Report of the Independent Science Advisors on the San Diego East County MSCP (NCCP/HCP)

Part I: Recommendations Following the Workshop, February 2-3, 2006

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Introduction

The East County MSCP, being prepared by San Diego County and its consultants, is the third NCCP/HCP developed by the County. As such, the Plan has benefited from lessons learned during the previous planning processes within the County, but also from the many NCCPs/HCPs prepared throughout the State of California over the last decade. Conservation planning is a rapidly evolving science, with many plans recently published in the technical literature, especially from North America, Australia, and South Africa. New tools and approaches are continually being developed and tested, and they are becoming increasingly sophisticated; hence, the bar for what constitutes a scientifically defensible plan is always being raised. The East County MSCP planning process already reflects the increased sophistication of conservation planning, for example in its use of various modeling approaches and a computer-based site-selection algorithm.

The East County MSCP is quite unique in that some 75% of the 1.6 million acre study area is public land. This public land forms a relatively unfragmented matrix in which private lands are embedded. The private lands that constitute the Plan Area and are of greatest conservation concern are concentrated in the Potrero-Campo-Jacumba, Borrego Springs, Oak Grove-Chihuahua Valley, Warner Spring-Ranchita, Cleveland National Forest inholdings, and Julian-Santa Ysabel areas. The Plan will have little effect on lands outside these key areas, except as prioritizations or guidelines for infill within the existing natural lands matrix.

The Natural Community Conservation Planning Act (SB 107) requires "inclusion of independent scientific input to assist the department and plan participants…" in development of NCCPs. The role of independent science advisors is to assure that high scientific standards are applied to the planning process. The benefits of including such advice include improving the chances of a Plan's technical success through 1) improved baseline data and knowledge; 2) improved analytical approaches; and 3) improved understanding of risks and uncertainties. The science advisory process also increases the credibility of the Plan for the public and stakeholders, and very likely enhances the legal defensibility of a Plan (W. Spencer, unpublished). Therefore, our comments are meant to help the County develop a more defensible Plan than could be achieved otherwise, i.e., a Plan that is practical and politically acceptable, yet fully compatible with the goals of the NCCP program, the chief one of which is to "conserve natural communities at the ecosystem scale while accommodating compatible land use" (http://www.dfg.ca.gov/nccp/).

This report, the first of two to be issued, summarizes recommendations of a group of independent science advisors assembled to review the planning process for the San Diego East County MSCP (NCCP/HCP). Appendix A provides brief biographies of the independent science advisors.

In this report, which follows our review of planning documents, a tour of the Plan Area, and a workshop on February 3, 2006, we comment on 1) species, habitats, and other elements addressed in the Plan; 2) the quality and completeness of data applied to the planning process; 3) the planning methodology; and 4) monitoring and management considerations. We also provide other comments on the planning process, as it exists at this time.

Species, Habitats, and other Elements Addressed in the Plan

The large number of species (250+) being considered for possible inclusion as covered species is potentially problematic. We recognize that the County intends to narrow this list using a variety of criteria; this is almost certainly necessary. On the other hand, some important species may be missing from the list. There are advantages and disadvantages to having a large list of covered species. A small list is preferable from the standpoint of:

1) Acceptance by regulatory agencies, particularly the U.S. Fish and Wildlife Service and California Department of Fish and Game. The agencies properly want to avoid providing coverage for incidental take permits to species whose life histories and distributions in the Plan Area are not well understood, and which therefore may not be adequately protected by the reserve design or other aspects of the Plan. Hence, the precautionary principle would generally suggest that a smaller list is preferred in order to avoid unforeseen impacts to poorly-known species (Noss et al. 1997).

2) Logically, covered species should be those whose viability and recovery potential can be significantly affected by the Plan, and which can be monitored effectively within the Plan Area. Therefore, species whose known distributions are entirely or predominantly on public lands or are otherwise outside the private lands that constitute the Plan Area may not be legitimate covered species, as the Plan may have little effect on them. (We assume here that the public lands will be managed for the conservation of the species concerned; see our further comments on this issue, however.) On the other hand, if the private lands of the Plan Area potentially provide connectivity or buffering for populations on public lands, or if development of private lands has indirect effects on species that occur on private lands, the species so affected should be considered seriously for coverage. Species-specific analysis is needed to determine the potential direct or indirect effects of private land management on their viability. An example of indirect impacts might be downstream impacts within Forest Service lands from

construction activities on inholdings higher in the watershed, or effects of recreation, sound or light pollution, etc., on public lands from adjacent private lands. Additionally, we understand that there could be over-drawing of groundwater in this region, potentially leading to drying out of springs and creeks on public or protected lands in connected aquifers.

3) As implied in #1, above, covered species should be those whose distributions, life histories, and sensitivities to disturbance are reasonably well understood, so that the reserve design and management guidelines can be crafted to meet their specific needs. A relatively small proportion of the 250+ potential covered species meet these criteria.

On the other hand, a relatively comprehensive list of covered species may be preferred for several other reasons:

1) When a species is discovered on private lands, outside its known distribution on public lands—which is inevitable, over time—the County would benefit from legal coverage of that species in order to avoid the counter-productive morass of regulation that accompanies species-by-species, site-by-site conservation. One of the main arguments in favor of comprehensive conservation planning is avoidance of the inefficiency and bad public relations resulting from such piecemeal planning (Noss et al. 1997). From this standpoint, the more comprehensive the list of covered species, the better. Nevertheless, this approach is contingent upon the public land-managing agency managing for the conservation of the species, which may not always be the case if public land agencies lack the staff, expertise, or other resources required. If public lands fail to adequately protect and recover particular species, the private lands may indeed be very important for species viability and recovery.

2) A comprehensive list of covered species helps assure that the biological needs of each of those species is considered in the reserve design and management guidelines. If the list of covered species is small, the resulting design and management program may be biased and incomplete. Nevertheless, this argument does not hold water if the species are "covered" without solid knowledge of their ecological requirements and sensitivities, as noted above.

Given these conflicting arguments, we recommend that the criteria for selecting covered species include the following attributes:

1) The distribution, life history, and vulnerability to human activity of the species are relatively well known, even if not completely understood.

2) The viability and recovery of the species is dependent on or is greatly influenced by its management in the Plan Area. Species in this category obviously include those that are endemic to the Plan Area and those for which the Plan Area constitutes a significant portion of their range; for such species viability and

recovery are highly dependent on the Plan. However, species might also be included if their range extends well beyond the Plan Area (for example, into Mexico), but the Plan presents a significant opportunity to further the conservation the species.

3) The Plan Area is potentially critical for providing connectivity, buffer zones, or refugia from disturbance for the species in question, even if its primary distribution is outside the Plan Area (for example, on public lands in the region).

4) A species can be used as a surrogate to represent a rare or threatened habitat type or an imperiled or ecologically important functional group of species (albeit in most cases we would favor targeting the habitat type directly, as mentioned below).

Bats are an example of a taxonomic group that is biologically important in the County, but whose distribution and conservation status are poorly known. Hence, they are a problematic group from the standpoint of selection of species for coverage. Appendix B discusses some of the key conservation and coverage issues with respect to bats in the East County Plan Area.

