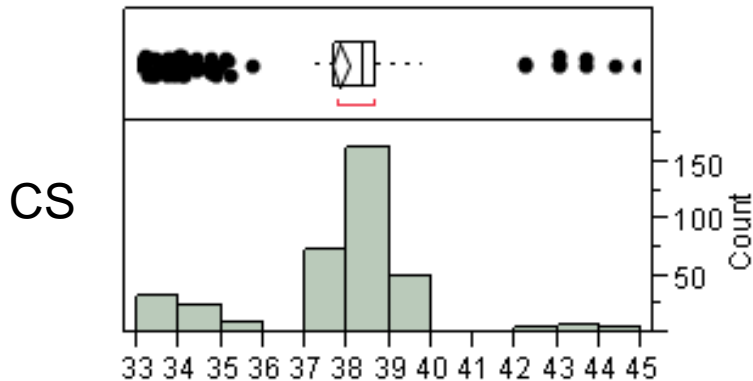


Mean	3.80747
Std Dev	0.52625
Std Err Mean	0.02821
Upper 95% Mean	3.86295
Lower 95% Mean	3.75198
N	348

Search Interval by String



Mean	80.0736
Std Dev	24.7943
Std Err Mean	1.10662
Upper 95% Mean	82.2478
Lower 95% Mean	77.8994
N	502



Mean	37.8383
Std Dev	2.00789
Std Err Mean	0.10763
Upper 95% Mean	38.0500
Lower 95% Mean	37.6266
N	348

Rich String Poor String

- Number of years
- Number of searches per year
- Search interval

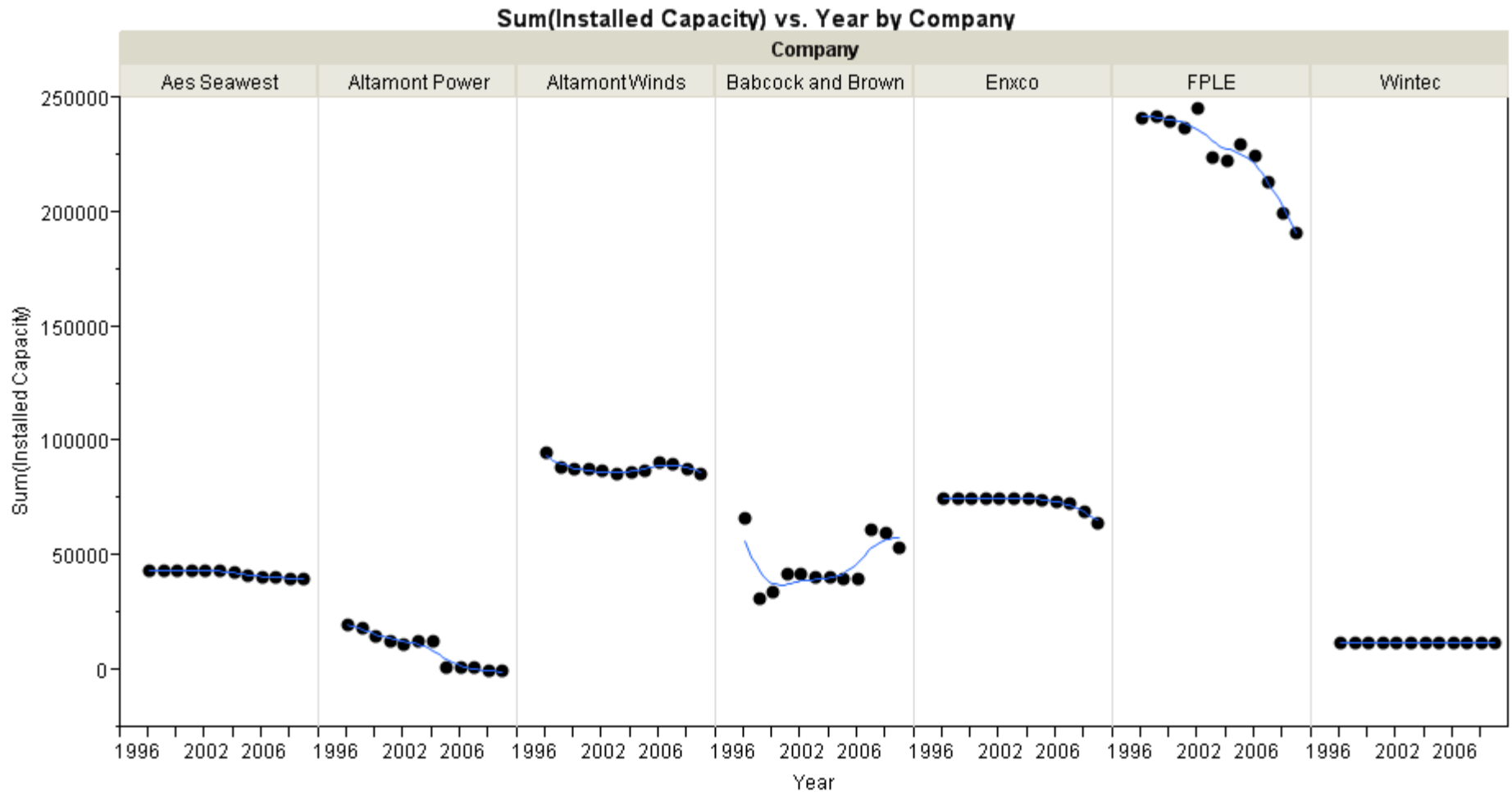
For this presentation:

