Regional Conservation Guide

Conception Coast Project

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www.conceptioncoast.org

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Executive Summary

The south-central coast of California is home to a globally unique array of natural resources, diverse wildlife, varied landscapes and unmatched human amenities. Located at the intersection of warm, semi-arid southern California and cooler, wetter central California, this "Conception Coast Region" hosts a natural bounty that blends northern and southern climates, landscapes and plant and animal communities together as nowhere else in North America. Consisting of Santa Barbara, Ventura and parts of their adjacent counties, the region's spectacular coastline, mountainous wild backcountry, verdant working agricultural landscapes and dramatic watersheds form the natural capital upon which our daily lives—whether we recognize it or not—are based. In a first sense, the Regional Conservation Guide (RCG) you are reading is a catalogue of our natural assets and a call for greater understanding of their needs.

More importantly, this Regional Conservation Guide represents a unique tool we hope will assist in community planning efforts to secure our natural heritage while seeing to the needs of our human communities. This Regional Conservation Guide provides focus on just what nature's needs are in this region. The Guide draws on a wealth of locally-produced biological data, guided by proven concepts of conservation biology to depict, for the first time, what would be needed to assure that future generations enjoy – and are sustained by – a thriving ecosystem with a healthy complement of wildlife, landscapes and natural resources.

The Guide also advances the notion of "ecosystem-based management" which focuses conservation effort on habitats and assemblages of plants and animals together and before their status is critical, preempting the crisis management associated with endangered species recovery efforts. We believe the Guide contributes an important, clarifying sense of an overall conservation vision to engage stewardship, guide action and empower stakeholders with a common, achievable set of goals. We suggest that no single interest will succeed alone in securing our common future without a new sense of teamwork, and offer the Regional Conservation Guide as a helping hand in that direction.

Following the catalogue of the region's natural bounty and a discussion of conservation planning concepts, the Regional Conservation Guide presents a powerful modeling tool with which conservation goals and ecological data are combined with anticipated future threats to resources from growing human population, consumption and land-use trends. An important and powerful tool in itself, the RCG model's graphical outputs represent achievement of an important goal of the Conception Coast Project for the past half-decade: usable, illuminating maps that identify the most ecologically important areas of our region, and, when combined with the factor of "threat," maps that identify priorities for near- and long-term conservation efforts. These maps present options for a region wide system of protected areas that meet the needs of the landscape for long-term ecological sustainability. To be clear, all of the areas identified as conservation priorities need not be secured in "reserves" – or highly protected status such as wilderness— in order to maintain the region's ecological integrity. "Stewardship zones" —areas of quality habitat that allow for human use of the landscape simultaneous to managing for biodiversity—may be used as part of an effective network of regional conservation designations. Stewardship zones can occur on public and private lands and include certain types of agricultural and grazing practices, ecologically sustainable forestry, and recreational use such as hunting and fishing.

Of critical importance in responding to and utilizing the information contained in this Guide is the use of the same long-range (25-100 years or more) planning perspective that was used in creating it. The Guide concludes with an extensive discussion of implementing its conservation recommendations, efforts we expect will take considerable time and greater financial and other resources than presently exist. Nevertheless, we believe the Guide presents urgently needed information as well as inspiration to guide the use of currently available time, energy and resources to ensure our conservation and stewardship efforts are efficient and pay maximum dividends. Given this timeline, we outline numerous voluntary, pro-active alternatives to complement existing effort towards assuring preservation of our natural heritage while meeting the complex and growing needs of our society.

Chapter 1
Introduction

Introduction

Origin and Development of the Regional Conservation Guide (RCG)

The Conception Coast Project (CCP) developed an initial vision of a landscape-scale conservation planning tool following its inaugural community workshop in 1995. This vision was twofold: to communicate the requirements of the landscape for long-term ecological sustainability, and to create a tool to guide community action towards achieving it. Over several years, CCP refined a set of goals and principles for this tool—the Regional Conservation Guide you are now reading—based upon community needs as well as those of the natural environment. CCP evaluated a variety of conservation planning frameworks for their suitability in meeting the needs of the local region and its array of land-use and resource management stakeholders. The cutting edge modeling framework developed at UCSB Biogeography Lab and the National Center for Ecological Analysis and Synthesis was selected (Davis, Stoms et al. 2003). This framework was created for the Legacy Program of the California Resources Agency. CCP then identified the portions of the framework that would be applied as well as the additional ecological sub-models that would be added. The resulting model will be termed the RCG Model for the rest of this document.

At the numerous decision points encountered in developing the RCG, local knowledge was incorporated as much as possible to ensure maximum regional applicability of the document as a planning tool for the public.

Two groups of advisors, the Land-Use Advisors and the Ecological Advisors, where assembled to augment the CCP Board of Directors and to advise CCP Staff. Periodic workshops, meetings, and focus groups were held to advise CCP staff regarding numerous technical decisions associated with the RCG.

CCP Staff and their associated roles during the period of RCG Development consisted of:

John Gallo, conservation director GIS analyst
James Studarus, operations director
Elia Machado, GIS analyst
Cory Gallipeau, GIS analyst and data manager
Ethan Inlander, conservation advisor
Michael Summers, development associate

The Land-Use Advisors are local resource professionals selected based on knowledge of conservation planning and land use and management in the region. They provided advice, feedback, and guidance in development of the land use components of the analysis as well as of the products. The organizational affiliations of these advisors is provided for identification purposes only, and do not reflect endorsement of or involvement of the organizations in this document.

Darcy Aston – program specialist, senior, Santa Barbara County Water Resources Division
Rachel Couch – administrative assistant to Santa Barbara County Supervisor Susan Rose
Robin Cox – director of planning, The Nature Conservancy
Jim Engel – executive director, Ojai Valley Land Conservancy
Michael Feeney – executive director, Land Trust for Santa Barbara County
Maeton Freel- senior biologist, United States Forest Service
Carla Frisk – project consultant, Trust for Public Land

Dr. Rod Nash- professor emeritus Environmental Studies
Martin Potter – wildlife biologist, California Department of Fish and Game
Lisa Plowman- senior planner, Santa Barbara County Planning and Development
Nancy Read – biologist, Vandenberg Air Force Base
Lorraine Rubin – regional planner, County of Ventura Planning Division
Kate Symonds –United States Fish and Wildlife Service
Bob Thiel – project coordinator, Southern California Wetlands Recovery Project
Alex Tuttle – planner, Santa Barbara County Planning and Development

The Ecological Advisors consist of local scientists, resource managers and naturalists selected based on knowledge of conservation planning and about one or several taxa or ecological principles. They provided advice, feedback, and guidance in development of the ecological components of the analysis as well as of the products. The organizational affiliations of these advisors is provided for identification purposes only, and do not reflect endorsement of or involvement of the organizations in this document.

Dr. LynneDee Althouse- Co-Director, Althouse and Meade, inc. Biological and Environmental Services
Liz Chattin- biologist, County of Ventura Planning Division
Chris Clervi- data manager, United States Forest Service
Paul Collins- curator of vertebrate zoology, Santa Barbara Museum of Natural History
Jim Greaves- principal, Jim Greaves Consulting
David Hubbard- UCSB Museum of Systematics and Ecology
John Labonte- doctoral candidate, Department of Ecology, Evolution, and Marine Biology, UCSB
Tom Olson – senior biologist, Garcia and Associates
Dr. Ralph Philbrick – botanical consultant
John Storrer- owner, Storrer Environmental Services
Dr. Sam Sweet- professor, UCSB Ecology Department, Herpetiles
Dr. Jaimie Uyehara – biologist, United States Forest Service

The Conception Coast Project's Board of Directors was instrumental in developing the original direction of the RCG as well in providing invaluable advice to staff throughout the process. Again, organizational affiliations are included for identification purposes only.

Greg Helms – The Ocean Conservancy
Rachel Couch
John Storrer
Darcy Aston
Paul Jenkin –Ventura County Surfrider Chapter

A group of academics and conservation planners was also consulted in order to provide an ongoing source of informal peer review in the development of the RCG. Some members of this group provided theoretical and technical input on an ad hoc (i.e. for the purpose at hand) basis and are listed in the acknowledgements section of the RCG. CCP extends its sincere thanks to each of the advisors for their contributions. They graciously volunteered their time and their wealth of knowledge.