We are generally supportive of the County's attempt to divide covered species into more specific categories (species-based, habitat-based, policy-based, etc.), although these lists need refinement. It is critical that definitions of the categories be explicit (i.e., definitions are not presented in the material we were given). At present, the distinction between the species-based and habitat-based categories is not clear. It is not explained how species were assigned to a particular category (i.e., what specific criteria were used) and, more importantly, it is not clear how assignment of species to these divisions will influence Plan development and/or implementation. This should be better explained based on known information about the species and/or habitat.

We emphasize that even when a species is not officially a covered species, it may serve a useful role as a focal species (Lambeck 1997, Carroll et al. 2001, Noss et al. 2002) for reserve network design. In the use of focal or surrogate species, it would be helpful if the role of the species were clearly spelled out. For example, is the species being used to identify connectivity between reserves, indicate presence of sensitive habitats (e.g. marshlands), or evaluate the health of the environment (e.g., water quality)?

A number of species that are currently deemed stable may, in fact, face future threats as habitats are degraded. Protection of sensitive habitats may, therefore, reduce the probability that species dependent on them would be listed in the future. For this reason, the Plan should also consider protection of key habitat types that are now threatened, or are likely to be threatened in the future. In southern California, habitats greatly influenced by water flow and groundwater levels (watersheds, marshes, springs, washes, and alluvial fans) and habitats representing rare soil types, are examples of habitats that should be considered.

A representation (gap) analysis that includes various habitat types, defined by physical parameters (e.g., geology, soils, topographic position, elevation, climate [both precipitation and temperature]) as well as vegetation, in the Plan Area and the broader study area would be valuable. Such an analysis would show, among other things, what proportion of each habitat type is on private lands (Plan Area) vs. public lands vs. the entire East County area; it would also indicate the proportion of each habitat type occurring in various protection/management categories (i.e., the classes I-IV described in Section 6 of the background document). Such an analysis would illuminate those elements/features that occur disproportionately on private lands and therefore should receive particular attention in the Plan.

The Data: Quality and Completeness

Significant questions regarding baseline data that we would like to see addressed more thoroughly in the planning documents include:

1) What is the quality of the data being applied to the planning process?
2) Are there additional data sources that might be incorporated?
3) What are the major gaps in information, and how will they be addressed?

We see a need for more complete and higher quality hydrologic data, including information on springs and other perennial water sources. The species mapping process, as currently described, does not include all habitat variables that may be important to some species. Hydrological layers, including streams, springs, and other perennial water sources should be included as covariates in models predicting habitat suitability. Points of convergence or surface water flows are suspected to be of high biological value, and should be identified and mapped. It should be relatively easy to identify quasi-perennial water sources and desert riparian communities using remote imagery taken during a dry season of a “normal” year. Stream flow and duration information should also be included, if possible, and may be available from government or university hydrologists.

The Plan should incorporate information on patch size requirements and some measure of dispersal distance/barriers for each focal species. That is, once a species’ habitat suitability is predicted and mapped, there should be some evaluation of patch size and isolation, to see if each patch is large enough to be useful for the species, either as live-in habitat, a stepping stone, or as a movement corridor. This type of exercise would be more achievable if the species list were reduced and limited to species for which some life-history data exists.

An evaluation of dispersal abilities and needs may be a necessary step in choosing the species list if the criteria for choosing species (as covered species) considers the issue of whether or how the Plan Area provides potentially important connectivity between populations living on public lands. It may be desirable to start with a larger candidate list of species, evaluate connectivity across areas within and outside of the Plan Area (for each species), and then identify a subset of species for which the Plan Area represents important connectivity areas.

<u>The Planning Methodology</u>

We find the overall planning methodology basically sound. However, we have several concerns. In particular, the composite Habitat Evaluation Model has a number of inherent problems and limitations. The overall composite index is of questionable utility because it combines components that may vary independently of one another. Not only does this lead to the “eclipsing” problem common to all multi-metric indices (Andreasen et al. 2001), but in this case it appears that several of the model components may conflict with each other. For example, the Habitat Diversity index conflicts with the objective to maintain large patches of particular vegetation types for area-sensitive species that require large patches. Large patches of grassland—and of chaparral, the matrix community of much of this landscape, which is typically undervalued—are of high conservation value, even when they have little habitat diversity. For some grassland species in particular, edges of non-grassland habitat, even native vegetation, are associated with reduced reproductive success. This is true, for example, for at least some populations of Grasshopper Sparrows (Johnson and Temple 1990, Delisle and Savidge 1996, Perkins et al. 2003).

We suspect that the Habitat Diversity Index will be correlated with the Edge Effects score, but whereas the former is considered positive, the latter is generally negative for native biodiversity. A correlation matrix and sensitivity analysis (i.e., applying different weightings to model components) would illuminate such problems. We also question the utility of Habitat Patch Size (Page 8-5 of the background planning document provided to the ISA) as a factor in the HEM, or as a stand-alone factor. Specifically, a patch size score seems to be assigned to each pixel (or each 5-acre hexagon) based on existing conditions, but as pixels or hexagons become part of (or are excluded from) PAMAs or other parts of the Reserve Design, this score becomes meaningless. The site-selection algorithm is a better place to consider the size of habitat patches included in the reserve design. (The patch size description also should clearly explain and justify whether the patches are defined by paved roads or dirt roads.)

Because time is of the essence, we suggest that the consultants spend much less time on the Habitat Evaluation Model, instead concentrating on factors—some of which are components of the model—that have demonstrated conservation value. These components include soils known to support sensitive plant species, habitats for key species or of inherent high conservation value, key species models (selected carefully), and areas of connectivity based on empirical data, species-specific movement models, or on continuity of key habitat types. Goals derived for these components should be applied directly in the simulated annealing site-selection algorithm (SITES or MARXAN). Indeed, Figure 8.1 of the planning document indicates that 5 model components of the Composite Habitat Evaluation Model will contribute to the site-selection algorithm. Thus, it appears that only a few elements of the HEM will be emphasized. We would go a step further, however, and avoid calculating any composite HEM score (Figure 8.9), which is of dubious value. Also, as discussed in our February meeting, one of these 5 components, the California gnatcatcher model, is not particularly germane to the East County MSCP.

Additional problems and limitations of the Habitat Evaluation Model were discussed by Noss et al. (2001) with respect to the North County MSCP. We are disappointed that these limitations were not acknowledged and addressed before applying the model to the East County Plan; indeed, the model is virtually unchanged from the model we critiqued in the North County Plan. We request that the consultants read and carefully consider the comments on the North County MSCP, with respect to all aspects of the methodology that are repeated in the East County MSCP. It would be redundant for us to repeat our full critique here.

The methods proposed in the planning document for predicting species' habitat have some limitations, and may be improved by using more statistically robust methods that use actual location (occurrence) data and a multivariate approach. For most species location data will be comprised of "presence-only" data, since the study area has not been systematically surveyed to determine true "absence" data. In addition, multiple visits over time may be necessary to determine that a site is actually *not* occupied, and some species may not currently occur in all potential habitat due to other ecological or anthropogenic constraints. Several methods of predicting species occurrence without absence data include the Ecological Niche Factor Analysis (ENFA) approach developed by Hirzel et al. (2002a) and implemented in the program BioMapper (Hirzel et al. 2002b), the Genetic Algorithm for Rule-set Production (GARP) method developed by David Stockwell (Stockwell and Noble 1992, Stockwell and Peters 1999), implemented in the program DesktopGARP (http://www.lifemapper.org/desktopgarp/), and resource-selection functions (e.g., Boyce and McDonald 1999, Carroll et al. 2001, Johnson et al. 2004).

