COMPOSITE REPORT

Science Advisory Panel Guidance for the East Contra Costa County Habitat Conservation Plan / Natural Community Conservation Plan Compiled during four meetings, May 2002 – December 2003

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I. INTRODUCTION

I.A. Background

The East Contra Costa County Habitat Conservation Plan / Natural Community Conservation Plan (HCP / NCCP) is intended to protect and enhance ecological diversity and function within the rapidly urbanizing region of eastern Contra Costa County, California while improving and streamlining the process of obtaining environmental permits for impacts on endangered and threatened species. The HCP / NCCP will allow Contra Costa County and the cities of Pittsburg, Clayton, Oakley, and Brentwood to better control local land-use decisions in the region while providing comprehensive conservation for species, wetlands, and other ecosystems and contributing to the recovery of endangered and threatened species in northern California. The HCP / NCCP will help to avoid project-by-project permitting that is generally costly and time consuming for applicants and often results in uncoordinated and biologically ineffective mitigation efforts. This document, developed in response to requests from the U.S. Fish and Wildlife Service (USFWS) and California Department of Fish and Game (CDFG), is intended to provide a topic-based summary of general guidance and major conclusions derived from the four meetings of the Science Advisory Panel for the HCP / NCCP.

The East Contra Costa County Habitat Conservation Plan Association (HCPA), a Joint Powers Authority consisting of Contra Costa County, the Contra Costa Water District, the cities of Brentwood, Clayton, Oakley, and Pittsburg, and the East Bay Regional Park District, has been charged with managing and funding development of the HCP / NCCP for submission to USFWS and CDFG. Pursuant to Section 10(a)(1)(B) of the U.S. Endangered Species Act, the approved HCP and associated permit will authorize incidental take of federally listed species within the permit area. The approved plan will also serve as a NCCP and allow CDFG to authorize take of covered species under Section 2835 of the Natural Community Conservation Planning Act. USFWS and CDFG also will provide assurances to local jurisdictions and HCP / NCCP participants that no further commitments of funds, land, or water will be required to address impacts on covered species beyond that described in the HCP / NCCP.

The East Contra Costa County HCP / NCCP also is intended to serve as a mitigation plan for a regional wetlands permit. The HCPA intends to apply to the U.S. Army Corps of Engineers for a regional wetlands permit under Section 404 of the Clean Water Act. The HCPA further intends to apply to CDFG for a regional Master Streambed Alteration Agreement under Section 1602 of the California Fish and Game Code.

I.B. The science advisory process

Under its Five-Point Policy, USFWS "encourage[s] the use of scientific advisory committees during development and implementation of an HCP" (65 FR 106 35256, 1 June 2000). Independent scientific input is required by the Natural Community Conservation Planning Act [Section 2810(b)(5)].

The HCPA felt strongly that independent scientific input would help ensure that the HCP / NCCP was based on appropriate and valid scientific principles and techniques. The HCPA also agreed that including scientific input from the earliest phases of development of the HCP / NCCP would help to uncover and resolve scientific issues before those issues threatened the schedule and budget for the plan.

In early 2002, HCPA staff selected a facilitator to assist with designing the science advisory process, selecting and recruiting science advisors, and supporting communication among science advisors, the HCPA, regulatory agencies, and the public. They selected a facilitator with a Ph.D. in conservation biology, relevant academic and practical background, and considerable experience coordinating teams of scientists and editing scientific documents. The facilitator then worked with HCPA staff and USFWS and CDFG representatives to identify and recruit potential science advisors.

Criteria for selection of science advisors included expertise in (1) the ecology or population biology of one or more key covered species in the HCP / NCCP, (2) moderate to large-scale ecological patterns and processes, (3) conservation biology and its application to preserve design, land-use planning, and adaptive management. Additional criteria included scientific credibility, no previous affiliation with the HCPA or the HCP / NCCP consultant, excellent oral and written communication skills, and strong interpersonal skills, including the ability to function as a responsible and productive member of a team.

The science advisors met four times (May 2002, September 2002, February 2003, December 2003) to discuss major scientific issues, both general and specific, and to address questions posed by the HCPA, regulatory agencies, stakeholders, and the consultant. All meetings were open to the public, and there was opportunity for public comment at each meeting. Summaries of public comments are included in reports from each of the four meetings. Issues considered by the science advisors included adequacy of data for development of the HCP / NCCP, identification of data gaps and sources of uncertainty, formulation of biological goals and objectives for conserving covered species and natural communities, identification of principles of preserve design and conservation measures for the permit area, and development of adaptive management guidelines for covered species and communities.

Representatives of the HCPA and the consultant team were present at each meeting of the science advisors to explain all relevant components of the HCP / NCCP, receive comments from the science advisors, and request clarification from the science advisors. The HCPA considered all comments from the science advisors (conveyed orally during their meetings and in writing through their meeting reports) when developing the HCP / NCCP. At the second, third, and fourth meetings, the consultant team reported on how previous comments from the science advisors were being incorporated into the HCP / NCCP.

After each meeting, the Science Advisory Panel produced a report documenting its discussion and recommendations; each report was made available to the public[1]. This composite document, developed in response to requests from USFWS and CDFG, is intended to summarize general

[1] Copies of the meeting reports are available at www.cocohcp.org, from John Kopchik (jkopc@cd.cccounty.us, 925 335-1227), or from Erica Fleishman (efleish@stanford.edu, 650 725-9914)

guidance and major conclusions from the four Science Advisory Panel meetings by topic rather than in chronological order. Much of the content might be applicable not only to the East Contra Costa County HCP / NCCP but also to development of HCPs and NCCPs for other regions.

II. THE PLANNING LANDSCAPE

II.A. Geographic scope

II.A.1. Inventory area

The East Contra Costa County HCPA initiated the planning process by defining a broad geographic region, the inventory area, in which all planning for the HCP / NCCP would occur.

The HCP / NCCP inventory area is located in the eastern portion of Contra Costa County. Contra Costa County includes more than 435,000 acres; the inventory area covers approximately one-third of the county, or 173,680 acres. The inventory area was defined as the area in which impacts would be evaluated and conservation would occur. Boundaries of the inventory area were based on a combination of political, ecological, and hydrological factors. Watershed boundaries were used to define the inventory area wherever possible.

The southern boundary of the inventory area was generally defined by the Alameda–Contra Costa county line. The southwestern portion of the boundary follows the western edges of the watersheds of Kellogg and Marsh creeks. From the peak of Mount Diablo to the north, the western boundary follows the Mount Diablo Meridian and the Clayton sphere of influence. The northwestern boundary generally follows the watershed line in the hills between Pittsburg and Concord but excludes the city of Concord and the Concord Naval Weapons Station.

The northern boundary of the inventory area was defined by the San Joaquin River shoreline. Current and historic tidal areas (as determined by Soil Conservation Service soil surveys [1977]) were excluded to avoid duplicating other conservation efforts focused on species and natural communities restricted to the Sacramento–San Joaquin Delta. The eastern boundary of the inventory area was defined by the course of the westernmost Delta sloughs between Oakley and the Alameda–Contra Costa county line near Clifton Court Forebay. Former tidal areas were excluded from the eastern boundary of the inventory area. The community of Discovery Bay was also excluded because it is already developed and will not require additional coverage under the U.S. Endangered Species Act or California Endangered Species Act.