Finally, although we believe the RCG is an important source of information and an outstanding basis for community-based conservation planning, we recognize that the document serves as a starting point rather than a conclusion. As discussed within this Conservation Guide, refinement of its components and implementation of its findings will necessarily entail a highly inclusive team of community members working together towards the common goal of protecting our natural heritage.

Acknowledgements

Many exceptional organizations and individuals aided in the creation of the Regional Conservation Guide. This project has been a bold vision for over a decade and came to this point through hard work, vision and generosity.

Conception Coast Project is grateful for the generous contributions from the numerous individuals and organizations who supported this effort. We are especially thankful for the following organizations that made it possible to complete the Regional Conservation Guide:

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Chapter 2
Key Concepts of Conservation Planning

Cottonwood - *Populus trichocarpa*

Key Concepts of Conservation Planning

Imagine a house of cards consisting of level upon level of cards, all stacked in an intricate display. Each level depends on the last for its stability, and each card depends on another to stand upright. Gravity is the force that holds the entire structure together. This illustration is not unlike the relationships that exist in the natural world. Our natural environment is an intricate display of interdependent forms of life, bringing forth a remarkable array of benefits to the whole.

A card can be pulled from a house of cards, one at a time, without collapse because gravity maintains a balance. But after enough cards are removed, a threshold is reached, and if just one more card is removed, the house collapses. The environment and all that it encompasses is of similar constitution, and it can only sustain so much degradation before functioning is impaired or its many components become dismantled or destroyed.

Today, society faces a significant challenge in balancing the needs of humankind with the needs of the environment. To begin to better understand these challenges, it is important to grasp some key concepts that are fundamental to the natural world.

Biodiversity

Biological diversity or biodiversity refers to the variety of life forms: the different plants, animals and microorganisms, the genes they contain, and the ecosystems they form. This living wealth is the product of hundreds of millions of years of evolutionary history. The process of evolution means that the pool of living diversity is dynamic. It increases when new genetic variation is produced, a new species is created or a novel ecosystem is formed; biodiversity decreases when the genetic variation within a species decreases, a species becomes extinct or an ecosystem complex is lost.

Biodiversity is typically considered at three different levels: genetic diversity, species diversity and ecosystem diversity. Genetic diversity refers to the variety of genetic information contained in all of the individual plants, animals and microorganisms. Such diversity occurs within and between populations of species as well as between species. Species diversity refers to the variety of living species. Ecosystem diversity relates to the variety of habitats, biotic communities, and ecological processes, as well as the immense diversity present within those ecosystems.

An important issue regarding biodiversity is that scientists don't know very much about it on a global scale. About 1.4 million species have been identified in some way or another, but the true number is estimated at between 10 and 100 million. We have scarcely begun to understand the scope of the biodiversity upon which our collective well-being is ultimately dependent.

Extinction is occurring at an unprecedented rate. Harvard University's E.O. Wilson predicts that one-third of the world's species could easily die out in the next 40 years. Anthropogenic (human) activities increasingly disturb the integrity of global biodiversity. Pollution, the introduction of exotic species, unsustainable agricultural practices, urban sprawl, fragmentation of habitat by roads and fences, draining of wetlands, elimination of natural fire processes, damming of rivers, clear-cut logging, and climate change all contribute to the loss of biodiversity through ecosystem disruption and habitat destruction.

Natural disturbance aside, species richness has decreased as the world's human population has grown.

Ecological Services

Ecological services rank high on the list of reasons the biodiversity crisis is of major concern. The term "ecological services" refers to the conditions and processes through which natural ecosystems sustain the environment, including the needs of humanity. They are a result of complex natural cycles, driven by solar energy, which operate on different scales, influencing the workings of the biosphere in different ways. Ecological services produce ecosystem goods, such as food, timber, energy, and natural fibers, as well as raw materials used in pharmaceuticals and industrial products. The harvest and trade of these goods is based upon "natural capital" and is a fundamental part of the global economy.

In addition to the production of goods, ecological services include life support functions, such as protecting watersheds, reducing erosion, cycling nutrients and providing habitats, as well as cleansing, recycling, and renewal. Examples of the benefits of ecological services include: purification of air and water, mitigation of floods and droughts, detoxification and decomposition of wastes, generation and renewal of soil and soil fertility, pollination of crops and natural vegetation, dispersal of seeds and translocation of nutrients, control of agricultural pests, protection from the sun's harmful ultraviolet rays, moderation of temperature extremes, and the force of winds and waves. A further benefit is the aesthetic value we receive from the world's natural ecosystems and landscapes.

Ecological services maintain the world's biodiversity, and biodiversity correspondingly maintains the world's ecological services. They are interconnected and unified. As you may recall in the house of cards analogy, all of the cards must stand upright, and all the levels must support the ones below, in order for the house to be sustained. If the cards cannot stand upright, or the levels collapse, what will be left of the structure? Both must be present and robust.

If left unchecked, failure and collapse of our important and valuable ecological services and biological diversity is a real possibility. In many respects, we are on the path of breakdown with a documented multitude of endangered or threatened species and habitat, as well as a long list of extinct species. Like a thermometer registering a fever, the accumulating trends of ecological decline are the indicators of our condition.

Sustainability

It is not the environment that needs to be managed. It is what we as humans do in our environment that needs better management. The ways in which humans manipulate biological diversity determine how sustainable human populations will be.

Sustainable development involves complex processes of purposeful change in the attitudes, behaviors, and institutions of human societies, in which humanity chooses to balance its consumption and development with the needs of the natural world. Sustainability asks that we attempt "…to meet the needs of the present without compromising the ability of future generations to meet their own needs (Bruntland, 1987).

Sustainability in this context – the decision to conserve resources so that impacts on the environment can be minimized to reduce the rate of environmental degradation – is an attainable goal. The economic and social fabric of human societies does not have to suffer as a result. By reevaluating our routine actions to avoid those that are unnecessary and wasteful, by reducing our consumption, and by recycling and reusing our wastes, we may begin to see a turn of the tide, and perhaps meet somewhere in the middle.

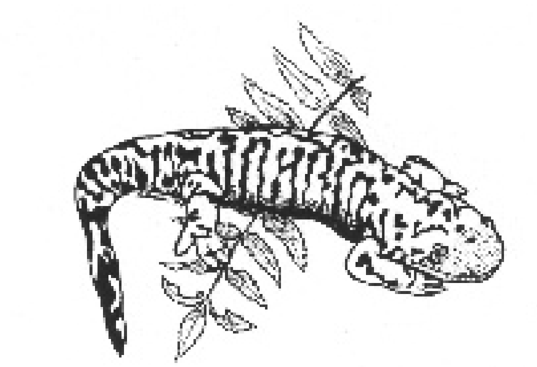
The intricacies and fragility of the world around us must be acknowledged. The environment is not as fragile as a house of cards, but degradation is rapidly occurring on a global scale and the cumulative impact is yet unknown. Awareness is crucial, and indicators of degradation should not be ignored. Loss of habitat and species diversity is real, and is creating concrete and as yet unknown implications for the future.

A Sense of Place

A final notion implicit in the development and use of this Regional Conservation Guide is a personal commitment to the place in which one lives. A personal commitment to understanding and caring for one's local social and physical environment plays an essential role in ensuring their long-term well-being. Increasingly, the sense of personal engagement in a particular landscape and community is diminished by modern society's transience, mobility and global concerns. Rural residents, although they may be physically farther from their nearest neighbor compared with urban dwellers, often retain a much greater personal involvement with their neighbors and with their physical surroundings. While modern amenities may have reduced the necessity of relying on one's neighbors, the active involvement of individuals with their local social and physical environment is increasingly being identified as a cornerstone of successful conservation work. Watershed groups are example of such a place-based, locally focused arrangement for directing collective action that emphasizes the values of teamwork, civility, dialogue, mutual aid and information sharing. Sociologists have termed this notion "bioregionalism," although its roots probably predate sociology itself.

Central to a "place-based" basis for addressing the concerns discussed in this Guide is the sense of shared responsibility to the land and to one another. A critical step in this direction entails developing an intimate knowledge and understanding of the natural and social character of a place. The process of gaining knowledge about the land brings with it an awareness of the history of the land, and understanding history produces a concern for the future. This Guide contains a modern and science-based interpretation of the landscape of the region, speaking directly to the needs of natural systems. Within the people and cultural history of this region lies another rich, invaluable source of information we must be willing and able to discover and use. For success over the long term, these resources must be integrated through a process of sharing, teamwork, and trust in each other.

