California Wind Energy Association

California Energy Commission
DOCKETED
09-RENEW EO-1
TN # 69240
JAN. 24 2013

January 23, 2013

California Energy Commission
Dockets Office, MS-4
Docket No. 09-RENEW EO-01
1516 Ninth Street
Sacramento, CA 95814-5512
via email to: docket@energy.state.ca.us

Re: Comments on the Description and Comparative Evaluation of Draft DRECP Alternatives

To Whom It May Concern:

This letter presents the California Wind Energy Association's ("CalWEA") comments on the December 17, 2012, document "Description and Comparative Evaluation of DRECP Alternatives" ("the Alternatives Document" or "the Document"). CalWEA writes to express our constituency's great disappointment in the Alternatives Document and to reiterate previously stated, but still very much relevant, concerns about the DRECP planning effort.[1]

At the outset, we note that these comments (particularly the attachments) focus largely on issues related to golden eagles, as we are ready to contribute materials on this topic that we have been developing over the past several months. The January 23, 2013, deadline to comment on the Alternatives Document provided wholly insufficient time to enable stakeholders to review and provide detailed comments on those voluminous materials, particularly the very troubling proposed land-use designations and related GIS files. We expect to provide additional comments on these materials at a later time.

As the REAT agencies are aware, CalWEA has been a dedicated participant in the DRECP planning process. Through our continued engagement, we have made a concerted effort to articulate the wind energy industry's concerns with the plan's direction and share solutions that would address those concerns. The Alternatives Document shows that the REAT agencies have made no attempt to address the concerns we have repeatedly raised. Put simply, none of the alternatives identified in the Document allow for the competitive development of wind energy resources in the planning area.

[1] "Comments on the DRECP July 2012 Stakeholder Meeting and Materials." California Wind Energy Association. August 16, 2012.

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Without the potential for wind energy, the State of California's goals for renewable energy production in the DRECP area will not only suffer from reduced market competition – and thus come at a higher cost, but will be met largely through utility-scale solar energy development, which carries with it significant terrestrial environmental disturbance. Because the Alternatives Document does not properly analyze either the lighter terrestrial disturbance or the avian impacts of wind energy, we urge the REAT agencies not to push forward with the Plan until viable alternatives allowing for wind energy development have been formulated. While CalWEA continues to engage in the planning process in the hope that a functional DRECP will emerge, we will not support a plan that categorically excludes wind energy development in the California desert. As a result, we urge the REAT agencies to address the issues raised in this letter.

A. OVERARCHING CONCERNS

Our concerns with the DRECP planning effort thus far focus on four primary issues:

- use of planning goals and assumptions that prejudice wind energy development in the plan area for the foreseeable future.
- exclusion of wind energy development from vast areas of land outside of development focus areas ("DFAs"),
- lack of a rational nexus between DFAs and the avian impacts of wind energy development, and
- lack of a satisfactory path to obtain golden eagle take permits under state and federal law.

Our concern over many of these issues is reflected in our comments below on legal inadequacies, but we first frame these issues in a broader sense.

First and foremost, the REAT agencies continue to use planning goals and assumptions that prejudice wind energy development in the plan area for the foreseeable future. Last April, CalWEA provided a detailed rationale to support planning for 25,000 MW of wind energy capacity through 2050, premised on the argument that future development should not be precluded by relatively arbitrary decisions made under the DRECP today. Although we disagree with the 2040 planning horizon, in August, we scaled this figure back to 12,500 MW in a 2040 context.

The REAT agencies are not only planning for a small fraction of that goal, but continue to misrepresent the amount of wind that is actually developable under the alternatives. Alternative 5 is touted as the "Wind Alternative," despite being extensively covered by the U.S. Department of Defense's High Risk of Adverse Impacts Zone and despite significant proposed expansion of Natural Landscape Conservation System lands ("NLCS lands") into remaining areas. In reality, Alternatives 2 or 6 are likely to be better alternatives for wind energy. Still, there is no chance that these areas can accommodate the purported ~2,600 MW over the next 25 years. As we explained in our August comments, much of the wind-DFA lands in these alternatives will prove undevelopable due to lack of sufficient wind resource quality and various conflicts. Even the purported figures represent an amount of capacity that the wind industry built in the California desert in just the past few years.

Second, the REAT agencies' approach to prescribing development in the DRECP area continues to exclude wind energy development from vast areas of land outside of DFAs. These exclusion areas encompass many active projects that site-specific investigation has shown to be very promising for near-term development. For example, wind development would be prohibited in existing and newly proposed Areas of Critical Environmental Concern ("ACECs") and NLCS lands, despite the fact that wind energy development is currently allowed within certain ACECs where it is compatible with management prescriptions. The Alternatives Document also appears to completely exclude wind energy development from desert tortoise areas, despite scientific evidence of compatibility.[2] It is unreasonable to presume incompatibility of wind projects and species of concern or environmental resources intended for protection within ACECs and NLCS lands given the lack of scientific studies and literature on the compatibility of wind projects with, for example, Mohave ground squirrels and golden eagles. As set forth in CalWEA's previously submitted comments,[1] the DRECP should include a research plan that would allow project proponents to conduct independent scientific research on the resource of concern, assuming the risk that the results may not be favorable to the placement of wind energy generation facilities.

Similarly, Appendix E proposes that Special Recreation Management Areas ("SRMAs") and OHV Open Areas should be ROW exclusion areas for utility scale solar and wind development, further prohibiting development from large swaths of potentially suitable land. This exclusion is proposed despite the OHV community at large calling for siting criteria (not complete prohibition) and would remove the opportunity for collaborative efforts between the wind industry and recreation groups to promote development in high-quality wind resource areas in which development and recreation could co-exist, not to mention the potential benefits the OHV community could accrue insofar as mitigation of impacts (e.g., improvement of trails). As a result of these broad-brush, unsubstantiated exclusions of wind energy development from federal lands, we must conclude that wind energy development's limited terrestrial impacts have not been properly evaluated.

Third, and relatedly, the wind DFAs identified in the Alternatives Document bear little, if any relationship to the potential for avian impacts of wind energy development. For example, the current lack of scientific knowledge regarding the golden eagle population in the DRECP area is widely acknowledged. As a result, the DFA concept cannot be used to meaningfully screen for potential golden eagle conflicts, and forcing wind energy development within DFAs while prohibiting it in other areas will do little, if anything, to minimize potential impacts on golden eagles.

Finally, the REAT agencies have yet to identify a workable path for golden eagle permitting. At this point, it is not clear that any golden eagle permits will be available, and it appears that no state eagle permits will be available outside of DFAs. This unnecessarily conservative approach to golden eagle permitting removes the largest incentive the DRECP could offer wind energy developers, and puts unreasonable constraints on the potential benefits of mitigation, research, and conservation to the desert eagle population.

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[2] Lovich, et al. 2011. Effects of wind energy production on growth, demography, and survivorship of a desert tortoise (*Gopherus agassizii*) population in Southern California with comparisons to natural populations. Herpetological Conservation and Biology 6(2): 161-174.

As our more detailed analysis below reveals, if left unaddressed, these issues will leave the DRECP vulnerable to litigation. As a result, we ask the REAT agencies to seriously consider our comments and to work with CalWEA and other stakeholders to identify viable solutions.

B. LEGAL INADEQUACIES THAT MUST BE ADDRESSED PRIOR TO THE RELEASE OF A DRAFT DRECP

CalWEA recognizes the preliminary nature of the Alternatives Document. However, as with other DRECP documents released by the REAT agencies thus far, the Alternatives Document fails to provide substantive support or explanation for many of its conclusions. As a result, if the REAT agencies move forward with the alternatives and permitting regimes contained in the Document, they risk running afoul of the many state and federal laws governing DRECP creation and implementation, including but not limited to the Administrative Procedure Act ("APA"), the National Environmental Planning Act ("NEPA"), the California Environmental Quality Act ("CEQA"), the federal Endangered Species Act ("ESA"), the California Endangered Species Act ("CESA"), the Natural Community Conservation Planning Act ("NCCPA"), the Warren-Alquist Act, and federal constitutional law protecting against taking of private property. If these legal issues are not addressed before the draft DRECP and its supporting EIS/EIR are released, those documents will not be legally defensible.

1. DFAs Presented in the Alternatives Document Are Not Related to the Environmental Impacts of Wind Energy Projects.

If the upcoming draft EIS/R fails to show that the federal agencies took a "hard look" at the environmental consequences of the DRECP, any decision to approve the plan based on the draft EIS/R would be arbitrary and capricious. *See, e.g., Kleppe v. Sierra Club*, 427 U.S. 390 (1976); *Blue Mtns. Biodiversity Project v. Blackwood*, 161 F.3d 1208 (9th Cir. 1998). Similarly, to comply with CEQA, the conclusions of the draft EIS/R must be supported by substantial evidence in the administrative record. *Jones v. Regents of Univ. of Calif.* (2010) 183 Cal.App.4th 818, 829. Here, the DFAs identified in the Alternatives document would fail to meet either test, as they are not reasonably related the environmental impacts of wind energy development. In the absence of alternatives that are related to the impacts of wind energy development and that allow viable wind energy development in the plan area, the REAT agencies risk running afoul of CEQA's and NEPA's requirement to consider a reasonable range of alternatives. See 40 C.F.R. § 1502.14; 14 Cal. Code Regs. § 15126.6. To adequately address the wind energy impacts, the REAT agencies should take action to ensure that alternatives considered in the upcoming EIS/EIR reflect a nexus between the limitations placed on wind energy development and the actual impacts of that development. *Cf. Dolan v. City of Tigard* (1994) 512 U.S. 374, 386-88 (citing *Nollan v. California Coastal Comm'n,* (1987) 483 U.S. 825, 837 for proposition that there must be an "essential nexus" between conditions on development and a "legitimate state interest").

In particular, the REAT agencies have provided absolutely no information showing that the DFAs are rationally related to the terrestrial impacts of wind energy development.

As the REAT agencies are aware, ground disturbance associated with wind energy development are far less intense than those of solar energy development, and research shows that wind energy can be developed without negatively affecting sensitive terrestrial species such as the desert tortoise.[2] As a result, the DRECP's limitations on project siting should not arbitrarily limit wind development based on impacts caused by large-scale solar energy projects. Doing so will preclude the possibility that wind development could account for a larger share of development in the Plan area with lower terrestrial environmental impacts associated with reaching California's important renewable energy generation goals. The environmental impact and mitigation requirements for development should be judged based on an appropriate ground-disturbance "footprint" for *each* technology.

Similarly, the DFAs are not reasonably related to the potential avian impacts of wind energy development. Instead, the avian-related constraints on DFA location are, at best, ad hoc and appear to be primarily based on incomplete data. For example, at p. 2.10-8, the Alternatives Document states that an early proposal by CalWEA identifying potential DFAs that would be compatible with wind energy development was rejected in part because the areas in the proposed "wind DFAs" overlapped with areas including a high concentration of nesting golden eagles and California condors. As the REAT agencies have admitted, knowledge of the golden eagle population in the area is limited. Moreover, presence of golden eagles does not translate directly to risk of impact. In the absence of better data, avoidance of avian high-risk areas is best achieved through detailed, site-specific studies, as has been outlined in the tiered structure of the USFWS Wind Energy Guidelines and the 2012 Eagle Conservation Plan Technical Appendices. Once project-specific data are collected, anticipated fatality rates are then calculated based on eagle use of the area, as well as avoidance and minimization. In addition, in order to be able to execute buffers and other avoidance and minimization techniques, project need flexibility with respect to siting turbines and other project facilities, a flexibility which is not available under the current DFA structure. To that end, excluding future wind energy development for the life of the plan based on incomplete data does little to ensure avian impacts will be minimized and would put the Draft EIS/R at risk under both CEQA and NEPA.

We also write to express our dissatisfaction with the REAT agencies' decision to not incorporate any aspect of CalWEA's proposal that the DRECP include wind evaluation areas ("WEAs").[1] Wind resource areas outside of the Wind DFAs that are not designated as part of the reserve design with potentially commercially viable wind resources should be subject to further studies illuminating the degree of compatibility of wind energy development in these areas, and/or associated actions by governmental entities. Development in these areas would be subject to meeting specifically defined criteria pertaining directly to the potential conflict(s). Incorporation of WEAs into the DRECP would allow for much-needed flexibility in siting to capture superior wind resources which may require fewer turbines and could lower total environmental impacts, accordingly.

2. Durable Conservation Must Provide Lasting Value

In addition to our concerns regarding the DFAs identified in the Alternatives Document and their relevance to wind energy development, and lack of inclusion of WEAs, we are also concerned about conservation durability in the DRECP. To meet relevant legal standards, the REAT agencies

must work to identify durable conservation opportunities that will provide lasting conservation value. In the absence of conservation durability, the DRECP will be vulnerable to legal attack and will fail to provide the certainty needed by renewable energy developers.

3. The BGEPA Permitting Regime Described in Appendix K is Inconsistent with the 2009 Eagle Permitting Rule, Will Not Protect Eagles, and is Not Supported by Data.

Not only will the DFAs place severe limits on the ability to responsibly develop wind energy resources in the DRECP, the unusually restrictive BGEPA programmatic permitting regime presented in Appendix K would place another severe obstacle in the path of California wind energy developers. As explained in Appendix K, take permitting would only authorize take of 1-5% of the local population annually, including take resulting from *all* forms of ongoing take, not to mention take coverage through the NCCPA would only be available within DFAs. According to the Appendix, very few eagle permits will be issued. The Appendix only mentions a potential role for compensatory mitigation in passing and suggests that compensatory mitigation may not be required for all projects. *See* App. K at p. 3 (noting that project-level compensatory mitigation will be required "where appropriate").

CalWEA's concerns with the permitting regime presented in Appendix K are four-fold. First, the regime is wholly inconsistent with the approach presented in the U.S. Fish and Wildlife Service's 2009 final rule interpreting BGEPA's statutory requirements for take authorization and promulgating regulations governing take permitting. *See* Eagle Permits; Take Necessary to Protect Interests in Particular Localities, 74 Fed. Reg. 46836 (Sept. 11, 2009) (codified at 50 C.F.R. Parts 13 and 22) ("2009 Rule"). As explained in the attached white paper entitled "Golden Eagle Take Permitting in the DRECP: An Analysis," the 2009 Rule explained that FWS would ensure that eagle take authorization is consistent with BGEPA statutory requirements by requiring new projects seeking programmatic golden eagle take permits to (1) minimize take of golden eagles to the point that any remaining take is unavoidable, and (2) *completely offset* any new take by reducing take from another source. *Id*. at 46840. Consistent with this approach, in subsequent guidance FWS explained the no-net-loss standard under which "additional mortality caused by the permitted activities is offset by compensatory mitigation that reduces another, ongoing form of mortality by an equal or greater amount." U.S. Fish and Wildlife Service, Draft Eagle Conservation Plan Guidance at 12 (January 2011).

In sum, because the rule and guidance require projects to completely offset any take of golden eagles, take that is authorized by a BGEPA permit in the DRECP should not count against regional take thresholds. The approach to permitting set forth in Appendix K is wholly at odds with this concept, as it requires all take to be counted against thresholds, whether offset or not, and does not make offsetting mandatory.

Second, Appendix K's complete departure from this approach to take permitting not only weakens the legal defensibility of the DRECP by running afoul of the 2009 Rule and subsequent guidance, it also fails to protect the desert golden eagle. Rather than putting in place an adaptive management and monitoring program that seeks to learn more about eagle take compensatory mitigation while using compensatory mitigation requirements to lessen the impacts of various

forms of ongoing take, Appendix K ensures continuation of the status quo. In other words, by committing to the issuance of very few take permits, this permitting regime squanders an opportunity to take positive action to preserve the golden eagle population in the DRECP area. As a result, it is subject to challenge on the grounds that take authorized under the permitting regime in Appendix K is not "compatible with the preservation of the… golden eagle," as required by BGEPA. 16 U.S.C. § 668a.

Third, and relatedly, the Appendix K permitting regime is not scientifically defensible. The appendix does not cite evidence supporting its conclusions and does not provide acreage estimates needed to evaluate the effectiveness of goals and objectives for golden eagle conservation. *See* Laura Nagy, PhD Memo to the California Wind Energy Association, Re: Review of Appendix K, 21 January 2013 for a more detailed narrative of our concerns.

Finally, Appendix K states that "taking high risk projects offline" could be used as a method for offsetting golden eagle take. Appendix K does not explain how this might be implemented, and we note a few legal and practical issues that strongly cut against relying on such measures to mitigate golden eagle take. The vast majority, if not all wind projects in the DRECP area will be developed pursuant to a federal right-of-way grant or a leasehold on private land. Rights-of-way and leaseholds for wind energy projects almost invariably limit a project developer's use of land to the construction, operation, and maintenance of a wind energy project. As a result, any attempt to take "high risk projects" offline would result in total deprivation of the economically beneficial use of the developer's property interest. For projects that have not "taken" eagles in violation of BGEPA, taking a "high risk project" offline would require just compensation, or else run afoul of the Fifth Amendment's guarantee against taking of private property. *See Lucas v. S. Carolina Coastal Council* 505 U.S. 1003, 1029 (1992). "Just compensation" for the taking of a utility scale wind energy generation project could run into the hundreds of millions of dollars.

Not only would it be completely infeasible to require a new project to mitigate for potential eagle take by taking such a project offline and foregoing all expected income to pay for the investment; on a cost-per-eagle basis, it would constitute thoroughly inefficient mitigation. As a result, CalWEA strongly encourages the wildlife agencies to consider more practical, more effective means of compensatory mitigation, such as those outlined in the attached document "Development of a Mitigation Framework for Golden Eagles in the Desert Renewable Energy Conservation Plan Region."

4. **The California Energy Commission ("CEC") lacks jurisdiction to issue take authorization to wind energy or solar photovoltaic projects.**

In addition to our concerns regarding the DFAs and BGEPA permitting regime included in the Alternatives Document, we are also concerned that the REAT agencies have failed to identify an entity with authority to issue federal or state take authorization to wind energy or solar photovoltaic projects in the DRECP area. The Document states that the CEC would be an applicant for a federal incidental take permit and would also provide state incidental take authorization for projects within its jurisdiction. Alternatives Document at p. 1.1-7 through -8. As explained below,

the CEC has no jurisdiction over wind energy or solar photovoltaic ("PV") projects and, as a result, cannot issue incidental take authorization to either.

Under the CEC's organic statute, the Warren Alquist Act, its jurisdiction is limited to electric transmission lines and thermal power plants with a generating capacity of 50 MW or more. *See* Pub. Res. Code §§ 25110, 25120. Wind energy and solar photovoltaic projects are specifically exempted from the Act's definition of a thermal power plant. Pub. Res. Code § 25120. As such, there is no legal pathway through which the CEC may issue take authorization to wind and solar PV projects in the DRECP area, and the REAT agencies must identify a permitting pathway that does not include the CEC and that will meet FWS's purpose and need of providing a streamlined permitting process. Alternatives Document at 1.1-5.

This major oversight in the Document exemplifies the rushed and incomplete nature of DRECP planning thus far and emphasizes the need for a more deliberate process. It also underscores the need for participation by counties in the DRECP area. Without county participation, streamlining benefits—one of the goals driving DRECP development—will not be realized.

In sum, given the plan's projected 25+ year lifespan and the vast renewable energy resources in the plan area, a functional, scientifically credible plan is crucial to the future of renewable energy development in California. Because we believe that the REAT agencies are neither on a path to creation of a legally nor scientifically defensible DRECP that will effectively govern future renewable energy development in the California desert, we urge the REAT agencies to address the issues raised in this letter as well as those detailed in other CalWEA submissions regarding the DRECP.

Sincerely,

Nancy Rader
Executive Director

Ashley R. Richmond
Director of Siting Policy

Encl: Laura Nagy, PhD Memo to the California Wind Energy Association, Re: Review of Appendix K, 21 January 2013.

"Golden Eagle Take Permitting in the DRECP: An Analysis". California Wind Energy Association. 18 December 2012.

"Development of a Mitigation Framework for Golden Eagles in the Desert Renewable Energy Conservation Plan Region". Tetra Tech. 20 November 2012.

TETRA TECH

Memo

To:	Nancy Rader, Ashley Richmond, CalWEA
From:	Laura Nagy, PhD, Tetra Tech, Inc.
Date:	January 21, 2013
Re:	Review of Appendix K

This document is a review of "Appendix K – Golden Eagle" of the Description and Comparative Evaluation of DRECP Alternatives and is arranged to provide both overarching comments for USFWS and specific section-by-section comments. This memo, as currently written, evaluates Appendix K to the level possible given the information included within the appendix; however, given the lack of details provided throughout this document, a comprehensive review is not possible at this time.

A. Comments Specifically for USFWS' Consideration

1. This document is primarily generalizations; however, the true substance of the document will be in the details which are absent. Without the details such as buffer distances, avoidance and minimization measures, acceptable mitigation, etc., it is impossible to provide true feedback on this document.
2. Throughout this document, there is reference to streamlining the environmental review and permitting process. Please provide an explanation of how this streamlining will occur or reference other sections of the document to provide the appropriate context.
3. Throughout this document, there are multiple terms that refer to conservation that need to be defined in order to correctly interpret this document. This includes "golden eagle conservation," "conservation program," "conservation strategy," "conservation standards," "conservation approach," "conservation actions," "conservation measures," and "advanced conservation practices."
4. This document makes many general statements without any citations; therefore making it impossible for the reader to understand the source of the information presented and to independently evaluate the quality of those data. To remedy this problem, please include citations for all biological statements as would be found in a scientific report.
5. The level of detail that is provided for the research topics is inconsistent and generally lacks the details needed to understand what specific question the proposed research is trying to answer, what techniques would be used to answer the question, and how the answers will be directly tied into the DRECP permitting process. Please provide these details for all research items so that they can be fully evaluated.

B. Questions Regarding Framework – Section 1 (Goals)

- Pg 1. "3) BGOs will be achieved in the DRECP through implementation of DRECP's conservation program". See general comment B.2 above regarding the meaning of the conservation program.

- Pg 1. "5) the DRECP will include an adaptive management and monitoring program to evaluate and enhance progress in achieving DRECP golden eagle BGOs". No examples of how this adaptive management program would work were provided. Please provide examples or context of this adaptive management program.