II.A.2. Permit area

The permit area is the area in which the HCPA is requesting authorization from USFWS and CDFG for activities and projects that may result in take of species covered by the HCP / NCCP. The initial permit area was defined by the Urban Limit Line (ULL) of Contra Costa; the footprint of specific rural infrastructure projects outside the ULL described in the HCP / NCCP; and the boundary of any land acquired in fee title or conservation easement and managed under the HCP / NCCP (i.e., the HCP / NCCP Preserve System).

The city of Antioch is not participating in the HCP / NCCP and therefore was excluded from the permit area. A limited number of rural infrastructure projects outside the ULL will be included in the permit area, as will management and restoration activities in the Preserve System. A decision has not yet been made on whether and how to address and / or cover a limited amount of rural residential development outside the ULL in the HCP / NCCP.

The HCP / NCCP has been designed to accommodate reasonable and expected growth of the participating jurisdictions based on current General Plans (Contra Costa County 1996, City of Pittsburg 2001, City of Clayton 2000, City of Oakley 2002, City of Brentwood 1993). However, the expected lifetime of a General Plan is typically 15 to 20 years. To respond to potential changes in land use plans of the participating jurisdictions within and beyond the terms of current General Plans, the HCP / NCCP permit area would expand or contract as a result of local land-use decisions made independently of the HCP / NCCP (e.g., change in the ULL, annexation), provided that the revised permit area boundary is consistent with successful implementation of the HCP / NCCP conservation strategy.

II.B. Identification of land cover and land use categories

The Science Advisory Panel commented that in general, identification of land cover and land use categories to include in an HCP / NCCP should be based on their relevance to the ecology of the covered species. Accordingly, it is helpful to link land cover and land use categories to descriptions of suitable habitat for covered species. It also is helpful for definitions and maps of land cover to identify categories that require continued human maintenance to persist (e.g., man-made stock ponds versus naturally occurring ponds). Further, it might be useful to identify land cover categories that are likely to change if there is a shift in land use—especially if those changes in land cover are likely to affect covered species.

Ideally, a land cover and land use map for an HCP / NCCP might discriminate among agricultural practices (e.g., non-irrigated agriculture versus irrigated crops such as alfalfa). Different agricultural crops and irrigation methods may support different covered species. It also could be valuable to distinguish between perennial and ephemeral streams.

II.C. Methods used to delineate land cover and land use

The primary sources of information for initial land cover and land use mapping in the inventory area were orthorectified black-and-white aerial photographs for the entire inventory area (flown in May 2000 using a scale of 1:4800 in rural areas and 1:2400 in urban areas); color infrared photographs (scale 1:6,000) taken in June 1987 and 1988, digital line graph data on streams and roads from the U.S. Geological Survey, and land use data from the California Department of Water Resources (1995). A suite of ancillary data sources was used to obtain information not available from the primary sources and to check the accuracy of the mapped information. Field visits were conducted to verify land cover types and consistency of mapping and to collect additional data for describing land cover types.

The Science Advisory Panel commented that definition of vegetation types is subject to professional judgment, and to some extent the status of vegetation types also is subjective.

Whether a land-cover mapping process is adequate to determine the status of vegetation types within an inventory area, and whether the land-cover categories accurately describe major vegetation types in the inventory area, depends on the goals of the vegetation categorization or land-cover mapping process. Different scientists might render different opinions.

The science advisors agreed that the most appropriate way to address questions related to adequacy and accuracy of land cover and land use mapping is with respect to specific habitat requirements and concerns for covered species. Initial land cover mapping for the East Contra Costa County HCP / NCCP was somewhat opportunistic. The methods were reasonable in light of financial constraints, but ideally the Science Advisory Panel would have been involved at the earliest stages in the land cover mapping process. The science advisors noted that the initial land cover categories represented fairly well the locations with high concentrations of species of particular interest or concern. The advisors reiterated that throughout the planning process, it is important to keep in mind that numerous co-occuring species may benefit from land acquisitoin and management efforts geared toward covered species.

The Scientific Advisory Panel's comments on the draft land cover and land use maps indicated the need for additional field surveys and analyses to increase the accuracy and resolution of the data set, particularly with respect to small features. After four additional days of field work and reexamination of aerial photographs (including March 2003 color photographs obtained by Contra Costa County), the HCPA updated land cover maps to reflect the current distribution of vegetation communities. Particular attention was focused on ponds, alkali grasslands and wetlands, seasonal wetlands, rock outcrops, and riparian woodland and scrub. Ruderal, cropland, pasture, and grassland categories were refined. In addition, the entirety of Clayton (2417 acres) and several smaller parcels were added to the inventory area.

A high resolution stream layer also was incorporated into the resources inventory and analysis process. This high resolution stream layer was created by Contra Costa County in 2003 by interpreting aerial photos, a 10' contour interval topography database, and the United States Geological Survey's high resolution National Hydrography Dataset.

III. DESCRIBING SPECIES AND ASSESSING THEIR STATUS

III.A. Criteria for coverage under the HCP / NCCP

The HCPA proposed that to be covered under the HCP / NCCP, a species must meet four criteria.

1. Range. Based on credible evidence, the species must be known to occur or be likely to occur within the inventory area.
2. Status. The species must currently be listed under the United States Endangered Species Act or the California Endangered Species Act, or be likely to become listed within the 30-year anticipated term of the permit.
3. Impact. The species will be or likely will be adversely affected by covered activities.
4. Data. Sufficient data exist on the species' life history, habitat requirements, and occurrence in the inventory area to adequately evaluate impact to the species and

to develop conservation measures to mitigate these impacts to regulatory standards.

Two categories of species were included on the "no take" list.

1. Fully protected species for which the state of California cannot authorize take.
2. Species that are sufficiently rare that any loss of populations or individuals might jeopardize its survival. Under this HCP / NCCP there will be no take of those species.

The Science Advisory Panel commented that a comprehensive understanding of covered activities makes it easier to determine which species should be covered. Considerable urban development (and associated adverse impacts on species) can occur over a 30-year period. Urban development has both direct effects and indirect effects. For example, increased human population density leads to more intensive recreational use that can have negative impacts on species of concern.

It also may be appropriate to prioritize species for coverage on the basis of the proportion of their distributional range contained within the inventory area. If a species primarily occurs south of the inventory area, for example, it probably should be assigned a lower priority for conservation than a species that largely is endemic to the inventory area.

III.B. Ecological profiles of covered species

III.B.1. Purpose of ecological profiles

The Science Advisory Panel noted that adequacy of ecological profiles must be assessed in light of their goal. The profiles in the East Contra Costa County HCP / NCCP were not intended to be treatises on each covered species. Instead, the profiles were intended to provide baseline information that could be used to identify impacts of covered activities and to develop appropriate conservation strategies.

The science advisors commented that it would be helpful to tie each profile as closely as possible to the species' ecology, status, and threats in the inventory area—i.e., to why the animal or plant was placed on the list of covered species. If the profiles specify what data currently exist on the species, they could be useful if the HCP / NCCP is amended. The profiles could serve as a record of the state of knowledge regarding the species during HCP / NCCP development against which future changes in the status of the species could be assessed and tracked. Recent iterations of the draft HCP / NCCP reflect substantial revision of the profiles in response to the science advisors' comments and suggestions.