Chapter 3
Regional Overview & Threats



Tiger Salamander - *Ambystona tigrinum*

Regional Overview & Threats

Defining A Regional Boundary

Defining the boundary for a conservation plan is a difficult but critical early step. A regional conservation planning boundary should be both ecologically and socially defined. The region should also be large enough to address biogeographic issues, yet small enough to be socially and politically tractable.

Setting the boundary of the "Conception Coast Region," presents a unique challenge in south-central California in that the area encompasses a "transition" zone between a truly southern California ecological setting and the distinct central California setting. Intuitively, residents of the area identify themselves as both southern and central Californians, and science from a host of disciplines confirms it. Widely accepted ecological subdivisions of California such as the Jepson Ecoregion system confirm this "in-between" character of the south-central coast of California, placing Santa Barbara County at the junction of the central western and southwestern regions. Drawing from studies of the distribution patterns of animal and plant taxa, climate regimes and ocean current patterns, the south-central coast of California stands out clearly as a "mixing zone" –an area in which northern and southern coastal ecological features occur together. This transition zone is unique in the United States, and represents a rich, diverse and critical biological "hotspot" that might be overlooked if treated simply as the northern extent of the southern California region or the southern end of the northern California region. Biologically and socially, this area of transition is distinct in itself, and the Regional Conservation Guide therefore establishes a region that encompasses this unique transition zone.

The Conception Coast Region extends from the Santa Maria to the Santa Clara River watersheds, and includes all of Santa Barbara County, most of Ventura County, and small portions of San Luis Obispo, Kern, and Los Angeles Counties, incorporating the watersheds that intersect the two Jepson ecoregions as its boundary. The Channel Islands, Santa Barbara Channel, and the coastal waters of the area are also included within the Conception Coast Region. These island and offshore areas will not be addressed in this first edition of the RCG. The Conception Coast Region also includes the Calleguas Watershed, which was included for important planning purposes for Ventura County. See Figure 1 (Conception Coast Region and Watersheds) and Figure 2 (General Land Use of the Conception Coast Region).

Major Habitat Types Of The Conception Coast Region

The 14,000 square kilometer Conception Coast Region is named after Point Conception, the geographic feature that defines the boundary between central and southern coastal California. The region serves as a geologic, topographic and climatic transition zone supporting a rich diversity of ecosystems and habitats. The region's ecosystem types are highly diverse, ranging from interior scrub-dominated desert landscapes to alpine conifer forests to coastal dune and wetland complexes. These ecosystems harbor approximately 1,400 native species, of which more than 140 are endemic to the region. The convergence of the Southern California and Central California climates occurs around the Santa Ynez ridge. The Conception Coast Region has a high diversity of plant and animal species as a result of the transitional characteristics of the area.

Figure 1: Conception Coast Region and Watersheds FRONT

Figure 1: Conception Coast Region and Watersheds BACK

Figure 2: General Land Use of the Conception Coast Region
FRONT

Figure 2: General Land Use of the Conception Coast Region BACK

A list of the major vegetation-based habitat types that was used in regional analysis appears at the end of this section. Below, the major habitat groupings present in the Conception Coast Region are briefly overviewed.

Coastal lowlands and seashore habitats bound the coastal edges of the region, with rocky shores predominating in the northern stretches and sandy beaches most typical in the south facing southern reaches. Rocky shore habitat is extensive north of Vandenberg Air Force Base, from Point Sal to Pursima Point, and along Point Conception. Sandy beaches are widespread, although often heavily disturbed (Lehman, 1994).

Coastal wetlands, although severely reduced in scope and size in the last century, are present in the region in the south at Point Mugu and Ormand Beach, in the north at the Santa Maria and Santa Ynez River mouths, and at the Devereux and Goleta Sloughs. A few freshwater marshes such as the Barka Slough and at the interior delta of the Santa Maria River near Guadalupe remain (Lehman, 1994).

The majority of the oak woodlands occur in sheltered valleys or along the north-facing slopes of canyons and coastal mesas. In the north, woodlands most frequently occur on hilltops or in wide valleys, providing habitat, shelter and refuge from heat for many species (Stephenson et al. 1999). They often occur in two distinct forms: as closed canopy stands in canyons or along streams, and as open savannas in broad valleys. Large fauna including mountain lions (Felis concolor), black bear (Ursus americanus) and mule deer (Genus Odocoileus) continue to inhabit the oak woodlands of the region. Oak woodland habitat types in the region include the coastal live oak community, the blue oak-foothill pine group and the valley oak savannah.

Grassland communities are present in the region at a wide variety of elevations. Lowland grasslands have been extensively converted to residential, agricultural and other uses, although examples of less-disturbed lowland grassland communities exist at More Mesa and the Ellwood Mesa in Goleta, in the Hollister/Bixby Ranch area, and elsewhere. Grassland areas in the mountains are known as “portreros,” which are highly localized in the Santa Ynez and San Rafael ranges but extensive in the Sierra Madre range (Lehman, 1994).

Chaparral covers much of the undeveloped coastal areas that lie in the South Western California Ecoregions. Areas along the front range of the Santa Ynez Mountains through the Ventura, Santa Clara and Calleguas watersheds host areas of undisturbed chaparral.

Riparian woodlands occur throughout the region, both inland and coastal. Inland riparian woodlands occur around the Santa Ynez and Sisquoc Rivers and along several tributaries, and may contain a complex understory/overstory structure including willow, cottonwood, and sycamore (Lehman, 1994).

Foothill and mountain pine/oak forests and Bigcone Douglas-fir forest occur sporadically along of the north facing mountain slopes of the region. Higher elevation areas such as Mount Pinos and Figueroa Mountain contain Montane conifer forest where Jeffrey pine and white fir are often found (Stephenson 1999).

Vernal pools were prevalent on the coastal and interior lowland areas of the Conception Coast Region during pre-settlement times. Vernal pools are seasonal wetlands that fill with water during fall and winter rains (Stephenson 1999). The coastal mesas and plains were dotted with vernal pools that provided habitat for an array of animals, including migratory waterfowl, frogs, toads, salamanders, and pollinating insects. Coastal dune, coastal sage scrub and estuarine salt marshes, along with the intertidal marine complex represent the dominant habitat types of the coast.

The current extent of the many habitat types within the region has been dramatically affected by urbanization, agricultural conversion and industrial uses. Chaparral such as coastal sage scrub has been reduced to only 15 percent of its former range in Southern California (Stephenson 1999). One major issue with chaparral is replacement of native chaparral with nonnative grasslands after frequent fire disturbances (Stephenson et al. 1999).

For an indication of the percent cover of each habitat type within the region, see the below Table 1. To see how these types are distributed geographically, see Figure 3: Habitat Types and Distribution within the Conception Coast Region.

Table 1: Habitat Types And Distribution Within The Conception Coast Region

Habitat Type	Percentage
Agriculture	7.00
Alkali Desert Scrub	0.34
Annual Grassland	13.8
Barren	1.35
Blue Oak Woodland	2.27
Blue Oak-Foothill Pine	0.05
Chamise-Redshank Chaparral	3.70
Closed-Cone Pine-Cypress	0.04
Coastal Oak Woodland	8.04
Coastal Scrub	16.8
Desert Scrub	0.97
Desert Succulent Shrub	0.01
Desert Wash	0.06
Freshwater Emergent Wetland	0.01
Jeffrey Pine	1.18
Joshua Tree	0.01
Juniper	0.71
Lacustrine	0.00
Mixed Chaparral	31.1
Montane Chaparral	0.47
Montane Hardwood	1.74
Montane Hardwood-Conifer	1.38
Montane Riparian	0.91
Pinyon-Juniper	5.67
Ponderosa Pine	0.01
Sagebrush	0.62
Saline Emergent Wetland	0.01
Sierran Mixed Conifer	0.68
Subalpine Conifer	0.00
Unknown Conifer Type	0.00
Unknown Shrub Type	0.19
Valley Foothill Riparian	0.12
Valley Oak Woodland	0.20
Water	0.60

Figure 3: Habitat Types and Distribution within the Conception Coast Region
FRONT

Figure 3: Habitat Types and Distribution within the Conception Coast Region
BACK

Summary of Ecological Threats in the Conception Coast Region

The natural landscape of the Conception Coast Region forms the backbone of its living community, supplying clean air, water and open space. California's population is roughly 36 million people, and is adding a half million people annually (California Legislative Analyst's Office, 2002). Undoubtedly, the region will experience drastic effects of this swelling population as pressures build for more housing, roads, commercial centers, and other developments. While an exhaustive treatment of negative ecological trends is beyond the scope of this document, it is vital to understand the broad types of threats facing the Conception Coast Region in order to create a conservation strategy that will be effective in addressing these problems.