- 1) 3 yrs of data
- 2) 6+ searches per year
- 3) Search interval <60 days
- 4) By individual strings & monitoring years

Operational Capacity

- APWRA-wide data
- String field data
- Next steps

Installed Operational Capacity



Monitored Strings Installed Capacity

String	Year	Percent Inst	Op Cap
100	1998	100	1235
100	1999	100	1235
100	2000	100	1235
100	2001	100	1235
100	2005	100	1235
100	2006	100	1235
100	2007	30.76923	380
100	2008	30.76923	380

Next Steps:

- 1) Peer review
Inst Cap Data
- 2) Peer review MT
Op Cap
Results
- 3) Where
possible, future
expansions
based on ind
Op Groups

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Fatality Information

- Data as of 10/16/2009
- General filters for BL-CS comparison
 - Between dates
 - Not WRRS
 - Not incidental or Injury
 - Days dead < 90
 - Not parts
 - <120m from turbine
 - Complete record
 - Turbine related

Fatality Data Quality

- Schwartz Estimate – ½-1% Data corruption rate
- Some fatalities do not match search dates or strings
- Some turbine data is still being reviewed

Records by Source

Source	Avian Group	Number of Records
Baseline	MAMMAL	4
Baseline	NON-RAPTOR	629
Baseline	RAPTOR	504
CS	MAMMAL	12
CS	NON-RAPTOR	2920
CS	RAPTOR	1237
KB	MAMMAL	3
KB	NON-RAPTOR	121
KB	RAPTOR	33
WRRS	MAMMAL	2
WRRS	NON-RAPTOR	28
WRRS	RAPTOR	41
WRRS Baseline	NON-RAPTOR	14
WRRS Baseline	RAPTOR	19

Backdated Out of Study

Period	Number of Records
Before 10/1998	64
Between 05/2003 & 10/2005	132
Null Year.Month	0

Incidentals

Source	Avian Group	Number of Incidentals
Baseline	NON-RAPTOR	12
Baseline	RAPTOR	14
CS	NON-RAPTOR	40
CS	RAPTOR	55

Number of Injuries

Source	Avian Group	Number of Injuries
Baseline	NON-RAPTOR	5
Baseline	RAPTOR	15
CS	NON-RAPTOR	7
CS	RAPTOR	5

Turbine Distance

Distance	Study Period	Avian Group	Number of Records			Distance	Study Period	Avian Group	Number of Records	
Missing	Baseline	NON-RAPTOR	6	1%		Missing	CS	NON-RAPTOR	2	0%
>125	Baseline	NON-RAPTOR	1	0%		>125	CS	NON-RAPTOR	17	1%
60-125	Baseline	NON-RAPTOR	26	4%		60-125	CS	NON-RAPTOR	212	8%
<60	Baseline	NON-RAPTOR	546	94%		<60	CS	NON-RAPTOR	2502	92%
<u>Total</u>			<u>579</u>			<u>Total</u>			<u>2733</u>	
Missing	Baseline	RAPTOR	1	0%		Missing	CS	RAPTOR	1	0%
>125	Baseline	RAPTOR	4	1%		>125	CS	RAPTOR	16	1%
60-125	Baseline	RAPTOR	28	6%		60-125	CS	RAPTOR	151	14%
<60	Baseline	RAPTOR	418	93%		<60	CS	RAPTOR	948	85%
<u>Total</u>			<u>451</u>			<u>Total</u>			<u>1116</u>	

