FINAL REPORT

Independent Science Review
For The
California Desert Renewable Energy Conservation Plan
(DRECP)

Prepared For
Renewable Energy Action Team:

California Department of Fish & Game
U.S. Fish & Wildlife Service
U.S. Bureau of Land Management
California Energy Commission

Prepared By
The DRECP Independent Science Panel

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Acronyms and Abbreviations

ACEC	Area of Critical Environmental Concern
AIC	Akaike’s Information Criterion
AUC	Area Under the Curve (of the Receiver Operating Characteristic)
BACI	Before/After-Control/Impact
BDCP	Sacramento-San Joaquin Bay Delta Conservation Plan
BIOS	Biogeographic Information and Observation System (of CDFG)
BLM	Bureau of Land Management
BLM SS	Bureau of Land Management Sensitive Species
BSSC	California Bird species of Special Concern
CDFG	California Department of Fish and Game
CEC	California Energy Commission
CEHC	California Essential Habitat Connectivity Project
CESA	California Endangered Species Act
CNDDB	California Natural Diversity Data Base
CNPS	California Native Plant Society
DFA	Development Focus Area
DRECP	California Desert Renewable Energy Conservation Plan
DTRNA	Desert Tortoise Research Natural Area
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ESA	Endangered Species Act (federal)
GAP	Gap Analysis Program
GIS	Geographic Information System
HCP	Habitat Conservation Plan
IPCC	Intergovernmental Panel on Climate Change
ISA 2010	Independent Science Advisors 2010
ISP 2012	Independent Science Panel 2012
IUCN	International Union for Conservation of Nature
MWh	Megawatt hour
MGS TAG	Mohave Ground Squirrel Technical Advisory Group
MSSC	California Mammal Species of Special concern
NCCP	Natural Community Conservation Plan
NGO	Non-Governmental Organization
NRCS	Natural Resources Conservation Service
NREL	National Renewable Energy Laboratory
NVCS	National Vegetation Classification System
OHV	Off-highway Vehicle
PIER	Public Interest Energy Research Program (CEC)
REAT	Renewable Energy Action Team
RESA	Renewable Energy Study Area
RPS	Renewable Portfolio Standards
SCML	South Coast Missing Linkages Project
SDM	Species Distribution Model
SSC	Species of Special Concern

SSURGO	Soil Survey Geographic Data base
UPA	Unique Plant Assemblage
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior
USGS	U.S. Geological Survey

Executive Summary

A panel of 15 independent science advisors (Independent Science Panel, or ISP 2012) reviewed draft documents prepared for the California Desert Renewable Energy Conservation Plan (DRECP or Plan). This was the second formal convening of an independent science panel for the DRECP; the first convened in 2010 ("ISA 2010") to present guidance for Plan development. The Scope of this ISP 2012 review was "…to evaluate whether the plan has considered the best available scientific information, has been prepared using the initial ISA 2010 recommendations to the extent practicable and appropriate, and has planned for climate change effects to extent practicable." The ISP 2012 review focused on draft consultant work products, including biological descriptions, species models, a climate change appendix, reserve design methods and associated maps, and other supporting documents.

We found that only some recommendations of ISA 2010 were embraced and addressed. Recommendations that appear insufficiently implemented included seeking continual scientific input and review of data, models, maps and other analytical tools and products; making all analyses and decisions as transparent and understandable as possible; matching the scale and resolution of each analytical task to the scale and resolution of the issues being addressed; subdividing the planning area into ecologically relevant units as appropriate for various tasks; and developing an Adaptive Management Plan and implementing monitoring studies early in DRECP development rather than near the end of the process.

ISP 2012 recommends nine major topic areas where improvements should be made:

1. **Add scientific expertise**. We recommend that DRECP immediately create a process that provides continuing, senior scientific leadership and fosters frequent and substantial engagement between the scientific community and the consultants and agency technical staff preparing the Plan. This enhanced science leadership should have on-the-ground knowledge of the deserts of California, knowledge of both the art and science of conservation modeling, and be capable of developing and vetting an analytical framework and system-integration strategy to guide how Plan components will be synthesized into a defensible, coherent Plan.
2. **Review, revise and explain the Covered Species list**. We recommend that there be an immediate and thorough review and revision of the Covered Species list based on clearly documented and scientifically justified decision-making. At the very least, the rationale for excluding California Species of Special Concern and BLM Sensitive Species must be clear, and the use of planning species for reserve design should be explored.
3. **Improve species distribution models.** We recommend development of new species distribution models by scientists having appropriate modeling and biological expertise, and using the most scientifically defensible variables, resolutions, and methods to ensure realistic depictions of habitat suitability and levels of uncertainty. Revised models should include either expert models or statistical models, not both, with preference for statistical rather than opinion-based models.
4. **Revise the Natural Communities designations**. Descriptions and ecological justification for designation of Natural Communities should be clear and analytically meaningful. The current community designations are overly broad and scientifically indefensible, with each

encompassing extreme variations in vegetation structure and composition, climate and soil conditions, supported wildlife species, and ecological processes. At a minimum, the Mojave, Sonoran, and Colorado deserts need to be clearly differentiated.

5. **Address mapping and land classification errors as well as important gradients**. We noted an apparent lack of knowledge about California's desert regions in the consultant documents we reviewed. Specifically there are significant deficiencies in treatment of special features, gradients, and ecological processes (such as fire) in Plan documents; use of available datasets (e.g., protected areas and species localities) in Plan analyses; representation of important protected areas and private conservation lands in reserve planning; and inappropriate use of overly coarse Macro group and Group vegetation data in models, reserve design, and analyses.
6. **Incorporate a climate change scenario into the DRECP reserve design.** The climate change appendix supplied for our review was not particularly useful or integrated into DRECP planning, contained questionable assumptions about species vulnerability, and offered a flawed example for Mohave ground squirrel response to climate change. To effectively address climate change in the DRECP, we recommend a select few climate scenarios, in the form of downscaled climate model simulations, to be used consistently across the matrix of DRECP concerns, and to evaluate vulnerabilities and linkages to other stressors on species and habitats. This approach should be conducted to establish a process that can be repeated in future and ongoing assessments. Climate modeling products available to conduct such analyses are provided in this report.
7. **Revise and explain the reserve design**. Although the consultants have followed ISA 2010 recommendations to apply objective site-selection algorithms and to use well-established reserve-design principles, the documents we reviewed do not adequately describe the methods, assumptions, and key decision points of the process. Furthermore, the design must be updated after items 1-6, above, are completed, and should more explicitly consider interactions among processes (e.g., climate change and development impacts on fire, invasive species, hydrogeology, and increased human use of the desert).
8. **Immediately craft an Adaptive Management Plan.** Consistent with ISA 2010, ISP 2012 considers that a *well-designed Adaptive Management Plan is the most critical element of a successful DRECP*. The need to establish current baseline conditions for Before/After-Control/Impact (BACI) sampling designs underscores the *urgency of initiating monitoring as soon as possible*. We recommend convening one or more focused science advisory processes as soon as possible to help identify monitoring priorities and methods.
9. **Employ a technical editor**. Finally, we recommend that a technical editor with a strong background in ecology be employed to purge unnecessary words, ensure consistency of terms, improve figure and map quality, and ensure completeness and clarity of presentation in all Plan documents. Key decisions in the planning process, and all scientific methods and assumptions, should be clearly documented to conventional scientific standards of transparency such that the decision-making rationale and uncertainties are sufficiently clear that the results of all analyses could be independently reproduced. This standard is essential to both scientific credibility and the ultimate success of the DRECP.

1 Introduction

This report was prepared by an independent science advisory panel[1] (ISP) for the California Desert Renewable Energy Conservation Plan (DRECP). It summarizes the ISP review of draft documents and procedures developed thus far in the planning process, and presents recommendations for improving the scientific defensibility of the Plan. To ensure objectivity, the advisors operate independently of the Plan applicants, their consultants, and other entities involved in developing the Plan. Our recommendations are not legally binding on agencies or individuals involved in planning or implementing DRECP, although we understand that DRECP agencies intend to implement our recommendations to the greatest extent feasible (Appendix A). We commend the DRECP agencies for recognizing the importance of scientific peer review and for seeking this ISP review in the spirit of basing the Plan on the best available science.

DRECP is intended to be a Natural Community Conservation Plan (NCCP) under California's NCCP Act of 2003. It may also serve as one or more Habitat Conservation Plans (HCP) under Section 10 of the U.S. Endangered Species Act. The NCCP Act requires input from independent scientific experts to ensure that Plan decisions are informed by best available science. Early in the DRECPs development and before any Plan documents were drafted, a first group of Independent Science Advisors (ISA) prepared a set of principles and recommendations to guide Plan development (ISA 2010). The second panel (ISP 2012) was asked by the DRECP Director and REAT agencies[2] to review draft planning documents, evaluate how well the ISA (2010) recommendations are being addressed, and make additional recommendations as the Plan is nearing a completed draft for public review. The second ISP includes experts in desert ecology, conservation biology, renewable energy technology, ecological modeling, computer mapping, climate change, and other pertinent fields, including four advisors that served on ISA 2010 plus eleven new advisors. Appendix B provides brief biographies of the advisors.

Contents of this report reflect the advisors' review of draft documents and maps as of late June, 2012 (Appendix C), results of a three-day science advisors' workshop, and subsequent research and discussions amongst the advisors. The ISP met in Riverside, California, from June 25-27,

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[1] ISP 2012 included four members from ISA 2010—Dr. Wayne Spencer, Conservation Biology Institute; Dr. Scott Abella, UNLV; Dr. Kristin Berry, USGS; Mr. Ted Weller, Ecologist—plus 11 new members: Dr. Steven Schwarzbach, USGS (Lead Advisor); Dr. James Strittholt, Conservation Biology Institute; Dr. Todd Katzner, West Virginia University; Dr. Lesley DeFalco, USGS; Dr. Julie Yee, USGS; Dr. David Stoms, CEC-PIER; Dr. David Bedford, USGS; Dr. Ted Beedy, Beedy Environmental Consulting; Dr. Dan Cayan, USGS and Scripps Institute; Dr. Ken Nussear, USGS; and Mr. Scott Haase, National Renewable Energy Laboratory. Collectively ISP 2012 represents substantial scientific expertise in desert ecology, conservation biology, renewable energy technology, computer mapping, ecological modeling, climate change, and related fields.

[2] The Renewable Energy Action Team (REAT) consists of representatives from the California Department of Fish and Game, California Energy Commission, Bureau of Land Management, and U.S. Fish and Wildlife Service. It was established pursuant to Memoranda of Understanding (MOUs) between these agencies and recognized in Executive Order S-14-08, issued by the Governor of California in November 2008, and an MOU signed by the Secretary of the USDI and the Governor of California in October 2009. The REAT's primary mission is to streamline and expedite the permitting processes for renewable energy projects, while conserving endangered species and natural communities at the ecosystem scale. Executive Order S-14-08 directs the REAT to achieve these twin goals in the Mojave and Colorado Desert regions of California through the DRECP.

2012 to hear the concerns of Plan participants, discuss technical methods with REAT agencies and consultants, and begin formulating recommendations.

It is important to note that our review covered various draft and partial draft documents and sections prepared by consultants that had not been fully vetted or reviewed by the REAT agencies, and that were not yet compiled into a comprehensive Plan document. The interim and incomplete nature of these work products made it difficult for the ISP to fully understand the relationships between various Plan components and how they will be integrated into a final Plan, or to understand the methods, criteria, and procedures underlying many Plan decisions. We also acknowledge that some problems we noted with these documents would likely have been rectified had REAT agencies had time to review them all first.

Nevertheless, based on our review of DRECP documents drafted to date, ISP 2012 is deeply concerned with the scientific quality of DRECP products and processes we reviewed, a lack of adherence to recommendations from ISA 2010, and inadequate or incomplete answers by Plan participants to questions we raised about methods, documentation, and other Plan elements. The panel unanimously concluded that *DRECP is unlikely to produce a scientifically defensible plan without making immediate and significant course corrections*, including strengthening leadership of the scientific program, increasing transparency in decision-making and documentation, improving scientific and technical foundations and analyses, and improving integration and synthesis of all analytical processes and products. ISP 2012 recommends that the DRECP add scientific expertise from government agencies and outside institutions to help achieve these improvements.

The following sections present our review of DRECP documents and work products we reviewed along with additional recommendations. Section 2 reviews how well DRECP has followed ISA 2010 recommendations thus far and provides clarifications and updates to ISA 2010; Section 3 provides more specific review of some Plan documents and maps; and Section 4 provides additional recommendations for improving the Plan's scientific defensibility.

2 Application of Previous Science Advice

Although a number of important ISA 2010 recommendations have been embraced by the Plan (e.g., develop an interconnected reserve network, use statistical species distribution models and objective reserve-selection algorithms), ISP 2012 is concerned that a number of the ISA 2010 recommendations appear to have been handled perfunctorily or not addressed, weakening the Plan's scientific defensibility. In addition to reviewing Plan documents and comparing them against the ISA 2010 recommendations, we reviewed a matrix prepared by consultants summarizing ISA 2010 recommendations and how they have been or will be treated by the Plan. For many recommendations, this response matrix gives the appearance of a "check-the-box" exercise rather than a rigorous effort to implement scientific recommendations. For example, simply obtaining or mapping a particular data set, or discussing an issue in a Biological Baseline Report, is not equivalent to *actively applying scientific information and advice toward achieving Plan goals*. To ensure the Plan's scientific defensibility, planners should strive to apply scientific information and recommendations in a more substantive way than they have demonstrated to date, and at least to clearly explain why specific recommendations of independent science advisors were not, or won't be, followed.

The following sections provide examples of how ISA 2010 recommendations have been handled to date, likely consequences of inadequate treatment of recommendations, and additional advice for improving the application of scientific guidance to the planning process.

2.1 Biological Goals and Objectives

ISP 2012 is generally pleased that the Plan embraced ISA 2010 recommendations concerning the development of hierarchical Biological Goals and Objectives (BGOs) to guide Plan development and to serve as input to the Adaptive Management and Monitoring Program. However, we note that the BGOs are only partially drafted and are to be revised based on additional input. Based on what we reviewed, some scientific foundations for BGOs seem weakly conceived and poorly documented. For example, Table B-1 (of Appendix B, Supporting Information….Strategy Methodology) summarizes "key conservation factors" used in the development of BGOs at various scales. The table lumps Covered Species into various categories with no definitions or explanation of how these categories were determined, how they are useful, and what rationale went into assigning species to these categories. Some categories are taxonomic groupings (e.g., bats, fish), others are based on gross vegetation or landcover classes (e.g., woodlands, wetlands), and still others are apparently based on functional ecological similarities (e.g., wide-ranging species, raptors). Upon examination, many of these groupings make little sense or are poorly defined as a foundation for developing BGOs or identifying conservation actions. For example, it is unclear whether the category "wide-ranging species" is intended to include species with extensive dispersal movements (e.g., bighorn sheep) as well as more sedentary species that have wide geographic ranges (e.g., desert tortoise). Something as foundational to setting BGOs should be more carefully thought through and documented.

We also note that the quantitative metrics being proposed for Biological Objectives seem rather arbitrary and not grounded in functional, ecological goals. While it is laudable that planners are striving to develop quantitative Objectives and metrics pursuant to ISA 2010 recommendations, ISP 2012 saw no clear rationale presented for how these are derived. The ISP recommends that the Objectives start with functional criteria, such as conserving "sufficient acreage to support viable populations of species X…." rather than putting in placeholders for arbitrary acreages or percentages of vegetation communities or modeled habitat. Acres or percentages conserved are not Objectives, although they may be appropriate metrics for measuring progress toward a biological Objective. For example, Objective DUNC1.1 very precisely calls for conserving "approximately 131,915 acres of existing North American Warm Desert Dunes and Sand Flats…" How was this acreage determined? Was it based on an arbitrary percentage of existing Dunes, as shown for other "Natural Communities," or was it calculated based on some analysis of the acreage required to sustain dune assemblages or representative species? For Covered Species Objectives, it appears that arbitrary percentages of "Modeled Habitat Available In Plan Area" were used to set metrics. This is problematic not only due to the subjective setting of percentages, but also due to the use of flawed Species Distribution Models as the foundation (see Section 2.8). We realize that deriving scientific rationale for setting Biological Goals and Objectives is a challenging task for conservation plans; nevertheless, we urge planners to lay out a transparent and biologically reasoned approach as DRECP continues developing Goals and Objectives.

2.2 Subdividing the Planning Area

ISA 2010 (Sections 2.2 and 4.2.2) recommended dividing the planning area into ecologically relevant regions or planning units and using them for various planning tasks, such as representation analyses, impact analyses, and establishment of region-specific mitigation requirements that reflect the regional clustering of renewable energy developments. ISA 2010 cautioned, however, against using "one-size-fits-all" subdivisions for all tasks, but rather fitting their scale and resolution as appropriate for any particular map, model, or analysis.

Although the Baseline Biology Report (Dudek and ICF 2012) contains figures of Ecoregion Sections and Subsections (e.g., Fig. 2-1), it is unclear whether and how these designations are being used for various tasks. Moreover, treatment of these designations seems inconsistent between different report sections, apparently without explanation. For example, Table 2-1 of the Baseline Biology Report lists five Ecoregions and 33 Subsections of Ecoregions whereas page 3-14 of Plan Section 3.4 (concerning representation analyses) states that "the natural community data were stratified by the 10 DRECP Ecoregions." It was not apparent to ISP 2012 where "the 10 DRECP Ecoregions" are defined in documents we reviewed.

The Ecoregion Sections and Subsections as delineated in Figure 2-1 (Dudek and ICF 2012)—based on USDA ecoregional mapping for California (Miles et al. 1998)—may be useful for some tasks (e.g., gap and representation analyses); however, they do not account for some important gradients and differences in climate and vegetation across the Plan area and therefore should not be used uncritically for all tasks. Climate variables change significantly from north to south and west to east across the Plan area, and strongly affect the distribution of plant and animal species, ecological processes, and consideration of climate change (see Crosswhite and Crosswhite 1982, Rowlands et al. 1982, and Rowlands 1995). Of particular importance are the percentages of precipitation occurring from October to March. Consequently, the Ecological Sections and Subsections should not be over used as variables in species distribution models, which should rely more on "useful environmental variables that can be derived from existing GIS layers, such as indices of habitat patch size, fragmentation, distance from water, primary productivity, insolation, or road densities" (ISA 2010, p. 55). ISP 2012 echoes this advice and recommends using variables that more appropriately capture environmental differences—such as winter and summer precipitation patterns, temperature patterns, composition of perennial vegetation, and an insolation index—rather than strict Ecoregion boundaries (see Section 2.8 for more guidance).

To better understand differences in perennial vegetation and the relationships of distribution of species to rainfall and numbers of days with freezing temperatures, the ISP 2012 recommends reviewing maps of plant species' distributions in Benson and Darrow (1981) and Turner et al. (1995), such as *Yucca brevifolia*, *Y. schidigera*, *Fouquieria splendens*, *Olneya tesota*, *Psorothamnus* (*Dalea*) species, *Krameria* species, and *Prosopis* species. Many of these species are constrained in north-south and east-west distributions by precipitation patterns (e.g., whether a location receives sufficient summer rain), elevation, the number of freezing days, and other similar variables. The distribution of vegetation in turn affects distribution of Covered animal species. The ISP 2012 recommends that Section 2.1.2 (Climate) be re-written to encompass these climate gradients in descriptions of the Ecoregions (pages 2-3 to 2-5 of the Baseline Biology Report). We further recommend recognizing that portion of the Owens Valley within

the Plan area as a separate Ecoregion (although it is included within the Mojave Ecoregion by Miles et al. 1998), because it differs significantly from the Mojave Desert in many characteristics (and is more similar to the Great Basin Desert in others).

The ISP 2012 also echoes the ISA (2010, Section 4.2.2) recommendation that representation goals should be established for each Covered Species and Natural Community by subregion (e.g., by Ecological Sections and Subsections), as well as for the entire DRECP area, to ensure adequate representation of biogeographic, genetic, and population variability across the Plan area. Plan Section 3.4 (under "Representation, Replication, and Refugia") vaguely discusses stratifying data by "10 DRECP ecoregions" to "ensure adequate representation" in the Plan area, but we can find no clear representation goals or a transparent process that was followed in the "iterative revisions of the …reserve design" to achieve them. Reserves should encompass the range of elevations, including valleys and alluvial fans to mountain ranges, present within each Ecoregion Section and Subsection.

2.3 Natural Communities

ISP 2012 finds that the current DRECP Natural Communities listed and described in Section 4.2 and Table 4-1 of the Baseline Biology Report are far too coarse and scientifically indefensible to be useful in reserve planning. Already coarse-scale vegetation Groups and Macrogroups from the National Vegetation Classification Standard (NVCS) were lumped into even broader "Natural Communities" that encompass extreme variations in vegetation structure and composition, climate and soil conditions, supported plant and animal species, and ecological processes. These designations demonstrate a lack of regard for ecological structure, composition, and function in this diverse region. Finer classification schemes that better reflect ecological and climate conditions should be used to define Natural Communities for such tasks as Gap analysis, representation analyses, impact analyses, and species distribution and habitat suitability modeling.