The principal threats of our region include:

-Development pressure
-Habitat Fragmentation
-Loss of top predators
-Oil development
-Climate change
-Agricultural intensification
-Aquatic fragmentation
-Loss of native species
-Exotic species
-Erosion
-Lack of coordinated conservation strategy

Development Pressure

The Conception Coast region faces immense and growing development pressure. In 2002, there were 4,536 more acres of urbanized land in Santa Barbara County than there were in 1990 (California Department of Conservation, 2002). This pressure, combined with a general resistance to increasing the density of urban and suburban areas, leads to a tendency towards sprawl and development of remaining urban open spaces and agricultural land. Compounding this problem are recent trends towards development of large residential developments and associated infrastructure in rural and semi-rural areas, fragmenting habitat. Such development adjacent to rural, wilder areas increases the incidence of wildlife-human interactions, which inevitably leads to harm to habitat and wildlife. Predator extermination is a common practice in residential-wild land interface areas, as is large-scale fencing, which closes off wildlife travel routes.

The effects of increased development are manifesting in other less-direct ways. Water demand is increasing, drawing down the water supply, reducing stream flow and threatening riparian vegetation and riparian-dependent species such as steelhead. In addition, automobiles and runoff from impervious surfaces have affected the health of streams and creeks, and consequently the ocean. Construction of roads in rural and semi-rural areas has impeded wildlife movement and increased human uses in these areas. Many urban creeks have been channelized and degraded, reducing their habitat functions.

Fragmentation

Habitat fragmentation has been identified as one of the chief threats to biodiversity (Burgess and Sharpe, 1981). Fragmentation refers to the isolation of one part of a habitat area from another, usually by a physical barrier such as a development, road or other impassable barrier, or to the general reduction in available habitat area. Fragmentation of habitat undermines ecological integrity on at least two levels: by reducing the extent of habitat available to a species or species group, and by isolating wildlife groups in a way that narrows their genetic strength. A classic example of habitat fragmentation is a highway. Highway 33, running between the two wilderness areas, fragments the Dick Smith Wilderness and the San Rafael Wilderness, disturbing historic animal linkages. Smaller fragmentation issues occur as a result of urbanization and conversion of habitat to agricultural lands, golf courses and housing subdivisions. While the fragmentation of habitat in the Conception Coast Region is extensive, a major finding of this Regional Conservation Guide is that significant restoration of habitat connectivity is feasible.

Loss of Predators

The range of top predators such as black bears and mountain lion has been significantly diminished. This has allowed for prey such as deer to swell in population. In turn, enhanced deer populations impact grasslands and other vegetation through overgrazing. Similarly, mesopredators (predators which are prey for other predators) such as skunks and raccoons have swelled in population. Thus, in many parts of the region ecological imbalance occurs as a result of top predators being eliminated, disrupting a properly functioning system. Loss of any species from a biological community disrupts biological structure, as with the explosion of rodent populations due to decline of coyotes, which has caused in dramatically decreased propagation success in oak woodlands. Overall, protection of "keystone species" – those species which have an ecological influence disproportionate to their numbers—is best achieved by setting aside connected wild lands. This protection provides stability to wildlife communities and sustains the ecological services they provide.

Oil Development

The Conception Coast region has also seen increased pressure to develop onshore and offshore oil reserves in recent years. The U.S. Forest Service has issued a study analyzing the potential for development of oil reserves in the Los Padres National Forest. Despite intense state opposition to increased oil development off California's coast, the federal government and elected officials have made numerous attempts to facilitate the exploration and development of the 36 federal oil leases off California's coast, most of which are off Santa Barbara County.

Climate Change

Climate change will have impacts on ecosystems of the Conception Coast Region. California winters are expected to become warmer and wetter during the next century. Summers will also become warmer, but the temperature increase will not be as great as the winter increase (Union of Concerned Scientists, 2003). California's natural ecosystems are highly sensitive to the availability of water. Thus, changes in the timing or amount of precipitation over the next century are likely to have a greater impact than changes in temperature. For example, decreased summer stream flows would intensify competing demands for water to meet the needs of agriculture, industry, and urban areas, and to sustain the health of California's aquatic and streamside ecosystems.

A large proportion of the effects of climate change on California ecosystems will be indirect; climate change may alter the frequency and/or intensity of extreme weather events such as severe storms, El Niños, winds, droughts, and frosts in still-uncertain ways. Similarly, the frequency and/or magnitude of some ecologically important processes such as wildfires, flooding, and disease and pest outbreaks is likely to alter as climate changes occur. Altogether, these difficult-to-predict phenomena, driven by shifts in climate patterns, may be more important for the future of California ecosystems than changes in average temperature and precipitation (Union of Concerned Scientists, 2003).

Agricultural Intensification And Expansion

Agriculture interacts with conservation planning in both beneficial and unfavorable ways. In addition to its economic, historic and cultural importance, agricultural landscapes define and, ideally, limit the extent of urban and suburban land uses. Agriculture often establishes a visible boundary between land primarily reserved for dense human settlement and more lightly used and less developed areas at the transition between urban and wild lands. While highly mechanized and intense forms of agriculture such as irrigated row crops offer little in terms of habitat, they represent a landscape that retains options – it has not generally been compacted, paved and transformed permanently as have the core of urban and suburban areas. Less intense agricultural landscapes such as grazing land often host valuable habitat and, despite strong and growing pressure for conversion to residential or other uses. Retaining the large single-owner working landscapes of the Region such as cattle ranches is a high priority for conservation. As discussed below, agricultural practices vary widely, and all forms of agriculture have environmental consequences that should be addressed on an ongoing basis. However, agriculture can and will play a significant role in conservation planning for the future.

Conversion of uncultivated land to agriculture has caused significant impact on regional resources. There are currently (2002) 8,321 more acres of cultivated land in Santa Barbara County than there were in 1990, mostly due to the conversion of grazing land (California Department of Conservation 2002). Of these, 5,404 acres of new cultivated land were created between 1998-2000 (California Department of Conservation 2002). Recent installation of new vineyards, primarily in the Santa Ynez Valley, has resulted in significant loss of oak woodland and savannah habitat and presented obstacles to wildlife movement.

Intensification of agriculture also alters the ecological value of the landscape it occurs on. A rough hierarchy of the value of agricultural land for wildlife would assign highest ecological value to grazing land, followed by orchards and dry farmed crops, followed by irrigated row crops. Agricultural practices such as application of pesticides, water use, wastewater management and other stewardship factors dramatically affect the impact of agriculture on habitat value.

Aquatic Fragmentation

In stream barriers have fragmented many waterways in the Conception Coast Region. This disrupts the flow of ecological processes, including the spawning (egg-laying) by steelhead, a keystone species. The steelhead's return from years at sea to spawn and to enter the food web is one of the few ecological processes in which nutrients are returned to the landscape from the ocean, instead of vice versa. There are many other beneficial effects of a vibrant steelhead population. Unfortunately, dams in large rivers such as the Santa Ynez, Ventura and Santa Clara prevent Southern steelhead from reaching most historic spawning grounds. Culverts and road crossings have also fragmented smaller creeks especially on the South Coast. In addition, water flows are often diverted or altered causing significant changes to the streams.

Loss Of Native Species

Depletion and loss of native species is occurring at an alarming rate and is clearly evident here in the Conception Coast Region. Loss of native species destabilizes the natural system as the ecological roles (predator-prey relationships, or seed transport, for example) are vacated and often re-occupied by invasive species, which crowd and compete with natives but do not serve the displaced species ecological role. Species loss tends to simplify biological community structure, leading to weaker and more highly fluctuating population dynamics. Weaker biological systems face greater likelihood of significant species declines, and the attendant social controversy over measures for their recovery.

Exotic Species

The introduction of exotic species such as European grasses, argentine ants – even household pets and livestock – has changed the vegetation and ecology of the land. Invasive species have altered ecosystem structures in chaparral and native grassland areas through a process described above. Nonnative eucalyptus trees and ice plant are common along many coastal areas of the region, displacing native plant communities. Disruption of vegetation and soils due to road building, development and agriculture are common pre-cursors to the introduction of invasive exotic species.

