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

California condor (*Gymnogyps californianus*) recovery has made substantial progress since the species comprised fewer than 30 individuals in the 1980s. However, substantial obstacles to full recovery persist. Kurle et al.,[1] in discussing contaminant issues for coastal California condors, confirmed potentially detrimental exposure of these birds to a variety of pollutants in marine food chains. Yet in targeting DDE for primary consideration, the authors may be focusing on the wrong culprit. An earlier paper by Snyder and Meretsky,[2] evidently overlooked by Kurle et al.,[1] provides cautionary data regarding DDE impacts on condor reproduction and encourages both greater insistence on a “smoking gun” for DDE impacts and broader investigation of the unfortunately large number of other contaminants to which condors are exposed.

Kurle et al.[1] reported high levels of DDE in blood plasma samples from coastal free-flying California condors feeding on contaminated marine mammals and noted that ongoing reproductive problems in coastal condor populations could trace to this contaminant. However, earlier studies with condors and DDE, largely focused on potential effects on eggshell thickness, did not provide consistent or persuasive support for such a link. Kiff et al.[3] reported a strong negative correlation of DDE with eggshell thickness in samples from just 7 inland nests of the 1960s and 1970s—a population not known to feed on marine mammals from 1930 through final capture in 1987.[4] But Snyder and Meretsky,[2] working with the same population and a considerably larger sample (46 nests from the 1960s, 1970s, and 1980s) were unable to confirm this correlation.

More recently, Burnett et al.[5] reported coastal condor eggs with thin, highly permeable shells that apparently resulted in increased failure to hatch, through dehydration. These authors also suggested that DDE was the primary cause of difficulties, but they did not present correlations of DDE levels with shell characteristics or other reproductive parameters, nor did they cite other studies correlating increased egg permeability (as opposed to fragility) with elevated DDE. Burnett et al.[5] noted that the egg permeability problems they identified did not match previously reported problems associated with DDE in other raptors. Thus, the present hatching problems may well have resulted, at least in part, from causes other than DDE contamination.

The tendency to suspect DDE when shell abnormalities are found stems from many historical raptor studies.[6] However, such suggestions with respect to condors neglect important evidence from the wild condor population of the 1980s presented by Snyder and Meretsky.[2] This population produced many eggs with high DDE levels in their lipid layers (>100 ppm), yet showed no clear evidence of the reproductive problems often tracing to DDE contamination in other bird species.[7,8] Fertility, hatchability, nestling survival, and nesting success were all evidently normal in those years and were crucial in the establishment of today’s vigorous captive population.

Similarly, data from the 1960s for the same wild population indicated apparently normal nest success similar to that in pre-DDT years.[9,10] Some eggs from the 1960s−1980s did exhibit abnormal shell layering, but this condition was not persuasively associated with either high levels of DDE or egg failure. The main stress to the population was very high adult and juvenile mortality, now confirmed as tracing mainly to lead poisoning[11,12] (except at very high tissue concentrations, DDE contamination does not normally produce adult or juvenile mortality problems in birds, and its primary documented detrimental avian effects have been reproductive).

In overlooking these contaminant and reproductive data from the original wild population of condors, Kurle et al.[1] missed evidence that condors may well be among the species that are relatively resistant to DDE effects. Bird species vary widely in their sensitivity to this contaminant.[13] And while we do not assert that DDE is without effects on condors, the failure to confirm any strong DDE influence on condor eggshell thickness and the absence of frequent egg breakage (other than occasional egg predation by common ravens) or any other pervasive reproductive problems in the highly contaminated condor population of the 1980s together suggest at most limited effects. The hatchability problems noted by Burnett et al.[5] were clearly not characteristic of condors of the 1980s, nor is there credible evidence for their existence in the 1960s and 1970s. All these populations and time periods yielded shell samples with similarly high levels of DDE, so involvement of DDE in hatchability problems seems unlikely unless produced by synergisms with other contaminants varying among periods and populations.

Given the worrisome egg hatchability problems in recent coastal condors, additional research on effects of various environmental contaminants, singly or in combination, is needed for the species. Tubbs[14] similarly recommended additional studies and noted the possibility that mixtures of contaminants might be responsible for eggshell issues in condors.

With lead poisoning mortality now well understood, if unsolved, reproductive problems become an important research area for condors. In addition to broad-based contaminants work, noncontaminant factors might also be considered. For example, Snyder and Meretsky[2] presented preliminary evidence that some eggshell abnormalities in wild condors might be related to nutritional condition of females. Similar results have been reported in other birds.[15,16]

Unfortunately, field studies of effects of contaminants and noncontaminant factors are often difficult to control rigorously,

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and it may be wise now to consider limited experimentation with captives. Such efforts with an endangered species may require novel authorization, but enough captive condors now exist that experimentation can be conducted without compromising the viability of captive populations. The vigorous breeding of captive condors and the ability to carefully control and measure the contaminant status of captives may make experiments with a few such individuals the fastest and most reliable way to answer many questions.

So long as the causal factors of current reproductive problems of coastal condors remain uncertain, viable wild populations may remain out of reach for the region. If DDE is not the real or only villain, expectations may be misplaced that these problems will decline without intervention as a result of an ongoing decline of DDE in coastal ecosystems. A wider and more comprehensive search for causes seems in order.

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Notes
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