For example, combining all chaparral, coastal scrub, and desert scrub types (each of which encompasses a wide diversity of macrogroups, groups, alliances, and associations) into a single "Scrub and Chaparral Community" is ecologically indefensible and analytically useless—especially since this "community" covers a majority (12,543,494 acres or 55%) of the Plan area. Chaparral differs from desert scrub communities in highly significant ways for purposes of reserve design, species coverage, and land management. Chaparral vegetation has, for example, been strongly shaped by fire as an ecological process, with natural fire-return intervals generally on the order of 30 to 100 years by extensive crown fires that naturally consume nearly all above-ground biomass ("stand-replacing fires"). So long as it does not burn too frequently, chaparral recovers readily following such fires from root sprouts and seed banks (Keeley et al. 2011). In contrast, desert scrub communities evolved with the near total absence of fire, and have historically been characterized by small, patchy ground fires—at least until the recent invasion of *Bromus* species that provide fuel continuity to support more severe burns. Many desert shrubs have little capacity to recover from high-severity burns. The lumped-together "Chaparral and Scrub Community" is thus so simplistic as to be useless for reserve planning, representation analysis, adaptive management, or other purposes.

Other examples of coarse-scale "Natural Communities" that are not useful include, but are not limited to:

- *Dune Community*—This designation (439,354 acres) lumps together all dune systems in California deserts, from the Olancha Dunes in the northern Mojave/southern Great Basin to the Algodones Dunes in the western Sonoran Desert. Separate dune systems can have unique floras and faunas, including Threatened and Endangered species.
- *Rocky, Barren and Unvegetated Community*—This designation covers a massive proportion of the Plan area (6,823,992 acres) by lumping extremely different communities—from Desert Playas, to Sierra Nevada Cliffs and Canyons, to Desert Bedrock and Outcrops. Desert playas are geologically, hydrologically, and biologically unique from all other types in this "Natural Community," and the flora and fauna associated with, for example, Sierra Nevada canyons versus rocky cliffs in desert interiors are very different as well.
- *Wetland Community*—This designation treats all moist areas in the deserts alike, despite huge differences in the species and processes supported by, for example, alkali-saline wetlands, to freshwater marshes and seeps, to large bodies of open water.

The ISP 2012 recommends that the DRECP Natural Communities be revised using a more ecologically sound approach and finer-resolution categories. One promising approach would be to stratify Ecological Sections (or Subsections) by NVCS Groups (or in some cases, perhaps, Macrogroups) and examining the range of conditions (e.g., climate conditions and species compositions) in the resulting draft Natural Communities. The resulting communities should be further refined with input and review from desert ecologists, and compared against the climatic variables and vegetation differences noted above in Section 2.2. They should also be compared with information on vegetation and climate variations as described in Benson and Darrow (1981), Crosswhite and Crosswhite (1982), Rowlands et al. (1982), Rowlands (1995), Turner et al. (1995) and other relevant literature. Stratifying Natural Communities in this manner by both ecoregional and vegetation categories will result in more ecologically meaningful and useful assemblages of species and processes.

2.4 Covered Species

ISP 2012 recommends an immediate and thorough review and revision of the Covered Species list pursuant to ISA 2010 and ISP 2012 recommendations. Mistakes in designating Covered Species will propagate errors throughout all subsequent planning steps, including species distribution modeling, reserve selection, reserve design, and design of the Adaptive Management and Monitoring Program. Because Covered Species are central to the conservation strategy as well as the regulatory context of DRECP, it is essential that the criteria and process used to select them be transparent and scientifically defensible (see Section 3.1); however, the process has not been documented and appears to be rather ad hoc, with no clear justifications for many decisions. We reviewed a draft Excel spreadsheet [3] that appeared to be a work-in-progress showing how various stakeholder groups, the consultants, and the REAT agencies evaluated a list of candidate species based on various criteria or "filters" to create a list of Covered Species. It also showed species that were being considered as potential "Planning Species" (see Section 2.5). However,

[3] DRECP_Working_List_Covered_Species.xlsx, dated 3/3/2011

this "Working List" appeared to be preliminary as of March 3, 2011, with many species indicated with "under review," conflicting opinions expressed for many species, and other indications that the list had not been finalized. Nevertheless, prior to our review (June-July 2012) the Plan proceeded with a draft list of 77 Covered Species—with no apparent documentation of how this list was generated or its relationship to the Working List. Some species shown as "Covered" on the Working List are excluded from the list of 77 Covered Species, with no rationale provided. Moreover, while the Working List indicates many taxa as Planning Species, these are not addressed in any of the documents we reviewed and appear not to have been used in the planning process.

We have concerns about the exclusion of some species from the current list of 77 Covered Species, which disproportionately represents species associated with wetlands, riparian habitats, and agricultural areas and omits many desert-dependent special-status species (e.g., CDFG Species of Special Concern and BLM Sensitive Species). It excludes some desert-dependent species of conservation concern that may be affected by utility-scale solar and wind projects (e.g., several bats and rare pocket mice, badger, and a variety of desert song birds, lizards, and plants; see below for details). It is not clear to the ISP how rare and endemic invertebrates were considered in determining the list. ISA 2010 made specific recommendations and gave detailed guidance on how to consider them. Potential consequences of an insufficiently inclusive Covered Species list are highly significant, including inadequate reserve design, misdirected adaptive management and monitoring actions, loss of biological diversity, and lawsuits and permitting delays if listed species that are not covered are found in a project area.

We stress that California Species of Special Concern (SSC) and BLM Sensitive Species (BLM SS) should be strongly considered as candidates for the Covered Species List. SSC meet California Endangered Species Act (CESA) criteria for listing as Threatened or Endangered, but have no formal, legal protections. The intent of SSC designation is to provide for the conservation and management of unprotected but at-risk species to preclude the need to list them as Threatened or Endangered in the future. Likewise, an objective of the BLM Special Status Species Policy is to "initiate proactive conservation measures that reduce or eliminate threats to BLM Sensitive Species to minimize the likelihood of and need for listing of these species under the ESA" (USDI BLM Manual 6840). It is therefore prudent to treat these species as if they are listed as Threatened or Endangered, and to provide for their conservation in an NCCP/HCP. In the event that SSC or BLM SS are considered highly unlikely to be listed during the life of the Plan (e.g., due to lack of significant threats), they could be treated as Planning Species (see Section 2.5) so that their conservation and management needs are addressed by the Plan. In general, we recommend maintaining an inclusive list of potential Covered Species and Planning Species during the planning process, and only removing species from these lists as the Plan nears completion and analyses indicate that specific taxa are unlikely to be affected by Plan implementation. We also recommend that the process for developing the list be clearly articulated, with scientific justifications provided to support decisions to include or exclude species from the list.

2.4.1 Mammals

The following mammal species or subspecies are excluded from the current DRECP Covered Species list (Appendix D), although they are known to occur in the Plan area, have potential to

be affected by renewable energy developments, and are on the California Mammal Species of Special Concern (MSSC) list, are likely to be added to the MSSC list in the near future, or are otherwise of conservation concern in the Plan area.

- **Western yellow bat** (*Lasiurus xanthinus*). This species is on the MSSC list and a large proportion of its distribution in California is within the DRECP area. Fatalities of this species at a wind energy facility have been recorded within the DRECP area (Chatfield et al. 2009).
- **Arizona myotis** *(Myotis occultus).* This species is on the MSSC list and its distribution within California is likely limited to the DRECP area. It has been recently documented in the Lower Colorado River Multiple-Species Conservation Plan area.
- **Cave myotis** (*Myotis velifer*). This species is on the MSSC and BLM SS lists and its distribution within California is likely limited to the DRECP area. This species has been recently documented in the Lower Colorado River Multiple-Species Conservation Plan area.
- **Pocketed free-tailed bat** (*Nyctinomops femorosaccus*). This species is on the MSSC list and a large proportion of its distribution in California is within the DRECP area. Fatalities of this species at a wind energy facility have been recorded within the DRECP area (Chatfield et al. 2009).
- **Big free-tailed bat** (*Nyctinomops macrotis*). This species is on the MSSC list and a large proportion of its distribution in California is within the DRECP area.
- **Jacumba pocket mouse** (*Perognathus longimembris internationalis)* is on the MSSC list and is found southwest of the Salton Sea and into Baja California, Mexico.
- **McKittrick pocket mouse** (*Perognathus inornatus neglectus)* occurs in the Western Mojave Desert and adjacent foothills. It is on the MSSC Watch List due to insufficient information to determine status, but is highly likely to be placed on the MSSC list in the near future (Spencer et al. In Prep.) due to restricted and declining geographic range and habitat loss and fragmentation. This subspecies occurs in areas where siting of solar energy is highly likely.
- **Yellow-eared pocket mouse** (*Perognathus parvus xanthonotus*). This narrow-endemic subspecies is BLM Sensitive and highly likely to be added to the MSSC list. It is known from only four localities on the eastern slope of the Tehachapi Mountains at Horse, Sage, Freeman, and Indian Wells canyons, between 1400 and 1615 m elevation. This range coincides with an area of high wind-energy potential. The DRECP Covered Species Working List spreadsheet contained the comment, "Wide Ranging Planning Species," which is certainly not accurate for a subspecies with such limited geographic range and dispersal abilities.
- **Mojave River vole** (*Microtus californicus mohavensis*). This subspecies of the California vole is an MSSC. It is restricted to areas along the margins of the Mojave River where water comes to the surface due to shallow water table, in and near Victorville and Oro Grande. Although it is unlikely to be directly impacted by energy developments, any actions that might affect the hydrology of the Mojave River would be detrimental. Other *Microtus californicus* populations are known to occur at other wetland areas throughout the planning area (e.g., at Harper Lake Marsh, China Lake, Tecopa Hot Springs, and Little Lake), but their taxonomic and genetic associations are not well documented (J. Patton, C. Conroy, and S.

Montgomery, personal communications). Regardless of their taxonomic designations, any populations of voles or other species restricted to isolated wetland habitats in the desert may be unique and should be considered sensitive (J. Patton, personal communication).

- **American badger** (*Taxidea taxus*). This wide-ranging carnivore is on the MSSC list. It generally occurs at low densities and is highly susceptible to population declines and extirpations due to habitat fragmentation and roadkill. At the very least badgers are a useful Planning Species for reserve design to ensure that reserve areas are large, unfragmented, and connected.
- **Pronghorn** (*Antilocapra americana*). Although not currently on the MSSC or BLM SS lists, this species is likely to be added to the MSSC list in the future (Spencer et al. In Prep.). There is a small, reintroduced herd of pronghorn on grasslands in the westernmost portion of the Mojave Desert. Potential impacts to this population should be considered in the Plan.
- **Desert (or "burro") mule deer** (*Odocoileus hemionus eremicus*). Although not on the MSSC or BLM SS lists, desert mule deer near the Colorado River, in the western Sonoran Desert, have been treated as a separate management unit for hunting by CDFG for decades and appear to be a part of a genetically distinct group of deer in southern California (Pease et al. 2009); they also occupy a unique ecological niche relative to other mule deer, in one of the hotter, drier, lower-elevation regions of the Sonoran Desert. These deer move seasonally between the Colorado River into washes and other parts of the desert to the west. Densities are low, forage is scarce, and body condition reflects rainfall. The desert mule deer could be adversely affected by both energy development and climate change and should be considered in the plan, whether as a Covered Species or a Planning Species.

2.4.2 Birds

The following bird species or subspecies were excluded from the current DRECP Covered Species list (Appendix D), although they are known to occur in the Plan area, have potential to be affected by renewable energy developments, and are either on the California Bird Species of Special Concern (BSSC) (Shuford and Gardali 2008) and/or the BLM Sensitive Species (BLM SS) list (CDFG 2011). BSSC species are prioritized into three groups: Priority 1, reductions in population and/or range size could seriously threaten the taxon's California population in the next 20 years; Priority 2, reductions in population and/or range size could greatly reduce the taxon's California population in the next 20 years; and, Priority 3, population and/or range size moderately reduced and at least one vulnerability factor could seriously reduce the taxon's California population in the next 20 years (Shuford and Gardali 2008).

- **Vermilion flycatcher** (*Pyrocephalus rubinus*). *Status: BSSC Priority 2.* This species was formerly considered a "fairly common" breeder in Colorado Desert portions of Imperial, Riverside, and San Bernardino counties where it was most common along the lower Colorado River (Grinnell and Miller 1944). Since the 1940s vermilion flycatchers have expanded their breeding range into the Mojave Desert, but their statewide population has declined due to the loss and degradation of their preferred native habitats: arid scrub, grasslands, and riparian forests where they are often associated with surface water. Degradation and fragmentation of these habitats, as well as surface water diversions and groundwater pumping (e.g., from utility-scale solar projects), are continuing threats to this declining species (Myers 2008).

- **Loggerhead shrike** (*Lanius ludovianus*). *Status: BSSC Priority 2—Mainland Population.* This species has declined throughout North America according to decades of Christmas Bird Count and Breeding Bird Survey data. The specific reasons for this decline vary by region, and some are apparently unknown. More numerous in the Mojave and Colorado deserts than in coastal southern California, they are primarily found in desert washes and sparse scrublands dominated by mesquite and saltbush within the Plan area. Extant breeding and wintering populations throughout California (including the desert regions) are threatened by the conversion of native scrub habitats to development projects and unfavorable agricultural crops (e.g., vineyards, orchards, and row crops). Collisions with vehicles are also a major source of mortality that could increase with development- and project-associated traffic in desert areas (Humple 2008).
- **Gray vireo** (*Vireo vicinior*). *Status: BSSC Priority 2; BLM SS.* While the overall California range of this species is essentially unchanged from historical times, gray vireos have been extirpated from large portions of formerly occupied habitat in Kern, Los Angeles, Riverside, and San Diego counties. Their current stronghold in California is the Mojave Desert where their habitat is characterized by a nearly complete cover of shrubs, such as chamise, big sagebrush, and ceanothus, often in association with small trees, including scrub oaks, yuccas, or Joshua trees. While the exact causes of this species' local extirpations are unknown, nest parasitism by the brown-headed cowbirds, improper fire management (e.g., unnaturally frequent fires or long-term fire suppression), and habitat losses threaten this declining species in the California deserts (Unitt 2008a).
- **Bendire's thrasher** (*Toxostoma bendirei*). *Status*: *BSSC Priority 3; BLM SS.* The California range of this species is restricted to isolated populations in the Mojave Desert of Inyo and Kern counties and Mojave and northern Colorado deserts of Riverside and San Bernardino counties. While many details of the Bendire's thrashers life history are unknown, they are typically associated Mojave scrub vegetation dominated by *Yucca* (especially Joshua trees), mesquite, acacia, and *Opuntia* and columnar cholla cacti (*Cylindropuntia*). They avoid steep terrain and are usually found in areas with open "desert pavement" rather than rocky soils. Habitat loss due to past and future housing and agricultural projects in the Mojave desert are the major threats to this species (Sterling 2008), Bendire's thrashers are also susceptible to habitat losses, fragmentation, and degradation from utility-scale wind and solar energy projects, fires, invasive plants, and heavy off-highway vehicle (OHV) use (Nevada BLM unpublished report).
- **Crissal thrasher** (*Toxostoma crissale*). *Status: BSSC Priority 3.* Similar to Bendire's thrasher, this species' California range is restricted to relatively isolated populations in Inyo, Imperial, Riverside, San Bernardino, and San Diego counties. Crissal thrashers primarily inhabit scrub and woodland habitats in desert washes and near rivers, and their center of abundance in California is along the lower Colorado River. They also occur near the Salton Sea, and along the Amargosa River in Inyo County. Preferred habitats include desert washes dominated by catclaw acacia, mesquite, ironwood, palo verde, and willows. Major threats to this species in the California deserts include the loss, fragmentation, and degradation of occupied riparian woodlands, desert washes, and patches of mesquite. Invasions of tamarisk along the lower Colorado River and near the Salton Sea have caused them to become "uncommon" in areas where they were formerly "common" (Fitton 2008a).

- **LeConte's thrasher** (*Toxostoma lecontei*). *Status: BSSC Priority 1, San Joaquin population; BLM SS.* The remaining populations of this declining species are primarily concentrated in western Kern County, with smaller, isolated populations in southern Fresno western Kings, and northeastern Santa Barbara counties. LeConte's thrashers primarily inhabit stands of saltbush on gentle slopes and desert washes, often on alluvial fans. They also occur in creosote bush scrub communities. Habitat conversions for agriculture, development, high-density livestock grazing, and stand-replacing fires are historical and ongoing threats to this species in remaining populations of the western San Joaquin Valley (Fitton 2008b).
- **Lucy's warbler** (*Oreothlypis luciae*). *Status: BSSC Priority 3.* Both historically and recently, the largest California breeding population of this species is along the lower Colorado River (Grinnell and Miller 1944and Garrett 2008). Lucy's warblers also breed in small, isolated populations in the Mojave Desert portions of Inyo, Riverside, and San Bernardino counties. They breed almost exclusively in patches of honey mesquite, but also range secondarily into riparian habitats dominated by palo verde, ironwood, willows, and cottonwoods. The loss or fragmentation of mesquite and other desert riparian habitats, invasive exotic plants, increasing OHV use, and overgrazing are the primary threats to this species in the California deserts. These habitats are increasingly threatened by surface water diversions and groundwater pumping (Garrett 2008).
- **Sonora yellow warbler** *(Setophaga petechia sonorana). Status: BSSC Priority 2.* Formerly considered "abundant" breeders along the length of the lower Colorado River (Grinnell and Miller 1944), their California breeding populations have declined dramatically due to the cessation of natural flooding following the construction of dams (e.g., Hoover Dam), invasion of tamarisk, and the destruction of riparian habitat (Heath 2008). Similar to other riparian-dependent birds that were included as Covered Species (e.g., yellow-billed cuckoos and least Bell's vireos) Sonora yellow warblers are susceptible to surface water diversions and ground water pumping that would be associated with utility-scale solar projects in the Plan area.
- **Summer tanager** *(Piranga rubra). Status: BSSC Priority 1.*Historically, the California range of this species was considered to be exclusively along the lower Colorado River (Grinnell and Miller 1944). While their range has expanded to include desert riparian areas in Kern, Inyo, San Bernardino, and San Diego counties, their overall statewide population has declined tremendously in recent decades, primarily due to the destruction of riparian habitats along the lower Colorado River and elsewhere in southern California (Unitt 2008). Similar to other riparian-dependent birds that were included as Covered Species (e.g., yellow-billed cuckoos and least Bell's vireos) summer tanagers are susceptible to surface water diversions and ground water pumping that would be associated with utility-scale solar projects in the Plan area.
- **Yellow-headed blackbird** (*Xanthocephalus xanthocephalus*). *Status: BSSC Priority 3*. Historically this species was considered "common" at a few marshes along the lower Colorado River, and its range has expanded since the mid-1940s with the growth of larger marshes associated with reservoirs and dam construction and the creation of wildlife refuges (Grinnell and Miller 1944, Jaramillo 2008). Yellow-headed blackbird colonies currently breed at scattered sites in the Mojave Desert in eastern Kern County, as well as in Los Angeles and San Bernardino counties; active colonies also exist near the Salton Sea in

Imperial County. Primary threats to these populations include the loss and degradation of wetland habitats due to surface water diversions and ground water pumping for irrigation, in addition to flood control and water-consumptive energy projects (Jaramillo 2008).

2.4.3 Reptiles and Amphibians

Several reptile and amphibian species or subspecies were recommended for consideration as Covered Species by the ISA 2010 but were excluded from the current DRECP Covered Species list of 77 species. These taxa are known to occur in the Plan area, have potential to be affected by utility-scale renewable energy developments, and are either on the California Amphibian and Reptile Species of Special Concern (SSC) (Shaffer et al. in review) and/or the BLM Sensitive Species list (BLM 2010). We request that these species be revisited, with clear justification if they are excluded from the Covered Species list.

- **Couch's spadefoot toad** (*Scaphiopus couchii*). *Status: SSC; BLM SS, recommended by ISA 2010.* This toad is narrowly distributed in eastern Imperial and Riverside counties within the DRECP planning area. It emerges and breeds in ephemeral pools only during summer rains, with rapid development of tadpoles and metamorphosis. Due to their dependence on rainfall for persistence may be especially sensitive to changes in climate. Habitat alterations that result in a loss of breeding sites (e.g. blading of habitat for Utility scale solar facilities) may adversely affect this species in the Plan area.
- **Banded Gila monster** *(Heloderma suspectum cinctum). Status: SSC; BLM SS, recommended by ISA 2010.* The banded Gila monster is a northern subspecies occurring primarily in the Mojave Desert. They inhabit desert scrubland, riparian, xero-riparian, desert grassland, succulent desert, and oak woodland, seeking shelter in burrows, thickets, and under rocks in locations with ready access to some source of water. While typically associated with habitats in the Sonoran and Northeastern Mojave deserts, they are rare, but known to occur in four California counties (Imperial, Inyo, Riverside and San Bernardino) included in the DRECP planning area (Lovich and Beaman 2007, Shaffer et al. in press). Utility-scale projects that degrade or fragment these habitats could adversely affect this rare subspecies in the Plan area.
- **Colorado Desert fringe-toed lizard** *(Uma notata). Status: SSC; BLM SS, recommended by ISA 2010.* Endemic to the Colorado Desert in Imperial and San Diego Counties, this species only occurs on dunes with fine sand, dry lakebeds, sandy beaches, washes, or areas with sparse desert vegetation. A fringe of scales on the sides of the toes help this lizard run quickly over fine sand, preventing them from sinking, and also to bury themselves quickly. They take cover in sand to avoid extreme temperatures and to hide from predators. Utility-scale projects that degrade or fragment sand dunes and wind transport corridors could adversely affect this species in the Plan area.
- **Desert night lizard** *(Xantusia vigilis).* Although this species currently has no special status, Leavitt et al. (2007) provide genetic support for the recognition of a new species within the *X. vigilis* complex, including *X. wigginsi* in California. Because habitat is restricted and the species' yucca habitats are likely to become more restricted in the next 30 years with climate change, coverage of this species within DRECP may be prudent. In addition, Leavitt et al. (2007) identify several major clades, four of which occur in California: *X. vigilis*, *X. wigginsi* (now a full species), a Yucca Valley clade, and a San Jacinto clade.