Erosion

Human induced erosion can be caused by numerous activities including mining, urban development and agricultural operations. Exposed soil that breaks down under the pressures of the wind and air ends up clogging rivers and creeks. Habitat for fish and other animals is degraded by excessive erosion. In addition, erosion from urban projects has contributed to degradation of our creeks and rivers.

Lack of Coordinated Conservation Strategy

The creation and management of protected areas in the Conception Coast region has occurred without a regionally coordinated strategy. While a crucial tool, the Endangered Species Act is based upon an inefficient, last minute species-by-species approach to conservation that has proven expensive and insufficient. The Regional Conservation Guide will aid in coordinating a regional conservation strategy.

There are positive forces that aid natural areas in our region. The Conception Coast Region benefits from environmental and social factors that positively influence the extent and condition of its natural resources. One is the high percentage of publicly owned land that is protected to some degree, including the Los Padres and Angeles National Forests, several wilderness areas and wild and scenic river segments, city and county parks, the Channel Islands National Park, the Channel Islands National Marine Sanctuary, newly enacted marine reserves and privately protected land.

There is strong and growing support for stewardship in the Region, as demonstrated through political awareness, activism and funding of conservation causes. Nonprofit and community organizations have aided in protecting key natural areas and bringing the community's attention to potential harmful developments. These groups have often been effective as a last line of defense to projects deemed unsuitable for the area.

Existing environmental and socioeconomic trends will likely continue in the foreseeable future and development pressures are likely to continue to escalate in the Conception Coast region. The California Department of Finance projects that Santa Barbara County's population will grow from its current 415,600 to 521,200 in 2020. Santa Barbara County's agricultural land will also continue to face development pressure in the foreseeable future. In Santa Barbara County, 1491 net acres of land were urbanized during 1998-2000, compared to 264 acres during 1996-98. Most of the urbanization in these four years took place in the Santa Maria area.

Chapter 4
Methods & Results

Mountain Lion - *Felis concolor*

Methods & Results

Overview of Regional Conservation Planning Approach

The Regional Conservation Guide (RCG) is a long-term, landscape-scale planning tool that describes and depicts the long-term requirements of the landscape and natural resources of the Conception Coast Region. The RCG draws together modern ecological principles and regional biological data using powerful computer technology. A Geographic Information System (GIS) is used to locate and depict biological information such as the location of specific animals or vegetation on a map. The RCG's GIS framework divides the Conception Coast Region into a grid of one and one-half kilometer "sites", each of which are assigned a color-code value for each of a series of ecological criteria. Modern concepts of biology and ecosystem-based planning are used to define a series of conservation objectives as the basis for a set of GIS "layers," described below. These layers can be overlain to perform analyses that "synthesize" two or more criteria through a process of "map algebra." The RCG adapts the powerful Legacy Framework tool developed at the University of California, Santa Barbara, which provides the recipe for these complex multi-level analyses to produce first-ever map outputs for the Conception Coast Region to guide conservation action over the long term (Davis, Stoms et al. 2003).

For a brief explanation of the above terms in quotes, imagine a piece of clear plastic Mylar with a square grid drawn on it. Each of those squares can have a color and numerical value associated with it that represents the importance of that square with respect to a particular ecological objective, such as species hotspots. Then all of the layers are "synthesized," or overlain such that, at a particular location on the landscape, the sum of the corresponding square of all the layers is determined. Similarly any other algebraic manipulation can be performed.

The Legacy Framework

Conception Coast Project's (CCP) Regional Conservation Guide extends and is based upon conservation assessment models such as the one developed by Dr. Frank Davis, Dr. David Stoms, and colleagues at the UC Santa Barbara Biogeography Lab and the National Center for Ecological Analysis and Synthesis (Davis, Stoms et al. 2003) for the State of California Resources Agency (http://legacy.ca.gov/). A revised manuscript of this model and its approach has been submitted to *Ecology and Society* (Davis, Costello and Stoms, *submitted*). This "Legacy Framework" is designed to help set conservation priorities over large geographic regions by examining the incremental value of all the specific areas within the region. It can use relatively coarse biological and environmental information. The Legacy Framework is designed to incorporate agricultural, aesthetic, and resource use objectives in addition to terrestrial and aquatic biodiversity objectives. The terrestrial biodiversity component of the framework is the portion adopted by Conception Coast Project. This portion of the framework recognizes and incorporates multiple tracks of conservation planning (Davis, Stoms et al. 2003). The multiple tracks included in the framework are: protecting hotspots of threatened and endangered species, representing habitat types, representing biophysical landscapes, protecting wild lands, and expanding existing reserves (i.e. protected areas) (Davis, Stoms et al. 2003).

The RCG Model

Two major additions were made to the terrestrial biodiversity component of the Legacy Framework in creating the Regional Conservation Guide (RCG). The resulting model is termed the RCG Model. The changes include introducing the concept of "landscape connectivity" into the process, as well as providing an output of raw "biodiversity value" that is not influenced by the complex concept of development threat. These terms will be defined and described in the following methodological sections.

The Regional Conservation Guide's six ecological objectives are as follows. Each objective and its rationale are explained within the discussion of its use in the RCG Model.

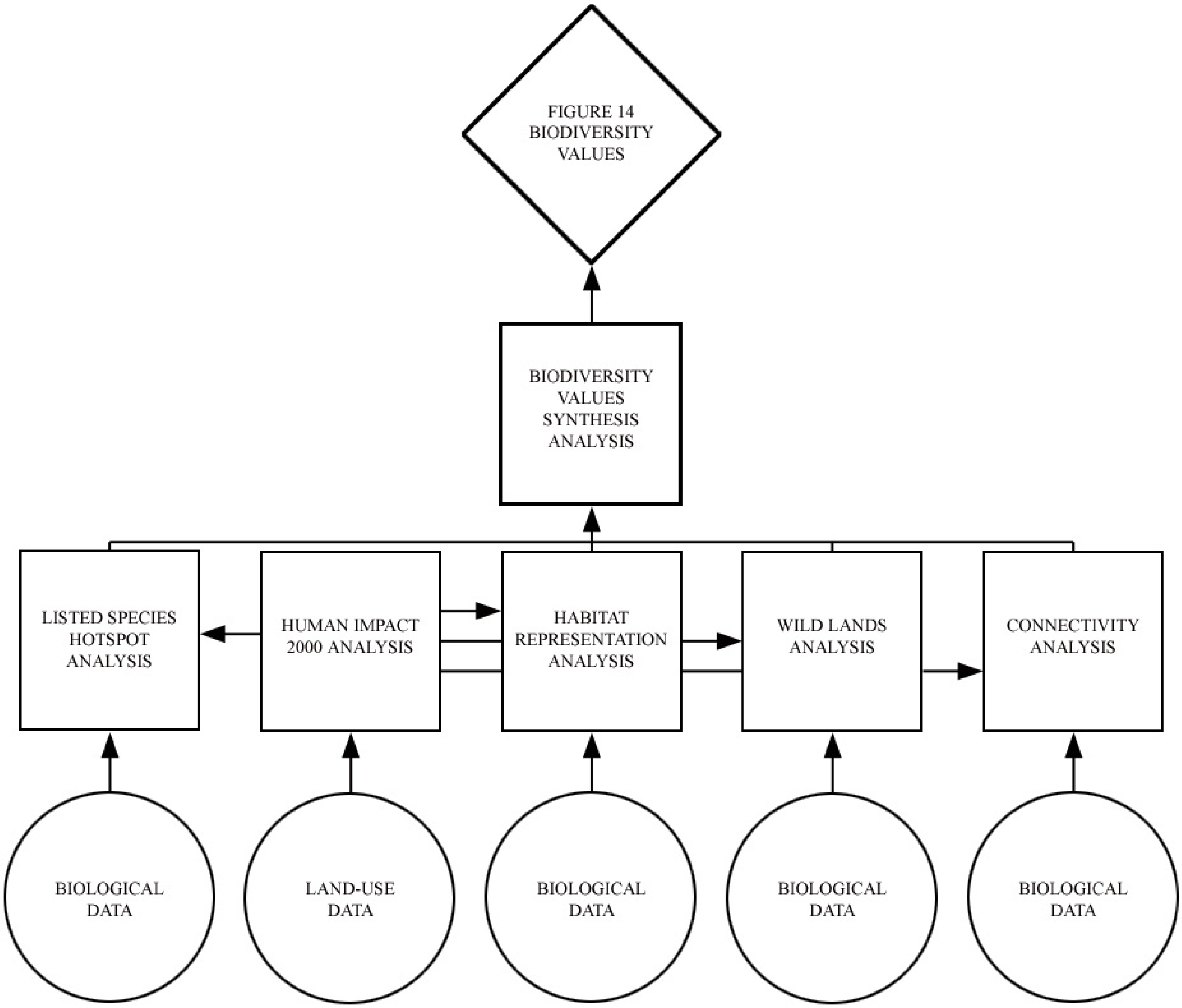
RCG Ecological Objectives

1. Conserve hotspots of endangered and threatened species
2. Represent all habitat types within protected areas
3. Protect biophysical landscapes to maintain ecological and evolutionary processes
4. Protect wild lands for large carnivores and other area-dependent species
5. Protect areas next to existing reserves
6. Establish landscape connectivity between wild lands

