Supplemental Report of the 2007-08 Budget Act

DEPARTMENT OF FISH AND GAME

January 10, 2008

DEPARTMENT OF FISH AND GAME

2007 BUDGET ACT
RESPONSE TO LAO SUPPLEMENTAL REPORT LANGUAGE

TABLE OF CONTENTS

Budget Act	Report Item #	Report Requirement
2007	**1**	**<u>WCB & DFG (3640 & 3600)</u>** **Vegetation Mapping -** The DFG and WCB shall report on the following: (a) By acre and location, how much vegetation mapping is planned to be conducted in 2007-08. (b) A map of general geographic areas that the DFG and WCB feel are priority locations to conduct vegetation mapping. (c) A map of the known wildlife corridors in the state, based on existing data available to the DFG and WCB.
	2	**Quagga Mussel** - A report on actions the state has undertaken containing the Quagga Mussel- including actions taken by the DFG, the Department of Boating and Waterways, the CDFA, the DWR, and any other state agency involved in the response to this issue. The report must also include a plan for future action and a cost estimate for those planned actions.
	3	**Stream Flow Money From the State Water Resources Control Board**, final report due on or before January 10, 2008.
2007	**SB 85**	**Reporting Requirement** – Vegetation Mapping Standard for the State of California due on or before January 10, 2008.

Legislative Analyst's Office
Supplemental Report of the 2007 Budget Act
2007-08 Fiscal Year

Item 3640-301-6051– Wildlife Conservation Board / Department of Fish and Game

1. ***Wildlife Conservation Board (WCB) Vegetation Mapping. The Department of Fish and Game and WCB shall report to the Legislature (including the budget and fiscal committees of both houses) on or before January 10, 2008, on the following:***

   (a) By acre and location, how much vegetation mapping is planned to be conducted in 2007-08.
   (b) A map of general geographic areas that the Department and WCB feel is priority locations to conduct vegetation mapping.
   (c) A map of the known wildlife corridors in the state, based on existing data available to the Department and WCB.

DEPARTMENT RESPONSE:

FY 2007-08 – Vegetation Classification and Mapping Program

Program Summary

The Department of Fish and Game's (Department) Vegetation Classification and Mapping Program (VegCAMP) facilitates and oversees efforts to develop accurate and scientifically defensible maps and classifications of vegetation and/or habitat throughout the state. It does this to support conservation and management decisions at the local, regional, and state level. Virtually all such efforts require a map and concomitant classification of vegetation and habitats to help drive planning and long-range management processes. VegCAMP works with many branches of local and state-wide agencies and organizations involved with such efforts to help ensure the best, most effective methods to accomplish such work (for example, see link to the vegetation MOU committee at http://ceres.ca.gov/biodiversity/vegmou.html).

The Department's VegCAMP program is a relatively new one, formed in the spring of 2003 and has evolved from previous programs within the Biogeographic Data Branch (BDB) including the Natural Communities program within the California Natural Diversity Database and the Significant Natural Areas Program. VegCAMP is a synthesis of these two previous programs that enables more focused effort on developing and maintaining the maps and classification of all vegetation and habitats in the state. The staff in the VegCAMP Unit are professional ecologists with training in landscape, vegetation, plant, and animal ecology.

The principal roles of the VegCAMP program include:

a) Developing and maintaining a standardized vegetation classification system for California.
b) Developing best methods of vegetation assessment including sampling, analyzing, reporting, and mapping vegetation at multiple scales.
c) Training resource professionals on these techniques and coordinating with other agencies and organizations to ensure a statewide, standardized approach toward collecting, reporting, and interpreting vegetation data.
d) Developing best practices for using these data for long-range conservation and management of natural lands in the state.
e) Conducting integrated vegetation assessments throughout the state in areas with high conservation and management interest to the Department and other agencies.
f) Archiving and distributing quality vegetation data to all who need it.
g) Coordinating with other state, federal, and local agencies and organizations involved in vegetation assessment.
h) Integrating vegetation assessment with single species and habitat assessment for unified conservation assessments.

Long-range goals of the program include:

a) Completing and maintaining a state-wide vegetation map and classification in collaboration with other agencies and organizations.
b) Developing the most appropriate vegetation products for conservation planning and natural resources management within the state.
c) Integrating the program with similar ones from other states and countries to facilitate national and international conservation and management of natural resources.

(See Figure A for a map of projects completed to date.)

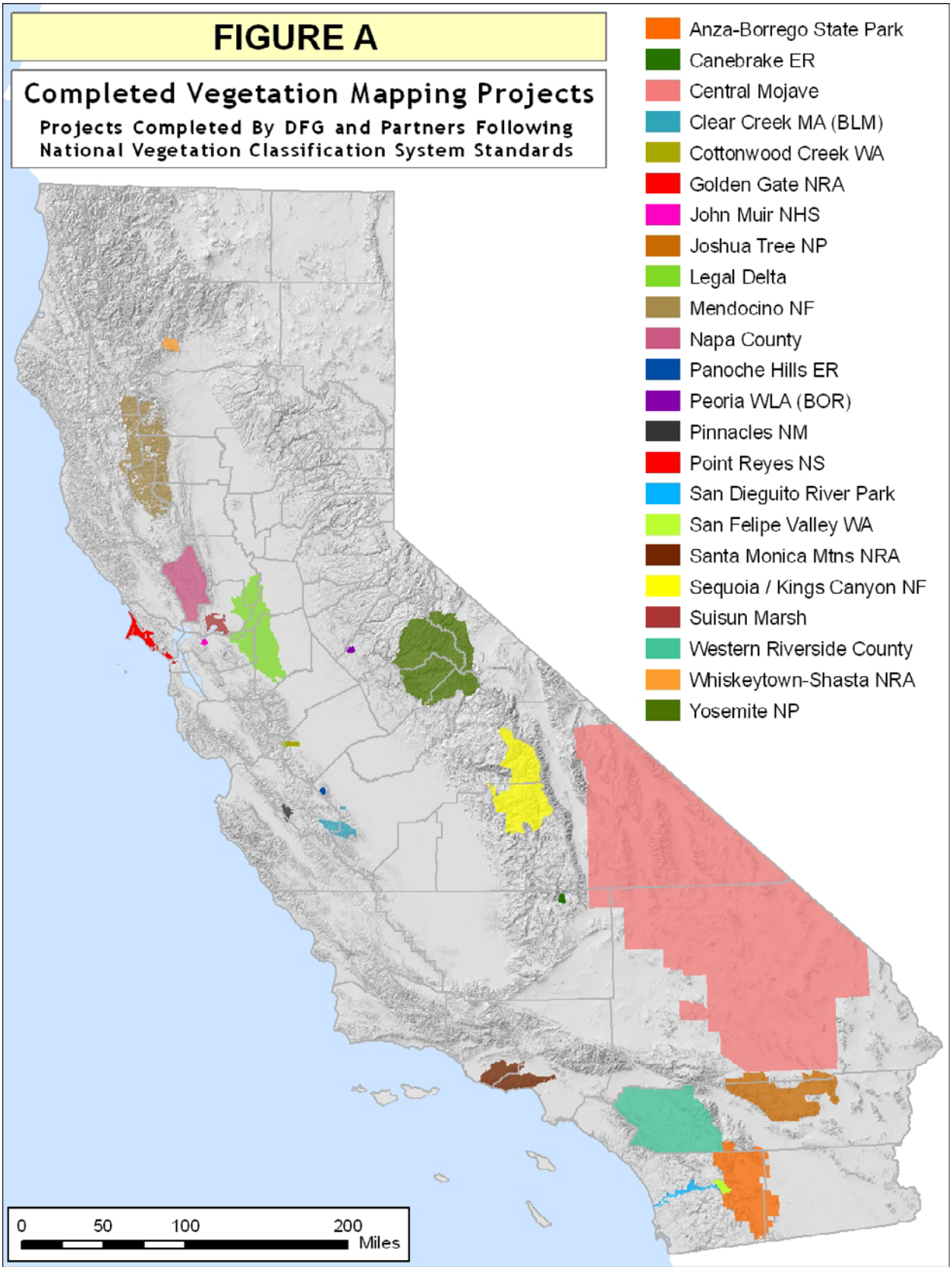


FIGURE A
Completed Vegetation Mapping Projects
Projects Completed By DFG and Partners Following National Vegetation Classification System Standards
Anza-Borrego State Park
Canebrake ER
Central Mojave
Clear Creek MA (BLM)
Cottonwood Creek WA
Golden Gate NRA
John Muir NHS
Joshua Tree NP
Legal Delta
Mendocino NF
Napa County
Panoche Hills ER
Peoria WLA (BOR)
Pinnacles NM
Point Reyes NS
San Dieguito River Park
San Felipe Valley WA
Santa Monica Mtns NRA
Sequoia / Kings Canyon NF
Suisun Marsh
Western Riverside County
Whiskeytown-Shasta NRA
Yosemite NP
0
50
100
200
Miles

a) By acre and location, how much vegetation mapping is planned to be conducted in 2007-08.

Completion of the Northern Sierra Nevada vegetation classification and mapping Project –

The first part of this project, the development of a vegetation classification of the northern Foothills, was funded by the Resources Assessment Program for $395,500 in 2004. The project area encompasses 2.56 million acres. The classification was finalized in the spring of 2007, the mapping project will start as soon as contracting allows. Mapping will be completed within 10 to 18 months. WCB is providing approximately $3.9 million of Proposition 84 funding, through a grant to the Department, to complete this project. The Department is providing the match through in-kind services of $1.5 million from existing salaries of permanent staff dedicated to the project, over the period of the grant. In addition, the Sierra Nature Conservancy has committed $300,000 annually from their operating budget for the current year and next, through a contract agreement with the Department.

A detailed vegetation map of the Northern Sierra Nevada Foothills will serve as a surrogate for wildlife and plant habitat for many species, and when combined with species and community level wildlife and plant inventory information could serve as the baseline for habitat quality and quantity monitoring. Such a map is critical for sound regional planning. Several wildlife areas and jointly-managed areas (including Tehama, North Table Mountain, Dye Creek, Daugherty Hill, Spenceville, and Pine Hill) are within the northern Foothills project area, and would also benefit from detailed mapping.

(Figure B – Northern Sierra Project Area map on next page).

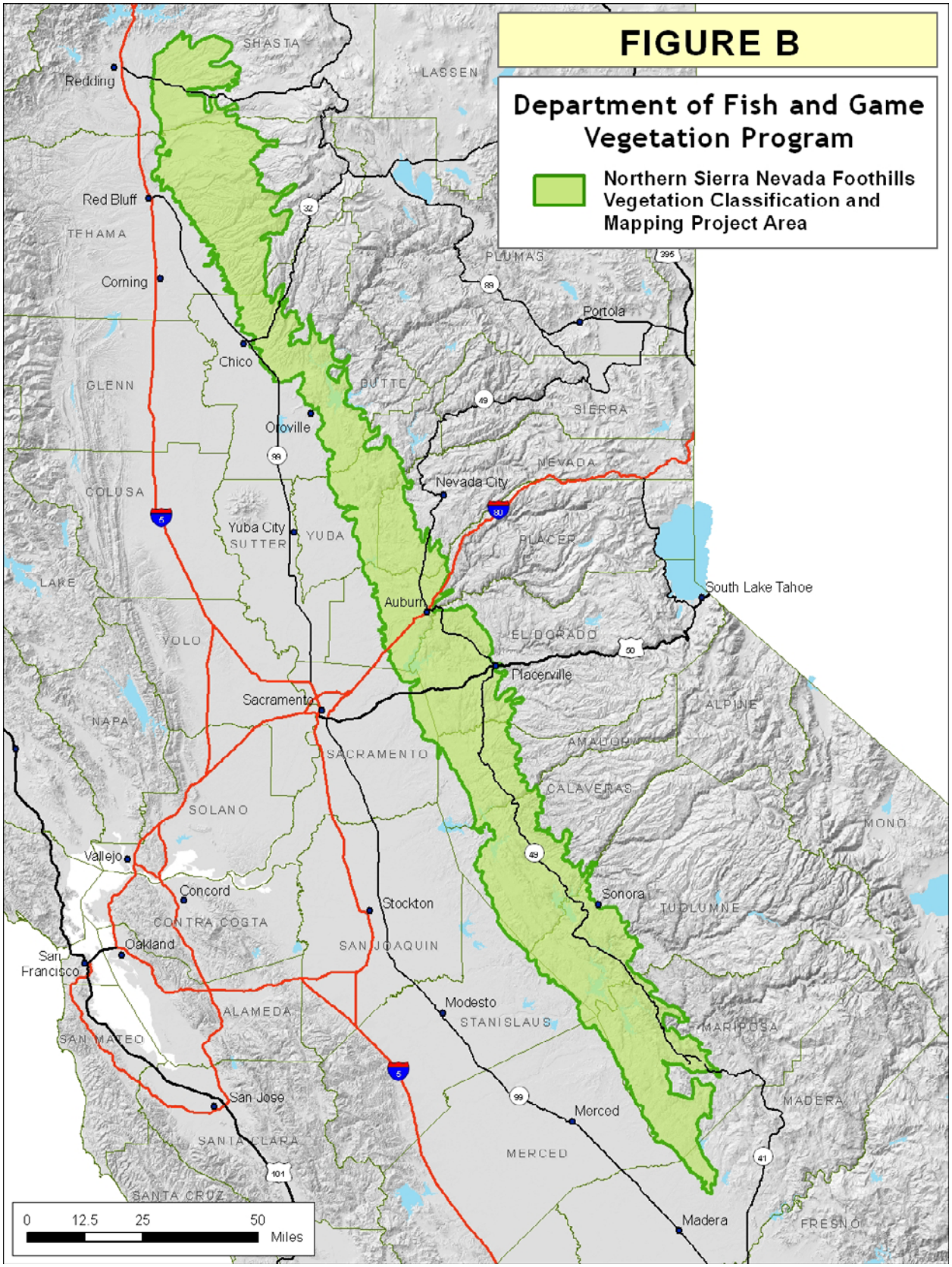


FIGURE B
Department of Fish and Game
Vegetation Program
Northern Sierra Nevada Foothills
Vegetation Classification and
Mapping Project Area
SHASTA
LASSEN
Redding
Red Bluff
TEHAMA
Corning
PLUMAS
Portola
Chico
GLENN
BUTTE
SIERRA
Oroville
NEVADA
Nevada City
COLUSA
Yuba City
SUTTER
YUBA
PLACER
LAKE
South Lake Tahoe
Auburn
YOLO
EL DORADO
Placerville
Sacramento
ALPINE
NAPA
AMADOR
SACRAMENTO
CALAVERAS
SOLANO
MONO
Vallejo
Concord
Stockton
Sonora
TUOLUMNE
CONTRA COSTA
Oakland
SAN JOAQUIN
San
Francisco
Modesto
ALAMEDA
STANISLAUS
MARIPOSA
SAN MATEO
San Jose
Merced
MADERA
SANTA CLARA
MERCED
SANTA CRUZ
Madera
FRESNO
0 12.5 25 50
Miles

In addition, the VegCamp Unit is wrapping up the final vegetation classification and maps for the Ballona Wetlands Ecological Reserve and the Pine Creek and Fitzhugh Creek Wildlife Areas, and is helping to coordinate the update to the vegetation classification and map for the Suisun Marsh.

