

**Ashy storm-petrel trends in abundance at the Farallon Islands, 2007-2021: Preliminary update
for the U.S. Fish and Wildlife Service, Farallon Islands National Wildlife Refuge**

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We are providing you a preliminary update on the trend in ashy storm-petrel abundance for the period 2007-2021. In Nur et al. (2019), we analyzed long term ashy storm-petrel capture data from 2000 to 2012 to quantify recent trends in storm-petrel abundance on the Farallon Islands National Wildlife Refuge. We then used estimates of storm-petrel survival and fecundity, together with the observed trends, to model projected population change up to 20 years into the future, assuming that owl abundance, storm-petrel survival rates, and storm-petrel fecundity remained unchanged from the most recent years in the study, 2009-2012. Given those conditions, we found that the ashy storm-petrel population could be expected to decline by an estimated 38% ($\pm 15\%$) after 10 years and an estimated 63% ($\pm 13\%$) after 20 years.

Recently, we had the opportunity to examine the observed capture rates from 2013 to 2021 to ask whether the previously observed declining trend has continued in recent years. To do this, we analyzed an ashy storm-petrel abundance index based on mist-net capture rates from the Farallon Islands and statistically corrected for nighttime visibility (moon phase and cloud cover) and netting date within the breeding season, factors which have been shown to influence capture rates. We then modeled the capture rates for the period of 2007 to 2021 as an index of the population trend during this time. We modeled capture rates since 2007, since this was the first year in which burrowing owl abundance began to increase, with the highest levels of owl abundance observed in the most recent years, i.e., since 2009.

We found that there has been an estimated 2.7% ($\pm 1.1\%$) per year decline in storm-petrel capture rates since 2007 ($P = 0.018$), resulting in an estimated cumulative decline in capture rates of 31.8% ($\pm 10.8\%$; Figure 1). These results demonstrate that the ashy-storm petrel population (as indexed by its capture rates) appears to have continued to decline significantly since years included in the initial modeling effort published in the Service's Final EIS (USFWS 2019) and Nur et al. (2019). This decline is well within the confidence interval of, and thus consistent with, the original model projection.

It is noteworthy that the results from the population projection model align well with the results from the analysis of the abundance index based on capture rates because the approaches are quite different. For the population projection model, we determined survival rates, how they varied with owl abundance, and combined that with estimates of fecundity to make projections of the change in population size beyond 2012, based on data from 2000 to 2012. In contrast, capture rates do not measure population size directly, but rather provide an index of population trend. While we can expect that capture rates increase as the abundance of storm-petrels increases, other factors also influence the rate at which storm-petrels are caught. Hence for our statistical analysis of capture rates, we controlled for the effects of nighttime visibility and for the time of year within the breeding season, which reflects changes in the flight behavior of ashy storm-petrels, and thus their susceptibility to capture. Controlling for these two factors provided us with robust estimates of changes in the abundance-index over time, which support the estimates of prospective population change reported in Nur et al. (2019).

We note that these results are considered preliminary and have not been peer reviewed. These analyses should be cited as Point Blue Conservation Science, unpublished data.

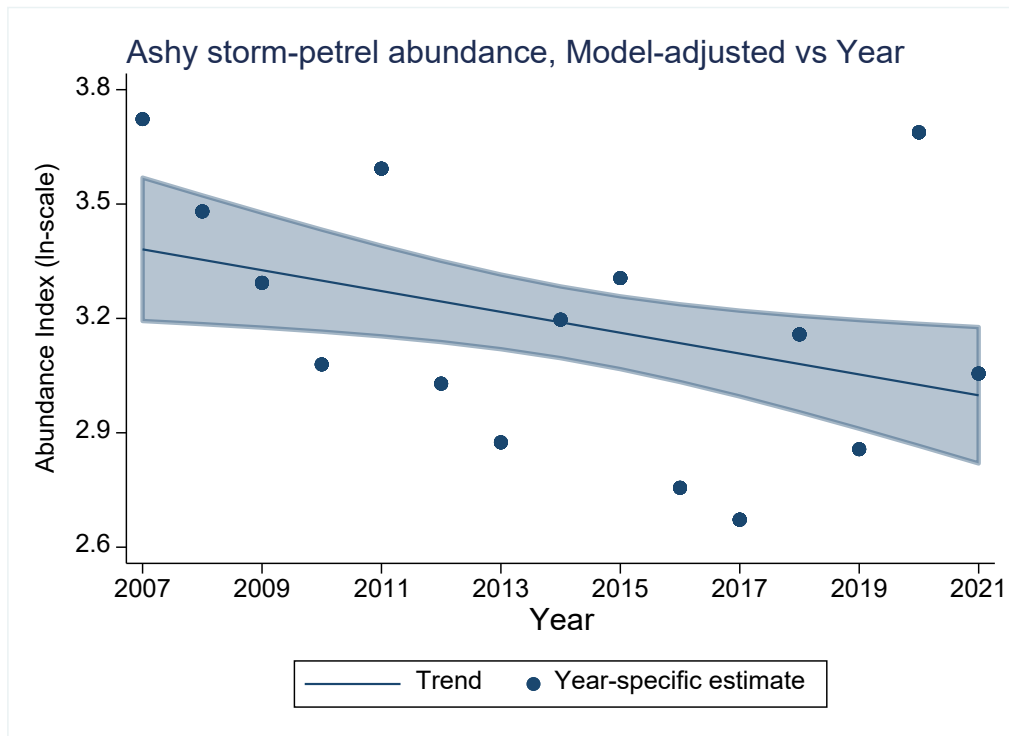


Figure 1. Estimated trend in ashy storm-petrel abundance index, 2007-2021, based on statistical model for capture rates (birds caught per net-hour, $n = 93$ netting sessions). 95% CI shown in shading. The abundance index is on natural-log scale. Individual values (filled circles) are year-specific estimates based on a statistical model controlling for visibility and netting date.

References:

- Nur, N., Bradley, R.W., Salas, L., Warzybok, P. and Jahncke, J. 2019. Evaluating population impacts of predation by owls on storm petrels in relation to proposed island mouse eradication. *Ecosphere*, 10(10). <https://doi.org/10.1002/ecs2.2878>
- U.S. Fish and Wildlife Service (USFWS). 2019. Farallon Islands National Wildlife Refuge: South Farallon Islands Invasive House Mouse Eradication Project: Final Environmental Impact Statement. U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Fremont, California.