- **Gilbert's skink (***Plestiodon gilbert) — Status SSC, recommended by ISA 2010.* Gilbert's skink is an insectivorous species broadly distributed in California, occupying a variety of habitats including: grasslands, salt flats, high desert, open chaparral, pinyon-juniper, open pine typically at mid to higher elevations, but associated with mesic habitat in the Mojave, in rocky open habitat with open shrub cover (Shaffer et al. In Review, Stebbins 2003). They are threatened by urbanization in the Central Valley and southern of California, and may be particularly vulnerable in desert habitats due to their relative rarity there. The taxonomic status of this species is currently under revision, which could result in added conservation challenges.
- **Western Pond Turtle** (*Emys marmorata*) *Status*: *SSC, BLM SS, recommended by ISA 2010.* The western pond turtle is broadly distributed in California, but the currently recognized subspecies *E. m. padilla* occurring in the DRECP planning area may merit species status (Shaffer et al. In Review). Although considered a habitat generalist, this species has suffered severe declines due to habitat loss and potential losses of nesting habitat due to agriculture, urbanization, and alteration of water bodies. In the planning area there are recent records for pond turtles at sites along the Mojave River in San Bernardino County. Climate change and further alteration of habitat and waterways may result adverse conditions for this species.

2.4.4 Plants

ISA 2010 referred to a comprehensive list of 171 rare and sensitive plant taxa for consideration as Covered Species. Most of these taxa are not on lists of state or federally Threatened or Endangered species, but renewable energy development is expected to impact sustainability of their populations (California Native Plant Society List 1B – Rare, threatened, or endangered in California and elsewhere, and 2 species – Rare, threatened, or endangered in California but more common elsewhere; see ISA 2010, Appendix E, p. 40-48). That the DRECP Covered Species list grew to only 36 plant taxa after ISA 2010, presumably derived from a mere 52 candidate taxa considered on the DRECP Working List of Covered Species (3/3/2011), portends a potential loss of the unique plant diversity within the Plan area. Similar to animal taxa, the rationale and criteria used for evaluating the candidate taxa and for reducing the comprehensive list of 171 to 36 is poorly documented in the Plan and the Working List. We recommend that the DRECP review the 171 plant taxa identified by ISA 2010 with qualified desert botanical experts that have field familiarity with these taxa to evaluate their potential inclusion in the Plan. We present several *examples* of plant taxa (i.e., *this is not a comprehensive list nor necessarily the most vulnerable among the candidates)* that are absent from the DRECP list but have been identified as requiring protection in part due to potential impacts from development (André and Clarke 2011), have CNPS threat status of 1B.1 (seriously endangered in California) or 1B.2 (fairly endangered in California), and recommended by CNPS (ISA 2010, see Appendix E) as high priority for conservation.

- **Forked buckwheat** (*Eriogonum bifurcatum*). *Status: BLM Sensitive and CNPS Rank 1B.2.* It is unclear why this species is missing from the DRECP because the final filtering decision for its recommendation was clearly justified as "Covered" (see DRECP Working List of Covered Species). This species occurs within the Plan area: shadscale scrub in western Pahrump Valley on barren clay, saline soils (André and Clarke 2011).
- **Creamy blazing star** (*Mentzelia tridentata*). *Status: BLM Sensitive and CNPS Rank 1B.3.* This species was not considered in the Working List of Covered Species and should be

evaluated as a Covered Species because it has a restricted range that falls exclusively within the Plan area. A few populations occur within Mojavean desert scrub of the Rodman and Ord mountains southeast of Barstow, the Black Mountain area near Calico northeast of Barstow, with possible occurrences in the southern Owens Valley (André and Clarke 2011).

- **Inyo County star tulip** (*Calochortus excavatus*). *Status: BLM Sensitive and CNPS Rank 1B.1.* Also omitted from the Working List, this species should be considered as a Covered Species because it is known to occur exclusively within the Plan area and has a restricted range with relatively few populations that have experienced recent widespread declines in grassy, alkali meadows in shadscale scrub of the Owens Valley region (André and Clarke 2011). It is currently at-risk due to ground-water development (Baldwin et al. 2002).
- **Rosy two-toned beardtongue** (*Penstemon bicolor* spp. *roseus*). *Status: BLM Sensitive and CNPS Rank 1B.1.*This species occurs in Joshua tree woodland and Mojavean desert scrub and is known only from one locality in California in the Castle Mountains (Baldwin et al. 2002; André and Clarke 2011). Statistical modeling of this species may be possible from nearby localities found outside of California in Nevada and Arizona (Smith 2005).
- **Coachella Valley milk-vetch** (*Astragalus lentiginosus* var. *coachellae*). *Status: Federal Endangered; CNPS 1B.2.* This milk-vetch occurs in the Plan area on loose wind-blown or alluvial sands on dunes or flats in the Coachella Valley area of the Sonoran Desert near Palm Springs. Filtering decision (DRECP Working List of Covered Species) resulted in removal of this species based on uncertainty of the variety in the area, but consideration to include it as a Covered species is recommended until the variety is confirmed and status evaluated.
- **Cuyamaca larkspur** (*Delphinium hesperium* ssp. *cuyamacae*): *Status: BLM Sensitive; CNPS 1B.2.* Occurring in mesic habitats such as lower montane coniferous forests, meadows and seeps, and vernal pools, it is suspected to occur on BLM lands. This species was recommended by ISA 2010 but not considered on the Working List; no rationale is presented in documents reviewed by the ISP 2012 indicating why it was omitted from consideration.
- **Santa Ana River woollystar** (*Eriastrum densifolium* ssp. *sanctorum)*: *Status: Federal Endangered; CNPS 1B.1.* This species is found in sandy or gravelly soils in chaparral and coastal scrub habitat. This species was recommended by ISA 2010 but not considered in Working List (*i.e.* no documented rationale indicated why it was omitted from consideration).
- **Slender-petaled thelypodium** (*Thelypodium stenopetalum*). *Status: Federal Endangered; CNPS 1B.1.* This species occurs in mesic, alkaline habitats such as meadows and seeps and is threatened by alterations in hydrology. It was recommended by ISA 2010 but not considered in Working List (*i.e.* no documented rationale indicated why it was omitted from consideration).

2.4.5 Invertebrates

ISA 2010 recommended a process and provided numerous experts and information sources for identifying rare invertebrates to be considered for inclusion as Covered Species. ISP 2012 is unaware of efforts made to follow this recommendation, although there is a comment (author anonymous) in the Working List spreadsheet asking why no invertebrates were considered, and another saying to "check with experts." Only a handful of invertebrate species was evaluated on

the Working List, with none being assigned as Covered Species. The importance of invertebrate taxa in "pollination, herbivory, population regulation and decomposition" (ISA 2010), and their critical roles in the food web, should not be overlooked. We echo the ISA 2010 recommendations for a comprehensive data-gathering effort to appropriately identify invertebrate taxa as Covered Species in the Plan area.

2.5 Planning Species

ISA 2010 recommended considering addition of some "Planning Species," for which take authorizations will not be required, but that may nevertheless be useful to achieving Plan goals and objectives (e.g., biodiversity conservation, reserve design, monitoring). ISP 2012 understands that this concept was discussed by DRECP participants, and that some Planning Species were considered (e.g., blackbrush and Joshua tree), but that the Planning Species concept has not been formally defined or adopted by the Plan. We reemphasize that including some Planning Species to assist with reserve design and adaptive management can be beneficial, and recommend that the Plan reconsider adding some Planning Species, including the 24 candidates recommended by ISA 2010.

2.6 Special Features, Ecological Processes, and Environmental Gradients

ISP 2012 was pleased that some effort was made to map special features and consider ecological processes (e.g., fire, sand transport, wildlife movement, range shifts) and gradients (e.g., elevation and moisture) in the Baseline Biological report. However, it remains unclear how these important issues were, or are, to be used in reserve selection and design, designation of Development Focus Area (DFA) alternatives, or analyses (e.g., representation and Gap Analyses). The Conservation Planning Process (Chapter 3 and Appendix B of draft documents we reviewed) vaguely describes that these issues will be addressed via an "iterative process" of reserve delineation with expert input. ISP 2012 thinks that a more rigorous approach with identified criteria and rules for incorporating these features into the reserve design is needed.

2.6.1 Special Features

ISA 2010 (Section 2.7) recommended including several categories of "special features" that greatly inform on ecologic and geomorphic function, sensitivity, stability, and resilience. While some special features were included in the Gap Analysis (e.g., dune and sand flats, playas) most of the special features recommended by ISA 2010 appear to have been ignored, although ISP 2012 believes that appropriate data are available to address them.

2.6.2 Environmental Gradients

ISA 2010 recommended incorporating environmental gradients into habitat models and other analyses, because species and natural communities tend to be structured by such gradients, and because they are important for accommodating range shifts (i.e., connectivity between existing habitat and habitat structured by changing climate conditions or human impacts). While the Plan discusses environmental gradients and claims to have maintained them with respect to reserve design and climate change, ISP 2012 saw no documentation describing how, and at what scales, environmental gradients were addressed or incorporated into the reserve design. ISP 2012 recommends clearly presenting the methods and metrics used to conserve environmental

gradients in the Plan. Climate gradients (e.g., precipitation and temperature variables) should also be incorporated into species distribution models.

2.6.3 Ecological Processes

The DRECP appears to focus primarily on the current distributions of species, communities, and features without apparent consideration of important ecological processes and how they may change over time due to changing climate and human impacts. While this focus is understandable, due to the regulatory context and near-term considerations that DRECP must address, ISP 2012 urges recognition that ecosystems are strongly structured by complex interactions between climate, soils, and biota that interact through time and space. Similar to ISA 2010, ISP 2012 recommends a stronger focus on ecological processes, especially when there is concern about ecosystem function into the future. We recognize that a robust spatial reserve design will accommodate many important ecological processes and changes through time, but a more detailed analysis of how interacting ecological processes may change in the future under a changing climate and human impacts could help reduce Plan uncertainties.

Several processes recommended by ISA 2010 appear not to have been adequately addressed by documents reviewed by ISP 2012, including (1) near-surface ecohydrological interactions of soils, vegetation, and runoff, (2) eolian and dust processes, and (3) ecological range shifts and wildlife population connectivity. Plan documents address ecological range shifts and wildlife population connectivity, but with limited description of methods. Ecohydrologic interactions and eolian/dust processes appear not to be addressed to the degree necessary. Eolian/dust processes are of special concern due to the prevalence of fragile bare-ground surfaces that can produce significant amounts of sand and dust following disturbance. Given that DFA areas are likely situated in areas with soil surfaces prone to wind erosion, and that DFA activities and associated near-installation activities will disturb soils, further analysis of the likelihood for wind erosion and its local and regional effects is warranted. This should be a component of the Adaptive Management and Monitoring Plan.

Extreme events—such as multi-year or decadal droughts, large floods, disease, and in some places fire—also need to be addressed. Such events, although infrequent, strongly structure desert ecosystems. A robust reserve design should consider the likelihood of these and other events to impact reserve areas and their capacity to sustain Covered Species and Communities.

2.7 Data Sets and Maps

ISA 2010 recommended a variety of spatial data sets and other information sources that should be obtained, incorporated, and applied during planning. Some of these recommendations have been followed; however, is unclear to what degree all of the most useful and reliable data sets have been incorporated or applied in the planning process. ISA 2010 also stated that "GIS data layers vary in their reliability, accuracy, and recency. All data should be carefully reviewed and assessed for accuracy in the field prior to use in models or for planning." ISP 2012 review suggests that this was not always carefully done, and in many cases it appears that datasets were chosen simply for their regional coverage rather than the appropriateness of their content. Some protected areas do not appear to be represented in maps and models we reviewed.

We are also concerned that locality data for many of the species (e.g., the Mohave ground squirrel) have errors from the sources that were cited in the documents we reviewed. Our experience with these data sets shows that they require substantial review in discussion with species experts to remove inaccurate or imprecise localities before using them in species distribution models. Note that revised locality data prepared by USGS for Mohave ground squirrel are now available at CDFG (contact the CDFG BIOS administrator). In addition, habitat suitability models prepared by USGS are available, or will soon be, for Mohave ground squirrel, desert tortoise, desert night lizard, and Gilbert's skink.

We recommend considering the following tasks and datasets to improve the DRECP database, if not already addressed:

- Acquire the updated Mohave ground squirrel data that were recently deposited to the CDFG database (CNDDB) by the USGS modeling effort, or use USGS habitat model once available.
- Acquire the latest protected areas update for the state from the Conservation Biology Institute or the Sonoran Desert portion from the BLM National Operations Center.
- Acquire updated information on lands owned or managed for conservation by land trusts, conservancies, and other similar organizations. These lands may be under conservation easements or contracts for protected status.
- Lands currently in the private sector and developed for housing, cemeteries, golf courses, businesses, or industrial complexes; lands currently or historically cleared for agriculture or development.
- California Mammal Species of Special Concern (MSSC) database (Spencer et al., In Prep., available upon request from http://databasin.org).
- California Amphibian and Reptile Species of Special Concern (ARSSC) database (Shaffer et al. in prep.) which is currently being updated (http://arssc.ucdavis.edu/).
- PRBO Conservation Science and the California Avian Data Center (www.prbo.org/cadc) which is a node of the Avian Knowledge Network.
- Cornell Laboratory of Ornithology's eBird database (http://ebird.org/content/ebird).
- Local BLM offices conducting biotic inventories.
- Museum records. Digital databases are now available for many museum collections, including:
    - ORNIS (http://ornisnet.org/) for avian museum databases.
    - MaNIS (http://manisnet.org/) for mammals[4].
    - HerpNET (http://www.herpnet.org/herpnet/index.html) for amphibians and reptiles.
    - VertNet (http://vertnet.org) for a large multi-institutional database of vertebrate records.

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[4] Note, however, that MaNIS data have already been incorporated into the MSSC database.

  - Consortium of California Herbaria (http://ucjeps.berkeley.edu/consortium/) for plants.
  - San Diego Natural History Museum's Plant Atlas (http://www.sdnhm.org/plantatlas/index.html) also for plants.
- Site-specific information from Environmental Impact Reports (EIRs) and Environmental Impact Statements (EISs) (compiled into a central database).
- Additional data sources for protected areas:
  - Protected Areas of California: http://app.databasin.org/app/pages/datasetPage.jsp?id=3369dec5de1242238bdac498a7e6c94d
  - The National Conservation Easement Database: http://app.databasin.org/app/pages/datasetPage.jsp?id=d85fb27b3b8f440ca2aeee2fc6f930bd.
- Fire history maps:
  - Randy McKinley (EROS data center in USGS) has completed fire history maps for the Mojave, including perimeters, severity, and frequencies for fires greater than 1,000 acres (and a few that are smaller) going back to 1984 (dNBR and RdNBR).
  - Matt Brooks (USGS) is developing a future fire risk model for the Mojave that will incorporate climate change.
  - Recent historical and current fire perimeters (and in some cases severity classes) in the U.S. can also be downloaded here:
    - http://app.databasin.org/app/pages/datasetPage.jsp?id=6ed18e2a72e74b0d81e14c93d5b46f07#tabId=overviewTab
    - http://www.geomac.gov/index.shtml

We further recommend the following improvements to QA/QC procedures, if not already being implemented (QA/QC procedures are not clear from documents ISP 2012 reviewed):

- Ensure accuracy and precision of point data and that species distribution models are not conducted at finer resolution than the accuracy of the point data.
- Ensure that point data represent observations of individuals and not artifacts of other processes (e.g., centroids of survey polygons or transect end points).
- Ensure that data are for the correct species.
- Ensure that the dates of the localities are sufficiently recent, so that presence records are not included in urban or agricultural areas from which the species has been extirpated; or mask out localities that lie in what are currently clearly unsuitable areas (e.g., urbanized).
- Ensure that data projections are correct, and that data are not repeats of one another from other projections that are incorrectly documented.

2.7.1 Vegetation/Landcover

Accurate, fine-resolution vegetation base maps are essential for Plan development and refinement (ISA 2010) and we are aware that vegetation mapping at a finer resolution is ongoing. We are pleased that CEC funded this effort, prioritizing the western Mojave Desert. However, it is unclear whether and when this refined map will be used for conservation planning efforts, and what the prospects are for mapping the rest of the study area. Moreover, we are deeply concerned with the current use of the very coarse Macrogroup and Group data in models, reserve design, and analyses. For example, the Group "Lower Bajada and Fan Mojavean-Sonoran Desert Scrub" represents a huge area (38% of the Plan area) without distinguishing significant Ecoregional differences in vegetation assemblages among the Mojave, Sonoran and Colorado Deserts. Moreover, the designation of "rural lands" as a landcover based on acreage and roads criteria ignores private lands purchased for conservation that support natural vegetation and habitat for Covered Species.

We highly recommend that various analyses (e.g., species models, reserve design, representation analyses) be updated as new and better mapping becomes available, in keeping with the ISA 2010 recommendation to phase the Plan in an adaptive management context, updating and improving on analyses as new and better information becomes available.

2.8 Species Distribution Models

ISA 2010 recommended careful application of species distribution models (SDM), provided detailed guidance for using both statistical and "expert-based" models, and urged DRECP to tap expertise from appropriate institutions to assist with model development because "learning-while-doing is inefficient and error-ridden." While ISP 2012 was pleased to see some attempts to follow these recommendations—such as identifying species having suitable data for statistical (e.g., Maxent) models—we noted serious flaws in modeling procedures, including deficiencies in input data selection, QA/QC, and processing, inattention to scale and resolution issues, inappropriate "one-size-fits-all" model extents, and lack of appropriate uncertainty metrics and optimization and thresholding methods (e.g., unconventional use of "Jenks Natural Breaks" to define suitability thresholds; see Liu et al. 2005 for a variety of other, better-justified, options). As a result, the species models we reviewed likely over-predict habitat suitability and species distribution for most species while providing a false sense of confidence in the results. This has potentially serious consequences for reserve design, because modeled species distributions are a key input to the reserve-selection and design process. If models that over-predict species distribution are used in reserve design, areas included in the reserve may be credited with conserving habitat for a given species even if it doesn't occur there. Over-estimating the amount or quality of habitat, contrary to what has been presented by consultants, is not necessarily a "precautionary" approach if it overstates the conservation value of the reserve design and doesn't adequately discriminate the most important habitat areas for Covered Species.

ISA 2012 strongly recommends that lands already developed for agricultural, industrial, urban, suburban, and other uses be removed from distribution maps of each species. Including locality points from historical species' locations that are no longer suitable to support the species can skew results for statistical models. In expert-based models, at the very least clearly unsuitable areas should be masked out from the final predictions of suitable habitat.

This section provides a general critique of the modeling methods and results, with recommendations for improvements. Section 3.3 provides more details and examples of species-specific problems with the SDMs we reviewed.

2.8.1 Statistical (Maxent) models

ISP 2012 questions whether proper QA/QC methods were used in compiling and treating species locality data before use in SDMs (see Section 2.7). There appeared to be inconsistencies between localities included on maps provided with species accounts and those used for SDMs, and some localities used for SDMs represent historic sightings in areas that are now developed and therefore inappropriate for this use (e.g., Mohave ground squirrel, Barstow woolly sunflower, coast horned lizard). There was also no documentation of whether coarse-resolution or inaccurate locality points were filtered out before modeling or any indication of an appropriate QA/QC screening process. Data resolution should be at a finer scale than model resolution. In addition, locality data are often biased due to uneven sampling effort, requiring some form of bias correction to minimize the influence of heavily sampled areas on model results (e.g., by filtering data to remove points closer than a minimum nearest-neighbor threshold distance to ensure spatial independence of the sample points, such as using an animal species' mean home range diameter). Maxent also has a built-in bias correction tool for this.

ISA 2010 also recommended carefully identifying the environmental factors most likely to affect each species' distribution and how these factors interact, and deriving meaningful variables from available data (e.g., using an insolation index based on slope, aspect, and elevation; Dubayah and Rich 1995). Instead, a single set of environmental predictors appears to have been used for all species, with no clear ties to their specific ecological needs. This "kitchen sink" approach is vulnerable to model over-fitting, inflated statistical confidence, and decreased utility for projecting future distributions under climate change. SDM modeling should start with key habitat constituents for each species (Guissan and Thuiller 2005) and use iterative modeling to identify and remove environmental data that contribute little to the model. Maxent has analytical tools to assist with such decisions, and Akaike Information Criterion (AIC) methods can be implemented to aid in model optimization (Warren and Seifert 2011).