III.B.2. Content of ecological profiles

The Science Advisory Panel commented that profiles of covered species could be expanded to address gradients of risk. The general discussion of ecological profiles in the HCP / NCCP might include an explicit acknowledgment that risk assessment is a complex discipline, and that formal, detailed risk assessments were not applied to determine which species would be covered by the

HCP / NCCP. For example, species evaluations did not consider geographic range boundaries and distribution (within versus outside of the inventory area), the extent to which each species occurs on lands that already are protected from development, or the likelihood of development in the locations occupied by the species.

III.C. Habitat models

III.C.1. Methods

Habitat models for the East Contra Costa County HCP / NCCP serve two purposes.

1. Estimate the amount of take under alternative conservation strategies. Estimates of take for all species were habitat-based.
2. Help develop the conservation strategy by providing guidance on patterns of species occurrence (i.e., where species are likely to be present and absent) and probabilities of occurrence.

Occurrence records were not used to build the models but were used to validate and refine the models. Records were obtained from a variety of sources including but not limited to the Natural Diversity Database, California Fish and Game, East Bay Parks District, and individual biologists.

Several members of the Science Advisory Panel suggested that colleagues might be able to contribute records of species occurrence that were not already included in the HCP / NCCP database. Therefore, a method based loosely on the California Natural Diversity Database was developed to fill data gaps. Aerial photographs with overlays of major roads that collectively covered the entire inventory area were distributed to individuals identified by the Science Advisory Panel. Also included were an index to the maps is provided and a form and instructions for submitting records of species occurrence in the inventory area. Contributors were asked to assign a unique number to each record and to mark its location on the appropriate map itself as well as providing associated information on the sightings form. This effort resulted in augmentation of data records for several species, especially birds and plants.

The Science Advisory Panel commented that limitations of a given method for mapping of land cover and habitat may vary by taxonomic group. For example, a minimum mapping unit that is adequate for birds and mammals may be too large for amphibians and other taxonomic groups with relatively small home ranges.

III.C.2. Utility and limitations of habitat models

The science advisors noted that an HCP / NCCP can be developed without quantitative models. Given the limitations of a given set of models, it is important to assess whether the models will be helpful in developing alternative conservation strategies. Whenever possible, habitat models should be linked to potential changes in management (e.g., potential use of livestock grazing and fire as management tools).

The science advisors commented that habitat models for the East Contra Costa County HCP / NCCP are essentially “best expert models.” The models tend to be quite general, and probably represent cautious, conservative expressions required by the incomplete datasets that were available to the HCPA. Such models are useful if numerous occurrence records exist and many experts are participating in the process of building and validating the models. However, it is important to assess the accuracy of the models using new data (ground-truthing). In the absence of new data, it would be helpful to assess how well the models performed using the existing data (i.e., the proportion of variance in the observed data explained by the models).

III.C.3. Aggregation of species for conservation planning

Science advisors noted that it may be possible to develop management "guilds" based on life history characteristics. A few studies have suggested that it may be possible to manage suites of species with similar life histories in the same way. A potential approach is to categorize species according to habitat (e.g., grassland) and then by life history (e.g., summer annuals, winter annuals).

There may be ecological linkages between ground squirrels, California tiger salamanders, and western burrowing owls.

If a management guild approach is considered, it may be possible to protect additional species of concern that are not covered by the HCP / NCCP. It also may be possible to conduct surveys for suites of species as opposed to conducting independent surveys for each covered species. Sandy substrates in open grassland, for example, may support not only San Joaquin kit fox, silvery legless lizard, big tarplant, and showy madia but also a large suite of locally rare plants, perhaps even a few remaining occurrence of *Eriogonum truncatum.* Similarly, alkali lowlands support *Tropidocarpum capparideum* in addition to San Joaquin kit fox, recurved larkspur, and *Atriplex* spp. (including brittlescale and San Joaquin spearscale). Chaparral contains resources for Diablo helianthella, Mount Diablo fairy-lantern, Brewer's dwarf flax, Mount Diablo manzanita, and Alameda whipsnake.

Advisors emphasized that the planning area includes core habitat for the last known occurrences of two plant species that recently had have been presumed extinct (and for that reason are not federally listed), *Eriogonum truncatum* and *Tropidocarpum capparideum.* Both species were included on the "no take" list. One of the last known records of *Eriogonum truncatum* was along Marsh Creek Road. A population of *Tropidocarpum capparideum* appeared several years ago in San Luis Obispo County, and the species once was abundant in the vicinity of Byron. Both species are annuals and potentially could potentially be present in the seed bank, so preservation of potential habitat should be given a relatively high conservation priority.

III.D. High-priority species and communities

III.D.1. San Joaquin kit fox

Note: see V.A for comments about land acquisition

The Science Advisory Panel emphasized that there are few quantitative guidelines with respect to corridors for San Joaquin kit fox. It is important to realize that corridors can have a negative effect and can function as population sinks. There are two kinds of corridors. (1) Temporary corridors for dispersal typically are no more than several miles in length and can be as narrow as 0.5 miles. (2) Permanent corridors that link patches of habitat should be at least a mile wide and can be longer than several miles. Permanent corridors must be able to support kit fox in the corridor itself; habitat quality must be greater within a permanent corridor than within a typical dispersal corridor. In general, minimum corridor width guidelines are more flexible when land cover adjacent to the corridor is not dominated by urban development.

Habitat quality of dispersal corridors should not be high enough to encourage long-term residence because the kit fox are likely to be removed by predators, but entrance to the dispersal corridors could be facilitated by improving habitat quality at the entrances to the corridors. For example, rock piles and cover boards could be used to encourage colonization of the corridors by ground squirrels that serve as prey for kit fox. Six-inch, above-ground pipes can be placed within the corridors to provide kit fox with cover from predators. Artificial sources of cover from predators and dens can improve the status of kit fox in locations in which their ranges have been restricted. It also may be possible and appropriate to improve the quality of kit fox habitat in parts of corridors that are relatively wide. This is not an optimal scenario—0.5 mile width is minimal if corridors are longer than several miles—but such a strategy may be the best possible option given the extent to which the inventory area has been developed. Patches of kit fox habitat do need to be connected. A patch area of five square miles often is considered minimum, but again options in the inventory area are constrained by previous development.

San Joaquin kit fox rely heavily on ground squirrels as prey. Historical reduction of ground squirrel populations by poisoning probably is a primary reason why density of kit fox in the inventory area is low. Increasing the prey base—especially ground squirrels—probably would benefit kit fox in the inventory area. It is not difficult to facilitate establishment of ground squirrels using habitat enhancements such as rock piles. It also would be useful to ensure that corridors are adequate for dispersal and / or occupancy by kit fox, but that can be a daunting task. The HCP / NCCP should consider translocating kit fox into the inventory area if the corridors do not function as intended; translocation, however, is a last resort that should not substitute for acquiring land and maintaining corridors.

III.D.2. Swainson's Hawk

According to the science advisors, anecdotal evidence suggests that the abundance of Swainson's Hawk is increasing in the western part of its distributional range (e.g., San Joaquin Valley and Contra Costa County), and that the edge of its geographic distribution is moving west. Relatively few individuals are believed to be present in east Contra Costa County at this time. If the westward distributional expansion continues, however, and if land management is consistent with resources needs of the hawk, then the inventory area could become more important in the future.