Turbine Related

Source	Avian Group	Cause of Death	Number of Records
Not Turbine Related	Baseline	NON-RAPTOR	8
Not Turbine Related	Baseline	RAPTOR	8
Not Turbine Related	CS	NON-RAPTOR	82
Not Turbine Related	CS	RAPTOR	26
Turbine Related	Baseline	NON-RAPTOR	564
Turbine Related	Baseline	RAPTOR	438
Turbine Related	CS	NON-RAPTOR	2632
Turbine Related	CS	RAPTOR	1073

Filtered Fatalities

Fatality Type	Source	Avian Group	Number of Records
Carcass	Baseline	NON-RAPTOR	383
Carcass	Baseline	RAPTOR	381
Carcass	CS	NON-RAPTOR	1587
Carcass	CS	RAPTOR	781
Feather Spot	Baseline	NON-RAPTOR	181
Feather Spot	Baseline	RAPTOR	57
Feather Spot	CS	NON-RAPTOR	1045
Feather Spot	CS	RAPTOR	292

Fatality Types

Bird Year	Carcasses	Feather Spots	Total	Percent Feather Spots	
1998	153	13	166	8%	
1999	167	24	191	13%	
2000	149	48	197	24%	
2001	167	95	262	36%	
2002	130	58	188	31%	22%
2005	418	137	555	25%	
2006	633	475	1108	43%	
2007	733	485	1218	40%	
2008	558	239	797	30%	34%
Totals	3108	1574	4682		

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Fatalities per Search

Bird Year	Carcasses	Feather Spots	Total	Number of Searches	Carcasses per Search	Feather Spots per Search	Fatalities per Search
1998	153	13	166	925	0.17	0.01	0.18
1999	167	24	191	715	0.23	0.03	0.27
2000	149	48	197	749	0.20	0.06	0.26
2001	167	95	262	1011	0.17	0.09	0.26
2002	130	58	188	580	0.22	0.10	0.32
Ave				796	0.20	0.06	0.26
2005	418	137	555	2118	0.20	0.06	0.26
2006	633	475	1108	3216	0.20	0.15	0.34
2007	733	485	1218	3582	0.20	0.14	0.34
2008	558	239	797	4104	0.14	0.06	0.19
Ave				3255	0.18	0.10	0.29

Fatalities by String (Type)

String	Monitoring Year	Number of Searches	Average Search Interval	Search Interval Std Dev	Max Search Interval	% Inst Cap	Inst Cap	Carcasses Detected	Feather Spots Detected
1001	2005	11	34	13	70	100	1980	1	1
1001	2006	10	37	16	79	100	1980		
1001	2007	11	32	5	39	100	1980		
1001	2008	12	30	4	39	100	1980	1	
1002	2005	11	34	14	70	100	1320	4	
1002	2006	10	37	16	79	100	1320	1	3
1002	2007	11	32	5	39	100	1320	1	
1002	2008	12	30	4	39	100	1320		4
1003	2005	11	34	14	70	100	1980	1	
1003	2006	10	37	14	71	100	1980		
1003	2007	11	32	5	39	100	1980	2	
1003	2008	12	30	4	39	100	1980	1	2
1004	2005	11	34	15	71	100	660	1	2
1004	2006	10	37	14	71	100	660	2	
1004	2007	11	32	5	39	100	660	2	
1004	2008	12	30	5	40	100	660	1	

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Raw RTHA Fatalities

DQ	Bird Year	#Strin gs	Carc/ MW	FS/M W	AVE		DQ	Bird Year	#Strin gs	Carc/ MW	FS/M W	AVE
Moderate	1998	105	0.26	0.00			Poor	1999	69	0.33	0.00	
Moderate	1999	71	0.47	0.01			Poor	2000	126	0.19	0.00	
Moderate	2000	44	0.18	0.00			Poor	2001	37	0.18	0.05	
Moderate	2001	131	0.41	0.01	<u>0.33</u>		Poor	2002	290	0.14	0.00	<u>0.21</u>
Moderate	2005	292	0.42	0.04			Poor	2005	10	0.15	0.00	
Moderate	2006	299	0.55	0.07			Poor	2006	42	0.47	0.07	
Moderate	2007	341	0.40	0.06			Poor	2008	3	0.00	0.00	<u>0.21</u>
Moderate	2008	338	0.22	0.00	<u>0.40</u>							