(Figure C – Dept of Fish and Game Vegetation Program 2007-08 Projects in Progress map on next page).

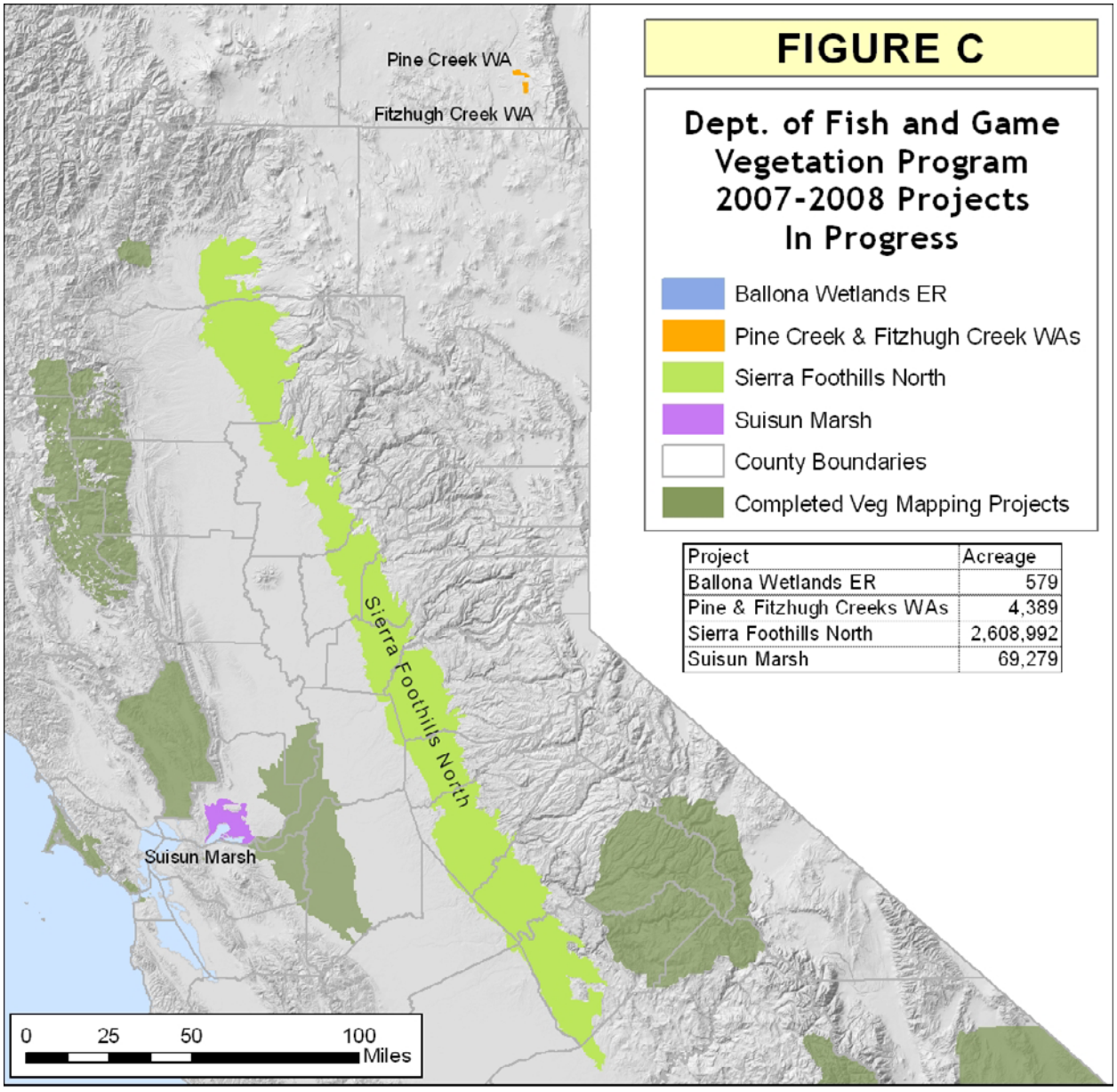
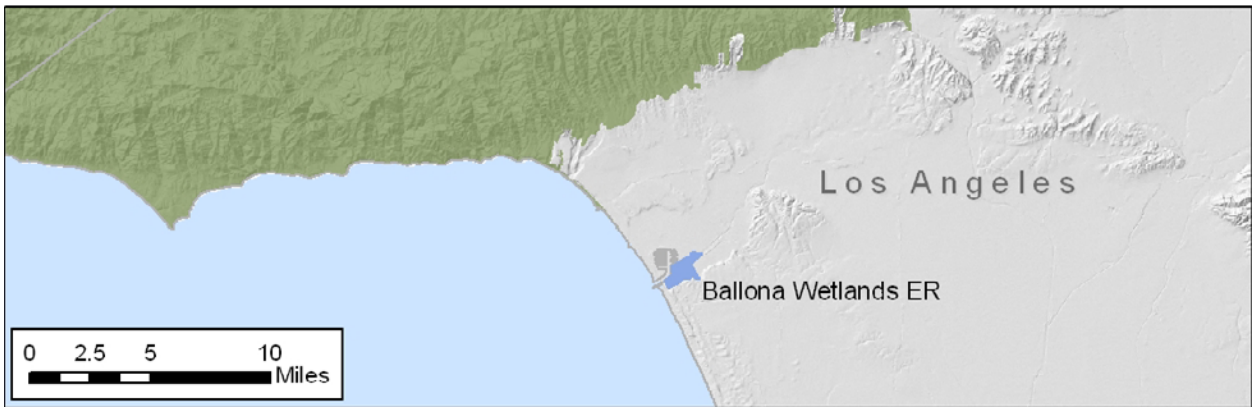


FIGURE C
Dept. of Fish and Game
Vegetation Program
2007-2008 Projects
In Progress
Ballona Wetlands ER
Pine Creek & Fitzhugh Creek WAs
Sierra Foothills North
Suisun Marsh
County Boundaries
Completed Veg Mapping Projects
Project | Acreage
Ballona Wetlands ER | 579
Pine & Fitzhugh Creeks WAs | 4,389
Sierra Foothills North | 2,608,992
Suisun Marsh | 69,279
Pine Creek WA
Fitzhugh Creek WA
Sierra Foothills North
Suisun Marsh
0 25 50 100 Miles


Los Angeles
Ballona Wetlands ER
0 2.5 5 10 Miles

b) <u>A map of general geographic areas that the Department and WCB feel are priority locations to conduct vegetation mapping.</u>

WCB and the Department have identified at least six priority areas for future vegetation classification and mapping projects.

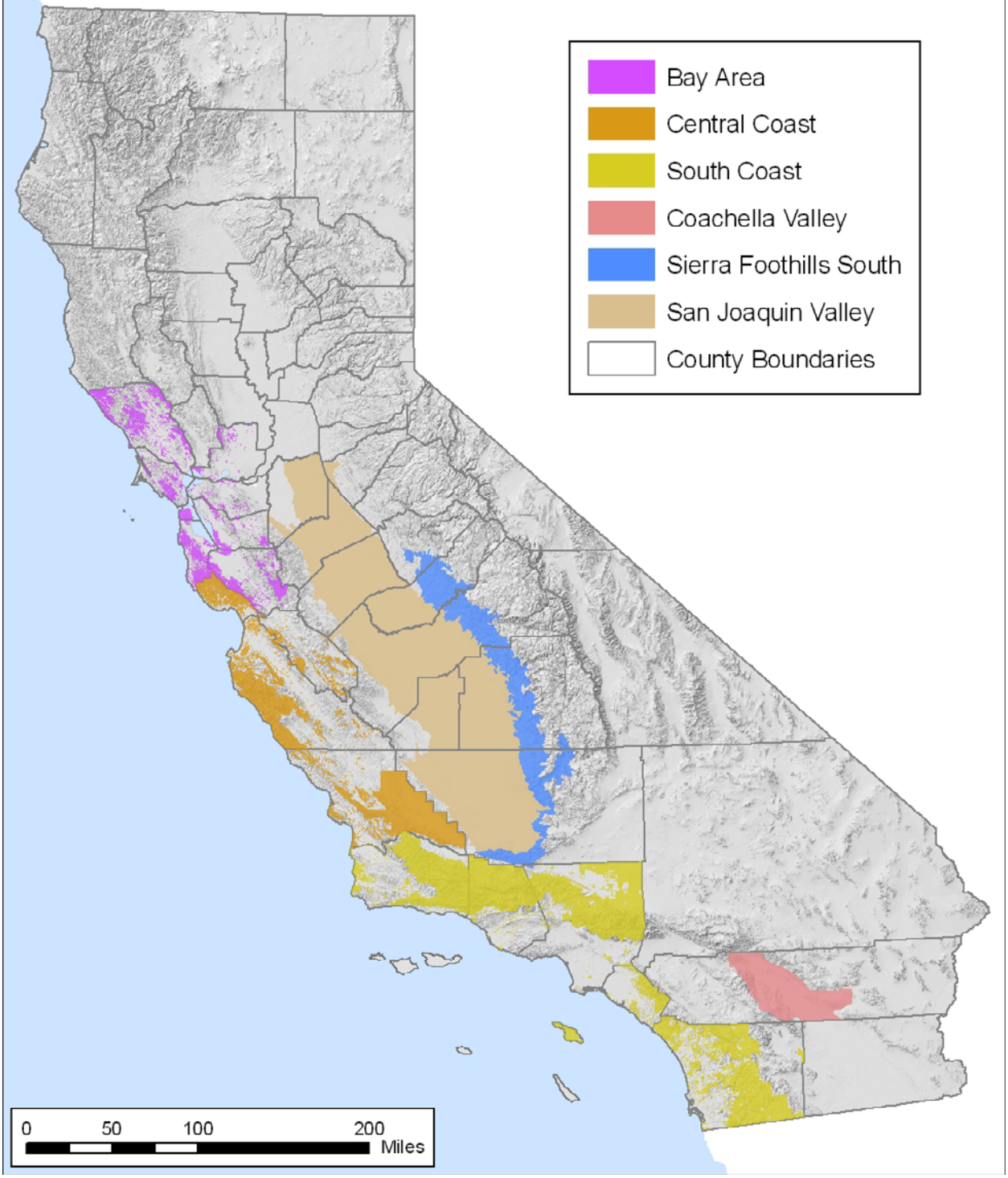
(Figure D – High Priority Areas map on next page):

- Southern San Joaquin Valley Counties—approximately 5,320,984 acres
- Southern California Association of Governments Area (SCAG) -- approximately 4,181,971 acres
- San Diego Association of Governments Counties (SANDAG) – approximately 1,008,255 acres
- Southern Hwy 99 Corridor—approximately 2 million acres
- Northern Hwy 99 Corridor—approximately 2.5 million acres
- Association of Bay Area Governments Counties (ABAG) – approximately 3 million acres

Other major infrastructure and NCCP projects such as Tehama-Butte-Yuba Counties, Contra Costa County, SACOG Counties; collectively several million acres.

FIGURE D

DFG Vegetation Classification and Mapping Program
High Priority Areas For Classification and Mapping



c) A map of the known wildlife corridors in the state, based on existing data available to the Department and WCB.

Brief introduction to ecological connectivity and corridors –

The term “wildlife corridors” is often used interchangeably with ecological connectivity. Connectivity, however, is a much broader term that refers to an important function of ecological systems. It is the degree to which the landscape (including waterways) facilitates or impedes the movement of species among preferred habitats (Taylor, et al, 1993). Functional connectivity can exist at a wide range of spatial scales (feet to hundreds of miles) for a variety of purposes (for example, daily foraging, seasonal migrations or expansion to new areas). It is important to recognize that the landscape is perceived differently by different species and functional connectivity for one species (deer or mountain lion, for example) may not work at all for other species (salamanders or plants).

Corridors are simply one way to facilitate connectivity. Connectivity can also be provided in other configurations, such as broad habitat mosaics over large, relatively natural areas or stepping stones of habitat patches (for example, wetlands along waterfowl migration routes) (Bennett 1999, Noss and Daly 2006).

Important wildlife corridors can be defined as crucial habitats that provide connectivity over different time scales (including seasonal or longer) among areas used by animal and plant species (WGA 2007). Most commonly, corridors are identified as relatively linear patches of habitat through which species may be able to move.

Wildlife corridors can exist within unfragmented landscapes or join naturally or artificially fragmented habitats. They may be connections that are not fully and routinely occupied by species of interest but that serve to ensure that such species are able to use disconnected tracts of habitat. They may also be habitat that serves as permanently occupied stepping-stones to facilitate multi-generational movement between larger habitat areas.

Types of approaches used to identify corridors –

Scientists, planners, and conservationists have applied a wide variety of methods to identify and design corridors. The variation in methodology can be traced both to technical issues (e.g., whether geographic information systems and associated modeling tools were available) and to the functions of connectivity of interest in particular cases. Three basic approaches to the design of broad-scale linkages: (1) intuitive or ‘‘seat-of-the-pants’’ approaches; (2) empirical approaches; and (3) modeling approaches, as well as many combined approaches. The following assessment of these approaches is summarized from Noss and Daly 2006.