- Pg 2. "1) facilitate recovery and conservation of the golden eagle, characterized by a resilient, stable or increasing population in the DRECP area". Please provide the citation for the implication that the DRECP golden eagle population is in decline and provide a definition of "resilient".

C. Questions Regarding Framework – Section 2 (Permit Issuance)

- Pg 2. "The Wildlife Agencies believe a programmatic eagle permitting process will be more effective in meeting golden eagle conservation and renewable energy development goals than site-specific eagle studies and project-specific permits." The use of "programmatic" in this sentence needs clarification because, as written in the final rule for eagle take permits, a project-specific permit is a programmatic permit.

- Pg 2. "Golden eagle take will be authorized only for DRECP-covered activities, which will include renewable energy projects sited in Development Focus Areas (DFAs) and appurtenant transmission facilities in the DRECP planning area." and "Proposed projects outside of DFAs would not be eligible to receive take coverage through NCCPA for golden eagles. Although a developer can choose to seek a project specific permit to take eagles under the BGEPA outside of designated DFA's, these projects would not comply with State laws that protect eagles." Please clarify if this limitation is true only for golden eagles or if species other than eagles can be covered outside of DFAs. If coverage of other species is available, please explain how this would meet the "the carrying out of an otherwise lawful activity" criteria under an HCP.

- Pg 2 "Take related to existing facilities in the Plan area is not covered by the DRECP." Please provide information on why these projects were excluded from the DRECP process and clarify if there will be options for these entities to participate in the DRECP process.

  Pg 2 "Projects seeking take authorization will be prioritized for permitting based on their ability to avoid and minimize eagle take, and may be based on their energy generation capacity." Please provide clarifying language for this statement. Specifically, please include what types of actions will result in prioritization and how energy generation capacity will be used in the prioritization process. In addition, please provide additional information on how any other metrics will result in prioritization and how USFWS plans to manage demand for this limited resource. Finally, please provide the scientific support for effective avoidance and minimization measures. Also, please provide additional explanation of what is meant by "may be based on their energy generating capacity".

- Pg 2. "The strategy for meeting DRECP's golden eagle biological goals and objectives is dependent on avoidance and minimization of take (from lethal and non-lethal sources)."

Avoidance and minimization were referred to as "conservation actions" in Section 1. Please clarify the wording in the text for consistency.

- Pg 2 "Golden eagle incidental take permits will authorize cumulative take of up to between 1-5%, of the local area population annually." Normally USFWS defines the local area population as within 140 miles of the project. How will USFWS define "local area population" here?

- Pg 2 "All forms of ongoing take, including renewable energy will count against the take limit." Please explain how the ongoing take will be calculated.

- Pg 3 "Golden eagle conservation measures will be developed to avoid and minimize take for proposed projects and to mitigate project impacts that cannot be avoided." Please define how conservation measures are different from conservation actions.

- Pg 3 "Currently, powerline retrofitting is the most evaluated mitigation (take offset) option; however, other mitigation options should be investigated and their effectiveness in reducing take should be quantified. These options include: lead abatement, bird collisions with cars, taking high risk projects offline, habitat enhancement that leads to increased eagle productivity, etc." Please provide detail of how and where the USFWS envisions taking high risk projects offline. What type of compensation do the agencies expect will be required under this step?

- Pg 3 "Permittees shall ensure that implementation of mitigation and conservation measures necessary to fully offset authorized golden eagle take under the DRECP shall be completed per the terms and conditions of the DRECP." Please explain how USFWS would credit strong mitigation efforts that may not have been completely successful. We are concerned that, because we are moving into unknown territory with respect to mitigation and conservation measures, if a company does not get some level of credit for "learning as we go" an effort that isn't completely successful will discourage companies from being creative. This lack of creatively could negatively impact eagles by limiting mitigation efforts.

- Pg 3 "A DRECP-wide population monitoring will be implemented, funded in part by fees collected from projects authorized by DRECP. The goals of the population monitoring program are: 1) to assess whether regulatory requirements and the conservation program goals and objectives under the DRECP are being met and 2) to estimate golden eagle population size through time." Please provide the details as to how this program would work so that it can be evaluated (e.g., what would the fees be, how would the fees be assessed). Please identify if the conservation program goals and objectives are different from the biological objectives. Please identify the methods that will be used to estimate the golden eagle population size through time and who will provide scientific oversight.

- Pg 3 "Permittees shall implement project-specific compliance measures including:
    - Standardized avoidance and minimization measures
    - Project level mortality monitoring

- Stepwise protocols ("Advance Conservation Practices") to adaptively manage project operations, and to minimize risk of future golden eagle fatalities
- Project level compensatory mitigation (where appropriate)

Please provide details for what each of these bullets entail include what the measures are and the scientific support and rational to allow readers to evaluate their effectiveness.

- Pg 3 "Golden eagle conservation measures are being developed based on the best available science, to avoid or minimize take and to mitigate project impacts." Please provide the citations for the best available science or an explanation of the science behind the choices made.

D. Questions Regarding Framework – Section 3 (Take Authorization)

- Pg 3. "Due to low population size of golden eagles in the plan area, and high conservation standards of BGEPA, few take permits will be available." Please clarify how, if few permits will be available, the DRECP will achieve its goal of facilitating and streamlining renewable energy development, in the case of wind energy?

- Pg 4. How will USFWS estimate the number of eagles in the DRECP?

- Pg 4 "The amount of take that can be authorized for renewable energy projects permitted under the DRECP must take into account ongoing, unpermitted mortality to ensure that permitted take in addition to unpermitted take does not exceed the amount of take that the population can withstand and meet conservation standards." Please explain how the ongoing take will be evaluated. Will this strategy encourage existing development to participate in the DRECP?

E. Questions Regarding Framework – Section 4 (Research and Monitoring)

- Pg 4. "The REAT Agencies commit to implementing the approach laid out in the DRECP and commit to continued work, funding, and collaboration on golden eagle research to improve conservation and adaptively modify the development and the conservation program. Research will be conducted in accordance with the research program developed by the Wildlife Agencies (see attached research program). A summary of the draft research program objectives follows:" Please explain what process will be put into place to ensure that the data are available to all interested parties. To date, although West Virginia University is conducting golden eagle research for the BLM, these data are not available to stakeholders. Please explain what avenues for input will be provided for non-agency personnel.

- Pg 4. "Refine the golden eagle local area population estimate." This implies the local area population is known; if so, please provide the estimated population size.

- Pg 5 "Develop models linking prey availability / abundance to eagle productivity and survival, taking into account vegetation changes anticipated from climate change." This statement implies that this linkage is clear in the desert. If so, please provide references to the supporting literature.

- "Research will be conducted in accordance with the research program developed by the Wildlife Agencies (see attached research program). A summary of the draft research program objectives follows." The list provided in this section does not match the key data evaluation needs for the DRECP research program. Please revise these documents for consistency.

F. Questions Regarding Framework – Section 5 (Review and Evaluations)

- Pg 6 "Four years after DRECP permit issuance, consistent with the BGEPA implementing guidance and the NCCPA adaptive management and monitoring requirements, the DRECP golden eagle conservation approach will be reevaluated and completed by year 5." Based on the information in this document, it is unclear what the intentions are here. Who will do the re-evaluation? Could existing permits be revoked? Please explain the questions that are anticipated to be answered at this time and how those changes will be used in the permitting process.

- Pg 6 "DRECP will be developed to explicitly plan for and with the capacity to incorporate new information to improve plan implementation." Please provide information for how this will be done.

- Pg 6 "The primary purposes of the evaluation will be to 1) ensure the standards of the Act and the DRECP biological goals and objectives are being met, 2) evaluate if the local area population is stable or increasing, and 3) provide feedback to the management program to improve the effectiveness of management actions" Please be consistent with language regarding population change (Section 1 used "resilient, stable, or increasing") and please describe how this trend will be evaluated including the number of years of data required and statistical analysis, if any. Please also include how this analysis will account for natural population cycling.

- Pg 6. "Also after five years, the Wildlife Agencies in cooperation with other entities implementing the DRECP, will evaluate 1) new compensatory mitigation opportunities, 2) improvements to technologies that avoid or minimize take, 3) the effectiveness of the golden eagle conservation measures and the take limit on take in maintaining the population, 4) opportunities for modification of covered activities, including siting and project development, that will avoid take of eagles and other covered species; 5) avoidance and minimization measures and; 6) refinement of the monitoring program." Please add context to show direct links between the studies that will be done and which ones will inform these steps. Please also add language to provide context of how the wildlife agencies will evaluate these steps and what processes are in place to allow for comment prior to the studies and prior to the agencies making a final decision.

- Pg 6. "Completing the research program (attached) is necessary to evaluate whether there may be other opportunities for additional renewable energy projects in the DRECP area while continuing to meet the requirements of BGEPA and NCCPA." Please clarify if this means that all research identified in this document must be completed before the wildlife agencies evaluate if additional projects can be located in the DRECP.

- Pg 6 "After permit issuance, expansion of plan area boundaries, expansion of impact areas not

originally analyzed, or increase of take would be required to follow the permit amendment process consistent with the National Environmental Policy Act, the California Environmental Quality Act, ESA, NCCPA and other laws, regulations, and policy." Please identify the approximate timeline for this type of amendment and the process for amendment approval.

G. Questions Regarding Framework – Section 6 (Roles of the Agencies)

- Pg 7. All of the agencies are apparently going to "pursue funding in collaboration with the parties of this framework through the California/Nevada Golden Eagle Working Group." The mission of the working group does not presently include the pursuit of funding and, as a group, they do not currently have funding to authorize. Please clarify this statement and the role of the working group.

H. Questions Regarding Draft DRECP GOEA Research Program

- Please provide clarification as to which of these research projects 1-15, if any, is currently underway and/or have been funded. Do the start times of 2012 and 2013 mean that research projects are funded?

- Please provide the plan for how the agencies will ensure that the data are available to all parties to avoid situations like the BLM telemetry data that is currently not available to inform developers' project permitting activities.

- Please identify if and how non-agency personnel will have access to the research proposals and if they will have the ability to provide comments to ensure that the projects meet both the needs of the eagle rule and the needs of project developers.

- Please increase the detail in the research program to identify clearly the research question being asked and how the data collected will be used in a permitting context.

- For ongoing research #16 and #17, please provide additional details about what question is being asked, the methods, the extent of the data collection, who is executing the research, and when it will be available.

- For ongoing research #18, please explain how research associated with surface disturbance will meet the "improve technologies to reduce mortality" needs.

- For ongoing research #19 and #20, please explain how results from these Wyoming projects will be applied in the desert context.

- Ongoing research #22. Please clarify the area to be covered and identify if the DRECP is included.

- Please provide an explanation for the difference between ongoing research and USFWS nationally initiated ongoing research.

- For research #25, please explain the relationship between research #1 and research #25. Will the DRECP use a different sampling strategy from the rest of the U.S. and how does this work with managing a wide-ranging species?

I. Questions Regarding Sample Biological Goals and Objectives

- Pg 12 "This is a sample of what will appear in the DRECP, and is not final." Please provide context of how these relate to the full list and when the full list will be available for review.

- Pg 12 "Create a landscape-scale reserve system for golden eagles that is adaptive to changing conditions, including range shifts, contractions, expansions, and recolonizations in response to local extirpations, climate change, and to temperature and precipitation gradients." Please explain how this expansive goal will be met.

- Pg 12, Objective's 1.1-1.5. Please explain if these conservation acres are considered to be independent or if they do or can overlap.

- Pg 12 "Objective GOEA1.1: Conserve a total of XXXX acres of nesting habitat within occupied habitat for golden eagle in the Plan Area. Target the following areas known to support dense nesting areas as well as other mountain ranges throughout the range in the Plan Area." Please explain how these areas were chosen, what definition of "dense" was used, and how this accounts for areas that have not been surveyed. Please add the number of acres and the rationale behind that decision so that this objective can be fully evaluated.

- Pg 12, GOEA goals 1.1-1.5. It is not clear how these acreages would be calculated and also if the data exist to make clear decisions about where foraging, wintering, and fledgling golden eagles are spending their time. Please explain what data were used to derive an understanding of golden eagle foraging, wintering, and fledgling foraging and how that is applied to the conservation acres. Specifically, please add the number of acres and the rationale behind that decision so that this objective can be fully evaluated.

- Pg 12. "Objective GOEA1.5: Protect high quality, unoccupied nesting habitat to allow
- expansion of new breeding pairs into the area." Please provide a definition of unoccupied nesting habitat, the scientific justification, and an explanation of how this agrees or disagrees with the final EA which identified the species as nest-site limited.

- Pg 13, GOEA goals 2.1-2.5. These goals seem reasonable to address the full range of stressors; however, many of these rely upon the cooperation of other entities to be successful. Please provide more details about how these will be executed, if all of them or a subset need to executed, and if they will be considered prescription-based or results-based as outlined in the USFWS's 5 Points Policy. In addition, the goals outlined in this list appear to be those that would be used in

compensatory mitigation. Please explain how these goals would be funded and how compensatory mitigation would be applied.

- Sample biological goals and objectives. Goal 2 is to remove or reduce potential threats and environmental stressors. Although it is a goal, by definition, it is compensatory mitigation for which credit should be given to wind developers. Please also clarify whether, as implied, this goal requires that renewable energy developers will be responsible for minimizing impacts outside of their control.

- Pg 13. Objective 2.5. "Decrease relative to existing conditions that reduce or inhibit prey species (e.g. jackrabbits, rabbits, squirrels) abundance." Please provide the conditions that will change prey abundance and the scientific evidence in support of that objective.

- Pg 13. "Goal GOEA3: Conduct research and monitoring to inform and support golden eagle conservation and to evaluate whether regulatory requirements are being met." Please provide content for the type and amount of research that needs to be done to meet this goal.

- Pg 13. "Goal GOEA4: Develop and promote public information and agency enforcement programs that foster public awareness of and compliance with golden eagle conservation, management, and research efforts." Please explain why the DRECP is responsible for developing and promoting law enforcement programs. Please provide details with respect to the ideas regarding public information.

J. Questions Regarding Sample Golden Eagle DRECP Conservation Actions

- Protection from Harassment: "Establish an X distance no-disturbance buffer for all activities around active nests during the breeding season (December through July). Activities (e.g. blasting) that produce very high or extremely loud noises (greater than 91 dB) will not occur within X distance of an active eagle nest during the breeding season (December through July). For active nests with recreational conflicts that risk the occurrence of take, provide public notification (e.g. signs) of the sensitive area and consider seasonal closures." Please add the distance and the rationale and scientific evidence behind that decision so that this conservation action can be fully evaluated. In addition, please clarify whose responsibility it will be to provide public notification of the sensitive area and if the reduction in a pre-existing disturbance will be counted as compensatory mitigation.

- Protection from loss of foraging habitat: "Loss of habitat within X distance to X distance buffer around active or alternative golden eagle nests will be limited to less than 20%." Please add the distance and the rationale and scientific evidence behind that decision (both the distance and the percentage) so that this conservation action can be fully evaluated.

- Protection from mortality: "Facilities that employ technologies that are known or anticipated to have lethal take of eagles will not be authorized within X distance of an active or alternate eagle nest, unless the eagle territory is determined to be abandoned (see definition below) and the proposed development site no longer constitutes habitat that can contribute to the viability of an

eagle territory." Please add the distance and the rationale and scientific evidence behind that decision so that this conservation action can be fully evaluated. Please explain how high quality habitat will be defined and evaluated.

- Protection from mortality: "All projects that risk taking of eagles will be required to integrate "Advanced Conservation Practices" (a process to reduce future take) into their project operations." Please provide a description of advanced conservation practices and the scientific rational behind their use.

- Management for ACEC/NLCS lands: "Maximum of 10% (cumulative) foraging habitat loss for any kind of activity within X distance of an active or alternate nest." Please add the distance and the rationale and scientific evidence behind that decision so that this conservation action can be fully evaluated.

- Definitions: "Active/occupied nest". Please explain why these definitions have been lumped together rather than defined separately.

- Definitions: "Abandoned nest: after 7 years of monitoring, if no adult eagles have been seen occupying a nest or working on a nest (e.g. repairing, adorning, or building) it can be declared abandoned." Please provide the scientific support for this definition.

Golden Eagle Take Permitting in the DRECP: An Analysis

California Wind Energy Association (CalWEA)

January 23, 2013

Under U.S. Fish and Wildlife Service's 2009 final rule interpreting the Bald and Golden Eagle Protection Act's (BGEPA) take authorization provision and promulgating regulations governing BGEPA take permitting, programmatic take of golden eagles must be fully offset by reductions in take from another source. Consistent with the final rule, and as explained more fully below, programmatic take of golden eagles in the DRECP should not count against regional take thresholds for the species because that take will be completely offset by reductions in take from other sources.

Take of Golden Eagles: Statutory and Regulatory Standards and Permit Types

The Bald and Golden Eagle Protection Act allows the U.S. Fish and Wildlife Service ("FWS" or "the Service") to permit take of eagles that is "compatible with the preservation of the bald eagle or golden eagle." 16 U.S.C. § 668a. In 2009, FWS issued a final rule interpreting this statutory mandate and promulgating regulations governing BGEPA take permitting ("the 2009 Rule"). Eagle Permits; Take Necessary to Protect Interests in Particular Localities, 74 Fed. Reg. 46836 (Sept. 11, 2009) (to be codified at 50 C.F.R. Parts 13 and 22). In the 2009 Rule, FWS interprets BGEPA's statutory mandate to mean that any take authorized must be "consistent with the goal of stable or increasing breeding populations." *Id*. at 46838.

Pursuant to the BGEPA permitting regulations, two types of permits are available: individual permits and programmatic permits. 50 C.F.R. § 22.26(a)(1). In the 2009 Rule, FWS explained the distinction between individual and programmatic BGEPA permits, and this distinction has important implications for the administration of BGEPA take permitting in the DRECP.

Individual BGEPA take permits are designed to address instances where take of bald and golden eagles is "quantifiable and of a specified amount." Eagle Permits; Take Necessary to Protect Interests in Particular Localities, 74 Fed. Reg. at 46841, fn1. These permits are "[f]or individual instances of take" where "the take cannot practicably be avoided." 50 C.F.R. § 22.26(a)(1). Before issuing an individual take permit, FWS must consider its population-based permit thresholds and determine that the eagle population can withstand the level of take authorized by the permit. Eagle Permits; Take Necessary to Protect Interests in Particular Localities, 74 Fed. Reg. at 46844. As a result, individual take permit holders typically will not be required to provide compensatory mitigation for the preservation of eagles because, prior to permit issuance, FWS has already concluded that the anticipated take is consistent with the goal of stable or increasing breeding populations. *See id*. Thus, in most instances, for individual take permits, there is no requirement that take be offset.

In contrast to individual take permits, programmatic take permits are appropriate where take is "recurring, not caused solely by indirect effects, and that occurs over the long term or in a location or locations that cannot be specifically identified." 50 C.F.R. § 22.3; Eagle Permits; Take Necessary to Protect Interests in Particular Localities, 74 Fed. Reg. at 46838. Programmatic take permits require permittees to implement Advanced Conservation Practices

("ACPs") that will reduce eagle disturbance and ongoing mortality to the point that any remaining take is unavoidable. *Id*. at 46841. Unlike individual take permits, which are based on the determination that the eagle population can tolerate the level of authorized take, programmatic permits are designed to provide long-term benefits to eagles by reducing ongoing unauthorized take. *Id*. at 46842. As a result, a programmatic take permit holder for a new project will be required to offset any take associated with its project.

Programmatic Permits: Ensuring Take is Consistent with Statutory and Regulatory Standards

To ensure that take is "compatible with the preservation of the … golden eagle," the 2009 Rule conservatively concluded that new projects seeking programmatic golden eagle take permits must (1) minimize take of golden eagles to the point that any take is unavoidable, and (2) completely offset any new take by reducing take from another source. 16 U.S.C. § 668a; see Eagle Permits; Take Necessary to Protect Interests in Particular Localities, 74 Fed. Reg. at at 46840. In other words, the 2009 Rule does not envision any reduction in golden eagle populations resulting from take by new projects because all such take must be completely offset through reductions in ongoing take. This conservative approach ensures that programmatic take will be "compatible with the preservation of the … golden eagle." 16 U.S.C. § 668a.

This approach to golden eagle permitting was reiterated in the Draft Eagle Conservation Plan Guidance released by FWS in January 2011, where the term "no-net-loss" was introduced:

> Where take is unavoidable and when eagle populations at the scale of the eagle management unit (as defined in USFWS 2009b) are not healthy enough to sustain additional mortality over existing levels, applicants must reduce the effect of permitted mortality to a no-net-loss standard, best accomplished through compensatory mitigation. *No-net-loss means that additional mortality caused by the permitted activities is offset by compensatory mitigation that reduces another, ongoing form of mortality by an equal or greater amount*.

U.S. Fish and Wildlife Service, Draft Eagle Conservation Plan Guidance at 12 (January 2011) (emphasis added)("2011 Guidance").

The statutory and regulatory standards for golden eagle take are met without counting programmatic take against regional take thresholds. This is because programmatic take permittees must minimize eagle take to the point that it is unavoidable and must also completely offset unavoidable eagle take. This interpretation is consistent with the 2009 Rule, which emphasizes the benefits of offsetting take that will inure to programmatic take permittees:

> One advantage of opting for the programmatic permit is it would remove liability comprehensively. It also lessens concern about whether additional take can be authorized under take thresholds in the future.

Eagle Permits; Take Necessary to Protect Interests in Particular Localities, 74 Fed. Reg. at 46842. Were FWS to count against regional take thresholds programmatic take that is offset through compensatory mitigation, these important benefits incentivizing projects to obtain programmatic take permits would cease to exist.

The 2009 Rule and the 2011 Guidance's requirements for complete offset of programmatic take have important implications for the administration of BGEPA take authorization in the DRECP. First, DRECP programmatic take permits should be conditioned on completely offsetting take; therefore, eagles taken by DRECP programmatic take permittees should not be counted against the regional threshold. Second, because programmatic take in the DRECP should not count against regional thresholds, development of a DRECP eagle take permitting regime should focus on identification and valuation of take offset opportunities, not on allocating the regional threshold amongst projects.