Some science advisors questioned whether establishment of multi-year contracts with farmers to maintain and enhance suitable habitat for Swainson's Hawk (e.g., raise certain kinds of crops, plant trees as windbreaks and nesting habitat) would be more effective than permanent conservation easements with crop restrictions for increasing the probability that the hawk will persist in the inventory area. The hawk is opportunistic and will cover a large area in order to take advantage of available resources. Swainson's Hawk can utilize grasslands, and alfalfa farming in particular may favor the hawk because populations of *Microtus* can persist in alfalfa fields. On the one hand, therefore, if the hawk has a positive response to availability of nesting habitat and to particular crops (e.g., alfalfa), then it may make sense to attempt to establish a more permanent contract or easement. On the other hand, multi-year contracts may be preferable to permanent easements because it is unknown whether the geographic range of Swainson's Hawk will continue to expand west. Maintaining and enhancing suitable habitat in the inventory area may have limited benefit if the hawk's range does not expand.

Extensive information does not exist on availability of nesting substrate (large trees) for Swainson's Hawk in Contra Costa County (including the inventory area) and Alameda County, but habitat for nesting in Acquisition Analysis Zone 6 is likely to be limited. Most of the resources available for Swainson's Hawk in Zone 6 may be associated with foraging. In addition, Swainson's Hawk in the inventory area may be competing for nesting sites with Red-tail Hawks (which probably have a competitive advantage) and Golden Eagles.

Particularly in the context of covered species like Swainson's Hawk, the HCP / NCCP should define and / or provide guidance about trees. For example, the HCP / NCCP might specify which species are preferable to maintain or plant and the size distribution of trees used by covered species. A decision algorithm also could be useful for determining which types of vegetation to maintain or plant under different sets of circumstances.

III.D.3. Alameda whipsnake

The Science Advisory Panel considered how Alameda whipsnakes might be affected by fire. Panel members commented that they would not recommend halting a prescribed fire if whipsnakes were present in the area, but it might be prudent to monitor whipsnakes closely or consider not applying fire in an area with a particularly high density of whipsnakes. It might be useful to conduct research on the seral stages at which colonization by whipsnakes is most likely. Representatives from USFWS noted that the Contra Costa Water District has been conducting research on this issue. The Water District recently conducted a burn in an area inhabited by whipsnakes, and will be conducting follow-up studies on the effects of fire on the snakes.

Acquisition of land in Subzone 4a would provide substantial benefits for the Alameda whipsnake by protecting core habitat for this species.

III.D.4. Alkali plants

One of the highest biological priorities for plants in the inventory area is preservation of alkali wetlands. If alkali grasslands and wetlands in the inventory area become isolated from others outside the inventory area, then preservation of those in the inventory area becomes more important. Some Science Advisory Panel members suggested that the conservation strategy take advantage of any opportunities to link alkali grassland in the Byron area with California Department of Fish and Game easements adjacent to the county line in Alameda County and with protected lands near Mt. Diablo. Threats to alkali wetlands from invasive species, including but not limited to perennial peppergrass, should be monitored and addressed as necessary.

III.D.5. Riparian areas

Although maintenance and restoration of riparian areas is an appropriate biological goal in a broad sense, relatively few projected impacts under the HCP / NCCP will occur in riparian areas. Because few impacts will occur in riparian areas, the science advisors believed that limited management focus on riparian areas is not a deficit in the plan.

Limiting total loss of streams to less than a certain percentage—five percent, for example—of the remaining streams in the inventory area seems arbitrary, yet may be a reasonable conservative target. If a loss limit is set for wetlands and streams but not for other land-cover types, or if the loss limit for wetlands and streams is set lower than for other land cover types, the rationale should be explained.

The ability of "reducing stream temperatures" and increasing the percent cover of brush in a riparian area to increase habitat quality for covered species depends on the attributes of a specific location and the resources needed by species of concern in that location.

III.D.6. Native grasslands

Definitions of land cover and biological goals and objectives should quantify, or at least categorize, the proportion of native versus non-native species and should distinguish clearly between grasslands categorized as "native," "non-native," "annual," or "perennial." It can be difficult to determine species composition of grasslands—thus to differentiate between native and non-native species, or between annual and perennial species—using aerial photographs and other remote sensing data.

Differences in phenology of native and non-native species sometimes can be detected by field surveys or remote sensing. For example, there can be conspicuous differences in timing of vegetative growth and senescence between *Avena*, *Bromus*, perennial bunchgrasses, and star thistle.

The inability to distinguish between native and non-native grasses, and fundamental gaps in our knowledge of the historical species composition of grasslands, makes it difficult to estimate the area that has been lost or restored. The occurrence patterns of grasses and forbs vary as a result of differences in soil type, vegetation associations, elevation, and management history. The potential for increasing the proportion of native perennials seems to be linked closely to site characteristics at relatively small scales, including soils, moisture, mulch levels, patterns of disturbance, and overstory. If increasing the proportion of native perennial grasses is a goal of the HCP / NCCP, an appropriate first step would be to identify sites in which the probability of success is high. Numerous publications provide some insight into the characteristics of such sites, but from a practical perspective, the easiest way to identify such sites is to locate areas that already have a substantial proportion of native perennials.

Many management techniques and combinations of techniques for attempting to increase the proportion of native grasses are available, most notably protection, prescribed grazing, burning, spraying, and planting, but results of all but the most intensive efforts have proved to be highly variable. Management efforts rarely are directed explicitly toward native annual grasses as opposed to native perennial grasses, and in fact little is known about native annual grasses. In broad terms, it may be possible to increase the proportion of native annual grasses through management, but little research has been done in this area.

Native annual grasses are sparse in most of the inventory area, but may flourish on endemic soils where there is little competition from non-native annual grasses. Some native annual grasses are well adapted to disturbance, and management to increase their abundance on sites where they are present may prove detrimental to native perennial grasses that also are likely to be present on endemic soils.

Given the limited number of species of native annual grasses in the inventory area, it seems unlikely that native annual grasses were at one time a major ecosystem component. However, it is probable that native annual forbs, especially clovers, were once considerably more abundant. Management that would support the restoration of the former abundance and species richness of native annuals—both grasses and forbs—would be desirable. In general, it would be highly desirable to monitor multiple species in addition to the targeted covered species.

III.D.7. Seasonal wetlands

It is helpful for habitat models to distinguish between perennial and ephemeral streams, especially from the perspective of the ability of different types of streams to provide habitat for amphibians. Research has shown that California tiger salamanders spend years in the uplands—sometimes as many as four years—before returning to water to breed. The uplands are much more important to this species than previously understood. In addition, foothill yellow-legged frogs are found in pools as well as perennial streams.

Stock ponds and other artificial structures can provide important habitat for some species. However, ponds that are created for management or mitigation purposes should not be constructed in an existing wetland.

Josh Collins and others are developing rapid assessment techniques for wetlands that may be useful in the context of adaptive management and monitoring.

Collins, J., M. Sutula, and E. Stein. 2003 (draft). Quality assurance project plan for the development of a wetland rapid assessment method in California. Draft manuscript submitted to California Environmental Protection Agency, San Francisco.

Mack, J.J. 2001. Ohio Rapid Assessment Method for Wetlands v. 5.0, User's Manual and Scoring Forms. Ohio Environmental Protection Agency Technical Report WET/2001-1. Ohio Environmental Protection Agency, Division of Surface Water, 401/Wetland Ecology Unit, Columbus, Ohio.

