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AND WASTE MANAGEMENT

Colonel Eugene H. Bishop
Office of the Program Manager
for Rocky Mountain Arsenal
ATTN: AMXRM-PM
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Re: RMA Fortuitous Specimen Collection and Necropsies.

Dear Colonel Bishop:

Shell has reviewed the State of Colorado assessment of the US Fish and Wildlife Service data for RMA fortuitous specimen collection and necropsies (September 20, 1993). It appears that the State's assessment of these data and its conclusions in many cases are simplistic, flawed, or inaccurate. Shell strongly recommends that the Army and US Fish and Wildlife Service request the State to reconsider the technical basis for many of the conclusions contained in their assessment.

Shell's conclusions are based on an independent evaluation of the State's assessment that included case histories and pathology reports. For your information, a summary of the most significant problems with the State assessment with specific examples is attached.

If you have any questions on this matter, please feel free to contact Dr. Marcy Banton at (713) 241-6486.

Sincerely,

W. J. McKinney
W. J. McKinney
Manager
Denver Site Project

WJM/rw

Enc.

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Attachment

EVALUATION OF STATE OF COLORADO'S ASSESSMENT OF THE USFWS DATA ON
RMA FORTUITOUS SPECIMEN COLLECTION AND NECROPSIES

INTRODUCTION

A review of the State of Colorado's assessment of the USFWS data on RMA fortuitous specimens was undertaken in conjunction with a review of the fortuitous specimen case histories and pathology reports in order to obtain a better understanding of each of the fortuitous specimen cases as well as the associated State's conclusions and concerns. This review, however, was necessarily limited by the available documentation on these cases; and thus does not constitute a comprehensive evaluation of each fortuitous specimen case.

The most notable observation about the State assessment was its tendency to construe almost every adverse effect as due to OCPs. This position is naive and simplistic. The fact is that animals die from a variety of natural causes in the wild and the existence of chemical contamination at a location like RMA does not necessarily mean that every death without an obvious physical cause is, by default, due to chemical poisoning. Without very careful and extensive evaluations, it can be extremely difficult to reliably distinguish those wildlife deaths that are due to natural causes from those caused primarily from chemical contamination. Too many of the the State conclusions are based only on subjective speculation; literature information regarding the potential toxic effects of RMA chemicals and alternative explanations for causes of death should have been considered more carefully by a reviewer familiar with wildlife pathology methods and diagnoses.

The primary conclusion of this review is that the State's assessment has a number of serious flaws in both assessment methodology and interpretation which invalidate many of its conclusory statements and diagnoses. Below is a summary of these flaws with some selected examples.

EVALUATION

Problems in the State Assessment Methodology

- Statements and conclusions were inadequately justified.

One of the fundamental tenets of scientific assessment is that all statements and conclusions (unless offered as hypothesis) must be adequately justified by verifiable data. The State, however, did not adhere to this principle and repeatedly advanced unsubstantiated statements and conclusions throughout its assessment of the fortuitous specimen cases. This assessment was

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frequently not based on good science, but rather an apparent effort to misinterpret the available data and overstate potential risks to wildlife at RMA.

This problem is particularly evident with statements and conclusions regarding the organochlorine pesticides (OCP). Specifically, within the State's summary of physiologic responses to chlorinated hydrocarbons and their discussion of fortuitous specimen cases (i.e., Coyote CVDL #923-856, Badger CVDL #923-5002, Rabbit CVDL #901-14668), there are a number of statements and conclusions regarding endocrine and immune system effects which appear to be unsubstantiated or exaggerated for dieldrin, the most relevant of the OCPs for RMA specimens. A review of the primary immunotoxicological investigations on dieldrin (1,2,6,8,11,14-18,20,25), however, does not substantiate the States's statements and conclusions but instead suggests that immune system effects from dieldrin are at best equivocal and of questionable biologic significance. The studies performed to date have a number of experimental design deficiencies including inappropriate routes of exposure, lack of information regarding the concentrations of dieldrin in relevant tissues, and a preference for the mouse (a species that is known to be uniquely affected by dieldrin which could influence its immunotoxic responsiveness). Moreover, many of these studies utilized rather high dosages which can be expected to induce a variety of toxic effects which further cloud interpretation of immunotoxic effects. These deficiencies taken together preclude a definitive conclusion of dieldrin immunotoxicity at this time. Similarly, the issue of endocrine effects is unresolved; effects have been noted in only a few studies of limited experimental design (6,10,20).