Each of these objectives is modeled through the input of existing biological data to create a GIS layer. Each layer is used by itself as an intermediate finding of the RCG, and is also combined with other layers to create subsequent analyses. The RCG Ecological Objectives are combined in different ways to create two major analyses. The first of the major findings of the Regional Conservation Guide is the Biodiversity Value Analysis Map. This analysis combines the layers representing each of the above RCG objectives to create a composite map identifying relative biodiversity values for each 1.5 km site. This analysis identifies generic biodiversity value of each site without regard to its status inside, outside or near a protected area (e.g. wilderness, etc) and without regard to the site's expected degree of future habitat degradation if no conservation occurs (i.e. no analysis of "threat" is included). The methodology for this analysis is illustrated by Figure 4, and described in Part 1, below.

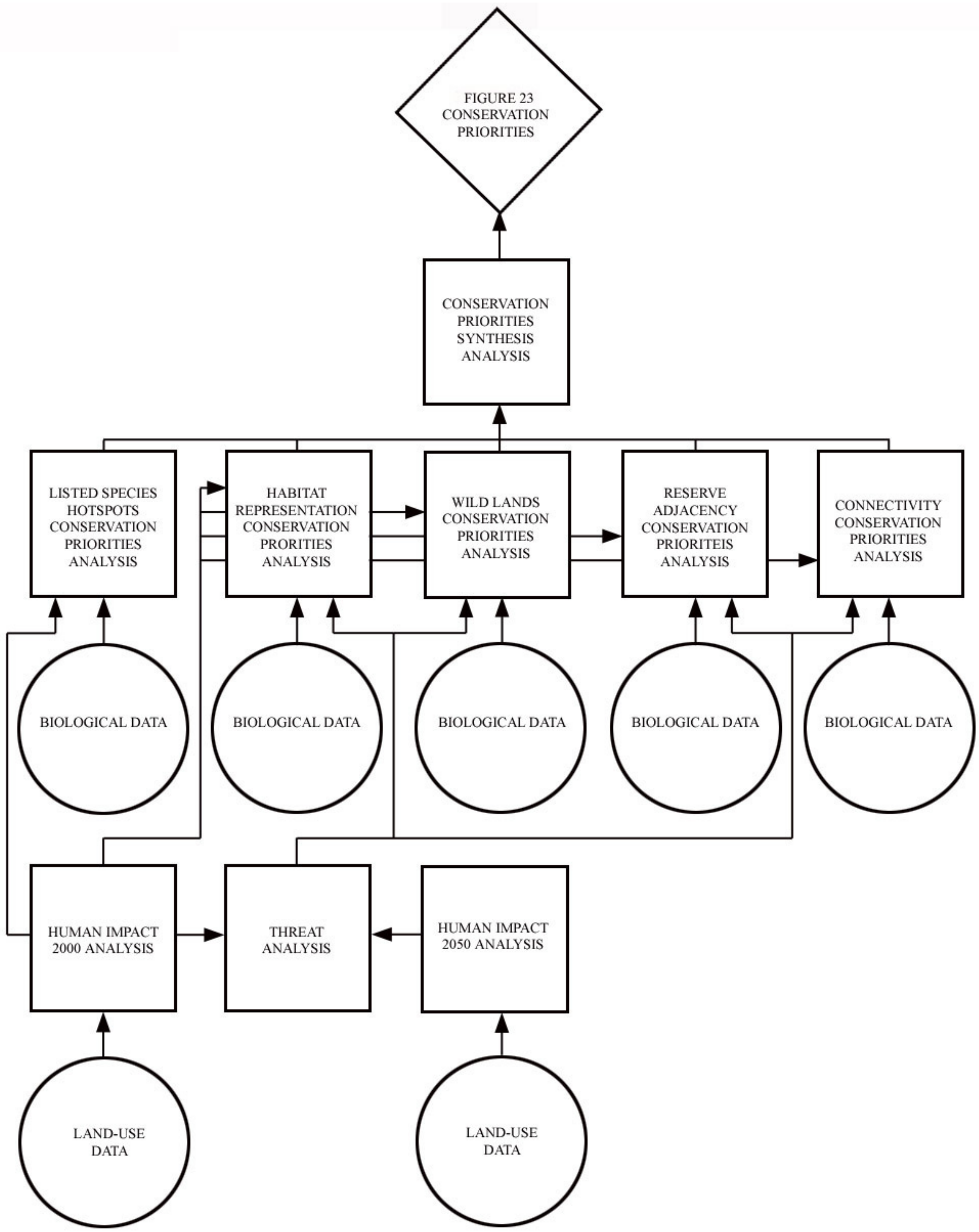
The second major finding of the RCG is the Regional Conservation Priorities Analysis Map, which includes the concept of threat. Under the Conservation Priorities Analysis, a site that is important ecologically, but is not perceived to be threatened with development receives a lower conservation priority score. A site receives a high conservation priority value only if it is both important ecologically and threatened with anticipated future degradation. A schematic of this analysis is provided in Figure 5. This finding is presented, along with the methods by which it was produced in Part 2, below.

Figure 4: Diagram of the Biodiversity Value Analysis



Note: Arrows indicate the flow of information and data.

Figure 5: Diagram of the Conservation Priorities Analysis



Note: Arrows indicate the flow of information and data.

Part 1: Biodiversity Value Analysis

This section provides the methodology of the Biodiversity Value Analysis of the RCG Model, along with the maps of the results. For a more detailed treatment of this methodology, see Appendix A: RCG Detailed Methodology. The analysis results from the combination of GIS layers representing four of the six ecological objectives listed above plus a GIS layer called Human Impact on Habitat at Year 2000, which depicts human impact on the landscape.

Human Impact On Habitat At The Year 2000

Many of the ecological data used in the RCG analyses identify the species or ecological communities that are present at a location, but the data do not indicate condition of the site. For example, species data do not distinguish between a stand of oaks surrounded by a golf course and roads versus one in a wilderness area. To incorporate this important ecological distinction, the Human Impact 2000 layer is combined with each of the GIS layers representing ecological objectives.

The Human Impact layer is a product of six different sub-layers. These sub-layers include:

-Development densities
-Industrial lands
-Agricultural lands
-Grazing lands
-Roads
-Reserves (areas under some form of protection) and known conservation easements.

The sub-layers were weighted for their importance in affecting overall ecological condition by CCP's ecological advisors. The six sub-layers were merged and the highest potential human impact value for any given area was used. The resulting map is presented here in Figure 6: Human Impact Types within the Conception Coast Region. To see the relative impact of these land use types, see Figure 7: Estimated Degree of Human Impact within the Conception Coast Region. Again, the details are provided in Appendix A.

Biodiversity Objective B1: Conserve Hotspots Of Endangered And Threatened Species

Efficient conservation effort requires directing conservation resources towards areas that are most vulnerable as well as contain high levels of biodiversity. Imperiled species usually include those with small populations, large ranges, poor dispersal abilities, low reproduction potential, or dependence on habitats that are themselves threatened (Noss 1991). Many conservation efforts give high priority to areas that support high densities of geographically restricted, threatened and endangered species (Dobson et al. 1997, Abbitt et al. 2000, Chaplin et al. 2000 in Davis, Stoms et al. 2003).