Regardless of method used, the accuracy of predicted habitat should be validated with an independent dataset—which may demand new fieldwork—and, furthermore, the resulting predictive map should be evaluated by competent outside reviewers with expertise on the species in question. If possible, the Plan documents should show maps of the predicted habitat of at least some of the individual covered species or focal species. We suggest, however, that models and associated maps with a high level of uncertainty should be displayed with appropriate caveats.

Connectivity Planning

The planning document indicates that linkages will be designed to accommodate "wide-ranging fragmentation-sensitive species" (3-8 and elsewhere). We endorse a focal species approach, but suggest that, given the relatively small size of some of the sites within the Plan Area, some species that are not "wide-ranging" (e.g., some reptiles, fishes, or plants) can be appropriate focal species for designing linkages. Planners often request recommendations on minimum corridor widths, but we caution that this should be one of the last questions addressed in planning for connectivity. We suggest such planning should be structured as follows:

- Identify groups of two or more important habitat areas whose biota would benefit from a corridor or series of stepping stones among them. These areas in need of connectivity may be on public lands inside or outside the Plan Area, or even outside the Study Area. In most cases, the areas should be reasonably expected to remain important habitats for the foreseeable future. However, in some cases (e.g., important habitats in Mexico, on tribal lands, or on water district lands), the conservation status of one of the habitat areas will be less secure. Nonetheless, explicit identification of areas to be linked is an important step, because it reduces the risk that the MSCP will build "corridors to nowhere." Review of previous work conducted by South Coast Wildlands (www.scwildlands.org/) may provide guidance in choosing some of these areas.

- Designate the area between these "rooms" as "potential linkage areas" and focus only on potential linkages that overlap private land under County jurisdiction. Because many public wildlands in the Study Area are contiguous, we expect that the East County contains no more than a dozen potential linkage areas relevant to this Plan. One obviously important area for connectivity is along the US-Mexico border, where at least two north-south corridors will probably be needed: one for desert species in the eastern planning area, and one for chaparral-semidesert species in the Campo area. Additionally, there are at least four watershed connections between Tecate and the Imperial County line that need to be maintained between the US and Mexico to maintain hydrological functioning and habitat quality for potential covered species. Development of border fences and other features might impact these processes.

- For each potential linkage area, identify species in need of connectivity in that landscape. In some cases, there may be only a single focal species, but whenever possible we advocate considering a larger group of species. These should be species sensitive to fragmentation at the scale of the particular landscape and species most affected by the types of human-caused barriers likely to occur in this landscape. Target species should also be diverse in their habitat affinities and movement abilities.

- Model potential habitat or habitat permeability for each focal species in a spatially explicit way. The type of model developed may vary depending on how well the habitat requirements of each focal species are understood. Noss and Daly (2006) provide an overview of spatially-explicit approaches, and Beier et al. (2006) outline a particular multiple-species approach which is currently being used to model movement of focal species across selected linkages within the East County Study Area (South Coast Wildlands; www.scwildlands.org/).

- Create an overall linkage design that serves each focal species. Set the minimum width that provides sufficient habitat for the most demanding species in that landscape (e.g., a species for which gene flow through the potential linkage area will occur only via a metapopulation over several generations, or a habitat specialist for a limited habitat type in the potential linkage area). From these examples, it is clear that the minimum width will be a function of the interaction between the focal species and the particular landscape. The South County MSCP Plan (1997) suggested a minimum width of 1,000 ft, allowing for "bottlenecks" or "chokepoints" as narrow as 400 ft for short distances (e.g. road crossings) within a longer corridor. Although this standard is not unreasonable, we emphasize that it is important to justify the width because it provides a high probability that target species or their genes will move from one defined habitat area to another. Recent data from the Santa Monica Mountains and Orange County shows that bobcats are lining up their territories along anthropogenic boundaries (urban areas or roads), which may reduce movement and gene flow in the absence of well-designed and adequately wide corridors (R. Fisher, personal observation). For the longest linkages (e.g., a north-south cross-border linkage in the Campo area), the average width of the corridor should greatly exceed 1,000 ft, although existing infrastructure will impose several narrower chokepoints.

- Write management prescriptions specific to each linkage design. This should address edge effects from lighting, domestic animals, and other factors (especially along chokepoints), restrictions on land use within the corridor, and amelioration of barriers such as highways within the corridor.

- Don't rely on focal species alone to assess connectivity. Hydrologic connectivity, for example, needs to be evaluated directly. Some watersheds are protected in downstream portions, whereas development will occur upstream or midstream, impacting the functioning of the watershed. Buffers around creeks, reduced development of ponds (impoundments) in creeks, and reduced channelization and stabilization features are measures that can help assure hydrologic connectivity and associated ecosystem function. Flow pipes across roads need to be of appropriate size, and in many cases should be soft-bottom culverts. These issues will need to be addressed in some detail during implementation of the Plan, but attention to their importance at this stage will make proper implementation more likely.

Pre-Approved Mitigation Areas (PAMA)

The concept of softline reserves, or Pre-Approved Mitigation Areas (PAMA), is worrisome because their precise boundaries are not determined at the time the Plan is approved; hence the PAMA inherently carry greater uncertainty and risk than a hardline reserve network. We appreciate the need for flexibility in designation of PAMA; it would be impossible to specify precise boundaries until individual projects (e.g., subdivisions, shopping malls) are proposed. We are very encouraged by the County's "assumption" (Section 3.6 of planning document) that approximately 75% of the overall PAMA "would be preserved." Nevertheless, we would like to see more explicit attention to PAMA configuration in the Plan, as well as more firm guidance for PAMA area than an "assumption" provides. A more detailed consideration of reserve design principles, for example as discussed by the independent science advisors for the North County MSCP (Noss et al. 2001; http://www.dfg.ca.gov/nccp/sdnosciadvpart1.pdf), should be part of the Plan and apply to PAMA as well as to hardline reserves.

Fig 3.1 (flowchart box #7) of the planning document indicates that the Plan will include "detailed species by species analysis of the degree to which implementation of the PAMA and management of the preserve areas will protect sensitive species and habitats." We commend this approach. We urge that these species analyses specifically address 1) uncertainty in the model for predicting distribution of the focal species or habitat; 2) likely scenarios by which management of adjacent public land could change in a way detrimental to conservation of the species or habitat, and whether the reserve design is robust to this sort of failure; and 3) whether the reserve design will facilitate range shifts in response to climate change. The latter is particularly important for species at the edge of their geographic range.

We also urge that each species analysis be reviewed by one or more competent outside reviewers with expertise on that species or habitat. For example, adoption of the priority bird species list provided by Phil Unitt of the San Diego Natural History Museum would greatly assist in reducing the covered species list while also giving added attention to species easily overlooked. Species identified as "not of conservation concern" could be dropped from the covered species list, as can species that occur in areas of Forest Service, State Park lands, or lands already in County possession. Nevertheless, there are exceptions to all rules. For example, spring species occurring on public lands, even if presently non-imperiled, could be seriously impacted by excessive withdrawal of ground water on private lands.