Intuitive, or opportunistic, approaches are based on subjective best-guesses, existing knowledge, or expert opinion. These may include the shortest, most direct, or most “logical” route between core areas, particularly in landscapes with little natural habitat

remaining and where options for connections between core areas are limited; the only remaining routes, such as in highly disturbed landscapes; routes incorporating sites of conservation interest, such as riparian zones; or routes based on expert knowledge of focal species, such as mountain lions or bighorn sheep. These approaches can be useful at times, particularly where there is little data and high uncertainty. For example, the most obvious route to the human eye may also be the most obvious to animals. But in other cases, animals may perceive the landscape very differently, using other sensory inputs such as smell. Expert-based approaches alone can be relatively subjective, lack rigorous scientific methods and documentation and are vulnerable to criticism from scientists as well as from members of the public. These expert-based approaches are best complemented by more rigorous empirical and modeling approaches, using both to inform each other in a step-wise, iterative fashion.

Empirical approaches use field-level data to document actual movement of species through a corridor. These include recording animal presence, movement, or signs based upon direct observation, use of movement-triggered cameras, or tracking; radio telemetry, and marking and recapturing. These approaches provide the most robust, defendable evidence of all approaches described here, but they are the most expensive way to document functional connectivity.

Modeling approaches typically use features of the landscape to identify areas that may be most suitable for movement. They provide a more rigorous, repeatable method for identifying corridors that reflect species needs than expert-based approaches alone. They are best complemented with use of knowledgeable experts and field validation. The usefulness of these models increases as the quality of data improves. Important data sets include natural vegetation and land cover, topography, species ranges and habitat preferences, as well as data that represent movement barriers such as housing and roads. “Least-cost path analysis” is a popular method of using geographic information systems (GIS) to identify corridors. ‘‘Cost’’ in this sense is the estimated cost to the animal or population; that is, how much the route might “cost” a species in terms of survivability and risk of danger while moving. It doesn’t predict the movement of animals, but rather it predicts the likelihood of surviving the passage from one area to another. The lower the cost, the higher the likelihood is for survival. The results from such modeling will vary depending on which species are targeted because different species have different conservation needs.

Landscape permeability, or habitat integrity, is modification on the least-cost path approach that estimates the relative potential for animal passage across the entire landscape, including the identification of potential barriers to movement. This approach can be useful where core or dispersal habitat for a particular species within a potential linkage is lacking.

A more complex approach is spatially explicit population modeling. This type of approach can be very useful because it explicitly includes the locations of habitat patches, individuals, and other features, allowing scenario testing of the effects of changing landscape structure on population dynamics. They can provide qualitative insights into factors, such as variance in population size, that are difficult to explore using static models. Although more powerful, these models are sensitive to the

availability of data on species dispersal factors, which are often poorly known for most species.

Survey methods –

A statewide assessment of wildlife corridors can be conducted in a variety of ways, with the quality of the results varying considerably with the amount of time, funding, and expert involvement. Given the short timeframe for this request, the Department elected to conduct a rapid survey of existing or recent efforts that already have identified wildlife corridors in California. The Department collaborated with the California Department of Transportation in conducting this survey.

This survey focused on terrestrial corridor assessments only, although efforts to identify aquatic connectivity are important also. It targeted those assessments directed at broad spatial scales, larger than thousands of acres. The survey contacted 136 individuals in 6 federal agencies, 9 state agencies, 11 local government agencies, 6 universities, and 15 non-governmental organizations.

Results –

Many different efforts are underway in California to identify wildlife corridors. Due to the time constraints on this report, we were able to obtain GIS data on only six connectivity assessment efforts by November 31, 2007. No single statewide study of connectivity has been conducted and not all parts of California have been studied equally.

Table 1 provides an overview of each of the data sets we identified. Each project is described in terms of the:

- lead researcher or coordinator to contact for more information,
- date of project completion,
- geographic scope,
- focal species or habitats, and
- type of approach used.

The table also indicates the type of data available for each project and the availability of other documentation.

These are only partial results of the survey. The survey will continue for a few more months with existing funding. However, these efforts help exemplify the type of connectivity assessments underway, as well as highlighting the differences in approaches and important gaps in our overall understanding of wildlife connectivity throughout the state.

Table 1. Identified Connectivity Assessment Projects

Project Name	Data Contact; Study Contact	Organization	Project Completion	Geographic Scope (by county or region)	Focal Species or Habitats	Method/ Technique	Areas Connected	Available on BIOS as of Nov 2007	Online Documentation
Central Coast Mountain Lion Connectivity Assessment	Thorne, James	University of California, Davis	2006	Central Coast	Mountain lion	GIS Analysis - Cost surface	Core areas of favorable mountain lion habitat	Yes	http://ice.ucdavis.edu/node/186
Bighorn Sheep	Epps, Clinton	University of California, Berkeley	2004	Mojave Desert	Big Horn Sheep	GIS Analysis - Least cost path	Defined areas of population derived from kernel density of radio telemetry data	Yes	
Coachella Valley Multiple Species Habitat Conservation Plan And Natural Community Conservation Plan	Peihl, Nickolas; Sullivan, Jim	Coachella Valley Association of Governments	Not specified	Riverside	Multiple focal species	Observation/ Analysis	Core Habitat areas defined as areas of unfragmented habitat for each species	No	http://www.cvmshcp.org/Plan_Documents.htm
East Contra Costa County Habitat Conservation	John Kopchik	East Contra Costa County Habitat Conservation	Oct-06	Eastern Contra Costa County	Multiple species and habitats	Observation/ Analysis		No	http://www.co.contra-costa.ca.us/depart/cd/water/HCP/documents.html

Project Name	Data Contact; Study Contact	Organization	Project Completion	Geographic Scope (by county or region)	Focal Species or Habitats	Method/ Technique	Areas Connected	Available on BIOS as of Nov 2007	Online Documentation
Plan and Natural Community Conservation Plan		Plan Association							
Missing Linkages Conference	Penrod, Kristeen	South Coast Wildlands	2001	Statewide	Multiple focal species varying by region and available data	Model: Delphi Approach	Zones of habitat that address needs of multiple focal species	Yes	http://www.calwild.org/resources/pubs/linkages/index.htm.
Recovery Plan for Upland Species of the San Joaquin Valley	Kelly, Patrick	Endangered Species Recovery Program	1996-1997	San Joaquin Valley	Proposed areas where connectivity and linkages should be promoted	Expert opinion	Non-native grassland and scrub communities outside areas of irrigated agriculture	Yes	http://esrpweb.csustan.edu/publications/pubhtml.php?doc=sjvrp&file=cover.html
South Coast Missing Linkages Project	Penrod, Kristeen	South Coast Wildlands	2001-2006	South Coast	Multiple focal species	Observation/ Analysis	Zones of habitat that address needs of multiple focal species	Yes	http://www.scwildlands.org/reports.aspx

Project Name	Data Contact; Study Contact	Organization	Project Completion	Geographic Scope (by county or region)	Focal Species or Habitats	Method/ Technique	Areas Connected	Available on BIOS as of Nov 2007	Online Documentation
UCD San Joaquin Valley Assessment	Huber, Patrick	University of California, Davis	Not specified	San Joaquin Valley	Multiple species and habitats	GIS Analysis	NA	Yes	
Ventura County	Chattin, Elizabeth	Ventura County Resource Management Agency	2004	Ventura	Multiple focal species	Model: Delphi Approach	Zones of habitat that address needs of multiple focal species	Yes	

Following is a brief discussion and map of connectivity assessment projects that exemplify the variety of approaches and results.

- **South Coast Missing Linkages Project (Map 1)**

South Coast Wildlands, a non-profit organization based in southern California, is working to maintain and restore connections between wildlands in the South Coast Ecoregion through an effort called the **South Coast Missing Linkages Project (Map 1)**. During 2002, the organization conducted a series of workshops in southern California, each involving from 90 to 190 participants from 30 to 95 different organizations. Participants identified focal species (plants, inverts, reptiles, amphibians, birds, mammals) representing broad range of connectivity needs.

The organization used existing GIS data to conduct landscape permeability analyses and least-cost path/corridor analysis. For selected species, staff conducted more specific analysis about quality and suitability of habitat patches in potential corridor and visited priority areas to identify and evaluate barriers to movement. Several reports are available online (http://www.scwildlands.org/reports.aspx) with more details of each area.

- **Bighorn Sheep Connectivity Assessment (Map 2)**

Researchers (Dr. Clinton Epps and a team) at the University of California Berkeley collaborated with the California Department of Fish and Game and the University of California's White Mountain Research Station to examine the effects of road barriers on connectivity and genetic diversity of 27 populations of desert bighorn sheep in the Mojave Desert.

This project used a least-cost path modeling approach to identify probable dispersal routes among these populations. Unlike other least-cost path approaches based on habitat preferences and landscape features, this effort incorporated population genetics data that predicted effective gene flow among populations. The GIS model was based on distance between populations and topographic slope. Topography has a strong influence on sheep distribution and habitat use. The researchers compared the modeling results with other movement evidence (direct observation or telemetry), which helped validate the importance of the modeled routes.

Epps et al (2007) describes their approach and results in more detail. This paper emphasizes that these routes represent only one variation on potential routes for sheep movement, acknowledges limitations in their approach, and suggests improvements for future modeling.

- **Central Coast Mountain Lion Connectivity Assessment (Map 3)**

Researchers at the University of California Davis and The Nature Conservancy developed a replicable conservation network design for the Central Coast region of California, intended as the first step in an iterative regional conservation design process

(Thorne, et al. 2006). The project selected the mountain lion as an umbrella species to identify large core areas for conservation.

A least-cost path analysis was used to identify potential habitat linkages between core areas, using factors related to distance, habitat quality, road density, and forest cover. The project then tested the resulting network for its ability to include other biodiversity elements, including five endangered terrestrial vertebrates, serpentine outcrops (as surrogates for rare and endemic plants), The Nature Conservancy portfolio conservation areas, and a variety of vegetation types, including old-growth redwood stands. The network of core areas and linkages represented some habitats (woodlands and forests, serpentine, high-quality steelhead habitat) better than others (grassland). It poorly represented the known distributions of the endangered vertebrates.

Thorne, et al. (2006) describes the strengths of this approach, inherent limitations due to the availability of spatial data, and the differences in conservation challenges for core and habitat linkages.

- **UCD San Joaquin Valley Assessment (Map 4)**

Researchers at the University of California Davis (UCD) provided technical analysis to identify potential conservation opportunity areas for the California Partnership for the San Joaquin Valley. One of the goals of the Partnership's Land Use, Agriculture and Housing Work Group (CPSJV 2006) is to "develop a high value parks and open space strategy to be used in the development of the Blueprint Plan, with a goal of encouraging the creation and long term management (including restoration, as feasible) of a permanent open space system in the San Joaquin Valley". UCD's analysis (Huber 2006) represents one interpretation of biological and natural resource data compiled for the study area. It provides an illustration of one of several potential sets of criteria and weighting systems that could be used to identify constituent biological and natural process elements for purposes of creating a coordinated open space system within the study area.

UCD researchers identified key criteria to identify "hotspots" of conservation priorities, based on workshops with natural resource planners representing federal, state, local, and private agencies and organizations. These included natural communities seldom found on protected lands, riparian areas, wetlands, concentrations of threatened or endangered species, and areas with restoration potential.

They used GIS data to identify important areas and conducted a connectivity analysis to identify potential linkages. This analysis used a GIS tool called the "Universal Model Builder" to identify linkages based on existing vegetation, protected lands, urban areas, and road and waterway density. The researchers acknowledge limitations to this analysis. For example, they recognize that, by selecting different criteria or weighting the criteria in other ways, a different distribution of opportunity polygons and different set of connectivity could have resulted.

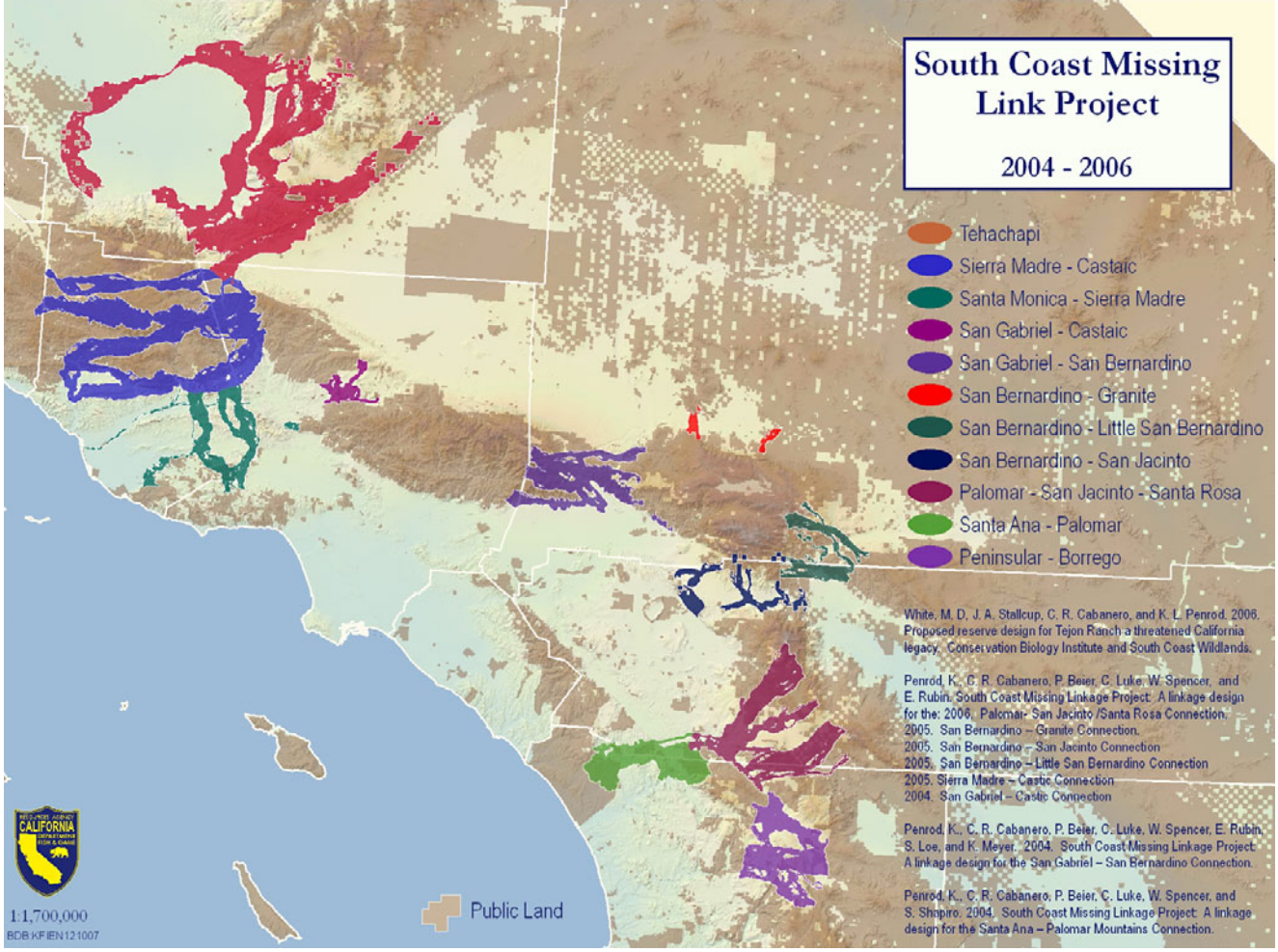
- **San Joaquin Valley Recovery Plan (Map 5)**

The US Fish and Wildlife Service's (USFWS) Recovery Plan for Upland Species of the San Joaquin Valley (USFWS 1998) provides a "step-down narrative" for implementation, with one of the goals to "maintain and establish linkages in existing natural lands and between islands of habitat on the Valley floor and natural lands around the fringe of the Valley". The project used expert delineation of linkages, based on locations of existing non-native grassland and scrub communities on the valley floor as well as physical features.