Programmatic Take Offset: Opportunities and Effectiveness

A variety of effective take offset opportunities exist within the DRECP. *See* Tetra Tech 2012. Published scientific literature supports the efficacy of lead abatement and power pole retrofitting as a means to reduce take in raptor populations. For example, after implementation of a voluntary program to use non-lead ammunition in big-game hunting in Arizona, the lead exposure rate in California Condors decreased. Parish et al. 2009. Another study of this program found that cessation of the program would lead to an increase in lead-related condor mortality. Green et al. 2008.

Studies of the effect of California lead abatement programs on golden eagle and turkey vulture populations have shown similar results. Following passage of the Ridley-Tree Condor Preservation Act, which created a mandatory lead ammunition ban, the prevalence of above-background lead exposure levels declined from 76% to 32% in golden eagles. Kelly et al. 2011. In addition, the prevalence of above-background lead exposure levels in non-migrant golden eagles dropped from 85% to 0%. *Id*. Turkey vultures also showed a decline in the prevalence of above-background lead exposure levels, from 61% pre-ban to 9% post-ban. *Id*. Given the amount of small mammal and game bird hunting that occurs in the DRECP area, pursuing lead abatement in the DRECP would likely benefit golden eagles. *See* CDFG 2007, 2008 (California Department of Fish and Game estimated that 51,000 pheasant, 39,000 chukar, 150,000 quail, 8,000 coyotes, 24,000 jackrabbits, and 24,000 cottontails were killed in hunting zones within the DRECP in 2007 and 2008).

Published studies also support the effectiveness of power-pole retrofitting as a means to offset raptor mortality. Harness and Wilson (2001) found that eagle species accounted for over half of all confirmed raptor electrocutions in a study of electrocutions associated with electric utility structures in the western United States. Golden eagles were electrocuted 2.3 times more frequently than bald eagles. *Id*. Fortunately, a majority of studies of the effectiveness of power pole retrofitting efforts in the United States have found that retrofitting results in a reduction in raptor mortality. *See* Lehman et al. 2007; Lehman at al. 2010.

As these studies show, both lead abatement and power pole retrofitting can provide real, effective offsetting for programmatic golden eagle take in the DRECP. Other

options, such as carcass removal and golden eagle rehabilitation programs, may similarly provide effective take offsetting opportunities. Given these opportunities to reduce golden eagle take from other sources, the DRECP presents a prime opportunity for implementation of FWS's programmatic take program in a way that will achieve the program's underlying goal—"to provide a net benefit to eagles by reducing ongoing unauthorized take." Eagle Permits; Take Necessary to Protect Interests in Particular Localities, 74 Fed. Reg. at 46842.

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DEVELOPMENT OF A MITIGATION FRAMEWORK FOR GOLDEN EAGLES IN THE DESERT RENEWABLE ENERGY CONSERVATION PLAN REGION

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November 20, 2012

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EXECUTIVE SUMMARY

The California Wind Energy Association (CalWEA), in collaboration with other stakeholders, is working toward the development of the Desert Renewable Energy Conservation Plan (DRECP) within southern California. The DRECP will address potential impacts to golden eagles through a programmatic Eagle Conservation Plan that includes compensatory mitigation options for unavoidable take of eagles, should this occur incidental to project-related activities. Power-pole retrofitting is the single example of mitigation for incidental take of an eagle provided in the U.S. Fish and Wildlife Service's 2011 Draft Eagle Conservation Plan Guidance, a mitigation option that may not be feasible within the DRECP region. For this reason, CalWEA contracted Tetra Tech to help develop alternative mitigation options to address potential golden eagle take within the DRECP region.

The first step in developing alternative mitigation options was to review and understand the documented causes of golden eagle fatalities, both nationwide and in California. Tetra Tech revisited the results of a recent review of information on the causes of bald and golden eagle fatalities on a national basis provided for the American Wind Energy Association, and updated this information with specific focus on golden eagle fatalities in California.

The review of databases, literature, and individual experience concerning eagle fatalities found documentation of 1,349 golden eagle fatalities recorded in the state of California between 1930 and 2012. Records of fatalities included those from human-related causes, natural causes, and unknown causes. Fatalities from human causes included those from wind turbine collision, electrocution, shooting, and vehicle strikes. Fatalities from natural causes included those from starvation/malnourishment, immature issues, disease, and eagle-eagle conflict. Numbers of fatalities varied among causes, with greater numbers reported for those causes of fatalities which were studied more frequently. With the exception of multiple studies on wind turbine collision and a single study on electrocution, all records of eagle fatalities were reported incidentally and as such do not represent true proportions of causes of golden eagle fatalities.

Identified causes of golden eagle fatalities were evaluated for their potential for mitigation (i.e., can fatalities from a particular cause be reduced). Opportunities for mitigation were subsequently evaluated for potential viability from a biological, logistical, and financial standpoint. Specifically, viability was evaluated based on whether mitigation of a cause of fatalities was feasible, generated measurable results, and was cost-effective. Three mitigation options were considered viable: roadside carcass removal, lead abatement, and wildlife rehabilitation, and were further developed as potential mitigation options for the DRECP region. A rationale and proposed implementation approach was developed for each of the three potential mitigation options, and key factors that may influence each program's success were identified. The feasibility of using each mitigation option in the DRECP region was evaluated, and its potential effectiveness as a means of compensatory mitigation for golden eagles in the DRECP region, either implemented alone or in combination with other mitigation options, was assessed.

All three potentially viable mitigation options would likely be feasible within the DRECP region. Both carcass removal and lead abatement programs would likely offset sufficient numbers of project-related golden eagle fatalities to be effective on their own as compensatory mitigation options; however, depending upon actual rates of eagle-vehicle collisions within the DRECP,

additional mitigation options may be needed to supplement a carcass removal program. Wildlife rehabilitation is not likely to offset sufficient numbers of project-related golden eagle fatalities because of the low numbers of golden eagles released from California rehabilitation centers. Therefore, a rehabilitation program would not be effective on its own, but may be used to supplement other mitigation options. Upon review of draft findings from this research effort, USFWS representatives indicated that both carcass removal and lead abatement programs were potentially acceptable as compensatory mitigation options for golden eagles in the DRECP, but had concerns about wildlife rehabilitation because of the limited data regarding the survival and future reproduction of released birds.

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1 INTRODUCTION

The California Wind Energy Association (CalWEA), in collaboration with other stakeholders, is working toward the development of the Desert Renewable Energy Conservation Plan (DRECP) within southern California (Figure 1). The purpose of the DRECP is to conserve and manage plant and wildlife communities in the desert regions of California while facilitating the timely permitting of compatible renewable energy projects (CEC 2012). The DRECP is a collaborative effort being developed under the California Natural Community Conservation Planning Act (NCCPA), the Federal Endangered Species Act (FESA), and the Federal Land Policy and Management Act (FLPMA). As part of its purpose, the DRECP will address potential impacts to golden eagles, a species which is protected under the Bald and Golden Eagle Protection Act (BGEPA) and susceptible to collision with wind turbines (e.g., Smallwood and Karas 2009).

The BGEPA prohibits take of bald and golden eagles, including killing or injuring an eagle. A rule change to BGEPA, promulgated by the U.S. Fish and Wildlife Service (USFWS) in 2009, allows for the permitting of take that is incidental to otherwise lawful activities. As a result, renewable energy developers can now apply for incidental take permits for eagles by submitting a programmatic Eagle Conservation Plan (ECP) for each project, although no programmatic permits have yet been authorized (USFWS 2009). For western populations of the golden eagle, the ECP must result in no-net-loss to the breeding population to be compatible with the permit regulations (USFWS 2009). The no-net loss requirement is usually met through compensatory mitigation that offsets any project-related fatalities of eagles by creating new eagles or saving existing eagles from other causes of fatalities. The Draft Eagle Conservation Plan Guidance issued by USFWS in January 2011 (USFWS 2011) provides recommendations for the development of an ECP and presents power-pole retrofitting as the single example of mitigation for incidental take of an eagle. Power-pole retrofitting as mitigation can be problematic because it requires the participation of a third party, the utility company, who may not be interested or able to participate. Therefore, if power pole retrofitting is not an option, renewable energy developers are left with no other USFWS-supported mitigation options. For this reason, CalWEA contracted Tetra Tech to help develop alternative mitigation options to address potential eagle take within the DRECP. At this time, the Final ECP Guidance has not been released to the public; however, the revised technical appendices were released in August 2012 (USFWS 2012).

The purpose of this paper is to evaluate potential mitigation options, and focus on those that would meet the requirement for no-net-loss of golden eagles. The first step in this process is to review and understand the documented causes of golden eagle fatality both nationwide and in California. Once the causes are summarized, an evaluation is made regarding which of these causes can be offset by mitigation.

A recent review of information was prepared on causes of bald and golden eagle fatalities on a national basis for the American Wind Energy Association (AWEA; Tetra Tech 2011). The present paper focuses on California-specific information derived from the AWEA review, supplemented by additional information available on golden eagle fatalities from various sources currently in the public domain. The causes of fatalities identified are further evaluated to assess their potential for mitigation, as well as the kinds of mitigation options that might prove viable. Suitability for mitigation looks at both financial and logistic feasibility. Additional research was performed on a subset of mitigation options that were considered the most viable.

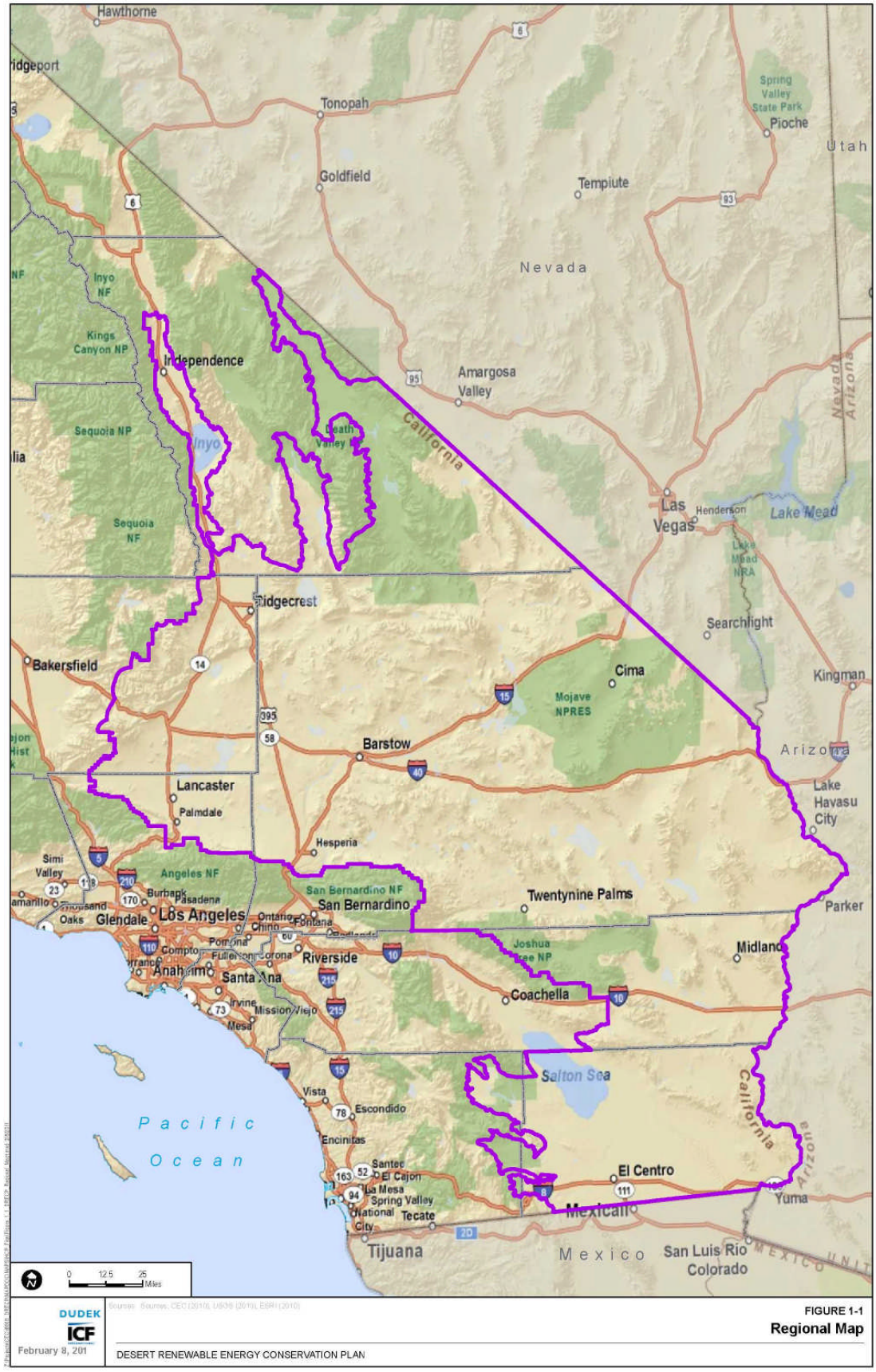

Figure 1. Desert Renewable Energy Conservation Plan Regional Map

2 METHODS

2.1 FATALITY ASSESSMENT

The objective of the fatality assessment was to summarize all publically available records of golden eagle fatalities and their associated causes, starting with the results of the AWEA synthesis (Tetra Tech 2011). First, any records of fatalities that were not specific to golden eagles in California were removed from further consideration. The AWEA results were then updated by re-searching the original information sources for new records of fatalities. Full details of the AWEA data synthesis methods can be found in Tetra Tech 2011. The sources used within the AWEA synthesis included peer-reviewed literature and technical reports that provided information on eagle fatalities, publicly available records, and sources designed to track avian fatalities:

- American Bird Conservancy (ABC) and U.S. Environmental Protection Agency (EPA) Avian Incident Monitoring System,
- U.S. Geological Survey (USGS) Bird Banding Laboratory Band Return Database,
- Federal Aviation Administration (FAA) Wildlife Strike Database, and
- USGS National Wildlife Health Center quarterly reports.

Additionally, the following California-specific data sources were reviewed:

- California Department of Fish and Game (CDFG) California Natural Diversity Database, CDFG Wildlife Investigations Lab, and
- California Roadkill Observation System.

In addition to databases and literature sources, a variety of individuals were contacted from state and federal agencies, non-governmental organizations, electric utilities, raptor experts, and state-licensed wildlife rehabilitators (Appendix A). For purposes of this effort, all records of injured or ill golden eagles were treated as fatalities.

2.1.1 Databases Revisited

Avian Incidental Monitoring System:

Records from the Avian Incident Monitoring System (AIMS) were reviewed. AIMS is a cooperative program between ABC and the EPA (ABC 2012). The AIMS dataset is designed to provide a centralized source for both lethal and sub-lethal impacts of pesticides on birds. The data were collected by the American Bird Conservancy with input from a working group of scientists and industry representatives. The full data range in the database from 1968-2005 was queried for the current review.

Bird Banding Laboratory Band Returns:

The USGS Bird Banding Laboratory (BBL) maintains a database of banded birds, including those that were banded and subsequently found dead, ill, or injured (USGS 2012a). These data are incidentally reported to the banding labs as banded birds are found. Data were received (August 30, 2012) on band encounters for golden eagles from the BBL from 1930 to 2012. These data were restricted to golden eagle bands recovered within the state of California and summarized by how the banded bird was encountered (Appendix A). Among that dataset,

golden eagle records occurred within 13 unique BBL categories for band encounters that were related to death, illness, or injury.

FAA Wildlife Strike Database:

Records were reviewed up to and including August 2012 from the Wildlife Strike Database, which is maintained by the FAA (FAA 2012). The database contains records of wildlife strikes by civilian and U.S. Air Force aircraft occurring since 1990. Reports of wildlife strikes are provided voluntarily to the database, which is searchable online or may be downloaded in its entirety.

USGS National Wildlife Health Center:

The USGS National Wildlife Health Center provides quarterly reports of wildlife fatalities. The source data for the reports are compiled from a database of wildlife mortality events maintained at NWHC since 1975. All quarterly reports from 1995 to 2012 were reviewed (USGS 2012b); with the exception of 2012, for which only Quarter 1 was posted as of August 2012.

2.1.2 New Databases Reviewed

CDFG California Natural Diversity Database:

The California Natural Diversity Database (CNDDB) is a program that inventories the status and locations of rare plants and animals in California. Tetra Tech contacted the Biogeographic Data Branch of the CDFG for information on any records of golden eagle fatalities that they might have within the CNDDB (Appendix A).

California Roadkill Observation System:

The California Roadkill Observation System (CROS) is a website that records observations from citizens who come across identifiable road-killed wildlife in the state of California. Records of golden eagle fatalities that have been reported in the CROS through August 2012 were searched (CROS 2012; Appendix A).

2.1.3 Literature Reviewed

The majority of literature reviewed was published articles and reports which focused on documenting mortality from wind farms (Anderson et al. 2005, Kerlinger et al. 2006, Insignia Environmental 2009, Sahagun 2012), and utilities and power lines (Boeker and Nickerson 1975, Woodbridge and Garrett 1993, Harness and Wilson 2001). Primary researchers Rick Harness and Brian Woodbridge, authors of utility studies, were also contacted in order to determine state-specific numbers of golden eagle fatalities. Other sources included published papers on pesticide poisoning (Littrell 1990) and results of raptor necropsies (Morishita et al. 1998). All articles that were reviewed for information on golden eagles in California are presented in the literature cited (Section 4). The literature search concluded in August 2012.

The Altamont Pass Wind Resource Area has been studied more intensively than any other U.S. wind farm, and multiple papers and reports are available that address raptor fatalities at this facility (Howell and DiDonato 1991; Orloff and Flannery 1992, 1996; Hunt 2002; Smallwood and Thelander 2004, 2005, 2008; Altamont Pass Avian Monitoring Team 2008; WEST 2008, Smallwood and Karas 2009). In the course of review, Tetra Tech found that the same fatality data appeared in many of these studies. Tetra Tech therefore compared major references for

Altamont Pass Wind Resource (Howell and DiDonato 1991, Orloff and Flannery 1992, Howell 1997, Hunt et al. 1997, Erickson et al 2001, Hunt 2002, Thelander et al. 2003, Dorin et al. 2005, Smallwood and Thelander 2008, Smallwood and Karas 2009), and totaled eagle fatalities that represented distinct events. This process left a reduced set of references that covered all reported eagle fatalities for the Altamont Pass Wind Resource Area (Howell and DiDonato 1991, Erickson et al. 2001, Hunt 2002, Smallwood and Karas 2009).

2.1.4 Individuals Contacted

Direct communication (via phone or email) with informed individuals supplemented the results. This effort included contacts with individuals at USFWS, CDFG Headquarters and Regional Offices, the California Bureau of Land Management District Offices, and California utilities for any records of golden eagle fatalities they had available and were able to release (Appendix A). Although the CDFG Wildlife Investigations Lab provides annual summary reports of wildlife rehabilitated in the state, information on the cause of admittance (e.g., injury, disease) is not currently tracked. Therefore, individual state-licensed wildlife rehabilitators and facilities that accept golden eagles (Appendix A) were also surveyed by phone and email for records of golden eagles admitted and their respective reasons for admittance. Lastly, non-profit agencies and researchers were contacted, including California chapters of the Audubon Society, the Wildlife Research Institute and Bloom Biological, Inc. (Appendix A). Direct communication efforts concluded in April 2012.

2.1.5 Data Summary

The data reviewed were collected over the past 80 years, and the frequency of reporting and research effort varied widely. Additionally, the databases and formal research reflect the environmental concerns at the time when the data were collected, and only fatalities associated with wind turbines have been systematically collected resulting in higher fatality counts due to a greater probability of reporting. For these reasons, the records of eagle fatalities discussed here provide information on known causes of fatalities but do not represent the proportions of eagle fatalities due to different causes.

Causes of eagle fatalities fell into one of three main categories: (1) collision, (2) poisoning, and (3) other (Table 1). Because of the higher potential of mitigating human-related fatality causes, data were further separated into fatalities resulting from human causes and the remainder resulting from natural causes. Collisions included eagles striking vehicles, aircraft, trains, wires, towers including their associated guy-wires, wind turbine blades (Altamont Pass and non-Altamont Pass), unspecified objects, and power lines (denoted as collision/electrocution). Causes of poisoning included lead, secondary anticoagulant (e.g., brodifacoum), secondary organophosphate pesticide (e.g., diazinon), secondary poisoning from predator control efforts (e.g., strychnine), and unspecified poison. Other human-related causes of fatalities included electrocution, gun shot, unspecified trap, building enclosure, and entanglement.

Mortality due to natural causes was limited to the Other category and included weather, eagle/eagle conflict, immature issues (i.e., fledging mishap, found outside nest, inexperienced hunters, orphaned), botulism, disease (e.g., aspergillosus, avian pox, macaw wasting disease, West Nile Virus), and starvation/malnourished (Table 1).

Fatalities were categorized as presented in their original source. The classification “unknown” was used for fatality, illness, and injury records that could not be assigned to any of the above

categories due to lack of information. Together with "trauma - cause unknown", these two classifications could not be assigned to either human-related or natural causes of fatality.

Table 1. Summary of Golden Eagle Fatalities in California with National Context

SOURCE[1]	CATEGORY	CALIFORNIA		U.S.[2]
		TOTAL	PERCENTAGE	PERCENTAGE
Collision				
Vehicle	Human	44	3.3%	3.8%
Aircraft	Human	5	0.4%	1.0%
Train	Human	1	0.1%	<0.1%
Wire	Human	9	0.7%	0.1%
Towers including wires	Human	14	1.0%	3.0%
Wind turbine blade – Altamont	Human	601	44.6%	16.7%
Wind turbine blade – non-Altamont	Human	14	1.0%	0.5%
Unspecified	Human	6	0.4%	0.1%
Collision/electrocution	Human	9	0.7%	0.0%
Poisoning				
Lead	Human	14	1.0%	0.1%
Secondary anticoagulant	Human	20	1.5%	<0.1%
Secondary organophosphate pesticide	Human	1	0.1%	4.3%
Secondary from predator control efforts	Human	11	0.8%	0.3%
Unspecified	Human	3	0.2%	5.2%
Other				
Electrocution	Human	121	9.0%	35.1%
Gun shot	Human	73	5.4%	3.2%
Unspecified trap	Human	16	1.2%	1.2%
Building enclosure	Human	2	0.1%	0.0%
Entanglement	Human	2	0.1%	<0.1%
Weather	Natural	1	0.1%	0.1%
Eagle/eagle conflict	Natural	7	0.5%	0.1%
Immature bird issues	Natural	14	1.0%	0.2%
Trauma - cause unknown	-	77	5.7%	0.1%
Botulism	Natural	1	0.1%	<0.1%
Disease	Natural	10	0.7%	0.1%
Starvation/malnourishment	Natural	18	1.3%	0.0%
Unknown	-	255	18.9%	25.0%
GRAND TOTAL		**1349**		

[1]Source data were collected incidentally with the exception of wind turbine blade collisions and electrocution (Appendix A).
[2]Tetra Tech 2011.