Species whose range or population within the Plan Area is minor in a regional context should in most cases be deleted or de-emphasized in consideration. Even if only a minor portion of a federally or state listed species population exists within the MSCP area, however, the listed species would still have to be included in coverage priorities due to its legal status. Outside review may help resolve the dilemma (discussed above) about how many species should acquire "coverage" under the Plan.

Resource Status and Multi-agency Participation

As suggested earlier, one key area of uncertainty (and therefore risk) concerns the degree to which the public lands that make up approximately 75% of the Study Area will contribute to conservation and recovery of covered species. Section 6 of the background document defines four classes of land with respect to protection. In general, the assumption seems to be that most public land in Classes I, II, and III will continue to be at least "passively managed" for conservation. However, we urge the County not to assume that resources for the management of these lands are guaranteed in perpetuity. Continued degradation of resources within public lands, even if formally protected, is possible, especially with changing state or federal policies, for example with respect to roadless areas on national forests. A summary of the new Forest Service plans (http://www.fs.fed.us/r5/scfpr/) in relation to biodiversity issues would be helpful.

It is not clear how differences among these classes, or among parcels within a Class, will be considered in the gap analysis or other steps in Plan development. At a minimum, we recommend that the Plan 1) include explicit discussion of assumptions about how various classes and parcels will be managed; 2) describe precisely how these classes will be treated in the Reserve Design process; and 3) document that major public landowners were invited to participate in a substantive way in the East County MSCP. With regard to the latter, we recognize that land-management agencies may have little incentive to participate in this NCCP/HCP. However, it is not clear that potentially important partners, such as State Parks (Palomar Mountain, Cuyamaca Rancho, and Anza-Borrego Desert, Ocotillo Wells SVRA), U.S. Department of Homeland Security, Water Authorities (Vista, City of San Diego), and Cleveland National Forest, have been *invited* to participate. A representative from the Bureau of Indian Affairs that could speak back to the tribes would also be a valuable participant. Participation by partner agencies could greatly reduce uncertainty and risk. Even if they decline to participate, having a formal presentation followed by an invitation may sensitize them to important conservation issues at this scale. It may also encourage them to pursue additional conservation and management actions on their lands, especially perhaps near the boundaries with the private lands that are included in the Plan, because they might appreciate the opportunity for complementary actions.

Protecting/managing bat roosts on public and private lands adjacent to or within the Plan Area provides an example of how outside agencies or other entities could play an important role in helping to maintain bat populations in the general planning area. There are several known examples of significant bat roosts occurring on public lands adjacent to (and agency/privately owned structures within) the planning area that are currently not protected or otherwise managed for. These roosts support bat populations that have ranges at least partially encompassed by the planning area yet are vulnerable because the roosts fall outside the planning area or are in a structure owned or managed by a potentially non-participating agency (or private land holder) within the Plan Area (some examples: ‘Ready Relief’ Mine and other mines on BLM land in Banner/Julian and Potrero, City of San Diego Water Authority structure known as ‘Barrett Flume’ in Dulzura, Old Hwy 80 bridge in Jacumba, Hwy 78 bridge in Sentenac Canyon, ‘Mamas’ Antique store in Santa Ysabel, and the USFS fire station structure(s) in Oak Grove).

We have significant concerns related to how other agencies will interface with the MSCP Plan. The Plan should explain how the Biological Mitigation Ordinance (BMO) and Resource Protection Ordinance (RPO) developed pursuant to the Plan will affect current proposals such as SDG&E’s “Sunrise Powerlink” and future proposals for major projects affecting the reserve design. Will the MSCP Plan and related Ordinances give the County any additional clout in commenting on and influencing such proposals? If water districts are not part of the MSCP, can the Plan effectively conserve groundwater resources needed for covered species? If the MSCP identifies important habitat areas that are influenced by—or influence—water flows, groundwater levels, etc., would that allow the County to better coordinate the two issues: habitat/species conservation and water management?

In cases where the efficacy of approved NCCPs/HCPs on private land is built on assumptions of long-term habitat conservation and species protection on public lands, concurrence from the public land management agencies should be sought and future guarantees assured. The U.S. Secretary of Agriculture and the Governor of California should be invited to stipulate that future land-management decisions and land-use plans and permits on state and federally owned lands within the Plan Area will not be allowed to diminish wildlife protection relied upon today by the County and property owners in developing the East County MSCP. It should be noted that similarly in the case of the City of San Diego's first MSCP/NCCP, then Secretary of Interior, Bruce Babbitt, noting reliance of the City's Plan on the wildlife and habitat resources of BLM-managed Otay Mountain, dedicated its future management in support of wildlife conservation values before all other "competing" uses. Similar assurances should be sought for the East County MSCP.

As federal agencies are encouraged by the Endangered Species Act to further the intent of the Act, it will be important for the County and its private landowner constituents to be assured that those agencies will not undertake actions that adversely affect Threatened, Endangered, and/or sensitive and declining species of plants or animals. For instance, what if activities undertaken on upstream public lands have adverse effects on private lands downstream? Such a situation would create an unequal burden of responsibility. The downstream spread of exotic, invasive plants and exacerbated flood scouring are examples of such potential problems.

Monitoring and Management

The East County MSCP must provide clear guidance for moving from the planning phase to the implementation phase. Crucial to this transition is an adequate discussion of monitoring and management in the Plan. Discussion of adaptive management and monitoring has been included in past ISA reports (e.g., Noss et al. 2001; see http://www.dfg.ca.gov/nccp/sdnosciadvpart1.pdf), so we will not repeat a full discussion here.

The current management and monitoring literature recommends increased attention to "ecosystem" indicators, for example, those derived from remote sensing and a variety of GIS databases. Although many such indicators are inadequately tested, they may ultimately provide for more cost-effective monitoring and assessment than considering every potentially imperiled species individually (Andreasen et al. 2001, Niemi and McDonald 2004). Nevertheless, periodic monitoring of species' populations will be necessary to validate and refine indices based on landscape patterns, processes, or habitat structure. Carefully selected indicator species remain useful in monitoring (Carignan and Villard 2002). Moreover, we recognize that agencies are likely to require species-level monitoring in some cases. This is another argument for keeping the list of covered species workably small. Monitoring at the species level will have to be prioritized—for example, federally and state listed species first, then other covered species or valid indicator species. A monitoring program should include both effectiveness monitoring (i.e., how effective a given management treatment has been) as well as implementation monitoring (i.e., have activities proposed or mandated in the Plan actually been implemented?).

Unfortunately, effectiveness monitoring has often yielded little usable data. Sample sizes are often too small and the “experiment” not well enough designed to detect significant trends in population status, i.e., the monitoring program lacks statistical power (Quinn and Keough 2003). The causes of trends in abundance may be difficult to interpret. Consultation with statisticians familiar with monitoring issues is essential to developing a defensible monitoring and adaptive management plan.

As an alternative to conventional monitoring programs, many scientists recommend formulating alternative *a priori* models of system behavior and distinguishing those models that most influence the system (e.g., Burnham and Anderson 2002). Monitoring programs often result in decades-worth of data that provide unreliable knowledge and ambiguous guidance for management because several different *a posteriori* models can explain the same results (Nichols 1999, Yoccoz et al. 2001). Considerable effort and funds are spent monitoring population size and reproductive success in some cases, but results of such monitoring may not match modeled trends based on the same or independent data (D. Breininger, personal communication).

