

# Spotted Owl PVA

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```
## Warning: package 'popbio' was built under R version 3.3.2
## Warning: package 'stargazer' was built under R version 3.3.2
##
## Please cite as:
## Hlavac, Marek (2015). stargazer: Well-Formatted Regression and Summary Statistics Tables.
## R package version 5.2. http://CRAN.R-project.org/package=stargazer
```

## Background

The spotted owl is an owl species that resides in the western United States from Oregon all the way down to California.

## Methods

Data were obtained from the USGS annual breeding bird survey in New Mexico, Utah, Colorado, and Arizona, and filtered for records pertaining to the Spotted Owl. Total species counts per year per state were summed and combined to create a representative yearly sample for the four state area. Lambda values of population growth were obtained by comparing count differences between years, which were then used to create the mu value by taking the mean value of lambda values transformed by application of the natural logarithm. An extinction CDF function was then run on a two century scale, presuming a quasi-extinction threshold of 10 owls, using values obtained from a linear regression of the change in log transformed lambda values by the change in time (yearly).

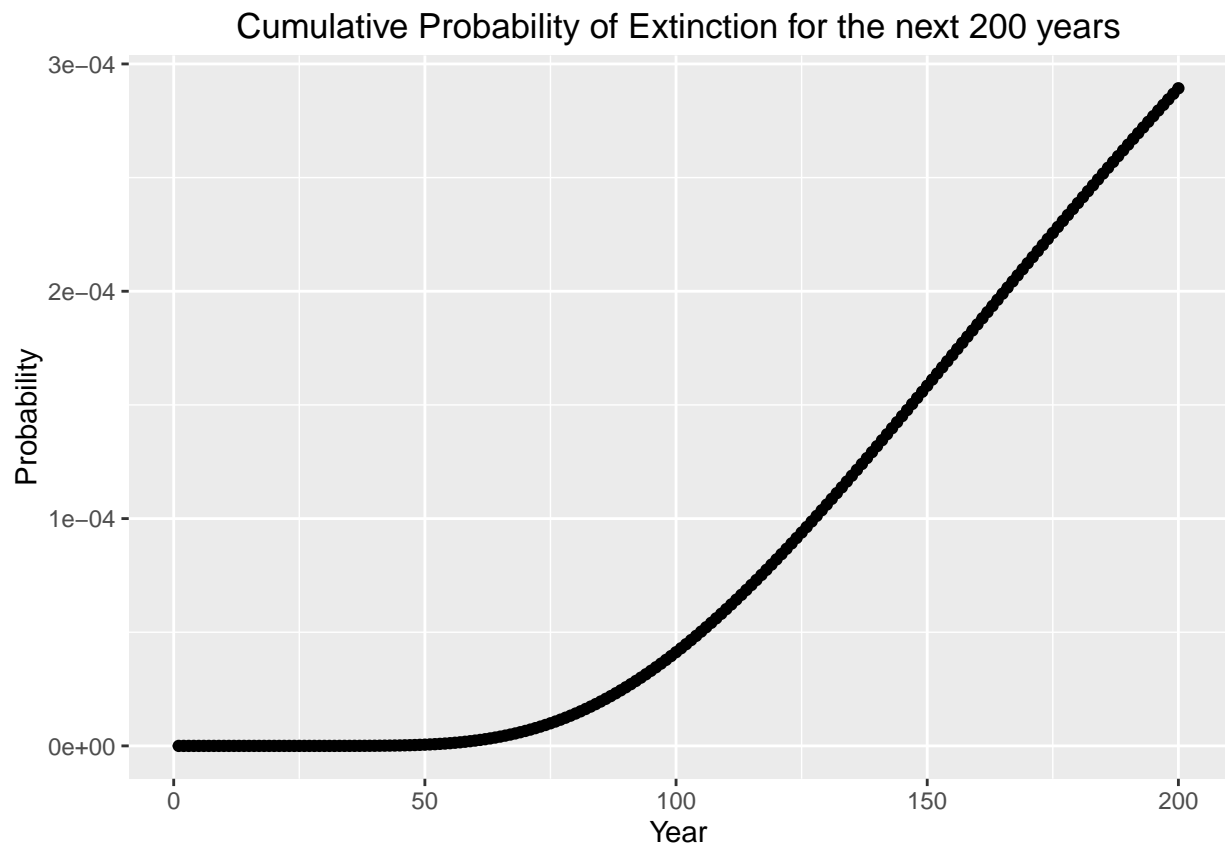
It is important to note that this population viability analysis (PVA) was conducted under the following assumptions: that current conditions will persist over the next two centuries, that observer error is minimal, and that the population growth rate is not or will not be influenced by population density. The quasi extinction threshold used was a population of ten owls, based upon findings from relevant literature regarding the species.

## The client is always wrong

