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Response to Reviewer Comments

16 April 2020

Thank you for your reviews and comments. We have provided responses to the specific comments made by each reviewer below. Our responses are in bold.

**Reviewer 1:**  
Line 92: Can you provide a little more information about the expert team? How many experts participated? What areas of expertise were represented (e.g. captive breeding vs. field surveys vs. human/snake interactions vs. habitat)?

**We have added a few sentences here to describe the expert team in more detail. Now on lines 89-92: “The team of nine participants included researchers from academic and non-profit institutions as well as the U.S. Fish and Wildlife Service Caribbean Ecological Field Office. Participants had experience working with PR boas and/or sister taxa (e.g., Cuban boa) either in field studies or captivity.”**

Line 95: What does it mean that the expert team decided/estimated things “by consensus”? Is this a general usage of the term or is there a decision-analysis definition for the reader to be aware of? Did all experts agree right away, was there initial variation in opinion that coalesced into a consensus through discussion or some process?

**We have added the following sentence for clarity, “If experts did not initially agree on demographic rate estimates, differing estimates were discussed until participants agreed on an average value.” (lines 94-95).**

Line 106: When information for the model was gleaned from captive zoo populations, was there a consideration that zoo populations might have different rates than wild populations?

**This was discussed during the expert meeting and experts were encouraged to provide estimates of demographic rates for natural populations, which may be different from those for captive populations. We have edited this sentence to read, “The experts used personal experience, unpublished data, and inference from captive zoo populations to provide estimates of average productivity, survival, and growth rates for the wild population” (line 104).**

Line 106: Suggest changing “personal information” to “personal experience”

**Edited as suggested.**

Line 107: Suggest changing “… populations to determine average productivity….” to “… populations to provide estimates of average productivity…”

**Edited as suggested.**

Line 118: Suggest removing “per USFWS recommendation”. Seems more concise to just say there are no clear records over 700m. Current wording makes it unclear whether USFWS recommended that there were no records over 700m, or they recommended only considering areas below 700m.

**Edited as suggested.**

Line 178: Why was a log-normal distribution used and what shape parameters were used for those draws?

**Edited to read, “For the fecundity rates, we randomly drew an average value from a log-normal distribution with the expert-estimated mean and derived standard deviation (Morris and Doak 2002). A log-normal distribution was used for the fecundity rates to allow for a continuous random variable with a lower bound of zero” (lines 172-175).**

Line 184: The figure in Appendix A was very helpful in understanding how the 15% parametric uncertainty and 15% annual variation worked. I was confused initially about whether they were the same 15% or different, but the figure helped clear it up.

**We’re glad this figure helped provide clarity about the simulation model. We did not include it as a main text figure due to its size and the number of other figures already included but would be willing to create a version of this figure for the main text if the Editor thinks it would be a useful addition.**

Line 201: Was the 0.5-1 range for the effect of urban habitat on survival informed by expert input?

**Yes. We have added a sentence here, “There was some uncertainty in the magnitude of this effect with some experts believing survival and growth rates in urban areas would be as low as 50% of the same rates in natural areas while others arguing that increased availability of small prey could mitigate threats. Therefore, so we allowed it this effect to vary among replications” (lines 193-196).**

Line 255: Suggest adding a sentence summarizing for the reader how the scenarios actually affect the model (e.g., lower carrying capacity and lower survival rates in response to more snakes with decreased survival in urban areas)

**We added a sentence earlier in this paragraph, “Habitat area directly influenced the carrying capacity, and the percent of habitat within developed areas influenced the proportion of the population subject to the randomly-varying habitat effect described above” (lines 235-237).**

Line 397: The github link leads to a 404 “This is not the web page you are looking for” error. Authors perhaps waiting until publication for the code to go live?

**Thank you for pointing this out. We have fixed the link.**

Figure 1: In the spirit of having each table/figure and its caption able to stand alone, I suggest either adding definitions for the parameter abbreviations, or simply having a note in the caption about what N means and that the rest correspond to the parameters listed in Table 1.

**We have edited this caption by adding the sentence, “ is the number of individuals in stage *x* in year *t*. Demographic rates are defined in Table 1.”**

Figure 3: May not be an issue when the figure is placed in context in the final layout, but consider using the words “sensitivity analysis” in the caption somewhere to help the reader quickly link the figures to the correct part of the methods/results.