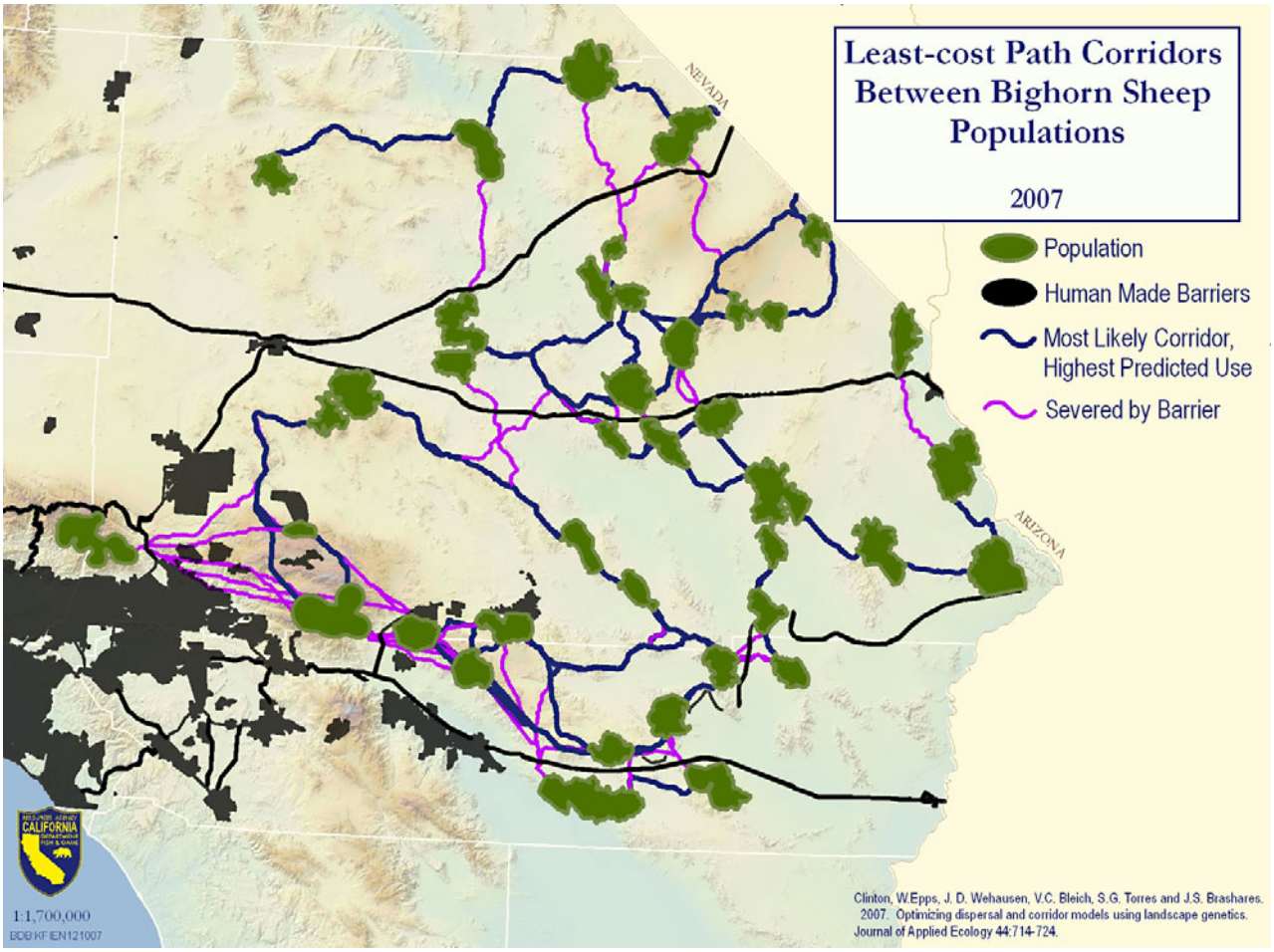
- **Missing Linkages Conference (Map 6)**

In 2000, the California Wilderness Coalition (2001) organized a conference in San Diego to identify potential wildlife linkage zones through California. This conference was sponsored by the California Wilderness Coalition, California State Parks, US Geological Survey, the San Diego Zoo, and The Nature Conservancy. It gathered 160 experts from public agencies, advocacy groups, consulting firms, and academia. The experts identified about 300 wildlife corridors thought to be vital to California's wildlife populations. Linkage priorities were based on the combined knowledge of the experts present and incorporated subjective information on presence of species, threats, opportunities for acquisition and support, and existence of supporting data.

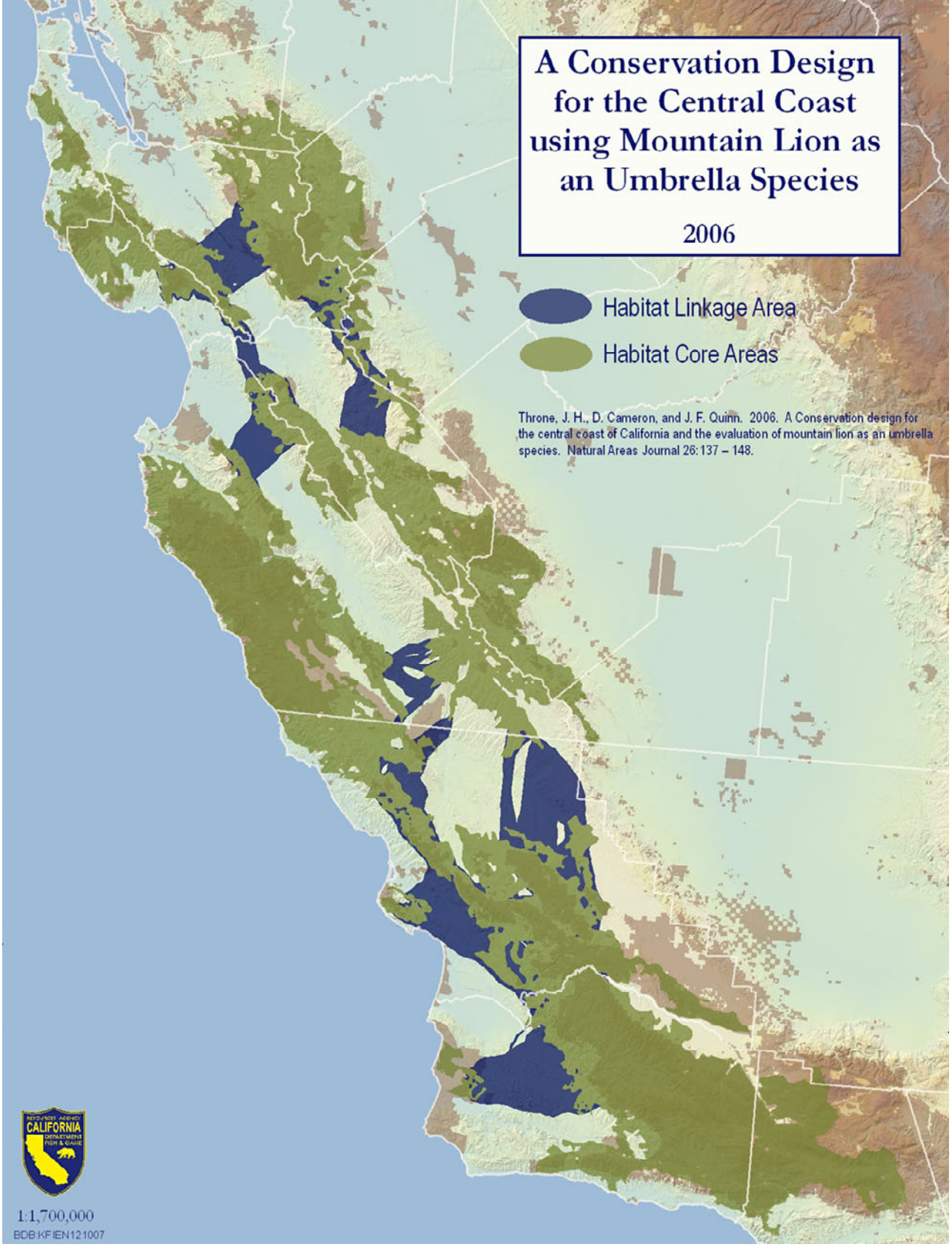
The results from this conference represent a wide mix of the types of approaches listed above. Some of the linkages have been well documented, including the use of field observations. Other linkages are based only on ideas that arose at the meeting by only one or two participants.



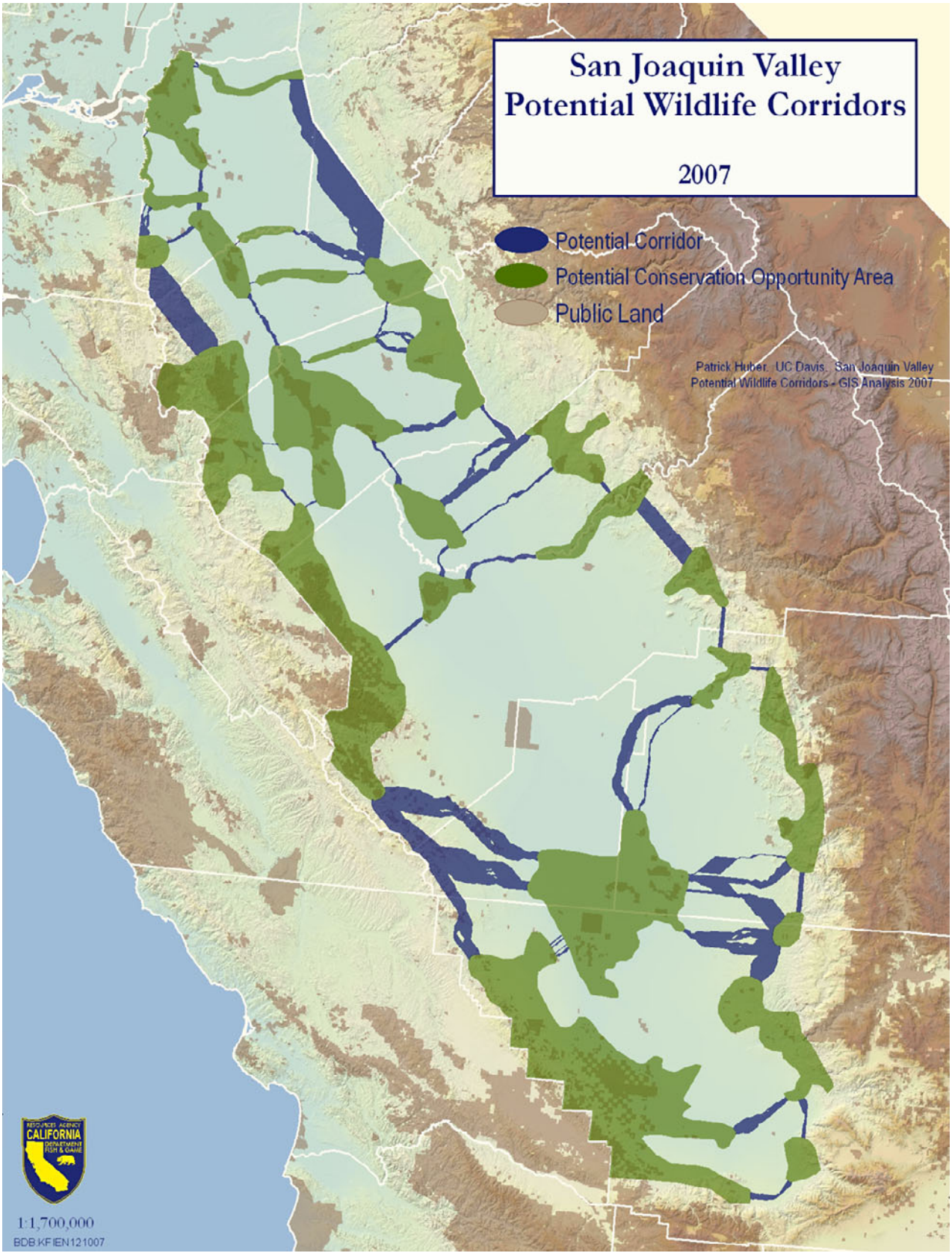
South Coast Missing Linkages Project (Map 1)



