the bird(s) identified. If the behavior changes significantly as it is closest to turbines, then record that behavior. If other interesting behavior occurs further from turbines then record that behavior in comments.

10 = other - specify in comments (ie.avoidance of blades, etc.)
20 = soaring
30 = flapping
40 = eating /foraging
50 = perching on ground
51 = " " on vegetation
52 = " " on lattice wind turbine
53 = " " on tubular wind turbine
54 = " " on power pole
55 = " " on conductor
56 = " " on other human-made structure - identify in comments
57 = " " on vertical axis wind turbine
58 = " " on guy wire of vertical axis turbine
60 = gliding
70 = diving

For flying behavior include the following if possible.

01 = into wind (upward)
02 = downwind
03 = crosswind

NCom: Natural Community within a 50m radius of the point the bird is flying over.

WRA: 1st Column: Is bird flying within a cylinder with an ~200m radius that includes or borders a wind resource area (any wind turbine)?

1 = yes
2 = no
3 = unknown

2nd Column: The closest distance (as it follows the general contour of the topography) a bird gets to a turbine within that 5 min. count. See protocal for exceptions & examples. Use codes for TDst. Note: Do not include guy wires of vert. axis turbines in TDst.

Dur.: Duration: How long each bird or group of birds remain in the area.

| = 0-1 min. ; || = 1-2 min.; ||| = 2-3 min.

|||| = 3-4 min.; ||||| = 4-5 min.

(c) = code # (1-5) that corresponds with the number of tick marks.

Comments/Map: Any comments not covered by codes. Also note if significant changes in weather occur. Note any bats flying in area whether or not during point count. Include a map to help map transect if needed.

Dd.#: Number of mortality records (dead/injured birds and/or solitary feather(s)) found within a 50m radius of the sublocation.

c = # mortality records

Mort.Rec.#: Mortality Record Numbers within that sublocation. Use #9999 if no mortality records.

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BIRD UTILIZATION COUNT [illegible] SHEET 1996

Date _____ sect # ____ Start. Pt. _____ _____ Angle _____ Obs _____ check1: ____ comp: ____ check2: ____ map: ____

Company/Area _____ Precip. ____|____ Fog ____|____ Cloud ____|____ Pg ___ of ___

Sloc: #_____-(m)____ TDst:_____(c)___ Op:___(c)____ Str.1ID:_____#_____(c)___ Str.1Dst.:_____ (c)___ Dens1:(1)_____(2)_____

Str.2ID:_____#_____(c)___ Str.2Dst:_____(c)____ Dens2:(1)_____(2)_____ Str.3ID:_____#_____(c)___ Str.3Dst:_____(c)____ Dens3:(1)____(2)____

NCom:_____(c)____ Topog:_____(c)____ Incline:_____(c)_____ Tp:____ WdSp:_____(c)____ WdDir: _____(c)____

Start:

Species	#	Dt (m)	Ht (m)	Behav.	NCom.	Topog.	Incline	WRA		Dur.	Dt.	Ht.		Beh.	NC	Top.	Inc.	WRA		Dur.

Dd#: Mort Rec#(s):

Comments/Map

CODES

Sloc: #_____-(m)____ TDst:_____(c)___ Op:___(c)____ Str.1ID:_____#_____(c)___ Str.1Dst.:_____ (c)___ Dens1:(1)_____(2)_____

Str.2ID:_____#_____(c)___ Str.2Dst:_____(c)____ Dens2:(1)_____(2)_____ Str.3ID:_____#_____(c)___ Str.3Dst:_____(c)____ Dens3:(1)____(2)____

NCom:_____(c)____ Topog:_____(c)____ Incline:_____(c)_____ Tp:____ WdSp:_____(c)____ WdDir: _____(c)____

Start:

Species	#	Dt (m)	Ht (m)	Behav.	NCom.	Topog.	Incline	WRA		Dur.	Dt.	Ht.		Beh.	NC	Top.	Inc.	WRA		Dur.

Dd#: Mort Rec#(s):

Comments/Map

CODES

1/8/96

MORTALITY/INJURY STUDY 1996
Field Data Sheet with Variables

(CEC 1/10/96)

Check1___ Comp____
Check2___ Map____
Spp. List___

CODE

_____ **Rec.#**: Record Number: sequential number starting with 001.(Will be assigned outside of field.)

_____ **Date**: Date bird discovered: month/day

_____ **Comp.**:Company/Area:
100 = Zond
110 = near Zond/Zond side of Cameron Rd.
120 = between TWS Rd.& Zond - West of Zond
200 = Cannon
210 = near Cannon/Cannon side of Cameron Rd
220 = area between Cannon & Sea West
300 = Sea West
310 = near Sea West
400 = FloWind

_____ **Trans#**: Transect Number or "0" for not applicable.

_____ **Subloc.**: Sublocation Number or "0" for not applicable.

_____ **Obs.**: Observer:
1 = Dick Anderson
2 = Natasha Neumann
3 = Jennifer Noone
4 = Judy Tom
5 = Michele Disney
6 = John Cleckler

_____ **Spp.**: Species: the 4-letter acronym for the species of bird found dead.

_____ **Age**:
1 = unknown 2 = immature 3 = adult

_____ **Sex**:
1 = unknown 2 = female 3 = male

_____ **Time**: Estimated time since death:
1 = undetermined
2 = fresh kill - < 2 days old
3 = few days - maggots starting to appear
4 = 1 week - maggots over entire body
5 = 2 week - flesh at least half gone
6 = 1 month - no flesh left, just bones and feathers
7 = over 6 months - bones and feathers disassembled
8 = bird alive - not applicable
9 = status unknown - not applicable

_____ **Cause**: Cause of Death or Injury
1 = unknown
2 = collission with turbine
3 = collission with wire
4 = electrocution
5 = other - explain in comments
6 = not applicable (ie.one feather)

* If bird/feather(s) found in association with a predator/scavenger den (ie. coyote, kit fox) or raptor nest, **exclude** from study. But be sure to include in an incidental observation report. Make sure to document in mort. rec. only if feather is of resident nester.