```
##
## Call:
## lm(formula = ystar ~ xstar + 0, data = owls3)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.85360 -0.17142  0.00431  0.23487  0.73052
##
## Coefficients:
##      Estimate Std. Error t value Pr(>|t|)
## xstar  0.04267    0.04953   0.861    0.393
##
## Residual standard error: 0.3396 on 47 degrees of freedom
## Multiple R-squared:  0.01554,    Adjusted R-squared:  -0.005405
## F-statistic: 0.742 on 1 and 47 DF,  p-value: 0.3934
##
##      2.5 %    97.5 %
## xstar -0.05698135 0.1423147
## [1] 0.1153282
```

```
## [1] 0.07963632
## [1] 0.1819302
##           Lower Estimate      Upper
## Mu      -0.05698135 0.0426700 0.1423147
## Variance 0.07963632 0.1153282 0.1819302
```

The spotted owl population has a positive but not significant trend in its yearly population, ( $\mu = 0.04267$ ,  $pvalue = 0.393$ ). Its growth is also uncertain, as shown in by Table 1 above. As the confidence interval includes 0, we cannot definitively state that the spotted owl population is growing. The variance of  $\mu$  is also given in



the same table.

Figure 1 shows that the cumulative probability of extinction does not exceed .003 even on a two century timescale. Thus, you our client can rest easy regarding the fate of the Spotted Owls, providing that there are no massive habitat losses or severe climate shifts during that time.

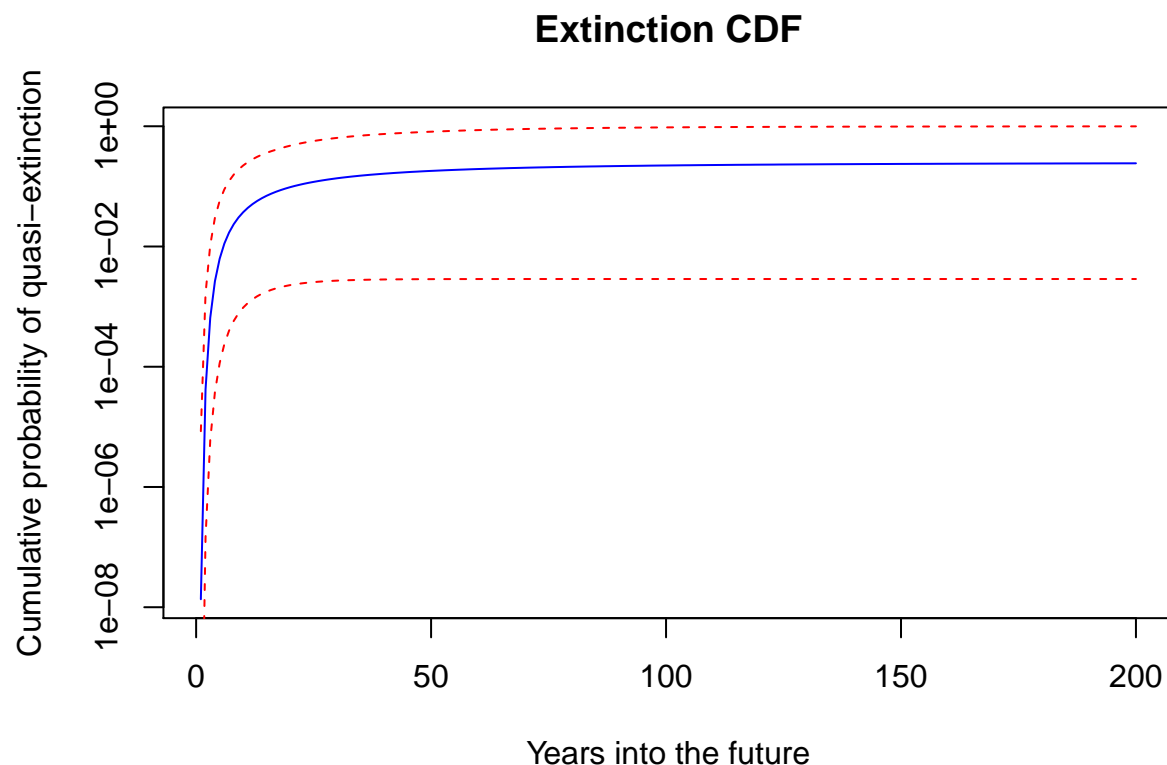


Figure two shows a more conservative estimate of the cumulative probability of extinction for the Spotted Owl, complete with 95% confidence interval indicated by the red lines. Table 2 shows this confidence interval at decennial intervals. At no point does the population reach an equal chance of persisting or declining, as even with the more conservative estimate the chance of extinction does not exceed 1%.