2.2 EVALUATION OF MITIGATION OPTIONS

Once the fatality data were synthesized to identify key causes of golden eagle fatalities in California, a stepwise process was used to evaluate which cause (or causes) of fatalities could be suitable for developing a mitigation strategy from a biological, logistical, and financial standpoint. First, only those causes of fatality where it was possible to reduce the number of fatalities in order to meet the no-net-loss criteria were retained. Second, the potential for reducing the fatalities from a given cause by directly addressing it, or indirectly addressing it (e.g., through an education program), was assessed. Third, similar mitigation programs already in existence were evaluated for their potential to be leveraged for expanded mitigation value. Fourth, the feasibility of implementation of a mitigation action was assessed. Fifth, mitigation options were evaluated for their potential to provide measureable results, (i.e., is it possible to quantify the mitigation action in terms of the number of eagle fatalities offset). Finally, the cost-effectiveness of the mitigation option was considered to ensure only realistically feasible mitigation options would be pursued. Because retrofitting power poles to address electrocutions is already an acceptable mitigation method to the USFWS, electrocution was not pursued further.

The causes of fatalities evaluated as being viable opportunities for mitigation based on their rankings above were further developed as potential mitigation programs for the DRECP. For each viable mitigation option information specific to the DRECP region was researched, and a rationale and proposed approach for its implementation within the DRECP region was developed. Key factors that may influence each program's success within the DRECP region were identified. The feasibility of using each mitigation option in the DRECP region was evaluated, and its potential effectiveness as a means of compensatory mitigation for golden eagles in the DRECP region, either implemented alone or in combination with other mitigation options, was assessed.

3 RESULTS AND DISCUSSION

3.1 FATALITY ASSESSMENT

The review of databases, literature, and individual experience concerning eagle fatalities found documentation of 1,349 golden eagle fatalities recorded in the state of California between 1930 and 2012. Of these, 19 percent of fatalities were due to unknown causes (Table 1). This value is lower than reported nationally, where 25 percent of fatalities were from unknown causes (Table 1). Among documented human-caused fatalities of golden eagles, the leading cause was collision with wind turbines at the Altamont Pass Wind Resource Area, with 601 fatalities documented between 1984 and 2007 (45 percent of all fatalities, 62 percent of all human-related fatalities; Tables 1 and 2). Some of these fatality records were reported by more than one source, and those that could be redundant with the most comprehensive listing (Smallwood and Karas 2009) are footnoted in Table 2. In comparison, wind turbine collisions at Altamont accounted for approximately 17 percent of nationally reported fatalities (Table 1). Other causes of golden eagle fatalities in California were electrocution (13 percent of human-related fatalities), shooting (8 percent), and vehicle strikes (5 percent; Table 2). The percentage of reported electrocutions in California is low compared to national records (9 percent of all fatalities compared to 35 percent in U.S.; Table 1). Golden eagle fatalities due to collisions with wind turbines at facilities other than Altamont Pass (14 fatalities as of February 2012) represented approximately 1 percent of the known human-caused fatalities in our dataset. Among natural

causes of golden eagle fatalities the leading causes were starvation/malnourishment (35 percent of naturally caused fatalities), immature issues (27 percent), disease (mostly West Nile Virus; 20 percent), and eagle-eagle conflict (14 percent; Table 3).

A limited amount of published data regarding fatality rates of golden eagles was identified in the background review for this report. Rates of eagle fatalities have only been systematically recorded for wind energy projects (5 rates reported from the Altamont Pass Wind Resource Area and 2 from other wind farms) and transmission lines (1 rate reported, Table 4). Most wind energy-related fatalities have occurred at the Altamont Pass Wind Resource Area; therefore, most of the rate estimates for wind energy were calculated for Altamont Pass, and likely have some overlap in their source data. Fatality rates at Altamont Pass ranged from 0.000 to 0.138 fatalities/MW/year, depending on the data source (Table 4). The only two wind energy facilities in California located outside the Altamont Pass Wind Resource Area that have reported golden eagle fatality rates have rates lower than those reported for Altamont (range 0.003-0.017 fatalities/MW/year). The single rate of golden eagle fatalities presented for transmission lines ranged from 3 to 17 golden eagle fatalities per year (Table 4). The approximate rates of golden eagles brought to rehabilitation centers ranged from 1 to 4 per year when all types of illness and injury were combined (Table 4).

The fatality data presented here provide an overview of causes of fatality in golden eagles in California, which, in turn, provides potential avenues for golden eagle mitigation. However, these results should be interpreted with caution because they represent non-random sampling of fatality events derived largely from incidental records (Appendix A). Therefore, these data provide a range of potential mitigation options from known causes of fatalities, but are not necessarily indicative of true proportions of causes of golden eagle fatalities (Tetra Tech 2011).

Table 2. Human-Related Causes of Fatalities in Golden Eagles in California

SOURCE	YEARS	TOTAL	COLLISION									POISONING					OTHER				
			Vehicle	Aircraft	Train	Wire	Towers, Including Wires	Wind Turbine Blade		Unspecified Collision	Collision/ Electrocution	Lead	Secondary Anti-coagulant	Secondary Organo-phosphate Pesticide	Secondary Predator Control	Unspecified Poisoning	Electro-cution	Gun Shot	Unspecified Trap	Building Enclosure	Entangle-ment
								Altamont	Non-Altamont												
ABC AIMS Database 2012	1968-2005	10											9		1						
CDFG California Natural Diversity Database 2012	1979-2012	2				1											1				
CROS Database 2012	1984-2012	2	2																		
FAA Birdstrike Database 2012	1994-2012	5		5																	
USGS Bird Banding Laboratory Database 2012[1]	1930-2012	49	11			3	14			1								2	6	2	
Anderson et al. 2005	1997-2000	1							1												
Boeker and Nickerson 1975	1972-1973	6															6				
Erickson et al 2001	1984-1988	26						26													
Harness and Wilson 2001	1997-not stated	33															33				
Howell and DiDonato 1991	1988-1989	2						2													
Hunt 2002	1998-2001	68	4		1	4		42				3	1				12	1			
Insignia Environmental 2009	2008-2009	3							3												
Kerlinger et al. 2006	2003-2005	2							2												
Littrell 1990	Not reported	1												1							
Sahagun 2012	2009-2012	8							8												
Smallwood and Karas 2009	1989-2007	495						495													
Woodbridge and Garrett 1993	1986-1992	66									5						61				
Larry LaPre - BLM	2008	1	1																		
All Wildlife Rescue & Education	1982-2012	1																			
Bidwell Wildlife Rehabilitation Center	1982-2012	90											10		10			60	10		

Table 2. Human-Related Causes of Fatalities in Golden Eagles in California (continued)

SOURCE	YEARS	TOTAL	COLLISION									POISONING					OTHER				
			Vehicle	Aircraft	Train	Wire	Towers, Including Wires	Wind Turbine Blade		Unspecified Collision	Collision/ Electrocution	Lead	Secondary Anti-coagulant	Secondary Organo-phosphate Pesticide	Secondary Predator Control	Unspecified Poisoning	Electro-cution	Gun Shot	Unspecified Trap	Building Enclosure	Entangle-ment
								Altamont	Non-Altamont												
California Foundation for Birds of Prey	2011-2012	5										2									
California Living Museum	2009-2012	1																			
Critter Creek	2008-2011	3	2														1				
Eastern Sierra Wildlife Care	2009-2012	4									1	3									
Gold Country Wildlife Rescue	2009-2012	3										1					1				
Lenore Will	Not stated	1	1																		
Lindsay Wildlife Museum[2]	2005-2012	38	2					31				1					1				
Living Desert Zoo & Gardens	1987-2012	7															1				
Moonridge Animal Park	Not stated	1																1			
Ojai Raptor Center	2011-2012	8								2		1					1	1			
Pacific Wildlife Care - Morro Bay	2009-2012	6	1									1									
Pacific Wildlife Care - San Luis Obispo	2012	1										1									
S.P.C.A of Monterey County	2008-2012	5	1							2											
San Joaquin Raptor Rescue Center	2002-2012	3														1		2			
Sierra Wildlife Rescue	2005-2011	2	1																		
Sonoma County Wildlife	2012	1																			
Stanislaus Wildlife Care Center	2007-2012	4								1						2					
Suisun Marsh Natural History Association	1996-2012	3				1					1						1				
Sulphur Creek Nature Center[2]	1994-2012	8						5													

Table 2. Human-Related Causes of Fatalities in Golden Eagles in California (continued)

SOURCE	YEARS	TOTAL	COLLISION									POISONING					OTHER				
			Vehicle	Aircraft	Train	Wire	Towers, Including Wires	Wind Turbine Blade		Unspecified Collision	Collision/ Electrocution	Lead	Secondary Anti-coagulant	Secondary Organo-phosphate Pesticide	Secondary Predator Control	Unspecified Poisoning	Electro-cution	Gun Shot	Unspecified Trap	Building Enclosure	Entangle-ment
								Altamont	Non-Altamont												
Tehachapi Wildlife Rehabilitation & Education	Not stated	1																			1
Tri-County Wildlife Care	1997-2012	2	1																		
Trinity Wildlife Survival Center	1990-2011	30																			
VCA Crestwood Animal Hospital	2003-2012	1	1																		
Wild Care	2007-2012	3																			
Wild Wings of California	1982-2012	6															1	5			
Wildlife Care of Ventura County	2010-2012	1										1									
Wildlife Center of Silicon Valley	2010-2012	1																			
Wildlife Rescue Center of Napa County	2001-2012	1															1				
WRI Wildlife Rescue Center	1999-2011	22	16								2							1			1
	TOTAL	**966**	**44**	**5**	**1**	**9**	**14**	**601**	**14**	**6**	**9**	**14**	**20**	**1**	**11**	**3**	**121**	**73**	**16**	**2**	**2**
	PERCENTAGE		**4.6%**	**0.5%**	**0.1%**	**0.9%**	**1.4%**	**62.2%**	**1.4%**	**0.6%**	**0.9%**	**1.4%**	**2.1%**	**0.1%**	**1.1%**	**0.3%**	**12.5%**	**7.6%**	**1.7%**	**0.2%**	**0.2%**

[1] Data from this source may be redundant with other sources, but details are not provided to permit estimation of that proportion.
[2] Fatalities from these sources may be redundant with Smallwood and Karas 2009.

Table 3. Natural Causes of Fatalities in Golden Eagles in California

SOURCE	YEARS	TOTAL	WEATHER	EAGLE/EAGLE CONFLICT	IMMATURE ISSUES	BOTULISM	DISEASE	STARVATION/ MALNOURISHED
CDFG California Natural Diversity Database 2012	1979-2012	1			1			
USGS Bird Banding Laboratory Database 2012[1]	1930-2012	130	1				1	1
Hunt 2002	1998-2001	32		4	6	1		
Morishita et al. 1998	1983-1994	17						
Bird Rescue Center	2007-2012	3						
California Foundation for Birds of Prey	2011-2012	5			3		2	
California Raptor Center	1980-2011	73						
Critter Creek	2008-2011	4			1			1
Fund For Animals	2010-2012	1		1				
Gold Country Wildlife Rescue	2009-2012	1			1			
Lenore Will	Not stated	1		1				
Lindsay Wildlife Museum	2005-2012	2		1				
Living Desert Zoo & Gardens	1987-2012	1						1
Moonridge Animal Park	Not stated	7						
Pacific Wildlife Care - Morro Bay	2009-2012	3						
Project Wildlife	2008-2012	2					1	
S.P.C.A of Monterey County	2008-2012	1					1	
San Joaquin Raptor Rescue Center	2002-2012	4					1	3
Sierra Wildlife Rescue	2005-2011	1						1
Sky Hunters	2012	2					2	
Sonoma County Wildlife	2012	1						1
Stanislaus Wildlife Care Center	2007-2012	1					1	
Tehachapi Wildlife Rehabilitation & Education	Not stated	3			1			2
Trinity Wildlife Survival Center	1990-2011	1						1
Wildlife Care of Ventura County	2010-2012	1			1			
Wildlife Rescue Center of Napa County	2001-2012	1						1
WRI Wildlife Rescue Center	1999-2011	7					1	6
	TOTAL	**51**	**1**	**7**	**14**	**1**	**10**	**18**
	PERCENTAGE		**1.96%**	**13.73%**	**27.45%**	**1.96%**	**19.61%**	**35.29%**

[1] Data from this source may be redundant with other sources, but details are not provided to permit estimation of that proportion.

Table 4. Golden Eagle Fatality Rates in California

SOURCE	YEARS	ACTIVITY	GOLDEN EAGLE FATALITIES PER YEAR		
			TOTAL	PER TURBINE	PER MW
Altamont Pass Avian Monitoring Team 2008[1]	2005-2007	Wind farm (Altamont)			0.000-0.138
Bidwell Wildlife Rehab Center	1982-2012	Rehabilitation	3		
Facility for Animal Care and Treatment	unknown	Rehabilitation	3-4		
Howell and DiDonato 1991	1988-1989	Wind Farm (Altamont)	2		
Kerlinger et al. 2006	2003-2005	Wind farm		0.006	0.003
Orloff and Flannery 1992[1]	1989-1991	Wind farm (Altamont)	39		
Smallwood and Karas 2009	1989-2007	Wind farm (Altamont)	55.3 (1998-2003); 64.7 (2005-2007)		0.070 (1998-2003); 0.091 (2005-2007)
Valley Wildlife Care	unknown	Rehabilitation	1-2		
WEST 2008[1]	2005-2007	Wind farm (Altamont)	3		0.04-0.07
Woodbridge and Garrett 1993	1986-1992	Transmission line	3-17		
Willits Wildlife Rehabilitation Team	unknown	Rehabilitation - Electrocution	1		
Woods, C. 2010 (pers. comm.)	2009-2010	Wind farm	2	0.025	0.017

[1] Fatalities from these sources are redundant with Smallwood and Karas 2009.

3.2 MITIGATION OPTIONS

Twenty-three causes of fatalities were evaluated for their viability as mitigation options (Table 5). Categories where the cause of fatality was not fully specified (e.g., unspecified collision) and natural causes of fatalities (e.g., harsh weather conditions, eagle-eagle conflict; Table 3) cannot be mitigated; therefore, they were eliminated from consideration as mitigation options. The exception was starvation/malnourishment which can be addressed through supplemental feeding (Table 5). Of the 14 remaining causes of fatality, ten could be mitigated by addressing the cause of fatality directly, and five could be addressed through education programs (Table 5). Lead poisoning falls into both categories since the cause of fatality can be mitigated directly as well as with education programs.

Three of the ten causes of fatality that can be mitigated directly have existing programs in place (e.g., APLIC 1994, Gehring et al. 2009, Sieg et al. 2009): collisions with wires, collisions with towers, and lead poisoning. The remaining causes can be further reduced because mitigation programs to address such causes as aircraft and train collisions, unspecified trapping, building enclosures, and entanglement are expected to have low feasibility, particularly because these types of fatalities are assumed to be rare occurrences, some of which will be widely dispersed geographically (Tables 4 and 5). Although mitigation of starvation/malnourishment would be feasible, it would very difficult to measure the results in a quantitative manner without a large scale study. In contrast, mitigating for wire and tower collisions through marking of lines and modification of tower lighting is a feasible option, and published success rates are available (e.g., Gehring et al. 2009, Barrientos et al. 2011). However, such mitigation is not likely to be cost-effective because of the large numbers of these structures and the infrequency of eagle collisions. The remaining two causes of mortality that can be addressed directly, collision with vehicles and lead poisoning, are both feasible (i.e., relative ease of implementation), have some information available to support their estimated effectiveness, and are moderately cost-effective. Therefore, they were considered viable as alternative mitigation options and were further investigated as mitigation options for the DRECP region (see Sections 3.2.1-2 below and Appendices B and C).

Five causes of golden eagle mortality are good candidates for education programs to help reduce golden eagle fatalities (Table 5), including shooting and poisoning. Although shooting of eagles made up 5 percent of eagle fatality records, no existing education programs were identified; however, law enforcement programs were not reviewed. The lack of education programs may possibly result from the audience not being receptive, given that shooting occurs despite legal prohibitions and threat of prosecution. California and other states have existing programs to address lead contamination and several other types of poisoning, so they are considered to be feasible mitigation options. Unlike programs that educate the public on best practices for pesticide application or predator control (e.g., University of California Integrated Pest Control 2012), educational programs dealing with lead poisoning have published data on success rates (e.g., Sieg et al. 2009), allowing for the measurement of program results. For these reasons only lead poisoning was considered viable as an alternate mitigation option and was further investigated as a mitigation option for the DRECP region (see Section 3.3.2 and Appendix C).

Wildlife rehabilitation was considered as an additional “catch-all” mitigation option because medical treatment at rehabilitation centers can address all non-fatal causes of eagle illness and injury. Funding of pre-existing rehabilitation programs would be a feasible mitigation option

because rehabilitation centers are currently in place and they produce directly measurable results (i.e., eagles released) that are cost-effective; thus, making wildlife rehabilitation a viable mitigation option. For these reasons wildlife rehabilitation was further investigated as a mitigation option for the DRECP region (see Section 3.3.3 and Appendix D).

Table 5. Evaluation of Potential Alternative Mitigation Options (Columns represent sequential evaluation steps, shading indicates when options were eliminated)

SOURCES OF MORTALITY	POSSIBLE TO MITIGATE	TYPE OF MITIGATION	EXISTING PROGRAM	FEASIBILITY	MEASURABLE RESULTS	COST-EFFECTIVENESS	VIABILITY AS A MITIGATION OPTION
Collision							
Vehicle	Yes	Address the cause	No	Moderate	Yes	Moderate	High
Aircraft	Yes	Address the cause	No	Low			
Train	Yes	Address the cause	No	Low			
Wire	Yes	Address the cause	Yes	Moderate	Yes	Low	
Tower kills including wires	Yes	Address the cause	Yes	Moderate	Yes	Low	
Unspecified	No						
Poisoning							
Lead	Yes	Education and Address the cause	Yes	Moderate	Yes	Moderate	High
Secondary anticoagulant	Yes	Education	Yes	Moderate	Yes	Low	
Secondary organo-phosphate pesticide	Yes	Education	Yes	Moderate	Yes	Low	
Secondary predator control efforts	Yes	Education	Yes	Moderate	Yes	Low	
Unspecified	No						
Other							
Gun shot	Yes	Education	No	Low			
Unspecified trap	Yes	Address the cause	No	Low			
Building enclosure	Yes	Address the cause	No	Low			
Entanglement	Yes	Address the cause	No	Low			
Weather	No						
Eagle/eagle conflict	No						
Immature bird issues	No						
Trauma - cause unknown	No						
Botulism	No						
Disease	No						
Starvation/ malnourishment	Yes	Address the cause	No	Moderate	No		
Unknown	No						

3.3 MITIGATION IN THE DRECP

Three mitigation options met the viability criteria and were further investigated for their suitability for use as mitigation options in the DRECP region. Summaries of the three mitigation options are provided in the following subsections, full details of each as developed for the DRECP are provided separately as appendices. Context is provided as to whether USFWS would potentially consider a given mitigation option as acceptable for compensatory mitigation for golden eagle fatalities cause by facilities in the DRECP.

3.3.1 Roadside Carcass Removal

Risk of golden eagle collisions with vehicles may be minimized through the implementation of a carcass removal program. By removing carcasses from roadsides, individual eagles that might feed on those carcasses would no longer be at risk of collision from vehicles and are thus saved (Appendix B). Components necessary for this type of mitigation program are sufficient concentrations of road-killed wildlife and eagles present within the area of interest. Although the DRECP region likely may have relatively low wildlife-vehicle collision rates given its rural nature and low human population density, the net benefits of removing carcasses may offset a sufficient number of eagle fatalities for it to be a suitable mitigation option. Alternatively, the carcass removal program could be implemented in combination with other mitigation programs. Research would be needed concurrent with the implementation of the program to test the inherent assumptions regarding eagle fatalities offset per unit of effort. USFWS appears to consider it as a potentially acceptable mitigation option because it was presented as an example of compensatory mitigation in the revised technical appendices to the Draft ECP Guidance (USFWS 2012).

3.3.2 Lead Abatement

Golden eagles are exposed to lead primarily through foraging on carcasses that were shot with lead-based ammunition. Lead abatement programs have had some success at reducing the exposure of golden eagles and other wildlife to lead through the use of educational efforts, physical removal of lead-shot carcasses and remains, and provision of non-toxic ammunition. Reductions in the number of lead-poisoned eagles can be translated directly into eagle fatalities offset using either information from existing studies or by implementing new studies over the DRECP area (Appendix C). A research component concurrent with the implementation of the program would be necessary to test the inherent assumptions regarding eagle fatalities offset per unit of effort. Additionally, decreasing sublethal levels of lead in golden eagles may reduce their chances of being killed by other causes such as trapping, collision, starvation/malnutrition because sub-lethal concentrations of lead can cause behavioral changes and impair digestion, hunting, and feeding (Wayland et al. 2003, Pain et al. 2009, Kelly et al. 2011). Because golden eagles travel long distances over the course of a year and lead exposure may occur anywhere within their range, the effectiveness of a lead mitigation program will be maximized over a large area. This spatial scale requirement makes this mitigation option particularly suitable for regional implementation under the DRECP. In addition, the USFWS has recognized that lead-poisoning in eagles is an issue of concern (B. Millsap, USFWS, 2012 pers. comm.), and would likely consider lead mitigation a viable option.