CODE

_____ **Certain.**: Degree of certainty for cause of death/injury.
1 2 3 4 5
low high
6 = not applicable

_____ **Cond.**: Condition (also describe in detail in comments)
1 = dead
2 = alive
3 = unknown - not applicable

_____ **Injur.**: Injuries (For both dead and alive birds)(Can include more than one code)
1 = no obvious signs
2 = wing sheared off
3 = head sheared off
4 = feet sheared off
5 = body sheared in half
6 = multiple dimemberment
7 = broken wing bone
8 = broken neck bone
9 = broken leg bone
10 = injury to wing
11 = injury to legs
12 = injury to eyes
13 = injury to body
14 = injury to head
15 = feather damage
16 = body and feathers intact
17 = feathers and body disassembled
18 = just feathers
19 = just bones
20 = just feathers and bones
23 = wing only
24 = electric burns on feet
25 = electric burns on wings
26 = internal injuries
27 = impact, then continued on
28 = stunned
29 = entangled in wires
30 = other - describe in comments
100 = unknown status - no indication of injury/mortality (ie.single feather; feather(s)of same species found within 1 sublocation.)
200 = unknown status of bird found outside of sublocation (ie. feather found only)
200 + code = injury of bird found outside of sublocation.

_____ **Collected**: Was the bird collected?
1 = collected
2 = not collected
3 = partially collected (ie.few feathers)

_____ **Mx.Dt.**: Maximum Distance(m)at which bird/bird part/feather could be observed: Refer to feather closest to turbine
1 = <0.5m
2 = 0.5m - 1m
3 = 1.1m - 5m
4 = 5.1m - 10m
5 = >10m

(MORE ON BACK)

RECORD OF DEAD BIRDS - SCAVENGING STUDY # __ __ __ 1996

Date: ________ Obs: _______ [chicken spp. not included in this list] *(CEC 12/12/95)*

Size: 1 = small (ie. sparrow); 2 = medium (ie. dove, kestral); 3 = large (ie.raven, hawk,) Cond(ition): 1 = fresh; 2 = old

Band#	Spp.	Size	Cond.	Band#	Spp.	Size	Cond.	Band#	Spp.	Size	Cond.

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STUDY VARIABLES (CEC 3/4/95)

Scavenging Study#: 01-?

Company/Area:
- 100 = Zond
- 110 = near Zond - Zond side of Cameron Rd
- 120 = West of Zond - between TWS Rd. & Zond
- 200 = Cannon
- 210 = near Cannon - Cannon side of Cameron Rd.
- 220 = area between Cannon & Sea West
- 300 = Sea West
- 310 = near Sea West
- 400 = FloWind

OBS: Observer
- 1 = Dick Anderson
- 2 = Natasha Neumann
- 3 = Jennifer Noone
- 4 = Judy Tom
- 5 = Michele Disney
- 6 = John Cleckler

Date: month/day

Note: Take weather information at the beginning of each scavenging check

Time: Time at which weather information is taken.

Temp.: Temperature from the thermometer (F).

Wind: Use (Beaufort scale + 1) X 10. Obtain information from wind energy companies.
- 10 = calm = 0-1mph
- 20 = light air = 1-3mph
- 30 = light breeze = 4-7 mph
- 40 = gentle breeze = 8-12 mph
- 50 = mod. breeze = 13-18 mph
- 60 = fresh breeze = 19-24 mph
- 70 = strong breeze = 25-31 mph
- 80 = mod.gale = 25-31 mph
- 90 = fresh gale = 32-38 mph
- 100 = strong gale = 47-54 mph
- 110 = whole gale = 55-65 mph
- 120 = storm = 66-72 mph
- 130 = 72+ mph

Is the wind constant or gusty?
ie. 31 = a constant light breeze; 102 = a gusty strong gale
- 01 = constant
- 02 = gusty
- 03 = variable

Cloud: Cloud Cover. Best estimation
- 10 = no information
- 20 = clear
- 30 = partly cloudy (>15% cloud cover)- no other info.
- 40 = overcast (> 80%)- no other info.

Precip.: Precipitation.
- 100 = no information
- 200 = no precipitation
- 300 = rain - no other info.
  - 310 = sprinkle/mist
  - 320 = moderate
  - 330 = hard
- 400 = snow (amount presently on ground) - no other info.
  - 410 = < 4"
  - 420 = ≥ 4" but ≤ 12"
  - 430 = > 12"

Fog:
- 10 = no information
- 20 = no fog
- 30 = light
- 40 = dense (visibility < 100m)

At the bottom of the page. Note any weather changes you feel are significantly different from those recorded (ie. storm comes in on an otherwise sunny day).

Moon:
- 10 = ● new
- 20 = ◐ first quarter
- 30 = ○ full
- 40 = ◑ last quarter

Time & Cond.: See time and conditon further down columnn.

Site#: The site number assigned to where the bird was placed.

Band#: Band placed on dead bird for scavenging study: 001-60.

