City of Loma Linda Official Report

Floyd Petersen, Mayor
Stan Brauer, Mayor pro tempore
Robert Christman, Councilmember
Robert Ziprick, Councilmember
Charles Umeda, Councilmember

COUNCIL AGENDA: June 22, 2005

TO: City Council

VIA: Dennis R. Halloway, City Manager

FROM: Deborah Woldruff, AICP, Community Development Director

SUBJECT: GENERAL PLAN UPDATE PROJECT – The project is a comprehensive update to the City's General Plan document (text and maps) that will set policy and guide the City's development over the next twenty years. Areas directly affected by the update project include all properties located within the City's corporate limits, and properties within the City's Sphere of Influence in the County unincorporated areas generally east and south of the City limits to the Redlands City limits and Riverside County Line.

RECOMMENDATION

The recommendation is that the City Council takes the following actions:

1. Review and approve in concept the Land Use Element (except for the Special Planning Areas); and,
2. Continue the Special Planning Areas (SPA) to the regular meeting on either July 26, 2005 or August 23, 2005 so that staff and the consultant can further refine the draft policies for residential densities within SPAs D, G, H, and J.

Staff also recommends that public testimony be limited to the topic at hand. Copies of the Draft Land Use Element (April 2005) and Draft Hillside Designation (revised June 1, 2005) were previously distributed.

BACKGROUND

On April 26, 2005, the City Council began their review of the Draft Land Use Element (2.0). Staff and the General Plan Consultant presented the Draft Land Use Element, the City Council briefly discussed certain aspects of the document, and some public testimony was received. Because the City Council felt that there was too much information to absorb and comprehend in one meeting, the Draft Land Use Element was continued to a special meeting on May 17, 2005. A special meeting was held on June 7, 2005 for the Draft Hillside Designation. During that meeting, the City Council discussed the proposed policies for the South Hills Area and received

public testimony. No action was taken other than to continue the Draft Hillside Designation, along with the Draft Land Use Element, to the June 28, 2005 City Council Agenda.

Additional background information on the Draft Land Use Element (including the Hillside and SPA Designations) is available in the April 26, 2005, May 17, 2005, and June 7, 2005 City Council Staff Reports that was previously distributed.

ANALYSIS

During the three public hearings that the City Council has been reviewing the Draft Land Use Element, staff and the consultant have been keeping track of map and text changes that have been discussed. As we have stated on prior occasions, the intent is to incorporate all of the changes into a final Draft General Plan document. For this meeting, the discussion will rely upon the Draft Land Use Element (April 2005) and Draft Hillside Conservation Designation (revised June 1, 2005) documents that were previously distributed to the City Council.

The City received four letters of comment related to the Draft Hillside Conservation Designation during the month of June 2005. The following is a list of the four letters in question:

- Douglas F. Welebir, Welebir & McCune (June 6, 2005)
- Chris Taylor, Empire Homes (June 6, 2005)
- Lisa T. Belenky, Center for Biological Diversity (June 6, 2005)
- Kevin P. Varner, Mission Development Co. (June 21, 2005)

Three of the four letters were previously distributed to the City Council and copies are referenced in Attachment 1 [Letters of Comment (Received June 2005)], but not included. The letter from Lisa T. Belenky of the Center for Biological Diversity was not previously distributed because its main focus is on the Draft Environmental Impact Report (DEIR). Staff and LSA Associates will prepare a response and forward it to the City Council for consideration with the Draft Final EIR. However, Ms. Belenky's letter does identify concerns relating to the South Hills Area and the Draft Hillside Conservation Designation and for this reason, a copy is included in Attachment 1 for consideration.

ENVIRONMENTAL

The General Plan Update Project is subject to the California Environmental Quality Act (CEQA) and a Draft Environmental Impact Report (DEIR) has been prepared to evaluate the potential impacts of the project. The DEIR and Draft Responses to Comments that were received during the 45-day mandatory public review period will be reviewed by the City Council sometime in August or September 2005.

The project is also subject to the Regional Congestion Management Plan (CMP) and Traffic Impact Analysis (TIA) has been prepared to address the CMP requirements. The CMP TIA will be scheduled for the City Council's review in August or September 2005.

FINANCIAL IMPACT

Other than the costs associated with the preparation of the Draft General Plan and related environmental documents, the financial impacts of the General Plan Update are not known at this time.

ATTACHMENTS

1. Letters of Comment (Received June 2005):
   a. Douglas F. Welebir, Welebir & McCune (June 6, 2005 – previously distributed)
   b. Chris Taylor, Empire Homes (June 6, 2005 – previously distributed)
   c. Lisa T. Belenky, Center for Biological Diversity (June 6, 2005)
   d. Kevin P. Varner, Mission Development Co. (June 21, 2005 – previously distributed)

PREVIOUSLY DISTRIBUTED DOCUMENTS

1. Draft General Plan (October 2004); Draft Land Use Element (April 2005); and, Draft Hillside Conservation Designation (Revised June 1, 2005)
2. Draft Existing Setting Report (June 5, 2002)
3. Draft Program Environmental Impact Report (March 22, 2004)
4. Traffic Impact Analysis (May 13, 2004) (CMP document)
5. Draft Final Program Environmental Impact (Report Response to Comments) (June 21, 2004)
6. City Council Staff Reports (October 12, 2004; November 16, 2004; December 7, 2004; December 14, 2004; January 11, 2005; February 1, 2005; February 8, 2005; February 22, 2005; March 8, 2005; April 12, 2005; April 26, 2005; May 17, 2005; and, June 7, 2005)
7. Planning Commission Staff Reports (April 6, 2005)

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LETTERS OF COMMENT

(RECEIVED JUNE 2005)

a. **Douglas F. Welebir, Welebir & McCune (June 6, 2005 – previously distributed)**
b. **Chris Taylor, Empire Homes (June 6, 2005 – previously distributed)**
c. **Lisa T. Belenky, Center for Biological Diversity (June 6, 2005)**
d. **Kevin P. Varner, Mission Development Co. (June 21, 2005 – previously distributed)**

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CITY OF LOMA LINDA

CALIFORNIA AND PACIFIC OFFICE

protecting and restoring natural ecosystems and imperiled species through science, education, policy, and environmental law

June 6, 2005

VIA ELECTRONIC MAIL (without exhibits) and FEDERAL EXPRESS OVERNIGHT (with exhibits)

City Council Members
c/o Deborah Woldruff
Community Development and Planning Division
City Hall
City of Loma Linda
25541 Barton Road
Loma Linda, CA 92354
dwoldruff@lomalinda-ca.gov

RE: City of Loma Linda General Plan Update Final Program Environmental Impact Report SCH No. 2003101159.

Dear Council Members,

I. INTRODUCTION.

These comments are submitted on behalf of the Center for Biological Diversity ("Center") on the Final Program Environmental Impact Report ("FEIR") for the City of Loma Linda General Plan SCH No. 2003101159 ("the project"). The Center is a non-profit environmental organization dedicated to the protection of native species and their habitats through science, policy, and environmental law. The Center has over 13,000 members throughout California and the western United States, including in San Bernardino County where the project is located. The Center objects to approval of the project based on the inadequacy of the current environmental documents. The FEIR has failed to identify and adequately analyze several potential environmental impacts of the project and has failed to provide alternatives that would avoid those impacts or enforceable mitigation measures to minimize those impacts. The City Council should not certify the FEIR and should not consider adopting the general plan update until adequate environmental review is completed.

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Lisa Belenky, Staff Attorney
1095 MARKET STREET, SUITE 511 • SAN FRANCISCO, CA 94103
TEL.: (415) 436-9682 x. 307 • FAX: (415) 436-9683
Email: lbelenky@biologicaldiversity.org • www.biologicaldiversity.org

These comments are timely because they have been submitted prior to the FEIR's certification. Pub. Res. Code § 21177(a),(b); *Galante Vineyards v. Monterey Peninsula Water Management District*, 60 Cal. App.4th 1109, 1117-1121 (1997). Therefore, the Center hopes and expects that the City will give full consideration to all comments submitted regarding this project.

II. THE FEIR FAILS TO MEET THE REQUIREMENTS OF THE CALIFORNIA ENVIRONMENTAL QUALITY ACT.

A. The FEIR Improperly Defers CEQA Mandated Environmental Review and Mitigation.

Many of the inadequacies of the FEIR identified in these comments can be attributed to the fact that the FEIR improperly defers identification and analysis of many of the project's impacts, as well as formulation of mitigation measures, to a later time when development of specific projects is considered. This deferral frustrates informed decision-making and violates CEQA. "An EIR should be prepared with a sufficient degree of analysis to provide decision-makers with information which enables them to make a decision which intelligently takes account of environmental consequences." CEQA Guidelines § 15151. *See Concerned Citizens of Costa Mesa, Inc. v. 32nd District Agricultural Association*, 42 Cal. 3d 929 (1986) ("the EIR must contain facts and analysis, not just the agency's bare conclusions or opinions."); *Berkeley Keep Jets Over the Bay Committee v. Board of Port Commissioners*, 91 Cal.App.4th 1344 (2001); *Stanislaus Natural Heritage Project v. County of Stanislaus*, 48 Cal. App. 4th 182 (1996).

While the level of detail required in a program level EIR is not the same as that required in an EIR for a specific development project, a lead agency is required to "use its best efforts to find our and disclose all it reasonably can." CEQA Guidelines §15144. In addition, "[a]n EIR on a project such as the adoption or amendment of a comprehensive zoning ordinance or a local general plan should focus on the secondary effects that can be expected to follow from the adoption or amendment." CEQA Guidelines §15146. The FEIR fails on both counts.

Here, the FEIR has not demonstrated that the formulation of mitigation measures now for the project as a whole is infeasible. Nor has the City adopted specific design criteria or performance standards as mitigation measures for this project and ensured no environmental harm will occur until such design criteria are met. *See, e.g., Sacramento Old City Association et al. v. City Council of Sacramento,* 229 Cal. App. 3d 1011, 1028-9 (1991); *Laurel Heights Improvement Assn. v. Regents of University of California,* 47 Cal. 3d 375, 418 (1988). As a result, this lack of analysis and deferral is contrary to CEQA.

Unfortunately, the FEIR abounds with examples of impacts that are identified in only the most cursory fashion, and left both unanalyzed and unmitigated. For example, while part of the Planning Area represents critical habitat for the California Coastal Gnatcatcher, analysis of the status of the Gnatcatcher is left to future EIRs and thorough discussion of mitigation for lost habitat is likewise limited. Further, the FEIR will allow extensive development in the Hillside

zone and fragmentation of open space that provides habitat to many species as well as providing wildlife corridors but completely fails to adopt any specific feasible mitigation measures or design criteria that will ensure continuous wildlife corridors are preserved or that direct, indirect, and cumulative impacts to rare, threatened and endangered species and their habitat will be adequately mitigated. The June 1, 2005, Draft Hillside Conservation Designation attached to the City Council Staff Report for the June 7, 2005, meeting ("June 7, 2005, Staff Report") provides some additional "guiding policy for Hillside Conservation" and clarifies some provisions for clustered development, but fails to provide the necessary detailed, enforceable mitigation measures that will lessen the impacts of the proposed Hillside build-out. Rather, it provides vague policies that may not, in fact, provide any protection to biological resources.

Feasible mitigation measures that should be included in the FEIR, include but are not limited to the following requirements: (1) buffer zones between housing, streets, driveways and open space to reduce noise and light impacts; (2) limits on outdoor night lighting and street lighting to reduce impacts, including specific criteria for positioning, directing, and shielding lighting to avoid light spill into open space and sensitive habitat; (3) restrictions on off-leash dogs in the Hillside zone; (4) walls or fences that will inhibit domestic animals from harassing and harming native species including "cat-proof" fencing to prevent house cats from accessing sensitive habitat; (5) identification and purchase of mitigation habitat of equal or greater quality *before* any grading or construction may begin on any project within the Hillside zone including but not limited to construction of any infrastructure, streets, or housing; (6) securing adequate dedicated wildlife corridors throughout the Hillside zone *before* any site specific approvals can be considered including, but not limited to, construction of any infrastructure, streets, or housing; (7) mitigation of at least 3:1 for all habitat loss in the Hillside zone to reflect the cumulative impacts of the loss of a large contiguous area of open space and habitat; (8) erecting educational signs that indicate the importance of the open space and sensitive habitat areas, prohibiting pet access, motorized vehicle use, and all activities that may harm or significantly disturb wildlife; (9) providing educational materials to all local schools regarding the importance of the open space and sensitive habitat areas and the connection between species survival and habitat conservation; (10) requiring gates to restrict access to lands set aside for habitat preservation by animals and motorized vehicles; and (11) requiring the use of native vegetation for all development in the Hillside zone.

The FEIR claims that the detailed work is better left to Project specific EIRs. However, such deferral fails to understand the significance of a Program EIR. In this instance, once the General Plan update is approved, the southern hills will be opened to development. The City's duty to provide a detailed analysis of environmental impacts of the proposed project and to impose enforceable mitigation measures cannot be shifted to the future, therefore the FEIR's repeated reliance on general background law, general plan standards, and other local planning standards is misplaced.

Furthermore, the City's duty cannot be shifted onto other agencies, therefore its reliance on federal, state, or regional planning standards is misplaced. For example, the FEIR fails to adequately identify and analyze the direct, indirect and cumulative impacts to water and air quality that may occur due to build out of housing within the Hillside zone. Rather, the FEIR

attempts to rely on standard conditions, such as conforming with SCAQMD rules during construction to fully mitigate any impacts from project construction, and "encourages" use of efficient materials, heating, and cooling in housing. *See* FEIR at 5-6. As the City is well aware, mitigation measures should be *required* in order for the City to rely on them to reduce a projects impacts to the environment.

The City's duty to provide as much detail as possible in its environmental review, including identification and analysis of the direct, indirect, and cumulative impacts of the proposed project as a whole, identification and analysis of alternatives that will avoid those impacts, and adoption of enforceable mitigation measures must be met before the general plan can be amended or updated. Because the FEIR is inadequate the City should not certify it and must revise and recirculate it before considering approval of the general plan update.

B. The FEIR's Description of the Environmental Setting and Environmental Baseline are Inadequate.

As described in Section 4.4 of the DEIR, an extensive amount of land covered by the Loma Linda General Plan is currently undeveloped and contains high quality habitat--coastal sage scrub and nonnative grasslands--for the California Coastal Gnatcatcher. FEIR Appx. C at C-8. This undeveloped area, referred to as the southern hill, consists of approximately 3000 acres, 1,910 of which are currently designated as critical habitat for the Gnatcatcher.

Unfortunately, the FEIR is not based on current protocol surveys for the Gnatcatcher in this area. The only information provided in regards to this extensive Gnatcatcher habitat is that the closest known occurrence of the Gnatcatcher was in the hills of the City of Colton, approximately one mile southwest of the southwest corner of the Planning Area and contiguous with the southern hills, and that surveys conducted on 900 acres of the southern hills in 1998 found no Gnatcatchers. Such limited information, however, fails to provide even a basic foundation on which to adequately ascertain how development will impact the Gnatcatcher. One survey conducted on 900 acres in 1998 tells us very little about the 1,910 acres of designated critical habitat or about the entire 2,939 acres of actual habitat. One outdated survey cannot be used to make broad conclusions--seven years have passed since that survey and the survey failed to examine the entire habitat. Moreover, the fact that Gnatcatchers are known to occur within one mile of the southern hills contradicts the idea that the southern hills are currently unoccupied. Unless and until the EIR provides adequate data regarding the current status of the Gnatcatcher in the southern hills, based on adequate protocol surveys, it is premature to discuss how development will impact the species.

The FEIR is equally inadequate in its identification of the presence of other species in the area. For example, the Stephen's Kangaroo Rat ("SKR") also uses coastal sage scrub as habitat. Although Appendix C of the FEIR claims that the threat to the Stephen's Kangaroo Rat from the General Plan is low to moderate, no background or status information or analysis is provided. Without such basic information, however, accurate future planning is impossible. Since the southern hills represent important habitat for the SKR, protocol surveys and meaningful analysis

must be provided that address the actual current status of the SKR and mitigation that can be adopted to protect it.

Even if it were proper to assume that no Gnatcatchers or SKRs currently occupy the southern hills, which it is not, that would not relieve the City from the duty to identify and analyze impacts to these species due to the fact that the Planning Area contains valuable high quality habitat that Gnatcatchers and SKR will need in the future in order to adequately recover, which of course, is the goal of the ESA. In other words, just because habitat is not currently occupied does not mean the habitat is unnecessary or inessential to conservation of the species which includes both survival and recovery of the species. To the contrary, every acre of coastal sage scrub that is left is critically important to the future recovery of the Gnatcatcher and other endemic species. Therefore, without adequate current surveys to the contrary, the FEIR must assume that Gnatcatchers, SKR, and other species associated with the coastal sage scrub are present in the southern hills and that, even if these species are not present, the loss of high quality unoccupied habitat to development may directly, indirectly, and cumulatively impact the conservation of these species.

Likewise, the FEIR fails to include recent botanical surveys and fails to provide necessary information about rare, threatened, and endangered plant species that are known to be present in the southern hills including, but not limited to, the Nevin's barberry (*Berberis nevinii*).

C. The FEIR Fails To Properly Identify The Full Range Of Direct, Indirect, And Cumulative Impacts To Biological Resources And to Avoid or Mitigate Those Impacts.

The southern hills of Loma Linda do not exist in a vacuum. As the FEIR itself points out in section 4.4-11, the southern hills are part of an extension of larger undeveloped areas. Since species like the Gnatcatcher require large blocks of un-fragmented habitat in order to survive in the long term, it is vital that habitat such as the southern hills be preserved intact and provide continuity with other surrounding open space areas. In other words, if the southern hills become fragmented and/or destroyed due to development, the surrounding open space loses its value because of the overall reduction in size of contiguous habitat.

The FEIR, however, does not fully discuss how the proposed zoning changes will contribute to habitat fragmentation and destruction. The FEIR fails to discuss the impacts to surrounding open space or to the southern hills itself. There is mention of clustering the development but the discussion does not provide any meaningful analysis of how the clustering will prevent significant destruction of habitat or how destruction of habitat will actually be mitigated. *See* FEIR 4.4-15; *see also* June 7, 2005, Staff Report There is also talk of "maximizing the permanent preservation of large blocks of unbroken open space," the desire to "acquire, preserve, and maintain open space," and the need to "preserve…wildlife corridors," but no real analysis as to how that can actually be accomplished in the face of extensive development. *See* FEIR 4.4-15. As the FEIR itself admits, the proposed General Plan may result in the direct loss of 1,437.5 acres of sensitive habitat and will create a "checkerboard pattern of small habitat patches of limited biological value." *See* FEIR 4.4-17-18. Instead of doing what

CEQA requires—thoroughly discussing how such a significant loss of habitat will impact species, alternatives that will avoid these impacts, or specific mitigation measures to lessen such impacts—the overall theme of the FEIR is just the opposite, stating that "loss and fragmentation of critical coastal California gnatcatcher habitat will remain significant and unavoidable." Such a conclusion is unwarranted and premature given the inadequacy of the FEIR's identification and analysis of impacts required by CEQA, and the lack of meaningful alternatives analysis or mitigation measures.

The FEIR calls for a minimum of 1:1 replacement of developed habitat (FEIR 4.4-17) but there is no concrete analysis of how that will actually happen given the fact that coastal sage scrub communities are already extremely rare and that replacement habitat will likely be fragmented. Thus, even if 1:1 replacement is accomplished, it may not adequately protect the Gnatcatcher because the replacement habitat will not be contiguous or as extensively connected or as high quality as the current southern hills habitat. Thus, 1:1 replacement of fragmented areas will not properly mitigate the loss of contiguous open space and wildlife corridors, therefore, the FEIR should require a minimum of 1:3 mitigation of equal quality habitat if the areas are not contiguous. Moreover, the FEIR fails to require that all mitigation lands be secured *before* and grading or destruction of habitat in the Southern Hills. Mitigation that is delayed by months or years is *not* of equal quality and value to the species that depend on it, this is particularly true for nesting habitat and other breeding areas. Where terrestrial species such as the SKR may be found, the FEIR provides no measures for preservation of individuals or any requirements that grading and other land disturbing activities avoid breeding seasons.

The FEIR also fails to adequately analyze the applicability of the Endangered Species Act ("ESA") to the proposed project. Section Nine of the Endangered Species Act forbids the "take" of threatened and endangered species. 16 U.S.C. §1538, ESA §9; 50 C.F.R. § 17.31. Take is defined by the ESA as "harass, harm, pursue, hunt, wound, kill, trap, capture, collect, or attempt to engage in such conduct," 16 U.S.C. § 1532(19), and harm "means an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering." 50 CFR §17.3. The proposed General Plan update will result in harm to the Gnatcatcher, at minimum, through modification and degradation of its habitat, and may result in harm to several other listed species. Unfortunately, the FEIR fails to adequately identify or analyze these issues.

The Center has compiled a database entitled *Summary of Authorized Impacts to the Coastal California Gnatcatcher,* attached as Exhibit A. This database tracks gnatcatcher take authorized by the USFWS over a 10-year period from 1993 to 2003. The Center has recorded authorized take of 832 gnatcatcher pairs via individual biological opinions, at least 236 additional pairs through the "Proposed Special Rule to Authorize Take of the California Gnatcatcher" pursuant to Section 4(d) of the ESA, and at least 212 pairs through the California Natural Communities Conservation Planning ("NCCP") process. Some NCCPs authorize take of large amounts of habitat and "all associated gnatcatcher pairs" without quantifying the number of pairs authorized for take, and therefore 212 pairs is an underestimate of take authorized to date. Thus, the Center has documented take of at least 1,280 pairs of gnatcatchers since listing.

Authorized take, is itself an underestimate of harm to the species, because coastal sage scrub habitat is often lost, and Gnatcatchers are harmed, harassed, or killed, without the perpetrator obtaining any permits. In biological opinions in 2000 and 2001, the U.S. Fish and Wildlife Service estimated that only 2,898 pairs of gnatcatchers remained in the U.S. While this number purportedly accounted for take authorized up to that time, it is questionable whether this is true since multiple biological opinions issued for the take of many pairs of gnatcatchers all used the same number, and the most recent biological opinions we have obtained do not give a population estimate. Regardless, many pairs have been lost since the 2000 and 2001 population estimates.

In addition, other events such as the October 2003 fires in Southern California, had a substantial adverse impact on the gnatcatcher and other species. While periodic fires are normal and desirable in healthy southern California ecosystems, the combined impact of habitat destruction, fragmentation, non-native species, and larger and higher intensity fires than normal (caused by factors including past fire suppression, drought, and global warming) can have a catastrophic impact on species that already have severely reduced populations and face grave threats to their continued existence. Overall, more than 743,000 acres burned in southern California in October 2003. This was a historical landscape-altering event, and it is not possible to accurately describe the environmental setting or address impacts to sensitive species without including information on the status of species following the fires.

The Center has recently released a report analyzing the potential impacts of the 2003 southern California wildfires on the Quino checkerspot butterfly, mountain yellow-legged frog, coastal California gnatcatcher, and least Bell's vireo. Bradley and Bond, "Impacts of the 2003 Southern California Wildfires on Four Federally Listed Species," attached as Exhibit B. Each of these four species has a highly restricted range, occurring only in limited microhabitats within rapidly dwindling vegetation communities of southwestern California, and both the Gnatcatcher and the least Bell's vireo may be found in the Loma Linda hills. FEIR Appx. C. The Center's fire report uses USFWS and USFS GIS data to analyze the potential effects of the 2003 wildfires on known occurrences, modeled habitat, and designated critical habitat for each species throughout its entire range. While the report recognizes that fire is a natural and important ecological disturbance in southern California, the response of organisms to fire can be complicated by invasion of non-native species and fragmentation and isolation of habitat patches due to urban sprawl.

The GIS analysis documents that the wildfires burned 19% of critical habitat and 27% of known occurrences of the Quino checkerspot butterfly; 40% of modeled habitat for mountain yellow-legged frog; 4% of known occurrences, 16% of critical habitat, and 28% of modeled habitat for the California gnatcatcher; and 3% of critical habitat and 2% of modeled habitat for least Bell's vireo. The Center hopes that the information provided in the report will prove useful in re-evaluating baseline conditions for these species in the wake of the 2003 fires, and will assist in determining the cumulative effects of current and future development projects, planning, and large-scale habitat conservation plans. These species have been rapidly losing habitat to rampant and widespread urban development in the region, and the FEIR should have considered the effects of temporary habitat modification due to the fires.

Unfortunately the FEIR improperly defers identification and analysis of these impacts. The Program FEIR is precisely the stage at which the City is required to consider landscape-wide impacts from the potential loss of critical habitat and fragmentation of large areas of contiguous habitat.

D. The FEIR Fails To Identify And Analyze The Full Range Of Direct, Indirect, And Cumulative Impacts To Water Resources and Water Quality And To Avoid or Mitigate Those Impacts.

The FEIR acknowledges that the project will cause significant impacts to water supply but fails to adequately identify or analyze the actual impacts that may occur. FEIR at 5-11 to 5-12. Indeed, the City admits that there are no assurances that "the provision of water supplies adequate to support development that may occur as a result of implementation of the proposed General Plan, therefore significant unavoidable impacts will remain." FEIR at 5-12. CEQA requires more. CEQA requires that the City identify the source of water for the development allowed by the project and examine the environmental impacts that may result if that water supply is tapped for the build-out of the project. *See Santiago County Water Dist. v. County of Orange*, 118 Cal. App. 3d 818 (1981); *Stanislaus Natural Heritage Project v. County of Stanislaus*, 48 Cal. App. 4th 182 (1996). Moreover, where, as here, the water supply is uncertain and a shortfall in those supplies theoretically available is likely, the EIR must evaluate that issue, identify other potential sources, and identify and analyze the environmental consequences of tapping those resources. *Santa Clarita Org. for Planning the Environment v. County of Los Angeles*, 106 Cal. App. 4th 715 (2003); *Napa Citizens for Honest Government v. Napa County Bd. Of Supervisors*, 91 Cal. App. 4th 342, 371 (2001). Where there is remaining uncertainty that the water supply will be available, the EIR must provide mitigation measures that will prevent development until water supply is secured. *See Napa Citizens*, 91 Cal. App. 4th at 374. The FEIR fails on all counts.

The FEIR notes that the water available to the City wells in the Bunker Hill Basin is artificially recharged from many sources including, but not limited to, the Santa Ana River, Lytle Creek, Mill Creek and other local creeks and streams. Moreover, recharge water also comes from the State Water Project which imports water to the region. Nonetheless, the FEIR attempts to defer the required analysis of impacts to local and regional water resources by stating that the project "will not directly result in new development. Rather, it will dictate where and in what manner development will occur." FEIR at 4.8-13. This statement is fundamentally misleading—the project will facilitate development and, indeed, the General Plan Update will facilitate far greater development than could otherwise be expected to occur in the City. In particular, the project will greatly increase the amount of development allowed in the southern hills, than could have occurred under the existing General Plan. Build-out of the project will significantly impact water resources and the FEIR must be revised to properly address these issues.

The most glaring omission in the FEIR is the failure to identify or analyze the direct, indirect, and cumulative impacts to water resources and the biological resources dependent on them. For example, the FEIR fails to identify the current baseline impacts that result from water

diversions from local streams and rivers to recharge the groundwater basin, including but not limited to impacts to in-stream biological resources and fails to identify any new impacts from potential increases in water diversions for recharge. Moreover, although the FEIR notes that water may be sought from the San Bernardino Valley Municipal Water District ("Muni") under the City's existing "option to purchase," the FEIR completely fails to identify or analyze the environmental impacts that are caused by Muni's current water diversions from local streams and rivers or the impacts that will be caused by its pending proposals to divert additional water from the Santa Ana River. Because the FEIR fails to properly identify, analyze, avoid or mitigate impacts to water resources, the EIR must be revised.

The FEIR's discussion of water quality is also inadequate. The FEIR completely ignores increased impacts to water quality caused by increased development—particularly due to increases in runoff and surface contamination. The FEIR completely ignores the impacts that increased runoff potentially contaminated by a host contaminants may have to local creeks and rivers including the San Timeteo Wash and the Santa Ana River. The only issue that the FEIR does address is the quality of the well water in the City. Thus, the water quality section of the FEIR is wholly inadequate.

E. The FEIR Fails to Adequately Identify And Analyze Impacts to Air Quality, and To Avoid or Mitigate Those Impacts.

The FEIR's air quality section falls far short of CEQA's requirements. The project is located in the South Coast Air Basin ("SoCAB"), which has one of the most severe air quality problems in California and the nation. The FEIR explains the state and federal Clean Air Act regulatory framework at some length, but then fails to conduct a complete analysis of the project's air quality impacts. The fact that other agencies have regulatory control over some aspects of air pollution pursuant to other statutes in no way lessens the City's responsibility to fully disclose, analyze, avoid, minimize, and mitigate all air quality impacts of the proposed project. The past failure of many agencies to do so has been a major contributing factor to the SoCAB's current air quality crisis.

The FEIR looks at several criteria pollutants under the Clean Air Act including carbon monoxide (CO), oxides of nitrogen (NOx), oxides of sulfur (SOx), and particulate matter (PM). Under the California Clean Air Act, the California Air Resources Board (CARB) regulates these same criteria pollutants, in addition to others including sulfate, hydrogen sulfide, vinyl chloride, and visibility (a measure of air quality rather than a pollutant). However a range of other Hazardous Air Pollutants (HAPs), also called Toxic Air Pollutants (TACs) under California law should also be evaluated. The federal Clean Air Act requires the U.S. EPA to develop new regulations for 189 such toxic substances, in an effort to protect human health and decrease cancer risk. The U.S. EPA considers that an "acceptable" cancer risk caused by HAPs is a one-in-one million chance of contracting cancer over the course of an average person's lifetime. The ARB currently monitors and assesses the health risks of 10 HAPs in California, including Acetaldehyde, Benzene, 1,3 Butadiene, Carbon Tetrachloride, Chromium (Hexavalent), para-Dichlorobenzen, Formaldehyde, Methylene chloride, Perchloroethylene, and diesel particulates. The FEIR contains no real description of these HAPs and no analysis of the project's impacts.

The project's generation of HAPs during both the construction and operation phases of the project must be fully disclosed, analyzed, avoided, minimized, and mitigated in an EIR.

A wealth of information on the environmental and health ramifications of the SoCAB's poor air quality is readily available. These reports contain critical information on the health and environmental impacts of air quality. One study found that in San Bernardino County alone, 486 deaths per year are due to current PM 2.5 levels, and 231 deaths and 34,127 asthma attacks per year are due to current PM10 levels. Exhibit C, *Particle Civics, How Cleaner Air in California Will Save Lives and Save Money*, at 19. The FEIR's failure to include even the most basic information on the link between air quality, health impacts, and impacts to biological resources renders it inadequate.

The Air Quality Section of Appendix G of the CEQA Guidelines (Environmental Checklist Form) specifically calls out a project's potential to conflict with or obstruct implementation of any applicable air quality plan as an impact to be discussed. The FEIR contains no discussion of the proposed project's contribution to this problem. Failure to meet regulatory deadlines have serious economic, environmental, and health ramifications for the SoCAB, all of which should be discussed.

The FEIR also fails to address the proposed project's contribution to excess nitrogen deposition. This phenomenon is impacting vegetation in southern California and in particular causing losses of coastal sage scrub, a rare and threatened plant community that supports many threatened, endangered, and sensitive species. Exhibit D, Allen, et al., *Nitrogen Deposition Effects on Coastal Sage Vegetation of Southern California*, 1998; Exhibit E, Cione, et al., *Restoration of Native Shrubland Impacted by Exotic Grasses, Frequent Fire, and Nitrogen Deposition in Southern California*, June 2002. This impact must be disclosed and analyzed in a revised EIR.

The FEIR does not adequately explore mitigation measures to reduce air quality impacts. The FEIR finds that the project will have long term impacts on air quality but fails to avoid or mitigate those impacts below the level of significance. Most of the measures relate only to construction impacts to air quality and none of the long term operational mitigation measures identified in the FEIR are enforceable conditions of the project approval other than those measures which require adherence to existing laws and regulations—which is already required by law. FEIR at 5-3 to 5-6. Most of the operational mitigation measures are entirely voluntary, rely on implementation strategies of other agencies, and encourage changes in energy use and alternative materials. None of the measures adequately address vehicular traffic or alternative transportation.

The FEIR has also omitted entirely any discussion of the project's long term cumulative air quality impacts. Air quality is an area where the always important cumulative impacts analysis is particularly crucial, because major air quality problems are created by a vast number of small sources which may appear individually insignificant. A revised EIR must be circulated that contains an adequate cumulative impacts analysis for each criteria pollutant and HAP and

addresses topics including human health, and impacts to biological resources, including nitrogen deposition.

F. The FEIR Fails To Analyze A Meaningful Range of Feasible Alternatives.

An FEIR is required to describe a range of reasonable alternatives to the project, which would feasibly attain most of its basic objectives but would avoid or substantially lessen its significant effects. Cal. Code Regs § 15126.6(a). The City has a substantive duty to adopt feasible, environmentally superior alternatives. Pub. Res. Code § 21002, Cal. Code Regs §§ 15002(a)(3), 15021(a)(2). A lead agency cannot abdicate this duty unless substantial evidence supports a finding that the alternative is infeasible. *See, e.g., Citizens of Goleta Valley v. Board of Supervisors*, 197 Cal. App. 3d 1167, 1181 (1988). The FEIR identifies the No Project/ General Plan and the No Project/No build alternatives as the environmentally superior alternatives. Because the FEIR clearly shows that denial of the project is the environmentally superior alternative, the City should not adopt the General Plan update.

The FEIR identifies significant unavoidable effects including loss of open space, degradation of air quality, fragmentation and loss of extensive areas of natural habitats and associated biological resources (including harm to the Gnatcatcher), impacts to water resource availability, and increased traffic and congestion. FEIR at 5-11 to 5-12. Nonetheless, the FEIR fails to describe a reasonable range of alternatives to the proposed project. For example, the Reduced Residential Hillside Density Alternative does not fairly provide a reasonable alternative, but rather sets up a straw-man for the City to discount. A meaningful alternative would continue the current land use provisions in the southern hills while increasing density in other areas of the City. For example, an alternative should be examined that calls for town houses and clustered development around shopping and transportation hubs. Such transit based, high density development could mitigate the impacts of the project to both air quality and biological resources.

III. THE EIR SHOULD BE REVISED AND RECIRCULATED FOR PUBLIC REVIEW AND COMMENT.

A lead agency must recirculate an EIR for further public comment under any of four circumstances:

(1) When the new information shows a new, substantial environmental impact resulting either from the project or from a mitigation measure;

(2) When the new information shows a substantial increase in the severity of an environmental impact, except that recirculation would not be required if mitigation that reduces the impact to insignificance is adopted;

(3) When the new information shows a feasible alternative or mitigation measure that clearly would lessen the environmental impacts of a project and the project proponent declines to adopt the mitigation measure; or

(4) When the draft EIR was "so fundamentally and basically inadequate and conclusory in nature" that public comment on the draft EIR was essentially meaningless.

Guidelines §15088.5.

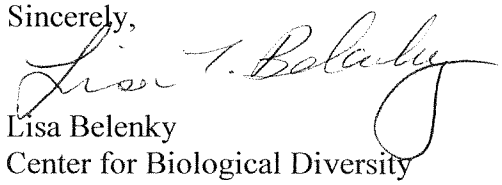
Based on the comments above, it is clear that the EIR must be re-drafted and recirculated. Conditions (1), (2) and (3) above will be met by meaningful and adequate discussion of the project description, impacts, mitigation measures, and cumulative impacts. The combined effect of these omissions makes it clear that the fourth condition has also been met.

IV. THE CITY COUNCIL SHOULD NOT CERTIFY THE FINAL PROGRAM EIR AND SHOULD NOT ADOPT THE GENERAL PLAN UPDATE BASED ON THE FEIR.

The City Council should not certify the Final Program EIR, because the Final Program EIR fails to adequately disclose, analyze, avoid, minimize, and mitigate the environmental impacts of the proposed general plan update. As detailed above, the FEIR fails to comply with CEQA and fails to provide necessary information about the impacts of the project in many areas including biological resources, open space, and air and water quality.

Neither decision makers nor the public can make informed decisions about the costs to the environment of proposed general plan update based on this fundamentally flawed and cursory environmental review. Therefore, the City Council should reject the proposed general plan update and postpone further consideration of the project until adequate environmental review is completed.

Sincerely,



Lisa Belenky
Center for Biological Diversity

List of Exhibits

Exhibit A: *Summary of Authorized Impacts to the Coastal California Gnatcatcher,* Center for Biological Diversity, 2003.