3.3.3 Wildlife Rehabilitation

Wildlife rehabilitation centers in California regularly treat golden eagles that have been injured or are ill. Treatment can, in some cases, result in individuals being released back to the wild that would otherwise have perished, thus equaling eagles saved. Although rehabilitation of eagles is ongoing, additional funding would increase the level of care for eagles and allow for routine lead-testing and treatment (Appendix D). Lead-chelation therapy is an effective treatment that has a brief captivity period and a high success rate, but is cost-prohibitive for most rehabilitation centers because they are funded solely by donations. However, due to the small number of eagles released from California rehabilitation centers in a given year, this mitigation strategy alone would not be suitable for the DRECP to meet the no-net-loss standard; however, funding of rehabilitation could be combined with other mitigation options to make it more viable. Additionally, rehabilitation could be a suitable mitigation option for individual facilities seeking a one-time take permit. USFWS has expressed concern regarding funding of rehabilitation because of the limited data regarding the survival and future reproduction of released birds. Without supporting research, funding of rehabilitation may not be a mitigation strategy acceptable to the USFWS.

3.4 CONCLUSIONS

Of the various causes of fatality identified for golden eagles in California, only three mitigation options were considered viable in this study – roadside carcass removal, lead abatement, and wildlife rehabilitation. Although both roadside carcass removal and lead abatement programs may be suitable for mitigating eagle take within the DRECP, additional research is needed to test the inherent assumptions regarding eagle fatalities offset per unit of effort. Wildlife rehabilitation may be useful as a supplemental mitigation option for the DRECP, but would require supporting research on the survival of released eagles in order for USFWS to consider it to be an acceptable form of mitigation.

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Appendix A: Supporting Data for Golden Eagle Fatality Records

Appendix A. Supporting Data for Golden Eagle Fatality Records

TYPE OF DATA SOURCE	DATA SOURCE	HOW INFORMATION OBTAINED	TYPE OF DATA	YEARS
Database	ABC Avian Incident Monitoring System Database 2012	Data were collected by the American Bird Conservancy with input from a working group of scientists and industry representatives.	Incidental	1968-2005
Database	California Roadside Observation System Database 2012	Volunteers report road-killed wildlife observed. Data presented in this report were provided by Dr. Fraser Shilling who sent detailed information on the golden eagle records that they had within the CROS.	Incidental	1994-2012
Database	CDFG California Natural Diversity Database 2012	Incidental records, used search term within database for dead eagles. Data presented in this report were provided by Brian Accord, a Lead Zoologist within the Biogeographic Data Branch, who performed a query using the RareFind application of golden eagle fatalities through April 2012.	Incidental	1993-2008
Database	FAA Birdstrike Database 2012	Database of strike records. Data presented in this report were collected by running an advanced search, selecting United States only, and using golden eagle in the field “any part of a bird’s name.”	Incidental	1994-2010
Database	USGS Bird Banding Laboratory 2012[1]	Incidental eagle finds reported to the Lab. Data presented in this report were sorted by cause of death, illness, or injury for all cases in which it was known, and assigned as death due to unknown cause for the following BBL “encounter how obtained description” categories: “found dead – unknown cause” and “band number obtained – unknown cause.” Band recoveries from the BBL category “dead on highway – unknown cause” were assumed to be the result of vehicle collisions and were therefore grouped with “struck by vehicle.”	Incidental	1960-2012
Database	USGS National Wildlife Health Center 2012	Compiled from a database of wildlife mortality events maintained at NWHC.	Incidental	1975-2012
Literature	Altamont Pass Avian Monitoring Team 2008[2]	Carcass surveys at the base of Altamont wind turbines.	Systematic	2005-2007
Literature	Anderson et al. 2005	Carcass surveys below turbines.	Systematic	1997-2000
Literature	Boeker and Nickerson 1975	Document raptor electrocutions.	Incidental	1969-1971

Appendix A. Supporting Data for Golden Eagle Fatality Records (continued)

TYPE OF DATA SOURCE	DATA SOURCE	HOW INFORMATION OBTAINED	TYPE OF DATA	YEARS
Literature	Bortolotti 1984	Reviewed mortality data recorded on study skins.	Incidental	not reported
Literature	Dorin et al. 2005	Literature review of avian mortality due to wind energy facilities and power lines.	Literature review	1985-2002
Literature	Erickson et al 2001	Review of literature on wind turbine-caused mortality.	Literature review	1984-1988
Literature	Franson et al. 1995	Necropsy of birds submitted to the USGS National Wildlife Health Center.	Incidental	1960-1995
Literature	Harness and Wilson 2001	Review of records from 58 utilities in western U.S.	Database review/Incidental	1986-1996
Literature	Howell 1997[2]	Carcass surveys at the base of Altamont wind turbines.	Systematic	1993-1995
Literature	Howell and DiDonato 1991	Carcass surveys at the base of Altamont wind turbines.	Systematic	1988-1989
Literature	Hunt 2002	Data from a radio telemetry study near Altamont.	Systematic	1998-2001
Literature	Insignia Environmental 2009	Carcass surveys at the base of wind turbines.	Systematic	2008-2009
Literature	Kerlinger et al. 2006	Carcass surveys at the base of wind turbines.	Systematic	2003-2005
Literature	Kramer and Redig 1997	Number of eagles admitted to the Raptor Center at the University of Minnesota.	Incidental	1980-1995
Literature	Littrell 1990	California Department of Fish and Game Records.	Incidental	not reported
Literature	Morishita et al. 1998	Reports for raptor submitted for necropsy.	Incidental	1983-1994
Literature	Nemeth et al. 2006	Thirteen naturally infected birds (WNV seropositive) were provided by various raptor facilities to the animal care facility at Colorado State U.	Incidental	2002-2004
Literature	Orloff and Flannery 1992[2]	Carcass surveys at the base of Altamont wind turbines.	Systematic	1989-1991
Literature	Phillips 1986	Review of eagle mortality records and interviews with raptor biologists.	Incidental	1941-1985
Literature	Sahagun 2012	News article of dead golden eagles at Pine Tree wind farm.	Systematic and Incidental	2009-2012
Literature	Smallwood and Karas 2009	Review of database for Altamont fatalities.	Systematic and Incidental	1989-2007

Appendix A. Supporting Data for Golden Eagle Fatality Records (continued)

TYPE OF DATA SOURCE	DATA SOURCE	HOW INFORMATION OBTAINED	TYPE OF DATA	YEARS
Literature	Smallwood and Thelander 2008[2]	Carcass surveys at the base of Altamont wind turbines.	Systematic	1998-2003
Literature	Thelander and Rugge 2000[2]	Carcass surveys at the base of Altamont wind turbines.	Systematic	1998-1999
Literature	Thelander et al. 2003[2]	Carcass surveys at the base of Altamont wind turbines.	Systematic	1998-2000
Literature	USFWS 2009	Take permits - Technical Assistance, 22.21 scientific collection, 22.22 - religious take, 22.23 – depredation.	Database review/systematic	2002-2007
Literature	WEST 2008[2]	Carcass surveys at the base of Altamont wind turbines.	Systematic and Incidental	2005-2007
Literature	Woodbridge and Garrett 1993	Transect surveys under distribution lines.	Systematic	1986-1992
Literature	Woods 2010[3]	Carcass surveys at the base of wind turbines at Pine Tree wind farm.	Systematic	2009-2010
Pers. comm.	Kelly Bahr, Technician, Eastern Sierra Wildlife Care	Records of golden eagles brought in for rehabilitation.	Incidental	2009-2012
Pers. comm.	Tina Bartlett, CDFG Region 2	No information available.	-	-
Pers. comm.	Carie Battistone, CDFG	No information available.	-	-
Pers. comm.	Heather Beeler, USFWS	No information available outside of sources already reviewed.	-	-
Pers. comm.	Marlene Benton, Coordinator, Facility for Animal Care and Treatment	Records of golden eagles brought in for rehabilitation.	Incidental	unknown
Pers. comm.	Rose Britton, Animal Care Director, Sulphur Creek Nature Center[2]	Records of golden eagles brought in for rehabilitation.	Incidental	1994-2012
Pers. comm.	Donna Burt, Director Stanislaus Wildlife Care Center	Records of golden eagles brought in for rehabilitation.	Incidental	2007-2012
Pers. comm.	Kandie Cansler, Independent wildlife rehabilitator	Records of golden eagles brought in for rehabilitation.	Incidental	not stated
Pers. comm.	Nicole Carion, CDFG Wildlife Investigations Lab	2010 Annual report of wildlife rehabilitated in California.	Incidental	2010

Appendix A. Supporting Data for Golden Eagle Fatality Records (continued)

TYPE OF DATA SOURCE	DATA SOURCE	HOW INFORMATION OBTAINED	TYPE OF DATA	YEARS
Pers. comm.	Angela Cistone, Director of Mammal Care, Wildlife Rescue Center of Napa County	Records of golden eagles brought in for rehabilitation.	Incidental	2001-2012
Pers. comm.	Nancy Connie, Director, Sky Hunters	Records of golden eagles brought in for rehabilitation.	Incidental	2012
Pers. comm.	Ali Crumpacker, Director, Fund For Animals	Records of golden eagles brought in for rehabilitation.	Incidental	2010-2012
Pers. comm.	Lisa Culver, Chief Executive Officer, Project Wildlife	Records of golden eagles brought in for rehabilitation.	Incidental	2008-2012
Pers. comm.	Louise Culver, Director, Critter Creek	Records of golden eagles brought in for rehabilitation.	Incidental	2008-2011
Pers. comm.	Dr. Cherie Decker, Medical Director, VCA Crestwood Animal Hospital	Records of golden eagles brought in for rehabilitation.	Incidental	2003-2012
Pers. comm.	Kara Donohue, Southern California Edison	Unable to release records to public.	-	-
Pers. comm.	Judy Everett, Rehabilitation an Education, Wild Wings of California	Records of golden eagles brought in for rehabilitation.	Incidental	1982-2012
Pers. comm.	Dan Fidler, CDFG Region 4	No information available.	-	-
Pers. comm.	Anne Fletcher-Jones, Registrar, Living Desert Zoo & Gardens	Records of golden eagles brought in for rehabilitation.	Incidental	1987-2012
Pers. comm.	Ron Freeman, San Diego Gas & Electric	Unable to release records to the public.	-	-
Pers. comm.	Kari Freidig, Lead volunteer, Gold Country Wildlife Rescue	Records of golden eagles brought in for rehabilitation.	Incidental	2009-2012
Pers. comm.	Vivian Gaddie, Raptor Team Lead, Sierra Wildlife Rescue	Records of golden eagles brought in for rehabilitation.	Incidental	2005-2011

Appendix A. Supporting Data for Golden Eagle Fatality Records (continued)

TYPE OF DATA SOURCE	DATA SOURCE	HOW INFORMATION OBTAINED	TYPE OF DATA	YEARS
Pers. comm.	Marilyn Gamette, Co-Director, Bidwell Wildlife Rehabilitation Center	Records of golden eagles brought in for rehabilitation.	Incidental	1982-2012
Pers. comm.	Sue Hammer, Director, Tehachapi Wildlife Rehabilitation & Education	Records of golden eagles brought in for rehabilitation.	Incidental	not stated
Pers. comm.	Rick Harness, EDM International, Inc.	Provided California-specific numbers from 2001 paper.	-	-
Pers. comm.	Susan Heckly, Wildlife Rehabilitation Director, Lindsay Wildlife Museum[2]	Records of golden eagles brought in for rehabilitation.	Incidental	2005-2012
Pers. comm.	Dr. Vickie Joseph, Lead Veterinarian, California Foundation for Birds of Prey	Records of golden eagles brought in for rehabilitation.	Incidental	2011-2012
Pers. comm.	Karen Kovacs, CDFG Region 1	No information available.	-	-
Pers. comm.	Shannon Lankford, Director, Trinity Wildlife Survival Center	Records of golden eagles brought in for rehabilitation.	Incidental	1990-2011
Pers. comm.	Larry LaPre - BLM	Incidental record reported to BLM by the public.	Incidental	2008
Pers. comm.	Susan Manning, Director of Animal Care, Tri-County Wildlife Care	Records of golden eagles brought in for rehabilitation.	Incidental	1997-2012
Pers. comm.	Nancy Meredith, Co-Director, WRI Wildlife Rescue Center	Records of golden eagles brought in for rehabilitation.	Incidental	1999-2011
Pers. comm.	Lydia Miller, Director, San Joaquin Raptor Rescue Center	Records of golden eagles brought in for rehabilitation.	Incidental	2002-2012
Pers. comm.	Jackie Pealatere, Wildlife rehabilitator, Willits Wildlife Rehab Team	Records of golden eagles brought in for rehabilitation.	Incidental	2008-2012
Pers. comm.	Mary Ellen Rayner, Executive Director, Bird Rescue Center	Records of golden eagles brought in for rehabilitation.	Incidental	2007-2012

Appendix A. Supporting Data for Golden Eagle Fatality Records (continued)

TYPE OF DATA SOURCE	DATA SOURCE	HOW INFORMATION OBTAINED	TYPE OF DATA	YEARS
Pers. comm.	Anna Reams, Executive Director, Wildlife Care of Ventura County	Records of golden eagles brought in for rehabilitation.	Incidental	2010-2012
Pers. comm.	Kristen Reeder, Education Outreach Director, Sonoma County Wildlife	Records of golden eagles brought in for rehabilitation.	Incidental	2012
Pers. comm.	Debbie Richardson, Curator, Moonridge Animal Park	Records of golden eagles brought in for rehabilitation.	Incidental	not stated
Pers. comm.	Don Richardson, Curator, California Living Museum	Records of golden eagles brought in for rehabilitation.	Incidental	2009-2012
Pers. comm.	Amber Rindy, Wildlife rehabilitator, Wildlife Center of Silicon Valley	Records of golden eagles brought in for rehabilitation.	Incidental	2010-2012
Pers. comm.	Sam Rome, Liberty Energy (CalPECO)	Incidental reporting of wildlife incidents.	Incidental	2011-2012
Pers. comm.	Jessica Shipman, Wildlife Center Supervisor, S.P.C.A of Monterey County	Records of golden eagles brought in for rehabilitation.	Incidental	2008-2012
Pers. comm.	Bret Stedman, Operations Supervisor, California Raptor Center	Records of golden eagles brought in for rehabilitation.	Incidental	1980-2011
Pers. comm.	Kim Stroud, Director, Ojai Raptor Center	Records of golden eagles brought in for rehabilitation.	Incidental	2011-2012
Pers. comm.	Dave Thraen, All Wildlife Rescue & Education	Records of golden eagles brought in for rehabilitation.	Incidental	1982-2012
Pers. comm.	Larry VanCantfort, Volunteer, Wild Care	Records of golden eagles brought in for rehabilitation.	Incidental	2007-2012
Pers. comm.	Lenore Will, Independent wildlife rehabilitator	Records of golden eagles brought in for rehabilitation.	Incidental	not stated
Pers. comm.	Brian Woodbridge, USFWS	Provided species-specific numbers from 1993 report.	-	1986-1992

Appendix A. Supporting Data for Golden Eagle Fatality Records (continued)

TYPE OF DATA SOURCE	DATA SOURCE	HOW INFORMATION OBTAINED	TYPE OF DATA	YEARS
Pers. comm.	Jason, Program Lead, Valley Wildlife Care	Records of golden eagles brought in for rehabilitation.	Incidental	2009-2012
Pers. comm.	Karen, CDFG Region 3	No information available.	-	-
Pers. comm.	Lynn, Volunteer, Pacific Wildlife Care – San Luis Obispo	Records of golden eagles brought in for rehabilitation.	Incidental	2012
Pers. comm.	Margie, Manager, Suisun Marsh Natural History Association	Records of golden eagles brought in for rehabilitation.	Incidental	1996-2012
Pers. comm.	Tamar, Volunteer, Pacific Wildlife Care - Morro Bay	Records of golden eagles brought in for rehabilitation.	Incidental	2009-2012

[1] Data from this source may be redundant with other sources, but details are not provided to permit estimation of that proportion.
[2] Fatalities from these sources may be redundant with Smallwood and Karas 2009.
[3] Fatalities from this source are redundant with Sahagun 2012.

Appendix B: Carcass Removal

CALWEA EAGLE MITIGATION OPTIONS: CARCASS REMOVAL

Prepared for the California Wind Energy Association

Prepared by Tetra Tech

November 20, 2012

1 SUITABILITY OF CARCASS REMOVAL AS A MITIGATION OPTION FOR THE DRECP

Programmatic permits for incidental take of eagles under the Bald and Golden Eagle Protection Act require compensatory mitigation for any unavoidable take. In this document, we provide background information, rationale, and a proposed approach for implementing a roadside carcass removal program to decrease eagle-vehicle collision fatalities within the Desert Renewable Energy Conservation Plan (DRECP) as a means of compensatory mitigation for incidental eagle take. For every eagle-vehicle collision prevented, a project-related eagle fatality can be considered offset. This document summarizes what is known about the occurrence rate of collisions between wildlife and vehicles, the use of road-killed wildlife by golden eagles, and the occurrence rate of collisions between vehicles and eagles using road-killed wildlife. It evaluates the DRECP for key factors likely to influence the success of a carcass removal program (e.g., the distribution and density of eagles, distribution and occurrence rate of carcasses of road-killed wildlife, type of carcasses, etc.). Based on these lines of evidence and the data currently available, we believe that there is potential for a carcass removal program to be viable as a mitigation approach in the DRECP. USFWS appears to consider it as a potentially acceptable mitigation option because it was presented as an example of compensatory mitigation in the revised technical appendices to the Draft ECP Guidance (USFWS 2012).

2 BENEFITS TO EAGLES OF CARCASS REMOVAL

Golden eagles are at risk of collision with vehicles when they forage along roadsides upon carcasses of road-killed wildlife (see Section 3 below). This source of eagle injury and fatality may be addressed by removing carcasses from selected roadsides, which would reduce the risk of vehicles colliding with eagles feeding upon those carcasses. The reduction in number of eagles injured or killed in vehicle collisions equates to the number of project-related eagle fatalities offset.

3 INFORMATION ON EAGLE FATALITIES ASSOCIATED WITH VEHICLE STRIKES

Vehicle strikes account for approximately five percent of golden eagle deaths from known anthropogenic causes in the U.S., and five percent within California (Tetra Tech 2011 and unpub. data; Table 1). However, these data are primarily incidental records and therefore underestimate the number of golden eagle fatalities caused by collisions with vehicles.

Table 1. Golden Eagle Vehicle Strike Data from California

AUTHOR	YEARS	VEHICLE STRIKE	TYPE OF OBSERVATION	GEOGRAPHIC AREA	TYPE OF OBSERVATION
Hunt 2002	1998-2001	4	Radio telemetry	Altamont Pass, California	Systematic
USGS 2012	1960-2012	11[1]	Band returns	California	Incidental
Larry LePre, BLM[2]	2008	1	Incidental report to BLM	California	Incidental
California Roadkill Observation System (CROS) Database	2008-2012[2]	2	Volunteer observation	California	Incidental
Caltrans	1965-2008	3	Volunteer observation	California	Incidental

[1] Includes five confirmed road-killed golden eagles and six found dead on highways.
[2] Personal communication from Dr. Larry LaPre, Wildlife Biologist at the BLM on March 13, 2012.

There are data available on eagle-vehicle collisions from wildlife rehabilitators (Table 2); however, these records represent a subset of all collisions because only individuals surviving the initial collision receive treatment. California wildlife-rehabilitation facilities admitted 38 golden eagles in 2010 according to the California Department of Fish and Game (N. Carion, CDFG, pers. comm. 2012). Although causes of admittance are not tracked by CDFG, communication with individual rehabilitators suggests the majority were likely injured by collision or other unknown trauma (Tetra Tech unpub. data). Additionally, wildlife rehabilitation facilities report that they have admitted 26 golden eagles over various timeframes due to injuries specifically caused by vehicle strikes (Table 2; Tetra Tech unpub. data).

Table 2. Number of Golden Eagles Injured by Vehicle Strikes Admitted to California Wildlife Rehabilitation Facilities[1]

REHABILITATION FACILITY	LOCATION	NUMBER OF EAGLES STRUCK BY VEHICLES	TOTAL NUMBER OF GOLDEN EAGLES ADMITTED	TIMEFRAME
Critter Creek Wildlife Station	Squaw Valley	2	7	2008-2012
Lenore Will	Yucaipa	1	2	Unknown
Lindsay Wildlife Museum	Walnut Creek	2	40	2005-2012
Pacific Wildlife Care – Morro Bay	Morro Bay	1	9	2009-2012

Table 2. Number of Golden Eagles Injured by Vehicle Strikes Admitted to California Wildlife Rehabilitation Facilities (continued)

REHABILITATION FACILITY	LOCATION	NUMBER OF EAGLES STRUCK BY VEHICLES	TOTAL NUMBER OF GOLDEN EAGLES ADMITTED	TIMEFRAME
SPCA of Monterey County	Monterey	1	6	2005-2011
Sierra Wildlife Rescue	Placerville	1	3	2008-2012
Tri-County Wildlife Survival Center	Jackson	1	2	1998-2012
VCA Crestwood Animal Hospital	Ridgecrest	1	1	2004-2012
WRI Wildlife Rescue Center	Fort Jones	16	29	1999-2011

[1]Data provided directly from wildlife rehabilitation centers (Tetra Tech unpub. data)

4 PROPOSED CARCASS REMOVAL PROGRAM FOR THE DRECP

Given that golden eagles are susceptible to fatality from vehicle collisions while foraging on road-side carcasses, removal of road-killed wildlife carcasses can reduce eagle fatalities from vehicle collisions. In order to evaluate the effectiveness of a carcass removal program within the DRECP region, it is necessary to translate the carcass removal effort (e.g., miles of road where carcasses are removed) into the number of project-related eagle fatalities offset. A stepwise process is presented for this translation which outlines the existing information available, any assumptions used where data are lacking, and the confidence level of the information at each step (Table 3).