ISA 2010 also recommended matching the scale and resolution of the environmental variables to the biology of each species. Modelers often average variables (e.g., land cover or road density) at a landscape resolution appropriate to habitat selection for each species, for example averaging over a circular moving-window based on home range size or seed dispersal distance (e.g., Spencer et al. 2011). The model extent (the geographic area covered by a model) should also be set individually for each species to maximize discrimination between selected versus unselected areas (e.g., by limiting it to the union of all ecological sections or subsections occupied by the species). However, it appears that all the Maxent models we reviewed used the same input resolution (the raw resolution of available variables?) and modeling extent (using the DRECP boundary) regardless of species' biology or distribution. For species whose ranges extend beyond DRECP boundaries, the model extent should incorporate a reasonable amount of area outside of the DRECP planning area to increase locality sample size and avoid biasing model results by truncating the range of conditions the species actually experiences. For example, for species like arroyo toad, whose range is mostly outside of DRECP, using the DRECP boundary

as the modeling extent provides a false depiction of model certainty (AUC = 0.999 despite only 23 training points) but with poor discrimination of their actual distribution in the Plan area.

Several assessment statistics can be used to evaluate model performance, including: Boyce index, Cohen's kappa, and AIC. While AUC statistics were presented with the models we reviewed to demonstrate model performance, the inappropriate methods described above caused these metrics to be inflated in many cases (e.g., AUC values $\geq$ 0.99) without metrics of model uncertainty (Lobo et al. 2008, Phillips et al. 2006, Raes and Steege 2007, Warren and Seifert 2011). AUC is often used to characterize model performance due to its ability to assess model performance through the entire range of habitat suitability scores, rather than being dependent on a threshold like the Cohen's kappa score (Pearce and Ferrier, 2000). However, the AUC score is not without drawbacks, and can mislead researchers into choosing models that actually provide a poor fit to the data, but with good discrimination ability (e.g., the ability to correctly classify training data into presence or absence; Lobo et al. 2007). Due to these shortcomings we recommend the use of multiple statistics to assess model performance, including using multi-fold cross-validation methods (which are easily done in Maxent; Lobo et al. 2008, Phillips et al. 2006, Raes and Steege 2007, Warren and Seifert 2011). Furthermore, model performance and accuracy should be stated after models are thresholded. Collectively, the decisions made thus far in the models we reviewed have contributed to grossly inflated estimates of model accuracy and reduced discrimination.

2.8.2 Expert-opinion Models

Expert-opinion models were used for species having insufficient locality data for Maxent modeling. The assumptions behind the models we reviewed are unclear, and transparency is essential. From the draft documents it is difficult to connect the habitat needs from species accounts to the variables used in models (e.g., how *specifically* were SSURGO or NRCS soil classes translated into habitat variables for sand-dwelling species, and which horizons were used?). The methods described for the expert-based SDMs (Appendix C 3.1) list the GIS layers available for model development, but states that "not all data layers were needed or used in every model," with no documentation of the process used to select variables for each model. This reduces the transparency of the process, our ability to evaluate it, and ultimately confidence in the results.

Climate variables did not appear to be used in the expert-based SDMs (i.e., none are listed in Appendix C 3.1), despite the fact that some climate requirements are known for many of the species (e.g., some temperature preference information is given for flat-tailed horned lizards). These variables are essential if expert models are also to be used to forecast future distributions under climate change. By far the majority of the species accounts go only as far as listing elevational limitations to species distributions, rather than the mechanisms behind these patterns. We recommend using more environmental gradient variables (e.g., an insolation index, evapotranspiration index, seasonal or annual precipitation, temperature means and extremes, and distance from water sources, depending on species). For models intended for use in predicting future conditions, variables that confound with climate (e.g., elevation, slope, and aspect) should be excluded to avoid obscuring the influence of climate change.

We are unsure why both expert models and statistical models were prepared for many of the species. Given the inherent work load that is needed to complete the scope of work required for this effort, we recommend focusing on only the appropriate model for each species, with a preference toward statistical, rather than expert-opinion, models whenever possible (as recommended also in ISA 2010). Statistical models, if properly constructed and parameterized, can be readily adapted to predict changes based on climate changes.

2.9 Reserve Selection and Design

ISA 2010 recommended identifying (1) areas important to conservation and (2) areas not important to conservation, where utility-scale energy development projects could be preferentially sited. The DRECP *appears* to be following these recommendations via the two separate paths of reserve design and DFA delineation, but it is not clear to ISP 2012 how these two paths are to be integrated into a final conservation design. We were asked to review methods being used for reserve design. However, we were not provided with, nor asked to comment on, the methods, data, assumptions or results of the analysis undertaken to estimate the quantity of renewable energy needed to meet state mandates, the acreage required to obtain this quantity of renewable energy, the quantity of this renewable energy that is to be sited in the DRECP area, and the processes used for delineating DFA alternatives. We are concerned that this lack of transparency about the DFA delineation process could undermine stakeholder confidence in the outcomes. ISA 2010 had similar concerns about lack of transparency in reviewing the 2010 REAT "Starting Point" maps, which also identified areas potentially suitable for development, but with no supporting methods or data (see Section 4.1 of ISA 2010).

2.9.1 Protected Areas and Gap Analysis

In Plan Chapter 3.3, Dudek and ICF (2012) describe 4 protected area types (Types 1, 2, 3, and 4) as consistent with widely used Gap Analyses and conservation practices. The ISP recommends refining these categories and the mapping of reserve areas based on the following considerations and data sources. There is a long history of public involvement in developing land management plans in California's deserts since 1973 that appears not to be fully reflected in the DRECP documents we reviewed. The ISP recommends that the Gap land types be refined to better suit the existing situation regarding land uses, dedication, and management by government agencies and private entities in the planning area. The following are recommended refinements:

- Type 1 is defined as managed conservation lands protected in perpetuity and includes Wilderness Areas and National Park Service Lands, among other lands. Note that, although the assumption of perpetual protection is generally reasonable, the U.S. Congress has authority to remove lands from protection or alter allowable uses. Most important are the specific land management uses allowed on various lands (e.g., grazing). We recommend researching more carefully the specific land management actions allowable and not allowable on the various Type 1 lands and their compatibility with DRECP goals.
- "Private Non-profit Conservancy Lands" are listed in Table 3.3-1, as Type 1 lands, yet many of these lands do not appear to have been mapped and included in the reserve design process. Properties held by the Desert Tortoise Preserve Committee, Riverside Land Conservancy, and the Mojave Land Trust are protected through conservation easements or other contracts and agreements as mitigation banks. These lands qualify as Type 1 lands and should be

treated as reserves protected in perpetuity. The National Conservation Easement Database should be consulted for other lands protected by easements that could be included as Type 1 lands: http://app.databasin.org/app/pages/datasetPage.jsp?id=d85fb27b3b8f440ca2aeee2fc6f930bd.

- BLM has considerable holdings acquired under formal contracts and mitigation agreements for Threatened and Endangered species and BLM Sensitive Species. These lands are to be managed for the agreed-upon use (e.g., Threatened or Endangered species protection), and thus should be shown as Type 1 lands. Likewise, the State of California's Wildlife Conservation Board/CDFG holds similar lands, not all of which are in formal "Ecological Reserves." They may be in BLM ACECs. A map should be generated to show these lands, because they are not available for renewable energy development or uses incompatible with the intended purpose. Updated data for many of these lands are available from the BLM National Operations Center. However, care must be taken to make sure each site actually prohibits different activities, because they are not all managed the same way
- The land types fail to take into account various protections provided by existing BLM land-use plans. Also missing are lands protected from livestock grazing and mining. Some of these lands are even more protected than Wilderness Areas, because they have been withdrawn from livestock grazing and are fenced, designated as Research Natural Areas (see Code of Federal Regulations), or designated as Critical Habitat for Threatened and Endangered species. These types of lands are not shown in Table 3.3-1 and appear not to have been considered in the reserve planning process.
- We especially stress the importance of continuing to conserve the Desert Tortoise Research Natural Area (DTRNA) because of its high-quality tortoise habitat and its long history of undisturbed research on desert tortoises and other species. The ISP is concerned that this important conservation and research area appears to be at least partially included in several DFA alternatives, rather than treated as a Type 1 reserve area. The DTRNA has a long-term record of research on tortoise ecology, the effects of various stressors (e.g., sheep grazing, diseases, predation, and OHV use), and the effectiveness of mitigation actions (e.g., fencing), as well as research on other desert species and ecological processes. In addition to its relatively dense tortoise population and high habitat value, the DTRNA's history of research makes it invaluable not only to tortoise conservation, but to adaptive management of the Mojave Desert. This deep and long-term data set is not replicated anywhere else in the Plan area, and it represents an important baseline for adaptive management. See Appendix Efor a more detailed assessment of the DTRNA's contributions to research and management.

2.9.2 Reserve-selection Algorithms

The consultants have followed ISA 2010 recommendations to apply objective site-selection algorithms and modify the outputs using well-established reserve-design principles. They used an appropriate planning tool (Marxan with Zones) and developed a rational set of scenarios with incremental changes in assumptions. However, the documents we reviewed did not adequately describe the methods, assumptions, and key decision points such that they could be independently replicated. For example, assumptions for estimating zone-specific conservation and energy values and costs were unstated, and no interpretation of the scenario analyses was provided to illustrate the impact of each additional constraint. The ISP refers the consultants to a best practices handbook (Ardron et al. 2010) for guidance on many of the issues discussed below. Although the handbook was developed for Marxan, most of the points apply equally well

to Marxan with Zones, which was derived from Marxan (Watts et al. 2010). The reserve selection and design steps will need to be repeated using revised species distribution models and other adjustments, and should be done in collaboration with experienced conservation planners.

The ISP also recommends a more careful review and integration of additional datasets on protected lands, because we noted some important protected lands that appeared to be missing (see Sections 2.7 and 2.91). Finally, we note that reserve selection and design are strongly driven by Covered Species concerns, which may not adequately account for broader goals of biodiversity conservation. ISA 2010 recommended identifying Planning Species, for which permit coverage is not required but that may be useful for achieving other Plan goals, such as reserve design and adaptive management. This recommendation has not been followed to date, and ISP 2012 recommends reconsidering whether adding some Planning Species may be useful. For example, including additional desert-dependent species along with Covered Species in the reserve-design modeling process may help accomplish a more balanced plan-wide reserve system. Cameron et al. (2012) used 521 plant and animal taxa and 44 vegetation communities and Marxan to identify 740,000 ha of land in the Mojave that could be suitable for meeting renewable energy project requirements and that were of low conservation value.

ISA 2010 suggested the following elements as essential conservation targets for which high representation goals should be established (i.e., approaching 100% in some cases): ISP 2012 notes that, although most of these elements were apparently addressed in the reserve design process, lower conservation targets were generally used in Marxan with Zones, and it is unclear exactly how these elements were addressed in the post-Marxan reserve-design process.

- Unique Plant Assemblages (UPAs) as identified in Section 2.4.1 of ISA 2010.
- Special Features, as identified in Section 2.7.
- Areas of known importance to key Covered or Planning Species, including at least the following:
    - desert tortoise critical habitat and other protected areas for the tortoise;
    - bighorn populations and linkages;
    - "core populations" and hypothesized linkages for Mohave ground squirrel;
    - populations of species that are endemic or near-endemic (e.g., over 75% of total distribution) to the planning region;
    - known habitat or populations of other species that are determined to be at high risk of extinction within the planning region including designated CDFG SSC and BLM SS);
- Linkages between core habitat areas identified by any of the following: the California Desert Connectivity Project (Penrod et al., in preparation), South Coast Missing Linkages (SCML) Project (Beier et al. 2006, South Coast Wildlands 2008) and California Essential Habitat Connectivity (CEHC) Project (Spencer et al. 2010).
- Habitat predicted to be essential to accommodate distributional shifts, in response to climate change, as predicted based on existing (e.g., Wiens et al. 2009) or future models.

- Areas important to maintaining dynamic geological processes, including eolian sand sources, wind corridors, and settling areas.
- Hydrologically important areas (e.g., washes, groundwater recharge areas, springs, seeps, etc.), including first- through fourth-order washes and washlets.

The review document described assessing representation of Covered Species and communities across the "ten DRECP Ecoregions" as part of the Iterative Reserve Design Analysis. The document did not say if the design was modified to ensure adequate representation and did not define "adequate." The ISP recommends that a more objective approach would be to disaggregate conservation features into their Ecoregional subsets and treat each as a separate feature-Ecoregion entity with its own target. This would ensure adequate geographic distribution of protection. The plan-wide distribution of features can also be assigned conservation targets if the sum of Ecoregional targets is less than the plan-wide target.

As with other models, Marxan with Zones requires a large number of choices in addition to the conservation features discussed above. Many important choices for the DRECP Reserve Design process were not described, not to mention justified, in the review documents. Once again, this reflects a lack of transparency in the planning process and makes it difficult for the ISP to judge its scientific merit. These omissions include:

- Planning units are the spatial building blocks for designing the reserve system. The size and shape of planning units can influence the reserve design. Bigger units tend to be less efficient at meeting conservation targets because they generally include land with low conservation values (Davis et al. 1996, Pressey and Logan 1998). They also determine how precisely the boundaries of existing protected areas can be characterized. The number of Marxan runs and iterations needed to converge on good solutions also depends on the planning units (Ardron et al. 2010). Using many small units requires longer runs to explore the larger decision space than fewer large units. Units should also be consistent with the purpose and scale of the reserve design and the resolution of data inputs (Ardron et al. 2010). Therefore units must be chosen carefully and clearly documented.
- Marxan with Zones allows planners greater flexibility in allocating planning units than the simpler reserve-or-not option of the original Marxan. Zones can represent intermediate management levels with partial conservation value and/or resource value, usually with different costs. The initial reserve design process generated five primary scenarios beginning with simply meeting biological targets and then systematically adding additional constraints of existing protected areas and potential renewable energy focus areas. In each DRECP scenario generated by Marxan with Zones, the software allocated planning units to three potential zones—Reserve Zone, Compatible Use Conservation Zone, and Development Focus Area Zone. The documents reviewed by the ISP provided no explanation about why zones were needed at all, the objectives of each zone, what the respective costs and benefits were, and the basis for those assumptions. The final documentation needs to explicitly describe this information. In particular the ISP could not determine the intent of the Compatible Use Conservation Zone. The oral presentation at the ISP workshop public session indicated that the Development Focus Area Zone had no conservation value and that

the Compatible Use Conservation Zone had 0.75 conservation value and zero energy value. Additional comments on the Development Focus Area Zone are located in section 2.9.3.

- The objective function in Marxan with Zones is to minimize costs, defined as the sum of the management/acquisition cost of allocating planning units to zones, a penalty cost for not meeting conservation targets, and another penalty for failing to aggregate planning units into sufficiently large reserves. Reserve designs can be highly sensitive to these costs and the relative weights between them. The review documents provided no information about cost values or the basis for them. The algorithm will always select planning units for the Reserve Zone with full conservation value over the Compatible Use Conservation Zone with reduced value unless the cost of the latter was less or some other constraint was invoked. What were the costs for the DFA Zone in scenarios 1-3 and 5, and how were they reduced in scenario 4 for Renewable Energy Study Areas as an incentive? Were conservation and energy costs different for public versus private lands? The importance of costs in reserve design suggests that a sensitivity analysis be conducted.

- Aside from parameters directly related to reserve design principles, such as conservation targets, Marxan with Zones also requires a number of other technical parameters that should be provided by experienced conservation planners (Ardron et al. 2010). These parameters include the number of restarts and iterations to allow the simulated annealing process to converge on near-optimal solutions, the penalty for failing to meet a conservation target, and the factor for clumping planning units in a zone. The quality and sensitivity of solutions from Marxan with Zones can be affected by the choice of parameters (Fischer and Church 2005). Best practice calls for exploring the effects of variation in the parameter values and documenting how the final values were determined (Ardron et al. 2010).

Completing all the analysis of scenarios with variations in conservation features and targets provides a crucial opportunity for communication of the key findings before advancing into the iterative reserve design analysis (section 2.9.2). What areas appear essential to the conservation plan? Are there other issues with those locations? Which conservation features are driving the solutions in Marxan with Zones because they are the most challenging for meeting targets? Where are the largest trade-offs between renewable energy and conservation value? The ISP notes that such an interpretation and synthesis of the Marxan with Zones analysis was not presented in the review documents.

2.9.3 Iterative (Post-Marxan) Reserve Design

As recommended by the ISA 2010 and best practices generally (Ardron et al. 2010), the preferred Marxan initial reserve design was iteratively modified with expert input on factors not easily integrated into Marxan with Zones. This crucial step was not documented in any detail beyond general summaries of conservation principles and generally vague statements that these additional features were considered. Section 3.4 of the Draft Plan document did not identify the experts who made the modifications to the initial reserve design or reviewed it for achievement of biological goals and objectives. Documenting this process is crucial for transparency.

Marxan with Zones generates many different outputs for each scenario, including a "best" solution (i.e., most efficient) and "summed solution" or the number of times a planning unit was

selected out of all the runs or restarts. The review documents suggest that the summed solution or frequency of selection for scenario 5 was used as the basis for the iterative reserve design analysis. The documents, however, are vague about this, indicating only that areas selected "most frequently" formed the starting design. How was this threshold decided? Experts also warn against using summed solution as the same thing as importance because a site may be selected many times in poor solutions while a really good site may not be selected so often (Fischer and Church 2005, Ardron et al. 2010). The ISP recommends that all the results from the scenario analysis discussed in section 2.9.1 be used to inform the initial reserve design that forms the basis of the iterative process.

The ISP recommends that the reserve design process more explicitly consider future conditions in the Plan area to ensure that areas identified as DFA's or Conservation areas remain compatible with their intended use as future conditions change. Given the likelihood for a variety of interacting processes to change in the future, the integrity of ecosystem structure and function within the Reserve under changing conditions needs to be considered. Furthermore, analysis should include time periods throughout the reserve period (e.g., 5 year increments) rather than just the start and end. The AMP needs to also reflect the changing and interacting conditions.

The iterative reserve design process partially described in the review documents could be considered a "dry run" to produce a prototype of a biologically based reserve design. Between ongoing revisions by the consultants (e.g., improvements in species distribution modeling) and our recommendations, the ISP 2012 assumes that the inputs to the Marxan with Zones analysis will be modified. Consequently, the initial reserve design from scenario 5 will be different, and all the iterative design modifications will need to be redone. The ISP recommends that the REAT agencies and consultants, supplemented with other experts, hold a "post-mortem" session to codify this process to be as effective and transparent as possible for the final implementation.

2.9.4 Development Focus Areas

DRECP is delineating Development Focus Areas (DFA) where the Covered Activities are primarily expected to occur to meet the plan's renewable energy goals and objectives. DFAs were not within the scope of the ISP 2012 review, but the panel points out that DFAs interact with the biological domain in two essential ways that make it difficult to avoid commenting on this critical aspect of the Plan. Further compounding the challenge for ISP 2012 is that DFAs were used for two distinct purposes that had little apparent connection. First, DFAs were used as a "zone" in the Marxan with Zones analysis. This device was merely to attempt to induce avoidance of areas with renewable energy value in designing the initial reserve system. Lands allocated to the DFA Zone, however, were not carried forward in the plan. The DFA Zone was constrained in scenario 5 (and emphasized by an unidentified incentive in scenario 4) to previously-identified Renewable Energy Study Areas (RESA). RESAs were delineated by the REAT agencies in part for having low biological conservation value, although this was done before the spatial data on conservation features were compiled and modeled. ISP 2012 did not have the opportunity to review RESA delineation, despite this biological value assessment.

Second, configurations of DFAs were designed for the Plan alternatives based on different geographic and other drivers. This process was still underway at the time of the ISP 2012 review and thus was outside the scope of our review. From the summary in review documents

concerning how that process would be performed, the alternative DFAs would be overlaid on the biologically based reserve design, and the latter would be modified as needed to achieve biological Goals and Objectives. The same recommendations for the iterative reserve design analysis (Section 2.9.2) also apply to DFA design analysis. ISP 2012 thinks a more defensible approach would be to delineate the reserve system first, without considering potential development areas (DFAs), and then overlay DFAs to determine areas of conflict. Rather than altering the reserve system, however, we recommend it is better to alter the DFAs to avoid placing developments in areas deemed important for conservation purposes.

This disconnect between these two distinct DFA processes makes it hard to judge whether the resulting Plan will provide the best balance between biological and renewable-energy goals and objectives. Marxan with Zones is intended for planning situations where multiple uses must be allocated with different levels of conservation management and resource use. To date, DRECP appears to be using it essentially to design a reserve system—*given* that lands deemed suitable for development are considered off-limits for inclusion in the reserve system—while designing the resource use areas by a separate process. The original Marxan may be better suited to this conventional conservation planning problem than Marxan with Zones. In Marxan, the desired avoidance of conflict between conservation and renewable energy could be accomplished by assigning an energy "cost" to planning units within RESAs. An alternative approach would be to use the DFA Zone in the Marxan with Zones analysis more fully in designing alternatives. That is, instead of designing a biologically based reserve system informed by energy opportunities, then modifying it for other conservation principles and features, adding DFAs, and modifying the reserve design again, the alternatives themselves could be designed initially with Marxan with Zones and modified once for other features. This approach would minimize the conflicts specific to the alternative rather than the current approach, which attempts to minimize conflicts more generically. If neither of these two recommendations is followed, ISP 2012 at the very least recommends that the term "DFA Zone" in the Marxan with Zones analysis be changed to avoid our confusion with DFAs in the alternatives.

