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Correspondence/Rebuttal

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Reply to Comment on "Terrestrial Scavenging of Marine Mammals: Cross-Ecosystem Contaminant Transfer and Potential Risks to Endangered California Condors (*Gymnogyps californianus*)"

Meretsky and Snyder's comment on our paper "Terrestrial Scavenging of Marine Mammals: Cross-Ecosystem Contaminant Transfer and Potential Risks to Endangered California Condors (*Gymnogyps californianus*)" highlights the complexities inherent in assessing effects of environmental contaminants on wildlife. Meretsky and Snyder raise concerns that there are not adequate data to definitively link DDE contamination in California condors foraging on the coast to decreased reproductive success and stress that additional research is needed to determine if DDE may be the ultimate cause of problems with "egg hatchability" in coastal-feeding condors. Although we appreciate this opportunity to expand the discussion with respect to the potential effects from DDE on California condor reproduction, linking DDE contamination in condors to decreased reproductive success was not an objective of our published study. Our study objective was to "quantify the degree to which condors are using marine mammals as a food resource, as well as predict potential reproductive risk from this behavior". We provide a comprehensive assessment of the transfer of polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), mercury, and a suite of chlorinated pesticides in addition to DDE (*p*,*p*′-DDE, a major metabolite of the chlorinated pesticide DDT), and present strong positive relationships between observations of condors feeding on marine mammals and concentrations of DDE, sum PCB, sum PBDE, and mercury in condors (see Figures 3, 4).

We used DDE threshold levels in our predictions of the flock-wide exposure of central California condors to marine-associated contaminants (Figure 5) for three main reasons:

(1) Negative effects of DDE exposure on avian reproductive success are well-established.[1]

(2) Of the contaminants we evaluated, DDE was the most abundant compound in California condors. DDE represented >90% of the sum chlorinated pesticides measured, and plasma DDE concentrations were ∼3-fold greater than plasma concentrations of sum PCBs and sum PBDEs, and ∼7-fold greater than total whole blood mercury concentrations (Table S7).

(3) Our colleagues published data showing that condors in central California, which have been observed feeding on marine mammals, had lower hatching success (20−40%) than those in southern California (70−80%),[2] (In our original article, an error caused this to read: "condors breeding along the Big Sur coast of California had a hatching success rate of 20-40% lower than that of noncoastal breeders." The correct figures are listed here) and we found that condors in central California had higher DDE concentrations than condors in southern California ($P < 0.001$, Mann−Whitney U-test, Figure 2B, DDE comprises >90% of the sum chlorinated pesticides shown). We also found a very strong relationship between the number of years a condor was observed feeding on marine mammals and their plasma DDE concentration ($P < 0.0001$, Figure 4A).

We agree with Meretsky and Snyder about the unknown sensitivity of condors to DDE and the potential effects of other contaminants, including those that we documented in coastally feeding condors. Indeed, we caution in our manuscript that "a range of sensitivity to DDE-associated eggshell thinning has been reported both between and within avian species,[1] and this sensitivity might be confounded by co-exposure to other organochlorine compounds[3]". We are conducting a broader assessment of the population-level impact on California condors from feeding on dead-stranded marine mammals and look forward to future investigations of the linkages between DDE exposure and condor reproduction. More broadly, we welcome and encourage discussions related to the challenging issues associated with assessing the effects of contaminant exposure on wildlife health.

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Notes

The authors declare no competing financial interest.

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