Pavlik, B.M. 2003. Botanical evaluation of wetland restoration projects in the San Francisco Bay Area. Report to the Regional Water Quality Control Board, Oakland, California. 47 pages.

Stein, D.D. and R.F. Ambrose. 1998. A rapid impact assessment method for use in a regulatory context. Wetlands 18:379–392.

IV. GUIDING PRINCIPLES, GOALS, AND OBJECTIVES

IV.A. Conservation principles for HCP / NCCP development

The Science Advisory Panel assumed that conservation principles were intended to describe the scientifically-based foundation of the overall goals of the conservation planning process, including creation of a preserve system. There are virtually no default goals or objectives for development of an HCP / NCCP. Instead, conservation goals and objectives should be based on well-founded evidence of need.

Maximizing the size of reserves is important, but estimates of habitat quality for covered species also are relevant. Measures of species-level diversity also can be helpful in prioritizing locations for conservation or acquisition. A location that has relatively high diversity of native species should be assigned a higher conservation value than a similar location with comparatively low diversity of native species.

Proximity of threats, including non-native invasive species, is another important criterion for prioritization. For example, a location adjacent to a field with a high percent cover of a non-native plant species like star thistle should be assigned a lower conservation value than a location that is further from sources of invasive species.

Some very small reserves may be necessary to accommodate species that are rare or have unusual resource requirements. To the greatest extent possible, the number of small reserves should be minimized in favor of larger reserves that contain habitat for those rare species. It is easier to manage one reserve than to manage two reserves.

With respect to map-based versus process-based approaches, a purely process-based approach is unlikely to provide the spatially-explicit perspective needed for an effective HCP / NCCP, especially over long periods of time during implementation. Mapping core preserve areas (e.g., existing parks and reserves), with outlying (unprotected) resources of concern, would provide the necessary perspective. When combined with the acquisition and conservation criteria, the question of what to acquire will not have to answered using mapping—it will be relatively easy to infer.

IV.B. Biological goals and objectives

Biological goals and objectives should not contradict conservation strategies. Sweeping or unclear goals and objectives do not provide standards against which to measure success or attainment of those goals and objectives. In particular, biological goals and objectives should not contain sweeping generalizations about major changes in management that would be difficult and perhaps even risky to implement. For example, changes in management of livestock grazing and fire, and how those changes would affect the specific needs of animals and plants of concern, need to be considered carefully prior to implementation.

Biological objectives should be specific enough to account for variation in the response of individual species to environmental changes. For example, some species will benefit from enhanced recruitment of oaks, whereas others may realize greater benefit from maintenance of relatively open grassland and woodland. In addition, when objectives of an HCP / NCCP are relatively general, it is somewhat difficult to comment on whether objectives for individual species are adequate and appropriate.

Objectives for plants that include “compensate for” and “salvage seed from” individuals lost seem to imply transplantation, which may not be effective. It would be preferable not to disturb existing populations. Similarly, apparently simple objectives such as “compensate for individuals lost as a result of covered activities” and “conduct experimental management” do not convey how difficult these objectives are to achieve in reality (at least with respect to reintroductions and population enhancements of rare plants). The research required to support ecological restoration is substantial (see IV.D). Because this research cannot take place on the same schedule as covered activities, restoration objectives that sound reasonable from a permitting standpoint may not be realistic from a conservation standpoint. Salvage of plants rarely is successful. If plants are likely to be destroyed by development, then it may make sense to attempt salvage. Alternatively, plants that are likely to be destroyed could be harvested as a source of seeds for locations in which managers are trying to control invasive non-native species or to establish new populations of native plants.

It may not be possible to assess whether the output of a viability analysis is accurate until 20 or more years have passed. Viability analyses are helpful in the conservation planning process. They generate some useful ideas, but their predictions should not be regarded as highly certain. Existing population models for certain taxonomic groups, such as amphibians, may be helpful for estimating whether preserves for some covered species (e.g., red-legged frog) may contribute to population viability.

IV.C. Definition of ecological terms

The NCCP Act of 2002 contained new requirements for applicants. The Act includes many ecological terms but does not define those terms. Terms that seemed to warrant particular attention and definition during the science advisory process were “ecosystem function,” “biological diversity,” and “environmental gradients.”

The Science Advisory Panel commented that definitions in the preliminary meeting materials seemed reasonable. There is no “best” definition for terms such as ecosystem function and biological diversity. Ultimately, it is more important to consider how parameters will be measured. For example, how would “ecosystem function” be measured during implementation of the HCP/NCCP? It will be necessary to choose surrogate measures of function. Suggestions included but were not limited to nutrient cycling, hydrographs, and concentrations of urban and agricultural pollutants. In addition, the definition of “improved functioning” needs to be clear. In particular, how will “function” be measured? An explicit definition might assist the Science Advisory Panel and HCPA in setting goals or developing measures to gauge success.

Some science advisors suggested that the HCPA consider measuring human disturbance of ecosystem function in watersheds in addition to measuring extent of non-native invasive species. For example, a potential index of fragmentation within a watershed (and possible effects on hydrology, nutrient flows, and erosion) would be the ratio of linear road length to watershed area (e.g., km/km^2). This ratio could be calculated easily for paved roads, and perhaps dirt roads, depending on the data available for spatial analysis.

Biodiversity is a vague term that is difficult to measure. Will measures be focused on vertebrates and plants? Will all covered vertebrates be measured? Will additional vertebrates not included in the plan be measured? The HCP / NCCP should emphasize that one of its goals is to maximize native biodiversity. It may be useful to maintain non-native species, but non-native species should be considered on a case-by-case basis. Certain non-native species are undesirable in the context of the goals and objectives of the HCP / NCCP.

IV.D. Feasibility of ecological restoration

The potential for ecological restoration is location-specific. In some sites active management would be unlikely to help restore a natural community (e.g., native grassland); in other sites a few management changes could make a considerable difference.

The research required to support ecological restoration objectives is fairly substantial and includes clearly-focused experiments, scientific expertise, funding, and a long-term time framework. An explicit framework for adaptive management will be necessary to provide scientific guidance as to whether restoration objectives can be achieved under existing ecological conditions.

Mitigation is a challenging objective, and mitigation directed toward certain species may not be appropriate. For example, efforts to mitigate for California tiger salamanders using pond-based netting and relocation may not be effective and could represent a waste of money. At any given time, the bulk of the population is located in the uplands surrounding the ponds. Mitigation efforts may be more effective if they included drift fences and pitfall traps to capture adults in the uplands.

There is a need for directed literature review and field research on whether restoration of grassland is feasible on a large geographic scale. Before restoration of grassland or any other aim is stated as a goal or objective in the HCP / NCCP, it is important to verify that the goal or objective is ecologically feasible. The adaptive management process might include some pilot studies on restoration of native grasslands. Existing evidence suggests that restoration potential is highest in areas where viable populations of native species still exist, and where annual non-natives do not thrive. If the restoration potential of a site in which no natives exist must be evaluated, soil and microsite similarities to areas where natives flourish might also be indicative of potential success.

An Implementing Entity with sufficient scope could play an important role in collection of data on ecological restoration, with associated opportunities to secure outside funding.