2.10 Adaptive Management and Monitoring

Consistent with ISA 2010 recommendations, ISP 2012 considers *a well-designed Adaptive Management Plan to be the most critical element of a successful DRECP*. Desert ecosystems are less well studied than other biomes, elevating uncertainties and the importance of adaptive management. For example between 2000 and 2011 most scientific publications in ecology focused on forest biomes (67%) as compared with desert systems (9%) (Durant et al. 2012). Due to huge uncertainties about the effects of development and management actions in the deserts, ISA 2010 strongly recommended developing key aspects of the Adaptive Management and Monitoring Program at the beginning of Plan development, and initiating some monitoring actions early—during planning—rather than waiting until the conservation plan is drafted:

> "*In essence, DRECP should be treated as a huge environmental experiment that should be developed and implemented incrementally in an adaptive management framework—with continuous monitoring and scientific evaluation to reduce uncertainties and improve plan actions over time*" (ISA 2010, page 85).

Unfortunately, this recommendation has not been followed, the critical adaptive management framework is only partially drafted, and opportunities to collect and learn from monitoring data have been missed.

Section 6 of ISA 2010 also provided comprehensive guidance on developing an effective adaptive management and monitoring program, including its institutional structure, use of hypothesis-based monitoring, appropriate sampling designs, and important research studies to fill critical information gaps. The following sections reiterate, update and elaborate on these issues.

2.10.1 Implement Monitoring and Adaptive Management Immediately

Given uncertainties about the impacts of diverse renewable energy developments and associated infrastructure on covered species and communities, ISA 2010 recommended that DRECP should *immediately begin developing and implementing monitoring protocols and securing access to lands proposed for renewable energy development*. It went on to say:

> Researchers from governmental and nongovernmental research institutions *must have access to lands proposed for development before, during, and after construction and operation of energy developments and appurtenance structures.* Access prior to construction is necessary to characterize ecological baseline conditions in and near proposed developments and thus allow Before/After-Control/Impact (BACI) sampling designs (Green 1979). BACI designs allow for much stronger inference about impacts of developments on biological resources than the "after-the-fact" monitoring typically implemented by conservation plans. Results of these studies should be used to evaluate impacts during and after construction, and use the results to inform future developments. Moreover, the Plan should initiate some systematic, landscape-scale sampling across the study area to better characterize baseline environmental conditions prior to implementation of large-scale energy developments and further climate change.
>
> *The advisors recommend obtaining additional scientific input as soon as possible to assess monitoring priorities, metrics, sampling designs, and related matters to implement at renewable energy projects permitted during within the coming months or year.* Solid baseline sampling should occur as soon as possible, prior to any construction. Monitoring designs and protocols can be modified over time, but it is essential that initial sampling is robust to any likely changes to ensure comparable data over time. Detailed monitoring recommendations were beyond the scope of this science advisory report, given available time (ISA 2010, page 86).

ISP 2012 observes that these foundational recommendations have not been followed and we re-emphasize their importance. *We strongly recommend convening one or more science advisory panels as soon as possible to help prioritize monitoring tasks and methods so that useful information is being collected before too much more time passes.*

2.10.2 Framework and Institutional Structure

ISA 2010 pointed out that a key principle of the adaptive management process is that *the process of transferring and transforming the results of technical analyses into knowledge to support decisions cannot be taken for granted in the hope that it will occur in the absence of a body*

specifically charged with making it happen. This function requires remarkably skilled people, who are truly inter-disciplinary ("polymaths"). Whatever their training, these individuals (or team of individuals) need to be comfortable with a wide range of technical information, as well as understand the functioning of government, law, economics, and the management of large projects. ISP 2012 re-emphasizes the importance of these recommendations.

ISP 2012 notes that the Adaptive Management framework is not yet developed and the institutional structure not yet fully defined. An Implementation Structure is only vaguely described in the partial draft of the Adaptive Management and Monitoring section (Chapter 5) that ISP 2012 reviewed, and the definitions of many key entities are deferred to a Chapter 8 that either does not exist or that ISP 2012 was not provided. A well-defined structure should have the roles and responsibilities of all entities, as well as their relationship mechanisms, clearly established. For example, the ISP 2012 recommends an institutional structure or process with strong, senior scientific leadership, perhaps as a technical advisory committee to provide ongoing guidance to those implementing the Plan. The draft Plan's Implementation structure appears to include scientific participation inside and outside of the Implementation Structure (in Section 5.5.2 Advisory Participants under Section 5.5 Implementation Structure for MMP, and in Section 5.6 Outside Input); however the roles of these two sets of scientific participants are undefined and their distinction is unclear. A role of the Implementation Structure entities should be to collectively and clearly establish the quantitative objectives of the DRECP, particularly which species and processes should be targeted and prioritized for monitoring, and what are the threshold criteria for a management action.

2.10.3 Monitoring Design and Research Recommendations

ISA 2010 recommended developing statistically robust monitoring designs to (1) clearly establish the effects of new developments and mitigation actions on covered species and communities, (2) better understand population distribution and dynamics of key covered or planning species, and (3) establish baseline conditions across the planning area to better understand and respond to future changes, due, for example, to climate shifts. ISA 2010 also endorsed (4) additional research on genetic and demographic connectivity of select species' populations across the study region to better delineate important landscape connectivity areas for conservation and adaptation to climate change. ISP 2012 re-emphasizes these recommendations and adds that the scope of monitoring, how the data will be compiled, managed and analyzed, and what thresholds will trigger adaptive management, should be developed as soon as possible with input from an expert panel of desert ecologists, statisticians, and other relevant experts. We provide further details on this recommendation in Section 4.6.

2.10.4 BACI Design for Renewable Energy Developments

ISA 2010 strongly recommended establishing BACI sampling designs (Green 1979, Underwood 1994, DeLucas et al. 2005) as early as possible to cover a carefully considered range of species, ecological conditions, and impacts. *A critical issue is that access to researchers must be established in potential renewable energy development areas before, during, and after development.* As explained by ISA 2010:

> "The basic idea is to establish impact sites (e.g., areas to be developed) and control sites (those with no development) and to sample them before the impacts occur (to establish

> comparable baseline conditions in the two types of sites) and after the impacts occur (for sufficient duration to observe an environmental response to the impacts). Only with this sort of design can one differentiate spatial and temporal influences to better understand potential cause-effect relationships between the development and the environmental responses….DRECP should establish requirements for research and monitoring access as a condition on renewable energy permits, and should use results of BACI studies to refine siting, mitigation, and other requirements for future permits."

ISP 2012 re-emphasizes the importance of establishing well-conceived BACI monitoring designs as soon as possible. Importantly, accurate characterization of conditions *before* impacts may require multiple seasons of work. As such, we re-emphasize the importance of beginning planning such studies *immediately* so that field studies may be implemented as soon as possible. The Adaptive Management science workshop(s) recommended in Sections 2.10.1 and 4.6 should identify monitoring priorities and sampling designs for BACI studies.

Details on various forms of BACI designs and their advantages can be found in the literature (Morrison et al 2001). This includes BACI with temporally replicated samples in both the before and after periods to measure natural temporal variations—so that it can be statistically distinguished from an impact effect that is only measured in narrow time intervals (Hurlbert 1984, Underwood 1994)—and BACI with temporal replication at uneven time intervals in order to avoid cyclical biases (Stewart-Oaten et al 1986). As with other monitoring components of the DRECP, BACI studies should be oriented towards answering specific questions, in the form of hypotheses to be tested or confirmed, that serve the goals and objectives of the DRECP.

2.10.5 Population Monitoring

ISA 2010 recommended using site occupancy estimation measures (Scott et al. 2002, Manley et al. 2004, MacKenzie et al. 2006) for monitoring covered species populations. ISP 2012 supports these recommendations and adds that, in addition to providing a relatively inexpensive alternative to population size estimates, the systematic monitoring of presence-absence data would provide data for testing and updating of population distribution and habitat suitability and selection models. Such updates can be critical under different contexts across time. Across periods of management actions or land use changes, post-treatment presence-absence data provides new information on the impacts of those changes. Across periods of little land change, presence-absence data can confirm and validate model-based predictions as well as improve the reliability of future prediction models. Such validation is currently lacking as the statistical assessments of model accuracy utilized in the draft DRECP are most likely inflated.

2.10.6 Focused Research Studies and Surveys

ISA 2010 recommended some focused research studies and surveys to fill critical information gaps. ISP 2012 supports these recommendations and adds the following refinement:

- **Fatality monitoring**. Guidelines for producing credible fatality estimates of bats and birds at wind energy facilities in California already exist (CEC and CDFG 2007). The existing Guidelines (CEC and CDFG 2007) should be modified for implementation at other types of renewable energy developments (e.g., solar) and associated infrastructure within the DRECP. Importantly, *a framework for compiling and tracking fatality rates from individual facilities*

should be established and made publicly available. Such a database will facilitate comparison among sites and technology types and ultimately allow for adaptive learning about the impacts of various renewable energy impacts on bats and birds.

2.10.7 Other Environmental Monitoring

In addition to monitoring biotic conditions and processes, ISA 2010 recommended that at least the following physical conditions and processes should be systematically monitored using BACI designs for new developments and to establish baseline conditions and changes throughout the planning area. ISP 2012 re-emphasizes the importance of these monitoring recommendations:

- Ground water levels and impacts—e.g., to determine whether water use or hydrological effects of developments are adversely affecting water tables and dependent resources.
- Local weather and impacts—e.g., to determine whether large solar arrays or wind energy developments may affect local or regional climate conditions (Baidya Roy and Traiteur 2010) and hence ecological conditions.
- Erosion and deposition effects—e.g., to determine whether developments are altering soil erosion/deposition processes, eolian transport and dune maintenance processes, or levels of toxins in the atmosphere or on desert vegetation and watersheds.

2.10.8 Adaptive Management for Renewable Energy Technologies

ISP 2012 recognizes that over the next 20 to 30 years, renewable energy technologies are likely to continue evolving in terms of increased conversion efficiencies and potential for reduced environmental impacts (e.g., developing more efficient air cooling technologies for solar thermal plants). ISP 2012 recommends that the DRECP Adaptive Management Plan include provisions that recognize likely evolutions in technology, as well as incorporating lessons learned through the implementation of recommendations in this report. ISP 2012 suggests that the Adaptive Management Plan incorporate the following principles:

- As renewable energy technologies improve over time, agencies should encourage developers to site only the most efficient technologies (in terms of maximizing the quantity of Megawatt-hours produced per acre) within the DFAs.
- Based on the data developed through future environmental monitoring, long-term BACI studies, and other recommendations of this report, industry, NGOs and agencies should constantly seek to modify and improve best management practices for project siting, construction, operations and maintenance, and decommissioning.

3 Reviews of Plan Documents

ISP 2012 reviewed various draft documents, maps, and other materials prepared by DRECP consultants and agencies (Appendix C). The focus of our review was on (1) how well these documents adhere to sound scientific standards and principles, including how well they followed ISA 2010 recommendations, (2) how well they clearly and transparently described the data, methods, assumptions, uncertainties, and conclusions of scientific analyses and assessments, and (3) how well such scientific information was being applied to the planning process to help with achieving Plan goals. Our review of these draft Plan documents was hampered by the fact that, at this phase in DRECP development, there is no comprehensive Plan document, but rather an

incomplete set of draft pieces of the document that don't provide a complete overview. We again acknowledge that many of the documents we reviewed are draft consultant products that had not yet been vetted by the REAT agencies. Nevertheless, at this point at least, the draft Plan sections do not represent a complete, transparent, repeatable or understandable description of a conservation plan.

3.1 Document Transparency and Clarity

All key decisions in the planning process, and all scientific methods and assumptions, must be clearly documented to conventional scientific standards of transparency such that the rationale behind each decision is clear and the results of all analyses could be independently reproduced. Specifically, it is critical to document the many decision points about data, models, assumptions, parameters, expert judgment, spatial and temporal scale, and use of peer review so that a reviewer or planner could understand what was done, how, and why—and where the greatest sources of uncertainty remain.

Our review of draft documents found a pervasive lack of transparency about many such key decisions—from the process used to identify Covered Species to the methods used to define DFAs—despite the fact that transparency was also a foundational recommendation of ISA 2010. The documents often identified data that were used without describing what efforts were made to search for the best available data, how data were processed, what QA/QC procedures were used, and specifically which sources of data were used in any given analysis. We frequently found it difficult to identify key assumptions, and even in cases where they were clearly stated, most were not justified by citing literature or an identified, credible expert. Many decisions were based on expert judgment without making it readily apparent who the experts were, how their input was acquired and integrated, and whether they subsequently approved of the methods and results. Each of the decision points introduces uncertainty that is propagated into the Plan. The risk of insufficient transparency is that stakeholders may question whether the best available science was truly used, which could lead to delays in Plan approval and permitting. This outcome is possible even if the planning process met high scientific standards but was documented poorly.

3.1.1 Presentation Style and Organization

All Plan documents, including all supporting technical documents and appendices, should be *clear, concise, informative, complete, and accurate*; and *each document and section should provide a clear contribution toward Plan goals*. At this stage in Plan development, there was no comprehensive Plan document for ISP review, and it was very unclear to us how the various components we reviewed are intended to fit together into an integrated Plan. Many of the draft documents vaguely describe planning components and processes, with no clear depiction of the strategic vision or goals they are intended to attain, how they relate to other Plan components, how various goals or actions may compete with one another, or the rationale, data, methods, and uncertainties involved. For example, although the Biological Baseline Report (Dudek and ICF 2012) compiles ample useful information, it provides no clear direction on how that information is to be applied as a foundation for planning, and indeed we saw little evidence that important Plan components (e.g., selection of Covered Species, species distribution models, reserve selection and design, adaptive management) adequately incorporated such information. Each

section of the report should state upfront goals that link back to the overarching goals and context of the Plan.

Much of the writing we reviewed was wordy, redundant, and confusing. A technical editor with a strong background in ecology should be employed to purge unnecessary verbiage, ensure consistency of terms, and ensure that all essential information is presented as clearly and concisely as possible. A more concise, strategic, goal-directed approach to documenting the Plan will convey an impression of crisp competence, and increase confidence by readers that this Plan is well conceived and constructed.

Example improvements to verbose phrases:

- "provides a graphical representation of" = "illustrates"
- "plan-wide biological reserve design context" = "reserve design" or "reserve system"
- "This section provides a brief summary of" = "This section summarizes"
- "The process to estimate the effects" = "Estimating effects"
- "Calculate an estimate of impacts" = "Estimate impacts"
- "The primary purpose of the conservation analysis is to evaluate" = "The conservation analysis evaluates"

Some of the writing is also confusing or counter-intuitive:

> "…larger polygons bounded by roads were considered less rural and smaller polygons were considered more rural."

This use of "more rural" or "less rural" is awkward and counter-intuitive, as "rural" is usually contrasted against "urban," whereas this usage seems to contrast it against "wild" or "undeveloped."

Clarity could also be added by writing in the active voice. Documents we reviewed were written in the passive voice, which causes ambiguities: Not only do readers not know how something will be done, they also do not know who will do it. For example, the following is stated with regard to the compilation of available information:

> "A review of this information will also identify knowledge gaps and critical uncertainties that will need to be addressed in the development of monitoring and adaptive management models and actions, including the need to develop baseline information."

Who will conduct the review to identify the gaps? By what criteria will those gaps be identified, and who will address them once they have been identified?

The documents also rely heavily on extensive tables or matrices to summarize complex information, often with little effort to explain how or why the tabular information was derived, to synthesize the information into meaningful conclusions, or to help the reader understand the relevance of the information to the planning process or achievement of Plan goals. Synthesis is essential.

Finally, ISP 2012 found it difficult to navigate the documents when supporting detail was referenced to detailed appendices (which also omitted much important information). The use of hypertext could enable more precise navigation from overview text to the supporting material.

3.1.2 Review of Maps and Figures

Maps are an extremely important communication device for a conservation plan, and it is essential that all tell a clear and compelling story. We found many of the draft maps to be difficult to read and interpret due to poorly discriminated colors, confusing overlays and legends, extremely small fonts, and similar issues. For example Figure 4-1 of the Baseline Biology Report uses 18 shades of green, which are nearly impossible to discriminate, and an extremely small font, which is nearly illegible.

Some of the non-map figures (flow diagrams, etc.) could also be more carefully and meaningfully presented, or even omitted. For example, Figure 2 of the Biological Goals and Objectives Memorandum (June 14, 2012) is confusing and should either be redesigned to provide a clear and compelling message or dropped if the concepts can be more clearly conveyed in text.

3.2 Review of Baseline Biology Report

The Baseline Biology Report (Dudek and ICF 2012) compiles considerable useful information, but it is somewhat uneven in depth of treatment of various issues; and it is often unclear how the information is intended to serve as "a foundation for conservation planning." For example, Section 5 (Species Considered for Coverage) supplies lengthy summaries of each species' natural history, with no indication of how this information may be useful for developing a Conservation Strategy or defining Biological Goals and Objectives. This section could be made much shorter and more useful by focusing on the information most important for conservation planning, and how to apply this information. For example, is information about vocalizations, clutch size, incubation periods, etc., actually going to be used in designing a reserve system? Such detailed information is already provided in longer species accounts in Appendix B and need not be repeated here. Instead, we suggest that the accounts in Section 5 should focus just on those aspects of a species' biology that may interact with covered activities and are important to consider in reserve design and analysis. Accounts should conclude with *clear direction as to how these issues should be accommodated by the Conservation Strategy*. In other words, each section and subsection of the Baseline Biology Report *should frame and justify what the conservation Goals and Objectives are for a particular Covered Species, Natural Community, Ecological Process, etc*., *with guidance for how those Goals and Objectives can be achieved via Reserve Design, Adaptive Management, and other Plan aspects.*

ISP 2012 also noted a flaw in procedures on page 4-2 of the Baseline Biology Report: Road-bounded polygons $\leq$ 500 acres in size and on private lands were classified as "rural" and replaced any underlying natural land cover. This criterion resulted in an inappropriate classification of thousands of acres in the western, central, and southern Mojave Desert that have been acquired by land trusts and conservation groups as reserves. Furthermore, many such smaller parcels are targeted for future acquisition for such species as the Mohave ground squirrel, desert tortoise, and burrowing owl as part of mitigation agreements with federal and

state agencies. We do not understand why natural landcover, which may provide habitat value, would be replaced with a poorly justified land-use designation for purposes of conservation planning.

3.3 Review of Species Accounts and Maps

The ISP reviewed species profiles (Appendix B of the Plan documents) and species habitat models (Appendix C of the Plan documents). We examined these for adequate information for each species to address geographic distribution and habitat requirements, with a focus on the importance of the project area, current condition of habitat and populations within the Plan area, genetic diversity in extant populations, and life history characteristics important to conservation planning. We also investigated whether there is sufficient information provided to evaluate potential effects of climate change.

3.3.1 Review of Species Profiles (Appendix B)

Species accounts need to be based on the most recent and credible scientific information, published or in reports, because the information they provide is essential to reserve design, delineation of DFAs, and future planning. The potential impact of Covered Activities should be explicitly described and form the centerpiece of each account; and each account should focus on how the species' needs can and should be addressed by reserve design and adaptive management actions. In addition, each species account should contain data sufficient to determine whether the species will be affected by climate change. Many species accounts and their associated maps we reviewed did not meet these criteria. One example follows for Agassiz's desert tortoise.

Desert Tortoise. A recent analysis described Agassiz's desert tortoise (*Gopherus agassizii*) as a unique species with a geographic range only about one third the size of the formerly recognized "desert tortoise" range (Murphy et al. 2011). Over 70% of the geographic range of the Threatened Agassiz's tortoise occurs in the Plan area, emphasizing the importance of this species in the Plan. The Species Account is out of date regarding references and contains significant errors. It predominantly references old literature, doesn't deal with the genetic diversity that needs to be maintained in critical habitat and other protected areas, provides very limited and old material on foraging habits (e.g., missing papers by Jennings 1993, 1997, 2002; Oftedal 2002; Oftedal et al. 2002), presents nothing on home range or fidelity to home sites (several papers), contains serious errors on disease (several papers), and offers nothing on effects of drought (several papers, see section below on Climate Change). Perhaps due to these oversights, important considerations were not addressed in the climate vulnerability assessment we reviewed (Plan Appendix on Climate Change), such as the long period to reproductive maturity, low egg production, reliance on a limited selection of native annual plants and few perennial plants, requirement for drinking free water, and physiological responses to drought. The Species Account references the draft 2008 recovery plan and recovery unit boundaries that are no longer in the revised plan. The USFWS distributed the revised recovery plan in August 2011. With this very limited and deficient presentation, the Agassiz's desert tortoise does not receive the attention it deserves in either the proposed reserve system or in the climate change Appendix. The foundation of information critical for designing an appropriate reserve system to maximize genetic diversity (see Murphy et al. 2007) and conserve ecological, morphological, physiological, and behavioral differences is lacking. This account and subsequent

recommendations and decisions developed from it, should be framed to enhance recovery of the species. On August 15, 2012, Peter Paul van Dijk and Brian Horne, co-chairs of the IUCN's Tortoise and Freshwater Turtle Specialist Group, announced at an international meeting that *Gopherus agassizii* was to be upgraded from Vulnerable to Critically Endangered status on the international Red List.