Instead of purely retrospective analyses, monitoring programs should develop *a priori* models about the effects of different management treatments, then apply an experimental design with statistical tests capable of discriminating among competing models. Because populations fluctuate widely, and it is often difficult to differentiate among variation associated with measurement errors, deterministic factors, and stochastic events, a superior approach is to develop a plan to monitor variables (e.g., survival, fecundity, dispersal, density, extinction, recolonization) in relation to habitat quality, landscape configuration, and especially alternative management treatments (D. Breininger, personal communication).

We realize that the County cannot possibly monitor population trends of all covered species, as well as habitat structure, landscape patterns, and other important variables. We discourage the Plan from promising a long list of monitoring actions that have low probability of being implemented (or, as discussed above, a low probability of providing reliable information for management). Nonetheless, the final MSCP Plan should include several cost-effective and meaningful monitoring activities. These could include actions such as documenting acres of living mesquite in Borrego Valley, quantifying the spatial genetic patterns of black-tailed jackrabbits north and south of the US-Mexico border in the Campo area every 5 years, or reporting percent of stream reaches occupied with arroyo toad and chub every 4 years, and new occurrences of invasive species. Bat richness/activity levels (including focus on specific species) could be monitored over time using fixed, passively recording bat-detector stations set up in various parts of the planning area. Placing fixed bat-detector stations in a variety of settings (perpetually core areas, currently fragmented areas, and ‘to-be-fragmented’ areas) in the planning area would provide the opportunity to monitor trends in bat populations as the landscape changes over time. Bat roosts identified within/adjacent to the planning area could also be monitored for potential trends in population sizes simultaneous with monitoring of bat activity and richness using bat detectors (see Appendix B).

These hypothetical examples (which will require confirmation of their importance and relevance by species experts) are intended to illustrate monitoring activities that 1) are directly related to species of concern significantly affected by use of land under County jurisdiction; and 2) involve relatively low investment of time and money. We caution that the time length between surveys or censuses be short enough to allow time for management correction.

During the workshop on February 3, agency representatives brought up the issue of fire ecology and management, and asked that the independent science advisors offer guidance for how the Plan might address fire in reserve design and management. Unfortunately, we do not believe that the Plan can do much to influence the fire regime in the study area, especially because the Plan Area constitutes only one-quarter of the study area, in scattered and isolated blocks. The fire regime is ultimately a function of climate, extreme weather events, topography, fire history, and the inherent flammability of the vegetation. Public land management, for example fuels-reduction treatments and prescribed burning, can probably influence the severity of future fire events in the montane forest communities within the study area, and there are some opportunities for this kind of management within the private lands that constitute the Plan Area. For chaparral, however, no management treatments have been convincingly demonstrated to be effective (Keeley et al. 2004), except the reduction of ignition sources, especially from roads (i.e., cigarettes [Viejas Fire], car fires, etc.) and structures in the urban-wildland interface that are not up to code. Fire-proofing homes and other human structures, as well as the area immediately surrounding structures, can be helpful, however, and should be considered in Plan regulations.

The East County Plan probably will not succeed in its biological goals unless it provides useful guidance to restrict water use within the Plan Area, which is subsequently implemented through regulation and incentives. Irrigation for crops, sprinklers to keep lawns and golf courses green, washing of cars and parking lots, and other wasteful water uses are not appropriate in desert areas dependent on fossil aquifers.

Other Recommendations

Regarding the biological goals of the Plan (section 2.1 of background document), it should be noted that all of these rules of thumb have important caveats and exceptions. For example, the tenet to "keep reserve areas close" should be interpreted from the spatial scale of the species considered; what is close to humans might be very far for small animals with limited mobility. If an impermeable barrier lies between two reserves, it does not matter how "close" they are. Similarly, the tenet to "keep habitat contiguous" should consider not only fragmentation by urban lands, as stated, but also by artificial linear features such as highways, powerlines, canals, vegetation removal, fire breaks, proposed border fences, etc. As noted with respect to PAMA (see above), it would be useful to provide more specific guidance on application of reserve design principles in this Plan (see Noss et al. 1997, Noss et al. 2001).

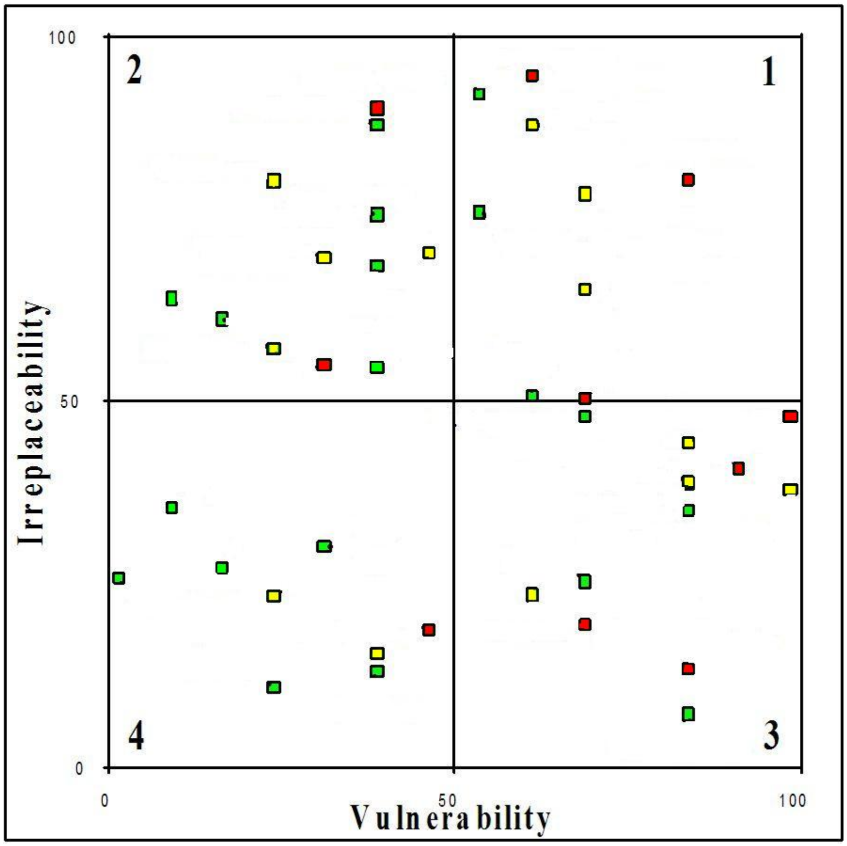
One of most striking features of this MSCP is that it is bounded to the south by the international border with Mexico. Regardless of our country's decision whether or not to erect a new, solid, multi-structured barrier to human migration, we cannot expect Mexico to prioritize wildlife conservation at its northern border, nor control land uses in such a way as to secure wildlife habitat values along the frontier. Therefore, it might save time, money, and endless conjecture to simply regard the border's future as an impassable barrier to native species, expect with regards to hydrological features that cross the border. The border lands of the East County MSCP may be required to support certain rare, locally distributed U.S. populations of plants and animals existing there at the far northern extreme of their current range. In other words, a precautionary Plan would design and perpetually manage for the viability of reserves and associated species without reliance on Mexico.