Spp: Species:4-letter acronym for the bird species. See list of acronyms for local Tehachapi bird species. Use CHIC for domestic chicken.

Size: Bird Size:
- 1 = small (ie. sparrow, chick)
- 2 = medium (ie. dove, kestral)
- 3 = large (ie. raven, hawk, chicken)

Time: Use military (24-hour) time.

Condition:
State of bird:
- 10 = not scavenged
- 20 = partially scavenged
- 30 = removed + scavenged/found
- 40 = removed/not found

Scavenged by: ie. 21 = partially scavenged by insects
- 00 = no other scavenging info.
- 01 = insects
- 02 = rodent
- 03 = mammalian carnivores
- 04 = non-raptor birds (crow/raven)
- 05 = raptors

Comments: Include specific comments regarding the condition of the bird as neeced.

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___ ___ ___ scavenging study #

SCAVENGING STUDY 1996

Company/Area ________ (c)___ OBS ____________ (c)___ pg — of —

heck 1 ☐
mp ☐
heck 2 ☐

Date																				
Time	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm
Temp.																				
Wind																				
Cloud																				
Precip.																				
Fog																				
Moon																				

SITE#:																					
Spp: ____ Size: ____ Bd#: ____	Time																				
	Cond.																				
	Comments:																				

SITE#:																					
Spp: ____ Size: ____ Bd#: ____	Time																				
	Cond.																				
	Comments:																				

SITE#:																					
Spp: ____ Size: ____ Bd#: ____	Time																				
	Cond.																				
	Comments:																				

SITE#:																					
Spp: ____ Size: ____ Bd#: ____	Time																				
	Cond.																				
	Comments:																				

SITE#:																					
Spp: ____ Size: ____ Bd#: ____	Time																				
	Cond.																				
	Comments:																				

Scavenging Study#: 001-?

Date: month/day bird is set out.

Obs: Observer.
1 = Dick Anderson
2 = Natasha Neumann
3 = Jennifer Noone
4 = Judy Tom
5 = Michele Disney
6 = John Cleckler

Comp/Area:Company/Area
100 = Zond
110 = near Zond - Zond side of Cameron Rd.
120 = West of Zond - betwenn TWS & Zond
200 = Cannon
210 = near Cannon - Cannon side of Cameron Rd.
220 = area between Cannon & Sea West
300 = Sea West
310 = near Sea West - East or South of S.W.
400 = Flowind

Site #: Assign this site a number that is preceded with the company's first letter(s). Begin with #1-? for each scavenging study and each area. ie. The first Sea West site in scavenging study #007 = SW1.

Bd.#: Band number placed on dead bird for scavenging study: 001-600.

Spp: Species: the 4-letter acronym for the bird species. See codes for Tehachapi bird species. Use CHIC if domestic chickens used. After "/" put the size code.
1 = small (ie. sparrow, chick)
2 = medium (ie. dove, kestral)
3 = large (ie. raven, hawk, chicken)

Time: Time when bird is set out. Use military (24-hour) time.

NCom: Natural Community. Include abbreviations with code - quick reference.
2 = high desert sub-shrub scrub (HDSSS)
3 = annual grassland with component of sub-shrub-scrub (AGSSS)
4 = oak woodland (OW)
6 = hard wood/conifer area (HWCA)
7 = other - include description
8 = Joshua Tree Woodland (JTW)(>8 Joshua tree clumps)
9 = high desert sub-shrub-scrub with a few joshua trees (<8 Joshua tree clumps)(HDSSSJT)
10 = annual grassland (AG)
11 = annual grassland with a few (<30%canopy cover)trees (AGT)
12 = scruboak chapparal (SC)
13 = chapparal/juniper (CJ)
14 = high desert sub-shrub scrub w/juniper component (HDSSSJ)
15 = riparian (R)
16 = perennial grassland (PG)
17 = perennial grassland w/sub-shrub-scrub (PGSSS)
18 = grassland (G)- no other info.
20 = no information/unknown

TDst: Turbine Distance: The distance(m) between the bird and the nearest turbine.
10 = 0-20m
20 = 21-40m
30 = 41-60m
40 = 61-100m
50 = 101-200m
60 = 201-400m
70 = 401-1km (if not more specific)
71 = 401-600m
72 = 601-800m
73 = 801-1km
80 = >1km (if not more specific)
81 = >1-1.5km
82 = >1.5-2km
83 = >2km
99 = no information

Str1ID: First Structure Identification: Description of the closest significant structure (# 1-9, #12)within a 200m radius of the bird. NOTE 1: Include lightly used roads and/or fences in structure i.d. spaces only if other structures (#1-9, #12)do not fill up all of the 3 structure identifications. NOTE 2: If other types of turbines w/in 200m are not accounted for in structure i.d. spaces, include descript., dens., and dist. for each type in comments
1 = lattice wind turbine
2 = tubular wind turbine
3 = vertical axis wind turbine
4 = distribution line assoc. w/wind turbine (usu. 1 wood pole , alum. lines)
5 = general distribution line
6 = telephone line (mult. lines in 1 cable)
7 = large transmission line (usu. metal/mult. wood configuration poles)
8 = metereological tower
9 = heavily used road - paved or dirt with vehicles usu. traveling at > 35 mph (ie main entrance road to Zond.)
10 = other human-made structure (ie. fence - see note above)- i.d. in space
11 = none in site (use dst.& dns. code #99)
12 = substation
13 = none (use code "0" for dist. & dens.)
14 = no information/unknown (use dst. & dns. code #99)
15 = moderate-lightly used road - usually dirt roads (see note above)

Str1Dst: First Structure Distance: Distance between the closest structure and the bird. Use same codes for TDst

Str1Dns: Density of first structure : total number of structure #1 within 100m(1) and 200m(2).
c = # structures
99 = no information

Str2ID & Str3ID:Secondary & Tertiary Structure Identification: Description of any secondary/tertiary structures in the area. Use same codes used for Str1ID.