3.3.2 Review of Species Habitat Models in Appendix C

In almost all cases, the habitat distribution maps, whether "expert-based" or statistical, show more suitable habitat than actually exists. One potential reason may be that urban, suburban, rural, agricultural, fallow, and other disturbed lands were apparently not excluded from the models. Thus the estimated geographic distributions of species appear to be displayed as if the deserts have experienced no development. Another reason may be the unconventional use of "Jenks Natural Breaks" for thresholding of suitable versus unsuitable habitats in statistical models. See Section 2.8 for general critiques of the modeling methods used and recommendations for improvements. This section reviews some additional issues with the model results, with a focus on some species-specific examples.

Some maps show large stretches of water (blue) in Superior, Death and Panamint valleys. These lakes are dry (playas) that occasionally have standing water during winter rains. In Death Valley, thin stringers of marsh occur in limited areas, and the lakebeds may have standing water for brief periods. The same blue color was used for Owens Lake and the Salton Sea. Owens Lake has limited areas of standing water, recently created artificially for the purpose of reducing dust, whereas the Salton Sea is a large year-round standing body of saline water. Assuming that ephemeral waters on playas are permanently standing water may account for some inaccurate species maps that erroneously show suitable habitat in Death, Panamint, and Searles valleys. For example, the statistical habitat model for the Yuma clapper rail shows significant habitat potential in the Mojave Desert at Cuddeback Dry Lake. Cuddeback Dry Lake is a playa that only temporarily fills with water following rains and does not support vegetative cover needed by rails. Similarly for the bald eagle, some of the supposedly suitable habitat identified on the map appears focused on playas, such as Rogers Dry Lake, Koehn Dry Lake, and Searles Dry Lake. Some of these playas have ephemeral waters, whereas others, like Searles, are sites of major chemical operations—and of course none of them support fish. Although bald eagles may pass over and stop when the playas have water, the map presents an inaccurate picture of potential occurrences and "habitat" use.

Other examples of poorly depicted habitat distribution include, but are certainly not limited to:

- **Coast Horned Lizard.** The expert-based Species Habitat Model provides a serious overestimate of potential habitat; developed areas and heavily disturbed areas should be excluded. While the draft statistical model is more reasonable, it too, needs to exclude developed areas. The figure shows habitat in areas within towns and scattered rural developments along the southern edge of the Antelope Valley, and toeslopes of the San Gabriel and San Bernardino mountains. Much of the area shown in the Antelope Valley at lower elevations is farmland, abandoned or fallow agricultural fields, or otherwise severely disturbed. It may have been cleared during dryland farming or for development or be fallow.

- **Mojave Fringe-toed Lizard.** Both the Expert-Based Model and the Statistical Model maps show habitat or potential habitat that is not there. For example, in the Expert-Based map, a very large polygon appears to the east of Ridgecrest and is probably associated with southern Searles Valley and Searles playa. The Searles Dry Lake or playa is the site of major chemical production and has been for about 100 years. Other unlikely areas to support the species are shown on the Statistical Habitat Model, e.g., around Koehn, Cuddeback, and China Lake playas, and dunes near Stovepipe Wells in Death Valley. Searches have been made for this species by several experts in recent years and this published information can be used to refine revisions to the maps.
- **Desert Tortoise.** The expert-based Habitat Model (SM-R4) shows less habitat than currently exists in the western Mojave and northwestern Mojave desert regions. Specific errors include, but are not limited to the following: (1) Polygons with *no habitat* are shown in the Rand Mountains, major parts of the El Paso Mountains, Red Rock Canyon State Park (both east and west of Hwy 14), Fremont Valley, Indian Wells Valley, and Searles Valley; however, tortoises have occurred there historically and are still present in these areas, although in diminished numbers. (2) Extensive habitat (which has not been documented, and is highly unlikely to occur in the amounts shown) is displayed for parts of Death Valley National Park. (3) Tortoises have been documented in eastern Chemehuevi Valley, but the distribution is not adequately displayed on the map. (4) Tortoises are present throughout much of the Marine Corps Air Ground Combat Center at 29 Palms, but this area is shown as not having tortoise habitat.
- **Mohave ground squirrel.** The expert-based Habitat Model excludes large areas of occupied habitat, whereas the Statistical Model appears to overstate current habitat conditions in areas that have been developed or disturbed, such as in Antelope Valley. Substantial urban, suburban, and rural developments, prisons, and fallow and operating agricultural fields are present and highly unlikely to support the species.
- **Plants.** For many species (e.g., alkali mariposa, Bakersfield cactus, Barstow woolly sunflower, Charlotte's phacelia, desert cympoterus, Mojave monkeyflower, and Red Rock tarplant) both the habitat models and statistical models vastly over-project species distribution. These species have very patchy distributions which are usually isolated from another. Habitat requirements for these species are very specific. In addition, the maps do not take into account and excise areas where habitats are heavily disturbed or have been developed for other uses.

3.4 Review of Climate Change Appendix

The partial draft of a proposed climate-change vulnerability assessment for Covered Species and Natural Communities we reviewed (ICF/Dudek 2012b, Climate Change Appendix) needs improvements. Uncertainties concerning future climate change effects were unevenly evaluated. The analytical extent should extend beyond the DRECP boundary to account for surrounding areas likely vital to species' range shifts, connectivity, and refugia. The species vulnerability analysis should be redone in more detail than the present matrix form, with a more comprehensive consideration of climate-change effects, and with input by an expert panel of desert ecologists to assist with defining the assumptions and methods to be used in evaluating sensitivity and exposure of Covered Species to climate effects.

Some of the discussion in the Appendix appears to address the Southwest in general and is not directly related to California's deserts. For example, the Franklin et al. (2006) paper on buffelgrass is for Mexico; buffelgrass, while a threat in California, is already a serious issue in the Sonoran Desert of Arizona and Mexico. Sahara mustard, an invasive and rapidly spreading alien annual, is a combustible source for fire, and is a threat in the western Sonoran and Mojave deserts of California. It should be discussed in depth because it may proliferate with climate change. The Sonoran Desert has unique regions, each with its own flora. The focus here needs to be on the Mojave Desert and western Sonoran and Colorado deserts in California and on references associated with these parts of the desert, not on material from the Sonoran Desert in Arizona or the Colorado Plateau. Examples of unrelated references include but are not limited to Munson et al. (2011, 2012), Weiss and Overpeck (2005), and Archer and Predick (2008).

The discussion of climate conditions also needs to address major gradients and regional differences across the DRECP area. For example the document states that 50% of rainfall in the Mojave Desert occurs during winter months. This is an over-simplification, lumping precipitation data and rainfall patterns without accounting for strong regional differences from east to west and north to south. In fact, in the west Mojave, about 90% of rainfall occurs in winter and very little in summer, resulting in major differences in distribution of perennial plant species (shrubs, tree yuccas, cacti, perennial grasses, and annual wildflowers) between west and east, north and south. The proportion of summer rain increases from west to east and from north to south in the California deserts. Distributions of animal species also change as timing and amounts of precipitation change. The same can be said of numbers of freezing days. Therefore, a regional treatment on potential climate change is critical.

Other examples of errors in the climate change appendix:

- The statement that "the policy of fire suppression also has increased fuel loads" may be true for some coniferous forests of the Sierra Nevada, but is certainly *not* true in the California deserts.
- The statement, "Recent observations show that some species may be showing downward shifts in elevation in response to changes in climatic water balance (Crimmins et al. 2011)," is based on a paper that has been thoroughly rebutted. Crimmins et al. (2011) were shown to have used a miscalculated deficit, and did not account for an important geographic bias of latitude. Unlike temperature, precipitation changes should not be expected to cause coordinated directional shifts in species elevations (Stephenson and Das 2011).
- The statement, "As warming and fire increase fuel loads will decline," is also poorly supported or not true in California's deserts. Future fuel loads may be more related to changes in precipitation, or more correctly water balance. Fire enhances invasive grasses in the desert, and can result in *increased* fuel loads at some elevations.

Climate Change Vulnerability Assessment (Section 10 of Climate Change Appendix). The preparers used two approaches: a vulnerability screening assessment based on an evaluation of the three components of vulnerability as defined by the IPCC (exposure, sensitivity, and adaptive capacity), and models of species distributions under current and future conditions (with one example presented for Mohave ground squirrel). The Species Accounts were not adequately developed with information critical for assessing vulnerability to climate change or to continued

human population growth and expansion into the desert (see Section 3.3). Thus, few species accounts contained sufficient information to make assessments of vulnerability to climate change.

The vulnerability screening process simplified a complex subject requiring substantial and scientifically defensible analyses. While the concept of vulnerability screening to prioritize which species should be subject to more quantitative analysis is useful, this one, as constructed, should not be used. It depends on numerous dubious and unsubstantiated assumptions according to ISP 2012 review. A few examples:

- It assumes that species associated with desert wetlands are necessarily more vulnerable than those not associated with wetlands, and assigns species "found in the rocky, unvegetated community group" a rank of "low" exposure. However, changes in precipitation may be expected to affect such non-wetland species even more than those that live in or near wetlands.
- It focuses on exposure of a species habitat (vegetation type?) to climate change, whereas exposure of a species' overall *niche* to climate change seems more a meaningful consideration.
- It assumes that some species have "no dependence on interactions with other species for reproduction, growth or survival," whereas essentially *all* species have some dependence on others.
- It assumes that listed Threatened or Endangered species are at higher sensitivity to climate change than others, whereas there is no reason that listing status, in addition to other factors contributing to risk (e.g., population size, habitat specificity, physiological tolerances.), contributes to risk. One could argue just the opposite, because listed species are more likely to receive management and monitoring attention than other species.

The desert tortoise is one of many examples of species that were inadequately treated regarding climate change. In Figure 8 of the Climate Change Appendix, the tortoise is placed in boxes of moderate sensitivity, moderate exposure, and to be monitored and evaluated further. The tortoise, along with several other species, belongs in the upper right box: it is quite vulnerable. The literature on the unique adaptations of the tortoise for surviving in the desert is substantial but not covered in the species account (Nagy and Medica 1986; Turner et al. 1984, 1986; Peterson 1994, 1996a, 1996b; Henen 1994, 1997; Henen et al., 1998; Christopher et al. 1999, 2003; Jennings 1993, 1997, 2002; Duda et al. 1999; Berry et al. 2002). The tortoise survives primarily by avoiding harsh conditions and taking advantage of free water (rain) and wildflowers in spring or both spring and summer, depending on the desert region. Every aspect of the tortoise's life—physiology, ecology, reproduction, and health—is tied to receiving adequate free water and food, as well as having stable, deep burrows to avoid excessive temperatures and predation. Tortoises as individuals and as populations exhibit fidelity to sites, and thus may not quickly disperse to higher elevations where more food and water may be available as the desert dries and becomes hotter under climate change. Finally, tortoises are prone to mortality during drought, and it is the length and severity of extreme events like drought that are most likely to increase with climate change, more so than average conditions.

Predictions in the climate change appendix of the Mohave Ground Squirrel Distribution for the Present and Projected for 2040-2069 are also highly suspect and in need of revision. First, in Figure 11 (Present), the higher elevation terrain in the Coso Range is not shown because it is outside the Plan boundaries. However, there is justification for including it in this type of modeling, because the Coso Range has a core population where extensive research has been conducted for several years by Phillip Leitner. Second, within Figure 10 of the climate change appendix (projected distribution of Mohave ground squirrel 2040-2069), arrows are directed south to the toeslopes of the San Gabriel and San Bernardino mountains—across urban, rural, and agricultural lands, including the heavily disturbed El Mirage Recreation Vehicle Area (open without restrictions). Mohave ground squirrels would likely not be able to connect to the modeled areas because of development, which is proceeding rapidly in that part of Antelope Valley. Third, in the north (Figure 12), the stronghold of core populations in the Coso Range may spread northward, into the Darwin Plateau, none of which is shown because it is outside the Plan boundaries. The existing model for the southern portion of the range may be deficient because existing heavily developed and disturbed lands were not included in the modeling effort. The model of future projections in the south also appears to be deficient for the same reason; growth of human populations and increased development in the future also do not appear to have been considered.

4 Additional Recommendations

This section summarizes some final recommendations of ISP 2012 for improving the DRECP planning process, over and above the recommendations of ISA 2010 and recommendations included in our review of how the Plan is addressing ISA 2010 recommendations (Section 2) and our review of Plan documents (Section 3).

4.1 Science Expertise and Leadership

We recommend that DRECP immediately create a process that provides ongoing, senior scientific leadership to the consultants and agencies and promotes more frequent and substantial engagement with the scientific community, perhaps in the form of a technical advisory committee to guide all scientific tasks and their integration and documentation in the plan. Ultimately the DRECP should have a clearly defined structure and process that employs feedback from monitoring and research studies to continually improve the Plan and its implementation in an adaptive management framework. This was also a recommendation of the ISA 2010 report. Our review of consultant work products suggests that the scientific expertise of the consulting team is deficient in some key areas (e.g., desert ecology, ecological modeling, fire science, climate science). As a result, occasional independent science input and peer review (e.g., ISA 2010 and ISP 2012) does not appear sufficient to ensure that the Plan is scientifically defensible and schedule-efficient. An ongoing technical advisory structure is needed to provide more frequent interactions between consultants and subject area experts, and for outside experts to perform some analyses that are outside the consulting team's expertise. The DRECP should therefore establish active, ongoing partnerships with scientists at academic institutions, science-based NGOs, USGS, or other institutions to assist with or to perform scientific tasks, and to provide advice and review on a more continuous basis. Such arrangements could have prevented a number of costly missteps we observed during our review, such as having to rerun models and recreate maps due to faulty assumptions or inappropriate data or methods. In addition, the

science program or technical advisory committee should be led by one or more scientists having solid scientific credentials and a broad understanding of scientific planning processes to ensure that analysts fully understand the context and goals of their work, maintain quality control, clearly document data, assumptions, uncertainties, decisions, and methods, and interpret, synthesize, and apply results effectively to problem solving. Finally, the team should include individuals with on-ground knowledge of desert ecology and geography, land ownership patterns, existing land management plans, and other essential information that should be considered in planning tasks.

4.2 Analytical Framework and Science Component Integration

We recommend immediately developing and vetting a more clearly thought-through analytical framework and system-integration strategy that will explicitly guide how Plan components will be synthesized into a defensible, coherent Plan that can be refined over time through adaptive management. The "DRECP Conservation Strategy Roadmap" (ICF/Dudek 2012a) and associated documents we reviewed (e.g., Section 3 and Appendix B) describe numerous planning components and processes, but are unclear about how these will be integrated into a defensible Plan or achieve DRECP goals. For example, ISP 2012 does not understand, from the information we were provided, how the parallel tracks of "Conservation Strategy Process" and "DFA Identification and Impact Analyses" are to be integrated into a final conservation strategy. Ad hoc inclusion of key scientific and planning components and analyses (e.g., species models, Marxan conservation targets, DFA alternatives, climate change analyses, adaptive management framework) in the hope that they will all come together at the end is likely to produce a Plan that is disjointed, simplistic, and scientifically unsound. Essential to a solid analytical framework is a set of practical decision-support tools (e.g., project siting tools, mitigation calculators, conceptual models for species management and monitoring) that can be used during planning and, perhaps more importantly, throughout Plan implementation. These tools require monitoring of carefully chosen indicators to track progress and to provide a practical mechanism to include new data and understanding fundamental to making the effort truly adaptive. Failure to integrate scientific decision-making tools into a transparent, cohesive and practical analytical framework increases uncertainties, may undermine Plan support by stakeholders and lead to future conflicts, and is likely to result in poor conservation performance.

4.3 Addressing Future Conditions

The ISP recommends that the reserve-design process more explicitly consider interactions between various processes that affect desert ecosystems and species, and how they are likely to change in the future. This is more than just addressing how the climate is changing, because numerous other processes (e.g., fire, invasive species, hydrogeology) already interact to affect desert ecosystems, and this interacting set of processes will change along with climate, development, and other factors. Thus, although climate change is clearly a stressor that must be addressed, it cannot be treated in isolation of the following other factors:

- **Fire**—Increasing fire frequency, coupled with invasive plants that increase fire risks, is a strong stressor on desert communities, and how fire will affect the location, quality, and management of reserves needs to be addressed. Spatial models of fire susceptibility and fire history (see maps by Randy McKinley of USGS EROS data center) should be considered

during reserve design to assess current and future habitat condition related to fire. Fire management should be a key focus of the Adaptive Management Plan .

- **Invasive Species and Subsidized Predators**—Invasive species, particularly annual grasses, have the ability to change desert fire regimes, compete for limited resources, and alter ecosystem dynamics (Brooks and Berry 2006, Brooks et al. 2006). These effects are exacerbated by anthropogenic nitrogen deposition and increased fire frequency (Brooks 1999, Brooks 2003, Rao et al. 2010), which can create a positive feedback loop for invasives. Subsidized predators, such as ravens, cats, dogs, and coyotes (ISA 2010) that increase due to human changes to the environment also pose a continuing threat to desert tortoises and other species (Esque et al. 2010). Reserve design and adaptive management techniques are needed to minimize invasives, pests, disease, and human-commensal species that may harm native resources in and near reserves.
- **Hydrology**—Ground water and surface flows in perennial and ephemeral stream channels have a significant impact on water availability to biota and are likely to change with the climate. Consideration of various soils, their distribution in reserve design, and their ecohydrologic function under future climate should also be considered.
- **Urbanization/Suburbanization**—Urbanization and suburbanization can impair ecosystems through a variety of processes, including surface disturbances, invasive species, predator subsidies, and draw-down of the water table.. Projections of urban/suburban growth should be considered in reserve design to better predict how cumulative effects of urban growth may affect reserves and potential management requirements to maintain the reserves.
- **Dust**—Dust generation from existing surface disturbances as well as future Covered Actions, and local disturbances (e.g. off-highway vehicle) facilitated by DFA's, needs to be addressed for impacts on energy generation efficiency, local ecosystems, human health, and far-ranging impacts (e.g., Rocky Mountain snowpack effects).

4.4 Climate Change

The DRECP should thoughtfully and thoroughly address how climate change will alter the desert environment and account for this as fully as possible in designing the reserve and Adaptive Management Plan. It appears that reserve selection and design and DFA alternatives are based on current conditions, and it is unclear how and to what degree future climate-change effects will be integrated into the process.

We recommend a climate-change effects analysis be conducted using a model scenario approach based on the available IPCC Assessments. To the extent possible it is desirable to consider an ensemble of climate model simulations to help understand uncertainties of major climate drivers and responses. A limited number of climate scenarios, obtained from a select few downscaled climate model simulations, should be evaluated consistently across the matrix of DRECP concerns to understand and evaluate vulnerabilities and linkages to other stressors on species and habitats. The Plan should establish an analytical process that can be repeated in future and ongoing assessments. Off-the-shelf climate modeling products can be accessed to conduct this analysis. Bias Corrected and Downscaled (BCSD) and VIC hydrological model projections from the CMIP3 dataset are part of the World Climate Research Programme's (WCRP's) Coupled Model Intercomparison Project phase 3 (CMIP3). This multi-model dataset can be obtained

from http://gdo-dcp.ucllnl.org/downscaled_cmip3_projections/ archive provided by the U.S. Bureau of Reclamation and partners (see Reclamation 2011, West-Wide Climate Risk Assessments: Bias-Corrected and Spatially Downscaled Surface Water Projections, Technical Memorandum No. 86-68210-2011-01, prepared by the USDI, Bureau of Reclamation, Technical Services Center, Denver, Colorado. 138pp.).

The analysis area should extend beyond the DRECP boundary to account for surrounding areas likely vital to species' range shifts, connectivity, and refugia. The species vulnerability analysis should be completely redone with a more comprehensive consideration of climate-change effects, and with input by an expert panel of desert ecologists to assist with defining the assumptions and methods. Key considerations include the scale and velocity of predicted changes (trends) as well as variability in climate conditions (e.g., severity and length of droughts and other extreme events). To the extent possible, climatic thresholds that delineate critical ecosystem and species responses should be identified and evaluated. Climate monitoring should be integrated into the Adaptive Management Plan with a clearly defined process for evaluating climate change impacts, updating vulnerability assessments, and refining management actions as conditions change.

4.5 Other Decision Support Models

Key Plan deliverables should include a solid analytical framework and a set of practical decision-support tools (e.g., project siting tools, mitigation calculators, conceptual models for species management and monitoring) that can be used during planning as well as implementation to guide decisions and reduce uncertainties via the adaptive management process. Monitoring indicators and criteria need to be chosen based on this framework to feed directly into the decision-support tools. Examples of existing or developing decision-support tools to consider include a GIS-based system for assessing biodiversity risks of impacts from solar energy development in the California Deserts (Stoms et al. 2011) and a similar effort for assessing risks of wind energy development in the Tehachapi region (Conservation Biology Institute, in preparation).

4.6 Adaptive Management and Monitoring

In addition to Section 6 of ISA 2010, three other key resources on adaptive management should be consulted: USDI Adaptive Management Technical Guide and Applications Guide (both available at http://www.doi.gov/initiatives/AdaptiveManagement/documents.html), and Atkinson et al (2004). The USDI Technical Guide suggests that an Adaptive Management Plan have three kinds of monitoring: (1) compliance or implementation monitoring, (2) effectiveness monitoring, and (3) targeted studies. The DRECP Adaptive Management Plan should identify management uncertainties affecting the achievement of specific conservation goals and objectives, develop simple conceptual models with testable hypotheses, design targeted monitoring to inform the uncertainties and test the hypotheses of the conceptual models, measure progress in achieving objectives, set up a process and institutional structure to adjust management actions, and finally conduct all of these activities within the legal framework of the permitting process for alternative energy development.