Exhibit B: Bradley and Bond, *Impacts of the 2003 Southern California Wildfires on Four Federally Listed Species,* Center for Biological Diversity.

Exhibit C: Sharp and Walker, Particle Civics, How Cleaner Air in California Will Save Lives and Save Money, Environmental Working Group.

Exhibit D: Allen, E.B, A. Bytnerowocz, R. Minnich, P.E. Padgett, *Nitrogen Deposition Effects on Coastal Sage Vegetation of Southern California,* USDA Forest Service Gen. Tech. Rep. PSW-GTR-166, 1998.

Exhibit E: Cione, et al., *Restoration of Native Shrubland Impacted by Exotic Grasses, Frequent Fire, and Nitrogen Deposition in Southern California*, Restoration Ecology, Vol. 10 No. 2, pp. 376-384, June 2002

CC: (via U.S. mail, without exhibits)

Field Supervisor
USFWS- Ecological Services
Carlsbad Field Office
6010 Hidden Valley Road
Carlsbad, CA 92009

Attn: Karin Cleary-Rose

EXHIBIT A

Summary of Authorized Impacts to the Coastal California Gnatcatcher

Center for Biological Diversity
2003

Key for: Summary of Authorized Impacts to the Coastal California Gnatcatcher (Center for Biological 2003)

Acq:	Acquisition
BMPs:	Best Management Practices
BMV:	Below Market Value
BIA:	Bureau of Indian Affairs
BiOp:	Biological Opinion
CAGN:	Coastal California gnatcatcher
CDFA:	California Department of Food & Agriculture
CHD:	Critical Habitat Designation
CMA:	Conservation Management Agreement
CSS:	Coastal Sage Scrub
DCSS:	Diegan Coastal Sage Scrub
DHS:	Department of Home Security
EPA:	Environmental Protection Agency
FAA:	Federal Aviation Administration
FEMA:	Federal Emergency Management Agency
FHWA:	Federal Highway Administration
FS:	Forest Service
FTA:	Federal Transit Administration
Gen:	General
H/S/W:	Health/Safety/Welfare
Hab Frag:	Habitat Fragmentation
Herb:	Herbicides
NA:	Not Applicable
NG:	None Given
NCCP:	Natural Community Conservation Plan
NJ:	'No Jeopardy' decision
NLAM:	Not Likely to Adversely Modify Critical Habitat
NLAM(P):	Not Likely to Adversely Modify Proposed Critical Habitat
NM:	None mentioned
NWR:	National Wildlife Refuge
MB:	Mitigation Bank
MOU:	Memorandum of Understanding
MR:	Mitigation Ratio
MSCP:	Multiple Species Conservation Plan
PCHD:	Proposed Critical Habitat Designation
Pest.:	Pesticides
Prop:	Property
RCHCA:	Riverside County Habitat Conservation Agency
Res Dev:	Residential Development
ReVeg:	Revegetation
Rod.:	Rodenticides
RSS:	Riversidian Sage Scrub
SDG&E:	San Diego Gas & Electric
SJHTC:	San Joaquin Hills Transportation Corridor
SR:	State Route
Veg:	Vegetation
USDOT:	U.S. Department of Transportation
UDHUS:	U.S. Department of Housing and Urban Development

1	BiOp DATE	BiOp CODE	PROJECT TYPE	CITY / AREA	COUNTY	FED AGENCY	JEOPARDY?	AD MOD?	HABITAT - Sage Scrub Acres Impacted	CH - Location and Amount (if given)	AUTHORIZED TAKE (in Pairs)
2	4/9/1993	1-6-93-F-11	San Diego North City Water Reclamation Plant (Construction & Upgrade)	San Diego	San Diego	EPA	NJ	NA	5.6	NA	1
3	6/9/1993	1-6-93-F-16	The Antonio to Portola Parkway (North) section of the Foothill Transportation Corridor	Eastern Orange County (Foothill Transportation Corridor)	Orange	Corps	NJ	NA	0.49	NA	6
4	6/11/1993	1-6-93-F-98	Multiple Lane Tollway from SR-73 (in Newport Beach) to I-5 (in San Juan Capistrano)	Newport Beach / San Juan Capistrano	Orange	FHWA	NJ	NA	155	NA	30
5	6/15/1993	1-6-93-F-17	Construction of the Executive Golf Course in the Irvine Coast Planned Community - Orange County	Laguna Beach	Orange	Corps	NJ	NA	2.3	NA	33
6	6/28/1993	1-6-93-F-23	Park & Ride Lot at North County Fair Overcrossing of I-15 in Escondido	Escondido	San Diego	FHWA	NJ	NA	2	NA	1
7	7/6/1993	1-6-93-F-39R2	SR-76 Oceanside Bypass Project	Lawrence Canyon	San Diego	FHWA	NJ	NA	21.6	NA	3
8	7/19/1993	1-6-93-F-28	San Diego Water Authority 4BI Pipeline Project on Miramar Naval Air Station and Capital Improvement Program	San Diego	San Diego	Navy	NJ	NA	196.7	NA	5
9	7/29/1993	1-6-93-F-20	Widening of the Pacific Coast Highway between Newport Beach & Muddy Canyon	Newport Beach / Muddy Canyon	Orange	Corps	NJ	NA	3.4	NA	2
10	8/11/1993	1-6-93-F-31	SDG&E's Sycamore Canyon Substation & Transmission Line Project (Miramar)	San Diego	San Diego	Navy	NJ	NA	21.5	NA	2
11	9/1/1993	1-6-93-F-27	Construction of Weapons Storage and Testing Facilities for the Fallbrook Annex of the Naval Weapons Stations	Seal Beach	Orange	Navy	NJ	NA	4.9	NA	2
12	9/7/1993	1-6-93-F-34	404 Permit - Construction of South Carlsbad High School Campus	Carlsbad	San Diego	Corps	NJ	NA	1.46	NA	1
13	9/15/1993	1-6-93-F-19	Extension & Realignment of Ford Road (connecting MacArthur Blvd & the SJHTC)	Irvine	Orange	Corps	NJ	NA	0.7	NA	3
14	10/8/1993	1-6-93-F-21	Widening of SR-54 from 0.1 mile west of I-805 and 0.6 mile west of Sweetwater Rd.	San Diego	San Diego	FHWA	NJ	NA	36	NA	1
15	10/12/1993	1-6-93-F-24	Widening of the I-5 and I-805 freeway confluence - San Diego County	I-5 / I-805 Interchange	San Diego	FHWA	NJ	NA	25.3	NA	9
16	18/1993	1-6-93-F-22	Construction of a 6-lane freeway on a new alignment between SR-54 and SR-94	San Diego / Lemon Grove	San Diego	FHWA	NJ	NA	30	NA	5
17	11/4/1993	1-6-93-F-43	Otay Valley Road Widening Project (four different elements)	Chula Vista	San Diego	Corps	NJ	NA	1.21	NA	0
18	11/12/1993	1-6-93-F-33	Construction of 290 Navy housing units and associated facilities in the Eucalyptus Hills area of Lakeside.	Lakeside	San Diego	Navy	NJ	NA	31	NA	2
19	11/14/1993	1-6-95-FW-009	MOU/CMA on Finisterra Farms residential construction project and granting of a Conservation Easement to RCHCA	Lake Skinner	Riverside	FWS (Intra)	NJ	NA	0	NA	0
20	11/15/1993	1-6-93-F-36	Construction of a Wal-Mart shopping center in Chula Vista	Chula Vista	San Diego	Corps	NJ	NA	6	NA	2
21	12/23/1993	1-6-93-F-26	Fieldstone's Arroyo La Costa Project	Carlsbad	San Diego	Corps	NJ	NA	11.2	NA	3
22	12/28/1993	1-6-94-F-6	Construction of Home Depot - Encinitas	Encinitas	San Diego	Corps	NJ	NA	0.15	NA	1
23	3/2/1994	1-6-94-F-7	Mesa Grande & Lusardi Grazing Allotments	Cleveland National Forest	San Diego	FS	NJ	NA	0	NA	0
24	4/11/1994	1-6-93-F-46	Wilmont Ranch Res Dev	Oceanside	San Diego	Corps	NJ	NA	3	NA	0

1	BiOp DATE	BiOp CODE	PROJECT TYPE	CITY / AREA	COUNTY	FED AGENCY	JEOPARDY?	AD MOD?	HABITAT - Sage Scrub Acres Impacted	CH - Location and Amount (if given)	AUTHORIZED TAKE (in Pairs)
25	4/18/1994	1-6-94-F-4	Extension of Woodhaven Rd to Provide Access to Proposed Palmera Subdivision	Oceanside	San Diego	Corps	NJ	NA	3	NA	1
26	4/19/1994	1-6-94-F-13	Construction of Wastewater Treatment Plant in the Tijuana River Valley	Tijuana River Valley	San Diego	EPA	NJ	NA	0	NA	4
27	5/26/1994	1-6-94-F-15	Realignment & Widening of La Costa Ave (Phase II)	Carlsbad	San Diego	Corps	NJ	NA	0.35	NA	2
28	6/22/1994	1-6-94-F-21	Dehesa Memorial Estates (Private Cemetery)	El Cajon / Alpine	San Diego	Corps	NJ	NA	35.2	NA	2
29	6/27/1994	1-6-94-F-14	Cajalco Creek Dam & Detention Basin Project (Lake Mathews Watershed)	Lake Mathews	Riverside	Corps	NJ	NA	26.6	NA	0.5
30	7/6/1994	1-6-94-F-17	Construction of Multiple Lane Tollway from SR 91 south and west to Interstate 5 in central Orange County (North & East Leg)	central Orange County	Orange	FHWA	NJ	NA	250	NA	25.5
31	7/13/1994	1-14-94-F-16	Construction of Multiple Lane Tollway from SR 91 south and west to Interstate 5 in central Orange County (West Leg)	northeastern Orange County	Orange	Corps	NJ	NA	44	NA	0.5
32	7/19/1994	1-6-94-F-26	MacArthur Boulevard Widening and Extension of Bison Avenue	Newport Beach	Orange	Corps	NJ	NA	1.96	NA	2
33	9/27/1994	1-6-94-F-28	New Owl Products Sand & Gravel Mine -	Wilson Creek	Riverside	Corps	NJ	NA	small areas	NA	0
34	9/29/1994	1-6-94-F-37	Miramar Landfill General Development Plan (New Facility Construction)	NAS Miramar	San Diego	Navy	NJ	NA	3.3	NA	0.5
35	10/4/1994	1-6-94-F-40	Widening and Realignment of SR-76 from Airport Road to Jeffries Ranch Road in Oceanside	Oceanside	San Diego	FHWA	NJ	NA	5	NA	4
36	11/7/1994	1-6-94-F-32	Expansion of the Runway at Montgomery Field	San Diego	San Diego	FAA	NJ	NA	12.5	NA	2
37	11/16/1994	1-6-94-F-42	Otay Water District Capital Improvement Program (Multiple Projects)	Jamul area	San Diego	Corps	NJ	NA	42.34	NA	2
38	11/28/1994	1-6-95-F-004	Cooperative Agreement on Methods for Fire Abatement (Riverside County)	countywide	Riverside	FWS (Intra)	NJ	NA	not given	NA	20
39	1/31/1995	1-6-95-F-16	Poinsettia/Interstate 5 Interchange (Widening)	Carlsbad	San Diego	FHWA	NJ	NA	2.1	NA	2
40	2/8/1995	1-6-94-F-27	Fire Management Program at the Fallbrook Naval Ordinance Center	Fallbrook	San Diego	Navy	NJ	NA	0	NA	5
41	2/13/1995	1-6-95-F-17	Sunbow Res Dev	Chula Vista	San Diego	Corps	NJ	NA	11 (perm) / 43.1 (temp)	NA	6
42	5/1995	1-6-94-F-29	Tozai (Cox-West) Planned Community (2 Res Devs & Golf Course)	Norco Hills	Riverside	Corps	NJ	NA	24	NA	1
43	3/3/1995	1-6-95-F-15	Domestic Waterline Project	Rincon Indian Reservation	San Diego	Corps	NJ	NA	0	NA	6
44	3/30/1995	1-6-95-F-25	San Onofre Sewage Effluent Compliance Project	Camp Pendleton	San Diego	USMC	NJ	NA	3.8	NA	1
45	4/3/1995	1-6-95-F-14	Bank of America Rancho Verde Res Dev	Carlsbad	San Diego	Corps	NJ	NA	6.8	NA	3
46	4/6/1995	1-6-95-F-13	Nationwide Permit Verification - Mockingbird Canyon Res Dev	Mockingbird Canyon	Riverside	Corps	NJ	NA	20	NA	2
47	4/12/1995	1-6-95-F-12	Remington Hills Housing Dev - San Diego	Otay Mesa	San Diego	Corps	NJ	NA	4.2	NA	1
48	4/13/1995	1-6-95-F-11	San Diego Gas and Electric's Pipeline 2000 Phase IV Project	Otay Mesa	San Diego	Corps	NJ	NA	2.8	NA	10
49	4/12/1995	1-6-95-F-26	Chevron La Habra Hills (abandonment & development activities)	La Habra	Orange	Corps	NJ	NA	18	NA	3.5
50	5/9/1995	1-6-95-F-10	San Sevaine Creek Water Project (Flood Protection/Groundwater Recharge	San Bernardino	San Bernardino	Bureau of Rec	NJ	NA	24	NA	0

1	BiOp DATE	BiOp CODE	PROJECT TYPE	CITY / AREA	COUNTY	FED AGENCY	JEOPARDY?	AD MOD?	HABITAT - Sage Scrub Acres Impacted	CH - Location and Amount (if given)	AUTHORIZED TAKE (in Pairs)
51	6/7/1995	1-6-95-F-18	Exclusion of Parcels of the Rancho San Diego property in purchase of land for National Wildlife Refuge	Rancho San Diego / Via Mercado site	San Diego	FWS (Intra)	NJ	NA	39.6	NA	4
52	7/6/1995	1-6-95-F-32	Construction of Hidden Valley Road - Sambi Seaside Heights - Carlsbad	Carlsbad	San Diego	Corps	NJ	NA	6.32	NA	0
53	7/13/1995	1-6-95-F-23	State Route 125 Project (from Fletcher Parkway to State Route 52)	La Mesa / Santee	San Diego	Corps	NJ	NA	34.6	NA	6
54	8/4/1995	1-6-93-F-44	Olivenhain Water Storage Project (Proposed Dam Reservoir)	Escondido / Lake Hodges	San Diego	BLM	NJ	NA	52.2	NA	24
55	9/27/1995	1-6-95-F-41	Cooperative Agreement on Riverside County's Road Maintenance Program	countywide	Riverside	FWS (Intra)	NJ	NA	42	NA	3
56	2/2/1996	1-6-96-F-08	Relocation of Equestrian Facility - Rancho San Diego	Rancho San Diego	San Diego	FWS (Intra)	NJ	NA	12	NA	3
57	2/22/1996	1-6-95-F-8	404 Permit - Rancho Carrillo Res Dev	Carlsbad	San Diego	Corps	NJ	NA	93.1	NA	3
58	3/26/1996	1-6-96-F-14	ITP (Ocean Trails Res Dev & Golf Course)	Rancho Palos Verdes	Los Angeles	FWS (Intra)	NJ	NA	36.9 (perm) 82.8 (temp)	NA	2
59	4/11/1996	1-6-95-F-33	Realign Miramar Marine Station	NAS Miramar	San Diego	USMC	NJ	NA	57.4	NA	16
6	11/1996	1-6-96-F-19	Multi-Agency Training Facility at the East Mesa Detention Facility - San Diego	Otay Mesa	San Diego	Corps/FBI	NJ	NA	12.7	NA	1
61	5/14/1996	1-6-96-F-6	Construction of Tollway Segment - Antonio Parkway to Oso Parkway Station	Chiquita Canyon / Chiquita Ridge / Oso Parkway Interchange	Orange	Corps	NJ	NA	68.11	NA	35
62											
63	6/3/1996	1-6-96-F-28	404 Permit - East Mountain Gorge Trunk Sewer Rehab Project	San Diego	San Diego	Corps	NJ	NA	0.3	NA	2
64	6/19/1996	1-6-96-F-09	Chevron 1-8" Pipeline Project - Defense Fuel Support Point	San Pedro	Los Angeles	US Navy	NJ	NA	1.23	NA	1
65	7/2/1996	1-6-96-FW-26	ITP (City of Poway Subarea HCP)	Poway	San Diego	FWS (Intra)	NJ	NA	1733	NA	53
66	7/9/1996	1-6-96-F-32	5-Year Pesticide Use Permit to CDFA	countywide	Riverside	BLM	NJ	NA	0	NA	2
67	8/14/1996	1-6-96-F-35	Operation & Maintenance of Crucible Challenge Course	Camp Pendleton	San Diego	USMC	NJ	NA	0	NA	0
68	8/15/1996	1-6-96-F-31	Agra Overhead/San Onofre Creek/Santa Margarita - Bridge Seismic Retrofit Projects	Camp Pendleton	San Diego	FHWA	NJ	NA	1.08	NA	2
69	10/11/1996	1-6-95-F-42	404 Permit - Urban Runoff Diversion - Sweetwater Reservoir	San Diego / Sweetwater Reservoir	San Diego	Corps	NJ	NA	10.9	NA	15
70	/21/1996	1-6-96-F-36	Santa Margarita River Area Sewage Treatment Compliance Project	Camp Pendleton	San Diego	USMC	NJ	NA	27.1	NA	4
71	30/1996	1-6-96-F-022	w/San Diego Fire Chief's Association	countywide	San Diego	FWS (Intra)	NJ	NA	745	NA	35
72	11/7/1996	1-6-96-F-16	ITP (Shell/MWD - Oil Field Remediation/Conversion)	Yorba Linda / Chino Hill SP	Orange	FWS (Intra)	NJ	NA	142	NA	9
73	1/14/1997	1-6-95-F-35	Cal Terraces/South Palm Vista/Otay Corporate Center North & South - Otay Mesa	Otay Mesa	San Diego	Corps	NJ	NA	156	NA	7
74	2/26/1997	1-6-97-FW-19	MOU on Standards for Fire Abatement	countywide	San Diego	FWS (Intra)	NJ	NA	745	NA	commensurate w/hab loss
75	3/11/1997	1-6-97-F-11	Oceanside-Escondido Rail Project (Improvements & Construction of new Right of Way)	Oceanside / Vista / San Marcos / Escondido	San Diego	USDOT/FTA	NJ	NA	6.99	NA	10
76	4/9/1997	1-6-97-F-13	SDCWA Reservoir Construction (Emergency Storage Project)	Lake Hodges	San Diego	Corps	NJ	NA	147.3 (perm) / 55.7 (temp)	NA	37
77	5/8/1997	1-6-97-F-22	Quarry Expansion & Access Road at 3M Industrial Mineral Products Pant	El Cerrito	Riverside	Corps	NJ	NA	1.94	NA	1
78	6/3/1997	1-6-97-F-36	Landfill Remediation at MCAS El Toro	MCAS El Torro	Orange	Navy	NJ	NA	9.75	NA	10
79	8/1/1997	1-6-97-F-30	Nobel Drive & I-805 Interchange & Extension Project	I-805 / Nobel Drive	San Diego	USDOT/FTA	NJ	NA	8.84	NA	3

1	BiOp DATE	BiOp CODE	PROJECT TYPE	CITY / AREA	COUNTY	FED AGENCY	JEOPARDY?	AD MOD?	HABITAT - Sage Scrub Acres Impacted	CH - Location and Amount (if given)	AUTHORIZED TAKE (in Pairs)
80	11/6/1997	1-6-97-F-54	Sloan Canyon Side Mine Project - Sweetwater River	Sloan Canyon Sand Mine / Sweetwater River	San Diego	Corps	NJ	NA	0	NA	0
81	12/18/1997	1-6-98-F-4	Geotechnical Survey Activities Along the Alignment of Crown Valley Parkway Bridge	Crown Valley Parkway Bridge	Orange	Corps	NJ	NA	0.02	NA	2
82	1/30/1998	1-6-97-F-61	INS San Clemente Checkpoint Project (Construction of a 1-mile Pre-Inspected Automated Lane)	San Clemente Checkpoint	San Diego	INS	NJ	NA	0.04	NA	1
83	2/12/1998	1-6-98-FW-12	ITP (Meadowlark Estates HCP) - Construction of the Meadowlark Estates Res Dev	San Marcos	San Diego	FWS (Intra)	NJ	NA	12.3	NA	1
84	3/9/1998	1-6-93-F-48R1	Route 30 Improvements Project - Reinitiation (new species present (CAGN))	Route 30 Service Area	San Bernardino	FHWA	NJ	NA	257.1	NA	6
85	4/20/1998	1-6-98-FW-11	ITP (Western Pacific Housing for Development of the Bennett Property (Res Dev)	Chula Vista	San Diego	FWS (Intra)	NJ	NA	4.2	NA	1
86	5/29/1998	1-6-98-F-29	Construction of the Granada Trunkline & Second Los Angeles Aqueduct Repair	Los Angeles	Los Angeles	FEMA	NJ	NA	0.5 (perm) / 0.25 (temp)	NA	3
87	8/2/1998	1-6-98-F-40	Firebreak Mowing	Canyon Lake	Riverside	BLM	NJ	NA	3.37	NA	3
88	8/12/1998	1-6-98-F-28	Repair of Route 78 Sinkhole	Oceanside	San Diego	FHWA	NJ	NA	0.65	NA	1
89	8/25/1998	1-6-98-F-30	Orchard 91 Sewer Line and Development Project (Res Dev)	Corona	Riverside	Corps	NJ	NA	31.82	NA	3
90	9/8/1998	1-6-98-F-27	Talega Substation Landslide Repairs - Camp Pendleton - Christianitos Creek	Camp Pendleton	San Diego	USMC	NJ	NA	"small amount"	NA	"not large"
91	10/23/1998	1-6-98-F-44	BLM & Starwood Environmental Trust Land Exchange	Santa Fe Valley	San Diego	BLM	NJ	NA	8.3	NA	2
92	11/23/1998	1-6-98-F-38	De Luz Housing Project	Camp Pendleton	San Diego	USMC	NJ	NA	3.93	NA	3
93	12/23/1998	1-6-99-F-10	Rancho Del Oro Village VII Res Dev	Oceanside	San Diego	Corps	NJ	NA	5.56	NA	2
94	1/20/1999	1-6-99-F-05	Forster Ranch Land Slide Remediation, Road, & Res Dev - San Clemente	San Clemente	Orange	Corps	NJ	NA	78	NA	NG
95	2/26/1999	1-6-99-F-14	State Route 125 South		San Diego	USDOT/FTA	NJ	NA	60.5		32
96	4/7/1999	1-6-98-F-40-R1	Canyon Lake Firebreak Project - *Reintiation (project occurring during breeding season instead of outside)	Canyon Lake	Riverside	BLM	NJ	NA	0	NA	3
97	7/19/1999	1-6-99-F-30	Construction of a Ammunition Handling Facility	Camp Pendleton	San Diego	USMC	NJ	NA	2.57 (perm) / 1.07 (temp)	NA	6
98	6/28/1999	1-6-99-F-45	Installation & Upgrade of the Power Distribution Line	Camp Pendleton	San Diego	USMC	NJ	NA	0.149	NA	41
99	7/19/1999	1-6-95-F-02-R10	Santa Margarita River Levee/Basilone Bridge Replacement Projects - *Reinitation (due to unanalyzed impacts to CAGN from Basilone Bridge replacement project	Camp Pendleton	San Diego	USMC	NJ	NA	1.65	NA	2.5
100	8/19/1999	1-6-94-F-14-R3	Cajalco Creek Dam & Detention Basin Project - *Amended BO 1-6-94-F-14 - Plan Revisions	Cajalco Dam	Riverside	Corps	NJ	NA	7.2 (additional)	NA	1 (additional)
101	8/17/1999	1-6-99-F-62	Ashby Financial Company Res Dev	Murrieta	Riverside	Corps	NJ	NA	96.88	NA	5
102	9/21/1999	1-6-99-F-64	Road/Lot/Loading Dock Maintenance & Improvements at Marine Corps Air Station Miramar	MCAS Miramar	San Diego	USMC	NJ	NA	0.22	NA	1
103	10/21/1999	1-6-99-F-063	Manzanita Partners Apartment Project	Carlsbad	San Diego	Corps	NJ	NA	3.4	NA	1
104	10/28/1999	1-6-99-F-76	Repair of Electrical Transmission Towers M3-T3 on Camp Pendleton	Camp Pendleton	San Diego	USMC	NJ	NA	0	NA	1
105	11/15/1999	1-6-99-F-11	Walnut Hills II Res Dev	San Marcos	San Diego	Corps	NJ	NA	20.6	NA	1
106	11/23/1999	1-6-99-F-69	Rilington Communities Res Dev	Temecula	Riverside	Corps	NJ	NA	11	NA	1

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107	5/26/1999	1-6-95-F-13-R1	Mockingbird Canyon Estates - Riverside County - *Amendment to BO 1-6-95-F-13 - (allowing for construction during nesting season)	Mockingbird Canyon	Riverside	Corps	NJ	NA	0	NA	0
108	NG	1-6-99-F-42	Construction & Extension of the North Levee at Sunwest's Lytle Creek Quarry	Rialto	San Bernardino	Army	NJ	NA	0	NA	2
109	NG	1-6-99-F-8	Crown Valley Parkway Extension over Arroyo Trabuco	Mission Viejo	Orange	Corps	NJ	NA	3.11	NA	1
110	10/8/1999	1-6-93-F-44R1	Olivenhain Water Storage Project (Proposed Dam Reservoir) - *Reinitiation (exceed take limit & construction during breeding season)	Escondido / Lake Hodges	San Diego	BLM	NJ	NA	0	NA	2 (additional)
111	2/11/2000	1-6-99-F-77	Construction of Otay Mesa High School	Otay Mesa	San Diego	Corps	NJ	NA	0.37	NA	1
112	2/18/2000	1-6-99-F-70	Pulte Homes/Silverhawk Res Dev	Winchester / Murrieta Hot Springs	Riverside	Corp	NJ	NA	136 (perm) / 14 (temp)	NA	16.5
113	2/18/2000	1-6-00-F-15	Pulte Homes Corp Res Dev - Yorba Linda	Yorba Linda	Orange	Corps	NJ	NA	170.9	NA	13
114	2/25/2000	1-6-00-F-4	Murrieta Hot Springs Road Extension	Murrieta Hot Springs Road	Riverside	Corps	NJ	NA	9.4	NA	2
115	4/24/2000	1-6-00-FW-12	Rancho Bella Vista HCP	north of Temecula / Murrieta Hot Springs Road	Riverside	FWS (Intra)	NJ	NA	68	NA	2
116	5/4/2000	1-6-99-F-59	Realignment & Widening of Laguna Canyon Road, SR 133	Laguna Canyon Road	Orange	FHWA	NJ	NA	21.51	NA	6
117	5/12/2000	1-6-00-F-34	Prescribed Burn in the San Mateo Watershed at Camp Pendleton	Camp Pendleton	San Diego	USMC	NJ	NLAM(P)	5	Y (Footprint covering 5 Acr of PCHD)	1
118	5/24/2000	1-6-00-F-35	ITP (Railroad Canyon-Lake Elsinore Development HCP)	Lake Elsinore	Riverside	FWS (Intra)	NJ	NLAM(P)	9.2	Y (PCHD)	1
119	8/25/2000	1-6-00-F-1	Ranch Viejo Res Dev	unincorporated San Diego County near Fallbrook	San Diego	Corps	NJ	NLAM(P)	1.6	Y (Project within Unit 7 of PCHD)	1
120	9/1/2000	1-6-00-F-18	Painted Hills Development (Res Dev)	Lake Mathews area	Riverside	Corps	NJ	NLAM(P)	3.6	Y (Project within PCHD)	1
121	9/12/2000	1-6-00-F-26	Victoria Grove Phase III Project	Riverside	Riverside	Corps	NJ	NLAM(P)	2	Y (Project within PCHD)	0.5
122	9/22/2000	1-5-00-F-420	Questar Southern Trails Pipeline Project (SoCal, AZ, UT)	Orange / Corona	Orange / Riverside	FERC	NJ	NLAM(P)	2.11	Y (Project within PCHD, 0.33 Acr of PCH to be impacted)	0
123	9/29/2000	1-6-00-F-23	Rancho Miramosa Project (Res Dev)	western Riverside County / Hunter Rd & Winchester Rd	Riverside	Corps	NJ	NLAM(P)	3.71	Y (Project within PCHD and will alter)	1
124	9/29/2000	1-6-00-F-38	Eagle Glen Specific Plan Amendment III	Corona	Riverside	Corps	NJ	NLAM(P)	75	Y (Portion of project within PCHD)	2
125	10/12/2000	1-6-00-XF-779.2	Lusk Elsinore Development Project	Section 3 - Township 6 South - Range 4 West, San Bernardino Base and Meridian	Riverside	Corps	NJ	N	44.47	N	1.5

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126	10/26/2000	1-6-00-XF-759.3	Lake Hills Crest Development	south of Riverside / Arlington mountain	Riverside	Corps	NJ	NLAM	25.94	Y	3
127	11/2/2000	1-6-01-XF-378.2	Willows Investment Group Project	Murrieta Hot Springs Road area	Riverside	Corps	NJ	N	22.4	N	2
128	12/18/2000	1-6-01-XF-775.5	Old Bridge Road Project (Res Dev)	Riverside	Riverside	Corps	NJ	NLAM	2.5 (perm) 8.5 (temp)	Y (Project will alter CHD)	1
129	8/23/2000 / 12/20/2000	1-6-01-F-1199	Morro Hills Village and Golf Course	Oceanside	San Diego	Corps	NJ	NLAM(P)	5.4	Y (PCH within project site)	2
130	12/27/2000	1-6-00-F-827.5	ITP (Granite Homes Inc. (Res Dev)	Lake Elsinore	Riverside	FWS (Intra)	NJ	N	14	N	3
131	12/28/2000	1-6-00-F-855	Water-Detention Basins on Loma Alta Creek and Garrison Creek	Oceanside	San Diego	Corps	NJ	NLAM	0.3 (perm) 0.3 (temp)	Y (Project within CHD and will alter 0.6 Acr)	1
132	1/17/2001	1-6-00-F-916.2	Canyon Vista Res Dev	Oceanside	San Diego	Corps	NJ	NLAM	14.6	Y (Project site within CHD)	5
133	1/18/2001	1-6-01-F-852.2	Tract 14551, Res Dev	Chino Hills	San Bernardino	Corps	NJ	NLAM	8.85	Y	0.5
13[illegible]	[illegible]/29/2001	1-6-01-7F-1320	Acceptance of Mitigation Fee for Geotechnical Drilling for the Festival Ridge Property	Anaheim	Orange	FWS (Intra)	NJ	NLAM	0.36 (temp)	Y (Within Unit 7 of 2000 CHD)	2
135	1/31/2001	1-6-01-F-1184.2	Sycamore Creek Res Dev	Temescal Canyon	Riverside	Corps	NJ	NLAM	107.1 (perm) 27.1 (temp)	Y	6
136	2/2/2001	1-6-2000-F-910.2	Las Flores Estancia Project	Camp Pendleton	San Diego	USMC	NJ	N	0.74	N	1
137	2/9/2001	1-6-01-F-1254.2	East Branch Extension, Phase I and Addendum No. 2 (Water pipeline & fiber optic cable - pump stations & other assoc facilities) - San Bernardino & Riverside Counties	Devil's Canyon / Crafton Hills	San Bernardino / Riverside	Corps	NJ	NLAM	0	Y (Portion of project is within Unit 11 of CHD)	0
138	2/26/2001	1-6-01-7F-1065.2	Southern California Gas Company Line 6900 Gas Pipeline, Phases II & III	Romoland to Temecula	Riverside	Corps	NJ	NLAM	3.58	Y (Project will alter CHD - loss of 2 acres)	1
139	2/27/2001	1-6-01-F-853.2	Pinehurst Res Dev	Chino Hills	San Bernardino	Corps	NJ	N	0	N	0
140	2/27/2001	1-6-00-F-773.2	LRMP for the 4 Southern California National Forests	regionwide	San Diego / Riverside / San Bernardino / Orange / Los Angeles / Ventura	FWS / FS	NJ	NLAM	0	Y	0.5
141	[illegible]/22/2001	1-6-00-F-59	Emery Ranch Res Dev Project	Fullerton	Orange	Corps	NJ	NLAM	13.5	Y (Project within Unit 9 of CHD)	3
142	3/30/2001	1-6-98-F-19	Mission Valley East Light Rail Transit Project - San Diego County *Reinitiation of former consultation to include CAGN	Mission Valley	San Diego	USDOT/FTA	NJ	N	4.8	N	1.5
143	4/27/2001	1-6-01-F-1694	Cleveland National Forest's Livestock Grazing Program	regionwide	San Diego / Riverside / San Bernardino / Orange	FS	NJ	N	0	N	small/undeterminable #
144	5/31/2001	FWS-WRIV-1183.2	La Sierra Ave & El Sobrante Rd Improvement Project	north of Lake Mathews / adjacent to Riverside	Riverside	Corps	NJ	NLAM	3.6	Y (entire action area within CHD)	2
145	6/8/2001	FWS-SDG-1373.2	Moreno-Lakeside Pipeline	Lakeside / Santee	San Diego	Corps	NJ	N	0.54 (perm) 5.35 (temp)	N	2
146	6/8/2001	FWS-SD-1393.3	Paloma/Las Posas Extension Project	San Marcos	San Diego	Corps	NJ	N	2.56	N	1
147	8/16/2001	FWS-SDG-915.2	Bressi Ranch Dev	Carlsbad	San Diego	Corps	NJ	NLAM	30.9 (perm) 34.4 (temp)	Y (Project within 2000 CHD and project will impact 70.819 acres)	1

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148	8/24/2001	FWS-OR-813.4	ITP (Deer Canyon Park Preserve Low-Effect HCP	Anaheim	Orange	FWS/Infra	NJ	NLAM	1.39	Y (Project within Unit 7 of CHD)	6
149	10/23/2001	FWS-WRIV-1463.2	Butterfield Station Project (Golf course, Res Dev, Comm Dev, etc.)	Corona	Riverside	Corps	NJ	NLAM	97.3	Y	3
150	11/9/2001	FWS-SDG-858.6	Wanis View Estates Res Dev	Oceanside	San Diego	Corps	NJ	NLAM	6.8	Y (Project within Unit 3 of CHD)	0
151	12/10/2001	FWS-MCBCP-1988.2	Talega Substation Expansion	Camp Pendleton	San Diego	USMC	NJ	N	2.57	N	0
152	1/3/2002	1-6-01-F-2250	Drainage Repair Projects on I-15 at Miramar	MCAS Miramar	San Diego	FHWA	NJ	NLAM	0.25	NM	0.5
153	1/4/2002	1-6-00-F-25	Altamira Canyon Drainage Improvement Project	Rancho Palos Verdes	Los Angeles	Corps	NJ	NLAM	2.47	Y (Project within Unit 8 of 2000 CHD)	2.5
154	1/31/2002	FWS-MCBCP-2464.2	SDG&E Access Road near San Onofre Housing Area	Camp Pendleton	San Diego	USMC	NJ	N	0.045	NM	0
155	2/8/2002	FWS-WRIV-1856.2	Secured Equities Sun City Res Dev	Sun City	Riverside	Corps	NJ	NLAM	5.6	Y (Project within Unit 10 of 2000 CHD)	0
156	2/8/2002	FWS-LA-810.1	Walnut Hills Res Dev & Golf Course	Walnut	Los Angeles	Corps	NJ	NLAM	62.67	N	1
157	2/17/2002	FWS-SB-1743.5	San Sevaine Creek Water Project - *Reinitiation (See also 23 Infra)	Etiwanda Creek / San Sevaine Creek	San Bernardino	Bureau of Rec	NJ	NLAM	64	Y	1
158	3/5/2002	FWS-WRIV-1083.4	North Ramsgate Res Dev	Lake Elsinore	Riverside	Corps	NJ	NLAM	35.9	Y (Project within Unit 10 of 2000 CHD)	2
159	4/9/2002	FWS-WRIV-2054.3	Green River Ranch Project	Corona	Riverside	Corps	NJ	N	4.47	N	1.5
160	5/15/2002	FWS-SDG-2285.9	Brookfield Homes/University Commons	San Marcos	San Diego	Corps	NJ	NLAM	130	Y (Project within Unit 3 of 2000 CHD)	6
161	5/23/2002	FWS-WRIV-2723.2	Menifee Meadows Project	Menifee Valley	Riverside	Corps	NJ	N	29.98	N	1
162	6/3/2002	FWS-SDG-2599.2	*Reinitiation for the Oceanside-Escondido Rail Project (See also 77 infra)	Oceanside / Vista / San Marcos / Escondido	San Diego	USDOT/FTA	NJ	NLAM	12.15	Y	7
163	6/7/2002	FWS-WRIV-2760.2	SR-71 Highway Widening Project	Pomona	Riverside	FHWA	NJ	N	1.817	N	1
164	6/11/2002	FWS-OR-918.5	Arroyo Trabuco Golf Course	Mission Viejo	Orange	Corps	NJ	NLAM	11.9	Y (Project within Unit 6 of 2000 CHD)	4
165	6/11/2002	1-6-02-F-1502	Salt Creek Interceptor Sewer Project	Chula Vista	San Diego	Corps	NJ	NLAM	1.94 (perm) 6.32 (temp)	Y (Project within Unit 1 of 2000 CHD)	11