Str2Dst & Str3Dst: Distance between the secondary/tertiary structures and bird. Use same codes for TDst.

Str2Dns & Str3Dns: Secondary & Tertiary Structure Density: Total number of secondary/tertiary structures within 100m(1) and 200m(2). Use same codes used for Dens1.

Bird Loc.: Bird Location. Place a bird within the area you are studying. Identify the closest and easiest identifiable landmark (ie. turbine, fork in road, joshua tree,etc.)to find the bird. Include identification numbers for turbines, roads, etc. Record distance in meters and/or paces and the magnetic bearing of the direction that the bird is located from the landmark. Do not use codes in this space.

Flag Loc.: Flag Location. Place the pin flag 10 m at magnetic north of the bird. Record meters and/or paces used.

Flag Color: The color of the pin flag.

Comments: Include any comments that may help locate the bird and/or describe significant points regarding its original condition.

Map: Map out the location of the birds while labeling significant landmarks, degrees, meters, paces, the direction of magnetic north,etc.
Example:

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Scavenging study # Date:_____ Obs: _____ Comp/ Area: _____(c)____ pg ___ of ___

CEC 12/12/95

Site#	Bd#:	Spp: /	Time:	NCom: (c)	TDst: (c)	Str1ID: (c)
	Str1Dst: (c)		Str1Dns: (1) (2)	Str2ID: (c)		Str2Dst: (c)
	Str2Dns: (1) (2)		Str3ID: (c)	Str3Dst: (c)		Str3Dns: (1) (2)
Loc:				Flag Loc:		Flag Color:
& Comments:						

Site#	Bd#:	Spp: /	Time:	NCom: (c)	TDst: (c)	Str1ID: (c)
	Str1Dst: (c)		Str1Dns: (1) (2)	Str2ID: (c)		Str2Dst: (c)
	Str2Dns: (1) (2)		Str3ID: (c)	Str3Dst: (c)		Str3Dns: (1) (2)
Bird Loc:				Flag Loc:		Flag Color:
Map & Comments:						

check 1 ☐ comp ☐ check 2 ☐

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OBSERVER BIAS STUDY
1996

DATE:_____ / _____ OSERVER:_____ (c) ____

NCom. Type:_____ (c) _____ SITE #:_____

ORDER: 1st 2nd 3rd

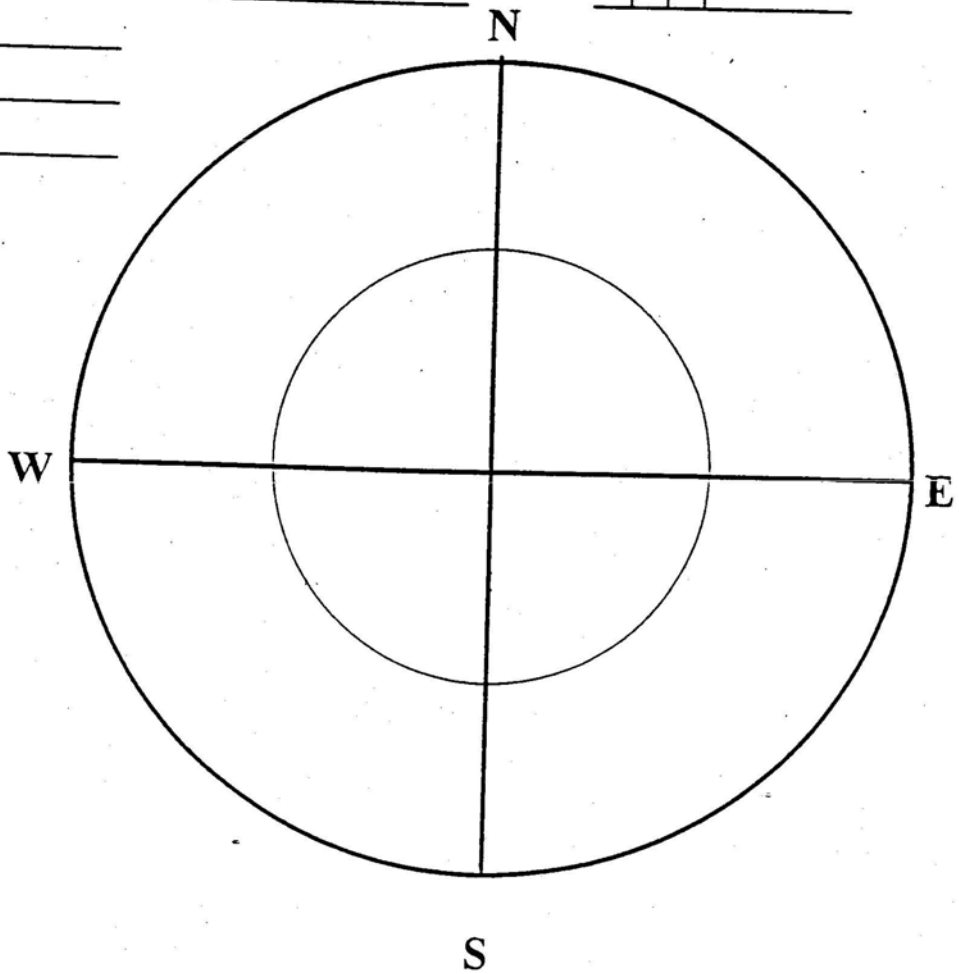
COMPANY:_____ (c) _____ TIME: Start _____ End _____

