

Comments on the 2019 Proposed Rule to List the West Coast fisher as a threatened DPS:

Jody M. Tucker, 12/2/19

(2) Information regarding population trend studies for the West Coast DPS of fisher.

The following statement in the proposed rule is a misinterpretation of data and should be corrected:

“An 8-year monitoring study that sampled an average of 139.5 units (range 90–189) per year during the period 2002–2009 throughout the SSN subpopulation showed no declining trend in occupancy (Zielinski *et al.* 2013, pp. 3, 10–14; Tucker 2013, pp. 82, 86–91). However, this study had been designed to be run for 10 years while sampling 288 units per year and was intended to have an 80 percent probability of detecting a 20 percent decline over 10 years (Zielinski *et al.* 2013, p. 11; Tucker 2013, p. 82). As a result of the smaller sample size and shorter duration, the results of this study must be considered inconclusive.”

The original sampling design requiring an estimated 288 units for 10 years pertained to an analysis of trend in proportion of occupied units using logistic regression. However the Zielinski *et al.* 2013 trend analysis was conducted using more powerful occupancy modeling and multimodel inference techniques (Mackenzie *et al.* 2017, Burnham and Anderson 2002) such that the original sample size estimate of 288/year was not relevant to these new analytical techniques. Updated spatially explicit power analyses that estimate power to detect trend using this occupancy modeling approach (Ellis *et al.* 2015) support the sample sizes used in the Zielinski *et al.* 2013 (~139.5/year) trend assessment are valid to detect a trend in occupancy (J. Tucker unpublished data).

Multispecies analysis 2002-2015. Population trends 2002-2015

I wanted to provide information regarding an ongoing analysis of fisher occupancy patterns in the southern Sierra Nevada. This study uses an expanded version of the dataset analyzed in the trend estimate detailed in Zielinski *et al.* 2013 collected through the USFS Sierra Nevada Carnivore Monitoring Program.

From 2012-2015 California experienced an extreme drought representing a major disturbance event with the potential to profoundly affect biological communities. We are assessing the effects of climatic and vegetation change over a 14 year period encompassing this drought (2002-2015) on fisher (*Pekania pennanti*), and three other mesocarnivore species in the southern Sierra Nevada Mountains that exhibit a variety of competitive interactions due to similarities in body size, diet, and habitat requirements; Pacific marten (*Martes caurina*), ringtail (*Bassariscus astutus*), and gray fox (*Urocyon cinereoargenteus*).

We are analyzing multispecies carnivore occupancy data from 2002-2015 using dynamic occupancy models which account for changes in occupancy over time as a function of the probability of site colonization and persistence. In year $t = 1$ (2002), occupancy was modelled as a latent random variable. In years $t > 1$ (2003–2015), we modelled site occupancy the probability persistence (a site occupied in the previous year remaining occupied) and colonization (probability of a site previously unoccupied becoming occupied in the following year). We divided the landscape into 6.25 km² grid cells, representing a small female fisher home range. We included covariates in our dynamic occupancy models, on vegetation (canopy cover) as well as climate (snowpack, annual precipitation, and minimum temperature). This enables extrapolation of occupancy estimates to un-sampled cells to predict occupancy across the entirety of the SSN fisher population area and to draw inferences about the functional relationships between occupancy and important environmental covariates

Results

(A summary of pertinent results is provided here, detailed manuscript in preparation by J. Tucker, D.Green, and S. Matthews)