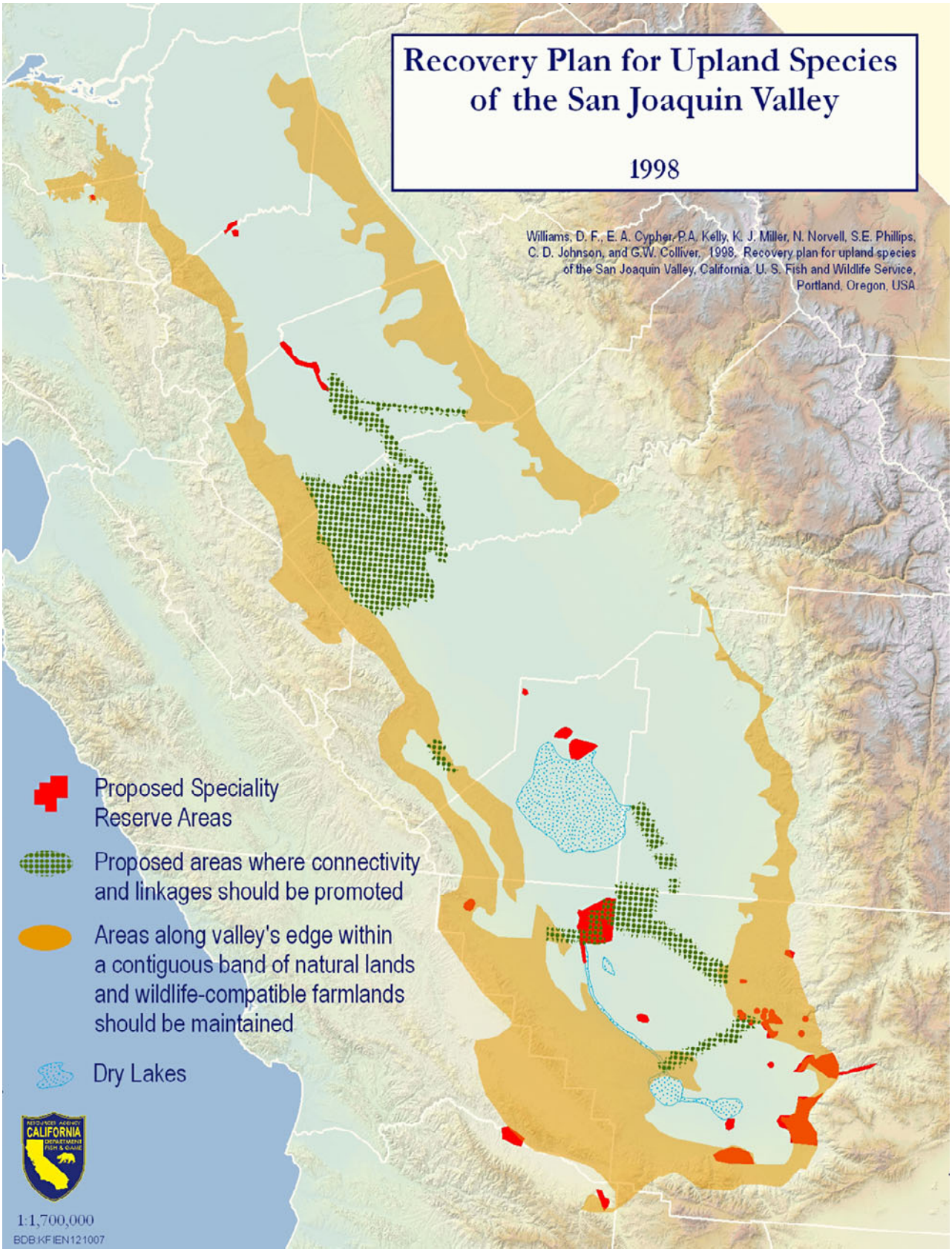
Bighorn Sheep Connectivity Assessment (Map 2)



Central Coast Mountain Lion Connectivity Assessment (Map 3)



UCD San Joaquin Valley Assessment (Map 4)



San Joaquin Valley Recovery Plan (Map 5)

Missing Linkages Conference (Map 6)

General Patterns from Partial Survey

Geographic Scope

Most of the identified connectivity efforts are regional or county in geographic focus. The Missing Linkages Conference data is the only data set that attempts statewide coverage, although it does not represent all potential corridors throughout the state. The **following map (next page)** shows the counties covered by connectivity assessments in the Department's survey. Much of the activity has focused on central and southern California. Broad assessments have been conducted in the Sierra Nevada and the Klamath-Siskiyou area of northwest California, but the Department has been unable to obtain that data in time to include in this report.


Counties Where Corridors Analysis Has Been Conducted
December 2007
Corridor Analyses
Reflects data received by November 30, 2007.
Department of Fish & Game GIS Analysis December 2007.
OREGON
DNT
SIS
MOD
HUM
TRI
SHA
LAS
TEH
PLU
MEN
GLE
BUT
SIE
NEV
LAK
COL
SUT
YUB
PLA
YOL
ELD
SON
NAP
SAC
AMA
ALP
SOL
MRN
CAL
TUO
CCA
SJQ
SF
ALA
STA
MNO
SMT
MPA
SCL
MER
MAD
SCR
NEVADA
SBT
FRE
INY
MNT
KNG
TUL
SLO
KRN
SBA
SBD
VEN
LAX
ARIZONA
ORA
RIV
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Selection of focal species or habitats

Many assessment projects select a set of focal species or habitats for which to design corridors. Others use a landscape permeability approach to assessing the overall landscape, without specific focal species. All of the projects in Table 1 used focal species, but they varied considerably in the number and type of species. The South Coast Wildlands Project used the broadest suite, including 109 species representing aquatic and terrestrial habitats, as well as vertebrates and invertebrates. The UCD Central Coast project and the UCD Central Valley project used a smaller set of three to six species, with a focus on birds and mammals. The San Joaquin Recovery Plan focused on the needs of rare and endangered species. The UCB Bighorn Sheep project had the narrowest focus on only one species.

Type of approach used

Several of the projects listed in Table 1 used modeling approaches, commonly using the least-cost path approach. Several projects also complemented this modeling approach with advice and review by field experts.

Types of areas needing connections

Different projects used different types of areas that needed connectivity. The South Coast Wildlands Project identified corridors between existing public lands. This is useful in a heavily developed area, where most of the remaining natural areas are already on public land. The UCD Central Coast project and the UCD Central Valley project identified corridors between large areas of natural or semi-natural lands, regardless of public lands. The UCB Bighorn Sheep project identified corridors between key population centers of bighorn sheep.

Local expertise

Each of these projects had varying levels of involvement by field experts familiar with either the focal species or the targeted study area. The involvement of other experts is valuable to complement and fill the gaps in existing GIS data sets. Some projects involved a few selected experts to review modeling results. The South Coast Wildlands Project was notable in the level of expert involvement, conducting a series of large workshops to identify focal species and their conservation needs and to review the results of modeling.

Interim Conclusions

Based on the limited number of efforts currently compiled, it is clear that the identification of priority corridors is strongly influenced by the goals of each assessment project. Important areas differ even in the same geographic area, such as the two different efforts in the San Joaquin Valley.

The Department's baseline budget does not support conducting a comprehensive statewide analysis to identify important areas for connectivity in California. The results

from such an approach would be more robust and defensible if it includes better quality data, advanced GIS modeling approaches, and the engagement of a wide range of experts knowledgeable in species conservation needs and current scientific thought related to connectivity design. One of the most essential data sets that need improvement is large-scale consistent vegetation mapping. This data needs to be of sufficient quality to model potential habitat and movement barriers for species.

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2. Quagga Mussel

A report on actions the state has undertaken containing the Quagga Mussel- including actions taken by the DFG, the Department of Boating and Waterways, the CDFA, the DWR, and any other state agency involved in the response to this issue. The report must also include a plan for future action and a cost estimate for those planned actions.

DEPARTMENT RESPONSE:

FY 2007-08 – Quagga Mussel Program

PROGRAM DESCRIPTION

The Quagga/Zebra (Dreissenid) mussel program is within Program 20 – Biodiversity Conservation and Program 40 – Law Enforcement in the Department of Fish and Game (Department)**.**

Program 20 – Biodiversity Conservation
Within Program 20, the Invasive Species Program mission is to reduce the negative effects of non-native invasive species on the wildlands and waterways of California. The Department is involved in efforts to prevent the introduction of these species into the state, detect and respond to introductions when they occur, and prevent the spread of non-native invasive species that have become established. Department projects address problems with introduced animals, plants and microbes, both terrestrial and aquatic. More fundamentally, this program attempts to address the ways by which the species are introduced, typically inadvertently, by human activities. Studies show that preventing introductions is the most effective and cost efficient way to respond to the problem of invasive species. Program work is conducted in coordination with other government agencies and non-governmental organizations.

Program 40 – Law Enforcement Program
Enforcement activities include the active participation of the Law Enforcement Division (LED); Program 40. The primary mission of wardens assigned to this program is to educate the public to the threat posed by Quagga mussels. The extended mission will

be to continually educate as well as to enforce laws which will shortly be enacted to hopefully prevent the further spread of this aquatic pest.

Dreissenid Mussel Program

Mussels of the genus Dreissena (Quagga and Zebra mussels) are native to Russia and Ukraine. Quagga/Zebra mussels are harmful invasive species that disrupt traditional aquatic ecosystems, and have severely impacted water infrastructure in the Great Lakes. These mussels are thought to have been transported to the Great Lakes region in the ballast water of transoceanic ships. Recently, Dreissenid mussels were discovered living in Lake Mead along the Arizona-Nevada border on Saturday, January 6, 2007. From Lake Mead they spread to the lower Colorado River, where California water agencies including Imperial Irrigation District and Metropolitan Water District of Southern California have intakes. These species can also be spread when they attach to boats that are subsequently trailered to other water bodies.

It is now reported that mussels have been found in the Colorado River in Lake Havasu to south of Parker Dam, throughout the length of the 242-mile aqueduct system, in Riverside County in both Lake Mathews and Lake Skinner, and in San Diego County in San Vicente Reservoir, Dixon Lake, Lower Otay Reservoir and Lake Murray Reservoir. A widespread infestation of these mussels could be extremely harmful to the California environment and economy.

Dreissenid mussels negatively affect the environment by reproducing quickly and in large numbers. Zebra mussel densities have been reported to be over 700,000 individuals per square meter in some facilities in the Great Lakes area. They get into and obstruct pipes in municipal and industrial raw-water systems, requiring millions of dollars annually to treat. They produce microscopic larvae that float freely in the water column, and thus can pass through screens installed to exclude other organisms. As filter feeders, Dreissenid mussels remove suspended material from the habitat in which they live. This includes the planktonic alga that is the primary base of the food web of aquatic ecosystems. Thus, the invasion of Dreissenid mussels may completely alter the ecology of water bodies.

Establishment of Dreissenid mussels in the Sacramento-San Joaquin river systems and the Delta could exacerbate the problems faced by California native species such as Chinook salmon and Delta smelt by removing food, at the base of the fish food web, upon which these native fish depend. This would heighten conflict between water users and environmental interests.

These mussels attach to submerged hard surfaces, and can severely foul water intakes, fish screens, outfalls, and other infrastructure. The Department of Water Resources (DWR) recently estimated that establishment of Dreissenid mussels in California would cost the State Water Project alone at least $70 million in capital costs and $40 million in additional annual maintenance. These estimates are being refined. They do not include the federal Central Valley Project, local water agencies and irrigation districts, power plants, or the 1,100 individual diverters in the Delta.

PROGRAM BACKGROUND

In January 2007, the Department instituted a formal Incident Command Structure to address the Lake Mead infestation of Quagga mussels. The Departments of Food and Agriculture (CDFA), Water Resources (DWR), and Boating and Waterways (DBW) assisted with the response. Federal representation was provided by the U.S. Fish and Wildlife Service and the Bureau of Reclamation. The Incident Command System (Incident) was demobilized in mid-March; however, representatives from state and federal agencies who were involved in the Incident continue to meet on a bi-weekly basis to continue working on the open actions items identified by the team.

On January 24, 2007, the Department of Finance transmitted the approval of the Emergency Deficiency Funding Request for the Department and CDFA. The Department was provided $462,537 General Fund to staff the multi-agency response, and CDFA received $581,149 General Fund to address additional staffing and operating expenses to implement watercraft inspection activities at three border protection stations. In FY 2007-08 and ongoing, the budget augmented $5.7 million General Fund and 18 positions for the Department ($3.3 million) and an additional 35 positions for CDFA ($2.4 million).

BUDGETED RESOURCES

Effective January 11, 2007, the Incident Command was allocated $462,537 General Fund to operate the unified response for the first 45 days. An additional $1,004,433 General Fund allocation was secured after the initial 45 days to continue the response through June 30, 2007, for a total FY 2006-07 allocation of $1,466,970. Actual expenditures from January through June 2007 were $1,005,518.

Effective in FY 2007-08, a General Fund augmentation of $5,731,000 was provided to the Department for ongoing activities, and a contractual agreement with CDFA for their Border Protection Station services. This included an increase for the Department of 18 new positions (8 permanent Wardens and 10 program staff scientists), and an additional 35 positions for CDFA. The eight new Wardens will provide the LED with additional resources to conduct statewide inspections, conduct checkpoints with inspection areas, and to quarantine boats and other watercraft to prevent the spread of Quagga mussels. Currently the Department Warden positions are scheduled to be placed as follows: Southern District - 4, Northern Coast District - 2, Northern District - 1, Central District - 1

The ongoing funds will be used to undertake statewide detection and monitoring programs and refine eradication, control and quarantine plans as well as provide law enforcement personnel to enforce the laws and regulations against carrying Quagga mussels and to make contacts with boat owners to encourage compliance.

PROGRAM ANALYSIS & OUTCOMES

For the reporting period January – June 2007, the following activities were undertaken:

Department of Fish and Game

Convening Quagga mussel Incident Command
The Quagga mussel incident command was led by an interagency command chaired by the Department of Fish and Game, Department of Water Resources and the U.S. Fish and Wildlife Service. The structure included a Liaison Officer, Public Information Officer, Planning Chief, Operations Chief, Logistics Chief, Finance/Administration Chief, and their associated units.

Perform Surface Surveys and Dive Surveys
With first emphasis on the Colorado River, 228 high priority water bodies were surveyed throughout the state for adult quagga mussels. Crews checked docks, marinas, buoys and other surfaces that could be accessed from the shore. The results of dive surveys focused on the lower Colorado River were no Quagga mussels detected.

Larval Sampling and Analysis
Larval samples were collected at over 30 high risk waterbodies. Laboratory analysis is scheduled to continue into FY 2007-08 and FY 2008-09.

Science Advisory Panel
A Science Advisory Panel of national experts was convened and a report of their recommendations was completed. An action plan based on the results is in progress.

Risk Assessment
Under the direction of DFG, the San Francisco Estuary Institute is performing a phased risk assessment of California waters in order to rank sites for further monitoring based on the likelihood that Dreissenid mussels will establish. Phase 1 of the risk assessment includes 160 waters and is available on the Department's internet website at: http://www.dfg.ca.gov/invasives/quaggamussel/docs/PotentialDistributionZebraQuaggaInCA.pdf.