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166	6/24/2002	FWS-WRIV-1190.5	Canyon Lake 44 Project	Canyon Lake	Riverside	Corps	NJ	N	15.9	N	1
167	7/16/2002	FWS-WRIV-2770.2	Cottonwood Hills/Canyon Hills Res Dev	Lake Elsinore	Riverside	Corps	NJ	N	234	N	5
168	8/7/2002	FWS-LA-810.3	*Reinitiation for Walnut Hills Res Dev & Golf Course (See also 161 Infra)	Walnut	Los Angeles	Corps	NJ	N	*see 161 Infra	*	3 (additional)
169	8/23/2002	FWS-WRIV-3059.1	La Estrella Road/Nutmeg Street Extension Project	Murrieta	Riverside	Corps	NJ	NLAM	9.7	Y (Project within CHD)	0
170	8/23/2002	FWS-WRIV-1945.5	The Retreat (Heritage Hills) Specific Plan No. 317	Corona	Riverside	Corps	NJ	NLAM	258.8	Y (Project within Unit 10 of 2000 CHD, will permanently remove 268.8 acres)	1
171	9/13/2002	FWS-WRIV-1281.3	Spring Mountain Ranch Specific Plan 323 & Landfill Site	Highgrove	Riverside	Corps	NJ	NLAM	73.5	Y (Project within Unit 10 of 2000 CHD, will permanently remove 103.9 acres)	0.5
172	10/3/2002	FWIS-SDG-1129.4	Payne-Woolley Property Comm Dev	Oceanside	San Diego	Corps	NJ	N	1.12	N	1
173	10/4/2002	FWS-SDG-3004.2	Eastern Otay Ranch Drainage Facilities	Chula Vista	San Diego	Corps	NJ	NLAM	2.5	Y (Will permanently impact 3.6 acres of 2000 CHD)	1
174	10/21/2002	FWS-WRIV-2752.5	Blackmore Development	Murrieta	Riverside	Corps	NJ	NLAM	54.6	Y (Project within Unit 10 of 2000 CHD, will permanently remove 55.2 acres)	0
175	12/19/2002	1-6-F-02-1202	Remedial Action at Sites 2 and 17, Former Marine Corps Air Station El Toro	MCAS El Toro	Orange	Navy	NJ	NLAM	25.35	Y (Project within Unit 7 of 2000 CHD)	4
176	12/31/2002	FWS-OR-2347.5	Nuevo Energy's Proposed Tonner Hills Planned Community	Chino/Puente Hills	Orange	Corps	NJ	NLAM	86.6	Y (Project within Unit 9 of 2000 CHD)	5
177	1/10/2003	FWS-MCBCP-3001.3	Range 314 Access Road	Camp Pendleton	San Diego	USMC	NJ	N	3.5	N	0
17[illegible]	16/2003	FWS-SDG-1328.5	Proposed Operational Improvements on I-15 (Reinitiation to include increased CAGN take)	I-15 (Lake Hodges, Los Penasquitos Creek, Green Valley Creek)	San Diego	USDOT/FHWA	NJ	N	65	N	17
179	/30/2003	1-6-02-F-3125.4	I-5 Northbound Auxiliary Lane Project	San Diego	San Diego	USDOT/FHWA	NJ	N	5.84	N	1
180	2/3/2003	1-6-03-F-2552	Escondido Research and Technology Center	Escondido	San Diego	Corps	NJ	N	45.1	N	6
181	2/7/2003	1-6-02-F-3131.2	Chollas Heights Navy Family Housing Erosion Control Measures	San Diego	San Diego	Navy	NJ	N	0.03 (perm) / 0.18 (temp)	N	1
182	2/27/2003	FWS-WRIV-2991.2	Top Capital Development Project	Corona	Riverside	Corps	NJ	NLAM	1.97	Y (Project within Unit 10 of 2000 CHD and project will result in removal of 19.52 acres)	0
183	3/3/2003	FWS-OR-909.9	Car Wash Strip Mall Project Feature, Santa Ana River Mainstem Flood Control and Norco Bluffs Toe Stabilization Projects	Anaheim / Chino/Puente Hills	Orange / Riverside / San Bernardino	Corps	NJ	NLAM	1	Y (Project within 2000 CHD and will alter 1.0 acre)	1
184	3/20/2003	1-6-03-F-1323.5	101-Acre Fee-To-Trust Transfer and Casino Project for the Jamul Indian Village	Jamul	San Diego	BIA	NJ	N	24.9	N	1

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185	3/20/2003	1-6-02-F-2124	Carlsbad Raceway Project	Carlsbad	San Diego	Corps	NJ	NLAM	9.6	Y (50.5 acres of 2000 CHD onsite)	0.5
186	4/10/2003	FWS-MCBCP-3223.3	Advanced Amphibious Assault Vehicle (AAAV) Program	Camp Pendleton	San Diego	USMC	NJ	N	low (unquatifiable)	N	low (unquantifiable)
187	4/15/2003	1-6-03-F-2820	Taylor Property (Taylor Estates Project)	Oceanside	San Diego	Corps	NJ	N	2.4	N	1
188	4/18/2003	FWS-WRIV-2415.5	Highpointe Communities - Clayton Ranch Project	Clinton Keith Road area	Riverside	Corps	NJ	N	16.43 (perm) 2.08 (temp)	N	1
189	6/5/2003	FWS-LA-3074.2	BKK Landfill Development Project	West Covina	Los Angeles	Corps	NJ	NLAM	6.5 (perm) 5 (temp)	Y (75 acres of 2003 proposed CHD onsite)	1
190	7/1/2003	1-6-03-F-1089.22	14-Miles Border Infrastructure System	US/Mexico border from Pacific Ocean to Tin Can Hill	San Diego	INS/DHS	NJ	NLAM	49.5	Y (Project overlaps 31.9 acres of proposed & designated CHD)	2.5
19	7/2/2003	FWS-WRIV-3544.2	Tentative Tract 28728	Riverside	Riverside	Corps	NA	NLAM	3.91	Y (26.29 acres of the project fall within CHD)	0
192	7/14/2003	FWS-WRIV-3426.2	Cleveland Way Road Crossing & Mountain Gate Specific Plan	Corona	Riverside	Corps	NJ	NLAM	12.78	Y (Project within Unit 10 of 2000 CHD)	1
193	7/15/2003	FWS-WRIV-674.6	Victoria Grove Phase IV Project	Western Riverside County - La Sienna Road & McAllister	Riverside	Corps	NJ	NLAM	12	Y (2.5 acres of project site within Unit 10 of 2000 CHD)	2
194	8/6/2003	FWS-WRIV-2285.15	Brookfield Commons University Project (Reinitiation: See infra 160)	San Marcos	San Diego	Corps	NJ	NLAM	6.25	Y (Project within Unit 3 of 2000 CHD and will directly impact 42.1 acres)	0
195	8/25/2003	1-6-03-F-2198	Rancho Santalina Project	San Marcos	San Diego	Corps	NJ	N	10.63	N	1
196	10/3/2003	FWS-WRIV-1492.3	Seraphina Road Residential Development Project	Temecula	Riverside	Corps	NJ	N	10.4	N	2
197	10/31/2003	1-6-02-F-703	Prima Deshecha Landfill Remediation Project - Amendment	San Juan Capistrano	Orange	Corps	NJ	NLAM	0.75	Y (7.74 acres of expanded remidiation area fall within Unit 6 of 2000 CHD	0
198	11/4/2003	FWS-SB-1640.11	Lytle Creek Master Planned Community	Lytle Creek	San Bernardino	Corps	NJ	NLAM	no specific CSS amount given	Y (Project within 2000 CHD and project will impact 577 acres)	0
199	11/6/2003	1-6-03-F-3648.2	Sewer Line Improvements at the Cabrillo Heights Navy Housing Development	San Diego	San Diego	Navy	NJ	NLAM	0.5	N	1
200	1/20/2004	FWS-OR-2233.8	North Yorba Linda Estates Development	Yorba Linda	Orange	Corps	NJ	NLAM	93.9		8
201											
202											**Total: 840**
203											
204											**Subtotals** (by County)
205											
206											Orange: **215.5**
207											San Bernardino: **3.5**
208											San Diego: **495**
209											Riverside: **111**
210											Los Angeles: **13.5**
211											Multiple Counties: **1.5**

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212											
213											
214											

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215	4(d) & NCCPs										
216	11/10/1993	1-6-93-FW-37	Proposed Special Rule to Authorize Incidental Take to CAGN - 4(d) & NCCP Program	regionwide	regionwide	FWS (Intra)	NJ	NA	20920 (5% of total sage scrub habitat)	NA	116
217	10/18/1996	1-6-93-FW-37R1	Reinitiation (I) of Special Rule for CAGN	regionwide	regionwide	FWS (Intra)	NJ	NA	17688 (5% of remaining total)	NA	80 (additional)
218	10/7/1999	1-6-98-FW-37R2	Reinitiation (II) of Special Rule for CAGN	regionwide	regionwide	FWS (Intra)	NJ	NLAM	12501 (5% of remaining total)	Y	40 (additional)
219	5/24/1996	1-6-FW-24	ITP - Orange County Central & Coastal NCCP/HCP	Central & Coastal Orange	Orange	FWS (Intra)	NJ	NA	7444	NA	121
220	7/2/1996	1-6-96-FW-26	ITP - City of Poway HCP/NCCP	Poway	San Diego	FWS (Intra)	NJ	NA	1726	NA	53
221	??/??/??	1-6-96-FW-05	ITP - Lake Mathews HCP/NCCP	Lake Mathews	Riverside	FWS (Intra)	NJ	NA	415.2 (perm) 1993 (temp)	NA	16
222	6/6/1997	1-6-97-FW-47	ITP - MSCP/NCCP - City of San Diego subarea	San Diego	San Diego	FWS (Intra)	NJ	NA	6185	NA	*all CAGN associated with acreage
223	9/30/1999	1-6-98-FW-10	ITP - MSCP/NCCP - City of La Mesa subarea	La Mesa	San Diego	FWS (Intra)	NJ	NA	117	NA	22
22	/18/2003	1-6-03-FW-882.1	ITP - MSCP/NCCP - City of Chula Vista subarea	Chula Vista	San Diego	FWS (Intra)	NJ	NA	1500	Y (10,108 acres within the planning area	*undetermined number associated with acreage
225											
226											
227											4(d) Total: 236
228											NCCP Total: 212*
229											BO/4(d)/NCCP Total: 1288

1	BiOp DATE	BiOp CODE	PROJECT TYPE	CITY / AREA	COUNTY	FED AGENCY	JEOPARDY?	AD MOD?	HABITAT - Sage Scrub Acres Impacted	CH - Location and Amount (if given)	AUTHORIZED TAKE (in Pairs)
230											
231											
232											
233											
234											
235											
236											
237											
238											
239											
240											
241											
242											
243											
244											
245											
246											

EXHIBIT B

Impacts of the 2003 Southern California Wildfires on Four Federally Listed Species:

Quino checkerspot butterfly
Mountain yellow-legged frog
Coastal California gnatcatcher
Least Bell's vireo

Curt Bradley and Monica Bond
Center for Biological Diversity

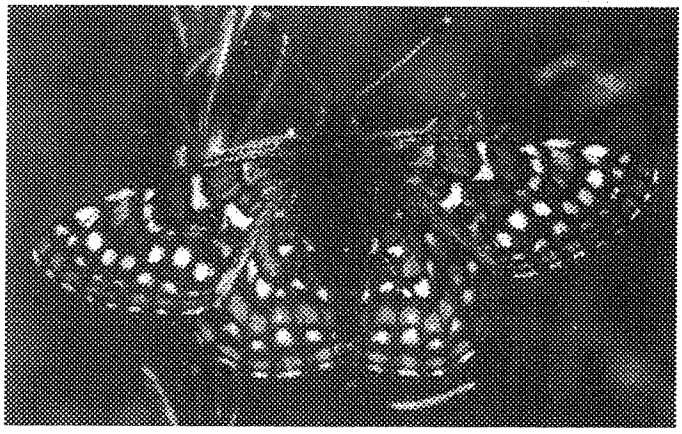

Photo of Quino checkerspot butterfly from Cleveland National Forest

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- Coastal California gnatcatcher 9
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Appendix A: Excerpts from the San Bernardino National Forest's *Resource and Biological Assessment for Threatened and Endangered Plants and Animals: Old and Grand Prix Fires* BAER report 24

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Introduction

The southern California landscape has been shaped by fire over millennia. Fire is a natural disturbance event upon which many ecosystems depend, creating wildlife habitat and forage, nourishing the soil, and perpetuating the native plant communities that evolved with fire. Southern California is also a hotspot of biological diversity, much of which is threatened by past and ongoing fragmentation, degradation, and outright destruction of native habitat. Human-caused changes in the environment resulting from urbanization, fire suppression, domestic livestock grazing, and spread of invasive species, in tandem with changing climate conditions, have altered the role of fire in this landscape, often leading to changes in fire effects on native species.

The effects of wildfire on animals vary spatially and temporally, by habitat type and by species. Wildfire does not permanently destroy habitat but instead temporarily creates new habitat that can be utilized by a different suite of species until the vegetation re-grows. However, natural re-colonization of burned habitat can be complicated by a variety of factors, including the isolation of habitat patches by urbanization and roads, which may prevent some species from re-establishing in isolated patches after fire, and the invasion of non-native species following fire, which can result in permanent type-conversion of habitat.

Individuals that are dispersal-limited or depend upon late-successional habitats may have difficulty finding new suitable habitat after fire, particularly very large wildfire and where there has been extensive habitat loss and fragmentation (Morrison 2003). In remaining habitat, there may be crowding effects, resulting in increased competition for resources, susceptibility to predation and nest parasitism, and other density-dependent effects. Direct and indirect effects of fire can be compounded by drought and disease, such as West Nile Virus which has been identified in San Diego County (Morrison 2003).

In coastal scrub, fire can be followed by invasion of non-native vegetation such as barley (*Hordium* spp.), foxtail fescue (*Vulpia myuros*), red brome (*Bromus madritensis* spp. *rubens*), and other Mediterranean grasses (Stephenson and Calcarone 1999). These invasions have led to increased fire frequencies and ultimately resulted in type conversion of many shrub-dominated habitats to non-native grassland (Minnich and Dezzani 1998). Riparian habitats are impacted by fire as well. Arundo (*Arundo donax*), or giant reed, is a large perennial invasive grass that forms dense thickets in riparian areas and supports few native wildlife species (Stephenson and Calcarone 1999). Arundo thickets are highly flammable and known to carry wildfire along riparian corridors, which normally are relatively resilient to fires (R. Minnich, UC Riverside, pers. comm.). Thus, the invasion of non-native species influences the responses of native species to wildfire.

In October 2003, more than a dozen wildfires swept across southern California, burning a total of 743,023.92 acres (Table 1). The vegetation types most affected by the fires were chaparral and coastal sage scrub. Approximately 90 to 95 percent of the area burned was in these two shrubland vegetation types (Stephens 2003).

Table 1. Extent of 16 Wildfires in Southern California, 2003. Source: USFWS

NAME	AREA	PERIMETER	ACRES	HECTARES
Roblar2	19584781.62	25899.607	4839.51	1958.478
Otay/Mine		70610.289	44698.71	18088.897
Coyote	75637735.01	57261.495	18690.52	7563.774
Locust	7676887.582	15581.183	1897	767.689
Lytle	3397051.906	13518.29	839.43	339.705
Mountain	41776322.83	35583.386	10323.17	4177.632
Pass	9930543.785	21651.556	2453.89	993.054
Paradise	226691778.6	119351.649	56016.85	22669.178
Old	185843351.5	101021.776	45922.97	18584.335
Grand Prix		206684.04	91503.2	37029.974
Padua/Grand Prix	42304784.47	46161.473	10453.76	4230.478
Cedar		281835.961	275619.07	111538.9
Cedar	11.387	15.885	0	0.001
Simi	435265076.6	216061.423	107556.51	43526.508
Piru	257871499.1	99965.366	63721.54	25787.15
Verdale	34348830.02	42130.605	8487.79	3434.883
		TOTALS:	**743023.92**	**300690.64**

A number of species in southern California have been federally listed as endangered or threatened due to extensive habitat loss in the region. The U.S. Fish and Wildlife Service ("USFWS") is charged with ensuring the conservation of these species under the Endangered Species Act. The agency also has the authority to issue incidental take permits for private or federal projects that might adversely affect listed species — provided the projects either individually or cumulatively do not jeopardize the continued existence of those species. At least four of these federally listed species may have been locally impacted by the recent wildfires: the Quino checkerspot butterfly (*Euphydryas editha quino*) and coastal California gnatcatcher (*Polioptila californica californica*), both occurring primarily in coastal sage scrub, and the least Bell's vireo (*Vireo bellii pusillus*) and southern California mountain yellow-legged frog (*Rana muscosa*), both riparian obligates. Each of these species has a highly restricted range, occurring only in limited microhabitats within rapidly dwindling vegetation communities of southwestern California. Thus, the fires had to potential to impact these species more than other species with larger ranges.

The objective of this report is to assess the potential landscape-scale effects of the 2003 wildfires on these four species to determine how the baseline conditions for each has changed, with respect to amount of habitat available. This information will prove useful for the USFWS in cumulative analyses of "take" of these species during current and future development projects.

Methods

To provide background on how the 2003 wildfires were likely to affect habitat suitability and availability in the short-term, we conducted a literature review and summarized response to fire of individuals and populations of the four species of concern. Sources included published studies, USFWS listing determinations and recovery plans, and Burned Area Emergency Response ("BAER") reports.

We were interested in investigating both the local and region-wide impacts of the wildfires on each of the four species of concern. We obtained any available reports on the individual 2003 fires that analyzed impacts to these species. We also conducted our own region-wide analysis of the fires on suitable habitat, designated critical habitat, and point locations for the four species of concern.

Local Impacts of 2003 Fires

For local impacts, we reported assessments from three BAER reports. Completed reports available to the public at the time of this analysis included the Simi-Verdale-Piru; Grand Prix-Old; Padua; and Cedar-Otay-Paradise fire complexes. BAER reports are developed by the U.S. Forest Service ("USFS") and Department of the Interior to assess impacts of fire and to prescribe post-fire restoration measures. These reports also provide summary data on each individual fire complex regarding effects on locally occurring sensitive, threatened, and endangered species.

Regional Impacts of 2003 Fires

For the region-wide analysis, various sources of GIS data were collected and imported into ArcGIS (ESRI Inc., Redlands, California). We obtained GIS layers representing designated critical habitat and point locational data from the Carlsbad office of the USFWS. For the mountain yellow-legged frog, we used point locational data from the California Natural Diversity Database ("CNDDB"). We used the California Wildlife Habitat Relations ("CWHR") program (Version 8: California Department of Fish and Game) to model suitable habitat for the mountain yellow-legged frog, coastal California gnatcatcher, and least Bell's vireo. The CWHR program is the standard classification system for wildlife habitat modeling in California. We downloaded a 2000 GIS coverage of California vegetation from the CWHR website; this map is a mosaic of the best available vegetation data for the state, using a 100-meter cell size for our area of interest. We clipped this vegetation coverage to coverages of habitat boundaries for each species, also available in CWHR, to create species-specific range maps.

Utilizing the Bioview tool, which links species-specific data available in CWHR with a vegetation database, we created Dbase tables that rank the different habitats for their value to each species based on habitat code, size class, and cover. These tables were joined to the clipped vegetation coverage to create a single coverage with habitat ranking values that ranged from 1–100, with 100 being optimal habitat. The CWHR program ranks habitat for foraging, cover, and reproduction. We provide an arithmetic mean of these 3 values, and assume any value above 50 to be "good" habitat.

Burn severity maps for the Grand Prix-Old, Cedar-Otay-Paradise, and the Simi-Verdale-Piru fire complexes were supplied by the U.S. Forest Service, Region 5. We re-projected and merged all burn severity GIS layers into a single coverage that had a uniform burn severity code (1 = unburned, 2 = low severity, 3 = moderate severity, 4 = high severity, 5 = unburned). The

suitable habitat coverage was intersected with the burn severity coverage. For the CWHR modeled habitat fire analysis, we conducted a frequency on the burn severity and habitat ranking values, and summarized the acres.

For the USFWS species occurrence fire analysis, locational data had been recorded as circles encompassing probable location. Different circle sizes represent the confidence of the location, with the most accurate circle being 160 m in diameter and the least accurate being 1,000 m in diameter. Confidence in the location is reflected as a precision code (PCODE). We utilized PCODE1 and PCODE 2, the most accurate locations. Because some circles overlapped different fire severities, we intersected the circles with the fire severity map to determine the percentage of each occurrence circle in each severity class. Different precision codes had different sized circles, so separate computations were conducted for each.

Results are presented in both tabular and spatial format.

Species Accounts

Below, we have summarized data on life history, habitat use, and any known effects of wildfire on each of the four species of concern. We also summarized local impacts of three of the fire complexes, based on BAER and other available reports.

Quino checkerspot butterfly

The Quino checkerspot butterfly occurs in topographically diverse, open, woody canopy landscapes of coastal California from south of Ventura County, and inland valleys south of the Tehachapi Mountains (USFWS 2003). The historic distribution extended from the westernmost slopes of the Santa Monica Mountains, the Los Angeles plain, and the Tranverse Ranges to the edge of the upper Anza-Borrego desert, and south to El Rosario in Baja California, Mexico (USFWS 2003). The current range of the species includes southern San Diego and western Riverside counties and northern Baja California Norte, Mexico (USFWS 2003). Urban and agricultural development, invasion of non-native species, habitat fragmentation and degradation, and other human-caused disturbances have resulted in substantial losses of habitat and declines in habitat suitability through the species' historic range (USFWS 2003). The butterfly apparently has been extirpated from Los Angeles, Orange, and San Bernardino counties (USFWS 2000).

The Quino checkerspot butterfly can occupy meadows, grasslands, coastal sage scrub, chamise chaparral, open red shank chaparral, open juniper woodland, and semi-desert scrub (USFWS 2003). Suitable habitat appears to contain loamy soils with high clay content or with cryptogamic crusts; sparse to moderate shrub cover; low to moderate levels of nonnative vegetation compared to non-occupied habitat; and ridges, rounded hilltops, or other topographic features within approximately 0.8 km (USFWS 2000; 2003). Primary constituent habitat elements are found in undeveloped areas that support various types of open-canopy woody and herbaceous plant communities including, but not limited to, plant communities that provide populations of host plant and nectar sources for the butterfly. The primary host plants upon which Quino deposit their eggs include dwarf plantain (*Plantega erecta*), woolly plantain (*P. patagonica*), white snapdragon (*Antirrhinum coulterianum*), and thread-leaved bird's beak (*Cordylanthus rigidus*), with dwarf plantain being both the most common and the most commonly used as a host (67 Fed. Reg. 2002 at 18361). Dwarf plantain is often associated with cryptogamic crusts and fine-textured clay soils. Owl's clover (*Castilleja exserta*) is an important pre-diapause secondary host plant. Adult Quino frequently take nectar from lomatium, goldenstar, yarrow, fiddleneck, goldfields, popcorn flower, gilia, California buckwheat, onion, and yerba santa.

The Quino checkerspot butterfly flies slowly, close to the ground, and tends to avoid flying over objects taller than about 2 meters (7 feet) high (USFWS 2003). Quino, particularly males, are often observed on hilltops and ridgelines (USFWS 2003). Reproduction depends heavily on precipitation patterns. Mating occurs during the adult active season, in March and April (depending on weather), and the female lays her eggs at the base of the host plant, where the larvae later feed on leaves (Ballmer et al. 2000). The larvae can live for several years briefly breaking and re-entering diapause over and over before reaching maturity, depending on precipitation (Ballmer et al. 2000).

Distribution of the Quino checkerspot butterfly is patchy at several scales, exhibiting a typical metapopulation structure. Local habitat patches are comprised of smaller patches of

larval host plants, all within the flight range of adults (up to 200 meters/660 feet) (USFWS 2003). A local population of 100 adults and prediapause larvae could be supported by a matrix of 150–200 micro-patches of 20 or more *P. erecta* plants (USFWS 2003). Linkage of suitable habitat patches by adult dispersal areas is crucial to metapopulation persistence, and long-term persistence of the species may depend on maintaining connectivity between metapopulations.

Quino conservation needs include protection and management of landscape connectivity, including habitat patches and intervening dispersal areas; habitat restoration and enhancement; and establishment of a captive breeding and release program (USFWS 2003). Quino recovery units and habitat complexes that have been identified by the USFWS include: 1) Northwest Riverside Recovery Unit, containing the Gavilan Hills habitat complex; 2) Southwest Riverside Recovery Unit, containing the Warm Springs Creek and Skinner/Johnson habitat complexes; 3) South Riverside Recovery Unit, containing the Oak Mountain/Vail Lake, Sage Road/Billygoat Mountain, and Brown Canyon habitat complexes; 4) South Riverside/North San Diego Recovery Unit, containing the Silverado and Dameron Valley/Oak Grove habitat complexes; 5) Southwest San Diego Recovery Unit, containing the San Diego National Wildlife Refuge, containng Otay Lakes, Otay Foothills, Otay Mesa, Marron Valley, and Tecate Habitat complexes; and 6) Southeast San Diego Recovery Unit, containing the Jacumba Peak habitat complex (USFWS 2003).

Little data are published about the direct and indirect impacts of fire on Quino checkerspot butterfly populations, nor on Quino host and nectar plants. The Recovery Plan (page 30) states that "a combination of naturally occurring events (e.g. drought, cold-snaps, flood, and fire), exacerbated by ongoing human-caused habitat destruction and degradation (development, agriculture, and grazing), resulted in the apparent extirpation of formerly resilient Quino checkerspot butterfly populations in Orange County." Wildfire is apparently a natural perturbation that can directly extirpate a population of Quino, but the habitat patch might be re-colonized depending upon its distance from a source population. Based on research on bay checkerspot butterflies (*E. e. bayensis*), dispersal areas greater than 2 kilometers (1.2 miles) distant do not appear likely to be used by adults belonging to the same metapopulation.

Mountain yellow-legged frog

The southern California mountain yellow-legged frog occurs in the mountains of southern California at elevations of 1,200–7,500 feet (370–2,290 meters) (USFWS 2002). The mountain yellow-legged frog historically occurred in about 166 creeks and drainages in the San Gabriel, San Bernardino, and San Jacinto Mountains (USFWS 2001). Currently, the mountain yellow-legged frog is known from only seven locations in portions of the San Gabriel, San Bernardino, and San Jacinto mountains, all at least partially on public lands (USFWS 2002). The population on Palomar Mountain identified in USFWS (2002) is now extirpated (Jennings and Hays 1994; D. Holland, pers. comm.).

In southern California, highly aquatic mountain yellow-legged frogs occupy perennial rocky, shaded streams with cool water from springs and snowmelt, in ponderosa pine, montane hardwood-coniferous forests, and montane riparian habitat types (CDFG 1988).

Some factors adversely affecting the species include non-native predators, mining, recreational activities, water diversions, and possibly contamination from roads (USFWS 2002; D. Holland, pers. comm.). The primary anthropogenic threats to this species are thought to be (1) the increasing spread of nonnative predatory fish and amphibians (i.e., trout and bullfrog), (2) loss of breeding pools as a result of siltation or declining surface water, and (3) disturbance of

individuals and egg masses by recreation and land use activities (USFWS 2001). Ongoing activities on National Forest System lands that are affecting mountain yellow-legged frogs include roads and trails, recreation facilities, and some small-scale mining and prospecting operations (USFWS 2001).

Mountain yellow-legged frogs have experienced a dramatic population decline over the past 40 years. This decline was not well documented, but the species was abundant in the Sierra Nevada and many southern California streams prior to the late 1960s (Jennings and Hayes 1994). Jennings and Hayes (1994) suggested that mountain yellow-legged frogs have been extirpated from 99% of their historic range in southern California. All of the remaining populations appear to be very small. On the Angeles National Forest, small populations of mountain yellow-legged frogs occur in the San Gabriel Mountains in the following locations: Bear Gulch, Devil's Canyon, Little Rock Creek, South Fork of Big Rock Creek, and Vincent Gulch. In the San Jacinto mountains of the San Bernardino National Forest, a single known population occurs in Fuller Mill Creek, although the species was detected in Dark Canyon as late as 1998 and adults were detected in Hall Canyon in 1995. In the San Bernardino Mountains, mountain yellow-legged frogs were rediscovered in the East Fork of City Creek in 1998 (USFWS 2002 at 44382). In the 2002 Final Rule listing the species as endangered, the USFWS estimated the current population in southern California to be about 79 adults (Fed. Reg. 67 at 44384).

The potential risk to populations from large wildfires and post-fire flooding is a major management concern (USFWS 2001). Little data are published on effects of fire on this species. No dead mountain yellow-legged frogs were observed during the BAER surveys after the Old and Grand-Prix fires, and some frogs, particularly adults, may be able to find over-wintering refuge in bedrock crevices in the stream channels or in other sites far enough from the stream to survive increased flows and loss of water quality (USFS 2003). However, individuals could have been directly killed by the fire (USFS 2003). Individuals might also be displaced downstream or die during the first big rains as a result of high steam flows, and sediment and ash delivery to aquatic habitats. Pools can also fill with sediment, smothering riparian vegetation and benthic organisms and resulting in total loss of some pool habitat and other pools becoming smaller and shallower and thus dry up from evaporation (USFS 2003).

Coastal California gnatcatcher

Coastal California gnatcatchers occur primarily in southern California on coastal slopes. The species ranges from southern Ventura County southward through Los Angeles, Orange, Riverside, San Bernardino, and San Diego Counties and into northwestern Baja California, generally at elevations of below 3,000 feet (Atwood and Bontrager 2001, USFWS 2001).

Within its U.S. distribution, the California gnatcatcher is an obligate resident of Diegan, Riversidian, and Venturan subassociations of coastal sage scrub (Atwood and Bontrager 2001). Although California gnatcatcher nest territories can include or be located within non-sage scrub habitats, these habitats are most often utilized after nesting, when territories are typically larger for foraging or dispersal (Campbell et al. 1998). Non-breeding home ranges may be up to 80 percent larger than territories defended during the nesting season (Atwood and Bontrager 2001). The use of non-sage scrub habitat may be most common on the edges of coastal sage scrub, scrub that is marginal or poor in certain resources, scrub that is heavily invaded by nonnative plant species, or where California gnatcatchers occur in high densities adjacent to productive non-sage scrub (Campbell et al. 1998). Larger patches can more consistently support breeding gnatcatchers, and non-nesting home ranges are significantly larger than nesting territories

(Atwood et al. 1998; Famolaro and Newman 1998; Preston et al. 1998; Atwood and Bontrager 2001). A cautious estimate of habitat that can support a pair of breeding gnatcatchers in the long term is at least 20 hectares (~50 acres).

Most juvenile coastal California gnatcatchers disperse less than 2 kilometers (1.2 miles) from the natal territory, with mean reported dispersal distances between 1.1 and 3.2 kilometers (0.7 and 2.0 miles) (Galvin 1998; Atwood and Bontrager 2001). Dispersal probably occurs in random directions from the natal site (Galvin 1998). Juvenal coastal California gnatcatchers appear able to pass through intensively modified anthropogenic landscapes for at least short distances (Bailey and Mock 1998).

As long ago as 1981, it was recognized that 85–90 percent of coastal sage scrub has been lost to development and land conversion (Westman 1981). The amount of coastal sage scrub available to California gnatcatchers has continued to decrease after the listing of this species (USFWS 2001). Temporary or permanent conversion of coastal sage scrub to other vegetation types results in a loss of habitat for coastal California gnatcatchers (USFS 2003).

In 1993, the USFWS estimated that approximately 2,562 pairs of coastal California gnatcatchers remained in the United States. Of these, 30 pairs occurred in Los Angeles County, 757 pairs occurred in Orange County, 261 pairs occurred in Riverside County, and 1,514 pairs occurred in San Diego County (USFS 2003). In 1997, the total number of coastal California gnatcatchers in the United States was estimated at 2,899 pairs, with two-thirds occurring in San Diego County (USFWS 1996), after accounting for all gnatcatcher pairs authorized for take (USFWS 2001). Since listing, many additional gnatcatchers have been lost. The Center for Biological Diversity ("CBD") is compiling a database entitled *Summary of Authorized Impacts to the Coastal California Gnatcatcher*. This database tracks gnatcatcher take authorized by the USFWS. The database is an underestimate of authorized take because all the biological opinions that have been issued since listing are not yet available, and hence the summary is still in draft form. To date CBD has recorded authorized take of 783 gnatcatcher pairs via individual biological opinions, and at least 832 additional pairs through the "Proposed Special Rule to Authorize Take of the California Gnatcatcher" pursuant to Section 4(d) of the ESA and the California Natural Communities Conservation Planning ("NCCP") process. Because we do not yet have all biological opinions and most of the NCCPs, the actual number of take may be hundreds of pairs higher than the current estimate. We will update this information as it becomes available.

High fire frequencies and invasions of non-native grasses are serious problems in coastal California gnatcatcher habitat (USFS 2000). Coastal sage scrub is a highly flammable vegetation type, and maintaining mature stands in fire-prone areas near the wildland-urban interface is a significant management challenge (Beyers and Wirtz 1997). Fire is the most serious threat to coastal California gnatcatcher populations on national forests, especially as public use of these lands increases (USFS 2000). Coastal sage scrub is not suitable habitat for California gnatcatchers for several years after fire. Total shrub cover is an important factor in determining habitat suitability for coastal California gnatcatchers (Beyers and Wirtz 1997). The species is most abundant in mature sage scrub stands, where woody perennial plant canopy cover is greater than 40 percent (Beyers and Wirtz 1997). However, coastal California gnatcatchers will forage in recently burned sites, and pairs have been observed establishing territories within 3 years after fire in burned areas on coastal sites (Wirtz et al. 1997). The speed of shrub regrowth appears to affect the rate at which coastal California gnatcatchers reoccupy burned areas, and inland sites are slower to recover than coastal sites (Wirtz et al. 1997).

Fire has been identified as detrimental to habitat quality for permanent residents of coastal sage scrub due to a reduction in vegetational structural heterogeneity (Stanton 1986). Mock and Bolger (1992) found that areas used by breeding gnatcatchers had not burned for at least 15–20 years. Beyers and Wirtz (1997) found that total shrub cover on plots in California gnatcatcher home ranges averaged greater than 55 percent at four sites and 43.8 percent at one site. The study also found that recently burned coastal sage scrub vegetation is not used by California gnatcatcher for breeding unless it is adjacent to unburned patches, and regrowing sage scrub will be recolonized once total shrub cover approaches 50 percent, which takes a minimum of 4–5 years. Beyers and Peña (1995) also reported that sites used by gnatcatchers averaged more than 50 percent shrub cover, and recently burned sites were not used by the species. Wirtz et al. (1997) documented that fire significantly reduces density of gnatcatchers, although the few gnatcatcher pairs that were able to establish territories on burned areas have similar reproductive rates. Frequent fires (fire return intervals of less than 5–10 years) also increase the probability of conversion from coastal scrub to nonnative grasslands, especially in drier inland areas (USFS 2003). Thus, fire can cause temporary reductions in gnatcatcher use of coastal sage scrub.

Least Bell's vireo

Least Bell's vireo, a small neotropical migrant, was historically widespread and abundant in riparian woodlands of the Central Valley and low-elevation riverine valleys of California and northern Baja California (USFS 2003). Its historical breeding range extended from near Red Bluff in Tehama County south through the San Joaquin Valley and Sierra Nevada foothills, the inner southern Coast Range from Santa Clara County south to approximately San Fernando, and the southern California coastal and interior valleys west of the deserts to the Mexican border; populations also were found in the Owens Valley and Death Valley and scattered oases and canyons throughout the Mojave Desert (USFWS 1998). Populations in Owens Valley, Death Valley, Sacramento and San Joaquin Valleys, the Sierra Nevada foothills, and Tehama County have been extirpated (USFWS 1998). Vast portions of these areas are no longer available for recolonization or expansion because of habitat destruction.