V. KEY ASPECTS OF THE CONSERVATION STRATEGY

V.A. Movement routes for San Joaquin kit fox

Note: see III.D.1 for general comments about life history and the role of corridors

Two important conservation issues related to movement routes for San Joaquin kit fox are corridor width and the ecological implications of temporary dispersal corridors versus more permanent corridors. Development of the Byron Airport area may be problematic because it is part of the main connection from Contra Costa County to the Bethany Reservoir area in Alameda County. Kit fox need a corridor that will facilitate movement to habitat south of the inventory area. The Round Valley area has a small and somewhat stable population of kit fox. If the reservoir expands and this western corridor is not protected, the population could be isolated.

It may be short-sighted to focus initially only on corridors for kit fox in Zone 2 if the animals do not have a way to move through Zones 5a / 5b to and from Alameda County to Zone 2. Connectivity between Contra Costa and Alameda counties is crucial for the sustainability of kit fox in this region. Therefore, it may be prudent to preserve lands in Zones 5a and 5b.

V.B. Invasive species

For many native plants, invasion of non-native species of plants effectively represents a loss of habitat. Therefore, to the extent possible, it is important to control invasion and expansion of non-native plants. Control measures could help compensate for impacts of human land-use or prevent further degradation of natural communities.

New invasive plants are likely to colonize the inventory area on a regular basis. Adaptive management will be critical for minimizing these threats. The adaptive management program should monitor both invasives already known to exist in the inventory area and potential threats—i.e., non-native species that have not yet invaded extensive portions of the inventory area but may do so in the near future. Because weed management typically is restricted to well-documented species on existing lists developed by management agencies, there should be a mechanism in the adaptive management process that allows scientific input on non-natives that are just starting to invade the inventory area. It might be useful to develop a list of invasives already known to exist in the inventory area. Lists of non-native invasive species developed by the California Exotic Pest Plant Council may be a good place to start. These lists categorize invasive species and potential control strategies.

It is important to consider effects that eradication of non-native invasive plants might have on covered species, such as kit fox. Few eradication efforts have been successful; attempts usually have involved prescribed burning and / or spraying. Managing for diversity of native species means managing against non-natives in areas where there is least risk of irreversible damage to natives and greatest likelihood of a favorable outcome (annual grasslands, for example).

V.C. Grazing and prescribed fire as management tools

Livestock grazing should be retained as an element of the "toolbox" for adaptive management. Grazing may be useful for reduction of fire hazard, controlling non-native invasive species, and manipulating natural communities to benefit covered species. "Livestock management" may be a more suitable conservation paradigm or experimental approach than livestock exclusion per se. Exclusion of livestock grazing may not be beneficial for some covered species. Grazing trials, with appropriate monitoring and revision of management and even testing of exclusion, could be part of the adaptive management strategy. In addition to livestock grazing, small burns, application of herbicides, and so forth should be retained as potential tools to achieve biological goals and objectives.

Some natural communities within the inventory area are fire-dependent. Fire should be emphasized as a potential management tool in chaparral, grassland, and other natural communities. Ideally, preserves created by the HCP / NCCP will be sufficiently large that application of fire will be appropriate. In general, consideration of potential management strategies should be incorporated into the process of preserve design.

V.D. Buffers for riparian areas and streams

Current regulations for riparian areas generally require establishment of buffers of a given width (e.g., 200 meters from the stream bank), but there is not uniform scientific agreement about these dimensions. Moreover, the most appropriate buffer width from an ecological perspective varies widely among locations. Also, the position from which the width of the buffer is measured is not trivial. Top of the bank is most common. Establishing a buffer of variable width probably is preferable from an ecological perspective, but this process tends to be quite complicated in practice. Although buffer widths are arbitrary, maximization of vertical and horizontal vegetation structure can benefit many species.

V.E. Conservation trade-offs between Acquisition Analysis Zones

The revised conservation strategy for the preliminary draft initial permit area focused land acquisition in Zones 2, 3, and 4 and de-emphasized land acquisition in Zones 5 and 6. The Science Advisory Panel emphasized that there are scientific and practical arguments for emphasizing land acquisition in Zones 2, 3, and 4 as well as in Zones 5 and 6. There are biological advantages to acquisition in both Subzones 4a / 4h and Subzones 5a / 5b, and there are biological trade-offs in emphasizing acquisition in either area.

On its own merits, acquisition in Zones 2 and 4 makes sense because those areas contain core habitat for Alameda whipsnake, California red-legged frog, San Joaquin kit fox, and other species. As noted in III.D.3, conservation in Subzone 4a provides substantial benefits for the Alameda whipsnake by protecting core habitat for this species.

The southern half of Zone 3B, on the north side of Mt. Diablo, contains serpentine grassland and is vulnerable to incursion of ranchettes. Development of rural ranchettes in Zone 4, or development beyond a certain threshold, could be used as a trigger for acquisition or for adjusting the prioritization of acquisition targets.

In general, the Science Advisory Panel suggested that the HCPA attempt to augment acquisitions in Zone 5 in the Acquisition Priorities for Preliminary Draft Initial Permit Area because of the biological benefits to several covered plants, alkali grassland, habitat linkages, and San Joaquin kit fox. The conservation strategy should take advantage of any opportunities to link alkali grasslands in the Byron area with protected lands near Mt. Diablo and CDFG easements adjacent to the county line in Alameda County. Most of the impacts to natural vegetation are occurring in grasslands on flat lands, so it is important to preserve similar patches of vegetation in the inventory area (like the patches in Zone 5). The panel encouraged the HCPA to explore potential tools to target funding for protection of patches of alkali grassland, even when funds are not yet available to purchase the entirety of larger parcels containing the patches.

Alternatively, there may be some value associated with de-emphasizing Zones 5 and 6 and instead emphasizing Zone 4a because land acquisition in Zone 4a will contain the potential spread of rural ranchettes along Morgan Territory Road and the sometimes-extensive indirect effects that rural ranchettes often have on adjacent lands. For example, there may be pressure to clear shrublands to reduce the probability of fire in response to recent fires in southern California. Therefore, in the interests of conserving natural communities and maintaining ecological processes, it may be useful to discourage people from developing rural ranchettes in Zone 4a. A mosaic of housing and patches of brush or dense woodland, especially in this hilly area, should be avoided. Ranchette development also is likely to facilitate invasion of non-native species.

As noted in V.A, it may be short-sighted to focus initially only on corridors for kit fox in Zone 2 if the animals do not have a way to move through Zones 5a / 5b to and from Alameda County to Zone 2. Therefore, it may be prudent to also preserve lands in 5a and 5b.

VI. ADAPTIVE MANAGEMENT

VI.A. Fundamental principles

Adaptive management is an iterative process that evaluates management actions through carefully designed monitoring and proposes subsequent modifications. The modifications in turn are tested by appropriate monitoring.

Although adaptive management is logical, can deal with uncertainty and data gaps, and is similar to the scientific process of hypothesis testing, few examples of successful implementation exist. There appear to be two main reasons for the limited success of adaptive management. First, planners or resource managers often are reluctant to rely on monitoring data for decision-making. Second, few monitoring programs are specifically focused on the management actions or sampling design (e.g., number of samples, spatial extent of study, duration of study) necessary to provide managers with an adequate level of comfort or certainty. Therefore, three principles are integral to implementation of an effective program for adaptive management: (1) policy-makers, resource managers, and scientists must collaborate on the design of the adaptive management program from its initial stages, (2) different types of monitoring programs provide distinctively different services, and (3) oversight committees must facilitate communication among government, scientists, and the private sector.