Occupancy Trends

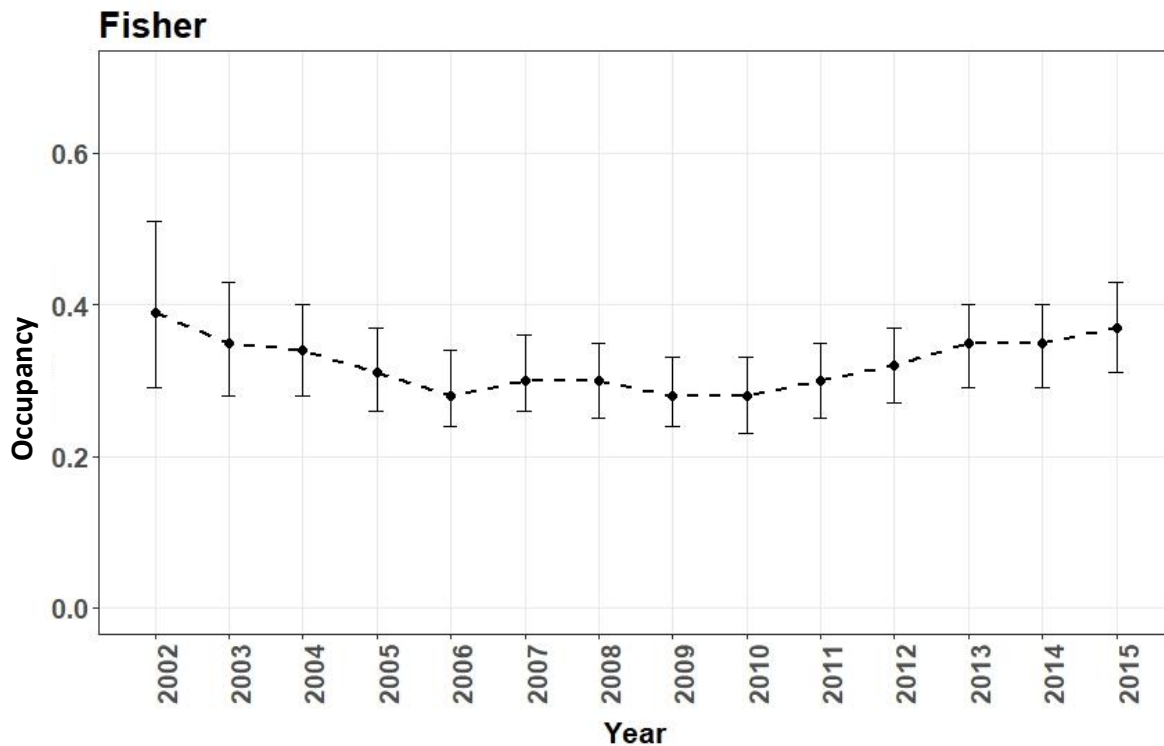
While there have been some fluctuation in occupancy across years from 2002-2015 there is no discernable trend in occupancy over the study period. Occupancy rates dipped slightly ~2005-2011 but have recovered 2012-2015 such that the occupancy rate in 2015 is not statistically different from 2002.

Table 1 & Figure 1. Annual estimated occupancy of the SSN fisher population 2002-2015 based off dynamic occupancy models.

Table 1

Parameter	Mean	SD	Credible Interval		
			2.50	50.00	97.50
p.occ[2002,fisher]	0.39	0.06	0.29	0.38	0.51
p.occ[2003,fisher]	0.35	0.04	0.28	0.35	0.43
p.occ[2004,fisher]	0.34	0.03	0.28	0.34	0.40
p.occ[2005,fisher]	0.31	0.03	0.26	0.31	0.37
p.occ[2006,fisher]	0.28	0.03	0.24	0.28	0.34
p.occ[2007,fisher]	0.30	0.02	0.26	0.30	0.36
p.occ[2008,fisher]	0.30	0.02	0.25	0.29	0.35
p.occ[2009,fisher]	0.28	0.02	0.24	0.28	0.33
p.occ[2010,fisher]	0.28	0.02	0.23	0.28	0.33
p.occ[2011,fisher]	0.30	0.02	0.25	0.30	0.35
p.occ[2012,fisher]	0.32	0.03	0.27	0.32	0.37
p.occ[2013,fisher]	0.35	0.03	0.29	0.35	0.40
p.occ[2014,fisher]	0.35	0.03	0.29	0.35	0.40
p.occ[2015,fisher]	0.37	0.03	0.31	0.37	0.43

Figure 1.



Covariate effects:

Climate:

For fisher we found a significant negative relationship between total annual precipitation and both fisher unit occupancy and colonization. Sites with lower precipitation were more likely to be initially occupied and decreased precipitation resulted in an increase in site colonization by fisher over time. Fisher occupancy increased slightly during the 2012-2015 drought likely due to expansion into higher elevation habitats where in normal precipitation years they were precluded by snow but had significantly reduced or no snow during the drought (also see Zielinski et al. 2017 for effects of snowpack on fisher).