Bird Mortality Sign Description (small = ≤ 8 in.; large = > 8 in.)
Distance at which sign was first observed

	sm	lg	dist.
1.			
2.			
3.			
4.			
5.			
6.			

	sm	lg	dist.
7.			
8.			
9.			

	sm	lg	dist.
10			
11			
12			



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APPENDIX F: RECOMMENDED FORMULAS FOR ADJUSTING FATALITY RATES

Conceptual Adjusted Fatality Equation

The conceptual equation for the adjusted fatality rate per megawatt of installed capacity per search interval estimate is:

$$\hat{M}_A = \frac{\hat{M}_U}{\hat{S}_{nr}\,\hat{p}_d}.$$

$\hat{M}_U$ -is the unadjusted fatality rate, the number of fatalities per megawatt of installed capacity per search interval. The standard interval recommended in the *Guidelines* for bird carcass searches is every two weeks. If intervals are of differing time periods, the estimates should account for this variation.

$\hat{S}_{nr}$ -is the probability that a carcass has not been removed in an interval.

$\hat{p}_d$ -is the probability that a carcass present at the time of a count period is detected.

Carcass Removal Rate Estimation

1. The estimation of carcass removal rate based on birds or bats planted by the researcher should be designed so that the estimate is statistically independent of the detection probability by the searcher.
2. The estimation of carcass removal rates should be repeated in all seasons because vegetation heights will vary, and scavengers move in and out of the area.
3. Estimate the removal rate per interval based on the simplifying assumption that the removal rate is constant over time. Two estimation methods are given here, one for the removal rate being variable over time and the second for the removal rate being constant over time (modified from Seber, 1982, pp.408–414).

Estimation Procedure - In this situation a cohort of planted carcasses is followed over various time intervals, and the number remaining is analogous to a cohort age specific life table approach described on pages 408–414 of Seber (1982). Therefore, the estimates and standard errors presented there can be used to solve this estimation problem.

Let S_x be the probability that a carcass is not removed in an interval x, l_0 be the number of carcasses planted at the beginning, and l_x the number of carcasses remaining at the end of each interval x = 1, 2,..w. Then following Seber (1982, p. 408)

$\hat{S}_x = l_{x+1} / l_x$.

Now consider the special case where S_x is constant (that is, $\hat{S}_{nr}$ in our original notation). This is a geometric model, which is just the discrete analogue of the exponential model. The maximum likelihood estimator is

$$\hat{S}_{nr} = 1 - (l_0 - l_w) / \sum_{x=0}^{w-1} l_x ,$$

and this can be rewritten as

$$\hat{S}_{nr} = \sum_{x=1}^{w} l_x / \sum_{x=0}^{w-1} l_x ,$$

with

$SE(\hat{S}_{nr}) = \sqrt{(l_0 - l_w)\sum_{x=1}^{w} l_x / [\sum_{x=0}^{w-1} l_x]^3}$. These equations are from Seber (1982 p. 413).

Estimation of Searcher Efficiency Trials

1. Searcher efficiency trials (also called carcass detection probability) should be repeated in all seasons since detection probability can vary during different seasons. Each estimate will be of a simple binomial form:

$\hat{p}_d = x/n, SE(\hat{p}_d) = \sqrt{\hat{p}_d(1-\hat{p}_d)/n}$. Here x is the number of planted carcasses detected and n is the number planted.

2. It is assumed that the detection probabilities estimated from the planted carcasses are an unbiased estimate of the detection rates for real bird fatalities.
3. The carcasses used should be native species and as fresh as possible.

APPENDIX G: ESTIMATING IMPACTS TO RAPTORS USING BIRD USE COUNT AND FATALITY DATA FROM EXISTING PROJECTS

This section provides examples and background information to evaluate a project's potential impacts to raptors. Raptors were used for these impact estimate examples because a large data set is available for use and fatality rates for this set of birds. Furthermore, raptors are a visible and valued wildlife resource in California, and raptor deaths from wind energy projects such as those at Altamont Pass Wind Resource Area in Alameda County, California, have received worldwide attention. Numerous studies have noted that raptors disproportionately collide with wind turbines (Orloff and Flannery, 1996; Anderson et al., 1995; Erickson et al., 2006). Consequently, raptors merit special attention at most proposed wind energy sites in California.

The data in Table 1 and Figures 1 and 2 were taken from studies at wind energy projects in California, Oregon, Washington, Wyoming, and Minnesota. These studies were selected as data sources because they used standardized methods similar to those recommended in the *Guidelines*. These wind energy projects are also useful for comparisons because the wind turbines at these sites (with the exception of Tehachapi and San Gorgonio) are the large, newer generation models (0.6 MW to 1.5 MW) similar to those that will be built on future projects. For several of these studies, raptor use had been estimated using 20-minute counts, so the data were adjusted in this table to provide a uniform metric of raptor use per 30-minute count.

Table 1. Raptor Use and Raptor Fatalities.