```
## [1] 2023 2033 2043 2053 2063 2073 2083 2093 2103 2113 2123 2133 2143 2153
## [15] 2163 2173 2183 2193 2203 2213
```

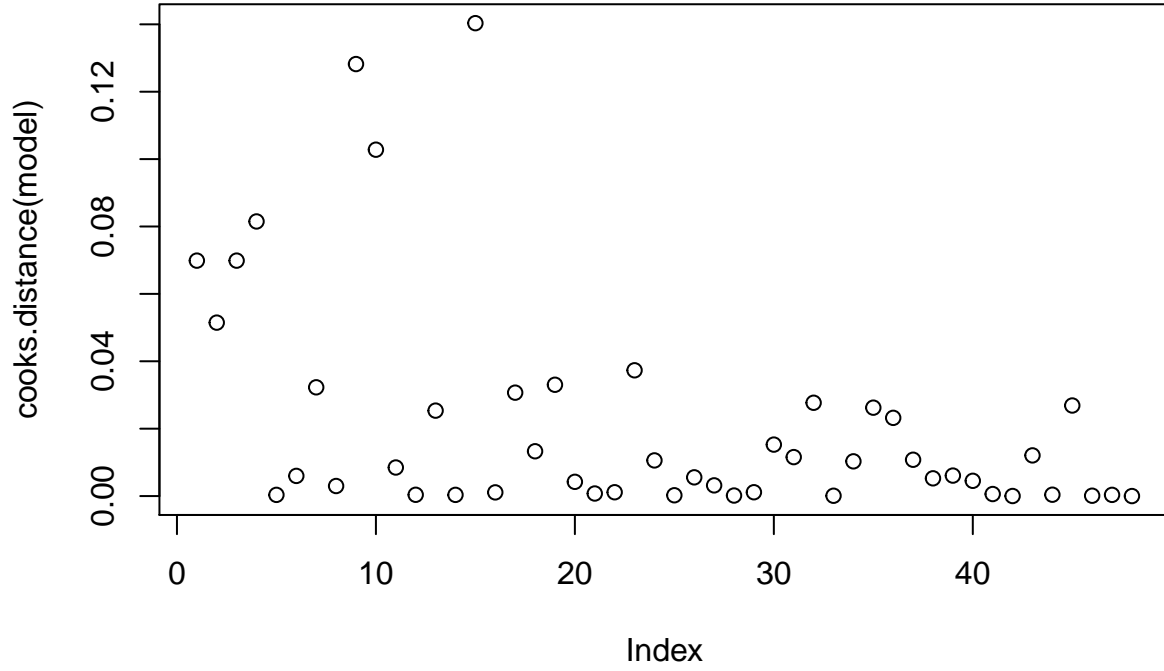
```
% Table created by stargazer v.5.2 by Marek Hlavac, Harvard University. E-mail: hlavac at fas.harvard.edu
% Date and time: Fri, Mar 31, 2017 - 5:34:11 PM
```

**You know what they say about assumptions...**

```
## lag Autocorrelation D-W Statistic p-value
## 1 -0.4301937 2.793459 0.002
## Alternative hypothesis: rho != 0
```

Table 1: Decennial Cumulative Extinction Probabilities

year	Lower	Estimate	Upper
2,023	0.001	0.037	0.222
2,033	0.002	0.097	0.475
2,043	0.003	0.136	0.641
2,053	0.003	0.163	0.744
2,063	0.003	0.181	0.812
2,073	0.003	0.194	0.863
2,083	0.003	0.204	0.900
2,093	0.003	0.212	0.925
2,103	0.003	0.218	0.944
2,113	0.003	0.223	0.957
2,123	0.003	0.227	0.967
2,133	0.003	0.230	0.975
2,143	0.003	0.232	0.980
2,153	0.003	0.234	0.985
2,163	0.003	0.236	0.988
2,173	0.003	0.238	0.991
2,183	0.003	0.239	0.993
2,193	0.003	0.240	0.994
2,203	0.003	0.241	0.995
2,213	0.003	0.242	0.996



The assumption of density independence was checked using AIC comparison of models fitted according to the

Ricker model and a density independent model. The AIC of the density-dependent Ricker model is 34.07, and the AIC of the density independent model was 33.95. The assumption holds! The crowd goes mild! However, following Durbin-Watson analysis of the earlier model, our data does appear to be autocorrelated. Analysis using Cook's Distance reveals that our results are influenced by outliers.

## Conclusion

We conclude that the Spotted Owl population in the four state area we examined, which represents most of the species' range, is not at risk. Barring extreme habitat changes, the Spotted Owls will remain viable for the next two centuries. This does not mean that conservation efforts for this species should be neglected. Moving forward, those concerned with this species should focus their efforts on preventing or mitigating large scale logging operations within this range, and the threat of catastrophic wildfire should be attended to. While our results tested positively for autocorrelation and outlier influence, the influence of these factors is not sufficient to fundamentally alter our findings.

## References

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