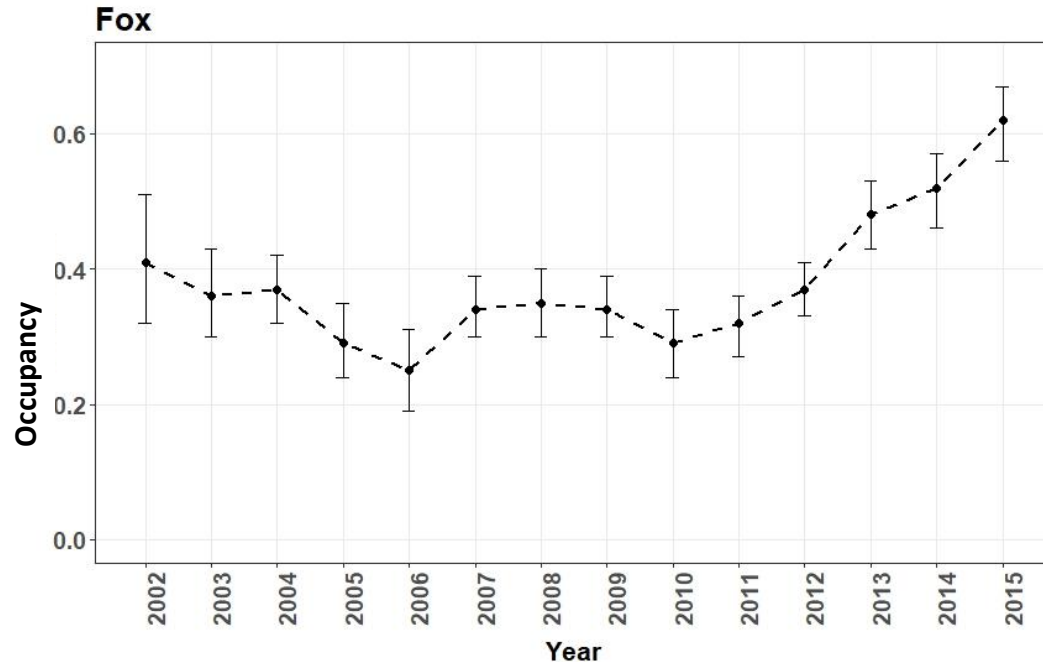
Vegetation:

However, we also found a significant strong positive relationship between canopy cover and both fisher occupancy and colonization. While a formal analysis of the effects of tree mortality on SSN fisher occupancy is pending completion of tree mortality mapping, the strong relationship we found between site occupancy and colonization and canopy cover indicates that we would expect the tree mortality to have a negative effect on occupancy due to the loss of canopy cover which is extensive throughout much of the SSN fisher habitat.

Co-occurring species occupancy trends

From 2012-2015 we found a large increase (~30% increase) in gray fox occupancy across the SSN (fox occupancy 2011 = 0.32, SD=0.02; fox occupancy 2015 = 0.62, SD=0.03). While this expansion occurred across all elevations, it was most prominent at high elevations (>7000 ft) where, similar to fisher, fox were likely able to colonize areas previously precluded by snow. It is unknown how this increase in fox may impact fisher, but the two species have been documented to show interspecific interactions where fisher is usually the dominant competitor. In the NCSO Green et al. (2018) found fisher to have a negative effect on fox occupancy and persistence but a positive effect on fox colonization which they interpreted as fisher causing an increase in variation and turnover in gray fox occupancy. In the southern Sierra Nevada there have been a number of documented instances of predation of fox by fisher (R.Green, N. Herbert pers. comm). It is possible that this large increase in fox indicates an underlying reduction in fisher densities to allow them to occupy and persist in new areas.

Figure 2: Fox occupancy rates across the SSN based off of dynamic occupancy models.



(5) Effects associated with small population size and (6) Information regarding effects of widespread tree mortality

“Some information is available that demonstrates fisher’s vulnerability to small population effects, particularly in the SSN population area, including fisher’s decreased genetic variability from north to south, limited gene flow, and existing barriers to dispersal (Wisely *et al.* 2004, pp. 642–643; see also additional discussion in Service 2016, pp. 134–137)”

It is worth emphasizing that not only is there decreased genetic diversity north to south, but the overall genetic diversity in the SSN is very low with the entire population fixed for a single mitochondrial DNA haplotype (Knaus *et al.* 2011) and nuclear DNA allelic richness estimated at 3.04 (Tucker *et al.* 2014) which is extremely low considering 2 alleles are required for a microsatellite to be considered variable in a population. This low variability put this population at increased risk of inbreeding depression which would be exacerbated if fragmentation within the population increases.

The SSN fisher population is under increased risk of genetic fragmentation in recent years due to:

- 1) many of the major connectivity routes within the population have been burned in high severity wildfires (Spencer *et al.* 2016)

2) the widespread tree mortality reducing canopy cover and the amount of dense forest habitat which has been found to facilitate gene flow in female fishers in the SSN (Tucker et al. 2017).

Female dispersal and gene flow has been hypothesized as a limiting factor for population expansion, and genetic fragmentation between females in the SSN has been shown to be significantly higher than males (Tucker et al. 2017). Consequently, the ongoing widespread loss of canopy cover and dense forest habitat due to tree mortality is likely to increase fragmentation of genetic connectivity in the SSN population.

- Additionally, the proposed rule states “We continue to recognize that the two geographic areas of fisher subpopulations in the DPS (i.e., SSN and NCSO, the latter of which includes the SOC and NSN for this analysis) are geographically isolated from one another with little opportunity for genetic interchange”

This statement is misleading in that there has been no documented evidence of genetic connectivity in either historical or contemporary genetic samples from the NCSO and SSN (Knaus et al. 2011, Tucker et al. 2012, K. Pilgrim pers comm.)

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