**We have edited this caption to begin with, “Sensitivity analysis of the effects of demographic rate inputs on model outputs.”**

**Reviewer 2:**

In the abstract, the authors provide a strong justification for using expert knowledge and a quantitative population projection for data deficient species, but they do not include their key findings nor do they suggest how their results can be used. I suggest the former (i.e., the justification) be streamlined so that the latter can be included.

**We have added two sentences to the Abstract to highlight some of the key outcomes of this modeling exercise and describe how our results and methods can be used.**

In the discussion section, it may be worth revisiting the impetus for this work in the opening paragraph.

**We have added a sentence to the beginning of the Discussion, “Conservation planning requires predictions about the future status of species and populations, which is challenging for data-deficient species.” (line 316)**

Is 30 years a long enough of a times series given the generation time of this species? Was any consideration given for evaluating a longer time series, say 50 to 100 years?

**The choice of a time horizon for population projections is challenging and unfortunately there are no clear “rules” for choosing an appropriate time frame. This projection was conducted in support of a Species Status Assessment under the ESA, and our FWS partners chose this time horizon as a reasonable target for the “foreseeable future” as defined by U.S. Department of Interior guidance (U.S. Department of the Interior 2009, Smith et al. 2018). We have added a few sentences here (lines 262-265): “The time horizon of 30 years was chosen by the team as a reasonable representation of the “foreseeable future” for this species (U.S. Department of the Interior 2009, Smith et al. 2018). For stochastic projections with many sources of uncertainty, shorter time horizons are recommended to minimize error propagation (Beissinger and Westphal 1998).”**

Specific Comments (references to line numbers are for interior numbers):

Line 1: Remove the letter ‘a’ before the word ‘Developing’ in the title.

**We have edited the title to reduce wordiness. It is now, “A demographic projection model to support conservation decision making for an endangered snake with limited monitoring data”**

Line 55: Are there any New World examples that could be included?

**As far as we are aware there have not been any comprehensive assessments of the population status of New World snakes.**

Line 68: Add, “Endangered Species” to the word “Act”.

**Edited as suggested.**

Lines 102–103: Specify if the total length or snout-vent length is used.

**We have replaced the word “size” with “total length.”**

Lines 292–294: This sentence should be move to the discussion. The authors might also consider providing some additional details in the discussion section regarding the assumptions and limitations associated with conducting sensitivity analyses where all parameters but one is fixed (single-factor), versus a sensitivity analyses where multiple parameters are permitted to vary simultaneously (e.g., Latin hypercube sampling. See Fordham et al. 2016 for a general explanation and Bradke et al. 2018 for an example using snakes).

**We moved the sentence, “we note that this sensitivity analysis is conducted assuming that only one demographic rate changes independent of the others, while, in reality, threats likely influence more than one rate simultaneously” to the Discussion as suggested. We have also added a sentence to address the reviewer’s question. Lines 370-374: “Methods that allow multiple rates to vary simultaneously, e.g. Latin hypercube sampling (Fordham et al. 2016, Bradke et al. 2018), may be better suited to capture nuances of parameter interactions. However, our approach still provides insight into how the future trajectories would change if the elicited demographic rates are incorrect.” To be frank, the key advantage of the single-factor sensitivity that we conducted was that it was quick and relatively straightforward to implement in R. If we had more time, we would have likely investigated the use of more complex approaches. However we do still think even a simple sensitivity analysis is useful and provides insights to model behavior, as discussed in the paper.**

Lines 331–333: It might be useful to provide a specific example of how the results from the sensitivity analyses might be used to establish priorities for future research.

**We have added a few sentences later in the Discussion to address this point. Lines 379-383: “Additionally, this analysis is useful at prioritizing future research. In this case, the expert-estimated average fecundity (4.5 offspring/female) is very close to the threshold at which projected probability of stability or decline changes drastically (Figure 3). Future research to refine this estimate would help reduce our uncertainty in the future trajectories for this species.”**

Lines 375–376: This sentence could be shortened to, “Estimates of adult boa survival rates using mark-recapture or known fate models would improve confidence in our model predictions and utility for decision-making.”

**Edited as suggested.**

Lines 519–521 (Table 1): The unit (i.e., annual) for the ‘Average’ should be specified in the

table legend.

**We have edited the caption by adding the sentence, “Survival and growth rates are annual probabilities and fecundity is the average number of young produced per adult in a given year.”**