Table 3. Summary of Steps to Calculate the Number of Eagles Saved per Unit of Road Where Carcasses are Removed

STEP	METRIC	UNITS	CERTAINTY
Step 1	Location of area to be targeted for mitigation	-	Moderate – based on golden eagle occurrence and habitat data available specific to the DRECP. Mostly qualitative information on locations of carcasses based on California roadkill databases
Step 2	Annual rate of carcasses occurrence	per mile per year	Moderate - can be substantiated with real data, although data may not be location specific.
Step 3	Carcasses available for eagles	total carcasses per year	Moderate - can be substantiated with real data, although data may not be location specific.
Step 4	Percent of carcasses with eagles	percent	Low – no data to substantiate, limited to expert opinion.
Step 5	Number of eagles per carcass	eagles per carcass	Low – based on expert opinion, anecdotal evidence.
Step 6	Number of eagles using carcasses	eagles using carcasses per year	Low to moderate - calculation based on other data with low to moderate confidence.
Step 7	Percent of eagles using carcasses involved in vehicle collisions	percent	Low - no data to substantiate, limited to expert opinion.
Step 8	Number of eagles that would be involved in vehicle collisions	eagle-vehicle collision fatalities prevented per year	Low - calculation based on few records of eagle collisions
Step 9	Miles of road to be used for carcass search/removal implementation	Miles of carcass removal in a year to offset one eagle fatality	Low to moderate – based on certainty of previous steps

4.1 LOCATION OF AREA TO BE TARGETED FOR MITIGATION (STEP 1)

Identifying the location of carcass removal efforts requires overlaying information on eagle distribution and use with information on carcass occurrence.

4.1.1 Golden Eagle Distribution and Use

Information on golden eagle distribution and use within the DRECP region is somewhat limited. Most eagles within the DRECP are year-round residents, but may move downslope for winter or upslope after the breeding season (Polite and Pratt 1990). The southern-most desert regions are generally occupied by golden eagles only during the winter, while the remaining portions of the DRECP region are used by golden eagles year-round (Harlow and Bloom 1989, Kochert et al. 2002). This information can be refined using breeding population density estimates from studies of golden eagles elsewhere in California. A study of golden eagles near Altamont Pass in central California revealed high breeding densities with one breeding pair per 49 square miles (Hunt et al. 1999). In comparison, studies by Bittner and Meador (2011) revealed density ranges from one pair per 36 square miles in western San Diego County to one pair per 62 square miles in the eastern portion of the county. These values may be adjusted for the DRECP based on knowledge of related factors (e.g., breeding habitat availability within the DRECP) and expert opinion to estimate the distribution and use of golden eagles within the DRECP.

4.1.2 Carcass Occurrence

Carcass occurrence rates within areas of golden eagle use must be determined to identify those locations with the greatest potential for eagle-vehicle collisions, and hence the most effective mitigation. The sections below summarize published carcass occurrence rates for various species across the country (Table 4) and highlight information specific to California and the DRECP region.

4.1.2.1 Vehicle and Wildlife Collisions

In general, wildlife collision rates vary (Table 4), but collisions are most likely to happen at night, on paved, unfenced primary roads that are open to the public where roads cross migration corridors (Gleason and Jenks 1993, Forman and Alexander 1998, Gunther et al. 1998, Kline and Swann 1998, Dussault et al. 2006, Grovenburg et al. 2008, McShea et al. 2008, Myers et al. 2008). Although golden eagles are likely to be attracted to all but the smallest road-killed carcasses (e.g., songbirds, mice, rats), they are more likely to remain on the roadside to feed on carcasses too large to carry off (e.g., ungulates); however, there are at least two records of golden eagles feeding on small- to medium-sized mammal carcasses from the road, one of which resulted in an eagle fatality (C. Farmer, pers. comm. 2012, CROS 2012).

Roadkill occurrence rates may vary throughout the year, with seasonal trends affected by species and location. For example, a study of medium-sized mammal roadkill occurrence in California found no seasonal patterns in occurrence rates (Caro et al. 2000), whereas studies of roadkilled mammals in New York and in the Great Plains found that roadkill occurrence rates peaked in the spring (Smith-Patten and Patten 2008, Barthelmess and Brooks 2010). For ungulates specifically, most collisions occur during the fall rut in areas where ungulate density is highest (Dussault et al. 2006, Bissonette et al. 2008, Grovenburg et al. 2008, McShea et al. 2008, Myers et al. 2008).

Table 4. Summary of Wildlife-Vehicle Fatality Rates in the U.S.

AUTHOR	FOCAL SPECIES	STATE	WILDLIFE KILLS
Barthelmess and Brooks 2010	All mammals	New York	6.13 fatalities/mile[1]
Bissonette and Kessar 2008	Deer	Utah	0.84 fatalities/mile/year
Caro et al. 2000	Medium-sized mammals	California	0.019 fatalities/mile[1]
Craighead et al. 2009	Deer, elk, moose	Montana	10.9 large mammal fatalities/mile/year
Dodd and Gagnon 2010	Elk	Arizona	1.10 elk fatalities/mile[1]
Gleason and Jenks 1993	Deer	South Dakota	10.2 fatalities/mile[1]
Grovenburg et al. 2008	Deer	South Dakota	1.32 fatalities/mile/year
Gunther et al. 1998	Bison, moose, antelope, white-tailed deer, black bear	Wyoming	0.44 large mammal road fatalities/mile/year
Kline and Swann 1998	All vertebrates	Arizona	11.5 fatalities/mile/year and 6.0 fatalities/mile/year (depending on location)
Myers et al. 2008	Deer	Washington	0.19 fatalities/mile/year (eastern) 0.63 fatalities/mile/year (western)
Smith-Patten and Patten 2008	All mammals	Great Plains States	0.14 fatalities/mile[1]
Wakeling et al. 2008 (reviewed in Gagnon et al. 2009)	Bighorn sheep	Arizona	2.1 fatalities/mile/year

[1]Rates originally presented in kilometers (km).

4.1.2.2 Carcass Occurrence Within the DRECP Region

Few studies have been conducted on wildlife-vehicle collision in California, and data on the occurrence of road-killed wildlife that may attract golden eagles to roadsides in California are limited to incidental records. There are two sources of data available: the California Roadkill Observation System (CROS) from the University of California Davis (UCD) Roadside Ecology Center, and the California Department of Transportation (Caltrans; F. Shilling, UCD, pers. comm. 2012; Table 5). The CROS program is working on collecting data from standardized transects to provide carcass occurrence rates, but is still at the early stages of this effort (CROS 2011). In the absence of carcass occurrence rates within the DRECP region, incidental data along with published rates from other regions (Table 4) can be used to develop estimates of carcass occurrence rates.

Table 5. Number and Type of Carcasses Recorded by CROS and Caltrans in Counties within the DRECP Region

COUNTY	NUMBER OF CARCASSES RECORDED		SPECIES RECORDED
	CROS (2008-2012)	CALTRANS (1965-2008)	
Imperial	7	Unknown	Data currently unavailable
Inyo	614	76	Jackrabbits, cottontails, deer, elk
Riverside (eastern only)	40	Unknown	Data currently unavailable
San Bernardino	49	3	Coyotes, bighorn sheep, squirrels, kangaroo rats, 2 mountain lions, 1 tortoise

Data from both CROS and Caltrans are likely biased due to a number of factors. Roadside carcasses will be undercounted because they are incidentally reported. This undercounting is likely exacerbated in remote areas, on less-frequently traveled roads, or for smaller, less-visible species. Additionally, CROS has more data on carcasses in areas where there are more volunteers, which correlates to more densely populated areas, as well as areas where there is a greater interest in recording roadkill (e.g., park employees at Death Valley National Park in Inyo County). Therefore, these data should be treated as the minimum number of carcasses and species diversity available and are likely a significant underestimate of the actual number of carcasses. Nonetheless, these data may be useful in deriving the most likely locations for intersections between eagle use and hot spots of carcass occurrence. For example, a recent study by Wilson (2012) examined occurrences of carcasses in counties of southern California using incidental reports from 1994 to February 2012. Several hotspots of carcass occurrence were revealed, including one within the DRECP region and one less than 10 miles outside the DRECP region (Wilson 2012). Additionally, habitat associations with carcass occurrence were examined, revealing frequent occurrence within desert shrub habitat (Wilson 2012), which is the dominant habitat type within the DRECP. This provides useful information for targeting carcass removal efforts within the DRECP. Funding of systematic road surveys within eagle use areas of the DRECP region can further inform selection of these high eagle-vehicle collision risk areas, and can be used to evaluate assumptions used in carcass occurrence rate estimates.

4.2 ANNUAL RATE OF CARCASS OCCURRENCE (STEP 2)

In order to calculate the number of golden eagles saved, the number of carcasses must be converted to an annual per-mile rate. In the absence of specific roadkill rates for the DRECP region, a conservative assumption would be that the rate of occurrence of carcasses that would attract a golden eagle occurs at the low end of the rates in Table 4 (0.02 carcasses per mile per year). Summary data from the CROS database indicates that over 14,000 carcasses were reported statewide over more than 12,000 km of roads (7,456 miles) over a two-year time span. This would generate a conservative estimate of 0.6 carcasses per km per year, or 1 carcass per mile per year. We have moderate certainty in these values because limited location or species-specific comparable values are available, and the CROS data is strictly incidental. This assumption could be tested using systematic road surveys funded in addition to carcass removal within the DRECP.

4.3 TOTAL CARCASSES AVAILABLE FOR EAGLES (STEP 3)

The annual occurrence rate of carcasses per mile (Step 2) would be multiplied by the number of miles of road on which carcasses are removed in order to calculate the total number of carcasses per year that are available along roadsides to eagles. We have moderate certainty in this value because limited location or species-specific comparable values are available.

4.4 PERCENTAGE OF CARCASSES ATTENDED BY EAGLES (STEP 4)

Of those carcasses available to eagles per year (Step 3), it is necessary to determine the percentage used (i.e., fed upon) by eagles. Eagle researchers within California and other desert habitats could be contacted to estimate a range of the proportion of carcasses along roads that are attended by eagles depending on the time of year, the location of the carcass, the availability of live prey, and other variables. We would have low certainty in this value because the information would be anecdotal, and there are multiple variables that could change the probability that an eagle uses a carcass.

4.5 NUMBER OF EAGLES PER CARCASS (STEP 5)

Of those carcasses attended by eagles (Step 4), it is necessary to determine how many eagles are present per carcass. Eagle researchers within California could be contacted to estimate how many eagles may be present at a single carcass. We would have low certainty in this value because information would be anecdotal.

4.6 NUMBER OF EAGLES USING CARCASSES (STEP 6)

The number of carcasses available to eagles (Step 3) is multiplied by the percentage of those carcasses attended by eagles (Step 4), the product of which is then multiplied by the number of eagles per carcass (Step 5) to estimate the number of eagles that may attend roadkills in the target area annually. We have low to moderate certainty in this value because it is based on calculations using other low to moderate values.

4.7 PERCENTAGE OF EAGLES ON CARCASSES THAT HAVE A VEHICLE COLLISION (STEP 7)

Although there are data available on eagle-vehicle collisions in California, all are incidental. To supplement this data gap, eagle researchers could be contacted to estimate what percentage of eagles that are feeding on roadside carcasses (Step 6) would likely have a vehicle collision. We would have low certainty in this value because collision records are incidental, and expert opinions would likely be based on anecdotal observations.

4.8 TOTAL NUMBER OF EAGLES THAT WOULD HAVE BEEN STRUCK BY VEHICLES (STEP 8)

To estimate the number of eagles that would be saved by the carcass removal program, the number of eagles using carcasses (Step 6) is multiplied by the percentage of eagles feeding on carcasses involved in a vehicle collision (Step 7). We have low certainty in this value because multiple data points used in this calculation were based on interpreting incidental observations.

4.9 MILES OF ROAD TO BE TARGETED FOR MITIGATION (STEP 9)

In order to estimate the number of project-related eagle fatalities offset by a carcass removal program, it is necessary to translate the number of eagle-vehicle collision fatalities avoided into the number of miles of roads on which the program would be implemented. The number of miles targeted for carcass removal would be determined based on the estimated number of eagle fatalities to be mitigated and the logistics of implementing the removal program. Carcass removal may be focused to specific seasons or months if additional data on roadside fatalities and eagle use suggest an increased benefit at specific times of year (see Section 4.1.2.1). Although a California study found no seasonal patterns in roadkill occurrence rate (Caro et al. 2000), systematic road surveys within the DRECP region may reveal region- or species-specific differences, and could be used to adaptively manage the carcass removal program. We have low to moderate certainty in this value because it is based on calculations using other low to moderate values.

5 NECESSARY CARCASS REMOVAL PROGRAM ELEMENTS

Implementing a carcass removal program would be relatively straightforward once the specific locations and mileage of roads are selected for implementation. The various elements necessary to implement the program and how they might be broken down by cost are identified below.

- Field staff to drive selected roads to remove carcasses (hourly wage + mileage per season);
- GPS units to record carcass locations (one time per unit cost);
- Data management and report preparation (hourly wage per season and report frequency);
- Applicable federal, state, and local permits to collect, move or dispose of carcasses (annual permit fees and reporting costs); and
- Optional: field staff to drive selected roads to survey eagle use (hourly wage + mileage per season).

6 POTENTIAL OBSTACLES TO SUCCESS OF CARCASS REMOVAL PROGRAM

There are various potential hurdles present that affect the success of a carcass removal program being used as mitigation for eagle fatalities. These are identified below, along with what may be done to surmount these obstacles.

- Data on golden eagle distribution and use within the DRECP region are somewhat limited. Renewable energy projects with golden eagle survey data within the region may share results for a collaborative research and mitigation efforts. Information from Bureau of Land Management (BLM) research on nesting locations may be used if publically available. Assumptions about eagle use of an area can be included in an adaptive management framework and tested by conducting roadside or other types of surveys.
- Systematic data on carcass occurrence rates are not currently available, and incidental data are unsuitable for calculating rates of occurrence. However, specific hotspots of

wildlife collisions within and near the DRECP have been identified (Wilson 2012), and data from systematic index road surveys may be forthcoming from the CROS (2011). It is unlikely that the CROS data would be specific to the DRECP region, but they may still provide useful context. Because assumptions about carcasses removal rates are easily testable once the program is implemented, uncertainty in this topic can be managed through adaptive management.

- Data on use of road-killed carcasses by golden eagles, as well as eagle-vehicle collision rates, within the DRECP are unavailable. This assumption would be based on expert opinion and is challenging to test without exposing the eagles to risk from collisions. Eagle use surveys concurrent with carcass removal efforts may help to address this knowledge gap, and adaptively manage the carcass removal program.
- Costs will need to be developed and would depend on the lead organization (possibly CDFG or the UCD Roadside Ecology Center). Costs may change over time depending on results from testing assumptions during the adaptive management process.

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Appendix C: Lead Abatement

CALWEA EAGLE MITIGATION OPTIONS:

LEAD ABATEMENT

Prepared for the California Wind Energy Association

Prepared by Tetra Tech

November 20, 2012

1 SUITABILITY OF LEAD ABATEMENT AS A MITIGATION OPTION FOR THE DRECP

Programmatic permits for incidental take of eagles under the Bald and Golden Eagle Protection Act require compensatory mitigation for any unavoidable take. In this document, we provide background information, rationale, and a proposed approach to implementing a lead abatement program within the DRECP region as a means of compensatory mitigation for incidental eagle take. It summarizes what is known about the effects of lead on eagles, the prevalence of lead poisoning in eagles, and the effectiveness of similar lead abatement programs for raptors, and evaluates the DRECP region for key factors likely to influence the success of the program (e.g., eagle population, eagle behavior, use of lead bullets, types of hunting, etc.). Based on these lines of evidence, we identify the reduction or elimination of lead-based ammunition for non-game and upland game bird hunting and the improvement of carcass handling/disposal practices by hunters as the most effective means of reducing lead exposure of golden eagles in the DRECP. Results of lead abatement programs elsewhere in California suggest that substantial reductions in lead exposure can be achieved in a short time by such an approach. Recent successes in other lead abatement programs and the relatively high rate of lead exposure of eagles within the DRECP suggest that a well-designed program of lead abatement can be an effective means of offsetting eagle take by renewable energy projects. In addition, the USFWS has recognized that lead-poisoning in eagles is an issue of concern (B. Millsap, USFWS, 2012 pers. comm.), and would likely consider lead mitigation a viable option.

2 EFFECTS OF LEAD ON GOLDEN EAGLES

Since the 1960s, lead has been known to have detrimental effects on golden eagles and other birds of prey (Wayland et al. 2003). Lead is a known immuno-, neuro-, and nephrotoxin, with acute levels of lead known to cause direct mortality through organ and tissue damage and paralysis (Redig et al. 1983, Church et al. 2009). However, even sub-lethal concentrations of lead can cause behavioral changes and impair digestion, hunting, and feeding (Wayland et al. 2003). Clinical signs of lead toxicity in raptors include lethargy, vomiting, diarrhea, anemia, anorexia, blindness, and seizures (Parish et al. 2007). Thus, sub-lethal lead concentrations are thought to increase an individual's susceptibility to disease, starvation, predation, trapping, and collision, although this hypothesis has not been empirically tested (Wayland 2003, Pain et al. 2009, Kelly et al. 2011). This may explain why lead exposure is commonly found among bald and golden eagles admitted to rehabilitation facilities where the primary reason for admission was miscellaneous trauma (Kramer and Redig 1997). Because lead poisoning is not readily apparent (i.e., requires testing), and eagle mortality as an indirect result of lead poisoning is difficult to quantify, the impacts of lead poisoning may be more severe than currently realized (NAGESM 2010).

The primary sources of lead exposure to golden eagles are in the form of embedded lead shot or fragmented bullets ingested from carcasses of game animals wounded or killed with lead-based ammunition (Pain et al. 2009, Stauber et al. 2010). Lead absorption rate, or the rate at which the source of lead is broken down within the body, varies among individuals and species, and also depends on the amount of lead ingested and the surface area of the fragments (Pattee et al. 1981, Johnson et al. 2007).

3 QUANTIFYING LEAD IN AN INDIVIDUAL OR POPULATION

Lead exposure can be assessed by measuring the amount of lead present in the body. Concentrations of lead may be measured within blood, bone, growing feathers, and liver and kidney tissues using a variety of techniques. Making comparisons among studies is challenging because there is variation both within and among techniques for measuring lead (Redig et al. 1983, Bedrosian et al. 2009). Definitions of lead exposure or lead concentrations vary among species and among studies, but are generally categorized as baseline/background, elevated exposure, or severe/acute (Table 1).

Blood, liver, and kidney all reflect recent exposure to lead. Although the rate of elimination of lead (depuration rate) from these tissues is unknown for golden eagles specifically, elevated lead levels detected in a golden eagle are believed to indicate exposure to lead in the previous 3-4 weeks (Johnson et al. 2007). In contrast, lead is absorbed more slowly into tissues like muscle and bone; therefore, neither is useful in indicating recent lead exposure (Wayland et al. 1999), although bone can indicate lifetime lead exposure (Gangoso et al. 2009). Because lead signatures in feathers are representative of conditions during feather growth (Church et al. 2006), feathers are only useful for current lead exposure if they were actively growing when they were removed from the bird.

Metrics to assess lead in a given population generally include: 1) mean lead concentration of individuals in a population, 2) lead exposure prevalence (proportion of individuals with above-background lead exposure), and 3) lead-based mortality rate (number of individuals confirmed to have died due to lead poisoning over a given period).

Table 1. Categories of Lead Concentration in Golden Eagles

TYPE OF SAMPLE	BACKGROUND OR BASELINE EXPOSURE	ELEVATED EXPOSURE		SEVERE OR ACUTE EXPOSURE	SOURCE
		SUBCLINICAL	CLINICAL		
Blood[1]	<0.20 ppm	0.20-0.60 ppm	0.61-1.0 ppm	>1.0 ppm	Redig et al. 1983, Bloom et al. 1989, Domenech et al. 2009, Stauber et al. 2010, Kelly et al. 2011
Liver[2]	<6 ug/g dry wt	6-30 ug/g dry wt		30 ug/g dry wt	Wayland et al. 2003
Kidney[2]	<6 ug/g dry wt	6-20 ug/g dry wt		20 ug/g dry wt	Wayland et al. 2003

[1]Levels of lead in blood (weight per volume) may be measured in ug/mL or in ppm (parts per million) which are equivalent measures. 1 ug/mL is equivalent to 100 ug/dL.
[2]Levels of lead in liver and kidney tissues (weight per weight) may be measured in ug/g or in ppm which are equivalent measures; dry weight or wet weight may be used.

4 EFFECTS OF LEAD ON OTHER WILDLIFE

Many other avian species are susceptible to lead poisoning from ammunition, including gulls, owls, raptors (e.g., falcons, hawks, vultures), songbirds (e.g., sparrows), upland game birds (e.g., chukar, doves, grouse, turkey), waterbirds (e.g., coots, cranes, rails) and waterfowl (e.g., ducks, geese, swans; Pain et al. 2009). Waterfowl, upland game birds, and songbirds ingest

lead shot and bullet fragments directly while foraging, particularly near shooting ranges and clay-pigeon shoots where large amounts of lead are introduced into the surrounding ecosystems (Fisher et al. 2006). Lead shot was banned for waterfowl hunting in 1991 as waterfowl and geese would ingest lead shot that had settled to the bottom of lakes and ponds to assisting in grinding food. Ingestion of as little as one piece of lead shot or bullet fragment had been reported to cause mortality to bald eagles, California condors, loons, and mourning doves (Lahner and Franson 2009). When predators consume poisoned prey items they become poisoned in turn.

California condors are particularly susceptible to lead poisoning due to a combination of high lead exposure and high lead absorption rate, and most condors in California have been repeatedly exposed to lead in the wild (Fry et al. 2009). Lead poisoning from ingestion of spent ammunition found within carcasses is the most frequent cause of death of condors (Parish et al. 2007, Hunt et al. 2009), and the primary obstacle to the recovery of this endangered species. Lead chelation therapy for lead-poisoned individuals in conjunction with intensive monitoring and capture programs has been instrumental in increasing survival rates of free-ranging condors (Parish et al. 2009; see also Section 5.2). Concern for this species has led to both mandatory and voluntary lead abatement programs in California and Arizona (see below).