Having said this, however, the Plan should be designed to facilitate habitat connectivity across the border when opportunities allow, to permit species to continue natural movements across the international border, and to encourage land managers and politicians in Mexico to also work towards this goal as much as is feasible given border security developments and activities. The Plan should, therefore, follow two strategies. It should facilitate connectivity across the border to the extent feasible, but not rely on it for conservation of species that are also found in Mexico. For those species that inhabit the Plan Area as well as Mexico, the Plan should be designed to support viable populations within the Study Area.

One notable exception to the U.S./Mexico barrier is the endangered California condor. This species will require management and protection in both countries, regardless of border fences. The Zoological Society of San Diego's Conservation Research for Endangered Species (CRES) group is currently releasing, feeding, and satellite-tracking birds in the San Pedro de Martir mountains of Baja California. Birds have moved north to within 15 miles of the border and will likely, over time, include the Plan Area as part of their range. Thought should be given now to addressing future habitat needs and minimizing impediments to their full recovery, down-listing, and eventual de-listing.

Another striking feature of the land ownership map is the Vista Irrigation District's ownership of over 5,000 acres interrupting the Peninsular Range between Volcan and Palomar Mountains to the south and north respectively. While watershed protection might naturally be considered compatible with native habitat protection, VID's stewardship has arguably not achieved either of these goals. The important question is: what kind of reliance, in perpetuity, can be placed on this vast, ecologically significant, but currently degraded basin? In its current state the basin seems to provide habitat for Stephens' kangaroo rat, pallid bats, and south coast garter snakes, but many wildlife conservation initiatives could be pursued on these lands that are more compatible with water quality than intensive grazing by cattle.

We suggest that large sites being considered for inclusion within the reserve design for the Plan be prioritized based on their irreplaceability (i.e., biological value) vs. vulnerability (see Margules and Pressey 2000, Noss et al. 2002; these papers can be referred to for examples of criteria used to rank sites along these axes). Sites ranked in this manner would be aggregations of planning units that correspond to physiographic or other physical or ecological features. A possible third dimension in an irreplaceability vs. vulnerability graph would be represented by color-coded points, where the intensity of color indicates their economic value and, hence, the level of potential conflict with conservation objectives. See below for a hypothetical example:



Finally, we urge the County to consider, in addition to this report, those points made and the concepts discussed in greater detail in the North County ISA report, much of which is relevant to the planning effort in the East County.

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Appendix A
Biographies of Advisors

Paul Beier, Ph.D., Professor of Conservation Biology, School of Forestry, Northern Arizona University, Flagstaff, Arizona. Dr. Beier is probably best known for documenting that dispersing cougars find and use habitat corridors in urban southern California, and for related scientific papers on wildlife corridors. As a founding Board Member and Science Advisor to South Coast Wildlands, he has helped design wildlife corridors in California, and has engaged in similar collaborative efforts in Arizona and Ghana. He has worked on the recovery team for the ocelot in south Texas and as a science advisor to the recovery team for the Florida panther. In Ghana, he works with traditional chiefs and stakeholders to create and manage community-based wildlife sanctuaries, including the Wechiau Community Hippopotamus Sanctuary, the Red Volta Elephant Corridor, and the Bare-Headed Rockfowl Ecotourism Project. Beier serves on the Board of Governors of the Society for Conservation Biology. His current research includes projects on GIS methods for corridor design, birds of prey, forest-dependent birds, and top-down regulation by predators. Website: http://oak.ucc.nau.edu/pb1

Robert N. Fisher, Ph.D., Research Biologist, Western Ecological Research Center, United States Geological Survey, San Diego Field Station, San Diego, California. Dr. Fisher is a taxonomic expert on reptiles, amphibians, and freshwater fishes of southern California. His thematic expertise includes conservation biology, evolution, and natural history. He has conducted extensive work on the development of inventory and monitoring programs for animals within NCCP/HCP's in southern California, and has served as a science advisor on many plan teams and technical advisor on implementation of monitoring programs. He has particular interest in developing scientifically defensible physical surrogates for biological diversity and validating these surrogates against thresholds for triggering adaptive management.

Reed Noss, Ph.D., Davis-Shine Professor of Conservation Biology, Department of Biology, University of Central Florida, Orlando, Florida. Dr. Noss is an internationally known conservation biologist with expertise in landscape ecology, land-use planning, ecosystem management, and reserve design. He leads a conservation biology graduate program at the University of Central Florida. He has a particular interest in translating the principles of conservation biology to policy and management, and has authored influential books, including *Saving Nature's Legacy* and *The Science of Conservation Planning*. Dr. Noss has served as a member and as lead scientist on many scientific advisory teams, including those for several other NCCP/HCPs. He was a member of the Scientific Review Panel, appointed by Governor Wilson in the early 1990s, which developed science-based guidelines for NCCPs, with an initial focus on the coastal sage scrub of southern California. He has served both as President of the Society for Conservation Biology and as Editor-in-Chief of its journal, *Conservation Biology*.

Brian D. Foster, Ph.D., Consultant, Research Biologist, Avian Research Associates and Zoological Society of San Diego, Conservation and Reproduction of Endangered Species, San Diego, California. Dr. Foster has worked on a variety of bird research projects in Southern California since 1980. Under his monitoring and management program, the MCB, Camp Pendleton colony of California least terns has grown to be the largest colony in the United States. Western snowy plovers are another focus of investigation. He has done work for various governmental agencies including the Department of Defense, California Department of Fish and Game, and the County of San Diego. His past work has included diverse topics including the molecular biology estrogen receptor in human breast cancer, and the persistence of the effects of vestibular neuropathy.

Jeffrey D. Opdycke, Conservation Program Manager, Zoological Society of San Diego, The Beckman Institute for Conservation Research, Escondido, California. Mr. Opdycke manages endangered species captive propagation and reintroduction programs, oversees preserve habitat monitoring and adaptive management projects in San Diego County, and takes part in various plant conservation projects involving listed species translocations and seed banking. He serves presently on several boards of wildlife habitat conservation NGOs headquartered in the San Diego area. In addition, he served as a biologist, manager and field supervisor for the U.S. Fish and Wildlife Service in Washington, California, Colorado and Washington D.C., primarily dealing with large-scale navigation, hydropower, mass urbanization, and recreational development effects on migratory and endangered species as well as species listing and recovery planning under the Endangered Species Act.

Esther S. Rubin, Senior Ecologist, Conservation Biology Institute, San Diego, California. Dr. Rubin is an ecologist with expertise in conservation biology, population biology, and behavioral ecology. She has conducted extensive research on bighorn sheep, and played a key role in writing the U. S. Fish and Wildlife Service's Recovery Plan for bighorn sheep in the Peninsular Ranges of southern California. She serves on the board of South Coast Wildlands, furthering their efforts to maintain habitat connectivity in southern California. Dr. Rubin is also helping to guide graduate student research on impacts of nonnative species and on habitat use of mule deer in southern California.

