Comment: Recent trends in survival and mortality of wolves in Minnesota, United States

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Chakrabarti et al. [1] reported, “We did not observe evidence that survival was markedly reduced during years when a regulated hunting and trapping season was implemented for wolves (years 2012–2014).” (Abstract and Discussion). This and similar statements on pages 7 & 9 suggested that hunting and trapping were fully or nearly fully compensatory. Based on our arguments below, we suggest that such a claim would be extraordinary and seems to be unintentionally misleading for several reasons.

First, [1] seemed to report a decrease in survival of >36% and an increase in hazard of >300% over the study period 2004-2019 (their Figure 2). That background of decreasing survival over time should be reflected in the language used to compare pre- and post-hunt survival rates, e.g., more accurately, their result should state, ‘against a background rate of declining survival, we did not detect separate declines due to wolf-hunting.’ However, even that conclusion would need clarification. The caption to Figure 2 references a regression but neither the methods nor R script sent by a co-author in [1] explained how those regressions w fit. If the lines in Figure 2 are regressions, then they should include error estimates on the slopes and alternative models should be compared, such as nonlinear or slope discontinuity models. Even these fixes might require reconsideration because of the next four problems of confounding variables well-known in the literature we expand on next.

Second, a much larger study by Barber-Meyer et al. [2] also analyzed marked wolf survival before, during, and after a similar period in Minnesota, including 74 wolves alive during some or all of those wolf hunting and trapping seasons. Those 74 exceed all of Chakrabarti et al.’s sample [1]. Also, [2] reported, “The annual survival rate for adults during pre-harvest years [0.79] was higher than that during harvest years (0.68…) and post- harvest years (0.74…)” p.5, [2]. [1] did not address this difference. We are inclined to trust the analysis by [2] based on sample size (261 vs. 59 known fates) and their caution with the potentially confounding variable of age. Namely, the rarity or absence of marked pups during and after the hunting seasons [2] could have created an artifact in the analysis by [1]. Specifically, adults had lower mean mortality than pups, hence the absence of pups in the later periods would raise overall mean mortality compared to the pre-hunt rates that included more young wolves. Accordingly, that could confound the analysis of period effects in [1]. A strict comparison of adults would be illuminating, with acknowledgment that aging Upper Midwest wolves from the size or appearance of animals in the field can be inaccurate [3].

Third, [1] were particularly interested in the period 2012-2014 (wolf-hunt years), yet they assumed the wolf biological year starting 15 April was the appropriate temporal unit for replication. By contrast, numerous studies that were not cited have found that examinations had to account for the timing of policy and management events spanning less than one year in some cases and more than one year in other cases [4; 5; 6; 7; 8; 9; 10]. Indeed, the earliest set found the length of the period was an important factor. Therefore, 12 months starting 15 April is arbitrary when one is interested in policies that do not start and end near that date. Arbitrary
time intervals can conceal the potential effects of intra-year and multi-year influences on animal survival by breaking up biologically meaningful periods of life history and demography. Additionally, April is not a time that aligns with the start or stop of human activity related to wolves (eg., mammal hunting seasons, hound-training seasons, baiting seasons), in the region [9]. To get a complete and accurate description of human-caused mortality patterns and population dynamics, one needs to consider intra- and inter-year changes in human behavior, management, and policy as we explain next.

Quite a bit is known about intra-year and inter-year effects of humans on wolf mortality. Previous work indicates that the start and end dates of policy periods (such as wolf-hunts or delisting) illuminate both population dynamic analyses and individual wolf survival analyses [4; 5; 6; 7; 8; 9; 10]. One major conclusion was that liberalizing wolf-killing produced substantial changes in population dynamics and individual wolf survival that was detectable within years and between years. The slow-down in population growth above and beyond that expected from legal killing [4; 5; 6] provides a mechanistic explanation for findings by numerous investigators [11; 12; 13; 14; 15] that humans impose additive or super-additive mortality on wolves. In short, [1] should have accounted for (and cited) possible super-additive mortality beyond the hunting seasons and beyond that reported by legal hunters and trappers. Another relevant conclusion about individual survival came from studies of marked wolves in four population. These authors inferred that disappearances of collared wolves increased substantially during periods with lower protections for wolves [7; 8; 9; 16] These studies built on the finding that disappearances of collared wolves can neither be treated as random causes of death nor assumed to occur in the same proportions as known causes of death. That inference derives from the observation that legal causes of death must be reported and therefore never disappear from the dataset, whereas tampered transmitters lead to marked wolves disappearing from the known fates dataset so they are therefore most likely over-represented among the unknown fates [3; 17; 18].

In short, estimates of survival are biased when disappearance is not treated as an independent endpoint for collared wolves, which [1] and [2] ignored. Rather, [1] made unsubstantiated and unclear assertions about disappearances of marked wolves (Table 1). Besides the call to authority without evidence and citation to a single study, the assertions are misleading because percentages of radio-collars that were lost to monitoring and hence unknown fates routinely exceeds 50% of collared animals [7; 8; 9; 16; 18]. MN wolves were no exception with 63-65% unknown fates in the marked wolf datasets [1; 2]. Also the papers that [1] did cite and related ones [19; 20; 21; 22; 23] have not answered challenges to their statistical analyses or lack of transparency [6; 24; 25]. Given five studies contradicting the quoted assertion above [7; 8; 9; 16; 18], we recommend reanalysis of the data in [1] (A) at the appropriate temporal scales of ‘life history and demography and (B) including disappearance as an endpoint. Also, [1] should have transparently engaged with all this omitted scientific evidence, as they did with regard to age- and sex-differences [1, p.9].

In conclusion, and given that Chakrabarti [1]’s claim of no mortality increase following Minnesota’s wolf-hunting and trapping seasons was important enough to the authors to be reported in the Abstract. Moreover, readers deserve explicit alternative hypotheses stated a priori, appropriate citing of relevant work, and an evaluation of alternatives interpretations as guided by effect sizes, e.g., Bayes Factor analysis [26]. Without such even-handed evaluations and without examining intra-year and inter-year shifts in policy at the appropriate scale of analysis, the claim of no significant increase in mortality is unpersuasive.

Disclosures
We declare no financial competing interests. For complete disclosures of potentially competing interests whether financial or non-financial, see full CVs for
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