Least Bell's vireo currently occupies a very small fraction of its former range (USFWS 2001). The species' breeding distribution is currently restricted to eight California counties: Kern, San Diego, San Bernardino, Riverside, Ventura, Los Angeles, Santa Barbara, and Imperial. Designated critical habitat occurs in six of these counties (USFWS 1998). Breeding populations are concentrated in San Diego, Santa Barbara, and Riverside Counties. The northern limit of breeding populations is the Santa Ynez River in Santa Barbara County (USFS 2000). Least Bell's vireos winter in southern Baja California, Mexico. Least Bell's vireos are usually found at elevations below 2,000 feet (610 meters), although individuals have been reported up to 4,200 feet (1,280 meters), primarily in desert areas (USFS 2003).

Least Bell's vireo is an obligate low-elevation riparian species during the breeding season. It inhabits dense, low-elevation, willow-dominated riparian habitats with lush understory vegetation in the immediate vicinity of watercourses (USFWS 1986). The most important structural habitat characteristic for least Bell's vireos is a dense shrub understory approximately 2–10 feet (0.6–3.0 meters) above ground (USFS 2003). Habitat elements essential for conservation of least Bell's vireo can be described as riparian woodland vegetation that generally contains both canopy and dense shrub layers and includes some associated upland habitats, preferably where flowing water exists (USFWS 1998; 2001).

Suitable breeding habitat consists of an overstory of willows, cottonwoods, sycamores, or

oaks, with an open midstory, and a dense shrubby understory of willow, mule fat scrub, and one or more herbaceous species. Canopy cover is generally greater than 50 percent with occasional small openings. Most areas that support least Bell's vireo populations are in early stages of succession where woody vegetation is generally 5–10 years old (USFS 2003). Least Bell's vireos nest primarily in willows but also use a variety of shrubs, trees, and vines (USFWS 1986). Nests are generally located within 3 feet (1 meter) of the ground. Least Bell's vireos forage in riparian and adjacent upland habitats (USFWS 1986).

In California, fledglings have been reported to disperse 1 mile (1.6 kilometers) from their natal site by the time a second brood was produced (Gray and Greaves 1984). Most fledglings that survive apparently return to breed at their natal site (Brown 1993). Adult least Bell's vireos often exhibit strong breeding site fidelity, and nest sites are sometimes located within 3.3 feet (1 meter) of the previous year's nest (USFS 2003).

Northernmost breeding populations of least Bell's vireo typically begin leaving the breeding grounds in August and September, and most birds leave by early October (USFS 2003). Spring migrants begin arriving at their breeding grounds by early to mid-March; northernmost populations of Bell's vireo arrive by early May (USFS 2003).

Least Bell's vireos exhibit strong territoriality. Territory sizes vary depending on habitat extent and quality, population density, and nesting stage. In California, reported territory sizes of least Bell's vireos were 0.5–4.0 acres (0.2–1.6 hectares) and 0.7–3.2 acres (0.3–1.3 hectares) (see citations in USFS 2003). Least Bell's vireos home ranges vary in size from 0.5–4.5 acres (0.2–1.8 hectares), and a few may be as large as 10 acres (4.0 hectares) (USFWS 2001). In the last several decades, least Bell's vireo has undergone a precipitous decline in numbers, attributed primarily to extensive loss and degradation of breeding habitat, as well as brood parasitism by brown-headed cowbird (USFS 2003).

Habitat loss, habitat degradation, and nest parasitism by brown-headed cowbirds were identified as the biggest threats to least Bell's vireo populations in southern California (USFWS 1998). When the least Bell's vireo was federally listed in 1986, the statewide population was estimated at 300 pairs. In 1996, the population had increased to 1,346 (USFWS 1998); in 2000, the population had increased to 2,000 pairs (USFWS 2001), probably due to an intensive cowbird removal program (USFWS 1998). In addition to an increase in population size, it appears that least Bell's vireos are expanding their range and recolonizing sites that have been unoccupied for years (USFWS 1998).

Riparian vegetation, especially willows, generally recovers quickly after fires, with good shrub cover levels returning within a couple of years (USFS 2003). However, substantially higher than normal flows and sediment movement are expected to occur and there is a high likelihood that the riparian vegetation at the least Bell's vireo nest sites may be scoured out of stream channels (USFS 2003). The higher the precipitation levels, the more severe the effects will be. If drought occurs for 1–2 years after a fire, impacts may not be as severe, but even average rainfall amounts are expected to result in substantial increases in sediment and erosion (USFS 2003).

Local Impacts of 2003 Wildfires

The scale, severity, and pattern of the 2003 southern California wildfires may exacerbate problems for native endangered and threatened fauna, due to extensive past and ongoing habitat fragmentation, invasion of non-native vegetation that may follow fire, and erosion or siltation of aquatic and riparian habitats within and downstream from burned areas. With such extensive acreages burned, particularly in San Diego County, it is not clear where there were adequate refugia for some species within or near the fire (Morrison 2003). Below, we provide summarize the effects of the fires from available BAER reports, on the Old-Grand Prix, the Piru, and the Cedar-Otay-Paradise fire complexes.

Old and Grand-Prix Fire

Mountain yellow-legged frog — Table 9 in Appendix A shows that of the 5,389 acres of modeled MYLF habitat within 15 drainages in the Old/Grand Prix Fire area, acres were almost evenly split between the high (1,714 ac), moderate (1,593) and low (1,456) burn severity categories. Thus, a total of 88% of modeled habitat within the perimeter of this fire was burned.

Coastal California gnatcatcher — Table 15 in Appendix A displays the burn severity effects on California gnatcatcher habitat affected during the fires, although it not stated whether this includes modeled, occupied, or critical habitat. Approximately 76% of the mapped habitat (including FS and non-FS lands) burned at moderate or low severities or did not burn at all. Less than 24% of the mapped habitat burned at high severity (and none of that contains known occurrences). A total of 26,779 acres of gnatcatcher habitat burned in the Old and Grand-Prix fires; 6,353 acres burned at high severities.

Least Bell's vireo — Table 17 in Appendix A displays the acres of modeled and occupied habitat within each watershed that burned during the fires. It appears that approximately 25% burned at high severity; the rest burned at low/moderate severity or did not burn. The areas that burned at high severity likely experienced losses of suitable habitat. Approximately 75% burned at low or moderate severity levels, or did not burn at all (water and rock areas). Within those areas, it is likely that some of the riparian vegetation did not burn at all; in some areas, some patchy underburning probably occurred. Substantially higher than normal flows and sediment movement are expected to occur after the fire, and there is a high likelihood that the riparian vegetation at the least Bell's vireo nest sites may be blown out of stream channels. A total of 3,055 acres of least Bell's vireo habitat burned in the Old and Grand-Prix fires; 760 acres at high severity, 1,005 acres at moderate severity, and 1,047 acres at low severity.

Cedar-Otay-Paradise Fire

Quino checkerspot butterfly — Areas of particular concern are within the Cedar fire (Otay Mesa and Rancho Jamul populations). Tables in Appendix B demonstrate that 45.9% of quino occurrences and 21% of quino habitat burned in the San Diego County fires.

Coastal California gnatcatcher — The extensive scale of the fire been a source of concern because many non-migratory species appear to be highly sensitive to habitat loss and habitat fragmentation, and particularly susceptible to isolation effects of habitat fragmentation;

colonization of habitat islates appears limited by urban and residential "matrix." Also, the Crestridge Reserve, with the Lakeside Archipleago of hilltops, was intended in part to provide a stepping-stone corridor for CSS avifauna species; much of its vegetation burned in the Cedar fire, and potentially severed north-south coastal sage scrub connectivity for the foreseeable future. Tables in Appendix B show that 13.9% of coastal California gnatcatcher occurrences burned and 27.7% of habitat burned.

Least Bell's vireo — Of the three San Diego fires, the Paradise Fire is of the most concern for these species (although the impacts to riparian species throughout the County warrant attention.). The San Luis Rey river corridor was notable for containing the highest densities of riparian nesting birds in San Diego County, including the federally endangered Least Bell's Vireo. Fire related concerns to riparian species pertain to loss of habitat (e.g., loss of riparian vegetation due to burning, as well as potential loss of habitat due to increased runoff and scouring of drainages). Loss of habitat quality may occur if direct and indirect fire effects facilitate the invasion of non-native vegetation in drainages. About 3% of least Bell's vireo occurrences and 10.2% of habitat burned in the fires (see tables in Appendix B)

Piru Fire

Least Bell's vireo — Designated critical habitat for the least Bell's vireo occurs in portions of Reasoner Canyon, which is within the Dominguez sub-watershed (see Appendix C). Burn intensity within the designated critical habitat for the least Bell's vireo was light to moderate. With the light to moderate burn intensities, it should be expected that the habitat should recover relatively quickly. No specific information on acreages or occurrences burned was provided in the Piru report.

Regional Impacts of 2003 Wildfires

We determined acreage of both CWHR modeled habitat and designated critical habitat that were burned at low, medium, and high severities. We also determined how many known occurrences recorded by the USFWS burned at each of the severity classes. This is a coarse-scale analysis: Burn severity is generally averaged across a cell, and actual occupancy both pre- and post-fire is unknown. Lack of a known occurrence does not necessarily indicate that an individual was not present in an area; conversely, a known occurrence does not indicate that the site was occupied at the time of the fire. However, the following analysis provides a rough idea of the potential extent of impact of the 2003 wildfires on each of the four species of concern throughout their respective ranges.

CWHR Modeled Habitat

To generate the amount of "good" CWHR modeled habitat that was burned in the fires, we divided the total burned acreage of habitat ranked at >50 suitability, by total acreage of all habitat ranked at >50 suitability. Habitat ranked at >50 suitability was considered "good" habitat. No CWHR modeled habitat was available for the Quino checkerspot butterfly because the CWHR program includes only vertebrates.

Mountain yellow-legged frog —

A total of 6.45% of "good" CWHR modeled mountain yellow-legged frog habitat was affected by fire of all severities throughout the range of the species (Table 2).

Table 2. Burn severity, and acres and percent burned of California Wildlife-Habitat Relations modeled habitat for Mountain Yellow-legged Frog throughout the range of the species in the U.S. Source: CWHR.

Habitat Suitability (Arithmetic mean)	Burn Severity	Acres Burned	Percent Burned
100	Low	7.77	0.72
100	Medium	19.30	1.78
100	High	30.99	2.86
All 100 Habitat		1084.89	
77	Low	44.66	2.54
77	Medium	67.09	3.81
77	High	10.56	0.60
All 77 Habitat		1,758.81	
66	Low	4,018.70	2.00
66	Medium	5,106.25	2.55
66	High	3,677.43	1.83
All 66 Habitat		200,622.11	
55	Low	38.90	3.91
55	Medium	138.90	13.95
55	High	34.59	3.47
All 55 Habitat		995.82	
33	Low	2,355.00	2.00
33	Medium	6,847.21	5.80
33	High	7,080.20	6.00
All 33 Habitat		117,987.67	

Coastal California gnatcatcher —

About 13.42% of "good" CWHR modeled gnatcatcher habitat throughout the range of the species was affected by fire of all severities (Table 3).

Table 3. Burn severity, and acres and percent burned of California Wildlife-Habitat Relations modeled habitat for Coastal California Gnatcatcher throughout the range of the species in the U.S. Source: CWHR.

Habitat Suitability (Arithmetic mean)	Burn Severity	Acres Burned	Percent Burned
100	Low	4,291.61	10.40
100	Medium	1,530.62	3.71
100	High	64.04	0.16
All 100 Habitat		41,246.61	
66	Low	23,128.29	6.57
66	Medium	23,190.96	6.59
66	High	607.61	0.17
All 66 Habitat		352,155.10	
33	Low	984.54	0.79
33	Medium	2,760.72	2.22
33	High	63.39	0.05
All 33 Habitat		124,322.96	
22	Low	17,049.38	3.44
22	Medium	54,316.03	10.95
22	High	3,704.57	0.75
All 22 Habitat		495,872.87	

Least Bell's vireo —

A total of 1.64% of "good" CWHR modeled least Bell's vireo habitat was affected by fire of all severities throughout its range (Table 4).

Table 4. Burn severity, and acres and percent burned of California Wildlife-Habitat Relations modeled habitat for Mountain Yellow-legged Frog throughout the range of the species in the U.S. Source: CWHR.

Habitat Suitability (Arithmetic mean)	Burn Severity	Acres Burned	Percent Burned
100	Low	115.05	2.16
100	Medium	30.68	0.58
100	High	0.31	0.01
All 100 Habitat		5,325	
77	Low	35.55	2.54
77	Medium	28.66	3.81
77	High	0.74	0.60
All 77 Habitat		7,529	

Designated Critical Habitat

No critical habitat has yet been designated for the mountain yellow-legged frog, so the following tables include the Quino checkerspot butterfly, the coastal California gnatcatcher, and the least Bell's vireo.

Quino checkerspot butterfly — A total of 19.22% of quino checkerspot designated critical habitat burned in all severity classes in the 2003 wildfires (Table 5).

Table 5. Burn Severity, Acreage and Percent Burned of Designated Critical Habitat For the Quino Checkerspot Butterfly. Source: USFWS.

Burn Severity	Acreage of CH Burned	% CH burned
Low	25,019.85	14.58
Medium	7,001.65	4.08
High	956.37	0.56
Total CH	**17,1638**	**19.22**

Coastal California gnatcatcher — A total of 16.31% of coastal California gnatcatcher designated critical habitat burned in all severity classes in the 2003 wildfires (Table 6).

Table 6. Burn Severity, Acreage and Percent Burned of Designated Critical Habitat For the Coastal California Gnatcatcher. Source: USFWS.

Burn Severity	Acreage of CH Burned	% CH burned
Low	27,109.00	5.47
Medium	45,125.00	9.10
High	8,627.00	1.74
Total CH	**495,750.00**	**16.31**

Least Bell's vireo — A total of 2.51% of least Bell's vireo designated critical habitat burned in all severity classes in the 2003 wildfires (Table 7).

Table 7. Burn Severity, Acreage and Percent Burned of Designated Critical Habitat For the Least Bell's Vireo. Source: USFWS.

Burn Severity	Acreage of CH Burned	% CH burned
Low	627.13	1.70
Medium	68.51	0.19
High	227.78	0.62
Total CH	**36,959**	**2.51**

Species Occurrences

Occurrence data from the USFWS were used for all species but the mountain yellow-legged frog. The USFWS did not have occurrence data for the frog, so we utilized CNDDB data which we determined are most similar to the USFWS occurrence data.

Quino checkerspot butterfly —

About 27% of all known quino checkerspot butterfly occurrences were burned in the fires. Most of the occurrences burned in low-severity fire (24.53%), while 1.85% of occurrences were burned in medium severity fire and 1.10% burned in fire of unknown severity (Table 8).

Table 8. Percent of Quino Checkerspot Butterly Occurrences Burned by Low, Medium, and High Severity Fire. Source: USFWS.

Total acres of occurrences	Acres of occurrences in fire	Total number of occurrences	Number of occurrences in fire	Fire severity	% of occurrences in fire
2,561	716.363	518	149.87	Low	24.53
4,490	240.142	93			
2,561	55.773	518	11.29	Medium	1.85
4,490	0.488	93			
2,561	14.832	518	6.74	Unknown[1]	1.10
4,490	180.342	93			

[1] Mountain Fire

Mountain yellow-legged frog —

About 9% of all known mountain yellow-legged frog occurrences were burned in the fires (Table 9). Most of the occurrences burned in medium-severity fire (5.62%), while 2.25% burned in low and 1.12% burned in severity fire.

Table 9. Percent of Mountain Yellow-legged Frog Occurrences Burned by Low, Medium, and High Severity Fire. Source: CNDDB.

Total number of SoCal occurrences	Number of SoCal occurrences in fire	Fire severity	% of occurrences in fire
89	2.00	Low	2.25
89	5.00	Medium	5.62
89	1.00	High	1.12
Total			**8.99**

Coastal California gnatcatcher —

About 4.08% of all known coastal California gnatcatcher occurrences were burned in the fires (Table 10). Most of the occurrences burned in medium-severity fire (2.15%), while 1.81% of occurrences were burned in low severity fire and 0.08% burned at unknown severity during the Pass Fire.

Table 10. Percent of Coastal California Gnatcatcher Occurrences Burned by Low, Medium, and High Severity Fire. Source: USFWS.

Total acres of occurrences	Acres of occurrences in fire	Total number of occurrences	Number of occurrences in fire	Fire severity	% of occurrences in fire
13,937	265.124	2,819	58.31	Low	1.81
19,649	226.235	407			
13,937	308.126	2,819	69.31	Medium	2.15
19,649	337.412	407			
13,937	5.518	2,819	1.21	High	0.04
19,649	4.563	407			
13,937	12.736	2,819	2.58	Unknown[1]	0.08
19,649	0	407			

[1] Pass Fire

Least Bell's vireo —

About 0.09% of all known least Bell's vireo occurrences were burned in the fires, all at low severity (Table 11).

Table 11. Percent of Least Bell's Vireo Occurrences Burned by Low, Medium, and High Severity Fire. Source: USFWS.

Total acres of occurrences	Acres of occurrences in fire	Total number of occurrences	Number of occurrences in fire	Fire severity	% of occurrences in fire
8,414	7.088	1702	1.66	Low	0.09
2,607	11.139	54			
8,414	0.146	1702	0.03	Medium	0.00
2,607	0	0			

Conclusions

This report focused on the Quino checkerspot butterfly, mountain yellow-legged frog, coastal California gnatcatcher, and least Bell's vireo because these species are highly endangered, their range is restricted to specialized habitats in southwestern California, and their habitats were affected by the 2003 wildfires.

The Quino checkerspot butterfly was once thought to be extinct, and now is only found in western Riverside County and southern San Diego County. Roughly 2,000 pairs of both least Bell's vireos and coastal California gnatcatchers are thought to currently exist in the U.S. The southern California mountain yellow-legged frog is one of the most endangered amphibians in the country, with surveys indicating about 79 adult frogs remaining throughout its range (Fed. Reg. 67 at 44384). Therefore, it is imperative that the local and region-wide impacts of the 2003 wildfires be investigated, and that baseline conditions be updated to reflect any impacts to these species.

Our analysis for the entire range of the Quino checkerspot butterfly found that a total of 19.22% of designated critical habitat (Table 5) and about 27% of all known USFWS occurrences (Table 8) were burned in the 2003 wildfires. The Cedar-Otay-Paradise fire report to the BAER team found that that 45.9% of Quino occurrences and 21% of Quino habitat in San Diego burned in the Cedar-Otay-Paradise fires alone (see Appendix B). Little is published about direct effects of fire on Quino populations, but the recovery plan for the species noted that fire may have extirpated the species from Orange County. Therefore, the impacts of the fire on the Quino checkerspot butterfly may have been severe.

A total of 6.45% of all "good" CWHR modeled mountain yellow-legged frog habitat in southern California (Table 2), and 9% of CNDDB occurrences (Table 9) throughout the range of the distinct population segment were burned in the 2003 fires. The Old/Grand-Prix fire BAER report found that about 88% of all modeled habitat in the 15 drainages within the perimeter of that fire was burned (see Appendix A), suggesting serious local impacts. The species is also threatened with indirect post-fire effects, including erosion and siltation into breeding pools. The few remaining occurrences of the mountain yellow-legged frog in southern California are at risk of extinction, and any activities that result in disturbance to the species or harm to its eggs could jeopardize the continued survival of the population segment (Fed. Reg. 67 at 44387).

Our analysis documented that about 25,393 acres of "good" CWHR modeled gnatcatcher habitat burned at moderate and high severities (Table 3). In total, 13.42% of "good" CWHR modeled gnatcatcher habitat burned at all severities (Table 3), and a total of 16.31% of coastal California gnatcatcher designated critical habitat was burned at all severities (Table 6). About 4.08% of all known coastal California gnatcatcher occurrences from the USFWS database were burned in the fires (Table 10), although surveys for the species are usually only conducted on private lands for individual development projects, so the numbers may be unknown and our analysis may be an underestimate. The Cedar-Otay-Paradise fire report to the BAER team found that 13.9% of coastal California gnatcatcher occurrences and 27.7% of habitat in San Diego County alone was burned (see Appendix C). California gnatcatchers do not appear to utilize recently burned habitats for breeding. Given the rapid past and ongoing loss of gnatcatcher habitat in the range of the species due to urbanization, as well as the rapid degradation of remaining habitat patches due to edge effects, isolation, and fragmentation and the projected future loss of habitat under several HCP/NCCPs within the range of the gnatcatcher, the loss (although temporary) of about 15% of its habitat from the 2003 fires is a major change in the

baseline status of the species. As noted in the Cedar-Otay-Paradise fire report, some of the habitat burned was intended as stepping-stones to connect larger patches of habitat. Thus, indirect impacts of the fire include increased isolation of remaining suitable habitat patches.

The effects of the 2003 wildfires appeared to be less severe for the least Bell's vireo than for the other three species. Our analysis found that about 1.64% of "good" CWHR modeled least Bell's vireo habitat (Table 4) and 2.52% of least Bell's vireo designated critical habitat (Table 7) were affected by fire of all severities throughout its range in southern California. About 0.09% of known USFWS occurrences were burned in the fires. However, localized impacts may have been greater: about 3% of least Bell's vireo occurrences and 10.2% of habitat in San Diego County burned in the Cedar-Otay-Paradise fires (see Appendix B). The USFWS has stated in 1986 that no other passerine species in California is known to have declined as dramatically as the least Bell's vireo. While its numbers have been increasing in recent years, the loss of 10% of its habitat in San Diego County indicates that localized impacts must be investigated. In addition, the USFS has noted that least Bell's vireo nest sites may be scoured out of stream channels during heavy precipitation events following the fires, so the vireo is susceptible to indirect post-fire impacts.

The Center for Biological Diversity hopes that the information provided in this report will prove useful in re-evaluating the baseline conditions for these species in the wake of the 2003 southern California wildfires, and will assist in determining the cumulative effects of current and future development projects.

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Appendix A

Excerpts from the San Bernardino National Forest's *Resource and Biological Assessment for Threatened and Endangered Plants and Animals: Old and Grand Prix Fires* BAER report

Coastal California Gnatcatcher:

Current Status and Post-Fire Observations: There are no known occurrences of California gnatcatcher within the fire area on NFS lands. However, modeled habitat for California gnatcatcher within the fire area on NFS lands does occur. In addition, designated critical habitat for California gnatcatchers occurs on NFS lands within the burn perimeter of the Old/Grand Prix Fire.

There are a number of records for California gnatcatchers on non-FS lands within the burn perimeter and critical habitat on non-FS lands burned. Nineteen records exist for California gnatcatchers on non-FS lands within the burn perimeter: four of those are in moderate severity areas and the rest are in low severity areas. Another seven records exist outside the fire perimeter in downstream alluvium/riparian habitat that will likely experience higher flows and sediment delivery.

Immediate Fire Effects: Table 15 displays the burn severity effects on California gnatcatcher habitat affected during the fires. Approximately 76% of the mapped habitat (including FS and non-FS lands) burned at moderate or low severities or did not burn at all. Less than 24% of the mapped habitat burned at high severity (and none of that contains known occurrences).

Table 15. Coastal Gnatcatcher Habitat and Burn Severity (acres)

Watershed	High	Low	Moderate	Rock	Grand Total
Cable Creek	491	2298	788		3577
City Creek	1022		1058		2080
Cucamonga Canyon	445	641	7		1093
Deer Creek	1542	2510			4052
Elder Gulch	199		404		602
Etiwanda Canyon	891	3744	223		4858
Lower Cajon Canyon			15		15
Lower Lytle Creek	459	400	856		1715
Lower Santa Ana River	21	1	489		511
Middle Lytle Creek	356	1861	432	377	3026
Middle Santa Ana	1	98	47		146
Plunge Creek	257		325		581
Waterman Canyon	669	832	3022		4523
Grand Total	6353	12384	7665	377	26779

Since this species stays in the habitat year-round, they could have been present when the fire was burning. If California gnatcatchers occur undetected in the fire area, individuals may have been able to abandon the area without negative impacts. However, the extreme fire behavior associated with this fire may have resulted in individuals unable to escape due to the fast-moving, explosive nature of the fire. During post-fire surveys, a number of dead animals were discovered: many were burned, others appeared to have died from lack of oxygen. Since the fire occurred after nesting season, direct losses of brooding adults, eggs, and chicks are not believed to have occurred.

Potential Post-Fire Effects: All of the occurrence records for California gnatcatchers (burned and unburned) are located in downstream/downslope areas that will likely experience higher flows and sediment delivery. Increased debris flows may result in further losses of nesting and foraging habitat. Additional impacts to habitat on non-FS lands may occur as a result of measures to protect property from flooding and debris flows.

If California gnatcatchers were present in the critical or modeled habitat during fire suppression activities, it is possible that they could have been hit by water or retardant dropped by helicopters or airtankers. Injuries or death could have resulted from the impact of water or retardant.

Determination of Effects: *It is my determination that fire suppression and suppression rehabilitation activities may have adversely affected California gnatcatchers and their critical habitat. Emergency Consultation has been initiated for this incident.*

Least Bell's Vireo:

Current Status and Post-Fire Observations: There are two records for least Bell's vireo in within the burn perimeter, both in Little Sand Canyon (one on NFS lands at T1N R3W Section 18, and one on non-federal lands at T1N R3W section 19). Two other records for least Bell's vireos exist for Cajon Canyon which is outside of the fire perimeter: one on non-FS lands (T2N R6W Section 12) is likely outside the post-fire effects area; another on non-FS lands (T2N R5W Section 19) may be within the area of potential downstream post-fire effects.

Immediate Fire Effects: There is modeled habitat for least Bell's vireo in many of the drainages in the burned area. Suitable nesting habitat existed prior to the fire in many of the drainages mapped with modeled habitat. Table 17 displays the acres of modeled and occupied habitat within each watershed that burned during the fires. From the analysis below, it appears that approximately 25% burned at high severity; the rest burned at low/moderate severity or did not burn. The areas that burned at high severity likely experience losses of suitable habitat. Approximately 75% burned at low or moderate severity levels, or did not burn at all (water and rock areas). Within those areas, it is likely that some of the riparian vegetation did not burn at all; in some areas, some patchy underburning probably occurred.

Table 17. Least Bell's Vireo Habitat and Burn Severity (acres)						
Watershed	High	Low	Moderate	Rock	Water	Grand Total
Cable Creek	13	39	20			72
City Creek	138		146			284
Cucamonga Canyon	8	29	11			48
Elder Gulch	11		12			23
Etiwanda Canyon	4	20	8			31
Lower Lytle Creek			7			7
Lower Santa Ana River			2			2
Middle Lytle Creek	133	91	48	178		449
Middle Santa Ana		3	13			16
Mojave River Forks		667	426			1,093
Plunge Creek	246		51			297
Silverwood Lake	188	108	64		64	424
Waterman Canyon	20	91	196			307
Grand Total	760	1,047	1,005	178	64	3,055

These acres are based on the fire perimeter and do not take into account islands of unburned within the perimeter (cloudiness prevented satellite imagery needed to make those maps). Typically, many of the drainage bottoms do not burn or burn in patchy patterns with the result of some riparian vegetation surviving in tact. As such, the numbers reflected in the table below are likely overestimates of the habitat that actually burned. It is not possible to determine the degree of the overestimate at this point.

Since the Old/Grand Prix fire occurred so late in the season, it is unlikely that least Bell's vireos would still be in the area but, instead, would have already migrated out of the area. If least Bell's vireos occur undetected in the fire area, it is possible that they were able to abandon the area without negative impacts. Since the fire occurred after nesting season, direct losses of adults, eggs, and chicks would not have occurred.

Potential Post-Fire Effects: Some suitable nesting habitat for least Bell's vireos burned during the fire while other areas of suitable nesting habitat within the burn perimeter did not burn. Riparian vegetation, especially willows, generally recovers quickly after fires with good shrub cover levels returning within a couple of years. However, substantially higher than normal flows and sediment movement are expected to occur (Tables 4 and 5) and there is a high likelihood that the riparian vegetation at the least Bell's vireo nest sites may be blown out of stream channels. The degree of effects will vary depending on precipitation amount: the higher the precipitation levels, the more severe the effects will be. If the drought cycle continues for 1 – 2 years after the fire, impacts may not be as severe. However, even average rainfall amounts are expected to result in substantial increases in sediment and erosion in Little Sand Canyon will be 28 times normal, and it will be 12 times normal in Cajon Creek. Under these conditions, scouring of riparian vegetation may occur.

Determination of Effects: *It is my determination that fire suppression and suppression rehabilitation actions may have least Bell's vireos. Emergency Consultation has been initiated for these actions. Critical habitat or has been designated for this species; however, none occurs on the SBNF and none was affected by the suppression efforts associated with this fire.*

Effects of BAER Treatments: Even if least Bell's vireos occur undetected within the modeled habitat, the BAER watershed treatments are not expected to have any impacts to this species. Treatments would occur after nesting season has been completed and after the time that the birds have migrated out of the area. Thus, no disturbance would occur from those treatments. Additionally, no alterations of riparian habitat will occur under the proposed BAER treatments.

The treatment to monitor invasive [sic] for establishment of invasive plant species in the Old/Grand Prix Fire, especially in riparian zones, would occur in some suitable least Bell's vireo habitat. Because monitoring would need to occur during the blooming period, it may be necessary to enter the riparian zones during the least Bell's vireo nesting season. Training monitors on how to survey without disturbing vireos and their habitats would help reduce any potential inadvertent disturbance or losses of individuals. Despite precautions, the occasional entry of botanists in the vireo habitat does pose a small disturbance threat to this species. However, the short-term nature of the monitor entries is unlikely to result in abandonment of nests or territories, or loss of individuals.

Determination of Effects: *It is my determination that implementation of BAER treatments may affect least Bell's vireo. Critical habitat is designated for this species; however, none occurs on the SBNF. Endangered Species Act Section 7 Consultation is not required for this action.*

Instream and floodplain treatments, especially those using machinery, may result in temporary adverse impacts such as disturbances, channel alterations, and soil compaction. Use of heavy equipment in those areas should be avoided.

Mountain Yellow-legged Frog

Current Status and Post-Fire Observations: The southern California mountain yellow legged-frog (MYLF) is federally listed as endangered. This species was once widely distributed in numerous streams throughout southern California, but is now found in less than 1% of their historic range and is found to occur in fewer than eight locations, all within the Angeles and San Bernardino National Forests.

City Creek provides habitat for the only remaining population of MYLF known to exist in the entire San Bernardino Mountain Range. Discovered in 1998, MYLFs were only found above the Hwy 330/E. Fork City Creek Bridge until 2003 surveys when tadpoles and juveniles were found throughout the 1 ½-mile stretch below the bridge, extending down into main stem City Creek. The presence of brown trout in the lower portion of City Creek (near and below the confluence of the two forks) may prevent long-term establishment of MYLFs in that portion of the stream reach. A barrier above the confluence keeps the upper portion free of brown trout.

In southern California, mountain yellow-legged frogs inhabit perennial mountain streams (*i.e.*, streams that contain plunge pools or backwaters year-round, although not necessarily flowing

year-round) with steep gradients—often in the chaparral belt—but may range up into small meadow streams at higher elevations (64 FR 71714, USDI Fish and Wildlife Service 2001). Mountain yellow-legged frogs are seldom found more than two or three jumps from water (Stebbins 1985). Highly aquatic, they occupy rocky shaded streams with cool waters originating from springs and snowmelt.

In September of this year, the Bridge Fire burned through a portion of the drainage where the frog occurs, but during the Old Fire, the entire upper portion of the watershed inhabited by the frog in the main stem and East Fork of City Creek was burned.

Immediate Fire Effects: Of the 5,389 acres of modeled MYLF habitat within 15 drainages in the Old/Grand Prix Fire area, acres were almost evenly split between the high (1714 ac), moderate (1593) and low (1456) burn severity categories (Table 9). Some of the modeled habitat is considered suitable for this species but some still needs to be evaluated for suitability.

No dead MYLFs were observed during the BAER surveys; however, individuals certainly could have been lost as a result of the fire. Frogs were observed in East Fork City Creek (11 metamorphs, 1 adult and one tadpole possibly MYLF). The adult frog observed on November 5, 2003 appeared to have singed hind feet. The injury looked like it was healed: it is unknown whether it burned during the Old fire and started healing in the week between the fire and the capture. It may have been injured during the September Bridge fire or it may have been unrelated. The fire burned most of the riparian areas in the upper watershed including the upper reaches of the MYLF population; however, riparian areas in the vicinity of the Hwy 330/E. Fork City Creek Bridge were more intact with patches of unburned vegetation.

Table 9. Mountain Yellow-Legged Frog Habitat and Burn Severity (acres)

	Occupied		Modeled						
Watershed	High	Total	High	Low	Moderate	Rock	Water	Total	Grand Total
Cable Creek			124.7	42.3	53.6			220.5	220.5
City Creek	157.6	157.6	859.4	136.1	523.1			1518.6	1676.2
Cucamonga Canyon			1.9	83.5				85.4	85.4
Deer Creek			70.6	254.5	316.9	64.9		706.9	706.9
Etiwanda Canyon			9.2	157.9	148.3			315.4	315.4
Holcomb Creek			2.4	89.4				91.8	91.8
Lower deep Creek				38.3				38.3	38.3
Middle Lytle Creek			81.6	53.0	60.3	168.5		363.3	363.3
Middle Santa Ana			89.9		5.9			95.8	95.8
Mojave River Forks				26.3			0.8	27.2	27.2
Plunge Creek			257.5	64.8	146.4			468.7	468.7
Silverwood Lake			8.1	12.1			198.4	218.5	218.5
Upper Deep Creek			19.9	207.3	284.7			512.0	512.0
Upper Lytle Creek			10.7	57.2	53.0	193.2		314.2	314.2
Waterman Canyon			178.3	233.3	0.4			412.0	412.0
Grand Total	157.6	157.6	1714.1	1456.1	1592.7	426.6	199.3	5388.8	5546.4

Potential Post-Fire Effects: Most of the City Creek watershed experienced high burn severity in the Old/Grand Prix fires. The post-fire effects in City Creek are exacerbated by the fact that the lower portion of the E. and W. Forks of City Creek and part of the main City Creek stem burned in September during the Bridge fire.

It is expected that City Creek will have dramatic increases in post-fire stream flows (4 times the normal discharge the first year following the fire) and sediment loading (32 times normal sediment loading the first year following the fire). High sediment loading can result in filling of pool habitats, filling of interstitial spaces, and of smothering riparian vegetation and benthic organisms. Aquatic organisms in City Creek face a high risk of localized extirpation. It is possible that some frogs, particularly adults, may be able to find over-wintering refuge in bedrock crevices in the stream channels or in other sites far enough from the stream to survive increased flows and loss of water quality.

Post-fire changes can affect individuals in all stages of development (eggs, larval stages, and adults). It is likely that the many of the MYLFs in City will be displaced downstream or die during the first rainy season as a result of high steam flows, and sediment and ash delivery to aquatic habitats. Additionally, in portions of the creek that completely burned over, the lack of riparian vegetation may lead to changes in water temperature, evaporation rates, and water quantity/availability. The combination of these effects poses a significant threat to this important MYLF occurrence.

Post-fire effects are expected to be significant for MYLFs, especially for non-mobile lifestages. Where individuals occur downstream in any of the water courses that are expected to experience sediment-loading, ash flows, scouring, debris flows, channel rerouting, etc., they could be killed or injured during storm events. Post-fire changes in sediment delivery and water flow amounts can result in significant changes to pool and stream morphology. Pools are expected to fill with sediment, resulting in total loss of some pool habitat and other pools becoming smaller and shallower. Shallower, smaller pools are more likely to dry up completely due to evaporation. High flows may eventually scour out the pools. These changes will probably result in reduced habitat availability and habitat quality. In addition, a reduction in habitat availability may fragment the suitable MYLF habitat, isolating individuals within this occurrence and making them more susceptible to predation during movement.

In addition, MYLF habitat quality is expected to be affected by changes in riparian vegetation. Reduced vegetation cover in riparian areas may result in reduced overwintering opportunities for MYLF, at least within the first two years after the fire until riparian vegetation has recovered. Effects of vegetation removal and soil changes as a result of fire in the City Creek drainage will no doubt result in higher peak stream flows and sediment delivery. Changes in water temperatures are expected in areas where riparian vegetation burned leaving the streams more exposed.