To form the Listed Species Hotspots Layer, a list of species was compiled that fit the criteria of rare, endemic and threatened. Species that are utilized in this model and hereafter called "listed" species are:

-State and Federal Endangered, Threatened, Proposed Endangered, Proposed Threatened, Candidate, and CA Rare species.
-Imperiled Species of Natural Heritage Listing System (i.e. G1 or G2)
-State or Federal Species of Concern, or California Native Plant Society Rare Listing

These data were then placed into a GIS to create a map layer, using a data accuracy ranking code

Figure 6: Human Impact Types within the Conception Coast Region FRONT

Figure 6: Human Impact Types within the Conception Coast Region BACK

Figure 7: Estimated Degree of Human Impact within the Conception Coast Region
FRONT

Figure 7: Estimated Degree of Human Impact within the Conception Coast Region
BACK

and combining several different data sources to insure completeness (Figure 8: Listed Species Locations within the Conception Coast Region).

The Listed Species Hotspot value assigned to a site was determined by combining:

-the listed species at the site,

- the level of data confidence for each observation,

-the degree of endemism (rarity) of each species based on the total area of known occurrence in the region,

-the level of human impact at the site,

-and the human impact at all other sites where the species occurs (Davis, Stoms et al. 2003).

Maps produced from this analysis were then refined to produce a smoother, less blocky appearance than would be achieved using the raw, 1.5 kilometer site grid. This presentation depicts the fluid and interconnected aspects of ecological processes. It also conveys the inherent variability of data when collected on a regional scale. The final results of all objectives in both models utilize this procedure of smoothing results. For a full explanation of this process, please refer to Appendix A. The results for this objective are displayed here in map form as Figure 9: Listed Species Hotspots Biodiversity Value within the Conception Coast Region (B1).

Biodiversity Objective B2: Represent All Habitats Within Protected Areas

Modern biological and ecological science has long supported the necessity of representing all habitat types within protected areas in order to ensure long term protection of the entire regional ecosystem. "Representation" is the process of identifying various habitats and assessing their status in protected areas. Representation can also be understood using the metaphor of tinkering with the motor of an automobile: in order to ensure the continued function of the motor, one must "keep all the pieces."

Allowing for better inclusion of poorly represented natural communities within protected areas enables the survival needs of large numbers of species to be met simultaneously with less reliance on individual species protection. Thus, representing all habitats serves as a "coarse filter" serving to ensure the representation of species for which little data exists.

The RCG adds to the concept of habitat representation by assigning greater weight to habitats that are known to be scarce, or that occur below their historical range due to conversion to human uses (e.g. development). In addition, certain habitats host species that have declined or are regularly the focus of species recovery efforts. Such habitats might be common in the region, but scarce elsewhere in the ecoregion or state, and thus merit more attention.

The locations of each habitat were determined using a widely recognized dataset called the Multi-Source Land Cover Data (MLCD) (i.e. Figure 3). A "weight" (relative value) of each habitat was determined and is a function of these items: rarity of habitat (rare areas are assigned a higher value), ecoregional context (habitats which are rare elsewhere besides the CCP region are valued higher), the estimate of historical habitat loss (areas with large historical losses are valued higher) and inherent habitat value.

In sum, the site's habitat representation value is a function of the following:

-the habitat types at the site and their corresponding weights,
-the amount of each habitat type at the site
-the human impact on the land in the site,
-and the amount of human impact on all other sites where the habitat occurs (Davis, Stoms et al. 2003).

The results highlighting priority habitats for their conservation value were mapped and are again indicated as a map, Figure 10: Habitat Representation Biodiversity Value within the Conception Coast Region (B2).

Biodiversity Objective B4: Estimate Wild Lands Biodiversity Value

Conservation scientists have increasingly promoted the landscape-scale conservation benefits of protecting large wild areas that serve as habitat for large carnivores and other wide-ranging species that require large natural areas for survival (Soule and Terborgh 1999). These large wild areas also allow ecological processes and dynamics to proceed naturally. In addition to maintaining populations of space demanding species, and the food web that they support, wild lands also provide habitat for disturbance sensitive species.

This model estimates the location of suitable "core" wild areas, based on large areas of contiguous low average human impact. The results are again reported in map form (Figure 11: Locations of Large Wild Lands in the Conception Coast Region).

The wild lands biodiversity value of each site is simply a function of

-the amount of land of the site that is within a wild land
-amount of human impact on that land

The results are mapped in Figure 12: Wild Lands Biodiversity Value within the Conception Coast Region (B4).

Biodiversity Objective B6: Estimate Landscape Connectivity Biodiversity Value

Connectivity is the concept that if two or more large areas of quality habitat are connected by a narrower area of habitat that facilitates animal movement, then the overall biodiversity value of the region is increased (Soule and Terborgh 1999). These areas of connecting habitat are termed landscape linkages, or "linkages" for short. These linkages allow individuals to move from one habitat area to another, enlarging the available genetic pool to avoid inbreeding and allowing slower moving species to move across the landscape in response to changing conditions. If a species is "extirpated" (made locally extinct) from an area of habitat, such as through a wildfire or disease, then that population can be replenished by a surviving population from another habitat area by way of the linkage. Maintaining connectivity between protected areas is also a mechanism to reduce the total area of protected lands needed to sustain long-term ecological health—since the alternative is a single, overall larger protected area. The concept of connectivity applies at all scales, such as the suitable habitat between horned lizard populations, as well as the river corridors and ridgelines that connect populations of mountain lion.

A connectivity analysis is ideally performed at multiple scales, but if only one scale is feasible, it is best to use a coarse scale approach

Figure 8: Listed Species Locations within the Conception Coast Region FRONT

Figure 8: Listed Species Locations within the Conception Coast Region BACK

Figure 9: Listed Species Hotspots Biodiversity Value within the Conception Coast Region (B1)
FRONT

Figure 9: Listed Species Hotspots Biodiversity Value within the Conception Coast Region (B1)
BACK

Figure 10:Habitat Representation Biodiversity Value within the Conception Coast Region (B2)
FRONT

Figure 10:Habitat Representation Biodiversity Value within the Conception Coast Region (B2)
BACK

Figure 11: Locations of Large Wild Lands within the Conception Coast Region
FRONT

Figure 11: Locations of Large Wild Lands within the Conception Coast Region
BACK

Figure 12: Wild Lands Biodiversity Value within the Conception Coast Region (B4)
FRONT

Figure 12: Wild Lands Biodiversity Value within the Conception Coast Region (B4)
BACK

to ensure the core wild lands of a region are interconnected. Unless a protected area is millions of acres in size, individual core protected areas will not be able to function independently as whole ecosystems, in the sense of maintaining viable populations of animals and ecological and evolutionary processes (Noss and Harris 1986). The mountain lion was selected as the connectivity focal species because it operates at this coarse scale, with males having a home range of nearly 400 square kilometers (Dickson 2001). The mountain lion is also a keystone species since it maintains the integrity of an ecosystem by controlling the population of large herbivores and "meso-predators" (medium sized predators such as skunk and opossum). The loss of such keystone species are more profound and far-reaching than others, because their elimination from an ecosystem often triggers cascades of direct and indirect changes, leading eventually to loss of habitat and extirpation of other species in the food web (Noss and Soule 1999).

A "least cost path" analysis was utilized that indicates the path between two habitat areas with the lowest level difficulty of travel (i.e. "movement cost") for a mountain lion. A movement cost GIS layer is created such that the value of every location has a measure of how difficult or dangerous it is for a mountain lion to move across it. For example, a path across highway 101 will have a very high cost, whereas the path in the wilderness forest will have a very low cost. The "gated" variety of least cost path analysis used provides an output that has a width rather than a very fine line of habitat connecting two wild lands. Movement cost, which is the foundation of the analysis, is a combination of:

-Mountain lion habitat suitability (See Figure13: Habitat Quality for Mountain Lion Dispersal).
-Human Impact Value
-A specific consideration of roadedness, the primary source of death to mountain lions in southern California (Beier 1995; Beier, Choate et al. 1995)

The movement cost was analyzed using the gated least cost path to create a data layer that identifies the major movement linkages and their relative values (See Figure 14: Large Wildlife Linkages within the Conception Coast Region). The final connectivity biodiversity value of a site is a function of:

-the quality of the landscape linkage that the site lies within
-the mountain lion habitat suitability of the site
-the amount of human impact on the land in the site

The results are given in map format as Figure 15: Landscape Connectivity Biodiversity Value within the Conception Coast Region (B6).