Drew C. Stokes, Biologist, Western Ecological Research Center, United States Geological Survey, San Diego Field Station, San Diego, California. Mr. Stokes has worked on various bat research projects in Southern California since 1996. He has conducted a variety of field investigations focusing on bats for various governmental agencies including the US Forest Service, Bureau of Land Management, Department of Defense, National Park Service, California State Parks, California Department of Fish and Game, and County and City of San Diego. In addition, he has worked as a private consultant on a variety of bat-related projects in the counties of San Bernardino, Riverside, Orange, Imperial, and San Diego. He is recognized as one of few experts on the bats of Southern California. Mr. Stokes has also worked on several herpetological and multi-taxa inventory and monitoring projects in Southern California, and has participated in the development of a variety of wildlife survey protocols.

Kathy S. Williams, Ph.D., Associate Professor, Department of Biology, San Diego State University, San Diego, California. Dr. Williams is an insect population biologist who has conducted research on many species of native, rare, and endangered insects in California since 1977. She has conducted a variety of projects focusing on establishing and maintaining insect populations in managed habitats and how insect communities affect habitat quality for insectivorous birds for various agencies, such as the US Forest Service, Bureau of Land Management, Department of Defense, California State Parks, California Department of Fish and Game, and California Department of Transportation. In addition, Dr. Williams regularly supervises graduate students conducting research on the effects of nonnative plants on insect communities, and on how plant community composition and other aspects of habitat quality can influence insect population establishment and maintenance.

Appendix B
Bats as Potential Covered Species

Relevant Species

There is a general lack of information about any given bat species' current population status in the ECMSCP planning area. There have never been accurate historical estimates of abundance of any bat species in the area, and there are no current estimates. However, based on recent USGS bat surveys, it appears that the coastal form of the pallid bat (*Antrozous pallidus*) has suffered a range contraction (and probable associated population decline) in western San Diego County that is disproportional to other species, based on comparisons to survey work conducted in the 1930s and 1940s by Phillip Henry Krutzsch. The suggested reasons for this are two-fold:

1. Foraging Habits - Pallid bats have a specialized diet that typically includes large-bodied terrestrial arthropods (Jerusalem crickets, scorpions, long-horned beetles, centipedes, etc) that are captured from off of the ground. This terrestrial foraging behavior is not necessarily unique to the pallid bat, but appears to be more frequent in this species than in any other locally residing species. Useful pallid bat foraging grounds in San Diego County appear to be limited to low-gradient, sparsely vegetated areas such as grasslands, oak savannahs, broad riparian terraces (both wooded and non-wooded), and open scrubby environments (e.g., coastal sage scrub). They share habitat associations with a number of species already recognized as vulnerable to extirpation from the area such as the grasshopper mouse, grasshopper sparrow, Stephen's kangaroo rat, arroyo toad, and glossy snake. Favored pallid bat foraging areas appear to be restricted to the low-mid elevations (for example, pallid bats have yet to be found in and around Laguna Meadow but do occur in slightly lower elevation areas such as Descanso and Santa Ysabel). It is possible that high elevation meadows such as Laguna Meadow may become more usable in the future as a result of climate change. These favored pallid bat foraging grounds are also prime areas for human land-use (ranching, golf courses, shopping malls, housing developments, vineyards, orchards, agricultural fields, etc.). Some of these human land-use activities may be compatible with pallid bat foraging needs (e.g., ranching, fallowed agricultural fields) but most are likely not, particularly those where major habitat conversions occur (e.g., shopping malls, golf courses).

2. Roosting Habits – Pallid bat colonies readily take up residence in man-made structures. Krutzsch located approximately a dozen pallid bat roosts during his research in San Diego County prior to 1950; all were in man-made structures (yet not one of these roosts remains today!). Their inhabitance of man-made structures is usually easily recognized (i.e., they are a large bat, are vocal, have a distinctive 'skunky' odor, and the guano is large in size and amount and is exceptionally odiferous during summer heat). Pallid bats roosting in man-made structures typically are not well appreciated by those who own or manage such structures (D. Stokes pers. obs., S Remington pers. comm., P. Brown, pers. comm.). Therefore, pallid bats are exceptionally vulnerable to disturbance and worse, extirpation at roosts sites, where activities critical to their existence take place (resting,

nursing, thermoregulating, socializing, avoiding predators, avoiding extreme weather conditions, etc.). Also, pallid bats do not take well to the standard-design artificial bat houses, so most past and current bat-roost enhancement or mitigation activities have failed to properly accommodate pallid bats. However, a more recently designed artificial bat house has proven effective for accommodating roosting pallid bats, including breeding colonies (G. Tatarian, pers. comm.). Erecting these newer-designed bat houses may prove to be an effective roost enhancement/mitigation measure for accommodating displaced pallid bats.

Although there is not much information about the pallid bats' occurrence in the ECMSCP area of jurisdiction, it is known to occur there, and pallid bat habitat certainly occurs in the Plan's area of jurisdiction. Given that a potentially significant amount of pallid bat habitat likely occurs in the planning area, including on private land (especially roosting-appropriate features, e.g., man-made structures such as barns, bridges, unused buildings, residences, etc.) it seems appropriate that this particular bat species should be covered by the ECMSCP plan. However, whether it should be covered by species-based coverage, habitat-based coverage, or policy-based coverage (i.e., roost protection), or some combination of all three, is debatable. Pallid bats have been included in the South Sacramento HCP. An excerpt from the SSHCP document regarding pallid bats is attached at the end of this document.

Habitat-based Coverage

Most bat species should benefit from protection of particular habitat types. Therefore, potentially all other bats besides the pallid bat could be covered by habitat-based coverage (albeit it is premature to conclude this for certain). The exception is dealing with bat roosts, some or many of which will likely be occurring in habitats not normally covered by habitat-based coverage (i.e., man-made structures; see section below on policy-based coverage for bats – roost protection). Habitats important to bats that should be covered by a habitat-based coverage policy that would help to protect a diversity of bat species include:

1. Rocky cliffs and outcrops – very popular bat roost locations, particularly those that are inaccessible to predators and receive a fair if not large amount of solar radiation. Likely even more valuable would be sun-exposed rocky cliffs and outcrops adjacent to good bat foraging habitats (i.e., open water, riparian systems, woodlands, etc.). However, it is generally difficult to predict where bats roost, and can also be difficult to locate/pinpoint.

2. Dead trees/snags – Also popular bat roost locations, particularly those that have existed for some time. Snags on hilltops and ridgelines (or otherwise exposed to solar radiation) appear to be favored. However, it is generally difficult to predict where bats roost, and can also be difficult to locate/pinpoint.

3. Mines/natural caves (could also be in policy-based coverage – roost protection). Mines (prevalent in planning area) and caves (much rarer than mines but also occur in planning area) have long been recognized as important bat roosting locations. Some of the most

sensitive bat species in the Southwest (i.e., Townsend's big-eared bats, California leaf-nosed bats) are obligate cavity-roosting species and are dependent on caves and cave-like structures (mines) for their roosting needs. Some bat roost data exist for mines in the planning area, with known bat roosts in several mines. All mines and caves have potential use by bats as roosts. Some mines are more likely to be significant roosts (i.e., those near good foraging habitat, those inaccessible to human disturbance). However, it is very difficult to predict mine-use by roosting bats; considerable roost-switching takes place seasonally as well as year to year.