Effects of Fire Suppression and Suppression Rehabilitation Activities: No retardant drops were made in MYLF occupied habitat. No handlines or other suppression activities are known to have occurred in E. Fork City Creek during the Old/Grand Prix fire (some activities did occur in the September Bridge fire). It is unlikely that MYLF were injured during the suppression phase of

the Old/Grand Prix fire. While no dead frogs or tadpoles were observed during post-suppression surveys, it is possible that some losses did occur. *Determination of Effects: It is my determination that fire suppression and suppression rehabilitation actions may have affected mountain yellow-legged frogs. Emergency Consultation has been initiated for these actions. Critical habitat has not been proposed or designated for this species.*

Effects of BAER Treatments:

a) Mountain Yellow-Legged Frog Recovery Treatment: The proposed species treatment for MYLF would provide protection for this species from localized extinction due to post-fire run-off and sediment flows. It is possible that many or all of the MYLFs in City Creek will be pushed downstream into unsuitable habitats or killed during the first rainy season as a result of high flows, and sediment and ash delivery to aquatic habitats.

On November 3, 2003 MYLF specialists were contacted by Old/Grand Prix BAER team members to discuss the possible need to collect MYLFs from City Creek and place them in a holding facility. People and agencies contacted included: USFWS, Jesse Bennett; USGS, Adam Backlin; CDFG, Raul Rodriguez; Riverside Corona RCD, Kerwin Russell.

On November 4, 2003 the BAER Biological Specialists (Robin Eliason, Scott Eliason, Kathie Meyer, and Ann Carlson) met with USFWS, (Jesse Bennett and Matt McDonald), USGS (Adam Backlin), Riverside Corona RCD (Kerwin Russell, Dick Zimbal and Sue Hoffman), and several field biologists to discuss options for protection of MYLF in City Creek through the first few years following the fire. Discussion focused on alternatives of action and no-action. It was concluded that taking a collection of frogs and keeping them in captivity through at least the first year after the fire was needed as insurance that this population would not be entirely lost should a large storm event occur. While direct intervention of endangered species occurrences is generally not desirable, in this case due to the importance of this occurrence, it is a necessary measure to ensure the persistence of this population.

It was also decided that keeping frogs in more than one holding facility would be desirable if a suitable facility could be located. The Riverside-Corona RCD facility was reviewed by the group and with some modification could potentially be suitable (Russ Smith, L.A. Zoo should be brought in to make recommendations if this facility is to be used). Another option for a holding facility is the San Diego Zoo, although it is not known if they can hold juveniles and adults, they can hold tadpoles.

Risks to frogs that will be minimized by placing them in a holding facility versus natural or artificial streams include: 1) less chance of disease; 2) less chance of movement out of the habitat; and 3) less chance of predation.

Collection, handling, and release of mountain yellow-legged frogs (of all ages) would pose a slight risk of injury or death, although the probability is not very high because well-trained biologists would conduct this effort. Use of standard sterilization techniques for all equipment is standard protocol and would help reduce the probability of impacts. USGS biologists have the permit to handle and move frogs. USFWS will supervise and assist the collection. USFS will assist with collection and safety of persons working in the fire area. If frogs survive in City

Creek for the first 1 – 2 years following the fire, USFWS, USGS, and the SNBF will determine the fate of the frogs in captivity. It is unlikely that these frogs would be released back into the wild over an existing population.

On November 5, 2003, collection of 11 metamorphs and 1 tadpole took place. The collection was lead by USFWS and USGS. Frogs were transported to the L.A. Zoo for holding. No mortality occurred during collection, transport or placement at the Zoo. Key Contacts for the treatment include: Jesse Bennett and Matt MacDonald (USFWS 760.431.9440), Adam Backlin (USGS 949.215.3390), and Russ Smith (L.A. Zoo). The recovery effort was performed under the take authority of USGS's 10a1A permit. A second recovery effort, if conducted, will likewise be done under that authority. In order to ensure enough genetic diversity to make recovery viable, it is critical that more individuals be collected and held for the future release effort. Restoration of an extirpated population (if extirpation occurs) with only 11 or 12 individuals is poor management and would not ensure the viability of this critically important occurrence.

Determination of Effects: *It is my determination that an emergency exists for Southern California mountain yellow-legged frog as a result of expected post-fire effects that will potentially: 1) degrade occupied habitat, making it unsuitable and inhospitable for several years after the fire and 2) extirpate local populations of MYLF through high flows and excessive sediment transport through City Creek. The recommended treatment to mitigate the emergency is the MYLF recovery treatment (described above in Section III-A). It is also my determination that BAER Treatment for MYLF recovery may adversely affect mountain yellow-legged frogs. However, I have also determined that this species is at risk of local extinction and no-action may result in extirpation of this species from the City Creek drainage. Endangered Species Act Section 7 Consultation with U.S. Fish and Wildlife Service is required for this project and has been initiated through Emergency Consultation. Critical habitat has not been proposed or designated for this species.*

Emergency Determination for MYLF: It is my determination that an emergency exists for southern California mountain yellow-legged frogs as a result of expected post-fire effects that will potentially: 1) degrade occupied habitat, making it unsuitable and inhospitable for several years after the fire, and, 2) extirpate local populations of frogs through high flows and excessive sediment loading to stream channels.

Appendix B

Excerpts from *A Summary of Affected Flora and Fauna in the San Diego County Fires of 2003*, a report to the BAER Program, available at http://www.baerteam.net/severity/.

Quino Checkerspot Butterfly

Areas of concern are within the Cedar fire (Otay Mesa and Rancho Jamul populations).

Immediate concerns: Monitoring of affected Quino populations this spring and summer, and monitoring of Quino hostplant recovery *(e.g. Plantago erecta and Castellija* exserta).

Long term issues: Consideration of butterfly ranching on site to augment populations in the burned area, continued monitoring of Quino and hostplant populations and possible seeding to enhance populations of native's [*sic*] hostplants.

Coastal California Gnatcatcher

Coastal Sage Scrub/Chaparral/Grassland mosaic species of potential concern include the California Gnatcatcher (federally threatened, Rufous-crowned Sparrow and the Greater Roadrunner. Concerns relate to the extensive scale of the fire. Many of the non-migratory species appear to be highly sensitive to habitat loss and habitat fragmentation, and particularly susceptible to isolation effects of habitat fragmentation; colonization of habitat islates appears limited by urban and residential "matrix". Also, the Crestridge Reserve, with the Lakeside Archipleago of hilltops, was intended in part to provide a stepping-stone corridor for CSS avifauna species; much of its vegetation burned in the Cedar fire, and potentially severing north-south CSS connectivity for the foreseeable future.

Least Bell's Vireo

Riparian species of particular concern include the Southwestern Willow Flycatcher and the Least Bell's Vireo. Of the three San Diego fires, the Paradise Fire is of the most concern for these species (although the impacts to riparian species throughout the County warrant attention.). The San Luis Rey river corridor was notable for containing the highest densities of riparian nesting birds in San Diego County, including the federally endangered Least Bell's Vireo. The largest breeding population in California of the federally endangered Southwestern Willow Flycatcher is found in this corridor. These are among the factors that contributed to the designation of the upper San Luis Rey River as an "Area of High Ecological Significance" by the United States Forest Service. Fire related concerns to riparian species pertain to loss of habitat (e.g., loss of riparian vegetation due to burning, as well as potential loss of habitat due to increased runoff and scouring of drainages). Loss of habitat quality may occur if direct and indirect fire effects facilitate the invasion of non-native vegetation in drainages.

Recommendations:

- Continue monitoring where pre-fire datsets exist
- Assess viability of NCCP reserve network for focal species, e.g., California Gnatcatcher; model habitat recovery in terms of habitat suitability for the focal species.
- Monitor focal bird species for West Nile Virus infection; characterize population impacts.

- Monitor and manage invasion of non-native species in critical habitat areas for focal species.
- Conduct restoration where needed to enhance quality of critical habitat areas for focal species.
- Continue demographic studies to examine community effects on focal bird species, including effects of fire on food resources and predator communities.
- Examine subregional and regional spotted owl habitat distribution and reassess population viability.
- Develop forest management guidelines that protect both public safety as well as habitat values for focal species.

Initial Assessment of Burn Impacts on Species Occurrences (based on DOI BAER Vegetation Mortality - released 11/10/2003)			
Species	Pre-Fire Total	Occurrences Burned	Percent Burned
Euphydryas editha quino	388	178	45.9%
Polioptila californica californica	6,129	856	13.9%
Vireo bellii pusillus	2,652	79	3.0%

Initial Assessment of Burn Impacts on Predicted Species Distribution (based on DOI BAER Vegetation Mortality - released 11/10/2003)			
Species	Pre-Fire Total	Acres Burned	Percent Burned
Euphydryas editha quino	97,798.9	20,493.5	21.0%
Polioptila californica californica	112,183.7	31,104.4	27.7%
Vireo bellii pusillus	43,813.1	4,489.9	10.2%

Appendix C

Excerpts from the Los Padres National Forest's *BAER Plan: Wildlife and Fisheries Report and Assessment for the Piru Fire, November 2003.*

Least Bell's Vireo (*Vireo bellii pusillus*)

D. Findings/Observations

Designated critical habitat for the least Bell's vireo occurs in portions of Reasoner Canyon, which is within the Dominguez sub-watershed. This designated habitat occurs both on private and National Forest lands. Burn intensity within the designated critical habitat for the least Bell's vireo was light to moderate.

E. Values at Risk

Least Bell's vireo critical habitat.

II. Emergency Determination

The fire will negatively affect some of the riparian areas in the short term.

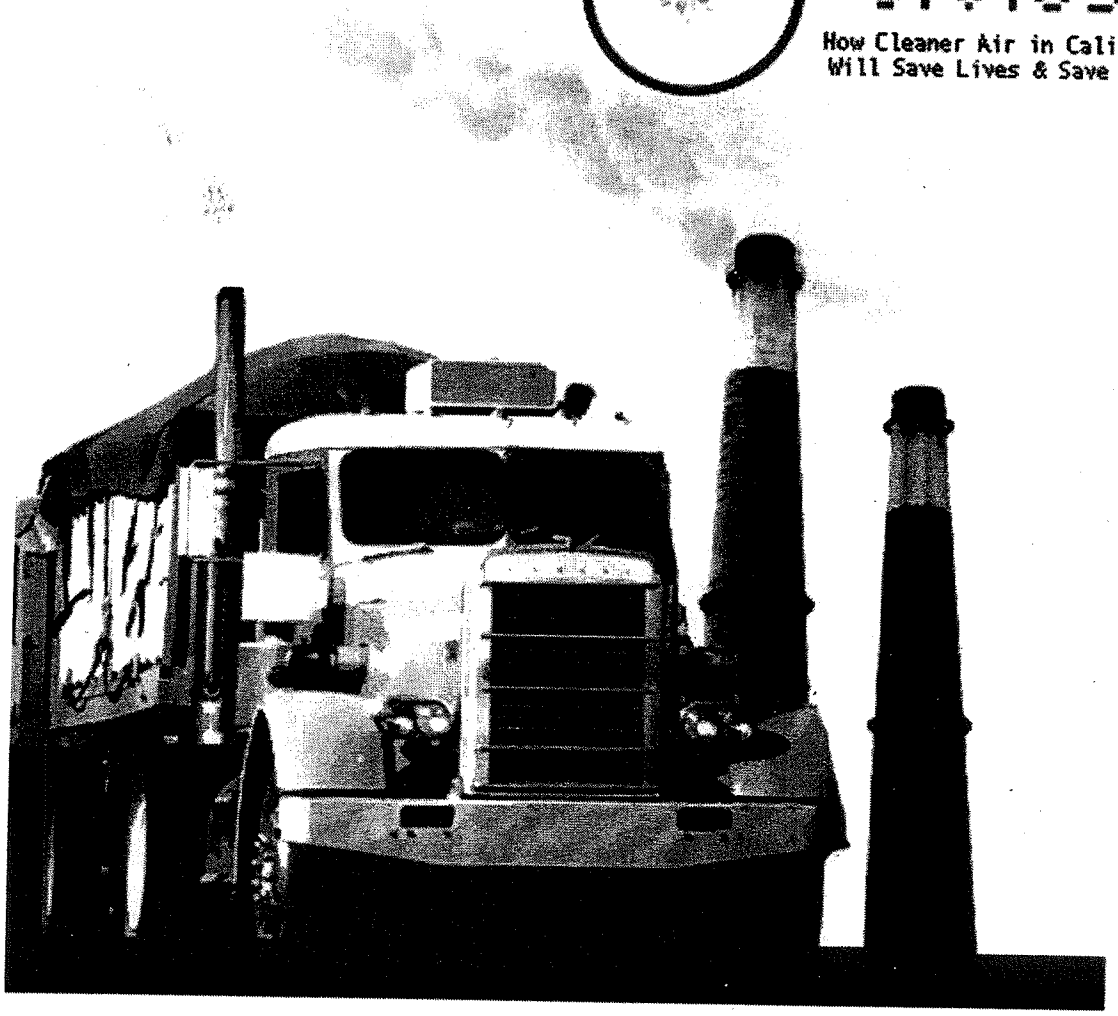
III. Discussion/Summary/Recommendations

The least Bell's vireo has not been recorded from within the Piru Fire perimeter and the closest record is approximately 10 miles southeast of Reasoner Canyon, on the Santa Clara River (LPNF GIS). This species winters from Baja California to northern Nicaragua, with most birds leaving the breeding area by September (Brown 1993). It is unlikely that any birds were in the area of the fire this late in the season and if present would have fled the burn. With the light to moderate burn intensities found in the designated habitat within Reasoner Canyon, it should be expected that the habitat should recover relatively quickly. Riparian plant species have adaptations to fluvial disturbances that allow survival and reestablishment following fires. This contributes to the rapid recovery of many streamside habitats (Dwire and Kauffman in press). The effects of the fire on the least Bell's vireo designated critical habitat are minimal. There is no recommended emergency rehabilitation for this habitat.

EXHIBIT C

PARTICLE CIVICS

How Cleaner Air in California Will Save Lives & Save Money



Renee Sharp
Bill Walker

Environmental Working Group™

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Executive Summary

Airborne soot and dust, technically known as particulate air pollution, causes or contributes to the deaths of more Californians than car accidents, murder and AIDS combined. State health officials are proposing new air pollution rules that could save or extend more than 6,500 lives a year, but the proposal faces strong and well-financed opposition from major oil companies and automakers.

Tougher state standards for particulate air pollution could save more than 6,500 lives and half a billion dollars a year.

In California, respiratory illnesses caused or made worse by airborne particulate matter (PM) are responsible for 9,300 deaths, 16,000 hospital visits, 600,000 asthma attacks and five million lost work days each year. By saving lives and preventing illnesses, tougher standards could save more than half a billion dollars a year.

In recent years, hundreds of studies worldwide have shown that PM pollution kills people. Both short- and long-term exposure to particulate pollution at levels lower than the levels currently experienced by millions of California residents can cause death. The proposed new PM standards are the first new regulations developed in response to a landmark 1999 state law requiring that air pollution standards must be adequate to protect children's health.

Statewide, total PM emissions are on the rise, and the great majority of Californians are exposed to potentially harmful levels. The worst particulate pollution in the state is found in Imperial County. But far more Californians are affected by the severe problems in the South Coast Air Basin, covering greater Los Angeles, which has the highest PM levels of any U.S. metro area, and the eight-county San Joaquin Valley, which is among the six worst areas in the nation. EWG estimates that the proposed new standards could save more than 4,200 lives a year in the South Coast Air Basin, and more than 800 lives a year in the San Joaquin Valley.

EWG urges the Air Resources Board to resist pressure from polluters and adopt the PM standards recommended by state scientists. Exemptions for agriculture should be eliminated. To further protect children and other sensitive populations, ARB should also set eight-hour PM standards, as it has for ozone. Finally, the state PM standards must be more rigorously enforced.

A Life and Death Decision

Particulate air pollution causes or contributes to the deaths of more Californians than car accidents, murder and AIDS combined, according to an analysis of state data by Environmental Working Group. EWG's investigation found that state health officials are proposing new air pollution rules that could save or extend more than 6,500 lives a year, but the safer standards face entrenched opposition from a deep-pockets alliance of major oil companies and automakers.

Airborne microscopic particles, much smaller than the width of a human hair, are known as particulate matter, or PM. (The smallest particles are often called "fine" particulates; the larger ones, still very tiny, are called "coarse" particulates.) California Department of Health Services (DHS) data shows that respiratory illnesses caused or made worse by PM pollution are responsible for the deaths of more than 9,300 Californians a year. That is three times more than are killed in car accidents, 4.6 times more than those who are victims of homicide and six times the number who die of AIDS. (Table 1.) What's more, even this number is an underestimate of the total number of PM-related deaths each year since it includes all deaths due to long-term exposure but only includes some of those due to short-term exposure to particulate air pollution[1].

The air polluters' lobby tries to divert attention from the overwhelming evidence that particulate matter is deadly by arguing that compliance with the "impossibly stringent" proposed new standards would be too costly and would not produce

Cause of Death	Number of Deaths in 1999
Particulate air pollution	9,340
Motor vehicle accidents	3,140
Suicide	3,047
Accidental poisonings	2,221
Homicide	2,042
HIV/AIDS	1,558
Accidental falls	1,202
Drownings	397

Source: EWG, from California Department of Health Services 1999.

Table 1. Particulate air pollution in California causes or contributes to more than 9,000 deaths each year.

"any greater protection of public health than the current California standards." (Ford 2002, AAM 2002.) But EWG's five-month review of hundreds of state, national and international studies found just the opposite: By saving lives and preventing illnesses, tougher PM standards could save the state and its citizens more than half a billion dollars a year.

The price tag: $1 billion a year

Each year, PM pollution is responsible for more than 16,000 hospital or emergency room admissions, at an estimated health care cost of $132 million. PM-triggered illnesses also cause Californians to miss almost five million work days a year, a loss to the state's economy of more than $880 million[2]. More difficult to put a price tag on are the thousands of less severe illnesses that result every year from PM pollution, including 600,000 asthma attacks and 13,500 cases of chronic bronchitis in California. (Tables 2, 3.)

Particulates, which are taken deep into the lungs by inhalation, have been linked with a long list of respiratory ailments such as chronic cough, chest pain, breathlessness, wheezing, phlegm, chronic bronchitis, decreased lung growth, decreased lung function, and the exacerbation of asthma symptoms.

Table 2. Proposed new standards would prevent hundreds of thousands of illnesses each year.

	Ages Considered	Cases at Current PM Levels	Cases Under Proposed Standards	Cases Avoided	Cases Reduced by
Long-term Mortality	30+	9390	2865	6525	69%
Short-term Mortality	All	4063	1772	2291	56%
Chronic Bronchitis	27+	13530	5696	7835	58%
Chronic Obstructive Pulmonary Disease Hospital Admissions	65+	2115	923	1192	56%
Pneumonia Hospital Admissions	65+	3061	1340	1721	56%
Cardiovascular Disease Hospital Admissions	65+	5452	2395	3057	56%
Asthma Hospital Admissions	64-	1624	692	933	57%
Asthma Emergency Room Visits	64-	3992	1691	2301	58%
Asthma Attacks	All	592736	254466	338270	57%

Notes: In this table, the long-term mortality values are for PM2.5 and the short-term mortality values are for PM10. Long-term mortality is deaths from long-term exposure to particulates, while short-term is deaths from short-term exposure. Because the estimates of long-term mortality include some but not all short-term deaths, the two cannot be added together to get an estimate of total mortality.

Source: EWG, from ARB/OEHHA 2001, EWG 2002.

PM concentrations have also been shown to be associated with hospital admissions for a wide variety of cardiovascular and pulmonary diseases, including asthma. Groups particularly at risk include children, the elderly, people who already suffer from respiratory illness, and those of low socioeconomic status, who tend to live in areas where particulate pollution is most severe.

In recent years, a major international scientific effort has produced a flood of studies that has clearly established that PM pollution can kill people. Epidemiological studies have been conducted in over 200 cities worldwide, examining the effects of different exposure durations, and accounting for contributing factors including age, smoking habits, weather, and other pollutants. The results have been remarkably consistent: Both short- and long-term exposure to particulate pollution at levels lower than currently experienced by millions of California residents can cause death. Compared to just a few years ago, scientists today are much more likely to say plainly that PM kills, than that it contributes to death.

Hundreds of studies worldwide confirm that exposure to particulate pollution at levels lower than millions of Californians breathe can cause death.

California's current PM standards were set in 1982. New standards proposed by scientists at the state Air Resources Board (ARB) and Office of Environmental Health Hazard Assessment (OEHHA) would reduce the number of PM-triggered deaths and illnesses dramatically. The scientists say cutting allowable levels of PM to recommended levels will reduce deaths by at least 69 percent, asthma attacks by 57 percent, hospital visits by 56 percent and cases of chronic bronchitis by 58 percent. (Table 2.) Statewide, the recommended standards would result in an annual reduction of about 3 percent of all mortality in the population above age 30. (ARB/OEHHA 2001.) EWG estimates that these new PM-standards would also result in savings of state direct and indirect costs of more than $580 million a year. (Table 3.)

The Children's Environmental Health Act

Gov. Gray Davis' appointed ARB directors are scheduled to vote on the proposed new standards in June 2002. Their decision is being watched closely by health and environmental officials and researchers across the country. In 1999, California enacted the landmark Children's Environmental Health Act (SB 25), the first law anywhere in the U.S. to require that air pollution standards must be stringent enough to protect children – as opposed to almost all other environmental regulations designed to protect the average adult male. SB 25 required the ARB to review all of the state's air pollution standards to determine whether they adequately protect children. A preliminary review determined that the current PM standards were inadequate and that revising them should be ARB's highest priority. Other standards determined to be inadequate must be revised at a rate of one a year[3]. The proposed PM standards could again make California the national leader in air quality standards to protect public health – but not if the air polluters' lobby gets its way.

The Western States Petroleum Association, the Alliance of Auto Manufacturers, the Engine Manufacturers Association and other industry groups and individual companies have mounted a well-financed major campaign against the proposed

Table 3. Costs Associated With PM10-related Illness in California.

	Ages Considered	Number at Current PM10 Level	Cost at Current PM10 Level (1999 $)	Number Avoided Under Proposed New Standards	Savings Under Proposed New Standards
Chronic Obstructive Pulmonary Disease Hospital Admissions [1]	65+	2,115	$24,792,990	1,192	$13,972,624
Pneumonia Hospital Admissions [2]	65+	3,061	$42,639,263	1,721	$23,971,809
Cardiovascular Disease Hospital Admissions [3]	65+	5,452	$34,362,621	3,057	$19,268,271
Asthma Hospital Admissions [4]	64-	1,624	$28,904,937	933	$16,601,802
Asthma Emergency Room Visits [5]	64-	3,992	$1,193,527	2,301	$687,999
Work Loss Days [6]	64-	4,910,652	$883,917,360	2,814,815	$506,666,700
Total		4,926,896	$1,015,810,698	2,824,019	$581,169,205

Notes:
1) Hospital charge cost only. Mean hospital stay is 6.02 days with a mean charge of $11,722 (1999 dollars). (Abt 2000)
2) Hospital charge cost only. Mean hospital stay is 7.01 days with a mean charge of $13,929 (1999 dollars). (Abt 2000)
3) Hospital charge cost only. Mean hospital stay is 5.44 days with a mean charge of $17,794 (1999 dollars). (Abt 2000)
4) Hospital charge cost only. Mean hospital stay is 3.03 days with a mean charge of $6,303 (1999 dollars). (Abt 2000)
5) The average asthma ER visit cost is $299 (1999 dollars). (Abt 2000)
6) The median per-day income of California residents in the year 2000 was $180. (US Census 2002)

Source: ARB/OEHHA 2001, EWG 2002, Abt 2000, U.S. Census 2000.

standards. Their tactics are familiar: carping on minor inconsistencies between scientific studies, exaggerating uncertainties although PM is perhaps the most-studied type of air pollutant, and drawing on industry-funded studies to dispute the overwhelming consensus of peer-reviewed academic and government research. If their campaign, for which a small army of lobbyists in Sacramento has millions of dollars to spend, is only partly successful in watering down the proposed standards, thousands more Californians will die from dirty air each year.

Unlike most other air pollutants, particulates are regulated by size. Particles with diameters less than or equal to 10 microns are called PM10 and are often referred to as "coarse particles." Particulates with diameters less than or equal

to 2.5 microns are called PM2.5 and are often referred to as "fine particles." (A single human hair has a diameter of 50 to 100 microns.) California's current standards regulate only PM10, but the proposed new standards would also cover PM2.5.

PM contains heavy metals, nitrates, sulfates, aerosols and other toxic chemicals, as well as ordinary soot, soil, dust and smoke from both man-made and natural sources, including cars, industrial pollution and unpaved roads. Recent research suggests that PM from industrial and other man-made sources is more harmful to human health than dust from natural sources. (See Chapter 3.) The makeup of PM pollution varies considerably among different locations and at different times of the year (or even day) in the same location. As a result, two areas in California with the same level of particulates in the air may have distinctly different PM problems, and within counties where overall PM levels are relatively low, individual cities or neighborhoods may be exposed to high levels. Although annual average PM levels have declined in recent years, only small, mostly rural Lake County is in full compliance with current state standards. Statewide, total PM emissions are on the rise, and the great majority of Californians are exposed to potentially harmful levels:

The Los Angeles–Riverside metro area has the worst particulate air pollution in the U.S., and the San Joaquin Valley's problem is also among the worst.

- Over 99 percent of Californians breathe air that violates the current PM10 standards during at least part of the year. (ARB/OEHHA 2000.)

- Fifty-five of fifty-eight counties have average annual PM10 concentrations that exceed the proposed standards and fourteen counties (or portions of counties) have average annual concentrations that are at least twice as high, based on the last three years of ARB monitoring data[4]. (Table 4.)

- Forty-three counties (or portions of counties) have average annual PM2.5 concentrations that exceed the proposed standards, based on the last two years of ARB monitoring data[5]. (Table 4.)

Preventing deaths and asthma

The worst particulate pollution in the state is found in Imperial County (and an adjoining part of Riverside County). But far more Californians are affected by the severe problems in the South Coast Air Basin (Los Angeles, Orange, Riverside and San Bernardino counties) which consistently records the highest PM levels of any U.S. metro area, and the eight-county San Joaquin Valley, which ranks among the six worst air basins in the country for particulate pollution. (Grossi 2002, Table 4.) Considering the same factors state scientists used in calculating statewide PM-related deaths and illnesses, EWG estimates that the proposed new standards could prevent or delay more than 4,200 deaths a year in the South Coast Air Basin, and more than 800 deaths a year in

Table 4.
55 of California's 58 counties are not in full compliance with existing PM standards.

Source: EWG, from ARB/ OEHHA 2001.

County	Portion of County	PM10 Annual Average (µg/m³)	PM2.5 Annual Average (µg/m³)
Alameda		21.7	15.8
Alpine		16.7	8,5
Amador		23.0	16.6
Butte		24.5	12.3
Calveras		23.0	16.6
Colusa		24.5	12.3
Contra Costa		21.7	15.8
Del Norte		17.5	7.5
El Dorado	Lake Tahoe Basin	20.8	7.5
El Dorado	Mountain Counties Basin	23.0	16.6
Fresno		39.5	22.3
Glenn		24.5	12.3
Humbolt		17.5	7.5
Imperial		70.2	13.1
Inyo		16.7	8.5
Kern	Mojave Basin	21.6	10
Kern	San Joaquin Basin	39.5	22.3
Kings		39.5	22.3
Lake		10.8	≤ 5
Lassen		13.0	≤ 5
Los Angeles	Mojave Basin	21.6	10
Los Angeles	South Coast Basin	40.7	22.2
Madera		39.5	22.3
Marin		21.7	15.8
Mariposa		23.0	16.6
Mendocino		17.5	7.5
Merced		39.5	22.3
Modoc		13.0	≤ 5
Mono		16.7	8.5
Monterey		24.2	7.5
Napa		21.7	15.8
Nevada		23.0	16.6
Orange		40.7	22.2
Placer	Lake Tahoe Basin	20.8	7.5
Placer	Sac Valley Basin	24.5	12.3
Plumas		23.0	16.6
Riverside	Mojave Basin	21.6	10
Riverside	Salton Sea Basin	70.2	13.1
Riverside	South Coast Basin	40.7	22.2
Sacramento		24.5	12.3
San Benito		24.2	7.5
San Bernardino	Mojave Basin	21.6	10
San Bernardino	South Coast Basin	40.7	22.2
San Diego		28.8	15.6
San Francisco		21.7	15.8
San Joaquin		39.5	22.3
San Luis Obispo		23.0	11.8
San Mateo		21.7	15.8
Santa Barbara		23.0	11.8
Santa Clara		21.7	15.8
Santa Cruz		24.2	7.5
Shasta		24.5	12.3
Sierra		23.0	16.6
Siskiyou		13.0	≤ 5
Solano	Sac Valley Basin	24.5	12.3
Solano	San Francisco Basin	21.7	15.8
Sonoma	North Coast Basin	17.5	7.5
Sonoma	San Francisco Basin	21.7	15.8
Stanislaus		39.5	22.3
Sutter		24.5	12.3
Tehama		24.5	12.3
Trinity		17.5	7.5
Tulare		39.5	22.3
Tuolumne		23.0	16.6
Ventura		23.0	11.8
Yolo		24.5	12.3
Yuba		24.5	12.3

the San Joaquin Valley. Each year, more than 76,000 asthma attacks could be averted in Riverside and San Bernardino counties alone. (Table 5.)

In December 2001, ARB and OEHHA staff scientists proposed that California's annual PM10 standard be lowered by one-third, from 30 micrograms per cubic meter of air ($\mu g/m^3$) to 20 micrograms, and that an annual state PM2.5 standard be set at 12 $\mu g/m^3$. But the agencies also had to decide about standards for short-term (24-hour) exposures to PM. They proposed to leave the short-term standard for PM10 unchanged at 50 $\mu g/m^3$. They at first opted not to propose a state short-term standard for PM2.5, continuing to rely on the federal level of 65 $\mu g/m^3$. After criticism from an external scientific review panel and pressure from state environmental advocates, however, ARB and OEHHA decided a state short-term PM2.5 standard was necessary, and in March 2002 proposed a level of 25 $\mu g/m^3$. (Figures 1 and 2.)

Gov. Davis' air quality board should adopt the tougher regulations recommended by state scientists, and enforce them rigorously.

When the ARB directors meet to set the final standards, the stakes are high. If the annual PM10 standard is strengthened only slightly to 28 $\mu g/m^3$, and the PM2.5 standard is set at the federal level of 15 $\mu g/m^3$, as the oil companies and automakers advocate, the result would be 3,000 more premature deaths, 3,000 more hospital admissions, 1,000 more emergency room visits for asthma, 3,500 more cases of chronic bronchitis, and 150,000 more asthma attacks each year than if the standards were set at the proposed levels. For thousands of Californians, it will be literally a life-and-death decision.

Recommendations

- Directors of the Air Resources Board should resist pressure from polluters and adopt both the annual and short-term PM10 and PM2.5 standards recommended by state scientists.
- The *de facto* state exemption from PM regulations for most agricultural activities – a major source of particulate pollution in California – should be eliminated.
- To further protect children and other sensitive populations from acute levels of particulates, ARB should also set shorter-term standards for PM10 and PM2.5, on the model of the state's eight-hour standard for ozone air pollution.
- The PM standards adopted by the state should be rigorously enforced. Currently the standards are non-binding, making enforcement inconsistent and ineffective.

Footnotes

[1] This figure is for estimated mortality due to long-term exposures to PM2.5 air pollution. It is difficult to arrive at an absolute number of PM-related deaths because of overlap in various estimates. For instance, the figures for long-term mortality are believed to encompass some but not all short-term deaths, and therefore estimates of short and long-term mortality can not be simply added together to get an estimate of total mortality.

[2] The median per-day income of California residents in the year 2000 was $180 (=46,802 dollars per year / 260 work days per year). (U.S. Census Bureau 2000.) The actual number of work days lost to PM10-related illness is 4,910,652. (OEHHA/ARB 2001.) The estimated cost to the state's economy is the product of these two numbers.

[3] OEHHA categorized the air pollutants under review into two tiers based on the agency's assessments of potential risks to public health. The first tier includes PM, ozone and nitrogen dioxide. The second tier includes lead, carbon monoxide, and hydrogen sulfide.' (OEHHA/ARB 2001.)

[4] Average PM10 levels were calculated by ARB using the last three years of data available (1998-2000). (OEHHA/ARB 2001.)

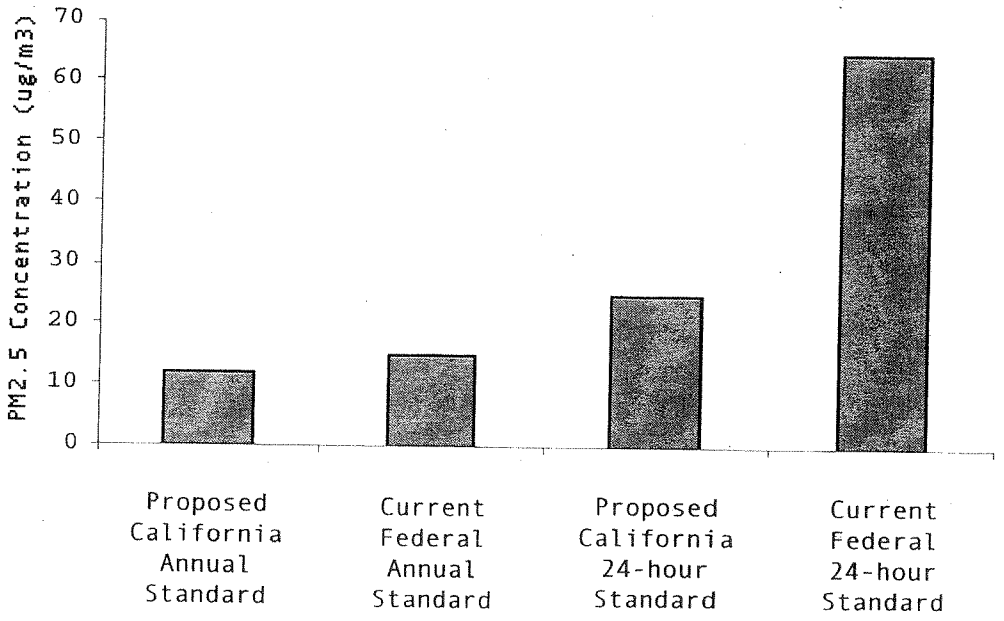
[5] Average PM2.5 levels were calculated by ARB using the last two years of data (1999-2000), which is all the monitoring data available. (OEHHA/ARB 2001.)

California's Particulate Problem

Emissions of particulates have been increasing in California for decades, from 2,017 tons of PM10 per day in 1980, to 2,240 tons per day in 1990, to 2,312 tons per day in 2000. (ARB 2001.) However, the increase has been far from uniform across the state. During this period, PM10 emissions in some counties have remained relatively steady or declined, while other counties have seen a marked increase. For instance, between 1975 and 2000, emissions in San Bernardino County increased by 93 percent and in San Diego County by 70 percent. (ARB 2001.) The increase in emissions comes from many sources, but one clear cause is the ever-growing dependence on automobiles: From 1975 to 2000 the number of vehicle miles traveled in California more than doubled, from 351 million miles per day to 800 million. (ARB 2001.)

While the total *amount* of emissions continues to rise, concentrations of PM10 *measured* by air quality monitors have actually declined. Statewide, annual mean concentrations measured by the state's 250 air monitors dropped 20

Figure 1. Proposed and Existing PM2.5 Standards



percent between 1988 and 1999, from about 80 $\mu g/m^3$ to 60. A big reason for this apparent discrepancy is that most of the monitors are in the South Coast Air Basin, where in recent years progress has been made in reducing PM emissions. Since the current PM standards were adopted in 1982, improvements in air quality have been achieved statewide, but today all counties except Lake County still fail to meet the state's short-term PM10 standard. (Lassen, Modoc and Siskyou counties lack enough data to measure compliance.) Twenty counties fail to meet even the considerably weaker federal short-term PM10 standard.' (Table 4.)