Augmentation of Border Protection Stations (BPS)
During the reporting period, the Department prepared a contract for $455,101 with CDFA for 24/7 coverage at three BPS in southern California. From January 1 – June 30, 2007: 31,257 boats were inspected and 2,675 boats were cleaned with thirteen positive mussel detections.

Inspection of Quarantined Boats
Department Biologists and Wardens have inspected and cleared all boats quarantined by the CDFA.

Law Enforcement Activity
The initial effort of enforcement personnel was to educate constituents by passing out pamphlets, and providing personal contact at boat ramps and at various bodies of water

in the state. Inspections were also conducted, however, laws to provide adequate jurisdiction in those inspections were not yet enacted. Efforts were made at areas such as Lake Havasu, Lake Isabella, Lake Kaweah, Crowley Lake, Success Lake as well as others. LED personnel were part of the survey dive teams along the Colorado River in the early stages of the program. Future tasks will center on enforcement of inspection/decontamination authority that will exist within the Fish and Game Code through the enactment of AB 1683.

LED Wardens are a key component in the inspection of boats, trailers and other equipment that transport Quagga mussels and will be a meaningful part of the anti-Quagga mussel effort. Without inspections and potential penalties, laws are perceived to be merely suggestions to many people. To aid in the detection of Quagga mussels the LED canine (K-9 Officers) program, which is in its initial stages of development, will include canine detection dogs that will be trained to detect Quagga mussels. The dogs' keen sense of smell will be used to detect Quagga mussels. The K-9 Officers will be trained to detect both visible and non visible Quagga mussels.

LED's largest effort was targeted along the Colorado River, based on information at that time. Overtime Hours worked by the Department's southern California LED personnel was 559 hours. ***Refer to the figures below.***

Quagga Mussel Travel Expense, Vehicle Miles and Boat Hours Used

Category	April	May	June
Hours Used	31	480	62
Travel Expenses	$0	$216	$436
Vehicle Miles	381	5,694	1,535
Boat Hours	4	153	19
Other Expenses	$32	$1,750	$0

- Total Number of Hours: 573
- Total Number of People Contacted: 6,467
- Total Number of Watercraft Contacted: 2,305
- Total Mileage: 7,610
- Total Boat Hours: 176
- Total Per Diem: $548
- Other Expenditures: $1,750
  (for 3 diving dry suites)
- Other Expenditures for posting of signs(post, wire, nails) : $32

Quagga Mussel Locations Patrolled By Southern California Personnel

1. Lake Havasu
2. Silverwood Lake
3. Lake Piru
4. Lake Casitas
5. Big Bear Lake
6. Lake Hemet
7. Canyon Lake
8. Lake Perris
9. Hidden Shores
10. Mayflower Park
11. Lower Colorado River
12. Irvine Lake
13. Oso Reservoir
14. Lake Elsinore
15. Lake Hodges
16. Upper & Lower Castaic
17. Lake Skinner
18. Puddingstone Reservoir
19. Pyramid Lake
20. Squaw Lake
21. Senators Wash
22. Lake Cachuma
23. Lake Arrowhead
24. Oxbow Lake
25. Lake Sutherland
26. San Vicente Lake
27. Lake Moreno
28. El Capitan Res.
29. Lake Crowley
30. Lake Jennings
31. Lake Wolhford
32. Parker Strip

Similar contacts and educational opportunities were conducted through the resources provided to the other Enforcement Districts within the state. Public education and outreach were a priority. Efforts conducted in the other Enforcement Districts include:

- Northern District: 50 overtime hours
- Northern Coastal District: 88 overtime hours
- Central District: 88 hours

Outreach and Education

Outreach and Education is being coordinated by the Department with an interagency working group. A communications plan has been completed for the program, a Quagga mussel hotline has been established, letters have been distributed to all registered boat owners by the DBW, posters and flyers have been distributed to various state and local agencies and at stakeholder venues, multiple articles and news stories have been developed, and updates of the program are provided biweekly on the Department's internet webpage at: http://www.dfg.ca.gov/invasives/quaggamussel/

Training

Ten training classes for boat inspectors have been arranged throughout the state. Throughout California, LED personnel have attended formal Quagga mussel training to learn about the history of the mussel, its characteristics and how to conduct inspections to detect the mussel.

Coordination with Water Agencies

The Incident and subsequent coordination team have coordinated closely with Metropolitan Water District and water agencies in San Diego to ensure the information is shared and each entity has access to the most current updates and technology.

Planning Documents
The Incident has prepared two Strategic Planning documents and is working on a third. The Department is providing advice for water agencies developing response and control documents for water bodies within their jurisdictions.

Governor's Office Updates
The Incident has prepared two Significant Issues Reports for the Governor's Office.

Legislation
Department staff assisted in the development of language for AB 1683, Chapter 419, Statutes of 2007, Wolk; authorizing the Department to conduct inspections, order quarantines, and take other actions necessary to prevent the spread of invasive Dreissenid mussels, including Quagga and Zebra mussels.

Department of Food and Agriculture
During this reporting period, operating hours at Border Protection Stations at Vidal Junction, Blythe, Yermo and Truckee were increased to 24/7.

From January 1 through June 30, 2007:

- Boats Inspected: 31,257
- Boats Cleaned: 2,675
- Finds: 13

Department of Boating and Waterways
DBW has been an active participant in the Communications Committee for the Incident. They have:

- distributed over one million letters regarding the impacts of Quagga mussels to registered boat owners,
- distributed materials at stakeholder events, and
- investigated the possibility of installing boat wash stations at boat ramps.

Department of Water Resources
DWR continues to be a leader in the Incident and provide considerable technical expertise to the program. DWR staff has expertise in the identification of Quagga mussels and have provided training to boat inspectors during the reporting period. DWR scientists and managers work closely with Metropolitan Water District in their detection, control and eradication efforts. In addition, DWR is developing consistent standards for the statewide monitoring and laboratory analysis efforts.

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3. Stream Flow Money From the State Water Resources Control Board
On or before January 10, 2008, DFG shall provide a report to the Legislature (including budget and fiscal committees of both houses) on the stream flow funds the department received during 2006-07 and how those funds were expended. The report shall identify what streams the department will study in 2008-09.

DEPARTMENT RESPONSE:

FY 2007-08 -- Stream Evaluation Program; Program 20

PROGRAM BACKGROUND

In 1984 the Department of Fish and Game (Department) developed a list of 21 streams and watersheds to guide development of flow requirements based on fishery needs. Until the mid-1990s, Department staff collaborated on the development of stream flow studies and flow recommendations for these streams and watersheds. Some of this work resulted in finalized stream flow reports submitted to the State Water Resources Control Board, while other efforts produced draft assessments that were not formally submitted.

The Department began the Stream Evaluation Program (STEP) in 1980. In 1985 the the Department received a one-time augmentation of $500,000 in Environmental License Plate Funds through passage of Chapter 1259, Statutes of 1985 (AB 723, DeVore) that expanded the program to assess fish-habitat relationships in streams and rivers of California. After the one-time augmentation, the program was funded by fees, in part, through Public Resources Code (PRC) Section 10000. The overall STEP objective was to determine stream flow and other habitat requirements for the protection, restoration, and enhancement of stream fishery resources. In FY 2005-06, STEP resources included a Senior Environmental Scientist, four Environmental Scientists and seasonally, up to five Fish and Wildlife Scientific Aids. Prior to FY 2002-03, STEP had two additional permanent Environmental Scientists. In addition to PRC Section 10000-related revenues, the program was primarily funded

from the General Fund, federal funds and reimbursements. As a result of General Fund budget reductions and internal reprioritization, based on remaining resources and limitations on the use of those funds, the employees in the STEP program were redirected in 2006.

Even as the STEP program staffing at the Fishery Branch was redirected, Environmental Scientists and Fisheries Biologists from the Regions contributed an average of at least two positions to the development of instream flow recommendations for both Water Rights and Federal Energy Regulatory Commission (FERC) proceedings on 39 streams and rivers.

FY 2006-07 Stream Flow Funds Received

The fees collected under PRC Section 10005 in FY 2006-07 came to $38,250. Over the last five years the fees collected have ranged from approximately $12,000 to $54,000. The highest amount of annual fees was $216,000 collected back in 1993.

FY 2006-07 Funds Expended on Activities

The Stream Flow Funds received were combined with other funds to support staff positions. Environmental Scientists and Fisheries Biologists contributed an average of at least 2 PYs to the development of instream flow recommendations for both Water Rights and Federal Energy Regulatory Commission (FERC) proceedings on a number of streams and rivers.

FY 2007-08 Planned Activities

Since completion of the original priority stream work, the Department's efforts have been largely project driven, often in response to proposed projects involving the diversion of water. The Department has recently created a new Water Branch to better manage water-related responsibilities. The Water Branch is focused on fulfilling DFG's public trust responsibility by providing sound leadership in the balanced and integrated management of California's water resources, for the benefit of aquatic and terrestrial species and those habitats upon which they depend.

The Water Branch's statewide water planning responsibilities include coordination and integration of the Department's activities related to water rights, water quality, FERC hydroelectric permitting, instream flow, Central Valley water operations, and California Water Plan. The Department is in the process of revitalizing an instream flow group of scientists and biologists tasked with the assessment of water project impacts on aquatic resources and the development of defensible recommendations to protect, mitigate and enhance fish resources as funding becomes available.

In FY 2007-2008 the Department is establishing an Instream Flow Coordinator position. With the creation of this position, the Department should be more proactive and refocus efforts on identifying priority streams based on aquatic resource and instream flow

needs. Funding for this position will in part be from PRC section 10005 revenues and environmental filing fees.

FY 2008-09 Streams the Department Proposes to Study

A preliminary list developed in March 2007 of priority streams and watersheds, for the collection of instream flow data includes:

Northern California/Sierra

- Klamath River
- McCloud River
- Shasta and Scott Rivers
- South Fork Battle Creek
- Butte Creek
- Yuba River
- Bear River
- Lower American River
- Middle Fork American River and Tributaries
- Tuolumne River
- Merced River

Central Coast

- Lagunitas Creek Watershed
- Walker Creek watershed
- Pine Gulch Creek
- Easkoot Creek
- Corte Madera Creek Watershed
- Arroyo Corte Madera del Presidio Watershed
- Green Valley Creek
- Salmon Creek Watershed
- Petaluma River Watershed
- Napa River Watershed
- And numerous other streams in Napa, Sonoma and Mendocino Counties

At present, the fees are being combined with other funding sources to support the new Instream Flow Coordinator position.

Instream flow studies are underway or planned (using other fund sources) for the Shasta and Lower American Rivers.

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This particular report is a requirement in Senate Bill 85, August 2007, which added Section 1940 to the Fish and Game Code (see attached), and included the following supplemental language:

> *(c) The department shall submit a report to the budget committee of each house of the Legislature no later than January 10, 2008, providing its mapping standard and advising how the department will ensure that its standard will be updated to reflect changing technology and serve as the state's center of expertise on vegetation mapping.*

DEPARTMENT RESPONSE:

FY 2007-08 – Vegetation Mapping Standard for the State of California

Program Summary

Senate Bill 85, Chapter 178, Statutes of 2007, added Section 1940 to the Fish and Game Code that requires the Department of Fish and Game (Department) to develop a vegetation mapping standard for the State of California. It also requires a report to be submitted to the Budget Committee of each house of the Legislature, "providing its mapping standard and advising how the department will ensure that its standard will be updated to reflect changing technology and serve as the state's center of expertise on vegetation mapping."

This report discusses the basic underpinnings of this standard and the steps the Department has undertaken to develop the standard in collaboration with stakeholders. The report includes the following five components:

1. Discussion of the published state-wide standard for vegetation classification
2. Methods for field data collection, image interpretation, and digital map production and attribution
3. Required training manuals and materials, tools, and database structures

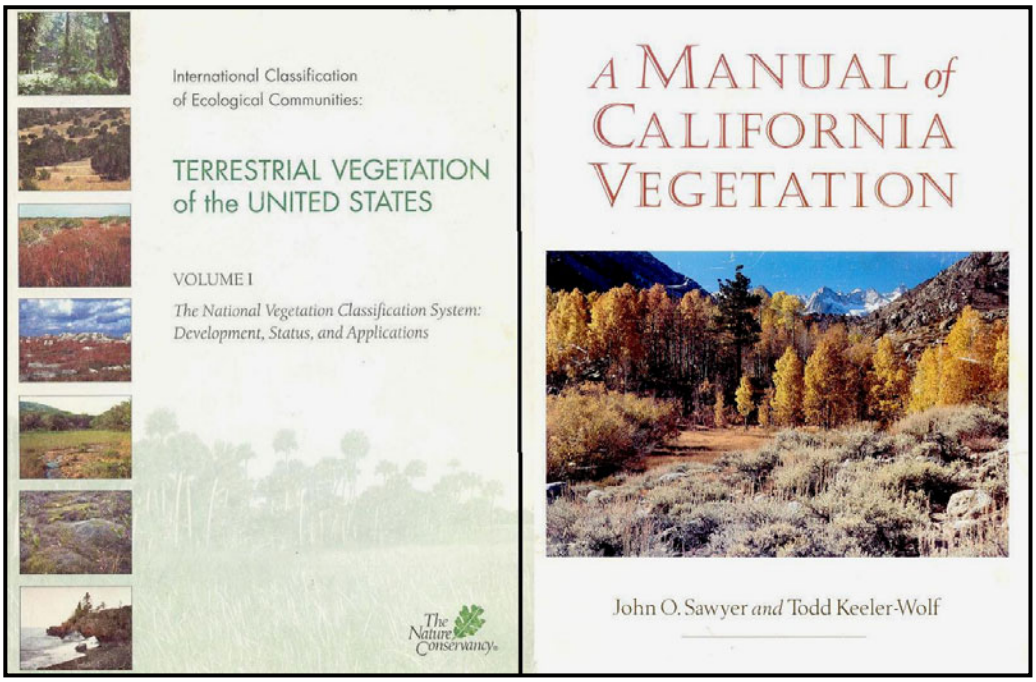
4. Post- project accuracy assessment and public review

5. Method of induction of new and updated map products into the state system

1. State Vegetation Classification Standard

The standard for the California vegetation classification results from the work of a consortium of state, national, and international scientists and natural resource professionals. The state classification is the California expression of the National Vegetation Classification System (NVCS). As a result of collaboration between vegetation scientists and working groups of agency and non-governmental organizations (NGO)\ users, the state and National Vegetation classification systems have developed in consort over the past 15 years (***Figure 1***). The first publication of the state vegetation classification system as a result of this effort came in 1995 with "A Manual of California Vegetation" by Sawyer and Keeler-Wolf.