Study Site	Raptor Use/30-Minute Count	Raptor Fatalities/ MW Installed Capacity/Year	Source
High Winds, CA	5.250	0.68	Kerlinger et al., 2006
Diablo Winds, CA*	4.350	0.52	WEST, 2006
Combine Hills, OR	1.350	0.00	WEST, 2006
Tehachapi Pass, CA *	0.900	----	Anderson et al., 1996
Foote Creek Rim, WY	0.735	0.04	Young et al., 2003
Buffalo Ridge, MN	0.720	0.02	Johnson et al., 2000
Klondike, OR	0.705	0.00	WEST, 2003
Nine Canyon, WA	0.660	0.05	WEST, 2001
Stateline, WA/OR	0.615	0.09	Erickson et al., 2003, 2004
Vansycle, OR	0.450	0.00	Erickson et al., 2000
San Gorgonio, CA	0.150	0.03	Anderson et al., 2005

*A range of 0.40 to 0.64 raptor fatalities per MW per year was calculated for Diablo Winds—the mid-range value of 0.52 is used in this table. Fatality data for studies at Tehachapi, California were not included because carcass searches were too infrequent to be comparable to other studies.

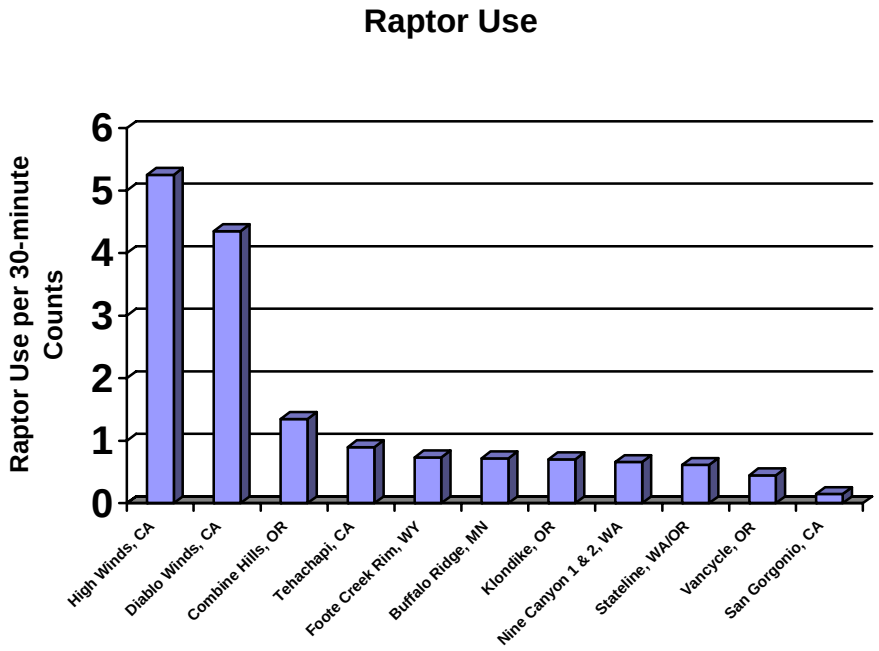

Figure 1. Raptor use per 30-minute count at wind resource areas in California, Oregon, Washington, Wyoming, and Minnesota.

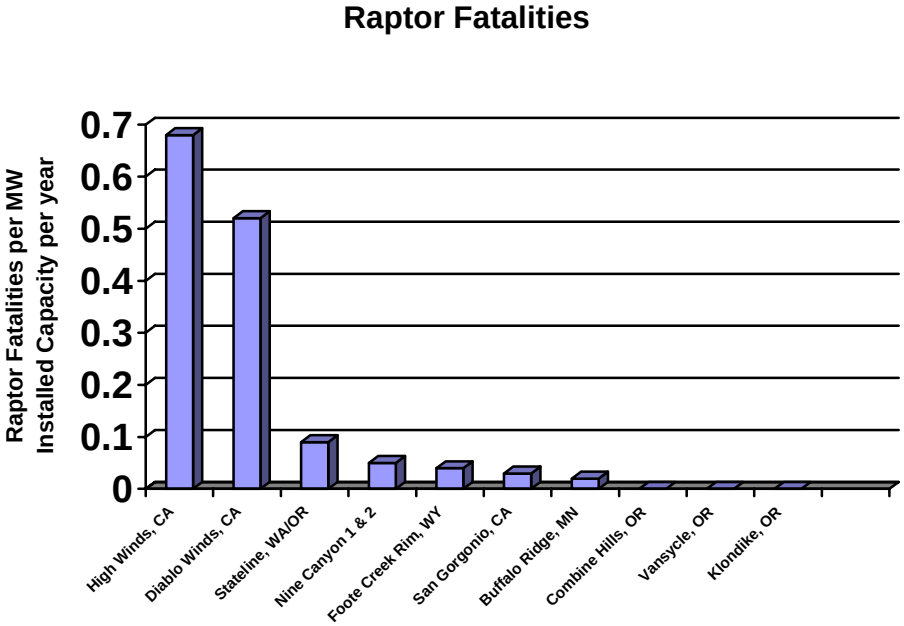

Figure 2. Raptor fatalities per MW installed capacity per year at wind resource areas in California, Oregon, Washington, Wyoming, and Minnesota.

Examples of Projects with Potential for High and Low Raptor Fatality Rates

Example 1: Pre-permitting bird use counts (BUCs) find an average of 0.15 raptors per 30-minute count at a proposed project site. Table 1 shows that the 0.15 raptors per 30-minute count is the same as found at San Gorgonio, California. Looking at Figures 1 and 2, raptor use and raptor fatality graphs, allows a visual comparison of where the 0.15 raptors per 30-minute count fit in the distribution of other projects that have been studied using standardized methods and metrics. The raptor use number of 0.15 is on the low end of the comparison graph, similar to San Gorgonio, which also is on the low side of the raptor fatalities graph. Therefore the proposed project might be expected to have a relatively low fatality rate for raptors.