Problem areas

In most areas of the state with elevated PM levels, the problem is not limited to short-term spikes in concentration but is a year-round concern. By far the highest levels are found in Imperial County and an adjacent portion of Riverside County, with an annual average of 70 $\mu g/m^3$ of PM10 – almost 3.5 times the proposed state standard. But annual levels of 40 $\mu g/m^3$ or more of PM10 – twice the proposed standard--- are recorded in twelve other counties or portions of counties: Fresno, Kern, Kings, Los Angeles, Madera, Merced, Orange, Riverside, San Bernardino, Stanislaus, San Joaquin and Tulare. (Table 4.)

PM differs from many other types of air pollution in that it is not a single compound, but rather a highly complex mixture of small solid particles and

Figure 2. Proposed and Existing PM10 Standards.

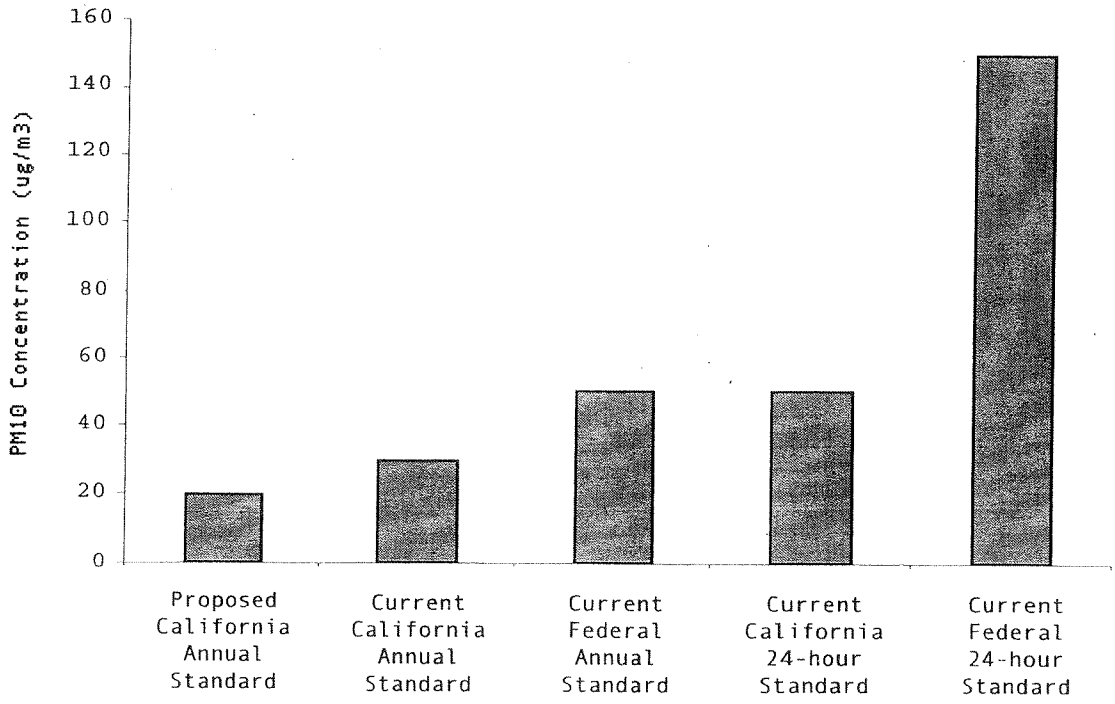


Table 5. Consequences of PM exposure, by county.

	Long-term mortality		Short-term mortality		Asthma Hospital Admissions		Asthma Emergency Room Visits		Asthma Attacks		Work Loss Days	
County	Deaths Due to PM2.5 at Current Levels	Fewer Deaths if Proposed Standards Achieved	Deaths Due to PM10 at Current Levels	Fewer Deaths if Proposed Standards Achieved	Admissions due to PM10 at Current Levels	Fewer Admissions if Proposed Standards Achieved	Visits Due to PM10 at Current Levels	Fewer Visits if Proposed Standards Achieved	Attacks Due to PM10 at Current Levels	Fewer Attacks if Proposed Standards Achieved	Days lost due to PM10 at current levels	Fewer Days Lost if Proposed Standards Achieved
Alameda	317	178	92	13	36	5	89	13	12,944	1,861	142,140	15,940
Alpine	0	0	0	0	0	0	0	0	6	0	93	0
Amador	12	7	4	1	1	0	2	1	349	80	3,334	626
Butte	32	3	24	8	6	2	14	5	2,257	704	21,072	5,629
Calveras	14	9	5	1	1	0	3	1	404	93	3,845	723
Colusa	2	0	1	0	1	0	1	0	209	65	2,053	548
Contra Costa	197	111	63	9	23	3	58	8	8,507	1,223	92,286	10,349
Del Norte	0	0	2	0	0	0	1	0	160	0	2,156	0
El Dorado	85	52	13	2	4	1	10	2	1,503	304	15,576	2,534
Fresno	311	243	126	83	49	33	121	81	17,894	11,905	138,277	99,442
Glenn	4	0	2	1	1	0	2	1	294	92	2,835	757
Humbolt	0	0	7	0	2	0	5	0	735	0	9,922	0
Imperial	15	4	38	32	17	15	41	35	6,370	5,348	40,840	42,511
Inyo	0	0	1	0	0	0	1	0	93	0	1,242	0
Kern	223	172	98	61	37	23	90	57	13,296	8,317	106,695	69,919
Kings	40	31	16	11	8	5	20	14	2,898	1,928	23,021	16,556
Lake	0	0	0	0	0	0	0	0	38	0	2,639	0
Lassen	0	0	0	0	0	0	1	0	78	0	2,061	0
Los Angeles	3555	2,759	1,387	930	599	405	1,469	997	217,366	146,105	1,672,103	1,220,537
Madera	50	39	21	14	7	5	18	12	2,756	1,833	21,026	15,121
Marin	55	31	16	2	6	1	15	2	2,217	319	23,452	2,630
Mariposa	6	4	2	0	0	0	1	0	170	39	1,644	309
Mendocino	0	0	5	0	1	0	3	0	501	0	6,680	0
Merced	79	62	32	21	13	9	32	22	4,713	3,136	36,585	26,310
Modoc		0	0	0	0	0	0	0	22	0	521	0
Mono	0	0	0	0	0	0	0	0	67	0	1,016	0
Monterey	0	0	27	8	12	4	30	9	4,391	1,318	44,102	11,262
Napa	37	21	11	2	3	0	7	1	1,114	160	11,536	1,294
Nevada	30	18	9	2	2	1	6	1	916	211	8,804	1,655
Orange	956	744	410	277	182	124	447	306	66,218	44,928	506,007	374,751
Placer	25	2	21	6	7	2	19	6	2,733	832	26,429	6,869
Plumas	7	4	2	0	1	0	1	0	207	48	1,981	372
Riverside	583	431	353	256	112	82	272	200	42,149	30,675	296,622	243,660
Sacramento	132	12	106	33	37	12	92	29	13,594	4,238	133,938	35,779
San Benito	0	0	3	1	2	0	4	1	582	175	5,969	1,524
San Bernardino	486	370	231	144	95	60	234	147	34,127	21,263	276,676	180,041
San Diego	560	308	279	131	110	52	273	130	40,465	19,074	358,663	159,824
San Francisco	203	114	60	9	19	3	46	7	6,964	1,001	73,543	8,247
San Joaquin	251	196	101	67	34	23	84	57	12,616	8,393	96,729	69,562
San Luis Obispo	26	0	21	5	7	2	16	4	2,471	581	24,534	4,727
San Mateo	150	84	45	6	17	2	42	6	6,340	912	67,890	7,613
Santa Barbara	37	0	29	7	11	3	27	6	4,000	940	40,532	7,809
Santa Clara	271	152	82	12	42	6	104	15	15,085	2,169	166,914	18,718
Santa Cruz	0	0	20	6	8	2	19	6	2,793	838	28,076	7,170
Shasta	25	2	19	6	5	1	12	4	1,814	566	17,043	4,553
Sierra	1	1	1	0	0	0	0	0	35	8	339	64
Siskiyou		0	0	0	0	0	1	0	102	0	2,428	0
Solano	60	29	23	5	11	2	26	5	3,790	773	40,655	6,672
Sonoma	99	56	35	4	11	1	26	4	3,938	520	42,970	4,336
Stanislaus	193	150	79	52	27	18	67	45	10,006	6,657	76,857	55,272
Sutter	9	1	7	2	2	1	6	2	877	273	8,519	2,276
Tehama	9	1	7	2	2	1	4	1	623	194	5,802	1,550
Trinity	0	0	0	0	0	0	0	0	76	0	966	0
Tulare	145	113	58	38	23	15	56	37	8,238	5,481	63,764	45,855
Tuolumne	18	11	5	1	1	0	3	1	542	125	5,148	968
Ventura	57	0	47	11	21	5	52	12	7,544	1,773	78,649	15,153
Yolo	15	1	13	4	5	2	13	4	1,874	584	18,826	5,029
Yuba	8	1	6	2	2	1	5	1	669	209	6626	1,770
Total	9,390	6,525	4,064	2,291	1,624	913	3,992	2,301	592,736	338,370	4,910,652	2,814,815

Source: EWG, from ARB/OEHHA 2001.

liquid droplets suspended in air. These particles may be emitted directly into the air or they may form in the atmosphere from "precursor" chemicals such as sulfur and nitrogen compounds. Substances that comprise PM range from soot, soil, organics, dust, and smoke to heavy metals, aerosols, nitrates, and sulfates. The makeup of PM pollution varies considerably among different locations and at different times of the year (or even day) in the same location. The diverse composition and distribution of particulate pollution makes it especially difficult to assess and control.

Particulate pollution comes from both natural and human sources. The five leading sources of PM10 emissions in California are in the catchall category of "dust" – unpaved road dust, paved road dust, and windblown dust together comprise about 55 percent of the total, with construction and agriculture each contributing another 9 percent. (Table 6.) Other significant human sources of PM10 emissions are industrial pollution and fuel combustion (6 percent combined), fireplaces and wood stoves (6 percent), burning waste (6 percent) and vehicle exhaust (5 percent). (ARB 2000a.)

Unlike most air pollutants, which are regulated based on their chemical composition, particles are regulated based on their size: those with diameters greater than 10 microns, those with diameters less than or equal to 10 microns (PM10), and those with diameters equal to or less than 2.5 microns (PM2.5). (One micron is one millionth of a meter, and a single human hair has a diameter of 50 to 100 microns.) The human respiratory system can filter out most particles larger than 10 microns. But as the particles get smaller they are

Table 6. Sources of PM10 pollution in California.

PM10 Source	Tons of PM10 Emitted per Year	Percent of Total
Unpaved road dust	235,060	27%
Paved road dust	140,890	16%
Windblown dust	106,945	12%
Construction	74,825	9%
Farming	79,935	9%
Woodstoves & fireplaces	51,465	6%
Waste burning	50,735	6%
Mobile vehicles*	45,625	5%
Wildfires	31,755	4%
Industrial	32,485	4%
Fuel combustion	15,695	2%
Other	11,315	1%
Total	876,730	100%

* includes cars, trucks, airplanes, trains, and boats

Source: EWG, from ARB 2000.

Table 7. Comparison of PM2.5 (Fine Particles) and PM10 (Coarse Particles).

	FINE	COARSE
Formed from	Gases	Large solids/droplets
Formed by	Chemical reaction Nucleation Condensation Coagulation Evaporation	Mechanical disruption (crushing, grinding, etc.) Evaporation of sprays Suspension of dusts
Composed of	Sulfate Nitrate Ammonium Hydrogen ion Elemental carbon Organic compounds Metals Particle-bound water	Resuspended dusts Soil, dust, street dust Oxides of crustal elements Sea salt, calcium carbonate Pollen, mold, fungal spores Plant/animal fragments Tire wear debris
Solubility	Largely soluble	Largely insoluble
Sources	Combusiton of coal, oil, gasoline, diesel, wood Atmospheric transformation products of nitrogen oxides, sulfur dioxide, and organics High temperature processes, smelters, steel mills, etc.	Resuspension of industrial dust and soil tracked onto roads and streets Suspension from disturbed soil, e.g. farming, mining Biological sources Construction Coal and oil combustion Ocean spray
Lifetime	Days to weeks	Minutes to hours
Travel distance	100s to 1000s of kilometers	<1 to 10s of kilometers

Source: EWG, from US EPA 1996.

able to penetrate deeper into the lungs, and are harder for the body to remove. Therefore, over the past two decades, researchers and regulators have focused on ever-smaller inhalable particles. The U.S. Environmental Protection Agency first set standards for PM10 in 1987 and set standards for PM2.5 in 1997.

PM10 and PM2.5 also differ in their sources, how they are formed, composition, and lifetime in the atmosphere. Fine particulates are generated from fossil fuel combustion and other high-temperature processes, are formed from gases which then react and coagulate in the atmosphere and persist in the air for days or weeks. Coarse particulates are usually generated from the suspension of dust from natural or man-made sources, are composed of very small particles or droplets rather than gases, and remain in the air for minutes to hours. (Table 7.) (U.S. EPA 1996.)

Dust in the wind

More than 70 percent of PM10 emissions in the state are from "dust," which includes wind-blown dust from paved and unpaved roads, farming and ranching, and construction sites. Agriculture is a major source of PM10, but its impact is somewhat hidden because ag-related emissions fall into a number of different categories: farming operations, windblown dust, waste burning, industrial processes and farm vehicles. All told, California agriculture produces 459 tons of PM10 a day, or more than 167,500 tons a year. The farm-related particulates problem is so severe in the San Joaquin Valley that the region has repeatedly been unable to meet federal PM standards, and stands to lose more than $2 billion in federal highway funds if the eight counties can't achieve a five percent annual reduction in particulate levels – the only air basin in the country to be hit with such sanctions.

Yet the agricultural industry is exempt from most air pollution laws. The federal Clean Air Act exempts emissions from farm equipment of less than 175

Table 8. Leading Industrial Sources of PM10 Pollution in California.

Facility Name	City	Tons of PM10 Emitted per Year
ADM Inc (Wood Products)	Benicia	1,376
US Borax	Boron	614
Kern Oil & Refining	Bakersfield	544
IMC Chemicals	Trona	526
Mitsubishi Cement	Lucerne Valley	472
Chevron	El Segundo	472
Arco	Carson	452
Ampine (Wood Products)	Martell	447
Port of Stockton	Stockton	436
Martinez Refining Company	Martinez	433

Source: EWG, from ARB 2001.

horsepower. Strictly speaking, California doesn't exempt farm sources from air pollution *regulations*, but does exempt farm operations from having to obtain an air pollution *permit* – and without the conditions attached to a permit, there is no effective control on emissions. The EPA has announced that it will commission the National Academy of Sciences to study agricultural sources of air pollution, which could lead to full-scale regulation of air pollution from farming operations.

Dirty diesels

"Mobile" sources (vehicles) contribute about 5 percent of California's annual PM10 emissions. Passenger cars and light trucks are responsible for about a quarter of this pollution, with most of the rest coming from heavy duty trucks, farm and construction and both commercial and recreational boats. But the bad actor of the category is diesel fuel. Even though diesel-fueled vehicles make up only 4 percent of the 31 million vehicles on the road in California, diesels are responsible for 53 percent of all auto-related PM emissions in California. (ARB 2000b.) And in addition to the adverse health effects associated with all other sources of particulate matter, diesel PM contains many known carcinogens. ARB estimates that diesel-derived PM is responsible for 900 excess cases of cancer per 1 million people exposed over a 70-year lifetime, accounting for 70 percent of the known statewide cancer risk from outdoor air toxics. (ARB 2000b.)

Agriculture is the largest industry in California and a major source of particulates, but is exempt from most air pollution rules.

Industrial emissions account for about 4 percent of California's PM10 pollution. The list of the leading industrial polluters includes petrochemical companies like Chevron, Arco and other refiners, but by far the worst offender is ADM Inc., a manufacturer of wood products in Benicia, Solano County, with more than 1,300 tons emitted in 2000. (Table 8.) Collectively, the ten worst industrial PM polluters in the state emitted 5,300 tons of PM10 in 2000.

Air Pollution, Illness, and Death

Scientists began investigating the link between air pollution, illness and death in response to a number of severe air pollution episodes that sickened and killed thousands of residents in the United States, England and Belgium between 1930 and 1952. Most of the early research looked the effects of very high pollution levels, but more recent inquiry has focused on how low-to-moderate levels of particulates and other air pollutants affect human health. In the past decade the amount of research in this area has exploded, as literally hundreds of studies have been conducted just on the relationship between particulates and death. The scientific consensus is undebatable: Particulates are significantly more harmful than previously realized, and levels well below current state and federal air quality standards can cause or contribute to death.

Relatively small increases in airbone particulates can significantly increase the incidence of respiratory disease and death.

PM pollution has been linked to an array of respiratory ailments in children and adults, including chronic cough, chest pain, breathlessness, wheezing, phlegm, and chronic bronchitis. (Abbey et al. 1995a,b, Pope and Dockery 1991, Braun-Fahulander et al. 1992, Hruba et al. 2001, Zemp et al. 1999.) PM also affects overall lung functioning. Researchers have found that levels of PM commonly experienced by Californians are associated with small but significant decreases in the ability of both children and adults to take and hold deep breaths. (Hoek et al., 1998, Raizenne et al. 1996, Ackerman-Liebrich et al. 1997.)

Kids + PM = Damaged lungs

More troubling, PM can also retard the growth of children's lungs. The Children's Health Study, a long-term investigation of the health effects of air pollution conducted on more than 3,500 children from 12 communities in Southern California, found that PM10 and PM2.5 exposure was associated with decreases in both lung function and lung growth. (Peters et al. 1999, Gauderman et al. 2000.) A follow-up study found that children who moved to areas with lower PM levels showed increased lung growth and functioning, while lung growth and function continued to decline in those who moved to areas with even higher PM levels. (Avol et al. 2001.)

Wherever the link has been investigated, including many studies conducted in California, the results have been consistent: For every 10 micrograms of PM10 added to every cubic meter of air, symptoms of respiratory illness increase, with some studies showing increases of up to 40 percent. State scientists estimate that more than 13,500 current cases of chronic bronchitis in Californians

over the age of 27 are due to particulate air pollution. PM is also responsible for upper respiratory symptoms in an estimated 418,000 California children between the ages of 9 and 11, for lower respiratory symptoms in almost 400,000 children between the ages of 7 and 14, and almost five million lost days of work each year for PM-related illnesses[1]. (ARB/OEHHA 2001.)

Between 1980 and 1994 the prevalence of asthma in the United States increased by more than 75 percent. (Mannino et al., 1998.) Asthma now affects more than 10 million adults and almost five million children. While the current scientific consensus holds that PM pollution does not cause asthma, studies in California and elsewhere have repeatedly found that PM can significantly exacerbate the disease.

The state's proposed 24-hour particulate standards may not cover a short enough exposure period to fully protect public health.

Both PM2.5 and PM10 are associated with many different measures of the severity of asthma, including frequency of attacks, increased use of medication, emergency room visits and hospitalization. (Ostro 2001, Delfino 1998, Pope and Dockery 1992, Yu et al. 2000, Gielen et al. 1997.) A study of asthmatic African-American children in Los Angeles found that one-hour maximum levels, 24-hour averages, and multi-day averages of PM10 were all associated with increases in asthmatic symptoms. (Ostro et al 2001.) State scientists estimate that almost 600,000 asthma attacks, almost 4,000 emergency room visits and more than 1,600 hospital admissions each year are linked to PM-induced asthma.

PM is also associated with increased hospital visits for illnesses other than asthma. Research in dozens of cities in California and other states has consistently found that short-term PM10 and PM2.5 exposures are associated with hospital admissions for cardiovascular and pulmonary diseases such as heart attack, congestive heart failure, cardiac arrhythmia and chronic obstructive pulmonary disease. (Linn et al 2000, Moolgavkar 2000 a,b, Samet et al 2000a, Sheppard et al 1999, among others). Overall, these studies have found that for each 10-microgram increase in PM10 levels in a cubic meter of air, hospital admissions for cardiovascular and respiratory diseases rose by 1.25 to 5 percent. (ARB/OEHHA 2001.) This holds true in locations where PM10 pollution was at low to moderate levels, as well as where levels were high. Data for PM2.5 is more sparse, but suggests that incremental increases in fine particulates may be associated with even greater increases in hospital admissions.

State scientists estimate each year PM10 pollution is responsible for 2,100 hospital admissions for chronic obstructive pulmonary disease, 3,000 admissions for pneumonia and 5,500 admissions for cardiovascular diseases. These estimates account *only* for people age 65 and older, but research has found increases in hospital admissions for these illnesses among younger people as well. (Table 9.)

Common sense says that breathing polluted air daily over an extended period of time is more dangerous than exposure for a few hours or days. Observed increases in mortality from short-term PM exposures are three to four times lower than those from long-term exposures. (ARB/OEHHA 2001.) Yet the impact of short-term PM exposures on public health cannot be ignored. ARB cautions that annual PM averages "do not give an accurate indication of the

seasonal nature of emissions." (ARB 2001.) Averaging means that an area could meet annual standards but have significantly higher PM levels for part of the year, and acutely high levels for a few days of the year.

Shorter-term standard may be needed

A 24-hour standard may actually not be short *enough* to protect public health, as there is evidence that exposure to high levels of particulates over shorter time periods can have significant health effects. One study found that exposure for only two hours was associated with the onset of heart attack symptoms. (Peters et al. 2001.) ARB says it may consider shorter-term standards in the future.

In 1993, Harvard researchers published the results of a 16-year study of 8,000 people in six cities, which found that residents of the city with the highest levels of particulates had a 26 percent higher death rate than the people living in the least polluted city. (Dockery et al. 1993.) An even more extensive seven-year study conducted of more than 550,000 people in 151 metropolitan areas found that residents of cities with the highest PM10 had a 17 percent higher mortality rate than those residing in cities with the lowest levels. (Pope et al. 1995.) These long-term studies have convincingly shown that chronic exposure to particulate matter increases death rates, but recent research shows that short-term PM exposure also is associated with increased mortality.

"The evidence in support of an association between the concentration of particulate air pollution and the mortality rate is consistent."

– Dr. James Ware, Harvard School of Public Health.

Studies in over 200 cities worldwide – cities with significantly different climates, racial profiles, weather patterns, pollution sources and pollution severity – have found a consistent connection between *daily* PM levels and *daily* mortality rates. These studies accounted for numerous other factors such as smoking, age, poverty, weather and other pollutants. Dr. James Ware of the Harvard School of Public Health summarized the findings: "The evidence in support of an association between the concentration of particulate air pollution and the mortality rate is consistent, is not affected by differences in statistical methods, and can be generalized." (Ware 2000.)

In assessing the health risks of a given pollutant, the standard scientific assumption is that risks decrease as exposure rates decrease, and that no harmful effects occur below a certain threshold. But PM does not fit this model. Studies show that the relationship between PM concentration and death is not a tapering curve but a straight line – that is, the health effects of particulates are directly proportional to the level of exposure. No exposure level, including levels below current state and federal standards, has been found at which PM does not have a measurable effect on mortality. (Pope 2000, Daniels et al. 2000.) This has important implications for the development of state air quality standards, which are required to determine the level above which a pollutant is known to harm sensitive populations and incorporate a margin of safety to protect them. (ARB/OEHHA 2001.)

Environmental pollutants do not affect everyone equally, but have greater impact on the very young, the very old, the poor, and those with pre-existing illnesses. The highest rates of PM-related death are among the elderly, especially those with heart or lung diseases.

PM and SIDS

But research into PM's effects on infants and children has found links to pre-term birth or Sudden Infant Death Syndrome (crib death). Most of these studies have been conducted outside the U.S., but indicate a 2 to 4 percent increase in mortality for each 10 micrograms of PM10 in a cubic meter of air. (Loomis et al. 1999, Ostro et al. 1999a.) A study of 98,000 newborns in Southern California born between 1989 and 1993 concluded that the likelihood of pre-term birth was significantly associated with elevated PM levels during the six weeks before birth. (Ritz 2000.)

Some critics argue that PM-related mortality is not a major public health concern, because most deaths are of people who are already ill and only shorten life by days or weeks. Yet in recent years scientists who have thoroughly investigated this notion found it wasn't true. For instance, studies have found that out-of-hospital deaths are between two and four times more strongly related to PM pollution than in-hospital deaths. This indicates that it is not just the critically ill who are more likely to die on days of high PM exposure. (Schwartz 2000, 2001b.) Addressing this issue, the ARB and OEHHA say PM-related mortality is "not the result of just a few days of life shortening . . . it appears that significant reductions in life expectancy may be involved." (ARB/OEHHA 2001.)

Not all particles are created equal. Research indicates that people are much less sensitive to dust and particulates from other natural sources than industrial emissions and auto exhaust. Two studies have found that exposure to particles derived from motor vehicles, coal combustion, and iron and steel manufacturing was significantly associated with daily mortality, while exposure to particles from soil was either not associated or less significantly associated with increased mortality. (Laden et al. 2000, Ozkaynak and Thurston 1987.) Another study was conducted after researchers in Utah noted that hospital admissions and deaths declined following the temporary shutdown of a local steel mill. (Pope 1989.) Scientists then exposed rats to a constant amount of particulates collected before, during and after the mill's closure and found that animals exposed to particulates collected while the mill was closed showed much lower rates of lung damage and related symptoms. (Dye et al. 2001.) The policy implications are clear: The largest sources of particulates, such as road dust, may not be as harmful as particulates from smaller sources such industrial emissions or auto exhaust.

PM-related illnesses carry significant economic impacts. For example, hospital visits for PM-induced COPD, pneumonia and cardiovascular diseases in the population aged 65 and over and visits for pollution-induced asthma in the population under 65 total $132 million a year (Table 3). PM-related illnesses cause Californians to miss almost 5 million work days a year, costing the state's economy more than $880 million[2]. Considering just these costs, the

price of PM air pollution in California exceeds $1 billion a year. (Table 3.) This does not take into consideration many hospital and non-hospital costs of other minor and serious PM-related illnesses.

If California's air quality met the proposed PM standards, an estimated $584 million could be saved each year, cutting the costs of particulate air pollution by more than half. (Table 3.) And if lower standards were reached, these costs would be reduced even further. By achieving a mean ambient PM10 level of 15 micrograms per cubic meter – just 5 micrograms less than the proposed standards – an additional $200 million would be saved each year.

Proposed state standards would prevent hundreds of thousands of asthma attacks each year.

Footnotes

[1] The studies on which OEHHA based their estimates of PM-related illnesses only looked at certain age groups. OEHHA/ARB decided not to extrapolate the results to other age groups and, instead, estimated the illness figures for only these same age groups.

[2] The median per-day income of California residents in the year 2000 was $180 (=46,802 / 260). (US Census Bureau 2000) The actual number of work days lost to PM10-related illness is 4,910,652. (OEHHA/ARB 2001) The estimated cost to the state's economy is the product of these two numbers.

Particle Civics

California has long been a national and global leader in pioneering efforts to improve air quality to protect public health. California developed the nation's first vehicle emission control program in 1963, instituted the nation's first heavy-duty diesel truck standards in 1973, and was the first state to sell unleaded gasoline in 1976. California has also been a trendsetter in developing health-based ambient air quality standards that reflect the most current science available. The existing PM10 standards are a perfect example.

California is the first state to require that air pollution standards be tough enough to protect children, rather than adult males.

In the late 1970s, ARB scientists were among the first to recognize that particulates with diameters of 10 microns or less (PM10) posed more of a human health risk than those with larger diameters. At that time, state and federal air quality standards treated this highly diverse group of compounds as one category called total solid particulates (TSP). But the ARB determined that separate standards were needed for PM10, which took effect in 1982. It took five more years for the U.S. EPA to follow suit, but the federal standards were set 1.5 to three times weaker than the state standards.

Since then, entire libraries of research on particulates and health have been published. There is no disagreement in the scientific and regulatory committees: PM has more profound negative effects on human health than ever before realized, and these effects are measurable at concentrations at or below current air quality standards. This research has established that particles with diameters less than 2.5 microns, or PM2.5, may be particularly hazardous to human health, making the need for tougher and more comprehensive standards more urgent.

Priority: Protecting kids

The need for a revision of California's particulate standards was highlighted with the passage of the Children's Environmental Health Protection Act of 1999 (SB 25 by State Sen. Martha Escutia.) As part of the Act, the ARB and OEHHA were required to review all existing health-based ambient air quality standards in California to determine whether they protected infants and children, as well as other sensitive populations, with a sufficient margin of safety. During this review, it became clear that the current levels of particulate matter in California were responsible for significant and measurable health effects, not

only on children but the public as a whole. As result, the agencies made PM standards the top priority for revision.

In December of 2001 the agencies proposed that California's annual mean PM10 standard be lowered by a third, and added a new standard for PM2.5 that is slightly more stringent than the corresponding federal standard. They recommended leaving the short-term standard for PM10 at current levels, and opted not to recommend establishment of a short-term standard for PM2.5. However, after criticism from an independent scientific review panel and pressure from the environmental community, ARB and OEHHA proposed a short-term standard for PM2.5 that is more than twice as stringent as the existing federal standard. (Figures 1 and 2.)

How many people will California allow to die or become ill each year from the very air they breathe?

The proposed annual standards would dramatically reduce the number of air pollution-related health problems in California. If these standards were attained, thousands of deaths and injuries would be prevented each year: 6,525 premature deaths, 6,903 hospital admissions for respiratory illness, 2,301 emergency room visits for asthma, 7,835 cases of chronic bronchitis, and 338,270 asthma attacks. **(Table 9.)** Overall, the number of PM10-induced illnesses and deaths would decrease by an average of 60 percent, and PM2.5 illnesses and deaths would be cut in half. Because these figures account only for certain illnesses and age groups, the actual health benefits of reducing PM levels would be even greater.

How many will die?

If the standards were set at levels slightly more stringent than those being proposed by the ARB, even more lives would be saved and illnesses avoided. For example, if California met an annual mean PM10 standard of 15 $\mu g/m^3$ and an annual mean PM2.5 standard of 10 $\mu g/m^3$ an additional 1,900 premature deaths, 2,700 respiratory hospital admissions, 850 emergency room visits for asthma, 3,000 cases of chronic bronchitis, and 127,000 asthma attacks could be avoided each year. Overall, PM-induced deaths and illnesses would drop by almost 80 percent.

The consequences of moving in the other direction, toward less stringent standards advocated by the oil and auto industries, would be deadly. EWG analysis shows that if the annual PM10 standard was weakened only slightly from proposed levels, to 28 $\mu g/m^3$, and the annual PM2.5 standard was set to correspond with the federal standard of 15 $\mu g/m^3$, there would be 4,000 more premature deaths, 3,000 more hospital admissions, 1,000 more emergency room visits for asthma, 3,500 more cases of chronic bronchitis, and 150,000 more asthma attacks each year. The question facing the ARB board next month is grim: How many people will California allow to die or become ill each year from the very air they breathe?

Table 9. Savings from Reducing PM-related Illnesses.

PM2.5

	Ages Considered	Number at current annual average PM2.5 level	Cost at current level (1999 $)	Number if proposed standard achieved	Number fewer if proposed standard was achieved	Percent fewer	Dollars saved if proposed standard was achieved	Additional number saved if proposed standard was tightened to 10 ug/m3	Additional dollars saved if standard was tightened to 10 ug/m3
Long-term Mortality [1]	30+	9,390	-	2,865	6,525	69%	-	1,895	-
Short-term Mortality	All	4,011	-	2,066	1,945	48%	-	573	-
Chronic Bronchitis [2]	27+	11,409	N/A	5,660	5,749	50%	N/A	1,612	N/A
Chronic Obstructive Pulmonary Disease Hospital Admissions [3]	65+	1,243	$14,575,966	642	601	48%	$7,529,519	179	$2,098,238
Pneumonia Hospital Admissions [4]	65+	1,791	$24,947,738	927	864	48%	$12,914,520	258	$3,593,682
Cardiovascular Disease Hospital Admissions [5]	65+	3,173	$19,999,436	1,646	1,527	48%	$10,376,736	456	$2,874,168
Asthma Hospital Admissions [6]	64-	950	$16,912,004	481	470	49%	$8,550,392	133	$2,366,602
Asthma Emergency Room Visits [7]	64-	2,352	$703,156	1,185	1,167	50%	$348,933	330	$98,670
Work Loss Days [8]	64-	2,923,535	$526,236,300	175,151	1,445,535	49%	$260,196,300	354,479	$63,806,290
Total			$603,374,599				$299,916,400		$74,837,650

PM10

	Ages Considered	Number at current annual average PM10 level	Cost at current level (1999 $)	Number if proposed standard achieved	Number fewer if proposed standard was achieved	Percent fewer	Dollars saved if proposed standard was achieved	Additional number saved if proposed standard was tightened to 15 ug/m3	Additional dollars saved if standard was tightened to 15 ug/m3
Long-term Mortality [9]	30+	7,470	-	978	6,492	87%	-	N/A	-
Short-term Mortality	All	4,063	-	1,772	2,291	56%	-	N/A	-
Chronic Bronchitis [10]	27+	13,530	N/A	5,696	7,835	58%	N/A	2,902	N/A
Chronic Obstructive Pulmonary Disease Hospital Admissions [11]	65+	2,115	$24,792,990	923	1,192	56%	$10,815,492	463	$5,427,286
Pneumonia Hospital Admissions [12]	65+	3,061	$42,639,263	1,340	1,721	56%	$18,664,007	671	$9,346,359
Cardiovascular Disease Hospital Admissions [13]	65+	5,452	$34,362,621	2,395	3,057	56%	$15,096,981	1,195	$7,532,085
Asthma Hospital Admissions [15]	64-	1,624	$28,904,937	692	933	57%	$12,311,563	346	$6,156,724
Asthma Emergency Room Visits [15]	64-	3,992	$1,193,527	1,691	2,301	58%	$687,999	850	$254,150
Work Loss Days [16]	64-	4,910,652	$883,917,360	254,466	2,814,815	57%	$506,666,700	953,659	$171,658,534
Total			$1,015,818,698				$564,242,742		$200,375,138

Source: ARB/OEHHA 2001, EWG 2002, Abt 2000, US Census 2000.

Notes - Table 9

1) The reason why the number of PM2.5-related deaths is higher than the number of PM10-related deaths even though PM2.5 particles are a subset of PM10 particles is related to the study which ARB/OEHHA based their calculations of long-term mortality. This study (Krewski et al. 2000) found long-term mortality to be assocaited only with the fine (PM2.5) fraction of PM10. Although the other major long-term mortality study (Dockery et al. 1993) did find an association between chronic exposure and mortality, ARB/OEHHA decided to based their calculations on the Krewski et al. (2000) study. See ARB/OEHHA 2001 for futher details.

2) The costs related to chronic bronchitis could not be calculated.

3) Hospital charge cost only. Mean hospital stay is 6.02 days with a mean charge of $11,722 (1999 dollars). (Abt 2000)

4) Hospital charge cost only. Mean hospital stay is 7.01 days with a mean charge of $13,929 (1999 dollars). (Abt 2000)

5) Hospital charge cost only. Mean hospital stay is 5.44 days with a mean charge of $17,794 (1999 dollars). (Abt 2000)

6) Hospital charge cost only. Mean hospital stay is 3.03 days with a mean charge of $6,303 (1999 dollars). (Abt 2000)

7) The average asthma ER visit cost is $299 (1999 dollars). (Abt 2000)

8) The median per-day income of California residents in the year 2000 was $180. (US Census 2002)

9) The number of PM10 related deaths at an annual average of 15 ug/m3 was not calculated because no studies have been done on mortality where PM10 is less than 18; as a result OEHHA/ARB uses 18 ug/m3 as background level.

10) The costs related to chronic bronchitis could not be calculated.

11) Hospital charge cost only. Mean hospital stay is 6.02 days with a mean charge of $11,722 (1999 dollars). (Abt 2000)

12) Hospital charge cost only. Mean hospital stay is 7.01 days with a mean charge of $13,929 (1999 dollars). (Abt 2000)

13) Hospital charge cost only. Mean hospital stay is 5.44 days with a mean charge of $17,794 (1999 dollars). (Abt 2000)

14) Hospital charge cost only. Mean hospital stay is 3.03 days with a mean charge of $6,303 (1999 dollars). (Abt 2000)

15) The average asthma ER visit cost is $299 (1999 dollars). (Abt 2000)

16) The median per-day income of California residents in the year 2000 was $180. (US Census 2002)

Who's Against Clean Air?

Lobbyists for the petrochemical industry, automakers and engine manufacturers have mounted a major campaign against the PM standards proposed by the Air Resources Board and Office of Environmental Health Hazard Assessment. The dirty-air lobby includes the Alliance of Auto Manufacturers, representing 13 U.S. and international automakers; Western States Petroleum Association, representing 36 oil companies; and the Engine Manufacturers Association, representing 27 companies. Individual corporations include ExxonMobil, General Electric and BP (formerly British Petroleum) ranked by *Forbes* as the second, third and fourth most powerful corporations in the world.