Figure 1: *The National Vegetation Classification (left) and California's Vegetation Classification (right) are linked and standardized through the functions of the NGO, NatureServe and are bound to standards set by the Ecological Society of America's Vegetation Panel (http://www.esa.org/vegweb/panelMembers.php).*



This book was a synthesis of all existing information on quantitative vegetation classification up to that time and was the product of a multi-year collaboration between a committee of state experts composed of scientists, managers, and other users of vegetation information. It was based on a draft National Vegetation Classification system (NVC) using defensible quantitative definitions of vegetation placed within a hierarchy of seven levels. This hierarchical classification system was first published in 1998 (Grossman et al. 1998). The NVC was adopted by the Federal Geographic Data Standards Committee (FGDC) as the National Standard for Vegetation Classification

to be used for all Federal Vegetation assessments including mapping; (FGDC vegetation website: http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation/index_html).

Since the FGDC acceptance of the NVC, a committee of local California users, under the aegis of the State Executive Biodiversity Council has formed. This committee is comprised of 11 state and federal agencies and NGOs that are directly involved in mapping and/or classifying vegetation in the state. It has become known as the Vegetation MOU Committee. In 2000, the Committee developed a Memorandum of Understanding (http://ceres.ca.gov/biodiversity/vegmou.html) outlining the agreement among the major users and producers of the state vegetation classification system. This agreement included several specific objectives:

- Develop common standards for data content, data capture methods, field procedures, accuracy assessment and documentation.

- Complete a hierarchical vegetation classification system adaptable to varying goals of the signatories and improve vegetation and habitat classification and crosswalks between systems

- Complete and maintain a vegetation map of all public and private lands in California on a regional basis through interagency cooperative efforts as the basis for vegetation inventories and assessments of habitats, including detection of changes.

Among the first completed objectives of the MOU Committee was agreement that the NVC, as outlined in Grossman et al. (1998; http://www.natureserve.org/library/vol1.pdf) and as updated for California use by the Vegetation Classification and Mapping Program of the Department, would serve as the state standard (minutes of MOU committee October 1, 2002, http://ceres.ca.gov/biodiversity/Meetings/Special/Notes_10.01.02.pdf).

Since that time, the Department's Vegetation Classification and Mapping Program (VegCAMP) has maintained an updated classification database based on new scientific information, (http://www.dfg.ca.gov/biogeodata/vegcamp/pdfs/natcomlist.pdf).

This classification complies with the National Classification, which is in turn regularly updated by the NGO NatureServe (http://www.natureserve.org/explorer/servlet/).

NatureServe and VegCAMP maintain a regular relationship of updating and refinement of the vegetation classification.

Currently, the California Vegetation Classification is reaching its second major milestone in the publication of the second edition of the Manual of California Vegetation. The manuscript has been accepted for publication by the California Native Plant Society, following extensive peer-review, and will be published in 2008. This publication embodies all work in the 12 years since publication of the first edition. This includes integrating the new formal definition and description of over 225 individual alliances (doubling the number in the first edition) and over 1,000 new plant associations. It includes a complete discussion of the relationship between the National and California

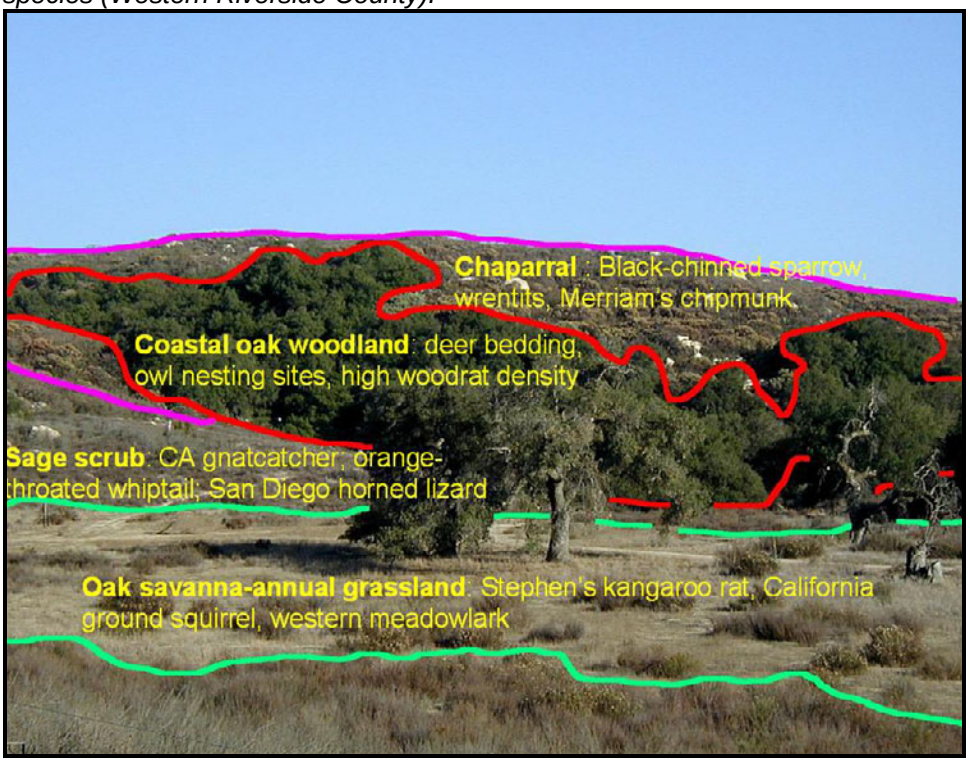
classifications and formally defines and describes almost 500 alliances. Revision of this classification is addressed within the VegCAMP program using periodic updates following scientific analysis and review of new quantitative data, much as new species are evaluated as they are discovered by science. These updates are fed periodically to the NatureServe National Vegetation database, which maintains the National Vegetation Classification.

2. Standard Methods

A complex and integrated process, vegetation assessment for the entire state requires a standardized methodology to collect, process, analyze, depict, update, and distribute information. This multi-step process has been refined by VegCAMP and its cooperators over the past several years, the result of work on more than 20 individual projects ranging from a few thousand acres to over 10 million acres.

2 a. Field Data Collection and Analysis: Field data collection is the basis for all vegetation mapping and classification. All vegetation data are collected from natural assemblages of plants called "stands" (***Figure 2***).

Figure 2: *Stands of vegetation delineated from a field view showing some associated animal species (Western Riverside County).*



A stand is the fundamental unit of vegetation. It is composed of a uniform group of individual plants growing together as a result of their shared ecological and physiological tolerance. Stands are arrayed in repeating patterns across the landscape. In the methodology supported by DFG, stands viewed from the field should also be, as much as possible depicted in the vegetation map.

Field data collection includes the selection, sampling, and recording of data from representative stands. This includes plant composition, stand size and structure, environmental characteristics, site history, and recent historical effects. This suite of characteristics is amassed in a standardized way for all projects using two basic protocols developed by a consortium of experts convened through the California Native Plant Society's (CNPS) Vegetation Committee. These protocols, described on the CNPS and DFG websites (http://www.dfg.ca.gov/biogeodata/vegcamp/ or http://www.cnps.org/cnps/vegetation/), are known as the Rapid Assessment and the Relevé protocols. Depending upon the business needs of specific users, these two techniques can be easily modified or augmented to collect further information on such things as fire and fuels data, or additional wildlife habitat information. However, taken alone, they provide all basic information needs to support standardized mapping and classification of vegetation.

The Rapid Assessment (RA) technique is the foundation for collecting field samples to support the classification, general ground-truthing, and accuracy assessment of most large mapping projects. This technique is valuable because it melds all required categories of information (species, cover, structure, site history, environmental characteristics) in a single page field form that can be quickly learned and efficiently completed. RA has proven to be adequate for sampling types of vegetation in the state including deserts, grasslands, scrub, woodland, forest, and alpine habitats. Because vegetation classification and mapping requires many repeated samples of each type of vegetation to ensure high accuracy in the classification and its mapping, the great value of the RA technique is its relatively short sampling time, enabling more than twice as many samples taken in a given period than other typical approaches.

The other basic technique is the Relevé (French for "abstract" or "summary"), a widely accepted method (Muller-Dombois and Ellenberg 1974) that is used as the basis for most descriptive work on vegetation classification worldwide. The Relevé approach collects the same basic information as the RA but requires a complete species list and estimates of cover in a measured area of uniform size. It typically requires about twice as much time per sample as the RA, but has great value when specific information is needed for diverse vegetation that has not been well described before, or for detailed comparative monitoring projects. Most projects include a combination of RA and relevé sampling, as most projects require a combination of many replicate samples and a set of samples that substantiate new types of vegetation and that form the basis for permanent monitoring plots.

Sample selection for all large area projects is undertaken using a three-tiered approach. First, physically and legally accessible areas are identified and a suite of existing GIS information on geology, climate, and topography are quantitatively analyzed. These landform data are broken into categories that equate to natural landscape units likely to contain differing types of vegetation. Secondly, a subset of the most accessible and representative landform units is selected for sampling by field teams. Finally, following at least a full sampling season, sites that have,

by physical inspection, been found to contain additional vegetation not sampled in the first pass are selected for sampling.

Data are analyzed using standard statistical software developed specifically for vegetation classification. A detailed sequence of steps includes error checking, removal of outlier samples, and statistical comparisons of similarities of all of the samples. This information is used to determine how to formally divide the sampled groups into individual vegetation types (called plant associations). Descriptions following standard and widely accepted reporting techniques are written along with technical keys used to identify each type of vegetation. This information is essential to determine the accuracy and utility of the final mapping project.

2 b. Image Interpretation: All vegetation maps that cover reasonably large areas are the result of expert interpretation of aerial photography, satellite, or airplane-born digital imagery. An important part of the standards for state vegetation mapping is the uniform treatment and application of this imagery. Without standards set for the scale and quality of the base imagery and the scale and quality of the interpretation of this imagery, no reliable integrated state-wide map would be possible. Over the life of this program, it is inevitable that today's standards for base imagery and the techniques used to interpret it will change as a result of technological improvements. The program acknowledges this and will adopt a flexible approach to such standards. Such standards are likely to be agreed upon through the regular meetings of the vegetation MOU committee (discussed in Section 1). The unchanging factors that will guide any new approaches are the basic units of vegetation and their natural size and distribution across the landscape.

The standard imagery for the first state wide mapping will be that provided by the National Agricultural Imagery Program (NAIP). This nationally mandated program (NAIP website: http://165.221.201.14/NAIP.html) is a federally supported program that provides uniform scale and quality digital aerial photography for all of the United States on a five year repeat timeline. The resolution of the imagery is 1 m, which translates to an approximately 1:39,000 scale image. The imagery is available in both true color and in color infra-red formats, providing a wide array of possibilities for detailed interpretation. The most recent NAIP imagery was flown in the summer of 2005. New imagery flown in 2010 will replace the existing data set in projects undertaken in following years.

The imagery is produced using nationally accepted standards for spatial accuracy and can be loaded onto computer workstations to be processed and interpreted through standard Geographic Information Systems (GIS) analysis. The NAIP imagery may be augmented by other locally available high quality and high resolution imagery, but to assure uniform, seamless representation, will be the accepted base imagery used for all mapping conducted during the first full state-wide mapping effort throughout the state.

Uniformity of image interpretation is established by relying upon:

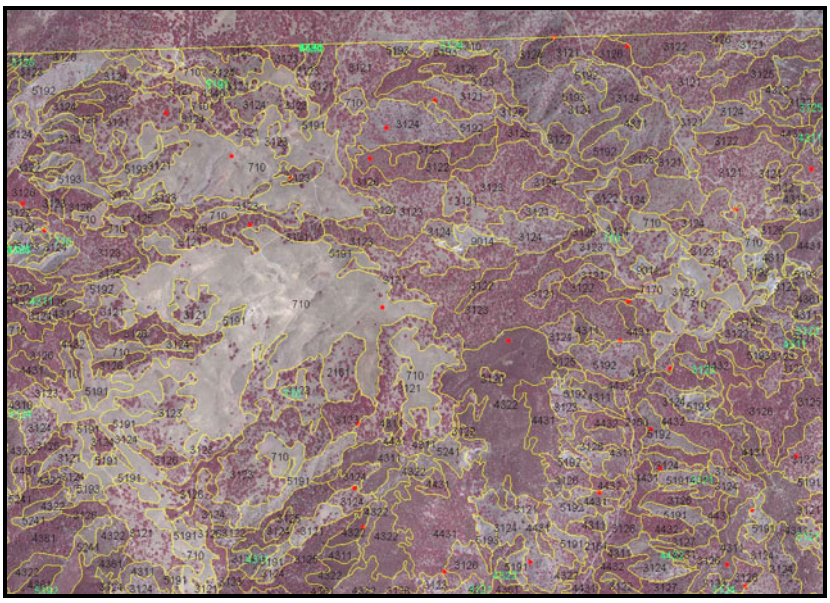
1) the national vegetation classification hierarchy, and
2) a standard minimum mapping unit size of one acre (0.471 ha) for wetlands and riparian and two acres for upland vegetation.

Vegetation types distinct on the ground, but indistinct at the above scales of imagery interpretation are aggregated using standardized rules that include a uniform application of the NVCS hierarchy and plurality rules for inclusions of minor types into larger regularly mappable classification units. A set of mapping standards has been produced through the Vegetation MOU Committee

Available at the following website:
http://ceres.ca.gov/biodiversity/Meetings/Special/mapping_standards2.pdf).

These will be adhered to and when new technology and needs arise, will be modified with the cooperation of the Committee.

Figure 3: *Example of detailed mapping effort overlain atop digital color infra-red orthophoto, showing coastal oak woodland, grassland, and chaparral matrix. Numbers are vegetation codes, red dots are field sample locations (eastern San Benito County).*



2 c. Digital Map Production: Mapping proceeds within a project area following the completion of the field classification and the refinement of the classification into consistent mapping units. The process of delineation of map units follows a series of steps. These include:

1) rough characterization of the vegetation by basic life-form (for example, woodlands are differentiated from shrublands, and grasslands),

2) refinement of polygons based on specific interpretation of type, cover, and other structural qualities, and

3) final modification of polygons following map accuracy assessment.