Raw + Adj RTHA/MW

Bird Year	#Strings	RTHA Carc/MW	Adj RTHA Carc/MW	Bird Year	#Strings	RTHA Carc/MW	Adj RTHA Carc/MW				
1998	105	0.26	0.28	1999	69	0.33	0.37				
1999	71	0.47	0.52	2000	126	0.19	0.22				
2000	44	0.18	0.20	2001	37	0.18	0.20				
2001	131	0.41	<u>0.33</u>	0.45	<u>0.36</u>	2002	290	0.14	<u>0.21</u>	0.16	<u>0.24</u>
2005	292	0.42	0.46	2005	10	0.15	0.17				
2006	299	0.55	0.59	2006	42	0.47	0.51				
2007	341	0.40	0.43	2008	3	0.00	<u>0.21</u>	0.00	<u>0.23</u>		
2008	338	0.22	<u>0.40</u>	0.24	<u>0.43</u>						

BUOW/MW

Bird Year	#Strings	Carc/MW	FS/MW		Adj Carc/MW		Bird Year	#Strings	Carc/MW	FS/MW		Adj Carc/MW	
1998	105	0.18	0.01		0.99		1999	69	0.07	0.00		0.51	
1999	71	0.12	0.07		0.80		2000	126	0.13	0.07		1.25	
2000	44	0.03	0.19		0.25		2001	37	0.04	0.00		0.34	
2001	131	0.02	0.01	<u>0.09</u>	0.13	<u>0.54</u>	2002	290	0.02	0.01	<u>0.06</u>	0.25	<u>0.59</u>
2005	292	0.14	0.03		1.00		2005	10	0.00	0.00		0.00	
2006	299	0.28	0.35		1.38		2006	42	0.18	0.09		0.93	
2007	341	0.17	0.18		0.82		2008	3	0.00	0.00	<u>0.06</u>	0.00	<u>0.31</u>
2008	338	0.07	0.05	<u>0.17</u>	0.30	<u>0.88</u>							

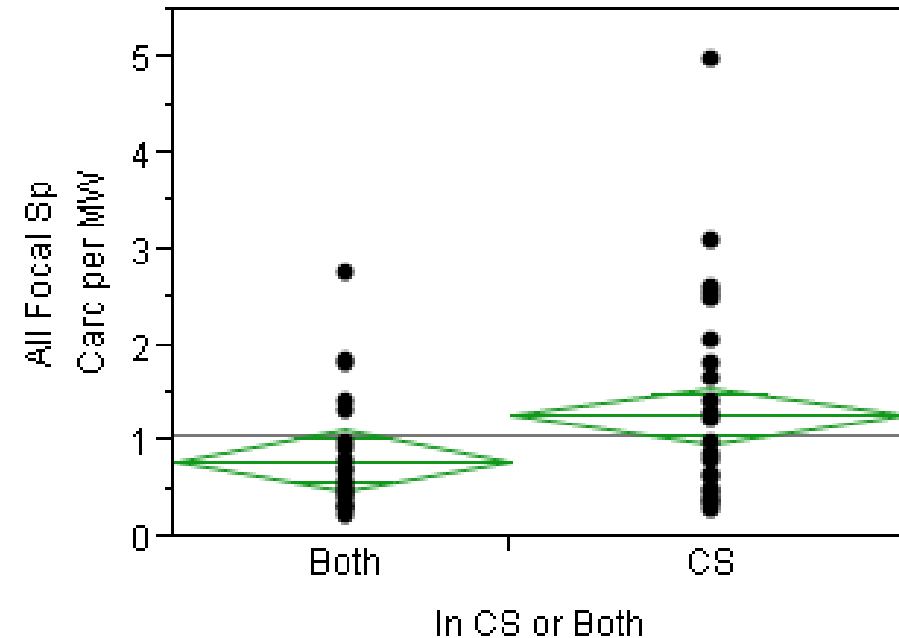
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All Focal Species