Oil companies and automakers opposed to cleaner air gave Gov. Davis $175,000 in the current election cycle.

According to records filed with the California Secretary of State, 22 industry associations and individual companies opposed to tougher particulate standards spent more than $7.5 million in 2001 on lobbying at the State Capitol. (Table 10.) Most of these associations and companies have full-time lobbyists in Sacramento or are represented by one or more lobbying firms, some of whom employ whole teams of lobbyists. Their lobbying activity is in addition to hundreds of thousands of dollars in campaign contributions to state politicians made by the associations and companies each year. Just three members of the Western States Petroleum Association – BP, Occidental Petroleum and Chevron Texaco-- collectively gave $175,000 to Gov. Gray Davis in 2000-2001. (Cal-Access 2002.)

The truth behind the smokescreen

Here's a sampling of their arguments against cleaner air, and the truth behind the smokescreen:

- The Alliance of Auto Manufacturers and Engine Manufacturers Association claim the proposed tougher standards will not "result in any greater protection of public health than the current California standards." (AAM 2002.) But the peer-reviewed risk assessment by state scientists found that attaining the "recommended standards would result in a reduction of . . . about 3 percent of all mortality in the population above age 30." (ARB/OEHHA 2001.)

- According to the Western States Petroleum Association, "as much or more public health benefit would be gained from uniform reduction targets than from a single statewide standard." (WSPA

2002.) But because the heaviest particulate pollution is found in lower-income communities of color, such a policy would perpetuate existing environmental inequities"– as if people who live in highly polluted areas have less right to clean air.

- Ford Motor Co. says the proposed standards are "impossibly stringent . . . with practically no hope of attainment." (Ford 2002.) It is hard to take this claim seriously when the auto industry's estimates of the cost of complying with other recent air quality regulations have been inflated by a factor of 14. (Browner 1997.)

Residents of communities of color, who are more likely to breathe dangerous levels of particulate pollution, would benefit most from cleaner air.

The attack on California's proposed particulate standards is a rerun of the same special interests' efforts to derail tough standards at the federal level.

In 1996, the U.S. EPA proposed for the first time to regulate PM2.5, after research had shown strong links between fine particles and death. The EPA proposed to cut allowable levels of PM2.5 in half, saving an estimated 35,000 lives a year nationwide. In California those standards would have saved an estimated 2,500 lives. In reviewing the EPA's 1997 proposal, the Air Resources Board went further, recommending an even tougher PM2.5 standard that would have saved an estimated 3,000 to 4,000 additional lives in the state.

Even before the EPA and ARB announced their proposals, more than 650 industry associations and companies banded together as the Air Quality Standards Coalition. The coalition included the National Association of Manufacturers, American Petroleum Institute, American Automobile Manufacturers Association, Chemical Manufacturers Association, Edison Electric Institute, National Mining Association, American Forest and Paper Association, and American Trucking Association.

Goodbye to barbecues?

The coalition spent $1.5 million on a nationwide lobbying and misinformation campaign, and millions more on industry-funded "sound science" to undermine the peer-reviewed science relied on by the EPA. They spread exaggerated claims about how the proposed standards would impact the American way of life –for example, forcing an end to backyard barbecues. (Skrzycki 1996) A fake "grassroots" group called Citizens for a Sound Democracy targeted African-Americans and Latinos, warning that the cost of new standards was too high for small minority-owned businesses. (Washington Post 1996.)

To the contrary, in 1997 EWG found that residents of communities of color in California would benefit the most from tougher PM standards, because people in communities of color were nearly three times more likely to breathe dangerous levels of PM pollution than Californians living in predominantly white communities. Based on then-current population and pollution data, residents of communities of color had a 54 percent chance of breathing unsafe levels of particulates, compared to a 19 percent chance for predominantly white communities. (EWG 1997a.)

After the standards were adopted by the Clinton Administration, the American Trucking Association challenged them in court, claiming that EPA had overstepped its authority in setting the regulations and that the agency should consider the cost of compliance as well as the benefits to public health. ATA's arguments were dismissed by the U.S. Supreme Court in 2001. The ruling stated that the law clearly established the agency's right to set standards and that the Act "unambiguously bars cost considerations." But the Supreme Court also sent parts of the case back to the U.S. Court of Appeals for clarification. In March 2002 the appeals court affirmed its ruling that "EPA must err on the side of caution – setting the [standards] at whatever level it deems necessary and sufficient to protect the public health with an adequate margin of safety, taking into account both the available evidence and the inevitable scientific uncertainties."

The unanimous appeals court ruling ended five years of counterattack by the opponents of cleaner air. In that period, according to EPA's estimates, 175,000 Americans died from PM pollution whose lives would have been saved or extended if air quality goals represented by the proposed standards had been achieved.

Table 10. Opponents of new PM standards spent almost $7.5 million to lobby against cleaner air in 2001.

	Lobbying Expenditures 2001	Contributions to Gov. Davis, current election cycle
Western States Petroleum Association	$2,137,100	
BP America	$1,253,634	$80,000
Chevron Texaco	$760,456	$35,000
General Motors Corporation	$549,434	
Equilon Enterprises	$521,600	
Ford Motor Company	$418,742	
Phillips Petroleum	$396,143	
General Electric	$255,774	
Nuevo Energy Company	$174,207	
Alliance of Automobile Manufacturers, Inc.	$161,790	
Aera Energy LLC	$151,466	
Occidental Petroleum	$135,225	$60,000
Ultramar Diamond Shamrock Corp.	$120,983	
Exxon Mobil	$112,937	
Toyota Motor Sales, U.S.A., Inc.	$85,673	
DaimlerChrysler Corporation	$51,213	
Kinder Morgan Energy Enterprises	$44,921	
Caterpillar Inc.	$41,735	
Deere and Company	$36,348	
Nissan North America	$25,156	
Venoco Inc.	$3,000	
TOTAL	$7,437,537	$175,000

Source: Compiled from lobbying and campaign finance reports as filed with the California Secretary of State. Available at http://CAL-ACCESS.ss.ca.gov

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EXHIBIT D

Nitrogen Deposition Effects on Coastal Sage Vegetation of Southern California[1]

Edith B. Allen,[2] Pamela E. Padgett,[2] Andrzej Bytnerowicz,[3] Richard Minnich[4]

Abstract

*The coastal sage scrub (CSS) vegetation of southern California has been declining in land area and in shrub density over the past 60 years or more, and is being replaced by Mediterranean annual grasses in many areas. Although much of this loss is attributable to agriculture, grazing, urbanization and frequent fire, even protected areas have experienced a loss in native shrub cover. Nitrogen (N) deposition has not previously been examined as a contributor to CSS decline, but up to 45 kg/ha/yr are deposited in the Los Angeles Air Basin. Several mechanisms were examined by which atmospheric N deposition might affect the shrubs and promote growth of weeds. Field nitrogen fertilization studies at sites of high and low deposition showed that most of the abundant native and introduced species had increased growth after fertilization in the low deposition site, but in a high deposition site only one weedy species, small-podded mustard (*Brassica geniculata *(Desf.) J. Ball), responded to N fertilization. Greenhouse studies showed that both shrubs and weeds had high plasticity in their growth response to N fertilizer, an unexpected result for the shrubs. Preliminary competition studies indicated there was no change in the relative competitive ability of the shrubs or grasses after fertilization. However, negative effects of high N have been detected on the growth and survival of the shrubs. Greenhouse grown California sagebrush (*Artemisia californica *Less.) began to senesce at 6 to 9 months when fertilized with 50 µg N/g soil. This soil N concentration corresponds to extractable N levels in polluted sites, while levels are typically less than 10 µg/g in unpolluted sites. Another source of damage to plants can be cuticular lesions caused by nitric acid, but how nitric acid affects CSS leaves is unknown. Fumigation of pine needles with high ambient levels of nitric acid caused cuticular lesions and stomatal collapse, as well as modifications to nitrogen assimilation pathways. The preliminary evidence suggests that CSS vegetation may decline due to elevated nitrate levels in the soil, and additional studies are need to test effects of ambient nitric acid on CSS leaves.*

Introduction

The coastal sage scrub (CSS) vegetation of southern California has been declining in land area and in shrub density over the past 60 years or more, and is being replaced by Mediterranean annual grasses (Davis 1994, Freudenberger and others 1987, Minnich and Dezzani [In press], O'Leary and others 1992, Zink and others 1995). Although much of this loss is attributable to agriculture, grazing, urbanization and frequent fire, even protected areas have experienced a substantial loss in native shrub cover (Minnich and Dezzani [In press]). Nitrogen (N) deposition has not previously been examined as a contributor to CSS decline, but up to 45 kg/ha/yr are deposited in the Los Angeles Air Basin (Bytnerowicz and Fenn 1996). Nitrogenous compounds in polluted air affect even those tracts of land that have been set aside as reserves, which are in many cases surrounded by urbanization in southern California (O'Leary and others 1992). The coastal sage scrub is of particular interest to conservationists because it supports some 200 sensitive plant species and several federally listed animal species (DiSimone 1995, O'Leary 1989). We need to understand how to manage lands that are influenced by urban air pollution, and whether the biotic communities of these lands can be preserved.

Nitrogen deposition is known to cause vegetation type conversions in other countries, notably the Netherlands (Bobbink and Willems 1987), which have up to 85 kg/ha/yr of N deposited, the highest measured in the world. Nitrogen deposition to reserves is a conservation problem in the Netherlands, where heathlands and species-rich pastures are turning into species-poor grasslands (Asman and others 1989, Bobbink and Willems 1987). The high rates of N deposition in southern California have caused increased soil fertility and surface litter decomposition rates in mixed conifer forests (Fenn 1991), but less is known about

[1] An abbreviated version of this paper was presented at the International Symposium on Air Pollution and Climate Change Effects on Forest Ecosystems. February 5-9, 1996. Riverside, California.

[2] Natural Resources Extension Specialist and Associate in the Agriculture Experiment Station, Department of Botany and Plant Sciences, University of California, Riverside, CA 92521-0124. E-mail: edith.allen@ucr.edu.ppadgett

[3] Forest Ecologist, Pacific Southwest Research Station, USDA Forest Service, 4955 Canyon Crest Ave., Riverside, CA 92507. E-mail: andrzej@deltanet.com

[4] Associate Professor, Department of Earth Sciences, University of California, Riverside, CA 92521. E-mail: richard.minnich@ucr.ed

vegetation change with elevated N deposition in this region. The coniferous forests of the San Bernardino Mountains exhibit symptoms of N saturation, such as high N:P ratios in leaf tissue, high soil N, high rates of N loss from the ecosystem, and others (Fenn and others [In press]). If the relatively productive forests of the Los Angeles Air Basin are N-saturated, then less productive vegetation such as CSS that is receiving similar levels of deposition would also surely be saturated. Less productive vegetation may become N saturated more rapidly than highly productive vegetation because the ratio of deposited N to plant biomass is greater, as suggested by Aber and others (1989, 1992) concept of anthropogenic nitrogen saturation. In addition, long-lived trees may respond less rapidly than shorter-lived shrubs, so we may expect to see a more rapid response in vegetation change in CSS than in nearby forests.

Here we examine the mechanisms by which deposited nitrogen might cause CSS shrubs to be replaced by Mediterranean annual grasses. We present three hypotheses with preliminary data to explain how nitrogen deposition may affect CSS species. Stated in the null form they are 1) CSS shrubs are equally plastic in their growth response to N as are introduced grasses, 2) CSS shrubs are equally competitive as the grasses after N fertilization, and 3) CSS shrub growth and mortality are not affected by high N levels.

Effects of N Deposition on Coastal Sage Scrub Vegetation

We have done series of field and greenhouse experiments on the effects of N deposition on CSS species. The field experiments were done along a gradient of atmospheric N concentrations, using one site with relatively high and another with relatively low N air concentrations for intensive measurements (*fig. 1*). The high deposition site is at Box Springs Mountain near the University of California, Riverside at an elevation of 670 m, and the low deposition site is some 60 km to the south at the Lake Skinner Reserve, elevation 540 m. Longterm climate data are not available at either site, but the city of Riverside, adjacent to Box Springs Mountain, receives 280 mm precipitation annually. We are still working out the actual deposition rates, which are likely lower than the estimated high values of 30 kg N/ha and more recently 45 kg N/ha at Camp Paivika on the western end of the

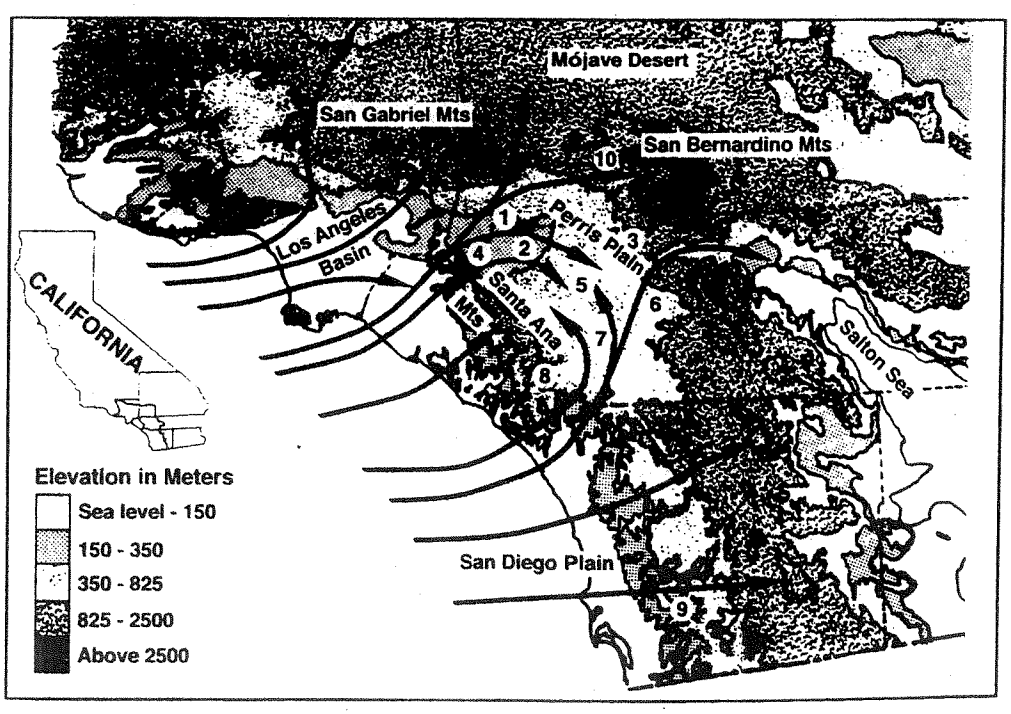

Figure 1 — Sample sites on the Perris Plain referenced in the text. The site of highest measured N deposition is Camp Paivika (10) and the site with lowest air concentrations is (9) at Mission Trails Park in San Diego. Arrows show air flow patterns, with polluted air flowing inland from Los Angeles and cleaner air flowing inland from other coastal sites. A convergence zone of polluted and clean air occurs in the middle of the Perris Plain.
1 = Jurupa Hills,
2 = Mockingbird Reservoir,
3 = Box Springs Mountain,
4 = Lake Matthews,
5 = Motte Rimrock Reserve,
6 = Simpson Park in Hemet,
7 = Lake Skinner,
8 = Santa Margarita Ecological Reserve,
9 = Mission Trails Park in San Diego,
10 = Camp Paivika, San Bernardino Mountains.

San Bernardino Mountains (Bytnerowicz and Fenn 1996, Fenn and Bytnerowicz 1993). Peak air concentrations were measured with an annular denuder system in August, 1994 as 31.0 μg/m³ NO_3^- plus 8.6 μg/m³ NH_4^+ at Box Springs Mt., and 13.9 μg/m³ NO_3^- and 3.9 μg/m³ NH_4^+ at the Lake Skinner Reserve (*fig.* 2). Sulfur was relatively low across the gradient, as is the case in other western air pollution measurements (Bytnerowicz and others 1987). The vegetation at both sites is CSS, with a higher proportion of introduced grasses on Box Springs Mountain than at Lake Skinner (Minnich and Dezzani [In press]). Both sites are on granitic soils. Additional sites were used for less intensive measurements.

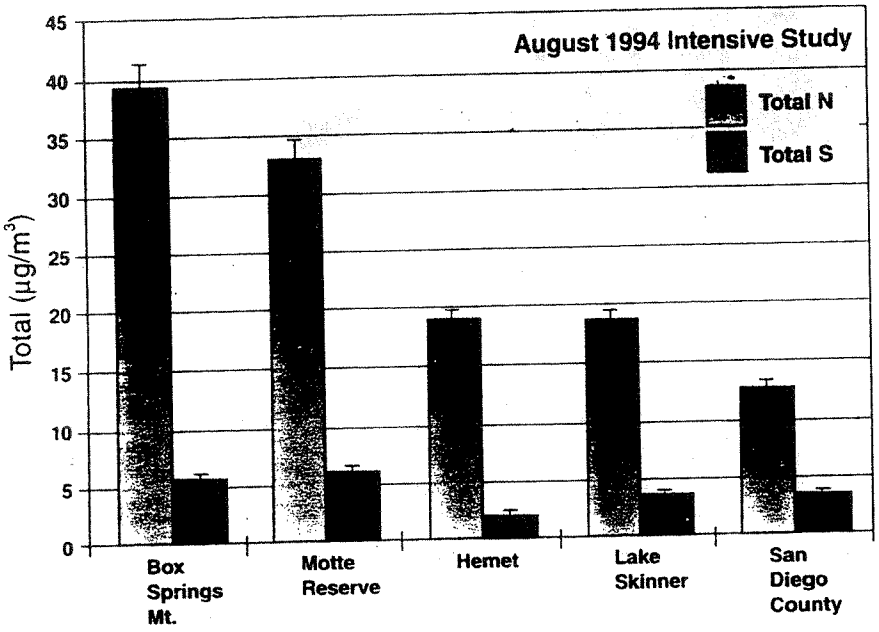

Figure 2 — Nitrogen (NO_3^--N and NH_4^+-N) and total S (SO_4^{2-}-S) concentrations in the atmosphere at five sites representing a gradient of air pollution from Box Springs Mountain in Riverside and southward to San Diego during August 1994. Location of sites is shown in *figure 1*.

In addition to air measurements, soil samples were taken along the gradient of pollution that also included sites to the northwest of Box Springs Mountain (*fig.* 3). The top 2 cm of soils of the Jurupa Hills had as much as 86 μg/g of extractable N in the form of nitrate plus ammonium (*fig.* 3), with nitrate predominating at the more polluted sites. Box Springs Mountain had 44 μg/g, and Lake Skinner had 8 μg/g of extractable N. These soils were collected in September during the dry season, when soil N accumulates because plants have senesced and are no longer taking up N. The soil N measurements confirm the gradient of N pollution by showing that the soils also accumulate N. We do not yet know if the soil N is higher because of accumulated N deposition, or because of increased mineralization that is induced by N deposition (Fenn and Dunn 1989). However, such high concentrations of N in the soil are likely to affect the plant community, which at each of these sites is CSS with an understory of annual grasses. At some sites, such as Box Springs Mountain and the Jurupa Hills, the annual grasses have become dominant with interspersed patches of shrubs. We explore the mechanisms to explain how the vegetation may change from shrubland to grassland after N deposition.

Plasticity Hypothesis

For one species to replace another in a high N soil, it must have a greater response to N, or in other words be more plastic in response to changes in resources (Jennings and Trewavas 1986). To test this hypothesis, we did N fertilization experiments in the field and the greenhouse. In the field, we fertilized plots at the Box Springs Mountain and the Lake Skinner sites. Both sites had burned in November 1993, and the fertilizer treatments included both burned and unburned vegetation. Each site had ten 5 by 5 m² plots and N was applied at a rate of 60 kg N/ha as NH_4NO_3 in two doses of 30 kg/ha each in February and March, 1994. Plant response was

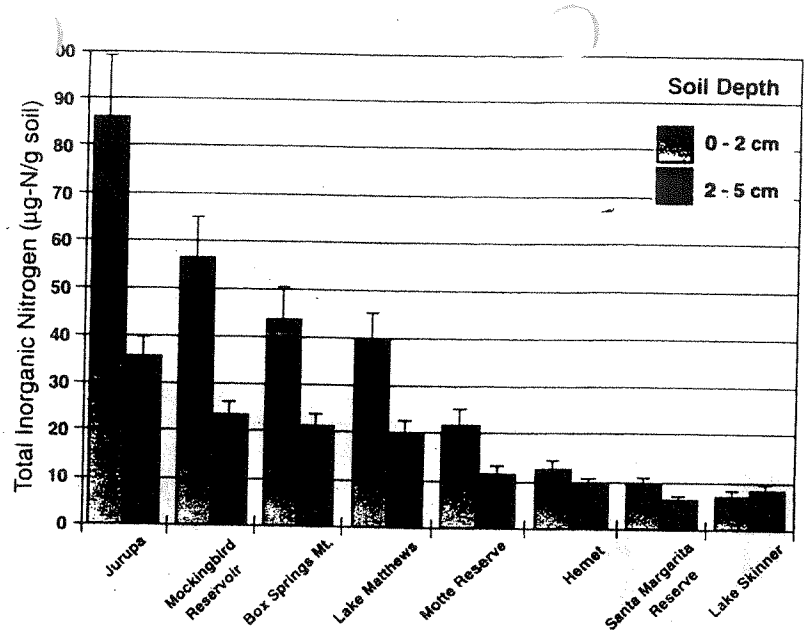

Figure 3 — Extractable soil nitrogen (NO_3^--N and NH_4^+-N) from sites on a nitrogen gradient in September 1995. Soil cores were divided into the upper 2 cm and lower 2 to 5 cm. Location of sites is shown in *figure 1*.

evaluated in May using non-destructive percent cover data. The unburned plots did not respond to fertilizer at either site with one exception described below, so results of fertilization trials are shown only from the burned plots (*table 1*).

At Box Springs Mountain only one introduced forb, small-podded mustard (*Brassica geniculata* [Desf.] J. Ball), responded significantly to N fertilizer on the burned plots, and this was also the only species that responded on the unburned plots (data not shown, but small-podded mustard increased from 17 to 29 percent after N fertilization on unburned plots). None of the other introduced grasses and none of the native species responded significantly at Box Springs Mountain in the burned plots (*table 1*). The introduced grasses included species in the genera wild oats (*Avena*), brome (*Bromus*), fescue (*Vulpia*) and split grass (*Schismus*), while the native species included a diverse mixture of some 70 species.[5] By contrast, at Lake Skinner almost all of the categories of species, both native and introduced, responded to fertilizer, with the exception of the introduced forbs (*table 1*). Small-podded mustard occurred infrequently at Lake Skinner, with < 5 percent cover. The total percent vegetative cover was greater in fertilized plots at both sites, but was higher overall at Box Springs Mountain. These results suggest that the plants are N deficient at Lake Skinner, and N saturated at Box Springs Mountain, with the exception of small-podded mustard, which continued to grow and take up N after fertilization. Leaf tissue N of small-podded mustard increased from 3.2 percent to 4.2 percent after fertilization. This suggests that small-podded mustard may be one of the "winners" in the high N deposition zones, as it can take advantage of additional N, even when soil N is already high. The results from the Lake Skinner site suggest that both native and introduced species are plastic in their responses to N, whereas our original hypothesis was that only the introduced species would be highly responsive to N, or "nitrophilous."

The responses in the field may have been influenced by a number of factors, especially competition in a complex community. To understand the responses of native and weedy plants under more controlled conditions, we performed greenhouse N fertilizer trials of monocultures of three introduced annuals (wild oats [*Avena fatua* L.], red brome [*Bromus rubens* L.], and small-podded mustard), and three native shrubs (California sagebrush (*Artemisia californica* Less.), brittle-bush (*Encelia farinosa* Gray.) and California buckwheat (*Eriogonum fasciculatum* Benth.). The plants were grown in 3.5l pots in native soil amended with 0, 10, 50 and 100 µg/g of N as NH_4NO_3. The soil was collected from the Motte Reserve after scraping off the top 5 cm of soil. After 4 month's growth in the greenhouse, the native shrubs were just as plastic in their responses to N as were the introduced

[5] Unpublished data on file, Department of Botany and Plant Sciences, University of California, Riverside.

annuals (*figs. 4 and 5*). In fact, the annuals tended to saturate at 50 µg/g, wh. the shrubs had continued increased growth to 100 µg/g. This was an unexpected result, as native wildland species are typically thought to have low responses to nutrient additions compared to weeds and crop plants (Chapin 1980). Clearly the native shrubs are adapted to rapid growth during the brief 4 to 6 month rainy period, at which time they likely take up nutrients as rapidly as possible. The growth period is brief in Mediterranean climates, which have a moist winter and spring but the other seasons are dry. However, in an unpolluted situation, the loading of available N in the soil would not be as great as after N deposition. Our field observations showed that available N built up as high as 86 µg/g in the upper 2 cm of soil (*fig. 3*) during the dry season, an amount that would be available to newly growing seedlings at the beginning of the next rainy season. Both the native shrubs and the introduced grasses are apparently able to take advantage of this high soil N.

These results were unexpected and not only confound our notions of how plants behave in the wild (the paradigm states they should have slow rates of nutrient uptake and growth), the results also do not explain why N deposition would shift the vegetation from a shrub-dominated to a grass-dominated type. An alternative hypothesis is that competition for N occurs between the grasses and shrubs that is skewed in favor of the grasses.

Table 1 *— Percent cover of vegetation in nitrogen fertilized and unfertilized treatments in burned plots at the high N (Box Springs) and low N (Lake Skinner) deposition sites.*

Species	BOX SPRINGS N Fert.	BOX SPRINGS No N		LAKE SKINNER N Fert.	LAKE SKINNER No N	
Brassica geniculata	17.1	9.0	([1])	0.0	0.0	n.s.
Bromus rubens	15.6	13.5	n.s.[2]	4.5	2.0	P = 0.07
Other exotic grasses	20.1	14.7	n.s.	10.5	4.2	([1])
Other exotic forbs	27.5	26.3	n.s.	19.8	18.9	n.s.
Native forbs	20.7	19.2	n.s.	37.5	22.7	([1])
Native shrubs	0.0	0.1	n.s.	11.1	4.9	([1])

[1] Significantly different using a t-test at $P < 0.05$.

[2] n.s.=not significantly different.

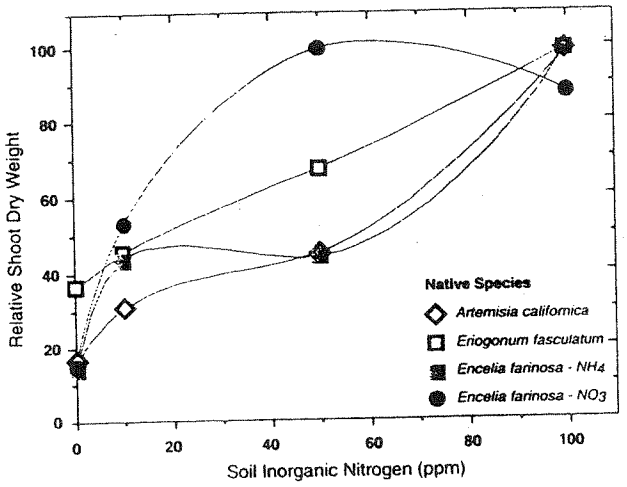

Figure 4 — Relative shoot dry weight of three native shrub species subjected to levels of 0, 10, 50, and 100 µg/g N as NH_4NO_3 in the soil after 4 months of growth. In the case of brittle- bush (*Encelia farinosa*), N was added either as NH_4Cl or as $Ca(NO_3)_2$.

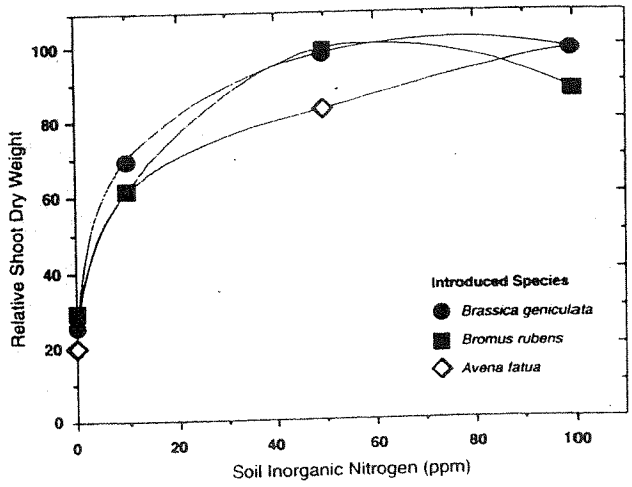

Figure 5 — Relative shoot dry weight of three introduced weed species subjected to levels of 0, 10, 50, and 100 µg/g N as NH_4NO_3 in the soil after 4 months of growth.

Competition Hypothesis

To determine whether N shifts the competitive balance between the grasses and shrubs, we initiated a competition experiment in a patch of introduced grassland that was once dominated by CSS species. This research was done at the Motte Rimrock Reserve about 24 km south of Riverside and intermediate in nitrogen deposition to the Box Springs and Lake Skinner sites. In a blocked experimental design we weeded grasses from ten, 1.2 m^2 plots and left an additional ten plots as controls dominated by the introduced grasses red brome and foxtail fescue (*Vulpia megalura* Rydb.) A few introduced forbs were also present, mainly species of storksbill (*Erodium*), but few native species. One-half of the cleared plots and one-half of the grassy plots were fertilized with two doses of NH_4NO_3 at the rate of 30 kg N/ha each time in spring 1995. Nine seedlings of California sagebrush were planted in each of the plots in a 2 by 2 factorial design to test two levels of N (0 and 60 kg/ha) and two levels of competition (with and without grasses) on the growth of California sagebrush. The seedlings were spaced 30 cm apart, so they did not interfere in aboveground growth during the first growing season. Because we did not wish to harvest seedlings during the first year, we did non-destructive measurements of height and width to calculate shrub volume. Volume was calculated by assuming that the shape of California sagebrush is spheroid.

The grass competition proved overwhelming for California sagebrush, which had only about one-ninth the volume in the grass plots compared to the cleared plots, with or without N fertilizer (*fig. 6*). Nitrogen did not shift the balance of competition in favor or against California sagebrush, it only increased the growth of California sagebrush with and without grass competition. Increased growth of California sagebrush after fertilization should be a benefit, if this means that it can survive competition from the grasses. But in fact most of the California sagebrush seedlings in grass plots died during the normal summer drought that followed these measurements, while many survived in the cleared plots. With or without N the seedlings that experienced grass competition were still tiny, and apparently not large enough, or with roots too shallow, to survive the summer drought. On the basis of this experiment, we cannot expect that areas with N deposition will have greater shrub seedling survival. In fact, we noted mortality of mature shrubs in areas of high N deposition, and proceeded to examine potential negative effects of N on shrub growth.

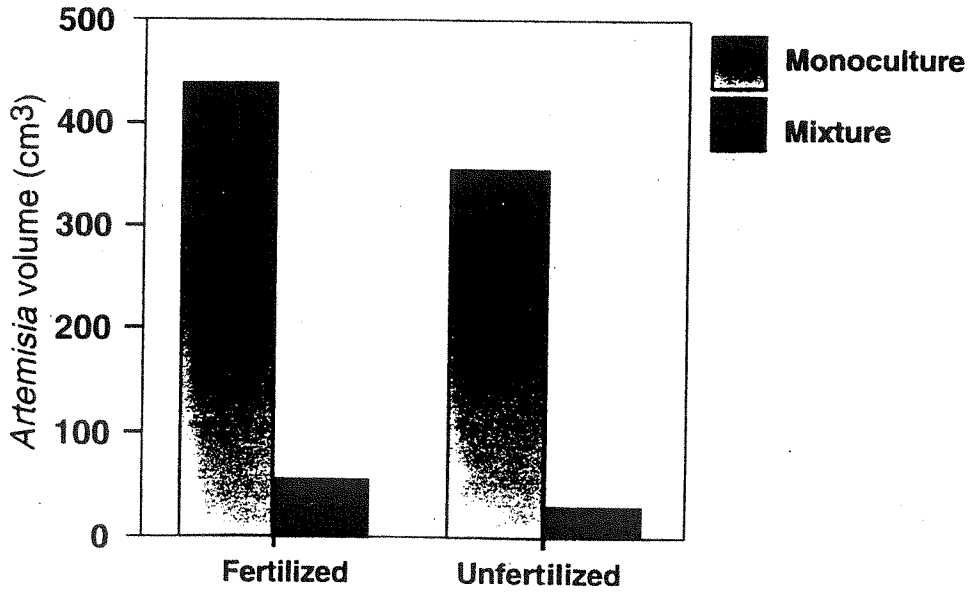

Figure 6 — Volume measurements of California sagebrush (*Artemisia californica*) in weeded (monoculture) and grassy (mixture) plots in the field after 3 months of growth, fertilized with 60 kg/ha N as NH_4NO_3 or unfertilized.

Negative Plant Response to Nitrogen Hypothesis

Because the plasticity and competition hypotheses did not explain why N might cause CSS decline, we continued to test alternative hypotheses. Shrubs in pollution-impacted urban areas have been dying, as can be seen by a walk through Box Springs Mountain County Park and other local reserves. Some 10 percent of the shrubs in the polluted areas that we marked for experimental purposes died during two growing seasons, but we did not experience shrub loss at the Lake Skinner site. We do not yet have an estimate of the rate of mortality on a larger scale, but Minnich and Dezzani [In press] have shown up to a 90 percent loss in shrub cover since the 1930's in urban areas of the Perris Plain (Riverside, California and southward). Shrub loss is lower in the more rural southern Perris Plain. They did their analyses from historic plots in CSS collected by the USDA Forest Service in the 1930's, which they resampled in 1993. Although they showed an increasing pattern of shrub loss toward the urban areas, some factors confounded the results, such as changes in soil type and CSS stand age since the most recent fire at the time of sampling.

Wellburn (1990) explained that N deposition may more frequently harm than fertilize plants, especially in the form of N oxides. We did a series of experiments to determine if elevated N levels might have negative effects on the shrubs. One was a greenhouse fertilization experiment with California sagebrush, where the seedlings were fertilized with 50 µg N/g as NH_4NO_3. Seeds were planted in a soil of low N, and after they were 3 to 4 months old they were fertilized with the 50 µg N/g soil. They were then fertilized every 2 months to maintain high soil N. During the first 6 months the seedlings grew rapidly, as was noted above. Senescence of individual branches at 6 months, and then complete mortality of all seven replicate plants between 6 and 9 months occurred. At 9 months, and even at 1 year, all of the plants that received low N fertilizer levels were still healthy. These negative effects are difficult to explain, as they appear to be a toxic effect. The soil N we maintained in the greenhouse was not as high as the highest levels we measured in the field, up to 86 µg/g in soils of polluted sites during the dry season. The greenhouse experiment was designed to maintain a concentration of 50 µg/g in the soil during the experiment, with two to three fertilizer additions during the 6 to 9 months. In the field, such a high level would build during the dry season and be maintained only until the beginning of the next rainy season. When vegetation begins to grow again in response to rain, the plants take up the available soil N, and our measurements showed that extractable soil N dropped to 10 µg/g even in the most polluted sites.[6] Leaching and denitrification might also remove some of the deposited N from the soil, although both of these are probably minor components of the N cycle in this semiarid shrubland. Such high levels of soil N were not maintained throughout the year, so high soil N would not cause as high a rate of shrub mortality in the field as in the greenhouse. But these results do suggest that, over time, high soil N may be a cause of shrub mortality.

The mechanisms by which shrub mortality occurred under high soil N is not known. Horticulturists have long known that native species from soils of low fertility will have short lifespans in a fertile garden, and advise that low fertilizer levels be used for native California shrubs (Keator 1994). We can discuss a number of alternative explanations for the adverse response of native shrubs to high N. It is likely that California sagebrush was taking up large quantities of N, because it has evolved only to take up this limiting nutrient in the soils, not to exclude it. The metabolic requirements for maintaining and detoxifying N in the tissues (NH_4^+ is toxic in high concentrations) may be expensive, and may lead to a shortened lifespan. Assimilation of NH_4^+ requires that carbon be shunted away from sugar synthesis into amino acid synthesis. This would leave a plant deficient in carbohydrates and consequently energy

[6] Unpublished data on file. Department of Botany and Plant Sciences, University of California, Riverside.

to c[illegible] out other biochemical functions. We plan to pursue research on this question, and currently are testing other species of CSS shrubs to determine if this direct effect is generalizable.