While the monitoring program should be initiated as soon as possible, it should not be started without careful planning to ensure that the monitoring protocol will yield information useful for evaluating the ultimate goals of adaptive management. Analogous to the ISA 2010 recommendation that the DRECP be approached as a huge environmental experiment, the monitoring should be approached as a corresponding environmental study designed to scientifically evaluate carefully targeted hypotheses that, when supported or refuted by the data, are useful for informing managers on what actions should be taken. *We recommend that one or more science advisory workshops be organized to get initial input on goals, objectives, metrics, hypotheses, and approaches for the monitoring program as soon as feasible, and to help Plan participants identify the highest priorities to initiate first.* These initial recommendations could be refined over time, guided by scientific members of the institutional structure or process described in 2.10.2, but it is important to begin the Adaptive Monitoring Program as soon as possible.

In addition to desert ecologists and species experts, statisticians and quantitative ecologists should actively participate in planning the monitoring program to ensure that suitable analytical and statistical methods exist to usefully interpret anticipated data characteristics. All too often, analytical methods are not determined until after data have been collected, only to find that the information does not adequately address the goals of the program. After establishing a method of statistical analysis, statistical power analyses should be employed to determine the sampling effort required to achieve a sufficient level of confidence about the data so that well-informed management decisions can be made. Ideally, power analyses should be conducted prior to implementing the monitoring program. However, power analyses require input parameters representing the amount of natural variation in the environment, in which case historic data might be researched or pilot monitoring might be conducted.

While monitoring should begin as soon as possible, ISP 2012 strongly cautions against hastily initiating monitoring without first following key steps in the process to developing an effective Adaptive Management Plan. *This is one reason why ISA 2010 recommended beginning this process as soon as possible.* Foremost among these is to clearly identify measurable management objectives. The Draft Biological Goals and Objectives is a start. However, with the exception of those objectives that specify acres of habitat to be conserved, the majority of objectives do not specify explicit quantitative goals by which science can evaluate success. The DRECP should identify and state all goals without ambiguity to establish metrics of comparison and data collection protocols that can be used to assess the achievement of those goals, and by which adaptive management can be effectively implemented. Careful planning and development of a framework and institutional structure is essential to initiating an Adaptive Management Program.

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Appendix A

REAT Agency Comments on ISP 2012 Review Draft

Steven Schwarzbach, PhD.
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October 31, 2012

Subject: Renewable Energy Action Team Agency Comments on the *REVIEW DRAFT Independent Science Review for the California Desert Renewable Energy Conservation Plan (DRECP) Report.*

Dear Dr. Schwarzbach,

The Desert Renewable Energy Conservation Plan Directors (DRECP) and the Renewable Energy Action Team Agencies (REAT Agencies) thank the 2012 Independent Science Panel (ISP 2012) for their review of key draft documents, which will help inform the biological analyses for the DRECP. The REAT Agencies take the scientific input from the ISP 2012 seriously and acknowledge the concerns expressed by the panel. We continue to work to address these concerns.

The ISA 2010 was convened by the State pursuant to the Planning Agreement prepared under the California Natural Community Conservation Planning Act (NCCPA). The DRECP and REAT Agencies stress that the specific purpose of the ISP 2012 was to review and give an independent assessment of selected draft DRECP materials. The REAT Agencies supported this process. The DRECP provided specific draft documents for this review, including biological descriptions, species list and models, reserve design methods, a climate change appendix, an outline of an adaptive management framework, along with associated maps and supporting materials and documentation. These documents are available on the DRECP website (http://www.drecp.org/meetings/2012-06-26_meeting/review/). We requested the ISP 2012 to review and evaluate these documents for the following:

- the use of best available scientific information,
- the incorporation of relevant recommendations and scientific guidance from the Independent Science Advisors , 2010 Report (ISP 2010), and,

- how the documents address potential climate change effects.

The DRECP and REAT Agencies have reviewed the *REVIEW DRAFT Independent Science Review for the California Desert Renewable Energy Action Plan (DRECP)* (ISP 2012 Report), and offer the following observations and comments.

The ISP 2012 responded with great concern to the draft and incomplete form of the documents and the preliminary state of some of the information that was provided. The DRECP and REAT Agencies acknowledge and agree that work remains to provide the clear documentation of assumptions, data decisions, and the methodology of the science-based analyses and professional judgment considerations behind the written materials reviewed by the ISP, as well as materials not provided to the ISP and additional materials that have been developed to date. The REAT Agencies have always realized this was necessary, and will pay close attention to providing this information as the DRECP documents develop. The DRECP continues to be a work in progress, and as we move toward the issuance of a draft DRECP document we continue to incorporate input not only from the ISP 2012 Report, but also from REAT and other Agency experts, stakeholders, and the public. There will also be additional opportunity for scientific review and comment during the public comment period for the Draft DRECP HCP/NCCP/LUPA.

DRECP and the REAT Agencies agree that use of best available scientific information and the understanding and minimization of uncertainties in that information will provide a strong scientific underpinning for the DRECP. We continue to carefully review the draft ISP 2012 Report and are evaluating which specific data sets and species models should be upgraded; and we are continuing to fully document our analytical approach and use of the best available science in developing the DRECP. The REAT Agencies are also evaluating to what extent these adjustments may affect the overall renewable energy development and biological conservation context that has been developed to date, and we are working to incorporate the appropriate information.

In accordance with our review of the draft ISP 2012 report, REAT Agencies are at work on the following specific items. Most of these activities have been ongoing in the development of the DRECP, but are also consistent with the suggestions in the ISP 2012 and ISA 2010 science reports.

Documentation, Transparency, and Clarity

The REAT Agencies and DRECP consultant team are improving documentation of: 1) the process of Development Focus Area (DFA) identification and potential alternatives; 2) the specific information and data used in the reserve design process and considerations; and 3) the professional consideration and judgment that contributes to the development and refinement of the DRECP conservation reserve.

Covered Species List/Planning Species

The REAT Agencies continue to review and consider refinement of the covered species list and we are utilizing information from ISA 2010, ISP 2012, and agency subject matter experts. Determination of the covered species list is an iterative Agency decision which must consider best available science, specific regulatory requirements, and various agency policies. We will continue to document this deliberative process as the species list evolves.

Natural Communities Classification and Vegetation Mapping

The REAT Agencies and DRECP consultant team continue to incorporate the new vegetation mapping information that is specifically funded and developed to inform the DRECP. Additionally, an up-to-date vegetation classification is being developed by the California Department of Fish and Game, which will assist in the integration and interpretation of this information. The updated information is being used to refine DRECP land cover maps, natural community descriptions and conservation analysis, and species models that have vegetation information as an input variable.

Species Modeling

The REAT Agencies and DRECP consultant team are revising and updating the expert-based species models using information from a series of individual science expert reviews of the species accounts, species models, and new vegetation mapping data, as well as completing the documentation of modeling assumptions and inputs. Not all of this work is yet complete, and it was not presented to the ISP 2012.

In considering the specific ISP 2012 comments on improving the species statistical (MaxEnt) models, we are continuing to complete the documentation of datasets, data quality assurance/control and variable parameterization to better explain the rationale used in the models. The REAT Agencies are assembling additional Agency staff and additional consultants with specific modeling and desert species expertise, to refine the most useful

species models to improve their accuracy and reduce uncertainty. Additional Marxan reserve modeling will be run using updated models and will be compared to the existing reserve design context as an additional check on the adequacy and completeness of the design. As part of the modeling work, we are continuing to document Marxan input assumptions, biological targets, scenarios that have been evaluated to date, and the interpretation and use of the outputs. This work is being used as an input to the final reserve design, and will inform the DRECP conservation and impact analyses.

In addition to the detail provided above, the REAT Agencies continue to review the science panel's comments related to data quality and completeness, climate change, and the development of an Adaptive Management and Monitoring Program. As DRECP Documents are developed, more specifics on how these items will be addressed will be included.

In completing work on species modeling, climate change integration, and development of the adaptive management and monitoring, the REAT Agencies and DRECP consultant team intend to consult with specific individual scientific experts, including some of the ISP 2012 panel members, on an individual basis, for additional expert science input.

Again, we thank the ISP 2012 for their review of the draft DRECP materials and for the specific information on critical elements of the DRECP. We look forward to continued collaboration with science experts in the development of the DRECP.

Sincerely,

David L. Harlow, Director
Desert Renewable Energy Conservation Plan

cc: Roger Johnson, Deputy Director, California Energy Commission
Kevin Hunting, Chief Deputy Director, California Department of Fish and Game
Jim Kenna, State Director, Bureau of Land Management
Alexandra Pitts, Deputy Regional Director, U.S. Fish and Wildlife Service

Appendix B

Advisor Biographies

Dr. Scott R. Abella, Associate Research Professor, Department of Environmental and Occupational Health, University of Nevada Las Vegas. Dr. Abella's research focus is applied ecology for supporting land management and conservation, in the areas of plant ecology, restoration ecology, fire ecology, and scientific literature synthesis. He regularly works directly with resource managers on projects, enabling mutually beneficial science-management partnerships and clear paths for scientific information transfer. Dr. Abella has published over 70 scientific papers and has 11 years of applied research experience in the Southwest. His work is regularly sought by media outlets such as the Las Vegas Sun, and he is invited to 4-6 conferences annually as a featured speaker on topics such as ecological restoration, fire management, and exotic species in southwestern deserts. He teaches UNLV courses in ecology, restoration ecology, land use management, and environmental science.

Dr. David Bedford, Research Geologist, Geology, Minerals, Energy and Geophysics Science Center, U.S. Geological Survey. Dr. Bedford's research is focused on the interactions between surficial and ecological processes throughout the western US. Combining geomorphology, hydrology, and ecohydrology, his research is aimed at understanding the processes that shape the surface of the earth across various time scales. His recent research is aimed at how ecosystems are disturbed and how and how long they recover. He has over 10 years of research in the Mojave Desert, and recently has been working in the Great Basin, Colorado River, and Coastal California. Dr. Bedford received his Ph.D. from the University of Colorado, Boulder in 2008 where he studied the relations between rainfall, vegetation and the patterns of infiltration and runoff. He received a B.S. from Colorado State University in 1996.

Dr. Edward C. (Ted) Beedy has more than 30 years of experience as a professional wildlife biologist. Prior to starting his own firm "*Beedy Environmental Consulting*" in May 2006, he worked for more than 20 years as a Senior Biologist and Associate Principal at Jones & Stokes in Sacramento. At J&S he served as Project Manager or Project Director for more than 200 large, complex projects including coordinating with local, state, and federal agencies for projects regulated by the California Environmental Quality Act, the National Environmental Policy Act, and the federal and state Endangered Species Acts. As an independent consultant he was the lead author of the Nevada County and Placer County Natural Resources Reports. Ted has led the Strategic Lands Acquisition effort and has been an active fundraiser for Nevada County Land Trust. He has studied wildlife throughout California, with an emphasis on special-status birds including Harlequin Ducks, California Gnatcatchers, Southwestern Willow Flycatchers, Yellow-billed Cuckoos, and Tricolored Blackbirds. He has a Ph.D., M.A., and B.Sc. in Zoology from the University of California at Davis. He is currently co-authoring a new book, *Birds of the Sierra Nevada: Their Natural History, Status, and Distribution*, that will have color illustrations of more than 300 species of Sierra birds prepared by Keith Hansen and will be published by the University of California Press in 2013.

Dr. Kristin H. Berry, Research Wildlife Biologist, U.S. Geological Survey, Riverside, California. Dr. Berry is a wildlife biologist and arid lands ecologist with expertise in plant and animal communities in the Mojave and western Sonoran deserts, the desert tortoise and other vertebrates. She has degrees from Stanford University (B.A., 1964), University of California at Los Angeles (M.A., 1968), and University of California, Berkeley (Ph.D., 1972), and has been an employee of the Department of the Interior since 1974. Dr. Berry has published over 50 scientific papers on desert topics and edited a volume of scientific papers on the Mojave Desert, which was published in 2006. Her field research covers a wide variety of topics, including ecology, behavior, and impacts of translocation on tortoises; health and diseases of desert tortoises; recovery of annual and perennial vegetation after disturbance; anthropogenic impacts in the desert and the relationship to population declines of the tortoise; and invasive annual plants. Berry conducts interdisciplinary research with research veterinary pathologists and microbiologists, geneticists, botanists, and geologists. She provides data and recommendations to wildlife biologists and managers in federal and state agencies and contributes to land-use plans.

Dr. Daniel Cayan, **Research Meteorologist, Scripps Institution of Oceanography, University of California, San Diego, and USGS.** Dr. Cayan's work is aimed at understanding climate variability and changes over the Pacific Ocean and North America. His research concerns how climate effects water resources, including precipitation, snowpack and streamflow in western North America, and the impacts upon ecosystems, agriculture, and elements of human health. Dr. Cayan has specific interests in the California region, and has played a leading role in the California Nevada Applications Program (CNAP; see http://meteora.ucsd.edu/cap/), sponsored by the NOAA RISA Program, the California Climate Change Center, sponsored by the California Energy Commission, and the Southwest Climate Science Center, sponsored by the USGS. These programs aim to deliver improved climate information to decision makers. Dr. Cayan received a BS degree in Meteorology and Oceanography in 1971 from the University of Michigan and a Ph.D. in Oceanography in 1990 from the University of California, San Diego. He has been employed by Scripps Institute of Oceanography since 1977 and by the USGS Water Resources Division since 1991. For additional information about Dr. Daniel R. Cayan visit http://tenaya.ucsd.edu/~cayan/index.html.

Dr. Lesley DeFalco, Research Plant Ecologist, U.S. Geological Survey, Western Ecological Research Center, Henderson, Nevada. Dr. DeFalco's research focuses on arid ecosystem function, primarily in the Mojave Desert, but with implications for global arid lands research and management. Her research program and scientific publications over the past 22 years have examined climate controls on the function of desert plant communities and the responses of arid lands to human disturbances in the context of climate variability. Her recent research addresses if and how to rehabilitate arid lands and their sensitive plant species once they become degraded, with broad application to disturbances associated with solar, wind and geothermal development. She also studies the autecology and disturbance impacts to threatened and endangered plants including Lane Mountain milkvetch, Amargosa niterwort, Eureka Valley evening primrose and Eureka Valley dunegrass. Dr. DeFalco regularly interacts and coordinates with resource managers to fulfill high priority research needs through her interdisciplinary field, greenhouse, and laboratory approaches.

Scott Haase, Senior Engineer, National Renewable Energy Laboratory, Golden, Colorado. Mr. Haase is a Senior Engineer with the National Renewable Energy Laboratory. He has over 20 years of direct experience working with multiple renewable energy technologies including solar, wind, biomass, biofuels, waste-to-energy and geothermal. He is the author or co-author of over 75 technical reports, feasibility studies, and papers for a variety of clients including federal, state and local government agencies, electric utilities, numerous Indian tribes, non-governmental organizations, and private sector companies. Mr. Haase holds an M.S. in Technology and Human Affairs (1992, Washington University in St. Louis) and a B.S. in Mechanical Engineering (1986, University of Vermont). Currently, Mr. Haase manages NREL's renewable energy programs for the U.S. Department of the Interior and several of its bureaus.

Dr. Todd Katzner, Research Assistant Professor, West Virginia University. Dr. Katzner's research focuses on wildlife conservation ecology and the interaction between wildlife and human-dominated ecosystems. Much of his work focuses on birds, especially birds of prey. Although based in West Virginia, he has worked in arid environments in the desert southwest and in central Asia for much of the past 15 years. Much of his work is built around utilization of novel technologies and approaches to wildlife ecology. In particular, he was part of a team that developed the first non-invasive monitoring scheme for any avian species, he is a co-founder of the wildlife telemetry company Cellular Tracking Technologies and he utilizes their products in his work, and he is currently developing camera trapping methodologies for monitoring avian species. Katzner has published ~50 peer-reviewed scientific papers, numerous popular science articles and books, and has received over $2 million in career research funding. He is currently the lead scientists on a series of research projects focused on golden eagles in California deserts.

Dr. Ken Nussear, Research Wildlife Biologist, USGS Western Ecological Research Center, Henderson, NV. Dr. Nussear earned a B.S. in Zoology at Colorado State University (1994), and a Ph.D. in Ecology, Evolution and Conservation Biology at the University of Nevada, Reno (2004), and has worked for the last 8 years doing research on desert organisms with the US Geological Survey. He has published ~ 30 peer reviewed journal articles and reports, and has served in a reviewing capacity on the Desert Tortoise Recovery Plan Assessment Committee (2005), and recently the BLM Rapid Ecoregional Assessment (REA) review panels for both the Mojave and Sonoran ecoregions. His research focuses on the application of physiological principles toward understanding the ecological limitations to species distributions at local, regional and landscape scales and the application of those principles toward their conservation. He works with a variety of desert organisms, especially reptiles, and notably desert tortoises. He has experience in the development of ecologically – based expert systems, and mechanistic predictive habitat models used for conservation planning for short (decision support for translocation) and long-term (recovery planning) applications. His current research projects include: research on the driving factors influencing desert tortoise habitat suitability, the influence of contributing factors of predictive habitat models on the genetic structure of desert tortoise populations, spatial analyses of stressors on the relative densities of desert tortoises, responses of desert tortoises to habitat alteration by desert wildfires, the effects of anthropogenic impacts on lizard, bird and plant communities, and influences of alternative energy development on the habitat, and genetic diversity in a multi-species context.

Dr. Steven Schwarzbach, **Director, USGS Western Ecological Research Center, Sacramento, CA.** Dr. Schwarzbach joined both the USGS and the Western Ecological Research Center in 2002 as one of the center's research managers and became Center Director in 2005. At the Western Ecological Research Center, Schwarzbach oversees 13 field stations in California and Nevada that conduct a wide variety of research on such topics as environmental contamination, avian influenza, fire ecology, invasive species, migratory bird ecology, conservation of threatened and endangered species, climate change, wetland restoration, and amphibian declines. Schwarzbach is a co-author of *Facing Tomorrow's Challenges, USGS Science in the decade 2007 to 2017*, which serves as the current strategic plan for USGS. He has authored 36 scientific publications ranging from book reviews to commentary articles in both Science and Nature. Prior to coming to USGS he served as chief of the division of Environmental Contaminants in the U.S Fish and Wildlife Service's Sacramento Field Office for 14 years. While in the Fish and Wildlife Service, he worked on linking science to the agency's policy on numerous environmental-contaminant issues affecting Department of Interior trust resources. He graduated in 1976 from the University of California, Santa Barbara, with a B.A. in environmental biology and environmental studies. He also has an M.A. in environmental education from San Francisco State University and earned both his M.S. and Ph.D. in ecology, in 1986 and 1989, respectively from the University of California, Davis.

Dr. Wayne D. Spencer, Director of Conservation Assessment and Planning, Conservation Biology Institute, San Diego. Dr. Spencer is a conservation biologist and wildlife ecologist with expertise in conservation planning and endangered species recovery. He has worked on various regional NCCPs and HCPs in California as a consulting biologist, science advisor, and science facilitator, and served as the Lead Advisor for the first DRECP Independent Science Advisory process (ISA 2010). Dr. Spencer has also been involved in developing and applying habitat connectivity and wildlife movement models throughout California and the western U.S. He was Principal Investigator of the California Essential Habitat Connectivity Project and is currently PI of the California Mammal Species of Special Concern update. His field research focuses primarily on rare and endangered mammal species, including the endangered Stephens' kangaroo rat and Pacific pocket mouse, and forest carnivores, including the Pacific fisher and Pacific marten. He is also a Research Associate with the San Diego Natural History Museum.

Dr. David Stoms, Energy Commission Specialist, California Energy Commission, Sacramento. Dr. Stoms was a Research Scientist in the Bren School of Environmental Science and Management and Department of Geography at the University of California, Santa Barbara for 20 years. He managed the Biogeography Lab, conducting research integrating conservation planning, landscape ecology, and geospatial techniques. He has published more than 100 scientific papers in ecology, conservation biology, and GIS/remote sensing. He was awarded second place from ESRI in 1993 for the best scientific journal paper in GIS for a sensitivity analysis of the effects of spatial data uncertainty in habitat suitability modeling. He participated in several working groups on conservation planning methods and tools at the National Center for Ecological Analysis and Synthesis. Dr. Stoms also served on two advisory panels on GIS assessment tools for the EPA Science Advisory Board. Prior to his research career, Dr. Stoms worked for nine years on a multidisciplinary planning team with the U. S. Forest Service at Lake Tahoe. He joined the Public Interest Energy Research program at the California Energy Commission in June, 2012.

Dr. James Strittholt, President and Executive Director, Conservation Biology Institute. Dr. Strittholt is President and Executive Director of the Conservation Biology Institute and has over 20 years of experience in applying computer mapping technologies to address numerous ecological assessments and conservation planning projects in the U.S. and internationally. Besides extensive organizational leadership and management experience, Dr. Strittholt maintains scientific expertise in a number of areas, including nature reserve designs, conservation planning, forest and watershed assessments, ecological modeling, web tool development, and remote sensing applications in conservation. He has received numerous awards for conservation leadership and for teaching excellence at both the high school and university levels.