Year	Inst Cap	Carc/MW		Carc/YR	FS/MW	FS/YR	Adj Carc/MW	Adj Carc/YR	Adj Carc+FS/YR	
1998	554.136	0.51		280	0.02	9	1.60	884	893	
1999	513.331	0.74		381	0.10	53	1.95	1002	1055	
2000	509.041	0.26		135	0.19	96	0.57	290	386	
2001	511.721	0.48		244	0.07	37	0.85	437	474	
2002	517.671	0.28	<u>0.45</u>	145	0.04	20	0.74	385	406	<u>643</u>
2005	486.611	0.67		327	0.11	54	2.06	1003	1056	
2006	484.096	1.04		502	0.52	250	2.60	1259	1509	
2007	493.376	0.80		395	0.44	216	2.00	988	1204	
2008	471.223	0.44	<u>0.74</u>	207	0.11	51	1.11	525	576	<u>1086</u>

Representativeness

(excludes “poor” DQ, zeros & Diablo)



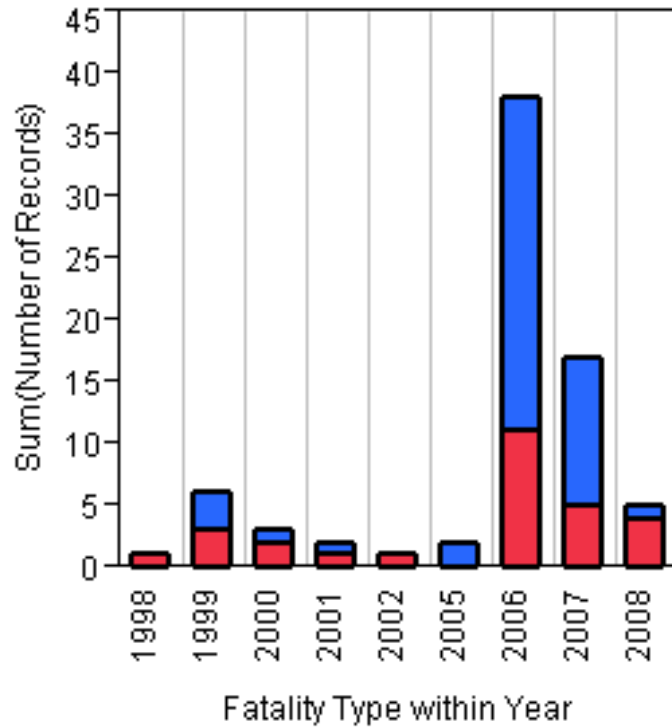
Rsquare	0.074
Adj Rsquare	0.059
Root Mean Square Error	0.851
Mean of Response	1.057
Observations (or Sum Wgts)	63

Diablo Winds (excludes “poor” DQ)

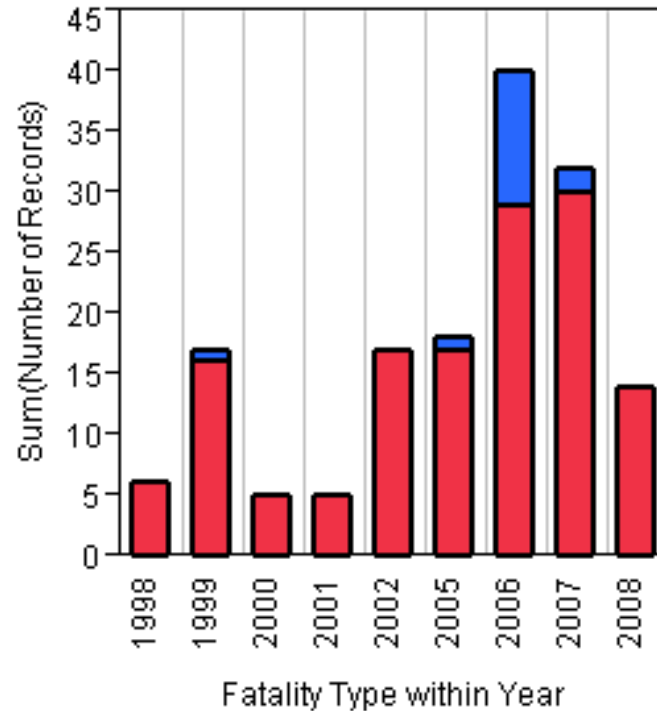
Diablo Winds	Monitoring Year	# Strings	All Focal Sp Carc per MW	All Focal Sp FS per MW	Adj All Focal Sp Carc per MW
DL	2005	13	0.29	0.33	0.59
DL	2006	13	0.16	0.37	0.55
DL	2007	13	0.35	0.16	0.51
DL	2008	13	0.46	0.26	0.58
			<u>0.32</u>	<u>0.28</u>	<u>0.56</u>
Non	2005	279	0.69	0.10	2.13
Non	2006	286	1.08	0.52	2.69
Non	2007	328	0.82	0.45	2.06
Non	2008	325	0.44	0.10	1.14
			<u>0.76</u>	<u>0.29</u>	<u>2.01</u>