Atmospheric N not only causes increased soil N, it results in exposure of vegetation to elevated levels of gaseous and particulate forms of N that may be deposited on leaf surfaces and interact directly with them (Krywult and others 1996). Fumigation experiments have not yet been carried out on CSS species, but they have been done on ponderosa pine (*Pinus ponderosa* Dougl. ex Laws.) and black oak (*Quercus kelloggii* Newb.). Fumigation with ambient peak summer levels of nitric acid (50 $\mu g/m^3$) caused cuticular lesions and stomatal collapse. These adverse responses by leaf surfaces could result in reduced stomatal control and increased exposure of the leaf to other stresses. In addition, nitric acid fumigation caused induction of nitrate reductase and increases in amino acid levels in leaf tissue (Padgett and others 1995). These negative effects can only be postulated for CSS species until similar research is done. Because up to 90 percent of the leaves of CSS shrubs senesce in the summer, there are fewer opportunities for foliar interaction with airborne N at peak summer pollution levels. The CSS plants would be subject to lower spring airborne nitric acid levels.

Conclusions

The decline of CSS vegetation is caused by a combination of complex factors, beginning with direct destruction of CSS for agriculture and urban construction, possibly including past grazing, and also including increased fire frequency in lands that are adjacent to urban areas. But even when these effects are held constant by examining CSS natural reserves that have not been impacted, these shrublands are still declining. The lack of response of the vegetation at Box Springs Mountain to additional N fertilization suggests that it is already N saturated, one response that is cited by Aber and others (1989) as being an indicator of N saturation. However, two forms of air pollution, ozone and N compounds, are likely both central players in the Los Angeles Air Basin and the Perris Plain. We have not discussed ozone in this paper, although it may also play a role in CSS decline. Ozone is known to increase the mortality of conifers in the local mountain ranges (Bytnerowicz and Grulke 1992, Miller and others 1963). Westman (1990) hypothesized that ozone may also be a cause of CSS decline because it reduced the growth of well-watered seedlings in greenhouse experiments at simulated ambient summer concentrations (Stolte 1982). However, during peak summer air pollution conditions stomates of CSS shrubs are closed and many leaves have senesced. Spring ozone concentrations are relatively low, so ozone effects in the field are likely smaller than greenhouse experiments would suggest. The effects of ozone may not be as serious as previously thought in CSS vegetation. However, until our work began, all of the air pollution effects were attributed to ozone and none to N deposition on this vegetation type.

Our studies showed that the annual grasses that replace CSS vegetation are not more nitrophilous than the shrubs, as they have equal plasticity in response to N. However, one species we have tested to date, California sagebrush, suffers a 100 percent mortality rate in the greenhouse in fertilized soils with available N at levels that are no higher than field soils in polluted sites. We are currently conducting experiments with two additional shrub species, brittle-bush and California buckwheat. We have not seen similar results from studies on ozone that would show such a rapid mortality rate. Most studies on ozone report only decreased growth rates at ambient concentrations, not mortality. In addition, the study on toxic effects of nitric acid vapor on pine and oak leaves suggests that more studies of deposited N on CSS shrubs are

needed. Increased mortality of CSS shrubs in N-polluted areas may be a cause of CSS decline in the Los Angeles Air Basin. CSS may be the first vegetation type in the western United States that exhibits stage 3 symptoms of N saturation, which is defined as toxic effects on the vegetation (Aber and others 1989).

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EXHIBIT E

Restoration of a Native Shrubland Impacted by Exotic Grasses, Frequent Fire, and Nitrogen Deposition in Southern California

Nancy K. Cione[1,2]
Pamela E. Padgett[1,3]
Edith B. Allen[1,4]

Abstract

Natural ecosystems globally are often subject to multiple human disturbances that are difficult to restore. A restoration experiment was done in an urban fragment of native coastal sage scrub vegetation in Riverside, California that has been subject to frequent fire, high anthropogenic nitrogen deposition, and invasion by Mediterranean annual weeds. Hand cultivation and grass-specific herbicide were both successful in controlling exotic annual grasses and promoting establishment of seeded coastal sage scrub vegetation. There was no native seedbank left at this site after some 30 years of conversion to annual grassland, and the only native plants that germinated were the seeded shrubs, with the exception of one native summer annual. The city green-waste mulch used in this study (C:N of 39:1) caused short-term N immobilization but did not result in decreased grass density or increased native shrub establishment. Seeding native shrubs was successful in a wet year in this Mediterranean-type climate but was unsuccessful in a dry year. An accidental spring fire did not burn first-year shrubs, although adjacent plots dominated by annual grass did burn. The shrubs continued to exclude exotic grasses into the second growing season, suggesting that successful shrub establishment may reduce the frequency of the fire return interval.

Key words: coastal sage scrub (Riversidean), herbicide, mulch, nitrogen immobilization, seedbank, weed control, fire, restoration, nitrogen deposition.

[1]Department of Botany and Plant Sciences, University of California, Riverside, CA 92521, U.S.A.
[2]Current address: Jones and Stokes Environmental Consulting, Irvine, California, U.S.A.
[3]Current address: USDA Forest Fire Laboratory, Canyon Crest Rd., Riverside, CA 92507, U.S.A.
[4]Corresponding author: Tel.: (909)787-2123; E-mail: eallen@citrus.ucr.edu

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Introduction

Centuries of human activity have resulted in biological invasions in most ecosystems worldwide (Vitousek et al. 1996). These invasions change species composition, nutrient cycling, resource availability, and disturbance regimes (D'Antonio & Vitousek 1992; Mack & D'Antonio 1998). Human activities such as urban development, agriculture, and anthropogenic nitrogen deposition enhance the spread of invasive species (D'Antonio & Vitousek 1992; Allen et al. 1998, 2000; Stylinski & Allen 1999) to the extent that native vegetation is undergoing type conversion to grasslands or other exotic vegetation types (Freudenberger et al. 1987; Minnich & Dezzani 1998; Pickart et al. 1998). Attempts to restore impacted vegetation types have had varying degrees of success that may be related to the degree of disturbance (Lockwood & Pimm 1999). We examined the potential for restoration of an area that was once a shrub community but has been converted to exotic annual grassland that has an increased fire cycle and has elevated levels of anthropogenic nitrogen deposition.

The study was conducted in coastal sage scrub (CSS), a severely impacted shrubland in southern California that has experienced some 90% loss of the original vegetation to development, agriculture, and vegetation type conversion (Westman 1981). Vegetation surveys indicated a large-scale conversion of undeveloped CSS to exotic annual grasslands since the 1960s, particularly in southern California (Freudenberger et al. 1987; Minnich & Dezzani 1998). Experiments have shown that the invasive annual grasses are more competitive than native perennial shrubs at the seedling stage (Eliason & Allen 1997; Allen et al. 1998, 2000; Yoshida & Allen 2001). Several factors facilitate the invasion of these exotic grasses, including historic grazing, habitat fragmentation and corridors due to urbanization, increased fire frequency, and nitrogen deposition (Alberts et al. 1993; Zink et al. 1995; Allen et al. 1998, 2000). The site that we chose is no longer grazed and is already a vegetation fragment in a city park, so that frequent fire and high soil nitrogen were the two perturbation types that we could control in a restoration experiment.

Increased exotic grass densities not only affect the biodiversity of an ecosystem, they also add a continuous ground cover of flash fuels that promotes recurrent fire (D'Antonio & Vitousek 1992; Brooks 1999). Before approximately 1960, CSS exhibited fire return intervals of approximately 30 years (Keeley 1986). Now, because of the grass cover these return intervals are less than eight years in western Riverside County (Minnich & Dezzani 1998). Although CSS stands dominated by native species are resilient to fire, when burned frequently (intervals of less than 5 years), all shrubs suffer high mortality rates and the landscape tends to convert to grasslands (Zedler et al. 1983; Keeley & Keeley 1984).

In southern California, the CSS has the added stress of nitrogen compounds deposited on the soil, acting like a fertilizer (Allen et al. 1998; Padgett et al. 1999). Up to 50 kg/ha per year of N is deposited downwind of urban areas in southern California, most as NO_3^- originating from automobile exhaust (Bytnerowicz et al. 1987; Fenn & Bytnerowicz 1997). A survey of CSS soils in western Riverside County showed up to 87 μg/g extractable N (nitrate plus ammonium), four times higher than in rural areas not impacted by air pollution (Padgett et al. 1999). Areas of high nitrogen deposition or fertilization tend to have high grass productivity, with shrub and forb communities being converted to low diversity grasslands (Bobbink & Willems 1987; Wedin & Tilman 1996; Padgett & Allen, 1999; Allen et al. 2002). Organic amendments have been used to immobilize soil nitrogen (Reever & Seastedt 1999), and bark mulch was more effective than straw in reducing extractable soil N and promoting CSS shrub establishment (Zink & Allen 1998).

The objectives of this study were to evaluate the effects of reduced grass competition and immobilization of soil N on establishment of native shrubs in an area of frequent fire that was dominated by exotic grasses. Hand cultivation and an herbicide were used to control exotic grasses; bark mulch was used to immobilize soil N. In turn, restoring shrubs should decrease the fire return interval in the area, and this study includes the results of an unplanned wildfire that passed through the research plots.

Methods

Study Site

The site chosen for the experiment was Mount Rubidoux, a 62-ha city park that is a CSS fragment surrounded by urbanization in Riverside, California. CSS consists of 1- to 1.5-m-tall semideciduous shrubs that occur below 1,000 m along the coast from San Francisco, California to Baja California, Mexico, and inland to the peninsular mountain ranges in southern California. This study involved the Riversidian CSS association, also known as the inland sage scrub, which experiences hotter summers and more leaf fall than coastal associations (Westman 1981). Nitrogen deposition, primarily dry deposition of nitrates, tends to be higher in the inland area (California Environmental Protection Agency 1998; Padgett et al. 1999). The area has a Mediterranean-type climate with 280 mm precipitation, most falling during the winter/spring growing season of November through May (Agricultural Experiment Station, University of California, Riverside). According to the Riverside Fire Department, the park burns almost yearly, posing a threat to adjacent neighborhoods. The north-facing slopes of the mountain are completely covered with exotic annual grasses. The south-facing slopes contain an open shrub cover of *Encelia farinosa* (brittlebush) and *Eriogonum fasciculatum* (California buckwheat) with an exotic understory of *Bromus madritensis* ssp. *rubens* (foxtail or red brome) and *Avena fatua* (wild oats).

Experimental Treatments

Before the experiment the northwest slope was burned by the Fire Department in May 1997 to clear annual grass vegetation. Five treatments were applied on the burned site to determine the most effective method to reduce available nitrogen in the soil and minimize competition from grasses. The experimental site covered an area of 59 × 35 m and was on a gentle slope of ca. 8%. It was subdivided into fifty 5 × 5-m plots with 1-m aisles between plots. Plot treatments were set up in a randomized complete block design with five blocks as follows:

(1) Control plots;
(2) Mulch applied (a mixture of eucalyptus leaf and bark mulch applied at a thickness of 2.5 cm) to immobilize soil nitrogen;
(3) Mulch applied plus nitrogen (at a level of 9g N/m^2 as NH_4NO_3) added twice a year, once in November and once in May. This was to control for changes in vegetation caused by nitrogen immobilization and those caused by higher moisture content in the soil due to the mulch;
(4) Grass removed by hand cultivation;
(5) Grass-specific herbicide application (Fusilade, Zeneca).

Each treatment had five seeded and five unseeded replicate plots at the beginning of the study, because it was not known if a native shrub seedbank existed in this area because it had been exotic grassland for approximately 30 years. Species included in the seeding mix were California buckwheat, *Artemisia californica* (California sagebrush), *Mimulus aurantiacus* (monkey flower), *Salvia apiana* (white sage), *Salvia mellifera* (black sage), *Malacothamnus fasciculatus* (bush mallow), and *Keckiella antirrhinoides* (bush penstemon). Species were selected based on a historical plant species list obtained

from Andrew Sanders, herbarium curator at the University of California, Riverside (UCR). The seed mix was applied at a density of 100 pure live seeds per m^2 for each species.

A single rainfall of 3 cm in late September was followed by the first major winter storm on 6 December 1997. The unusual early rains caused a large amount of wild oat emergence before the application of mulch and native seed. On 15 December 1997 all grass that germinated in the hand-cultivated plots was removed by hoeing and pulling. Mulch was obtained from the City of Riverside through the yard waste recycling program. The C:N ratio of the mulch was determined by the University of California Davis Analytical Laboratory using a Carlo Erba CNS Analyzer (Fisons, Dearborn, MI, U.S.A.) and was found to be 39:1. This was applied to the mulch and mulch–nitrogen treatment plots. The seed mix was broadcast to all seed-treatment plots at that time also, after light raking to scarify the soil surface. The grass was removed from the hand-cultivated plots again in April 1998 by cutting at 2 to 3 cm height aboveground. Weedy forbs were removed in early March and again in June.

On 14 January 1998 a 2% solution of Fusilade was applied to the herbicide-treated plots. One of the five seeded herbicide plots was missed during the application, and the Riverside County applicator sprayed it on 4 March 1998. The delay caused a large decrease in native seedling emergence relative to the other four seeded herbicide plots.

During the 1998–1999 growing season, the unseeded treatment plots, which were used to determine the lack of a native seedbank, were also seeded, leaving no unseeded plots in the study. The seeding took place in early January 1999. A 2% solution of Fusilade was used for grass control in all the newly seeded plots. This provided data on native shrub emergence in a year with annual precipitation approximately half the average amount, to compare with a season with almost double the average rainfall. The July 1997 to June 1998 growing season rainfall amount was 522 mm at the UCR Citrus Experiment Station, whereas the 1998–1999 rainfall amount was 142 mm (long-term mean of 280 mm).

Vegetation and Soil N Sampling

Vegetation surveys were conducted twice a year, once in the spring and once in the summer, to determine shrub emergence, shrub survival, and grass densities in the treatments. The first vegetation surveys were done on 31 March 1998 and again in mid-July. Two permanent 0.5 × 0.25-m frames were used for grass density measurements and two permanent 0.5 × 1.0-m frames were used for shrub seedling density in each of the 5 × 5-m plots. Each plot was subsampled twice for a total of 100 measurements for grass density and shrub seedling density. By April 1998 the wild oats were more than 1 m tall. The aisles were mowed and raked to access the plots for sampling. On 22 May 1998 an unexpected treatment was applied when an accidental fire swept through the site, burning grass but not shrub plots. In the second growing season, spring vegetation surveys were completed on 31 March 1999. Additional summer surveys for the newly seeded plots were conducted on 28 June 1999.

Extractable soil nitrogen was monitored throughout the 2-year study. Soil samples were collected from each plot monthly during the wet season (November through May) and every 2 months during the dry season. Initial soil samples were taken 1 November 1997 using a soil core of 2.5 cm diameter to a depth of 3 cm. All samples were frozen until they could be extracted with KCl and analyzed. Extracted soil samples were analyzed for nitrate and ammonium concentrations using a continuous flow analyzer (Technicon II) (Maynard & Kalra 1993).

To compare nitrogen available during the season between the treatments, ion exchange resins were used (Hook & Burke 1995; with modifications as in Padgett et al. 1999). Resin bags were made using rayon mesh. The bags were 5 × 5 cm and contained 5 g of anion resin (ASB-1PSG) or 5 g of cation resin (C-267SG, Polymetrics, Inc., San Diego, CA, U.S.A.). Three pairs of anion/cation ion exchange resins bags were buried to a depth of 5 cm in each plot in January 1998. The anion and cation bags were stapled together at the corner of the bag. The pairs of bags were removed 2 and 4 months after burial. The first set of resins was removed from the site on 19 March. All resin bags were frozen until they could be extracted, and the extract was frozen until it could be analyzed. The ion exchange resin bags were extracted in two separate washes, each being shaken for 24 hr in 50 mL of 1M KCl. The extract was then analyzed for ammonium and nitrate concentrations using a spectrophotometer.

Statistical Analyses

The data were analyzed using Statview 4.0. Analysis of variance was followed by Fisher's least significant difference at a 5% significance level to compare the treatment results. Before analysis, data were checked for normality. The measurements made at different times of the year were analyzed with separate analyses of variance. High mortality between spring and summer measurements resulted in plots with no seedlings of some species, precluding repeated measures analyses (empty cells cannot be included in the analysis). Plots were sampled with two frames each for the vegetation surveys, and the two subsamples were averaged to give the mean plot value. One soil sample per month

was taken and one set of resin bags was collected per plot for a given time period; therefore, for the nitrogen analysis $n = 5$. Monthly measurements were analyzed separately.

Results

Spring/Summer 1998

Annual Weed Cover and Density. Annual grass cover consisted solely of wild oats and was significantly lower ($p < 0.0001$) in the herbicide and hand-cultivated treatments than in all other treatments (Fig. 1). There was no difference in the grass cover between the mulched, mulched/nitrogen, and control plots. Grass cover averaged 76 to 85% in the control plots and mulched treatments, whereas the hand-cultivated and herbicide treatments contained less than 13% grass cover. The herbicide-treated plots had significantly lower grass tiller densities than all other plots (Fig. 2). Because the plants in the hand-cultivated plots (although cut) were still counted if the stems were green, the grass densities in those plots were not significantly lower than the control or mulched plots.

Several species of exotic forbs colonized the plots as well. Because of the high grass cover, very few of these exotics were found in any plots except for the herbicide and hand-cultivated treatments, with a cover of less than 15% in the latter two treatments (percent cover data reported in Storms 1999). The exotic forbs were dominated by two mustard species, *Sisymbrium irio* (London rocket) and *Brassica geniculata* (wild mustard), with 1 to 2% of other exotic annuals that included *Amaranthus* spp. (pigweed), *Salsola tragus* (Russian thistle), *Sonchus* spp. (sow thistle), and *Lactuca serriola* (wild lettuce). The only native forb that colonized was the summer annual *Eremocarpus setigarus* (dove weed). This species accounted for a high 90% of the plant cover in the herbicide and hand-cultivated unseeded plots in July 1998 but under 2% cover in the plots with high grass or shrub cover.

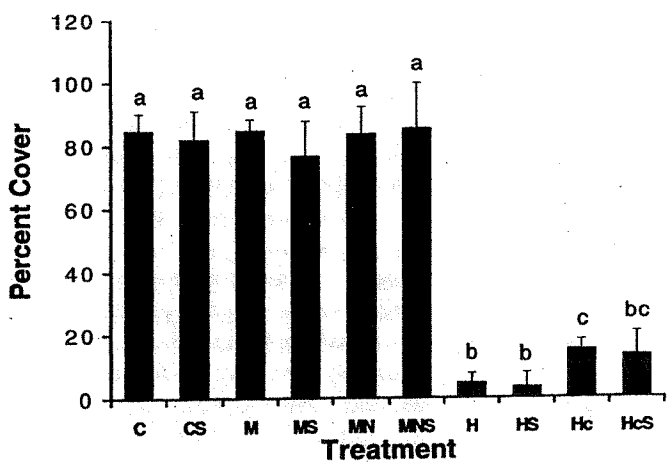

Figure 1. Percent cover of grass by treatment in spring 1998. Treatment codes are as follows: C, control (unseeded); CS, control seeded; M, mulch; MS, mulch seeded; MN, mulch/nitrogen; MNS, mulch/nitrogen seeded; H, herbicide; HS, herbicide seeded; Hc, hand cultivated; HcS, hand cultivated seeded. Bars, 1 SE. Different letters show treatments that are significantly different using least significant difference at 0.05.

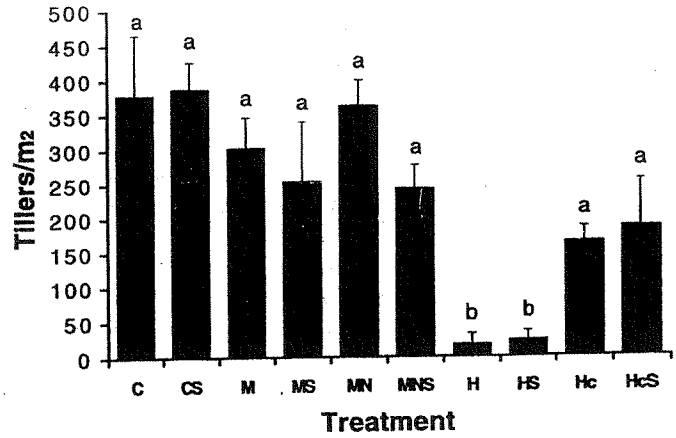

Figure 2. Grass densities in the treatments in spring 1998. See Figure 1 for treatment codes.

Shrub Density. Not a single native shrub species was found in plots that were not seeded. All seeded species had significantly higher ($p < 0.0001$) densities in the herbicide and hand-cultivated plots than in any of the mulch treatments or the control plots (Fig. 3). Seedling density in the herbicide and hand-cultivated treatments was an order of magnitude greater than the control plots for most of the seeded species. California sagebrush, black sage, white sage, and monkey flower tended to be most abundant in the herbicide and hand-cultivated treatments. California buckwheat had significantly higher densities in the herbicide treatment than in the hand-cultivated treatment. Bush mallow and bush penstemon had very low densities. The herbicide plot that received treatment late contained only two seeded species, black sage and bush penstemon, with fewer than two individuals per square meter of each. Because of the effects of the late treatment, that plot was omitted from the statistical analysis.

The accidental May 1998 fire denuded all plots with grass cover, killing all shrub seedlings in the mulched and control treatments. However, the herbicide and hand-cultivated treatments, both of which had less than 20% grass cover, did not burn. Because of the fire, only the herbicide and hand-cultivated plots still had shrubs and were resampled in July 1998. Most shrub species

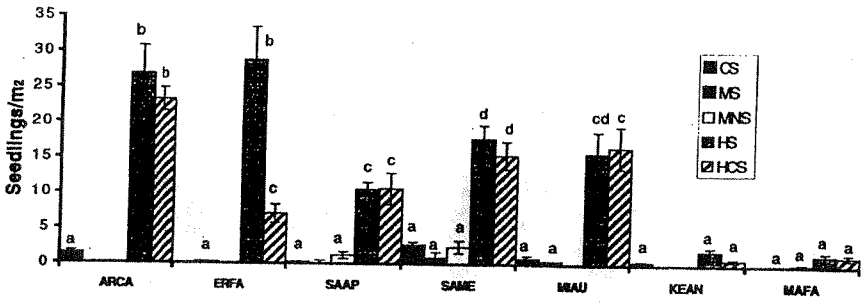

Figure 3. Shrub seedling densities for spring 1998. Only seeded plots are shown, because no shrubs emerged from unseeded plots. Treatment codes are as follows: CS, control seeded; MS, mulch seeded; MNS, mulch/nitrogen seeded; HS, herbicide seeded; HCS, hand cultivated seeded. Species codes are ARCA, *Artemisia californica* (California sagebrush); ERFA, *Eriogonum fasciculatum* (California buckwheat); SAAP, *Salvia apiana* (White sage); SAME, *Salvia mellifera* (Black sage); MIAU, *Mimulus aurantiacus* (Monkey flower); KEAN, *Keckiella antirrhinoides* (Bush penstemon); and MAFA, *Malacothamnus fasciculatus* (Bush mallow). No emergence occurred in the unseeded plots.

had at least 15% seedling survival in July 1998 compared with March density, except monkey flower, which had only 1 to 2% survival (data reported in Storms 1999).

Spring/Summer 1999

Plots Seeded in 1998 In plots seeded in 1998 the only treatments that still contained seeded CSS shrubs in 1999 were the herbicide and hand-cultivated treatments (Fig. 4). California sagebrush had significantly higher density in the herbicide treatment than in the hand-cultivated treatment or than any other species in the herbicide or hand-cultivated treatment. No further grass removal was necessary in these plots. The shrub density and total cover (50–100%) were so high that the only grass found was around the perimeter of the plot areas. In both treatments California sagebrush comprised 25 to 30% of the shrub cover (Fig. 5). Bush mallow, although making up a major part of the cover in the herbicide treatment, was only present as small seedlings in the hand-cultivated treatment. California buckwheat, black sage, and white sage had 3 to 17% cover in the two treatments. Bush penstemon and monkey flower occurred in both treatments, but they did not make up a significant amount of the plant coverage due to their small size and are not shown (Fig. 5).

Plots Seeded in 1999 In the March vegetation surveys of the plots seeded in the dry winter of January 1999, seedlings were found only in the herbicide and hand-cultivated treatments. In the hand-cultivated plots the only seedlings that emerged were black sage. Three species were found in the herbicide treatment, black sage, monkey flower, and California buckwheat (Storms 1999). All species occurred in very low densities of less than one individual per square meter. There was seedling recruitment of California sagebrush, white sage, and black sage through July, but total density was still 1 to 2 shrub seedlings per m^2 in contrast to approximately 100 shrub seedlings per m^2 in spring of 1998.

Soil Nitrogen

The ion exchange resins showed long-term availability of soil N over the 2- and 4-month sample periods. After

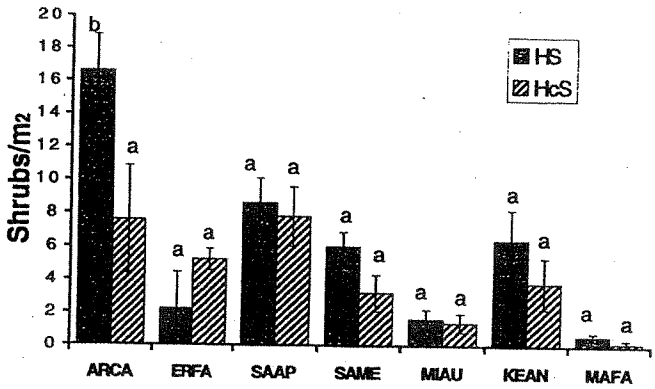

Figure 4. Shrub densities in spring 1999 for the plots that were seeded in 1998. Only seeded herbicide (HS) and hand-cultivated (HcS) treatments are shown, because there were no shrubs in the controls and other treatments. See Figure 3 for species codes.

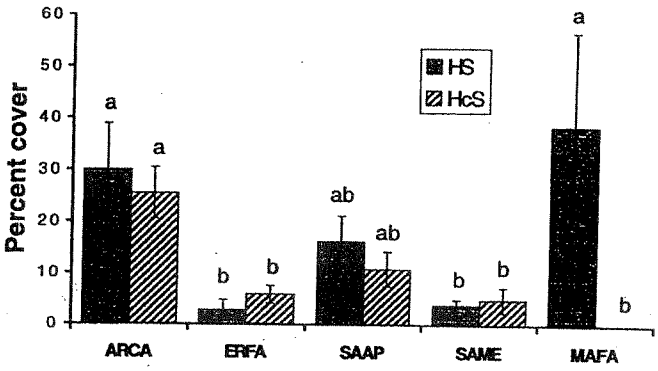

Figure 5. Percent cover of seeded shrubs on the site in spring 1999 for the plots seeded in 1998. See Figure 3 for treatment and species codes.

2 months in March 1998 the resins in the mulch seeded, mulch/nitrogen, and hand-cultivated seeded treatments had significantly lower nitrate levels than the herbicide seeded treatment and the control seeded plots (Fig. 6). The hand-cultivated plots had grass litter on the ground after treatment. However, N immobilization by mulch and possibly grass litter was short-lived, and after 4 months, in May 1998, there were no longer significant differences among nitrate concentrations in the resins. Ammonium concentrations in the resins were considerably lower than for nitrate, with mean values of 25 mg/g resin in March and 125 mg/g in May. In March, the hand-cultivated seeded treatment was significantly lower than any of the other treatments at 7 mg/g, and there were no significant differences in ammonium concentrations among the treatments in May (data not shown). There was no evidence of N immobilization at all in the mulched plots in 1999.

Extractable soil nitrate and ammonium each varied from about 2 μg/g soil to 25 μg/g soil in the control and mulched plots between December 1997 and April 1998. Variances were high, and there were no significant differences in extractable N among treatments at any sample date, except for higher N in the N-fertilized mulch plots (Storms 1999). Thus, the resins gave a more reliable estimate of soil N available to plants and microorganisms than the rapidly turning pool of extractable N.

Discussion

Shrub Establishment

The seeded shrubs established only in the two treatments that had nearly complete removal of annual grasses, the herbicide and hand-cultivated treatments. Mulched and control plots had high grass densities and little or no shrub establishment. Similar results occurred in experiments where survival and growth of California sagebrush transplants and seedlings were reduced by grass competition (Schultz 1996; Eliason & Allen 1997). A comparison of abundant seedling establishment in the herbicide plots that were sprayed in January and the poor establishment in the one plot sprayed in late February demonstrates the importance of eliminating grass competition early in the growing season. Soil moisture depletion by grasses may be a cause of poor shrub establishment and growth, as shown by soil moisture depletion plots with high grass densities (Eliason & Allen 1997).

There was a large decrease in the density of seedling establishment between the 1997–1998 El Niño growing season, with precipitation of about two times normal, and the 1998–1999 La Niña growing season, which received about one half the average precipitation. This suggests the potential importance of irrigation during a series of dry years when using seed as a propagule source. Padgett et al. (2000) initially achieved higher rates of California sagebrush establishment in CSS during a year of average precipitation using irrigation, but after a few months the seedling density of irrigated and unirrigated plots became more similar. Irrigation has been used successfully in other areas, such as a study in an arid region of Texas that found significantly higher shrub establishment with irrigation (Messina & Duncan 1993). However, irrigation is not always available or affordable. Another strategy may be to take advantage of the high predictability of El Niño years with high precipitation in this region (Greenland 1994). Knowledge of an upcoming wet year could be used to plan successful restoration seedings.

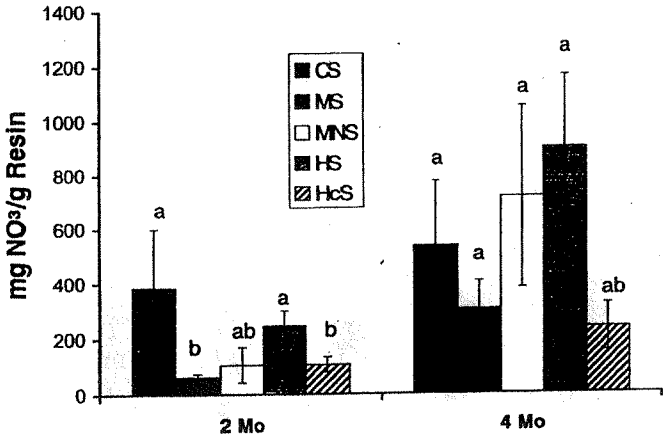

Figure 6. N concentrations as nitrate in the ion exchange resin bags in March (2 month) and May (4 month) 1998. Treatment codes are as follows: CS, control seeded; MS, mulch seeded; MNS, mulch/nitrogen seeded; HS, herbicide seeded; HcS, hand cultivated seeded.

Seedbank and Fire Cycle

Another notable finding of this study was the complete elimination of the native seedbank that occurred within 30 years since conversion to exotic grassland on the northwest side of the mountain (Andrew Sanders, UCR Herbarium, personal communication). Many species have seeds that persist in the soil for decades (Leck et al. 1989), and these are critical for both natural succession and restoration. For instance, abandoned agricultural soils that are cropped for decades may initiate succession from the many native species in the seedbank, although seed dispersal also plays a large role (Leck & Leck 1998). But the Mt. Rubidoux site was not tilled, only burned frequently, and still lost its native seedbank. The seedbank of CSS is especially important for recovery, because most shrub species are obligate seeders after fire (Westman 1981; Keeley & Keeley 1984; Keeley 1986). CSS shrubs do not have lignotubers that promote resprouting, as do many shrubs in nearby chaparral vegetation (Keeley & Keeley 1984;

Hanes 1988). In addition to shrubs, CSS includes a diversity of fire-following annuals that have long-lived seeds in soil, because this vegetation has a 30-year fire cycle (Keeley 1986). However, native annuals were also virtually absent after exotic grass control.

We hypothesize that the frequent fires at 2- to 3-year intervals may have stimulated germination of the native seedbank. Any native annuals or shrubs that germinated would have encountered competition from the exotics. The exotic grasses were apparently better able to take advantage of post-fire sites, and in fact we could see many of their seeds lying on the soil surface even after the May 1997 control burn. The shrubs may have declined because frequent fire did not allow them sufficient time to grow to maturity between fires, initiating a positive feedback of native vegetation decline that promoted the weed seedbank. Nearly total seedbank loss has been documented in tropical forest converted to pasture (Holl et al. 2000), but such rapid loss of the seedbank where no revegetation, tillage, or soil disturbance is involved may be unprecedented.

The control burn of May 1997 before restoration did not effectively reduce the seedbank of the exotic grasses, probably due to the late timing of the burn after seed dispersal. For fire to be used as a weed management tool it must be applied before the seed has a chance to fall into safe sites (Bowler 1990). For instance, prescribed burning was successful for control of *Centaurea solstitialis* (yellow starthistle). The burn was conducted before seed production in starthistle but after the desired species had gone to seed (DiTomaso et al. 1999). Similar careful timing of fire may be attempted in weedy CSS to avoid more costly herbicide or hand cultivation.

The accidental fire of May 1998, which burned grass plots but spared restored shrub plots, suggests that reestablishing native CSS shrubs may increase the interval between fires. Natural CSS communities have a discontinuous canopy that does not promote the spread of fire compared with grasslands. They also have a higher moisture content longer into the growing season than the grasses, which senesce and dry out by May of most years. The restored shrub vegetation planted during the wet El Niño growing season experienced minor grass reinvasion in the herbicide and hand-cultivation plots, but only in patches disturbed by ground squirrel digging. With a 30-year fire cycle, restored stands of CSS must, of course, burn at some time. Bowler (1990, 2000) suggested that the real test of CSS restoration will occur after currently restored stands have been subject to a natural fire cycle and are able to recover from their seedbank.

Soil Nitrogen

The elevated soil nitrogen in this region has promoted increased productivity of exotic grasses (Allen et al. 2002). The increased productivity of the grasses leaves a greater amount of standing dry matter, further exacerbating the fire cycle. A major objective of restoration in CSS is to reduce grass productivity, and one way to do this is to immobilize inorganic soil N. A number of studies have shown that adding organic matter to soil will not only reduce soil N, but will also decrease weed establishment and increase native plant establishment (Young et al. 1998; Zink & Allen 1998; Evans & Belnap 1999). By contrast, the mulch experiment of Reever and Seastedt (1999) did not improve native plant establishment because of the high volume of seed rain from the exotic species present in the area. Although the resin bag experiment showed short-term N immobilization during the critical seedling establishment period, there was still no beneficial effect on growth of the native plants and there was no reduction in the annual grasses. This may have two causes. One was the slight slope that caused downward sliding and patchiness of mulch cover. The second was the low C:N of 39:1 of eucalyptus mulch that may have caused the short-term immobilization of N. We used this mulch because it was provided through the Riverside green waste program and would realistically be available for large-scale restoration. However, Zink and Allen (1998) showed that bark mulch with a higher C:N of 200 is effective for revegetation of California sagebrush because of high N immobilization. The C:N of 39 may be borderline for immobilization in natural soils, which probably require 50 or greater (Barbour et al. 1987; Brady & Weil 1999).

Conclusions

This research showed that the seedbank can be rapidly depleted in frequently burned areas of CSS and must be reintroduced if restoration is to be successful. However, seeding will only be successful in average to high rainfall years (Schultz 1996; Eliason & Allen 1997; Padgett et al. 2000). Nursery transplants have been used in other sites, but these may need irrigation in dry years (Eliason & Allen 1997; Bowler 2000). Grass-specific herbicide and hand cultivation resulted in successful shrub establishment. N immobilization by mulch was short term and did not result in increased native plant establishment. Where a higher C:N mulch is available, this may be a practical solution to reducing high soil N.

Although native shrublands can be reestablished on highly degraded sites such as Mount Rubidoux, these projects cannot be abandoned once the shrubs have been established. Measures must be taken to minimize the reinvasion of the exotic grasses; otherwise, restoration efforts may be reversed. Spot treating with a grass-specific herbicide or hand weeding areas every few years are some methods to minimize reinvasion of exotic grass seed. This project has shown that short-term

small-scale restoration of a low diversity community of CSS is possible, as has also been demonstrated by Bowler (2000). The native understory has been reestablished on a small scale (Bowler 1999), but the long-term survival of planted CSS is unknown because of the short history of revegetation projects (Bowler 2000). Additional factors may also come into play in successful restoration, such as the decreasing density and diversity of arbuscular mycorrhizal fungi with increasing N deposition in CSS (Egerton-Warburton & Allen 2000). Longer-term large-scale restoration and reintroduction of missing species of plants and soil microorganisms are future goals for this declining vegetation type.

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