4.Riparian systems – usually very popular bat foraging grounds. Presence of open water in riparian systems likely bolsters value to bats (drinking and increased feeding opportunities). A suite of species (obligate foliage roosting species – hoary bat, western red bat, western yellow bat) also utilize riparian trees (primarily sycamores and cottonwoods) as roosts. Adequate protection of riparian systems (the bigger, and wetter, the better!) will likely help protect a number of foraging bats' needs, as well as those riparian tree-roosting types.

5. Oak woodland – also very popular to foraging bats, as this habitat supports many moth and flying beetle species that are popular bat prey items. Also, the bark and hollows of oaks provide good roosting opportunities for bats, both crevice and cavity-dwelling species. This may be the single most important woodland type for bats, because it appears to satisfy a diversity of needs. Oak woodland is prevalent in planning area.

6.Coniferous forests – provide bat foraging opportunities, and dead pines probably make good bat roosts. Some rare bat species (i.e., fringed myotis, long-legged myotis) are highly associated with coniferous forests, including transitional types (pinyon-juniper as main example).

7. Grasslands/open scrublands – particularly valuable to foraging pallid bats, but also popular with wide-ranging foragers such as the free-tailed bats in Molossid family (Western mastiff bat, big free-tailed bat, pocketed free-tailed bat, and Mexican free-tailed bat).

8. Palm groves – very important to roosting needs of western yellow bat. Also, very popular with foraging bats in general in desert settings. These groves constitute a special habitat feature that should be protected regardless of bat associations.

9. Open water – may be one of the most critically important habitat features for bats in the arid southwest. Most bat species do drink, and they typically do so on the wing. Therefore, most bat species are likely dependent on a source of open water for drinking: one that occurs within their range of flight from roosting location. To serve breeding female bats that are water-stressed during pregnancy and lactation (usually during late spring into early to mid-summer), open water sites must hold water into the summer months. Since roost sites are difficult to predict and locate, it would also be difficult to predict and locate open water sources near significant bat roosts. However, due to the potential lack of open water sites in arid areas, it could be predicted that any open water

may be important bat drinking sites, and bats may be selecting roosts due to their proximity to open water. Because differing bat species have differing maneuverability, not all open water sites are usable by all bat species. The less maneuverable species appear to depend on larger, less obstructed bodies of water while highly maneuverable species can utilize small cattle troughs and puddles (D. Taylor, pers. comm.). Also, emergent vegetation and vegetation that surrounds open water sites may obstruct bats from being able to drink. There must be an unobstructed flight path for bats to be able to drink from an open water site. Water quality may be a factor determining whether or not bats will make use of an open water site for drinking. There is evidence to suggest that breeding female bats choose drinking sites based on the presence of certain minerals (i.e., dissolved calcium).

Policy-based Coverage: Roost Protection

Roost protection as a way to provide policy-based coverage is an interesting concept that sounds easier to implement that it probably really is. Although suitable roost sites are considered to be a major limiting factor for the occurrence of bats, they have differing levels of significance (and are generally very difficult to predict and locate). For instance, a roost site that is accommodating a colony of 10 Yuma myotis (a common bat) that are all males and/or non-reproductive females would be much less significant than a roost of 10 California leaf-nosed bats (a much rarer species) that are all pregnant females. As another example, if one locates a colony of 10 male Townsend's big-eared bats (a sensitive species with legal status) and another colony of 10 pregnant female big brown bats (common bat, no legal status), which is more significant? The answer is not straightforward. It might be preferable to protect the pregnant female big brown bat colony first, even though they have no legal status. For bat species that are colonial, the most significant roosts are more obvious: maternity roosts (nursery sites) and hibernation sites. It is at these sites where a large number of individuals congregate and therefore are vulnerable to catastrophic loss. However, for an extremely rare solitary species such as the spotted bat, a roost site that accommodates a single individual may be significant to the population in the planning area. So, should all bat roosts be protected? This is not an unreasonable suggestion, but it is probably not possible. Whereas protection of all bat roosts in the planning area is desirable, for practical purposes it will be useful to devise a 'roost significance' ranking system based on roost type and species. Each time a bat roost is encountered, a bat biologist should be consulted to determine the type of roost and species. The bottom line: if bat populations are to be maintained in the planning area, some level of roost protection needs to be offered. Nevertheless, devising a suitable bat roost protection strategy will require considerable effort. Roost enhancement and/or mitigation for loss of roosts (if such is possible) also need to be considered in the Plan.

From South Sacramento County HCP:

Goal: Avoid and minimize impacts to Pallid Bat reproduction in SSHCP area.

Objective: Determine if direct impacts to Pallid Bat occurrences may occur as a result of development projects.

Action: Conduct pre-construction surveys. Locate roost sites by inspecting structures for bat sign.

Objective: Avoid and minimize impacts to Pallid Bat maternity colonies where development projects will remove roosting habitat.

Action: Avoid impacts to maternity colonies by limiting construction operating periods to October through March.

Action: Minimize disturbance to maternity colonies by excluding Pallid Bats from occupied structures in fall (October-November) and removing structures after bats are determined to be absent.

Objective: Minimize impacts to individuals and groups of Pallid Bats (males and non-reproductive females) where development projects will remove roosting habitat.

Action: Minimize impacts by excluding Pallid Bats from occupied structures and removing structures after bats are determined to be absent.

Goal: Preserve Pallid Bat roost sites and associated habitat.

Objective: Establish preserves that encompass known occurrences or potentially suitable habitat.

Action: Assess habitat based on the presence of potential roosting sites (e.g., in buildings, under overhangs, under bridges, in tree hollows) and conduct acoustic surveys (i.e. monitor with an ultrasonic detector) of foraging bats where activity may be concentrated such as water features and along tree and shrub lines (linear features and edges).

Action: Survey for Pallid Bat occurrences by inspecting structures for bat sign (i.e., bats in crevices or cavities, urine stains, guano deposits and especially discarded insect parts, and dead bats).

Action: Negotiate with landowners to acquire land that has known Pallid Bat occurrences or potentially suitable habitat.

Objective: Document existing habitat conditions and roost sites in preserve-specific Preserve Documentation Reports.

Action: Produce Preserve Documentation Reports for each preserve.

Goal: Maintain and enhance Pallid Bat habitat in preserves through management and monitoring.

Objective: Develop a Preserve Management Plan based on the Preserve Documentation Report for each preserve.

Action: State specific goals and objectives for Pallid Bats.

Objective: Maintain habitat through specific goals in Preserve Management Plans.

Action: Protect all roost sites (occurrences) and foraging areas on the preserves.

Objective: Enhance habitat where possible through specific goals in Preserve Management Plans.

Action: Restore vegetation communities that may provide suitable foraging habitat and support insect prey to health and structural diversity (e.g., riparian, oak savanna/woodland, grassland with shrub components, etc.).

Action: Incorporate bat-friendly designs into 100% of new bridge structures that are potential roosts, and retrofit 50% of existing bridge structures with roost potential with manmade habitats according to the latest available research.

Action: Install artificial roosting habitat in the form of bat house condominiums specifically designed for Pallid Bats.

Objective: Monitor roost occupancy and foraging activity as an indication of management effectiveness and use results to adapt management goals and objectives in Preserve Management Plans.

Action: Conduct annual or biannual roost occupancy counts of maternity colonies during June or July to obtain population indices.

Action: Conduct acoustic surveys at key water features and/or flight corridors where foraging activity is concentrated.