Inadequate justification was also noted in State comments and conclusions regarding dieldrin and neuropathology. Specifically, several of the fortuitous specimen necropsy reports (Badger CVDL #923-5002, Rabbit CVDL #912-19496, Kestrel CVDL #912-22822, Red Tailed Hawk CVDL #901-01535) indicated the presence of neuropathologic lesions in these animals which were concluded by the State to support the probability that the animal had been affected by OCP (i.e. "good candidate" for residue testing). Again, this conclusion is unwarranted particularly for aldrin/dieldrin. These chemicals do not cause specific primary neuropathologic changes but rather cause neurofunctional changes. There are anecdotal reports of neuropathologic lesions associated with aldrin and dieldrin (5,7,12,13,21-23); however, a review of this information suggest these findings are of questionable significance because of technical weaknesses in experimental design or data interpretation, confounding factors, and lack of concurrence with other studies (3,4,9,24) that examined similar dosages. Therefore, the available data on the neurotoxicity of aldrin/dieldrin suggest that there is not a causal relationship between these chemicals and primary structural changes in the

nervous system.

• The interpretation of data was inconsistent.

Consistent interpretation of data is an essential prerequisite for development of conclusions from that data. The State's assessment, however, is notably inconsistent in its interpretation of fortuitous specimen case findings versus their relatedness to OCP effects. Specifically, interpretation inconsistencies were evident for the parameters of body condition, lymphoid changes and primary/secondary effects. Body condition inconsistencies included the association of OCP in some cases with thinness/emaciation for several fortuitous specimens (i.e., Coyote CVDL #901-13120, Coyote CVDL #912-21430 and Great Horned Owl NWHRC #10943-001), whereas other specimens reported in "good body condition" (i.e., Rabbit CVDL #912-19496 and Red Tailed Hawks CVDL #'s 901-01535 and 901-8085) were similarly concluded by the State as "candidates" for OCP intoxication. Likewise, lymphoid tissue decreases in Coyote CVDL #923-856 were considered OCP-related by the State, as was the opposite effect, lymphoid tissue hyperplasia, that was observed in Badger CVDL #923-5002. Conflicting interpretation of primary/secondary effects were evident for Rabbit CVDL #901-14668 where the pathologist diagnosis of Clostridium perfringens type C enteritis was suggested by the State to be secondary to dieldrin immune system disruption; yet for Badger CVDL #912-4555 the diagnosis of canine distemper was accepted by the State without allegation of dieldrin immunosuppression.

• Diagnostic criteria were not applied uniformly and comprehensively.

An accurate diagnosis of toxicosis (and disease processes in general) requires utilization of information from five types of criteria including history, clinical signs, postmortem findings, chemical analyses and laboratory animal tests (19). Failure to consider these criteria together may result in an improper diagnosis. The State does not appear to uniformly apply these multiple criteria in their evaluations and conclusions of the fortuitous specimen cases. Specifically, history was either overlooked or assumed in the State evaluation of Coyote CVDL #923-856, Starling CVDL #2336 and Barn Owls NWHRC #11088-001 and -002. For example, the historical account of Coyote CVDL #923-856 is wholly inadequate for any conclusion to be warranted about this case. All that is available from the history is that this animal was found alive by a security guard and then euthanized at CVDL. Not addressed in this account is why this animal was euthanized. Among the possibilities are: 1) the animal was sick, 2) the animal was exhibiting unusual clinical signs, and 3) the animal bit a guard and rabies was a concern. Without this critical information, it is not possible to interpret the significance of the postmortem findings (i.e., lesions may have

been insignificant to the overall health of the animal). Similarly, the historical account of Barn Owls NWHRC #11088-001 and -002 is unsatisfactory to base reasonable conclusions. The critical questions for the barn owls are 1) were these birds trapped inside the building, and 2) if they were trapped, would the building be expected to house a satisfactory prey-base to accommodate the birds. The State, however, apparently neglected these critical questions and assumed the birds were not trapped in the structure and thus their emaciation must be attributable to OCP. The State's assumption may not be correct and in fact the "trapped scenario" may offer the best explanation for these findings since it seems unlikely that two birds would succumb to "chronic" OCP intoxication at the same time. As a final example, the Starling case (CVDL #2336) lacks both an adequate historical account and postmortem findings (apparently only a test for acetylcholinesterase activity was performed); yet the State was able to conclude this bird "was an excellent candidate for chlorinated residue testing".

Problems in State Assessment Interpretation

- Deficiencies in pathology evaluations were overlooked.

Careful review of pathology evaluations are required to assure that the postmortem findings of the pathologist are suitably accurate and reliable with which to base important conclusions. Unfortunately, it appears that a number of the pathology evaluations of the fortuitous specimens were deficient and that the State overlooked these deficiencies in their assessment.