An adaptive management program must be designed in the context of how decisions will be made. Until that context is clear, it is not productive to ask what hypotheses are most relevant to address, or what hypotheses can be addressed most effectively, through the process of adaptive management. Accordingly, it is difficult to develop a detailed strategy for adaptive management (e.g., prescriptions or requirements) during the planning phase of an HCP / NCCP. An advantage of avoiding detail during the planning phase is that preserve managers will have greater flexibility during implementation to use the full range of management tools. Similarly, it is difficult to identify key research questions during the planning phase of an HCP / NCCP because the most important issues vary geographically, and it is not yet known where land will be acquired.

Thirty years is a short interval in the context of conservation. The Science Advisory Panel recommended that the HCPA increase its emphasis on development of long-term funding mechanisms (i.e., beyond 15 or 30 years). At the same time, the science advisors recognized the importance of acquiring land to ensure that something remains to conserve in 30 years. It may be possible to work with private entities, especially on issues related to ecological restoration, in order to augment agencies' current budgets for land acquisition and management.

VI.B. Collaboration, communication, and oversight

Initial understanding by policy makers and resource managers of how adaptive management works, how a monitoring program should be used, and how a monitoring program cannot be used is essential. Policy makers and resource managers must specify management actions that most urgently require evaluation, provide focus on specific issues to be addressed using monitoring, and understand how monitoring will provide data necessary for modifying current actions or proposing new actions. Similarly, scientists must understand the needs of policy makers and resource managers, explain the design and limitations of proposed monitoring efforts (including concepts like error and power analyses), and interpret the monitoring data in a decision-making context.

It is difficult for scientists to provide guidance on collection of monitoring data without knowledge of management alternatives and protocols, such as responses to the expansion of non-native invasive grasses. When multiple agencies are involved, who ultimately will be responsible for taking action? In other words, how will it be determined that some type of threshold for action has been crossed? Who will then commit to doing the management action? Ideally, an adaptive management program will include a mechanism for seeking consensus among scientific experts and stakeholders, but execution and follow-up (i.e., monitoring and adaptive management) will be the responsibility of the Implenting Entity.

Information flows between decision-making bodies and constituencies must be facilitated to promote the synergy necessary for successful adaptive management. Various structures can be proposed, but efficient and timely exchange of information between policy makers, researchers, and managers must be of primary concern. A technical advisory group should consist of policy makers, resource managers, and scientific representatives that are responsible for the adaptive management program. Data from the various monitoring programs should flow back to the advisory group, which recommends management alternatives or modifications to the HCP / NCCP. The latter recommendations should feed back from the advisory group to a broader HCP / NCCP oversight group with more comprehensive representation (e.g., agencies, university officials, local government, development and agricultural interests) and the power to redirect or modify development or preservation activities.

VI.C. Identification and availability of management tools

As noted in V.C., all forms of management, including livestock grazing and prescribed fire, should be available for adaptive management. New tools also should be developed. Flexibility of management options should be a factor in prioritizing land acquisition. Livestock grazing should be available as a management tool on all lands that are acquired.

An HCP / NCCP should take into account links between the status of covered species and historical land uses, such as long-term livestock grazing. One cannot make assumptions about the effects of historical land uses practices on covered species and their resources. Little information is available about historical land use practices, but future changes in land use should be cautious, because changes in long-term management patterns will result in biological tradeoffs. Species that flourish in one land-use situation may fare poorly in another land-use situation, and connections between land use and species-level responses rarely are understood fully.

For many natural communities, introduction of new or revised management practices may help to meet biological goals and objectives. Changes in management should be carried out within an adaptive management framework that recognizes the possibility that such changes will have unintended or unanticipated effects on covered species. Preserve design should take into account preservation of options for management such as livestock grazing, prescribed fire, and active restoration efforts.

VI.D. Monitoring

VI.D.1. Types of monitoring

The term “monitoring” is too vague to convey the range of experimental designs and information feedbacks required for implementing an adaptive management program for a large geographic area. Therefore, effective implementation of an HCP/NCCP requires three types of monitoring: compliance monitoring, status and trend monitoring, and cause and effect monitoring.

Compliance monitoring is a simple information feedback on fulfillment of permit conditions; mitigations; rates of land conversion; spatial patterns of development, preservation, or other forms of land use; and other non-biological measures. In essence, compliance monitoring tracks whether the most basic objectives of the HCP/NCCP are being met.

Status and trend monitoring analyzes time-series data on population size, number of populations, spatial extent of populations, or quality of critical biological resources to determine how these variables are responding to relatively static environmental conditions or specific management regimes. Status and trend monitoring does not establish cause and effect, but simply evaluates resource condition though time. Consequently, its statistical power must be appropriately evaluated to give managers clear indications of its limitations and levels of uncertainties.

Cause and effect monitoring tests management hypotheses using field experiments. It attempts to fill data gaps by testing the effects of relevant variables (e.g., prescribed fire, grazing regimes, reintroductions of rare species) on resources of concern. A well-designed experiment with appropriate controls, replication, and statistical power can provide the best management guidance, but such experiments are specialized, time-consuming, and relatively expensive.

The U.S. Fish and Wildlife Service's five-point policy (2000) defines "effectiveness monitoring" as status and trend monitoring. To avoid confusion about the definition of effectiveness monitoring, it may be helpful to rename effectiveness monitoring as described in the preliminary draft HCP / NCCP. Measurement of the response of covered species to conservation measures could be called "validation monitoring," for example. "Cause and effect monitoring," placed under the umbrella of "directed research" in the preliminary draft HCP/NCCP, could be identified explicitly as a fourth type of monitoring.

VI.D.2. Feedback between biological goals and monitoring

Monitoring should address all biological goals of the HCP / NCCP; it would be helpful to review the suite of goals in the adaptive management section of the HCP / NCCP. Accordingly, monitoring should assess not only whether covered species are being maintained but also whether overall biodiversity is being preserved. The monitoring strategy inevitably will measure some surrogates of overall biodiversity; it should be made clear that surrogates are substitute measures of whether more comprehensive goals have been achieved.

Adaptive management is a continuum. A conservation strategy should include a mechanism to adjust management if objectives are not being met. Little is known about the effects of management on some of the covered species in the East Contra Costa County HCP / NCCP. It may be useful to identify both locations that might be relatively stable and locations that might be comparatively dynamic and therefore require more attention in an adaptive management program.

Perhaps the most substantial hypothesis implicit in the HCP / NCCP is that certain mitigation techniques are likely to compensate for take. In the process of adaptive management, it may be valuable to prioritize for experiments and monitoring (1) species that are the most highly endangered and (2) situations in which there is considerable potential for management to improve the status of covered species and natural communities. It also may be useful to assign a high priority to species with relatively short lifespans or those with considerable demographic variability.

VI.D.3. Measures of success

Measures of success may vary as a function of spatial scale. At a relatively local scale, objectives might include increasing the abundance of an individual species. At a larger scale, it might be more appropriate to concentrate on maximizing the proportion of native species with the assumption (or hope) that rare species will tend to benefit from this strategy.

It may be challenging to quantify whether implementation has been successful. It is relatively easy to map species occurrence, but it is more difficult to obtain reliable data on trends and to understand causal relationships between trends and management actions. Adaptive management should emphasize collection of data on trends and their connection to management.