Example 2: Pre-permitting BUCs find an average of 4.35 raptors per 30-minute count at a proposed project site. Table 1 shows that the 4.35 raptors per 30-minute count is the same as found at Diablo Winds, California (in Altamont Pass). Compare this BUC count in Table 1 with Figures 1 and 2. The raptor use number of 4.35 is on the high end of the comparison graph, similar to Diablo Winds, which also is on the high side of the raptor fatalities graph. Therefore the proposed project might be expected to have a relatively high fatality rate for raptors.

Figure 3, from Strickland et al. (2006), provides a regression analysis showing the association between standardized metrics for raptor use and fatality rates from projects with the newer turbines. This figure also illustrates the positive correlation of raptor use and raptor fatality rates at wind energy facilities.

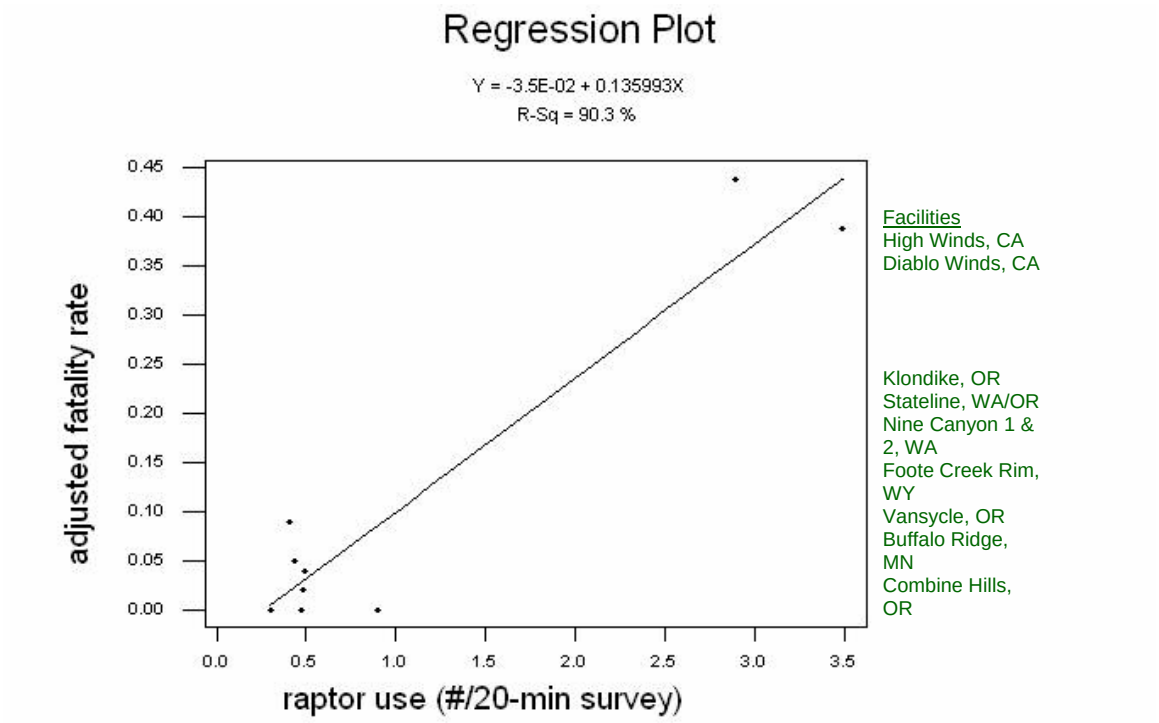

Figure 3. Comparison of raptor use and fatalities at new turbine sites that used comparable study methods (20-minute bird use counts) (Strickland, 2006).

Cautions

Exercise caution when using this simple assessment approach to extrapolate fatality rates and make impact assessments, and be careful in analyzing and presenting the data. Any regression analysis should be interpreted with the awareness that other important hidden or unmeasured variables might be present that could account for an apparent relationship between the variables of interest. Inappropriate grouping of data for species and bird groups can alter conclusions about potential impacts and mislead the reader, and behavioral differences between species are known to be an important explanatory variable for risk of collision with turbines. Be aware that grouping species into a bird group such as raptors can mask impacts to a particular species that may be of concern. For example, both Diablo Winds at Altamont Pass, California, and High Winds in Solano County, California have relatively high raptor use and fatalities; however, the mix of raptors is different. High Winds has more American kestrels and red-tailed hawks, while Diablo Winds has more golden eagles (Kerlinger et al., 2006; Erickson et al., 2006). These distinctions can be important for a project impact assessment that would be obscured if the analysis failed to separate use and fatality rates for each raptor species.