Theodore J. Weller, Ecologist, Arcata, California. Mr. Weller has worked with bats since 1996 and has published 10 papers on them in the peer-reviewed scientific literature. His research has focused largely on methodological issues and survey effort necessary to describe bat activity, characterize species assemblages, and monitor their population status at multiple spatial scales. More recently, his attention has turned toward documenting impacts and devising solutions to problems of bat fatalities at wind energy facilities in California. He has conducted research at two wind energy facilities within the DRECP planning area where he is applying multiple echolocation monitoring tools to characterize bat activity levels and develop predictive models of bat activity at wind energy facilities. He has served as a Science Advisor for the first DRECP Independent Science Advisory process (ISA 2010) and the Altamont Pass Wind Resource Area NCCP.

Dr. Julie L. Yee, Statistician, U.S. Geological Survey, Western Ecological Research Center, Sacramento, California. Dr. Yee has worked with the USGS since 1997 after earning her Ph.D. in Statistics with Emphasis in Biostatistics at the University of California, Davis. She helped design the collection and analysis of survey, radio-telemetry, and habitat data for the large multi-partner project on Ecology of Waterfowl in the Central Valley, which then served as the basis for development of the 2006 Central Valley Joint Venture (CVJV) Implementation Plan. In 2012 she was awarded a scientific recognition by the CVJV for her contributions in support of waterfowl research and conservation programs. From 2006 until current (2012), Dr. Yee has served on the Scientific Review Committee for the Altamont Pass Wind Resource Area to review the bird fatality monitoring program, provide recommendations to improve data collection, and help analyze the effects of wind turbines and mitigation actions on bird strike fatalities. Dr. Yee continues to provide statistical overview for WERC research and has co-authored about 30 scientific articles or reports and 20 presentations at scientific conferences.

Appendix C

DRECP Materials Reviewed by Independent Science Panel (ISP 2012)

Documents Posted for ISP Review

Document	Bibliographic Information
Documents Provided as Background Material	
Narrative Description of the DRECP Conservation Strategy Process Summary Diagram	ICF and Dudek. 2012. Narrative Description of the DRECP Conservation Strategy Process Summary Diagram. Memorandum from ICF/Dudek to DRECP Independent Science Panel (ISP). June 15, 2012. Posted to DRECP portal June 18, 2012.
DRECP Conservation Strategy Process Summary	ICF and Dudek. 2012. DRECP Conservation Strategy Process Summary [flowchart]. June 15, 2012. Posted to DRECP portal June 18, 2012.
Draft DRECP Baseline Biology Report	Dudek and ICF. 2012. Desert Renewable Energy Conservation Plan (DRECP) Baseline Biology Report. Prepared for California Energy Commission under contract to Aspen Environmental Group. March 2012. Posted to DRECP portal June 18, 2012.
Draft DRECP Biological Goals and Objectives	ICF and Dudek. 2012. Revised Draft DRECP Biological Goals and Objectives. Draft memorandum from ICF International/Dudek to DRECP Independent Science Panel. June 14, 2012. Posted to DRECP portal June 18, 2012.
Documents Provided for ISP Review	
Approach for Integration of Climate Change Analysis into Reserve Design and Adaptive Management and Monitoring	ICF and Dudek. 2012. Approach for Integration of Climate Change Analysis into Reserve Design and Adaptive Management and Monitoring. Draft memorandum from ICF/Dudek to DRECP Science Advisory Panel. June 11, 2012. Posted to DRECP portal June 18, 2012.
Technical Appendix on Climate Change	ICF and Dudek. 2012. Draft technical appendix on climate change. June 8, 2012. Posted to DRECP portal June 18, 2012.
Chapter 3, Conservation Planning Process	Dudek and ICF. 2012. Desert Renewable

Document	Bibliographic Information
	Energy Conservation Plan (DRECP). Internal screencheck draft. June 2012. Posted to DRECP portal June 18, 2012.
Section 3.1, Conceptual Conservation Planning Principles	Dudek and ICF. 2012. Desert Renewable Energy Conservation Plan (DRECP). Internal screencheck draft. June 2012. Posted to DRECP portal June 18, 2012.
Section 3.2, Biological Goals and Objectives	Dudek and ICF. 2012. Desert Renewable Energy Conservation Plan (DRECP). Internal screencheck draft. June 2012. Posted to DRECP portal June 18, 2012.
Section 3.3, Existing Conservation and Gap Analysis	Dudek and ICF. 2012. Desert Renewable Energy Conservation Plan (DRECP). Internal screencheck draft. June 2012. Posted to DRECP portal June 18, 2012.
Section 3.4, Plan-wide Reserve Design Process	Dudek and ICF. 2012. Desert Renewable Energy Conservation Plan (DRECP). Internal screencheck draft. June 2012. Posted to DRECP portal June 18, 2012.
Section 3.5, Renewable Energy Goals	Dudek and ICF. 2012. Desert Renewable Energy Conservation Plan (DRECP). Internal screencheck draft. June 2012. Posted to DRECP portal June 18, 2012.
Chapter 5, Monitoring and Management Program	Dudek and ICF. 2012. Desert Renewable Energy Conservation Plan (DRECP). Internal screencheck draft. June 2012. Posted to DRECP portal June 18, 2012.
Draft Appendix B, Supporting Information for the DRECP Conservation Strategy Methodology	Dudek and ICF. 2012. Supporting Information for the DRECP Conservation Strategy Methodology. Appendix B in Desert Renewable Energy Conservation Plan (DRECP). Internal screencheck draft. June 2012. Posted to DRECP portal June 18, 2012.
Draft DRECP Baseline Biology Report Appendix A, DRECP Baseline Biology Report Metadata	Dudek and ICF. 2012. DRECP Baseline Biology Report Metadata. Appendix A in Desert Renewable Energy Conservation Plan (DRECP) Baseline Biology Report. Prepared for California Energy Commission under contract to Aspen Environmental Group. March 2012. Posted to DRECP portal June 18, 2012.
Draft DRECP Baseline Biology Report Appendix B, Species Profiles	Dudek and ICF. 2012. Species Profiles. Appendix B in Desert Renewable Energy Conservation Plan (DRECP) Baseline Biology Report. Prepared for California Energy

Document	Bibliographic Information
	Commission under contract to Aspen Environmental Group. March 2012. Posted to DRECP portal June 18, 2012.
Draft DRECP Baseline Biology Report Appendix C, Species Habitat Model Results	Dudek and ICF. 2012. Species Habitat Model Results. Appendix C in Desert Renewable Energy Conservation Plan (DRECP) Baseline Biology Report. Prepared for California Energy Commission under contract to Aspen Environmental Group. March 2012. Posted to DRECP portal June 18, 2012.

Maps Posted for ISP Review

Map	Bibliographic Information
Maps Provided for ISP Review	
DRECP Plan Wide Energy Context	Dudek and ICF. 2012. DRECP Plan Wide Energy Context [map]. June 7, 2012. Posted to DRECP portal June 18, 2012.
DRECP Plan Wide Geographic Context	Dudek and ICF. 2012. DRECP Plan Wide Geographic Context [map]. June 7, 2012. Posted to DRECP portal June 18, 2012.
Figure 1-1, Regional Map	Dudek and ICF. 2012. Desert Renewable Energy Conservation Plan (DRECP). Internal screencheck draft. June 2012. Posted to DRECP portal June 18, 2012.
Figure 2-1, DRECP Area Physical Geography	Dudek and ICF. 2012. Desert Renewable Energy Conservation Plan (DRECP). Internal screencheck draft. June 2012. Posted to DRECP portal June 18, 2012.
Figure 2-2, DRECP Area Surficial Geology	Dudek and ICF. 2012. Desert Renewable Energy Conservation Plan (DRECP). Internal screencheck draft. June 2012. Posted to DRECP portal June 18, 2012.
Figure 2-3, DRECP Area Hydrology	Dudek and ICF. 2012. Desert Renewable Energy Conservation Plan (DRECP). Internal screencheck draft. June 2012. Posted to DRECP portal June 18, 2012.
Figure 2-4, DRECP Area Land Cover	Dudek and ICF. 2012. Desert Renewable Energy Conservation Plan (DRECP). Internal screencheck draft. June 2012. Posted to DRECP portal June 18, 2012.
Figure 3.5-1, Solar Resources in the Plan Area	Dudek and ICF. 2012. Desert Renewable Energy Conservation Plan (DRECP). Internal screencheck draft. June 2012. Posted to DRECP portal June 18, 2012.

Map	Bibliographic Information
Figure 3.5-2, Wind Resources in the Plan Area	Dudek and ICF. 2012. Desert Renewable Energy Conservation Plan (DRECP). Internal screencheck draft. June 2012. Posted to DRECP portal June 18, 2012.
Figure 3.5-3, Geothermal Resources in the Plan Area	Dudek and ICF. 2012. Desert Renewable Energy Conservation Plan (DRECP). Internal screencheck draft. June 2012. Posted to DRECP portal June 18, 2012.
Plan-wide Biological Reserve Context	Dudek and ICF. 2012. Plan-wide Biological Reserve Context [map]. June 7, 2012. Posted to DRECP portal June 18, 2012.

Appendix D

DRECP List of 77 Species Considered for Coverage

NOTE: This list is **not** recommended by the Independent Science Panel. It is copied from Appendix B of the DRECP Baseline Biology Report (Dudek and ICF, March 11, 2012) as a reference only.

Taxa	Common Name	Scientific Name	Federal Status[1]	State Status[2]
Amphibian/Reptile	arroyo toad	*Anaxyrus (Bufo) californicus*	FE	CSC
Amphibian/Reptile	barefoot gecko	*Coleonyx switaki*	BLM	ST
Amphibian/Reptile	coast horned lizard	*Phrynosoma coronatum blainvillei*	FC/FS/BCC/ BLM	CSC
Amphibian/Reptile	desert tortoise	*Gopherus agassizii*	FT	ST
Amphibian/Reptile	flat-tailed horned lizard	*Phrynosoma mcallii*	BLM/FS	CSC
Amphibian/Reptile	Mojave fringe-toed lizard	*Uma scoparia*	BLM	CSC
Amphibian/Reptile	Tehachapi slender salamander	*Batrachoseps stebbinsi*	BLM/FS	ST
Bird	American peregrine falcon	*Falco peregrinus anatum*	FD/BCC	SE/FP
Bird	bald eagle	*Haliaeetus leucocephalus*	FD/BLM	SE/FP
Bird	Bank swallow	*Riparia riparia*	BLM	ST
Bird	Bell's vireo	*Vireo bellii*	FE/BCC	SE
Bird	burrowing owl	*Athene cunicularia*	BLM	CSC
Bird	California black rail	*Laterallus jamaicensis coturniculus*	BCC/BLM	ST
Bird	California condor	*Gymnogyps californianus*	FE	SE/FP
Bird	Elf owl	*Micrathene whitneyi*	BLM/BCC	SE
Bird	Gila woodpecker	*Melanerpes uropygialis*	BLM/BCC	SE
Bird	gilded flicker	*Colaptes chrysoides*	BCC/BLM	SE
Bird	golden eagle	*Aquila chrysaetos*	BLM	FP
Bird	greater sandhill crane	*Grus canadensis tabida*	BLM/FS	ST/FP
Bird	Inyo California towhee	*Pipilo crissalis eremophilus*	FT	SE
Bird	mountain plover	*Charadrius montanus*	FPT/BLM/ BCC	CSC
Bird	Swainson's hawk	*Buteo swainsoni*	FS/BLM	ST
Bird	tricolored blackbird	*Agelaius tricolor*	BCC/BLM	CSC
Bird	western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	FC/FS/BCC/ BLM	SE
Bird	white-tailed kite	*Elanus leucurus*	None	FP

Taxa	Common Name	Scientific Name	Federal Status[1]	State Status[2]
Bird	willow flycatcher	*Empidonax traillii extimus*	FE	SE
Bird	Yuma clapper rail	*Rallus longirostris yumanensis*	FE/BCC	ST/FP
Fish	desert pupfish	*Cyprinodon macularius*	FE	SE
Fish	Mohave tui chub	*Gila bicolor mohavensis*	FE	SE/FP
Fish	Owens pupfish	*Cyprinodon radiosus*	FE	SE/FP
Fish	Owens tui chub	*Gila bicolor snyderi*	FE	SE
Mammal	Amargosa vole	*Microtus californicus scirpensis*	FE	SE
Mammal	California leaf -nosed bat	*Macrotus californicus*	BLM, FS	CSC
Mammal	hoary bat	*Lasiurus cinereus*	None	None
Mammal	Mohave ground squirrel	*Spermophilus [Xerospermophilus] mohavensis*	BLM	ST
Mammal	Nelson's bighorn sheep	*Ovis canadensis nelsoni*	FE/BLM	ST/FP
Mammal	pallid bat	*Antrozous pallidus*	BLM/FS	CSC
Mammal	Tehachapi pocket mouse	*Perognathus alticolus inexpectatus*	BLM/FS	CSC
Mammal	Townsend's big-eared bat	*Corynorhinus townsendii*	BLM/FS	CSC
Mammal	western mastiff bat	*Eumops perotis*	BLM	CSC
Mammal	western red bat	*Lasiurus blossevillii*	BLM, FS	CSC
Plant	Algodones Dunes sunflower	*Helianthus niveus* ssp. *tephrodes*	BLM	SE (CRPR 1B.2)
Plant	alkali mariposa-lily	*Calochortus striatus*	None	None (CRPR 1B.2)
Plant	Amargosa beardtongue	*Penstemon fruticiformis var. amargosae*	None	None (CRPR 1B.2)
Plant	Amargosa niterwort	*Nitrophila mohavensis*	FE	SE (CRPR 1B.1)
Plant	Ash Meadows gumplant	*Grindelia fraxinipratensis*	FT	None (CRPR 1B.2)
Plant	Bakersfield cactus	*Opuntia basilaris* var. *treleasei*	FE	SE (CRPR 1B.1)
Plant	Barstow woolly sunflower	*Eriophyllum mohavense*	BLM	None (CRPR 1B.2)
Plant	Charlotte's phacelia	*Phacelia nashiana*	None	None (CRPR 1B.2)
Plant	Cushenbury buckwheat	*Eriogonum ovalifolium var. vineum*	FE	None (CRPR 1B.1)
Plant	Cushenbury milk-vetch	*Astragalus albens*	FE	None (CRPR 1B.1)
Plant	Cushenbury oxytheca	*Acanthoscyphus parishii* var. *goodmaniana*	FE	None (CRPR 1B.1)

Taxa	Common Name	Scientific Name	Federal Status[1]	State Status[2]
Plant	desert cymopterus	*Cymopterus deserticola*	BLM	None (CRPR 1B.2)
Plant	Kelso Creek monkeyflower	*Mimulus shevockii*	None	None (CRPR 1B.2)
Plant	Kern buckwheat	*Eriogonum kennedyi var. pinicola*	None	None (CRPR 1B.1)
Plant	Lane Mountain milk-vetch	*Astragalus jaegerianus*	FE	None (CRPR 1B.1)
Plant	Little San Bernardino Mtns. linanthus	*Linanthus maculatus*	None	None (CRPR 1B.2)
Plant	Mojave monkeyflower	*Mimulus mohavensis*	BLM	None (CRPR 1B.2)
Plant	Mojave tarplant	*Deinandra mohavensis*	BLM	SE (CRPR 1B.3)
Plant	Orocopia sage	*Salvia greatae*	None	None (CRPR 1B.3)
Plant	Owens Valley checkerbloom	*Sidalcea covillei*	BLM	SE (CRPR 1B.1)
Plant	Parish's alkali grass	*Puccinellia parishii*	None	None (CRPR 1B.1)
Plant	Parish's daisy	*Erigeron parishii*	FT	None (CRPR 1B.1)
Plant	Parish's phacelia	*Phacelia parishii*	None	None (CRPR 1B.1)
Plant	Peirson's milk-vetch	*Astragalus magdalenae* var. *peirsonii*	FT	SE (CRPR 1B.2)
Plant	Piute Mountains jewel-flower	*Streptanthus cordatus* var. *piutensis*	None	None (CRPR 1B.2)
Plant	Red Rock poppy	*Eschscholzia minutiflora ssp. twisselmannii*	None	None (CRPR 1B.2)
Plant	Red Rock tarplant	*Deinandra arida*	None	SR (CRPR 1B.2)
Plant	San Bernardino Mountains dudleya	*Dudleya abramsii ssp. affinis*	None	None (CRPR 1B.2)
Plant	sand food	*Pholisma sonorae*	None	None (CRPR 1B.2)
Plant	Sodaville milk-vetch	*Astragalus lentiginosus* var. *sesquimetralis*	None	SE (CRPR 1B.1)
Plant	Spanish Needle onion	*Allium shevockii*	None	None (CRPR 1B.3)
Plant	Thorne's buckwheat	*Eriogonum thornei*	BLM	SE (CRPR 1B.2)
Plant	Tracy's eriastrum	*Eriastrum tracyi*	None	SR (CRPR 1B.2)
Plant	triple-ribbed milk-vetch	*Astragalus tricarinatus*	FE	None

Taxa	Common Name	Scientific Name	Federal Status[1]	State Status[2]
				(CRPR 1B.2)
Plant	white-margined beardtongue	*Penstemon albomarginatus*	None	None (CRPR 1B.1)
Plant	Wiggins' croton	*Croton wigginsii*	BLM	SR (CRPR 2.2)

Notes:

CRPR = California Rare Plant Rank

[1] Federal Status – FE: Federally Endangered; FT: Federally Threatened; FD: Federally Delisted; FS: Forest Service Sensitive; BLM: Bureau Land Management Sensitive.

[2] State Status – SE: California Endangered; ST: California Threatened; CSC: California Species of Concern; FP: Fully Protected. California Rare Plant Rank (CRPR, formerly known as the CNPS List) - CRPR 1B: Considered rare, threatened, or endangered in California and elsewhere; CRPR 2: Considered rare, threatened, or endangered in California, but more common elsewhere; CRPR 3: Plants which need more information; CRPR 4: Limited distribution – a watch list.

Appendix E
History and Importance
Of The
Desert Tortoise Research Natural Area

September 5, 2012

The Desert Tortoise Research Natural Area (DTRNA) was formally established as a Research Natural Area (RNA) and Area of Critical Environmental Concern (ACEC) through Congressional designation and withdrawal from the general land laws, mining, and livestock grazing, and through the California Desert Conservation Area Plan in 1980 (U.S. Dept. of the Interior [USDI], Bureau of Land Management [BLM], 1980). The formal designations of RNA and ACEC have remained in place in subsequent management plans for 32 years (e.g., USDI BLM and California Department of Fish and Game 1988; USDI BLM 1999, 2006). The fenced area, protected from sheep grazing and recreational vehicle use, offers opportunities for study and conservation unavailable elsewhere in the western Mojave Desert. Thus, DTRNA became either the focus or part of many research projects. Examples include but are not limited to tortoise health (Berry and Christopher 2001, Christopher et al. 1999, 2003), physiology (Peterson 1994, 1996a, 1996b), diseases (Jacobson et al. 1991, Jacobson et al. 2012), growth rings in juveniles (Berry 2002), behavior of juvenile tortoises (Berry and Turner 1986a, 1986b), foraging behavior of adults (Jennings 1993, 1997, 2002), genetics (Murphy et al. 2007), reproduction (Wallis et al. 1999), and anthropogenic impacts (Berry 1978, 1986, Berry et al. 1986). The DTRNA is the site for long-term, ongoing studies on demography of desert tortoises spanning >30 years (e.g., Berry and Medica 1995, Berry et al. 1986, Brown et al. 1999).

The DTRNA was the site where upper respiratory tract disease (URTD) caused by *Mycoplasma agassizii* was first discovered in wild desert tortoises (Jacobson et al. 1991) and where the first study on epidemiology of URTD was undertaken (Brown et al. 1999). The DTRNA was the site where raven predation of juvenile tortoises was first described (Campbell 1983). Sheep trampling of juvenile tortoises and potential impacts of sheep grazing on desert tortoises were first described here (Berry 1978). Other aspects of the flora and fauna have been studied at the DTRNA, such as the effects of the protective fencing on lizards, birds, mammals, and plants (Brooks 1995, 1999) and ecology, genetics, and population densities of the State-listed threatened Mohave ground squirrel. In 2011, the rare and western Mojave Desert endemic Barstow woolly sunflower was discovered on the DTRNA. Several graduate students have obtained masters (e.g., Jan Bickett, M.L. Brooks, W.B. Jennings) and doctoral degrees (R.W. Marlow, C.C. Peterson) on research conducted at the DTRNA (Marlow 1979, Bickett 1980, Jennings 1993; published papers from Brooks, Jennings, and Peterson are cited below). It is here

that researchers can be assured that their studies can occur in a relatively undisturbed and protected setting.

Both long-term studies and recent landscape-level studies within and adjacent to the DTRNA confirm that the DTRNA contains significantly higher densities of tortoises (Berry et al. 2012) and higher quality habitat than on adjacent BLM-managed lands and private lands (Brooks 1995, 1999, Berry et al. 2012). Densities of tortoises in the DTRNA are higher than in the western Mojave Desert in general (U.S. Fish and Wildlife Service 2010, Berry et al. 2012). Factors contributing to the higher tortoise densities and habitat quality include the protective fence, the removal of sheep grazing in the late 1970s and the closure to recreation vehicles.

Listed below are a few of the published papers, two theses and one dissertation from research conducted at the DTRNA. In summary, the DTRNA is a very important site for studies and long-term scientific research projects and merits special protection for its scientific and conservation value. It is the only such protected site established specifically as a Research Natural Area in the western Mojave Desert.

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