5 EFFECTIVENESS OF LEAD ABATEMENT PROGRAMS ON RAPTOR SPECIES

5.1 PROGRAM TYPE: MANDATORY FOCAL SPECIES: BALD AND GOLDEN EAGLES

A retrospective study by Kramer and Redig (1997) was performed to assess differences in prevalence of lead poisoning in U.S. bald and golden eagles from 1980 to 1995. The study encompassed the period before and after the mandatory federal ban on lead shot for waterfowl hunting. Based on 138 cases of lead-poisoned eagles accepted to the Raptor Center at the University of Minnesota, the prevalence of lead poisoning did not change after the ban, but mean blood lead concentrations decreased. Thus, although lead exposure continued, lead toxicity declined. Given that most eagles originated in Wisconsin and Minnesota, which had statewide bans on lead shot for waterfowl hunting since 1987 and had high hunter compliance rates, the authors concluded that lead found in eagles wintering in these states must have been obtained from food sources other than waterfowl. This study was one of the first to suggest that waterfowl are not the primary sources of lead exposure to eagles.

5.2 PROGRAM TYPE: VOLUNTARY FOCAL SPECIES: CALIFORNIA CONDOR

In Arizona starting in 2005, a voluntary program to use non-lead (i.e., non-toxic) ammunition for big-game hunting was implemented within the seven game management units (GMU) occurring within the California condor range (Sieg et al. 2009). The program included non-toxic ammunition provided at no cost to hunters that drew game tags in three of the GMUs nearest the condor release site, and a public education campaign for hunters drawing big-game tags in four of the other GMUS within the condor range for the 2005 and 2006 big-game seasons. Although participation was 50-60% in these seasons, the corresponding reduction of lead-laden carrion did not reduce condor lead exposure. Lead exposure prevalence was 52% (29/56

individuals) in 2005 and 95% (54/57) in 2006 compared with 81% (35/43) in 2004, and there were 2 and 3 confirmed lead toxicity fatalities in 2005 and 2006, respectively compared to 0 in 2004 (Parish et al. 2009). Increased lead abatement program efforts in 2007 included articles in sportsman's magazines, distribution of an educational DVD and brochure, increased field communication, and added incentives for offal pile retrieval. There was a reported 80% compliance rate in 2007. During the 2007 season, no lead toxicity fatalities of condors occurred and the lead exposure rate decreased to 82% (50/59) of condors (Parish et al. 2009). The reduction in lead exposure was less than expected likely due to increasing use by condors of southern Utah regions where lead ammunition is still used; there are plans to expand the program into this area in the near future (Sieg et al. 2009). A related study by Green et al. (2008) used data on movements and blood lead levels of condors in the same region from 2005 to 2007 to model the distribution of blood lead levels and estimate mortality rates, with and without the lead abatement program. The results suggest that if the program were to cease, the condor annual rate of mortality caused by lead would increase to 20.6%, causing drastic population declines. Effectiveness of the program at reducing lead exposure in other species was not assessed.

5.3 PROGRAM TYPE: MANDATORY FOCAL SPECIES: GOLDEN EAGLE AND TURKEY VULTURE

A study was conducted by Kelly et al. (2011) which sampled golden eagles and turkey vultures in the range of the California condor prior to and one year after the mandatory lead ammunition ban for hunting of big-game and non-game species (Ridley-Tree Condor Preservation Act). Given elimination rates of lead from blood in other large birds, it was assumed that above-background lead levels found in birds captured after the ban reflected post-ban exposure to lead. Their results revealed a statistically significant decrease in lead levels in golden eagles post-ban, with the prevalence of above-background lead exposure (> 0.10 ppm) decreasing from 76% pre-ban (13/17 individuals) to 32% post-ban (12/38 individuals). When restricted to non-migrants eagles (residents), prevalence was reduced from 85% pre-ban (5/6) to 0% post-ban (0/9). Non-migrant eagles had blood lead levels 2.5 times lower than eagles of unknown residency. Blood lead concentrations were higher in adults than subadults, although foraging behavior did not appear to differ between these groups. Turkey vultures were found to have an even greater decline in lead levels post-ban from 61% prevalence pre-ban (23/38 individuals) to 9% prevalence post-ban (3/33 individuals). The ammunition ban appeared to be effective at reducing blood lead levels in both golden eagles and turkey vultures, even during the first year when participation and availability of non-toxic shot may have been limited. Hunting rates were consistent throughout the study, however, hunting in the study site (Tejon Ranch, Kern County) was highly monitored by game officials, and compliance with the ban may be lower elsewhere.

5.4 PROGRAM TYPE: VOLUNTARY AND MANDATORY FOCAL SPECIES: STELLAR'S SEA-EAGLE AND WHITE-TAILED EAGLE

The Eagle Lead Poisoning Network (Network) civic group was formed in 1998 to prevent lead poisoning of Stellar's sea eagle and white-tailed eagle on the island of Hokkaido, Japan (Saito 2009). The Network initiated various mitigation efforts including: research on the effects of lead on eagles, a volunteer program to remove and dispose of abandoned deer carcasses, educational outreach, and funding for non-toxic ammunition and reloading equipment.

Beginning in 2000,the Hokkaido government instituted increasingly restrictive lead regulations for Sika deer and other big-game hunting and also provided drop boxes for unwanted remains during the hunting season. Actions of the Network and the Hokkaido government resulted in far fewer carcasses left behind by hunters and fewer eagles found dead from lead poisoning (maximum of 10 dead eagles annually post-ban compared to 26 pre-ban); however, eagle fatalities are found incidentally and numbers may be biased.

5.5 PROGRAM TYPE: UNDETERMINED FOCAL SPECIES: WHITE-TAILED SEA EAGLE

In Germany, development of a lead abatement program is underway to reduce lead exposure in the white-tailed sea eagle (Krone et al. 2009). An interdisciplinary approach is being used to work with stakeholders to reach a solution. Three expert talks/workshops have been held, the results of which have included: 1) agreement by stakeholders that lead intoxication of white-tailed sea eagle was caused by ingestion of lead-containing bullet fragments, and 2) agreement that action was necessary to reduce lead poisoning in the white-tailed sea eagle. Obstacles identified included the prohibitive cost of non-toxic ammunition and the negative response to the idea of legal regulation. The program has yet to be finalized and implemented, and it is unknown whether it would be voluntary or mandatory.

6 PROPOSED LEAD ABATEMENT PROGRAM FOR DRECP

There are multiple options for lead abatement efforts for golden eagles in the DRECP region. We present the most practical alternatives based upon existing research on golden eagles and related studies, along with implementation steps, metrics with which to measure success, ballpark costs, and pros and cons.

6.1 ECOLOGY OF EAGLES IN THE DRECP

6.1.1 Migrants vs. residents

Lead abatement programs have the greatest benefit to resident birds. Golden eagles are present year-round in much of the DRECP region, although some areas are thought to be populated only during the winter (Kochert et al. 2002). Based on telemetry data of golden eagles captured as nestlings in southern California, there are likely both resident and migrant eagles present within the DRECP region (Bittner and Meador 2011).

6.1.2 Food resources

Across its range, golden eagle food resources primarily consist of small mammals or non-game species (e.g., coyote) and secondarily of upland game birds; however, they are also known to feed opportunistically on carcasses (Kochert et al. 2002). Preying or scavenging upon these animal species may expose golden eagles to lead if the prey items were shot, or had ingested lead directly or indirectly in lead-contaminated prey items. As mentioned in Section 4, upland gamebirds are known to ingest lead directly while foraging (Lahner and Franson 2009), and shot coyotes are known to be a source of lead to scavengers (Stauber et al. 2010). Although hunters often remove upland game birds that they have shot, there are many killed or injured birds that are left unfound, and carcasses from non-game hunting (e.g., coyotes, ground-squirrels, rabbits) are usually left behind intact or skinned (J. Garcia CDFG, pers. comm. 2012). These unfound carcasses and remains potentially provide sources of lead for ingestion by eagles. Sub-lethally

injured animals and offal piles from hunting of these species also provide potentially lead-laced forage for eagles.

6.2 INSIGHTS FROM CALIFORNIA CONDOR RESEARCH

Although California condors differ from golden eagles in many aspects, research associated with condor recovery efforts provides information on sources of lead availability within and near the DRECP region. Three populations of California condor in California, Arizona and Utah, and Baja California are supported by releases of condors at reintroduction sites. When lead-poisoning was revealed in 2000 as an important source of condor mortality, a regular monitoring program was initiated which measured blood-lead levels of condors recaptured at California release sites (Parish et al. 2007, Hunt et al. 2009). A summary of condors sampled and the proportion which had above-background blood-lead concentrations showed that condors captured in central and southern California regularly had above-background lead levels (Table 2). These results may be an underestimate of blood-lead levels in the population as only live individuals were sampled, and only bi-annually (Finkelstein et al. 2012) thus excluding individuals that died of lead-poisoning. Furthermore, condor carcasses are often not recovered due to the rugged landscape in which they inhabit, and therefore cannot be tested for lead toxicity (USFWS 2012, Rideout et al. 2012). Lead poisoning in condors is thought to be more prevalent in areas that have higher numbers of hunters or in areas where hunters do not use non-toxic ammunition (Sorenson and Burnett 2007, Hunt et al. 2009).

Elevated blood-lead concentrations in condors captured in both central and southern California release sites indicate that lead-contaminated carcasses are present within the current condor foraging range (Table 2). This range overlaps with the DRECP region; therefore, a logical extension follows that lead poisoning in golden eagles is likely to be problematic within the DRECP region.

Table 2. Summary of Blood-Lead Concentrations in Recaptured Free-flying California Condors

STATE	CONDOR CAPTURE LOCATION[1]	CALIFORNIA COUNTIES	SAMPLES COLLECTED	CONDORS TESTED	YEARS SAMPLED	TIME OF RECAPTURES	BACKGROUND LEVEL	REPORTED AMOUNTS ABOVE BACKGROUND	PERCENT SAMPLES ABOVE BACK-GROUND	SOURCE
AZ/ UT	Arizona: Vermilion Cliffs, Colorado River Corridor, Kaibab Plateau; Utah: Kolob Region	-	437	-	2000-2004	Year-round	>15 ug/dL	15-60+ ug/dL	40	Parish et al. 2007, Hunt et al. 2007
CA	Pinnacles National Monument	Monterey, San Benito	63	24	2003-2007	Year-round	>20 ug/dL	20-100 ug/dL	44	Petterson et al. 2009
CA	Central and Southern	Kern, Monterey, San Benito, San Luis Obispo, Shasta, Ventura	1154	150	1997-2010	Year-round	≥10 ug/dL	-	71	Finkelstein et al. 2012
CA	Big Sur	Monterey	126	33	1998-2006	Year-round	>20 ug/dL	20-100 ug/dL	26	Sorenson and Burnett 2007
CA	Central and Southern	Kern, Monterey, San Benito, San Luis Obispo, Shasta, Ventura	148	72[2]	2008	January to June	>10 ug/dL	11-50+ ug/dL	59	USFWS 2009
CA	Central and Southern	Kern, Monterey, San Benito, San Luis Obispo, Shasta, Ventura	148	72[2]	2008	July to December	>10 ug/dL	11-50+ ug/dL	45	USFWS 2009

Table 2. Summary of Blood-Lead Concentrations in Recaptured Free-flying California Condors (continued)

STATE	CONDOR CAPTURE LOCATION[1]	CALIFORNIA COUNTIES	SAMPLES COLLECTED	CONDORS TESTED	YEARS SAMPLED	TIME OF RECAPTURES	BACKGROUND LEVEL	REPORTED AMOUNTS ABOVE BACKGROUND	PERCENT SAMPLES ABOVE BACK-GROUND	SOURCE
CA	Central and Southern	Kern, Monterey, San Benito, San Luis Obispo, Shasta, Ventura	248	90[2]	2009	January to July	>10 ug/dL	11-50+ ug/dL	60	USFWS 2010
CA	Central and Southern	Kern, Monterey, San Benito, San Luis Obispo, Shasta, Ventura	248	90[2]	2009	August to December	>10 ug/dL	11-50+ ug/dL	54	USFWS 2010
CA	Central and Southern	Kern, Monterey, San Benito, San Luis Obispo, Shasta, Ventura	469	95	2000-?	Year-round	>10 ug/dL	10-50+ ug/dL	59	Fry et al. 2009
CA	Central	Monterey, San Benito	-	18	2002-2004	Year-round	≥3.75 ug/dL	3.96-97.7 ug/dL	94	Church et al. 2006

[1] Not all populations were clearly defined by authors; assumed to be:
Central - Data from Ventana Wildlife Society, namely Big Sur or Pinnacles National Monument
Southern - Data from US Fish and Wildlife Service (USFWS) at Hopper Mt. National Wildlife Refuge (NWR), Lion Canyon, Castle Crags, or Bitter Creek NWR

[2] Total samples taken for year, not broken out by season.

6.3 ARE HUNTING RATES IN THE DRECP EQUIVALENT TO THOSE IN STUDIED AREAS?

Although eliminating lead-based ammunition for big-game hunting was central to most of the lead abatement programs, big-game hunting opportunities are more limited in the DRECP region, both in terms of species (only deer and bighorn sheep; CDFG 2012b) and numbers, than in the California condor range in California and Arizona. For example, among the regions of California deer hunting zones that overlapped the DRECP region (22,586,900 acres), approximately 500 deer are harvested annually (CDFG 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007a, 2008a, 2009, 2012c), compared to 4,157 deer harvested in 2009 from hunting zones within the condor lead ban region (21,018,800 acres; CDFG 2009). Thus, sources of large carrion (e.g., ungulates) in the DRECP may be less abundant compared to other regions. In contrast, small mammals and game birds are some of the most commonly hunted species within the DRECP region. In 2007 and 2008 combined, CDFG estimated that 51,000 pheasant, 39,000 chukar, 150,000 quail, 8,000 coyotes, 24,000 jackrabbits, and 24,000 cottontails were killed in hunting zones within the DRECP (CDFG 2007b, 2008b). Given that even a single lead fragment can cause a mortality event (Lahner and Franson 2009), it is likely that the hunting levels of large and small game animals in the DRECP are sufficient to cause lead poisoning in golden eagles.

6.4 HOW MANY EAGLES ARE LIKELY TO BENEFIT FROM THIS PROGRAM?

Intensive golden eagle nest surveys and monitoring have been performed in San Diego County by the Wildlife Research Institute since 1988. Bittner and Meador (2011) estimate that the average golden eagle territory size in eastern San Diego County, an area which overlaps with the DRECP region, is 62 square miles (42,880 acres). Based on the size of the DRECP and based on the assumption that nesting eagle density in the DRECP is one pair per 62 square miles, the number of golden eagle territories within the DRECP would be 527. If all territories were occupied by breeding pairs, there would be 1,054 adult golden eagles within the DRECP. This estimate does not take into consideration that habitat quality in the DRECP may affect the number of breeding individuals, nor does it account for migratory and non-breeding individuals. USFWS is also developing alternative methods to estimate the population size of golden eagles which may be used to estimate the anticipated benefits.

6.5 HOW WOULD THE MITIGATION EFFORTS BE TRANSLATED INTO EAGLES "SAVED"?

For this document, we assume each eagle fatality would need to be replaced with a healthy eagle, which would be created by reducing the number of eagles with above-background lead levels within the DRECP. This reduction may be estimated using success rates from other abatement programs, or measured directly from golden eagles within the DRECP.

6.5.1 Estimate using success rates from similar programs

One method of estimating success is to apply the lead reduction percentages found from other programs to the number of eagles in the DRECP region. Data from the California condor lead abatement program (Section 5.3) indicate that golden eagles with above-background lead levels decreased from 76% pre-ban (13/17 individuals) to 32% post-ban (12/38 individuals; Kelly et al.

2011), a 44% reduction within one year. If we assume a similar lead reduction rate as the result of a lead abatement program within the DRECP, this translates to 44% of the eagles that would have had lead impacts are now "saved". Applying this rate to our estimated population within the DRECP of 1054 adult golden eagles, approximately 464 eagles would be saved per year from lead impacts by instituting a lead abatement program.

6.5.2 Measure actual rates of change in lead exposure

In order to directly assess the impact of a lead abatement program on golden eagles, lead levels must be measured before the implementation of the lead abatement program, and then again after implementation. Changes in lead levels would be based on the most feasible sampling method (i.e., capturing live birds versus finding dead ones, Table 3), which may depend on cooperation from ongoing eagle research. Target individuals would be sub-adults and adults because lead exposure generally does not occur until individuals leave the nest and hunt for themselves (Berosian and Craighead 2009).

Table 3. Potential Ways to Assess Lead Exposure in Eagles

MEASUREMENT TYPE	ONGOING PROJECTS WHERE THESE DATA COULD BE COLLECTED	OTHER WAYS TO COLLECT THE DATA	PROS	CONS
Blood	• WVU telemetry study (n ~ 10 adults per year?) • UC Davis/CDFG current(?) study • Wildlife Research Institute current telemetry studies	• Blood levels from rehab birds (n ~ 38/yr statewide in 2010) • Capture birds specifically for this purpose	• Provides "real time" evidence of lead exposure	• Time consuming and expensive to capture eagles • Blood from birds in rehab centers may be biased because eagles with lead poisoning are easier to catch • Sample sizes may be small
Organs/Tissue	• UC Davis/CDFG collaborative study	• Carcasses found	• Provides "real time" evidence of lead exposure • Can be extracted from new and old carcasses	• Have to find the carcass • Sample sizes may be small
Feathers	• UC Davis/CDFG collaborative study	• Carcasses found	• Can be extracted from carcasses or nests	• Have to be growing feathers • Difficult to quantify recent lead exposure
Bones	• UC Davis/CDFG collaborative study	• Carcasses found	• Can be extracted from carcasses	• Provides "lifetime" exposure to lead, not necessarily recent exposure

6.6 WHAT ARE THE COSTS?

Costs will be dependent on the level of effort. For the Arizona lead abatement program (Section 5.2), annual operating costs were ~$170,000 (including labor) which equated to one box of non-toxic ammunition and outreach for ~1,500 big-game hunters, for a per hunter cost of $113. The Arizona program area is 7,405,903 acres in size, approximately one third the size of the DRECP (22,586,900 acres). However, there are roughly equivalent numbers of big-game hunting tags available between the two areas (2,000 – 7,000 per year in the condor range in Arizona, Sieg et al. 2009; 5,272 deer tags in 2008 within DRECP counties; CDFG 2008b). If we use the per-hunter cost from the Arizona program, and apply it to all big-game and non-game hunters in the DRECP region (8,334 in 2008, CDFG 2008b), the total program cost would be $941,742. Using our estimate of 464 eagles saved (Section 6.5.1), that equates to a cost of $2,030 per eagle. However, this does not include monitoring. The breakdown of approximate costs for various components of the program can be seen in Table 4. Costs presented here are reflective of information as of 2012 and outlined to provide an order of magnitude for costs. Depending on the level of effort, labor pool used, current hunter numbers in the DRECP, and costs for ammunition, the actual cost may be significantly different from costs presented here.

Table 4. Lead Mitigation Options for the DRECP

MITIGATION METHOD	METRICS OF SUCCESS	IMPLEMENTATION STEPS	BALLPARK COSTS (ANNUAL)[1]	PROS	CONS	ASSUMPTIONS
Hunter education - DVD	• Reaching a designated number of people (percentage of hunters?) • Non-toxic compliance % from post-season survey	• Design DVD • Survey post-hunt for compliance • Adjust effort each season based on compliance %	• DVD production cost $3,360 • Replicating and mailing of DVDs and info $2,800 labor + $3.10/DVD • Post-hunt survey $5,000	• Education materials could be based on what was done elsewhere • Additional outlet for DRECP outreach	• Lack of interest • Perception of 'taking away our ammo' • Perception of more regulations	• Compliance % = % fewer lead-laced carcasses = % fewer lead-poisoned eagles
Hunter education – articles/fliers	• Reaching a designated number of people (percentage of hunters?) • Non-toxic compliance % from post-season survey	• Design educational material • Survey post-hunt for compliance • Adjust effort each season based on compliance %	• Graphic designer $300 • Post-hunt survey $5,000	• Education materials could be based on what was done elsewhere • Additional outlet for DRECP outreach	• There can be too much info	• Compliance % = % fewer lead-laced carcasses = % fewer lead-poisoned eagles
Hunter education – focus groups	• Reaching a designated number of people (percentage of hunters?) • Non-toxic compliance % from post-season survey	• Organize meetings • Survey post-hunt for compliance • Adjust effort each season based on compliance %	• $10,000 for 3 meetings and final report • Post-hunt survey $5,000	• Education materials could be based on what was done elsewhere • Additional outlet for DRECP outreach	• Too much information can be overwhelming to the hunters	• Compliance % = % fewer lead-laced carcasses = % fewer lead-poisoned eagles

Table 4. Lead Mitigation Options for the DRECP (continued)

MITIGATION METHOD	METRICS OF SUCCESS	IMPLEMENTATION STEPS	BALLPARK COSTS (ANNUAL)[1]	PROS	CONS	ASSUMPTIONS
Providing non-toxic ammunition for big-game and non-game hunting	• % using non-toxic ammunition from post-season survey	• Determine caliber of ammunition typically used and provide non-toxic alternatives • Distribute non-toxic ammunition • Survey post-hunt for compliance	• 1500 boxes of big-game ammo cost $85,000	• Get higher compliance %	• Wide variety of ammunition used, hard to supply to all • Expensive	• Compliance % = % fewer lead-laced carcasses = % fewer lead-poisoned eagles
Removing carcasses/offal piles (by hunters or volunteers) where lead is used	• Participation % from post-season survey • # carcasses removed	• Survey post-hunt for compliance	• Post-hunt survey $5,000	• Doesn't require purchase and use of non-toxic ammunition	• Offal piles could be widely scattered • Difficult to transport	• % fewer lead-laced carcasses = % fewer lead-poisoned eagles

[1]Estimates of cost are from 2003-2007 program expenses provided by K. Sullivan of AGFD, May 11, 2012; labor estimated at $560/day ($70/hour).

Direct monitoring of the effect of the lead abatement by assessing individual lead exposure may be necessary and will add to the per eagle cost. There are a variety of options, the least expensive of which would involve collaboration with researchers capturing eagles in the area and/or with eagles captured at wildlife rehabilitation facilities (Table 5). Carcasses of golden eagles may also be sampled for lead levels. The most expensive option would involve paying for eagle capture efforts before and after implementation.