Grouping raptor use or fatality rates into overall bird use can also be misleading, as can use of national averages of bird use and bird fatalities when assessing impacts. Overall

bird use can be low, but raptor use can be high on a project, as illustrated theoretically in Table 2 below. Consider the following hypothetical example while referring to Table 2: assume a hypothetical national average of 17 birds per 30-minute bird use count and 3.0 bird fatalities per MW of installed capacity per year. Suppose studies at a wind energy site showed an average of 11 birds per 30-minute bird use count and 2.0 bird fatalities per MW of installed capacity per year. This hypothetical site looks reasonably good compared to the national average with lower bird use and lower bird fatalities. However, a closer review of the results shows the national average includes 0.3 raptors per 30-minute count and 0.07 raptor fatalities per MW of installed capacity per year, but the theoretical project raptor use is 3.0 per 30-minute count and 0.75 fatalities per MW of installed capacity. The new project has 10 times the raptor use and 11 times the raptor fatalities of the national average, while having less overall bird use and less overall bird fatalities. In this example, if only the "all bird use" numbers were used, the assessment would reach an inappropriate conclusion.

Table 2. Illustration that Overall Bird Use Can Be Low on a Project with High Raptor Use.

	Bird Use	Bird Fatality	Raptor Use	Raptor Fatality
Theoretical national average	17.0	3.0	0.3	0.07
Theoretical project	11.0	2.0	3.0	0.75

To avoid the problems described above, analyze data for each bird group and special-status species separately, as appropriate for the site. In making the impact assessment, consider whether a local bird population has experienced declines and the effects of additional losses to such a population. Be aware that the use-fatality rate relationship depicted in Figure 3 has only been demonstrated for raptors. Bird use data for songbirds does not reflect the same clear correlation of bird use to bird fatalities as does raptor use data.

Figure 4 displays raptor use information for many wind energy project sites throughout the nation. This figure shows the range of raptor use at wind energy project sites in California and elsewhere in the country and is provided to allow convenient comparisons for new project data.

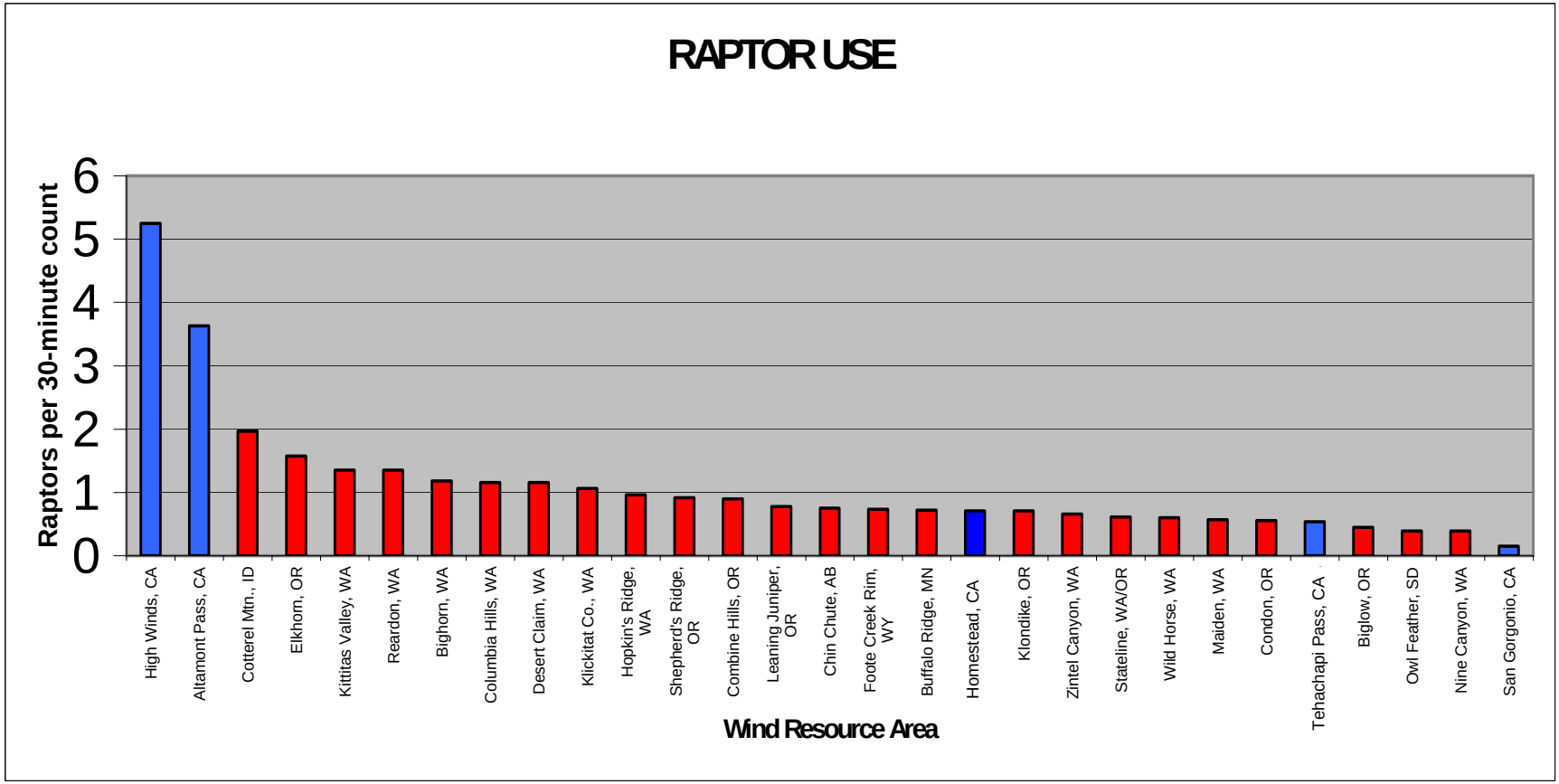

Figure 4. Raptor use estimates at several wind resource areas within and outside California. Blue columns depict data from studies at California wind resource areas.