Step 1 is commonly undertaken using learning-based computer programs that can reliably segment a digital aerial photograph into polygons. However, the final phases of production are undertaken by highly trained and calibrated image interpreters who rely heavily upon their expertise, field data, and classification data. Following the completion of Step 2, the map is subjected to an independent test of its accuracy using standardized techniques (discussed in the next section). As a result of the accuracy assessment phase and review by users of the map, the final map of each project area is produced, incorporating all corrections and agreed-upon modifications.

2 d. Map Attribution: The GIS format of the map products enables the thousands of individual polygons to be tagged with a number of useful attributes beyond simply the name of each type of vegetation.

The standard set of attributes has been agreed upon by the State Vegetation Committee (Standard vegetation map attributes table 2003: http://ceres.ca.gov/biodiversity/Meetings/Special/map_attributes_5.pdf).

In many ways, this is the crux of the broad utility for these map products, enabling them to be used for predicting species' habitat, fire and fuels modeling, timber productivity, and other conservation values. The suite of attributes include categories for vegetation height, vegetation cover (separate values for distinct layers of trees, shrubs, and herbs; conifer and broadleaf cover, etc.), and translations to other commonly used map classifications (for example CalFire's and Forest Service's CALVEG, or Wildlife Habitat Relationship's classification). Additional attributes for human-mediated impact (such as development, roads, trails, invasive exotic plant cover) are categorically ranked.

3. Required Training Manuals and Materials, Tools, and Database Structures

A series of training protocols have been developed, categorically describing each of the vegetation sampling techniques outlined in Section 2a. These have been taught through a series of trainings by Department and CNPS staff over the past 10 years. Mapping standards are similarly described for specific projects accessible via the BIOS portal (http://nrm.dfg.ca.gov/biogeographicdata.aspx). Mapping training materials have also been developed for a series of mapping workshops co-taught by staff from Department and CNPS and the private consulting firm Aerial Information Systems. These include example delineations, specific processing steps, and calibration tools for coding height, cover, checking on minimum map size, and disturbance categories.
All data, whether collected in the field, or recorded as attributes for the vegetation maps, are entered in standardized databases that are developed as part of the corporate biological data structure in the Department of Fish and Games BIOS format (http://nrm.dfg.ca.gov/biogeographicdata.aspx). Database development includes built-in error checking features for all scientific names, codes, and numeric values. Data updating is regularly undertaken for both the GIS maps and for the field data collection. Data downloading and uploading is accomplished through a series of tools that are web-compliant. This allows users to access all basic data and provide comments on

specific interpretations that may be in question by qualified users. All fields and data structures are supported by standardized metadata formats accessible for all projects via the BIOS portal.

4. Post- Project Accuracy Assessment and Public Review

The value of the map and associated data is only as good as its proven accuracy. Thus, each product undergoes an accuracy assessment. Mapping accuracy is tested by collecting an independent set of field data using the Rapid Assessment Protocol (described above in Section 2a)**.** The basis for accuracy assessment relies upon two main premises. First, the mappers have a general feel of how confident they are about each mapping unit used in the project. This can be estimated and acts as a means to determine how many independent checks of polygons of a specific category should be collected. Second, there is a statistically valid method of collecting and independently evaluating these data. Formulae are developed for each project that account for the estimated accuracy for each type of vegetation mapped and the certainty expected, based generally on the value that at least 80% of the time each mapping unit is correctly mapped for type, structure, and other valuable attributes (Meidinger et al 2003). Although it may seem surprising to see figures as low as 80% depicted as being acceptable, detailed mapping with fine levels of classification and delineation is never 100% accurate unless every map polygon can be visited and observed. The National Park Service vegetation mapping program, the most exacting and detailed so far, also has a standard of 80% minimum accuracy.

Figure 4: *Example of Accuracy Assessment Summary Table from the Legal Delta Mapping Project (blue indicates types that did not meet standards for accuracy and should be refined).*

Veg Code	Map Unit Name	number samples	samples used	average % score
1382	Salix gooddingii - Populus fremontii - (QuLo-SaEx-RuDi) association	26	26	94.6
3461	Salix lasiolepis - Mixed brambles (RoCa - ViTi - RuDi) MU	24	21	91.4
4511	Scirpus acutus Pure association	21	20	93
4514	Scirpus acutus - (Typha latifolia) - Phragmites australis association	18	18	92.2
4513	Scirpus acutus -Typha latifolia association	17	16	85
4710	California Annual Grasslands - Herbaceous MU	13	11	94.5
6211	Brazilian Waterweed Egeria -Myriophyllum Submerged	12	7	91.4
4701	Ruderal Herbaceous Grasses & Forbs	12	11	85.5
3481	Salix exigua - (SaLa - RuDi - RoCa) association	11	11	100
3442	Cornus sericea - Salix lasiolepis / (PhAu) association	11	11	80
1380	Black Willow (Salix gooddingii alliance)	10	10	96
3460	Arroyo Willow (Salix lasiolepis alliance)	10	8	77.5
3410	Blackberry (Rubus discolor alliance)	10	10	76
9300	Exotic Vegetation Stands	9	9	97.8
1360	Fremont Cottonwood (Populus fremontii alliance)	8	8	87.5
4502	Mixed Scirpus / Floating Aquatics (Hydrocotyle-Eichhornia) MU	7	7	100
2230	Valley Oak (Quercus lobata alliance)	7	7	85.7
1321	Alnus rhombifolia / Salix exigua (Rosa californica) association	7	6	73.3
4503	Mixed Scirpus/ Submerged Aquatics (Egeria-Cabomba-Myriophyllum spp.) MU	6	6	90

Due to the cost of collecting statistically valid sample sizes for accuracy assessment, compromises may be necessary. In many cases, full accuracy assessment may account for 1/3 of the cost of the entire project, if it is even logistically feasible. In some cases, there aren't enough individuals of certain types to get a valid sample. In addition, many of these samples may be difficult to access (for instance, they occur on private land). Thus, partial accuracy assessment (better known technically as "Quality Assurance") will be necessary. Under these circumstances, clear information will be provided to the public about the accuracy of the units assessed, and likewise, the reduction of certainty on other map categories. At a minimum, accuracy of the core

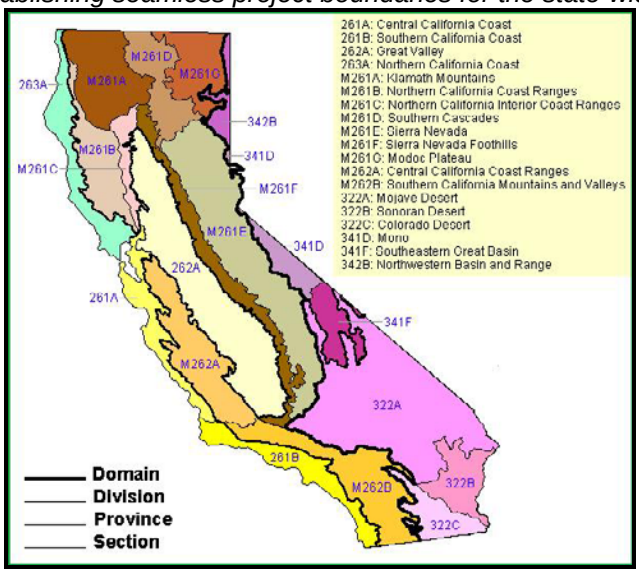
attributes determined for each project area will be assessed. These would include type, cover, height, and size of the vegetation for which it is logistically feasible to amass a significant sample size, and those types that are of particular importance to users of the data (determined case by case by the users groups).

5. Induction of New and Updated Map Products into the State System

The process of statewide vegetation mapping and classification is naturally iterative. A great deal of new information will be provided when areas are mapped for the first time. Once the entire state is mapped, the vegetation will continue to change, requiring regular updates.

As each portion of the state is mapped, an edge-matching process will take place to provide seamless continuity between individual mapping areas. A key first step in this process is determining how the areas will be chosen to minimize overlap and to ensure complete representation. This will be accomplished by using ecological section boundaries rather than political boundaries (***Figure 5***). There is great value to collecting and attributing data in ecologically defined units, within which are shared similar vegetation, climate, biological processes, and accessibility issues. This process also ensures greater efficiency in long-range planning, because the resources and time needed for upcoming projects can be planned well in advance, and are effectively divorced from possible political adjustments that could reduce planning, lower efficiency, and raise costs.

Figure 5: *Ecological sections of California as defined in Miles and Goudey (1997). There are 19 main sections, further divided into 208 subsections. The sections and subsections serve as the basis for establishing seamless project boundaries for the state-wide vegetation survey.*



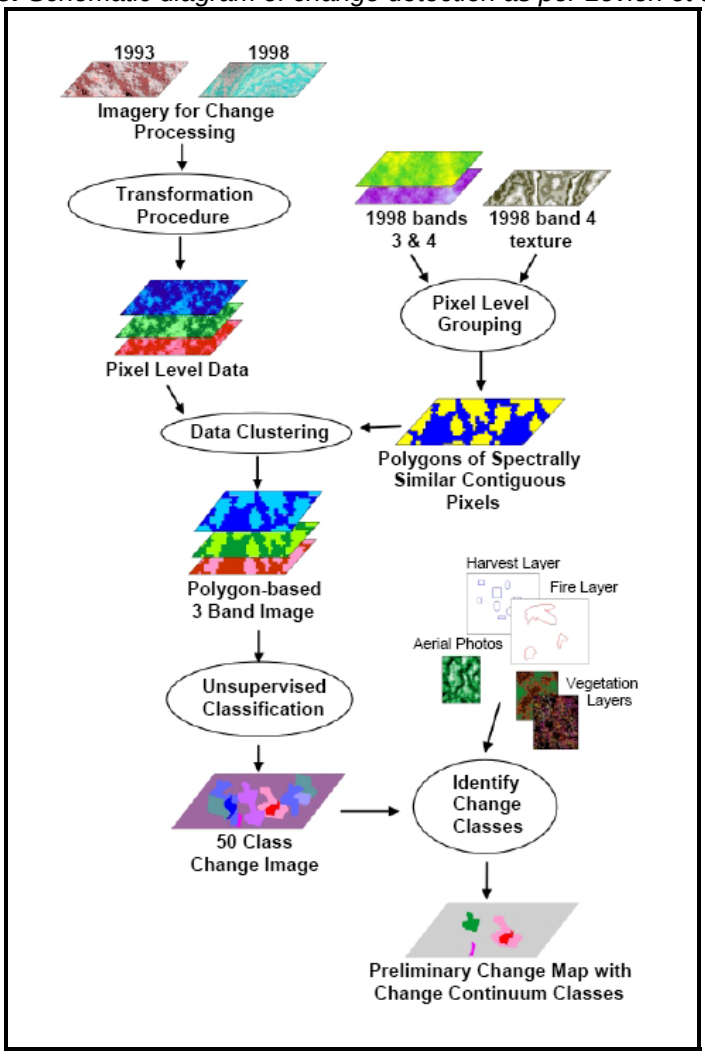
The physical border-matching between ecological sections will be aided by the standard imagery used throughout the state, standard rules for delineation and map unit creation, and detailed training and calibration of all image interpreters.

Building a data framework that accounts for the interweaving of new and updated information from the map and from the field work is a necessity. Flexible database

structures have been built that accommodate new information as separate updated categories. For example, individually revisited sample points can record multiple sets of data for each field each time they are sampled. Tools can be developed to summarize statistical changes between visits. Likewise, mapping updates are also accommodated using geo-databases that can accommodate both thematic shifts (changes in vegetation type or density, for example) and spatial shifts (changes in the shape and size of the polygon).

Change detection processing has been well developed by the U.S. Forest Service (Levien et al. 1999) and is a two-step process. Gross regional change is first assessed using algorithms to identify spectral changes in regional imagery.

Figure 5: *Schematic diagram of change detection as per Levien et al. (1999)*



Following this process, the areas detected as changed are further delineated using the Step 2 under Section 2c described above. This process will be enacted as each area of the state is re-visited maintaining a schedule based on the five year updates of the NAIP imagery and upon prior experience of detectable rates of vegetation change averaged throughout the state. All mapped and field inventoried change will be entered into the standardized databases and regular reports summarizing these changes will be produced on an annual basis.

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Senate Bill No. 85
CHAPTER 178

An act to add Section 1940 to the Fish and Game Code, to amend Section 12536 of, and to amend and repeal Sections 12846 and 12846.5 of, the Food and Agricultural Code, to add Chapter 4 (commencing with Section 12890) to Part 2.5 of Division 3 of Title 2 of the Government Code, to amend Sections 25173.7, 25174, and 25330.4 of, and to amend and repeal Section 25330.6 of, the Health and Safety Code, to amend Sections 5818.1, 5818.2, and 32580 of, and to add Sections 716, 5003.19, 5096.829, 5096.954, 5096.955, and 14317 to, the Public Resources Code, and to add Section 142 to the Water Code, relating to the environment, making an appropriation therefor, and declaring the urgency thereof, to take effect immediately.

[Approved by Governor August 24, 2007. Filed with Secretary of State August 24, 2007.]

The people of the State of California do enact as follows:

SECTION 1. Section 1940 is added to the Fish and Game Code, to read:

1940. (a) The Department of Fish and Game shall undertake the development of a vegetation mapping standard for the state.

(b) The development of a state vegetation mapping standard by the department shall be done in consultation with interested stakeholders, including, but not limited to, government agencies, nongovernmental conservation organizations, landowners, agriculture, recreation, scientific entities, and industry. Components of the standard shall include the following:

(1) A published classification system for all natural and seminatural vegetation communities present in California with sufficient detail to meet the analytical needs of government and nongovernment entities. The classification shall be consistent with national standards adopted by the Federal Geographic Data Committee.

(2) Methods for field data collection, image interpretation, and digital map production and attribution.

(3) Manuals, training materials, tools, and database structures for use by parties interested in performing vegetation mapping according to the standard.

(4) Documented methods for performing postproject accuracy assessments to quantify that validity of the work. Private and public landowners shall be given reasonable opportunity to review, and comment on the accuracy of, the data collected on their lands.

(5) Mechanisms for integrating new map products that meet the standard into a cohesive database with the intent of eventually completing statewide coverage.

(c) The department shall submit a report to the budget committee of each house of the Legislature no later than January 10, 2008, providing its mapping standard and advising how the department will ensure that its standard will be updated to reflect changing technology and serve as the state's center of expertise on vegetation mapping.

(d) The department may adopt regulations to implement this section.