Table 5. Monitoring Lead Levels Program Options and Minimum Costs

OPTION	MONITORING METHOD	ACTION	COST PER UNIT
1. Least Expensive	Monitoring blood lead levels in live eagles - collaborators	Pay for measuring blood lead levels of rehab eagles and those captured by collaborating researchers	Lead Care II testing device costs $2360[1]
			Per sample cost of $8[1]
2. Moderately Expensive (one example)	Monitoring blood lead levels in dead eagles - volunteers	Pay mileage for volunteers to survey roads, collect reported carcasses	$0.55/mile
		Measure lead levels in liver or kidney of carcasses	Unknown
3. Most Expensive	Monitoring blood lead levels in live eagles – pay for capture	Pay for capture of live eagles	$25,000 to capture a single eagle[3]
		Measure blood lead levels	Lead Care II testing device costs $2360[1]
			Per sample cost of $8[1]

[1]Price provided by Lead Care II System Sales Representative pers. comm. 2012
[2]Based on sample size used in Kelly et al. 2011
[3]Estimated cost of contractor to capture an eagle (Tetra Tech unpub. data)

7 PURPORTED KEYS TO "SUCCESSFUL" ABATEMENT PROGRAMS

Derived from Krone et al. 2009, Sieg et al. 2009, and Saito 2009.

7.1 6 PRINCIPLES OF INFLUENCE

1. Reciprocity—give someone something in exchange for their action—achieved through the free ammunition program.
2. Commitment and consistency—ensure dedication to what you are asking for—achieved by a multi-year dedication to a voluntary program and a consistent message.
3. Social proof—show that others are also participating—achieved by use of sports group publications for outreach and evidence from other studies.
4. Liking—show that others like them are also participating—achieved by the use of hunter quotes in outreach materials and also by consistently thanking hunters for their help.
5. Authority—exert influence on the decision—achieved through the use of AGFD, the regulatory agency for hunting and fishing, doing primary outreach.
6. Scarcity—indicate that not participating might limit future actions—achieved by stating that voluntary efforts could reduce calls for mandates or regulations.

7.2 LESSONS LEARNED FROM PAST EXPERIENCES

1. Get input and involvement from all stakeholders (e.g., hunting organizations, ammunition industry, ammunition suppliers, game park and hunting range owners, nature conservationists, state and federal agencies) before decisions are made.
2. Address non-toxic ammunition supply issues.
3. Education is key to a smooth transition.
4. Sales people should be trained, important source of information to hunters.
5. Establish sources of reliable, hunter-trusted information with understanding of common goal.
6. Need a consistent, single, simple message.
7. Focus groups are valuable.
8. Information shouldn't be technical, use marketing professionals.

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Appendix D: Rehabilitation

CALWEA EAGLE MITIGATION OPTIONS: REHABILITATION

Prepared for the California Wind Energy Association

Prepared by Tetra Tech

November 20, 2012

1 SUITABILITY OF EAGLE REHABILITATION AS A MITIGATION OPTION FOR THE DRECP

Programmatic permits for incidental take of eagles under the Bald and Golden Eagle Protection Act require compensatory mitigation for any unavoidable take. In this document, we provide background information, rationale, and a proposed approach to implementing a program to run eagle rehabilitation and release from California wildlife rehabilitation centers as a means of compensatory mitigation for incidental eagle take within the Desert Region Ecological Conservation Plan (DRECP). It summarizes what is known about the number of eagles entering wildlife rehabilitation centers in California, the information known about eagles released from wildlife rehabilitation centers, the approximate costs for eagle rehabilitation, and evaluates the key factors likely to influence the success of the program (e.g., the number of eagle released from rehabilitation per year, monitoring). Based on these lines of evidence, although we believe the wildlife rehabilitation is a defensible mitigation strategy, it would likely need to be combined with other strategies because of the limited number of eagles available for release. Additionally, U.S. Fish and Wildlife Service (USFWS) has expressed concern regarding funding of rehabilitation because of the limited data regarding the survival and future reproduction of released birds. Because of this concern, USFWS would likely require additional research before considering rehabilitation of eagles as an acceptable mitigation option.

2 REHABILITATION OF EAGLES

Golden eagles are frequently admitted to wildlife rehabilitation centers in the state of California. In 2010, 38 golden eagles were accepted at wildlife rehabilitation facilities, according to annual reports submitted to the California Department of Fish and Game (N. Carion, CDFG, pers. comm. 2012). Reasons for admission vary, but frequently include collision (vehicles, wind turbines), electrocution, gun shot, lead poisoning, disease (e.g., West Nile Virus), starvation/malnourishment, and unknown sources of trauma. In 2010, 20 (53 percent) of the 38 golden eagles admitted to rehabilitation were euthanized or died at the facility. Survival depends on the specific ailment, its severity, and how quickly the individual is admitted. For example, nearly all electrocuted eagles die or are euthanized; whereas as many as 25 percent of eagles with a broken wing, a common trauma, may be releasable according to Tetra Tech's surveys of California rehabilitators (Tetra Tech, unpub. data). Of the 38 golden eagles admitted in 2010 in California, 8 (21 percent) were eventually released back into the wild. Rates of survival after release are discussed in Section 3 below.

3 EFFECTIVENESS OF EAGLE REHABILITATION

The USFWS expressed concerns about funding eagle rehabilitation efforts as compensatory mitigation because of the uncertainty associated with the fate of eagles released from rehabilitation centers, particularly those eagles that had significant trauma and/or were held for long periods of time (B. Millsap, USFWS, 2012 pers. comm.). USFWS felt that cases where eagles need only short-term rehabilitation such as routine lead-testing and lead chelation therapy would be more likely to be considered acceptable as mitigation. Here we summarize data on the success of eagle rehabilitation from telemetry, banding, and patagial tagging of released birds. We have also provided relevant survival information from bald eagles as supplementary information.

3.1 TELEMETRY DATA

Of the data sources available, satellite telemetry units (PTTs, or platform transmitter terminals) provide unbiased data because they provide information on the eagles regardless of their location or fate (alive or dead). Below is a summary of information available from the release of rehabilitated golden eagles fitted with satellite telemetry units.

- A male golden eagle caught in a leg-hold trap (a trap designed to capture predators such as coyote and fox; eagles are unintended captures) and then released with a PTT transmitter indicated that this eagle lived from his release date in March 2009 until the transmitter stopped moving in September of 2011 (Mehus and Martell 2010, Audubon Minnesota 2012). The eagle traveled from Wisconsin to Hudson Bay and back.
- A male golden eagle (eagle #41) caught in a leg-hold trap in West Virginia was released in March 2007. This eagle summered in Quebec and returned to West Virginia in the winter of 2009-2010. This eagle was found dead in a leg-hold trap in May 2011 (T. Miller as cited in West Virginia Highlands Voice 2012).
- A female golden eagle found in New York with multiple puncture wounds to the leg was released from Tufts University in March 2011 (Katzner 2012). Data were still being received as of March 2012. This eagle summered near the border of Quebec and Labrador and returned to the New York-Connecticut-Massachusetts region in the winter of 2011-2012. In March 2012, the eagle initiated spring migration northward.
- An immature bird found with an injured wing was released in southern California on February 26, 2010. It traveled east and then north along the Morongo Valley before transmitting as deceased on April 12, 2010 (Bittner and Meador 2011).

3.2 BANDING DATA

Prior to releasing a bird from rehabilitation, it is occasionally fitted with a USFWS aluminum band that contains a unique identification number. Band returns from golden eagles released from wildlife rehabilitation centers also provide useful data on survival; however, these data are biased because most band returns come from dead birds, and only 8 percent of bands from of all banded golden eagles are returned (USGS 2012). Band return data show that 55 percent of banded golden eagles released from wildlife rehabilitation centers were found dead greater than 1 year after their band date (n = 58, range 0 to 10 years; USGS 2010), indicating that more than half of golden eagles survive the first year after release.

3.3 PATAGIAL TAGS

Observational and nest monitoring data exist for a breeding adult female that was victim to secondary rodenticide poisoning and then released back to her breeding territory in San Diego County in November 1999. Based on regular nest monitoring and sighting of patagial tags, she has bred regularly since then and is actively breeding in 2012. She has produced as many as 3 young in a single clutch (D. Bittner, pers. comm. 2012).

3.4 BALD EAGLES

Although there are species-specific differences, bald eagles are similar in many respects to golden eagles, and there is more information on the success of rehabilitated and released bald eagles than golden eagles. Martell et al. (1991) found that 68 percent of bald eagles released from wildlife rehabilitation centers survived for at least 6 weeks after release based on VHS

telemetry. One female nested for 3 years following her release, and successfully fledged young in 2 of those years. Two immature eagles that had been shot in the upper Midwest were later released at the Swan Lake National Wildlife Refuge, MO in January 1976 (Griffin and Redig 1978). They were repeatedly observed until they left the refuge and initiated spring migration northward in March 1976. Band returns on bald eagles show that 80 percent of banded bald eagles that were released from wildlife rehabilitation centers were found dead greater than 1 year after their band date (n = 333, range 0 to 23 years; USGS 2010), indicating that most bald eagles survive the first year after release.

4 REHABILITATION COSTS

Many wildlife rehabilitation facilities in California accept golden eagles for rehabilitation, and all operate on private funds. Given that rehabilitators do not charge for their services or facilities and most staff are volunteers, it is difficult to estimate the full cost of care (Table 1). Feeding a golden eagle costs on average $5 a day, and rehabilitation can take several weeks to several months. Long-term rehabilitation of an eagle requires a 90-foot minimum flight cage to maintain wing muscles in flight condition. Most licensed wildlife rehabilitation facilities in California do not have large flight cages, which can cost anywhere between $1,500 and $100,000 to build (WHWRC 2012, WVRRC 2012, K. Stroud of Ojai Raptor Center pers. comm. 2012); however, many facilities are able to provide treatment and housing to eagles before transferring them to a facility with a flight cage. Medical treatment may include antiviral, antifungal, or antibiotic medication; x-rays; surgery; anesthesia; blood transfusion; and/or lead chelation therapy. Lead chelation therapy may cost up to $1,000 per treatment, and individuals may need multiple treatments to sufficiently reduce lead levels. If the nature of the ailment is severe, eagles are generally transferred to the University of California Davis (UCD) School of Veterinary Medicine, UCD California Raptor Center, or to the California Foundation for Birds of Prey for intensive treatment or surgery.

Table 1. Care Costs for Eagle Rehabilitation[1]

EAGLE CARE	COST
Daily food[2]	$5/day
Housing and maintenance[3]	$25/day
Veterinarian appointment fee	$70/visit
Hospitalization (includes food, fluids, basic medications like antiviral and antibiotic medications)	$100-200/day
Surgery (depends on nature and extent of injury)	$300-1800/per surgery
Anesthesia (in conjunction with surgery or other treatment)	$150-300/per session
Blood transfusion (blood supplied by donor non-releasable eagles)	$150-300/per transfusion
Lead chelation (diagnosis, treatment, and testing of blood lead levels)	$500-$1,000/per treatment

[1]Information provided by Dr. David Guzman of the UCD School of Veterinary Medicine, May 8, 2012 unless otherwise noted.
[2]The Dalles Chronicle 2012.
[3]Derived from hospitalization fee, but assumes less expensive lodging and treatment costs and volunteer staff.

Given that the most common reason for admittance of eagles to rehabilitation centers is trauma, we estimate the following treatments and associated costs for the rehabilitation of an average eagle (Table 2). Sub-lethal lead poisoning is frequently associated with collisions and other traumas (Kramer and Redig 1997, Kelly et al. 2011), and more than 50 percent of golden eagles had high lead levels at one of the facilities that receives and tests the most eagles (K. Stroud Ojai Raptor Center pers. comm. 2012); therefore, we include the cost of blood testing and a single lead chelation treatment.

Table 2. Estimated Rehabilitation Costs for Average Golden Eagle

ACTION	COST PER UNIT	NUMBER OF UNITS	TOTAL COST
Retrieval of individual (round trip)	$0.55/mile	100	$55
Initial treatment at rehabilitation facility[1]	$100/day	2	$200
Transit to/from vet or hospital (round trip)[2]	$0.55/mile	900	$495
Veterinarian appointment fee	$70/visit	1	$70
Surgery	$1,800/surgery	1	$1,800
Anesthesia	$300/treatment	1	$300
Lead testing and chelation treatment	$1,000/treatment	1	$1,000
Hospitalization	$100/day	7	$700
Food at long-term facility	$5/day	90	$450
Housing at long-term facility[3]	$25/day	90	$2,250
Total cost per eagle			$7,320

[1]Assumes half the rate as hospitalization due to use of standard medicines and treatments, diagnosis, but less trained personnel
[2]Assumes average distance of travel from the five rehabilitation facilities within the DRECP to Davis, CA (450 miles one way)
[3] Derived from hospitalization fee, but assumes less expensive lodging and treatment costs and volunteer staff

4.1 LIMITATIONS AND ENHANCEMENTS TO CURRENT REHABILITATION EFFORTS

Resources for wildlife rehabilitation in California are often limited by funding which results in individual wildlife rehabilitation centers lacking differing resources. These shortages constrain the level of care that can be provided to golden eagles, but enhancements can be made to rehabilitation facilities or programs put in place that may alleviate some of the current limitations (Table 3). These improvements would increase the potential for recovery and release of rehabilitated golden eagles.

Table 3. Enhancement Options to Current Eagle Rehabilitation Efforts

ENHANCEMENT	PROBLEM ADDRESSED	PRACTICABILITY
Routine lead testing	Undiagnosed lead-poisoned eagles	High
More flight cages	Shortage of flight cages in some areas of the state	High
Education of rehabilitators	Improper housing/treatment of eagles	High
Improve transport network	Time lag between discovery of eagle and treatment	High
Search and rescue program	Injured/ill eagles that are not found	Low
Increased access to veterinary care	Time lag between discovery of eagle and professional medical care	Low

4.1.1 Lead testing

Most facilities do not have sufficient funding to test all admitted eagles for lead poisoning. Given that lead poisoning may be the underlying cause behind the collision or other trauma which caused an individual to be admitted (Kramer and Redig 1997, Kelly et al. 2011), releasing a potentially lead-poisoned individual without appropriate treatment reduces its chances of survival. Thus, routine lead testing of admitted eagles would identify those individuals which need lead chelation in addition to standard medical treatment. Lead testing is a highly practicable enhancement because test kits are available, easy to distribute to facilities, and do not require technical training to use (Lead Care II System Sales Representative pers. comm. 2012).

4.1.2 Flight cages

We interviewed wildlife rehabilitation facilities in California that handle the most eagles (≥ 2 golden eagles/year) to find out the factors limiting rehabilitation of golden eagles. The most common response was the shortage of flight cages large enough to maintain eagles in flight condition. As previously mentioned, most facilities do not have sufficiently large flight cages and must transfer eagles to the nearest facility with a flight cage, which may be 5 hours away. Additionally, there have been instances when the nearest facility with a flight cage is at capacity and unable to accept additional eagles. This problem results in eagles being housed in suboptimal conditions until space or transport is available which may in turn exacerbate the condition of already compromised individuals. Providing flight cages at strategic facilities would reduce the numbers of eagles being injured during captivity and allow for optimal flight conditioning, thus increasing both the probability for a full recovery and of survival post-release. This enhancement is highly practicable because construction plans for flight cages are available and most rehabilitation centers (including four within or near the DRECP region) without flight cages have the desire and capacity to build one.

4.1.3 Rehabilitator education

Although all wildlife rehabilitators in California are inspected and licensed by the state, improper handling and treatment of animals still occurs on occasion (K. Stroud pers. comm. 2012, V. Joseph pers. comm. 2012). For example, holding of an eagle within an area that is too small, or

in one with improper perch surfaces because there is no better alternative within the region. Certain perch materials can damage the feet of eagles and lead to infection, which may eventually result in an unreleasable bird. Many facilities receive eagles infrequently, and may not have clearly established eagle handling and housing protocols. Educational outreach to make sure all rehabilitators are aware of appropriate housing, handling, and treatment protocols specific to golden eagles would improve the care that admitted golden eagles receive, and improve their general outcome. This enhancement is highly practicable because rehabilitators have the desire to give the best care possible to their animals and would likely be open to improving their current program.

4.1.4 Transport

Most eagles are brought to wildlife rehabilitation facilities by volunteers trained in eagle capture and handling; however, the pool of trained volunteers that any given facility draws upon are limited. In some cases the limitation of trained transport personnel has caused delays in the retrieval of injured eagles. Any delay in retrieval of eagles will have negative effects, at best temporary and at worst permanent, on the condition of those eagles and their potential for recovery and release. Increasing the number of trained transporters and expanding the current retrieval area will have positive impacts on the condition of eagles received at facilities and likely increase the percentage of eagles released. This enhancement option is highly practicable because there are many people willing to work with eagles that need the appropriate training and resources to be able to transport them.

4.1.5 Search and rescue

One of the key issues limiting rehabilitation of eagles is finding those individuals that are ill or injured; eagles that are not found can’t be brought in for treatment. Eagles are often associated with remote areas where road access is limited and fewer people live, decreasing the chances than a downed eagle would be found. Increasing the rate of detection of ill or injured eagles would directly increase the number of eagles treated and subsequently released back to the wild. Given the size of the state of California targeted areas for monitoring would need to be identified, but this may be difficult due to the lack of detailed eagle distribution data or known concentration areas, and unknown use of the state by juvenile, non-breeding, breeding, and wintering individuals. Furthermore, it is possible that few eagles may be found during monitoring regardless of search effort. Therefore, this enhancement option has low practicability.

4.1.6 Veterinary care

Veterinarians trained in treatment and care of wild animals, particularly large raptors, are uncommon, and many wildlife rehabilitation facilities do not have access to such professionals. Lack of an appropriately trained veterinarian limits the care that a facility may provide to golden eagles, and licensed facilities without in-house or local veterinarians are required by the state to transfer eagles within 48 hours of admittance to a facility that has advanced veterinary care available. Although the shortage of veterinarians is not easily overcome, it is possible that a “roving veterinarian” program could be developed to get veterinary access to those facilities that do not currently have it. This enhancement has low practicability because there are few raptor-specialist veterinarians, and most are unable to take on additional patients due to the current level of demand for their services.

5 PROPOSED EAGLE REHABILITATION PROGRAM FOR THE DRECP

The DRECP could create a fund specific to rehabilitation costs for golden eagles. The fund could be administered directly with designated state and federally licensed wildlife rehabilitation facilities that are permitted to perform rehabilitation on golden eagles, or could be administered through an intermediary (e.g., the National Fish and Wildlife Foundation). In order to address concerns about the value of released rehabilitated eagles and their rates of survival (see Section 3), funding could also be provided for telemetry monitoring of released individuals, if agreed to by the USFWS.

5.1 LOGIC CHAIN, ASSUMPTIONS, AND COSTS

5.1.1 Rehabilitation

For the purposes of this document, mitigation for an eagle fatality would be accomplished through the replacement of an eagle by paying for the rehabilitation of a golden eagle and releasing it back to the wild. Using the CDFG value that 21 percent of admitted eagles are released into the wild (N. Carion, pers. comm. 2012), if we assume that 5 golden eagles enter rehabilitation facilities (Table 4: Steps 1 & 2), then 1 of those eagles would be released. Therefore, it would require rehabilitation of 5 sick or injured eagles to replace one eagle in the wild. Given that our estimated cost of rehabilitating one eagle is $7,320, the cost of a replacement eagle would be $36,600.

Table 4. Metrics to Replace One Golden Eagle

STEP	METRIC	VALUES	UNITS	BASIS OF ASSUMPTION	LEVEL OF CERTAINTY
Step 1	5 golden eagles are accepted at rehabilitation facilities	5	Sick/injured eagles	Number of eagles entering rehabilitation facilities needed to create 1 eagle saved given the other parameters	N/A
Step 2	21 percent are released back into the wild	1	Released eagle	CDFG 2010 rehab data (N. Carion, pers. comm. 2012)	Moderate, some data but variation likely among years

5.1.2 Telemetry monitoring of released eagles

In order to address the uncertainty behind the survival of rehabilitated birds released to the wild, funding may also be provided for telemetry tracking of released individuals. Cost estimates (Table 5) are based upon the average cost of a trained and permitted eagle professional, his/her hourly billing rate, and industry standard per diem rates. Duration of the telemetry study is assumed to be 3 years because that is the expected life of a telemetry unit. Telemetry of eagles would be conducted based on approval by the CDFG and USFWS.

Table 5. Estimated Cost of Eagle Telemetry Study

ACTION	COST PER UNIT	NUMBER OF UNITS	TOTAL COST
Purchase of GPS-GSM telemetry units	$3,500/unit	1	$3,500
Data plan for telemetry units	$500/year	3 years	$1,500
Eagle professional to fit tag onto eagle	$4,000/bird	1	$4,000
Reporting/management	$2,000	3 years/bird	$6,000
Total cost per eagle			$15,000

5.2 POTENTIAL OBSTACLES TO SUCCESS OF REHABILITATION PROGRAM

There are various potential hurdles that may arise that affect the success of a rehabilitation program being used as mitigation for eagle fatalities. These are identified below, along with what may be done to surmount these obstacles.

- USFWS may not accept rehabilitation as a mitigation option without evidence that released eagles survive and enter the breeding population. Cases where eagles need treatment for only a brief period may be more acceptable than eagles rehabilitated over several months, but would likely need to be accompanied with research on survival and success of released birds.
- Rehabilitated eagles may be non-breeders or floaters that then leave the area and do not contribute to DRECP eagle population, but resident status is impossible to distinguish in the field and non-breeding individuals still have potential to use the DRECP.
- There may not be sufficient numbers of rehabilitated eagles captured and released from the DRECP region to equate to “an eagle saved”; few eagles are admitted to facilities in the DRECP region (2 golden eagles and 1 bald eagle in 2010; N. Carion CDFG pers. comm. 2012), so rehabilitation efforts may need to be expanded statewide.
- The USFWS, CDFG, or individual wildlife rehabilitators might not approve telemetry of eagles, based on perception of units as handicaps to birds. The USFWS has recently discouraged telemetry of golden eagles for wind projects (J. Everett, USFWS, pers. comm. 2012). However, the telemetry of rehabilitated eagles would answer specific research questions, and evidence of telemetry units affecting survival of birds is equivocal (e.g., Murray and Fuller 2000, Steenhof et al. 2006).

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