

Red Pine Wind Energy Project Bald Eagle Risk Analysis Summary

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Facility Information

Facility: Red Pine Wind Project

Location: Lincoln County, MN

Latitude & Longitude: 44.452175, -95.787879

Year Online: 2017

Number of Turbines: 100 (50 Vestas V100 2.0MW turbines/50 Vestas V110 2.0MW turbines)

Hub Height: 80m/80m

Rotor Diameter: 100m/110m

Model inputs:

```
nTurbine<-c(50, 50)
```

- This refers to the number of turbines, and has two values to reflect the two turbine types.

```
SeasonType <-c("Winter" = "02/29", "Breeding" = "07/21", "Fall" = "10/30")
```

- This model was run with seasonal stratification. This defines the seasons as winter, breeding season, and fall.

```
HazRadKm<-c(110/2/1000, 100/2/1000)
```

- This calculates the hazardous radius surrounding each turbine. The turbine diameters (110m and 100m) are divided by 2, to calculate the radii, then by 1000 to convert the value from meters to kilometers.

```
HzKM2<-sum(nTurbine*pi*HazRadKm^2)
```

- This is the total facility hazardous area. The hazardous radii surrounding each turbine type (see above) is multiplied by pi (π), resulting in the hazardous area surrounding each turbine type. This is then multiplied by the respective number of each turbine type (50 of each). The values for the two turbine types are then summed, resulting in the total facility hazardous area.

```
CntHr<-c(60/60)
```

- This is the observation count duration at each turbine type (1 hour at each).

```
ExpSvy<-data.frame(row.names=c("Winter", "Breeding", "Fall"),
                    EMin=c(11, 29, 50),
                    nCnt=c(8400/60, 12480/60, 9158/60),
                    CntKM2=c(pi*(800/1000)^2),
                    DayLtHr=c(1146.658, 2170.160, 1146.658))
```

- This is a matrix (**ExpSvy**), with a row for each season as described above (winter, breeding, and fall). **EMin** is the number of minutes during which bald eagles were observed over the course of surveys in each given season. **nCnt** is the number of hours spent observing during each season. **CntKM2** is the area surrounding each turbine where counts occurred. **DayLtHr** is the number of daylight hours during each season (see Table 1).

Table 1: Daylight hours by season

Season	Days	DayLtHr (hr)	cRange	AveDayLen (hr)
Winter	120.25	1146.658	11/01 – 02/29	9.535616
Breeding	153.00	2170.160	03/01 – 07/31	14.184053
Fall	92.00	1146.032	08/01 – 10/31	12.456867

Outputs

Table 2: Seasonal bald eagle exposure

Season	Mean	Standard deviation
Winter	0.042	0.012
Breeding	0.071	0.013
Fall	0.16	0.023

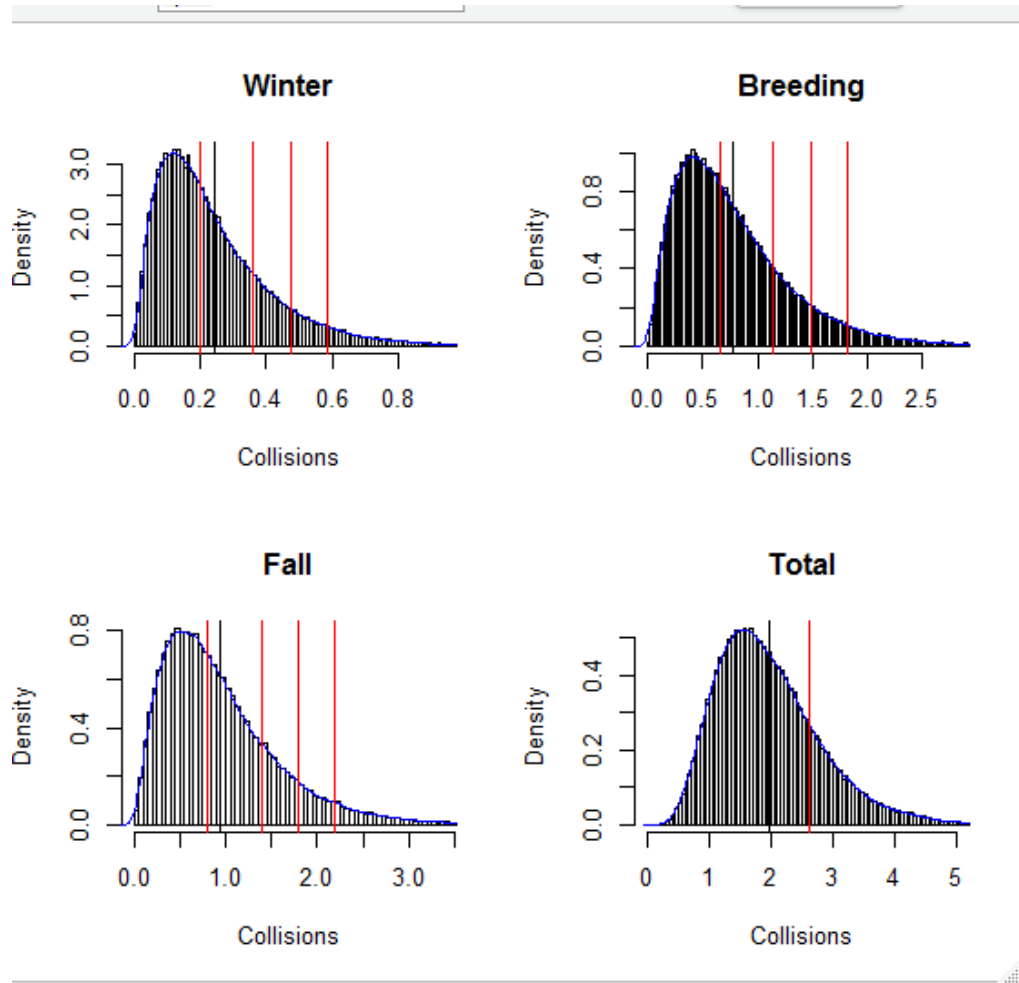
Table 3: Annual and seasonal estimated bald eagle take

Season	Mean	SD	CI50	CI80	CI90	CI95
Winter	0.24	0.18	0.20	0.36	0.48	0.59
Breeding	0.78	0.53	0.66	1.14	1.49	1.81
Fall	0.95	0.64	0.81	1.40	1.80	2.20
Total	1.97	0.86	1.83	2.61	3.10	3.55

For this project, the Service is basing its estimated bald eagle take, and thus permitted bald eagle take, on the CI80 (the 80th quantile) estimate. Between the time in which this model was run and permit issuance, the Service has adopted the 60th quantile as its new basis for estimated bald eagle take (<https://www.fws.gov/birds/management/managed-species/eagle-management.php>). This project is being grandfathered in under prior guidance and will use the 80th quantile.

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Figure 1: Annual and seasonal estimated bald eagle take



Each plot represents the Bayesian distribution for estimated eagle take over the 3 indicated seasons (Winter, Breeding, Fall) and the total (annual) estimated eagle take. The vertical black lines indicate the mean estimate of eagle mortality in each season/annually. For the seasonal plots, the 4 red vertical lines correspond to the credible interval quantiles laid out in Table 3. For the annual plot, the vertical red line indicates the 80th quantile.