Shutdown Experiment

BUOW



RTHA

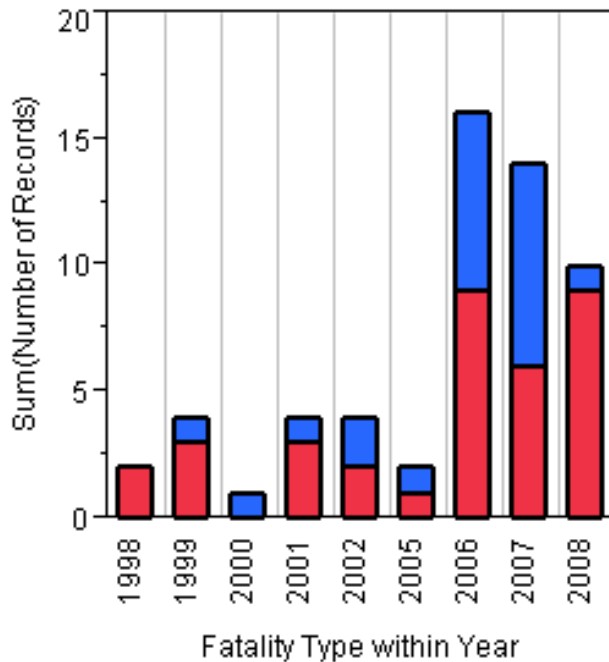


Fatality Type ■ Carcass ■ Feather Spot

Fatality Type ■ Carcass ■ Feather Spot

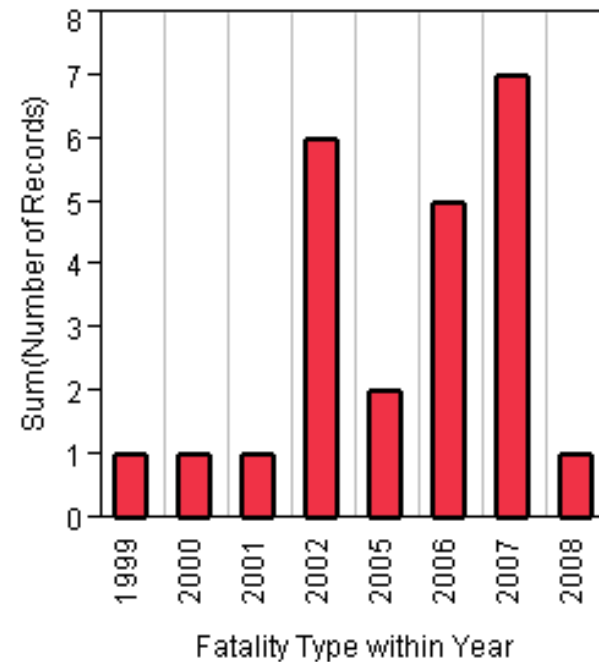
Shutdown Experiment (cont)

AMKE



Fatality Type ■ Carcass ■ Feather Spot

GOEA



Fatality Type ■ Carcass

Conclusions

- There is little evidence of an APWRA-wide 50% reduction in raptor fatalities
- There is evidence of a stable fatality rate per survey
- There is evidence of substantially lower fatality rates at Diablo Winds

Conclusions (cont)

- Organizing fatalities by monitoring years and strings appears to stabilize the metrics somewhat
- Large annual variances in fatality rates are evident
- The estimate of 1300 raptor fatalities per year is not supported in the data

Recommendations

- Consider a fatality/search and/or fatality per turbine metric
- Consider revisiting the baseline fatality rate assessment
- Revisit the shut-down experiment design questions, and develop recommendations regarding the low power there