The most serious deficiency in the pathology evaluations relates to the findings of neuropathology lesions. Two of the fortuitous specimens, Badger CVDL 923-5002 and Red Tailed Hawk CVDL #901-01535, were described by the pathologist to have neuropathology changes. However, in the badger the finding of CNS lesions is questionable because artifactual changes in the CNS could have caused similar changes. Thus, it is uncertain whether or not the axon sheath changes described were an antemortem finding and also, because this lesion appeared to be a subtle change, confirmation would require electron microscopy. In addition, although an apparently extensive sampling of the spinal cord was performed, it is still possible that a focal lesion could have been missed by the pathologist and that the etiology of the hind limb problems still could have been traumatic or parasitic. It would have been useful in this case to radiograph the badger prior to necropsy to more fully assess the vertebral column. Likewise in the red-tail hawk the pathologist concludes a finding of intramyelinic edema, yet this lesion may also be artifactual (26). Ideally, in a maximally preserved brain or spinal cord, electron microscopy would be needed to confirm the presence of intramyelinic edema.

A second type of pathology evaluation deficiency includes a number of internal inconsistencies in the pathologist diagnosis/remarks versus the actual gross and histological finding details. For example, Red-Tailed Hawk CVDL # 901-16992 was concluded by the pathologist to be emaciated, however, the bird was noted to be appreciably autolytic which should have precluded any interpretation of the animals body condition. Similarly, the pathologist diagnoses "presumptive" septicemia in the Swainson's Hawk NWHRC 10802-001, yet this conclusion is not supported by the bacteriology results. Coyote CVDL #901-13120 was speculated by the pathologist to have an ulcer "that may have been associated with severe chronic stress", however, this etiology appears inconsistent with some of the pathology findings in the cases. Specifically, the hypothesis of "chronic stress" was supported by the mesenteric lymph node depletion, however, other typical stress-associated changes, such as lymphoid depletion in the spleen and adrenal cortical hyperplasia, were not detected in this animal. Furthermore, "stress ulcers" are located mainly in the stomach only occasionally involving the duodenum (the site in this case) and although typically observed in domestic animals have not been reported in the wildlife literature. A final case example is the evaluation of Great Blue Heron CVDL #901-21736 where the pathologist remarks that the migration of a tapeworm larvae possibly caused the falling episode of the bird. This suggestion, however, is questionable because there was no described parenchymal damage associated with the presence of the tapeworm (which would seem to be necessary to result in "falling"). In addition, the finding of the tapeworm in the sulcus is suspicious without the concurrent parenchymal effects which might indicate that the finding was not an antemortem lesion but instead the result of contamination by the small intestinal parasites.

A general deficiency noted that would cause most pathologists to hesitate was that several of the necropsy evaluations were incomplete. For example, the Coyote CVDL # 901-13120 pathology evaluation failed to include bacteriology and mycology tests on the ulcer to help determine the cause; and the Red-Tailed Hawk CVDL #901-8085 evaluations apparently overlooked other likely differential diagnoses such as lead and acetylcholinesterase tests. There were many other examples of incomplete pathology evaluations.

• Pathologist diagnoses and remarks were overinterpreted and misinterpreted.

Proper conclusion of the significance of fortuitous specimen case findings requires careful interpretation of the pathologist diagnoses and remarks. Unfortunately, the State assessment included a number of errors in their interpretation of the pathologist comments.

Two pathologist misinterpretations were evident in the State's assessment of Coyotes CVDL #'s 912-21430 and 923-856. Coyote CVDL #912-21430 was concluded by the pathologist to be debilitated due to chronic cardiomyopathy and interstitial pneumonia, however, the State rejects these findings in favor of an alternative hypothesis of chlorinated hydrocarbon intoxication. Coyote CVDL # 923-856 was noted by the pathologist to have a small thymus depleted of mature lymphocytes. This finding was misinterpreted by the State as thymic degeneration when in fact it could have represented normal thymic involution which occurs as the animal matures. Also, if the thymic atrophy had been pathologic, a generalized phenomena probably would have been noted (i.e., other corresponding changes in lymphoid tissue including the spleen), yet these effects were not observed in this coyote.

In addition to the misinterpretations, the State consistently over-interpreted pathologist remarks regarding body condition. Specifically, the pathologist comments on thin body condition were interpreted by the State to mean emaciation. Examples of body condition over-interpretation included Coyote CVDL #923-856, Kestrel CVDL #912-22822 and Swainson's Hawk NWHRC #10802-001.

SUMMARY AND CONCLUSIONS

The fortuitous specimen collection represents a potentially valuable source of information regarding wildlife health at RMA. Therefore, it is imperative that both the fortuitous specimen data collected and any evaluations of these data are technically defensible. The results of our evaluation suggest there are significant quality concerns with both the fortuitous specimen data and the State's assessment of these data. We feel these problems preclude definitive conclusion of the significance of past fortuitous specimen data.

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