

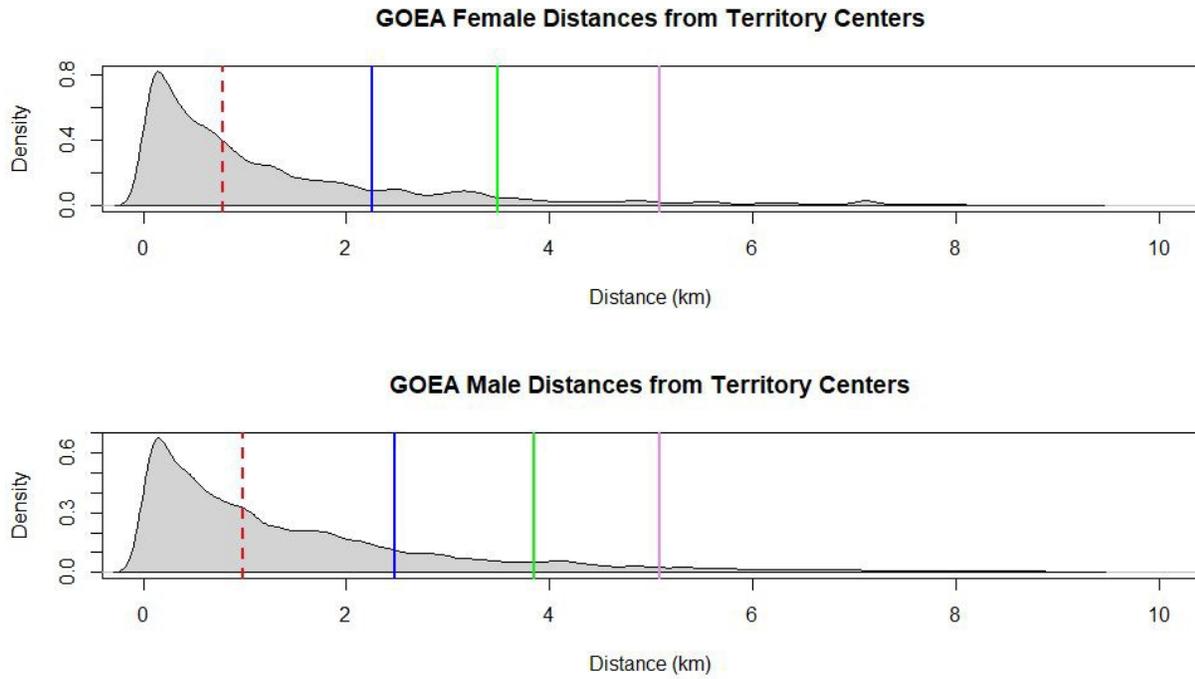
## Updated Eagle Nest Survey Protocol

U.S. Fish and Wildlife Service (Service) protocol for data collection to support an eagle incidental take permit application recommends surveys for occupied nesting territories be conducted potentially out to 10 miles around the perimeter of the area where take may occur (U.S. Fish and Wildlife Service 2013). The purpose of these surveys is to identify nesting pairs of eagles that might be disturbed or subject to potential lethal take by the activity associated with the permit request. Although the existing protocol recommends use of local information to inform more appropriate distances for surveys in areas of high eagle nesting density, application of this guidance in practice has proven difficult. In the years since the guidance was developed, the Service and collaborators have deployed satellite transmitters on over 700 golden eagles, many of which subsequently bred. The data from satellite-tagged breeding golden eagles provides new information on the ranging behavior of golden eagles around their nest sites. These data provide new quantitative information about the distance from nests at which risk of take becomes unlikely.

The Service conducted a preliminary analysis of satellite telemetry data for 101 breeding adult golden eagles from across North America to determine whether the existing nest survey guidance was appropriate, or warranted modification. The data set includes information from 55 breeding males and 46 breeding female eagles, 87 of which were tracked across >1 breeding season. Data from eagles that were not associated with breeding territories was excluded from the analysis. We computed distances between each eagle location in the data set and the geometric center of the individual's locations (likely the approximate nest location). We removed a few additional outlier locations, those in the 99<sup>th</sup> quantile of the distribution.

Based on the untransformed data, territorial breeding golden eagles appear to seldom range further than 3 km from their territory centers (Figure 1), and this pattern was evident for both males and females in nearly all geographic regions examined (Table 1). This is similar to the conclusion reached by Watson et al. (2014) in a more localized study of ranging behavior of satellite-tagged golden eagles. Available data from the literature suggest that bald eagle ranging behavior around nests is comparable, if not more constrained (Watson 2002, Smith et al. 2017). Moreover, recent studies have shown that bald eagle ranging behavior around communal roosts is such that a buffer distance of 2 miles (~3.2 km) would provide substantial protection for roosting eagles, as well as those moving into and out of roosts (Watts and Turrin 2017).

Considering all of this information, and in keeping with the Service's policy of adopting a risk-averse position with regard to eagle management, the Service believes that eagle nest surveys out to 2 miles from the boundary of the area associated with an incidental take permit will provide sufficient information to evaluate project impacts to nearby nesting eagles (in conjunction with eagle exposure information from within the project footprint, when required). This distance corresponds to the 85<sup>th</sup> quantile of the ranging distribution of satellite-tagged golden eagles in temperate North America, and appears to be sufficiently protective of bald eagles as well. With the release of this document, the Service revises its nest survey protocol to reflect this updated information.



*Figure 1. Density plots of distances from territory centers for 55 breeding male and 46 breeding female satellite-tagged golden eagles across the western United States. The dashed red line is the median, blue the 80th, green the 90th, and purple the 95th quantiles.*

Table 1. Sample sizes and quantiles of the distance-ranging distributions for 55 breeding male and 46 breeding female golden eagles equipped with satellite transmitters. Distances are in untransformed units of km from territory centers. Ecosystem categories are based on Level 1 Environmental Protection Agency (EPA) Ecoregions (<https://www.epa.gov/eo-research/ecoregions-north-america>).

Sex	Pooled L1 Ecoregions	n	Quantile (km)				
			Q50	Q80	Q85	O90	Q95
F	Arctic	16960	0.70	3.75	4.69	5.80	6.97
F	Great Plains	42748	0.78	2.07	2.53	2.99	3.77
F	Mediterranean California	24343	0.62	1.63	1.94	2.49	4.03
F	North American Deserts	56082	0.91	3.27	4.19	5.42	7.11
F	Northwestern Forested Mountains	57191	0.81	1.91	2.26	2.82	3.82
F	Pooled Female	197324	0.79	2.37	2.98	3.70	5.56
M	Arctic	2048	2.05	4.76	5.13	5.47	6.25
M	Great Plains	77944	1.10	2.47	3.02	4.02	6.24
M	Mediterranean California	30967	1.57	2.67	2.99	3.81	5.27
M	North American Deserts	111097	0.75	2.28	2.78	3.61	4.51
M	Northwestern Forested Mountains	68413	0.97	3.14	3.81	4.71	6.37
M	Pooled Male	290469	1.00	2.57	3.15	4.04	5.50
	Pooled Overall	487793	0.91	2.49	3.07	3.93	5.54

#### Literature Cited

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