VI.D.4. Understanding causation

Status and trend monitoring is essential. Because status and trend monitoring is time consuming and costly, however, it should be focused on data needs for defined purposes. It simply is not possible to monitor all things at all times. It makes sense to conduct status and trend monitoring on carefully selected target species that are at the crux of a decision-making process.

Without information on trend, it is not possible to infer the status of a species. We may know that abundance of a particular species within the inventory area is low, but we do not know whether that low abundance is stable, increasing, or decreasing. Without information on trend it is not possible to determine whether a change in management is needed, nor is it possible to assess the effects of management actions. Too often, we assume that low abundance of a particular species means a management change is needed, but in fact the abundance of that species may be high given the environmental attributes of the site. Monitoring data do not tell you how to respond or what is possible ecologically, the data only suggest that there is a problem (e.g., a downward trend). Over time, with controls, it often is possible to evaluate the effects of changes in management using cause and effect monitoring. It is also essential to clarify the options that are available to respond to trends, such as adjusting rates of acquisition and development or implementing new management practices.

Overall, the most important research questions might be related to determining trends for species of interest under current management. A suitable framework for hypotheses could relate to the effects of individual management strategies on the status of covered species (e.g., the strategy increases abundance of the species, decreases abundance, or has no effect).

VI.E. Implementing Entity

VI.E.1. Structure, responsibilities, and authority

The issue of who will be implementing an adaptive management plan—who will conduct monitoring and who will decide whether and how to adjust management, for example—is crucial. Evaluation of any and all aspects of an adaptive management strategy is qualified by who is in charge of executing the plan. The Science Advisory Panel was reluctant to consider what objectives were appropriate for adaptive management in the East Contra Costa HCP /

NCCP until they could be convinced that the adaptive management framework would function properly. The operational aspects of adaptive management cannot be separated from the structure of the implementing agency. The most important aspects of adaptive management are decision making and process. Too often, defining how decisions will be made and how the adaptive management process will operate is left until the end of the HCP / NCCP development process and treated as an afterthought.

Money and personnel inevitably are available to meet development goals long before money and personnel are available to meet goals for conservation. An institutional "home" for an adaptive management program should be established as early as possible in the HCP / NCCP process. It may not be ideal to locate the home within a governmental resource agency because so few personnel typically are available. There are few successful examples in which agency staff with little scientific training have been able to implement an adaptive management program effectively (the Science Advisory Panel was only aware of one such example—an adaptive management program for the Karner blue butterfly).

The structure of the Implementing Entity will have a tremendous effect on the success of an HCP / NCCP. It should not become a means for a large number of players to avoid taking responsibility. Adaptive management sometimes cannot be achieved using existing entities, in part because those entities have overlapping jurisdictions or because they do not have sufficient expertise.

An HCP / NCCP should provide explicit guidance on coordination of tasks associated with adaptive management (including subcontracting). For example, who will be responsible for conducting the work, and who will be responsible for payment? Who will pay for different types of surveys and monitoring? Will new preserves be developed, or will the conservation areas established by the HCP / NCCP add to existing preserves?

VI.E.2. Links between monitoring and decision-making

There needs to be explicit recognition during both development and implementation of the HCP / NCCP that the incidental take permit will be suspended if certain biological commitments, such as the stay-ahead provisions, are not met.

In the East Contra Costa County HCP / NCCP, the interface between the operational aspects of adaptive management and decision making is the Governing Board, and so there must be two-way feedback between the Implementing Entity and the Governing Board.

Participants in the HCP / NCCP (e.g., city officials) may not be comfortable "sharing power with scientists." Power sharing is unlikely to result in counties and cities withdrawing from the HCP / NCCP, but frank communication is vital. Realities about shared decision-making authority between scientists and politicians need to be made explicit. Permit holders must acknowledge that they are both gaining power, in terms of endangered species permitting authority, and sharing some new power, such as day-to-day management decisions on HCP / NCCP preserves. If it is not made clear to the permit holders that they are relinquishing some authority to the Governing Board, this knowledge gap can jeopardize the HCP / NCCP process. If city and county officials are unlikely to be interested in the day-to-day operations of the preserves, the input provided by scientists is unlikely to conflict with the interests of the permit holders. Because scientists often prefer to collect additional data before making a decision, the implementation strategy should emphasize explicit rather than implicit decision–making.

VI.E.3. Role of science

During the process of implementing the adaptive management strategy and the HCP / NCCP, science advisors should continue to play a role in development of key management questions, direction of research, and interpretation of data. Although some aspects of implementation center around regulatory issues that do not involve scientists directly, scientific input is important for ensuring the defensibility of data collection and data analysis. Decision-makers ideally should include trained scientists with detailed knowledge of the ecological system. Decision-making should be transparent, and should incorporate expert knowledge. Science advisory boards should include experts in the specific geographic / taxonomic focus of adaptive management (including monitoring) as well as individuals with knowledge of statistics and experimental design and individuals with expertise in management from a social science perspective.

VI.F. Implications of “changed circumstances”

The principles of conservation biology are designed to mitigate the effects of stochastic events. Sudden oak death and West Nile virus are among the examples of phenomena likely to affect the inventory area during implementation of the HCP / NCCP. The best we can do is to use adaptive management to identify changed circumstances and attempt to address those changes. Detailed speculation on the potential effects of the changes is beyond the scope of the HCP / NCCP. At this point in time it is difficult to take anticipatory action. For example, it is not realistic to preserve all oak woodland that might be susceptible to sudden oak death. Given the duration of the permit, adaptive management is the only viable strategy. Establishing reserves according to conservation principles also provides some insurance against stochastic events.

Sudden oak death is suspected to flourish under humid conditions. In some locations, this could be a mitigating factor in objectives related to increasing forest cover. Results of ongoing research on sudden oak death should be followed closely to assess risk in the inventory area.

VII. REFLECTIONS ON THE SCIENCE ADVISORY PROCESS

At the conclusion of the fourth and final Science Advisory Panel meeting, the science advisors held an open discussion about the science advisory process. They offered the following comments and suggestions.

• An additional (fifth) meeting within the same time frame might have been useful. The science advisory process was a bit prolonged, so it was difficult to remember ideas and discussion points raised in previous meetings.

• Some science advisors believed it would have been useful during the science advisory process, and still could be useful in the future, for the panel to communicate directly with political leaders involved in development of the HCP / NCCP.

• The Science Advisory Panel thanked the HCPA for their efforts to incorporate the comments and concerns of the science advisors.

• More interaction with members of the public who attended the Science Advisory Panel meetings might have been useful.

• The science advisors asked the HCPA to keep them informed about the HCP / NCCP process for East Contra Costa County in the future (i.e., beyond the fourth meeting), especially with respect to the adaptive management strategy.

• Science is the basis of a good HCP / NCCP, and the process of including science in this HCP / NCCP was facilitated well. It was critical to involve scientists from the beginning, and this aspect of the East Contra Costa County HCP / NCCP made panel members more comfortable with the outcome. This is a good model for future HCP / NCCPs.

• It is important to have a public relations component of an HCP / NCCP. Depending on the specific political climate, it may not be adequate to wait until forming a formal group of stakeholders that will provide input to elected officials and accept the plan.

• The presence of HCPA members and the public did not hinder the science advisory process overall. Although there are circumstances in which a scientist might prefer "closed doors"—if private meetings were legal and the audience volatile—there was no perceived need for closed doors during the science advisory process for East Contra Costa County.