Synthesis Part 1: Estimate And Map "Biodiversity Value"

Ecological advisors weighted the four objectives (Habitat Representation, Listed Species Hotspots, Wild Lands and Connectivity) at a workshop. The results are as follows: Habitat Representation: 20, Listed Species Hotspots: 15, Wild Lands: 10 and Connectivity: 10. The layers of these objectives were combined together using these relative weights to determine the Biodiversity Value of each site. The final results represent Part 1 of the Major Findings of the Regional Conservation Guide, and appear in map format as Figure 16: Estimated Biodiversity Value within the Conception Coast Region.

PART 2: CONSERVATION PRIORITIES ANALYSIS

The Conservation Priority Analysis of the RCG Model estimates the conservation value of the different areas in the region based on biodiversity value objectives and on development threat. This section provides the methodology of the Conservation Priorities Analysis, along with the maps of the intermediate and synthesis results. For a more detailed treatment of this methodology, see Appendix A: RCG Detailed Methodology.

The Conservation Priorities Analysis results from the combination of five of the ecological objectives to determine the resource value of the site and combines this resource value with threats (habitat conversion and degradation) to the landscape. The five objectives utilized are:

C1) Conserve hotspots of endangered and threatened species
C2) Conserve important habitats
C4) Protect wildlands for large carnivores and other "area-dependent species"
C5) Protect areas next to existing reserves
C6) Establish landscape connectivity between wild lands

A major characteristic of this analysis is that it incorporates a projection of how the landscape will likely be modified over time (e.g. from wild land to suburban) which is termed "threat". The threat layer is derived from this prediction of landscape change, which aids in identifying high biodiversity areas likely to be degraded in the future, and thus, conservation priorities.

PROJECTED HUMAN IMPACT FOR THE YEAR 2050

This analysis models the predicted land use changes in the region over the next half a century. These changes constitute a vital consideration in deriving the "threat" layer and in identifying conservation priorities. This analysis combines an urban growth sub-model, a suburban growth sub-model, an agricultural expansion sub-model, and an oil and gas expansion sub-model.

The urban outgrowth sub-model used was derived by a team at U.C. Berkeley and is called the California Urban and Biodiversity Assessment (CURBA) model (Landis, Cogan et al. 1998). CURBA predicts future urban growth patterns based on indicators of past growth patterns (Fulton, Wilson et al. 2003). The model is driven by human population growth, and uses the same growth predictions used by the state to formulate policy (Department of Finance 2004). For a depiction of the CURBA outputs, see Figure 17: Comparison of Current and Predicted Urban Extent within the Conception Coast Region.

To model rural and suburban growth in the region, CCP utilized the Western Futures Growth Model (WFGM) developed by David Theobald of the Natural Resource Ecology Lab at Colorado State University (Theobald 2001). This sub-model also bases is projections based on past patterns, but rather than looking solely at urban growth, it considers growth of all development densities. The primary data inputs are past and present U.S. Census Data patterns, distance from urban centers, and the population growth predictions of state demographers. For a depiction of the model results for our region, see Figure 18: Comparison of Current and Pre-

Figure 13: Habitat Quality for Mountain Lion Dispersal
FRONT

Figure 13: Habitat Quality for Mountain Lion Dispersal BACK

Figure 14: Large Wildlife Linkages within the Conception Coast Region FRONT

Figure 14: Large Wildlife Linkages within the Conception Coast Region
BACK

Figure 15: Landscape Connectivity Biodiversity Value within the Conception Coast Region (B6)
FRONT

Figure 15: Landscape Connectivity Biodiversity Value within the Conception Coast Region (B6)
BACK

Figure 16: Estimated Biodiversity Value within the Conception Coast Region
FRONT

Figure 16: Estimated Biodiversity Value within the Conception Coast Region
BACK

Figure 17: Comparison of Current and Predicted Urban Extent within the Conception Coast Region
FRONT

Figure 17: Comparison of Current and Predicted Urban Extent within the Conception Coast Region
BACK

Figure 18: Comparison of Current and Predicted Housing Density within the Conception Coast Region
FRONT

Figure 18: Comparison of Current and Predicted Housing Density within the Conception Coast Region
BACK

dicted Housing Density within the Conception Coast Region.

Areas available for agriculture expansion within a half a century were all areas that did not meet one of the following conditions: urban lands, reserves, conservation easements, current industrial areas, roads, water, creeks, and areas with too steep of a slope for agricultural operations.

The oil and gas industrial expansion model simply mapped out the two most likely oil extraction scenarios being planned for national forest land (USDA Forest Service 2001). The areas that occur in both scenarios are given a higher likelihood of development.

The urban, suburban, agriculture and industrial layers were overlaid to create the Human Impact Layer 2050. For an illustration of this GIS layer, and a comparison with the 2000 layer, see Figure 19: Comparison of Current and Predicted Human Impact within the Conception Coast Region.

The above two layers were used to create the "threat" layer. Threat to an area is based on predicted change between now and a half-century from now and is quantified by subtracting the Human Impact Value of that area in 2000 from the predicted value in 2050. The layer that results from this difference is called the threat layer for the remainder of the document, and is depicted as Figure 20: Predicted Change in Human Impact within the Conception Coast Region (i.e. Threat).

Conservation Objective C1: Listed Species Hotspots Conservation Value

Due to the fact that rare and threatened species already incorporates the concept of threat by definition, the GIS layer for Objective B1 is used for Objective C1 in the synthesis stage of the Conservation Priorities Analysis (Davis, Stoms, et al. 2003).

Conservation Objective C2: Habitat Representation Conservation Value

The analysis that created the Habitat Representation Biodiversity Value layer was augmented to include the concept of threat to create a new layer, Habitat Representation Conservation Value. Thus, the Habitat Representation Conservation Value of a site is a function of the following:

-the habitat types at the site and their corresponding weights,
-the amount of each habitat type at the site
-the amount of human impact of land in the site,
-and the amount of human impact at all other sites where the habitat occurs
-projected threat to the habitat on the site in 2050 if no conservation occurs
-and the threat on the total amount of that habitat in the region in 2050 if no conservation occurs.

For an illustration of the results, see Figure 21: Habitat Representation Conservation Value within the Conception Coast Region (C2).

Conservation Objective C4: Wild Lands Conservation Value

The Wild Lands mapped for B4 were used along with the threat layer to create a value for C4. The value of a site is a function of the following:

-the amount of land of the site that is within a wild land

-amount of human impact on that land
-the threat at the site if no conservation occurs
--the cumulative threat on the entire wild land the overlaps that site if no conservation occurs

For a map of the resulting layer see Figure 22: Wild Lands Conservation Value within the Conception Coast Region (C4).

Conservation Objective C5: Reserve Adjacency Conservation Value

Expanding small reserves is an efficient, low cost option to advance maintenance of species diversity. The species area curve derived from island biogeography indicates that the number of species that can co-exist in an area increases when the size of the area increases, but this increase in an inverse exponential manner. For an example, if a 100 acre area is conserved directly adjacent to a 100 acre reserve, the reserve area is doubled. Subsequently, the number of vertebrates that this combined reserve can harbor may increase by 50%, say from 100 to 150. At a later date, 200 more acres are conserved directly adjacent, and the reserve is again doubled. However, due to the species area curve, it is unlikely that 50% more species will be able to live solely in that reserve. A more likely result would be a 25% increase, from 150 to about 190 species. The second conservation action required a bigger land purchase and provided refuge for less species. Thus, conserving areas adjacent to small reserves is one of the effective strategies for biodiversity conservation.

The Reserve Adjacency Conservation Value assigns value to regional sites that are close to existing reserves. Further, adding to smaller reserves is considered more valuable to the region's overall biodiversity than adding to larger reserves. Thus, the value of a site is a function of the following considerations:

-distance to the nearest reserve
-size of the nearest reserve
-threat at that site if no conservation occurs

For a map of the resulting layer, see Figure 23: Reserve Adjacency Conservation Value within the Conception Coast Region (C5).

Conservation Objective C6: Landscape Connectivity Conservation Value

The importance of landscape connectivity was explained in Part 1. To produce the layer for this objective, the connectivity layer that was created for B6 was multiplied by the threat layer to produce the landscape connectivity conservation value layer.

The connectivity conservation value of a site is thus a function of

-the quality of the landscape linkage that the site lies within
-the mountain lion habitat suitability of the site
-the amount of human impact on the land in the site
-the threat at that site if no conservation occurs

For an illustration of the resulting layer, please see Figure 24: Landscape Connectivity Conservation Values within the Conception Coast Region (C6).

Synthesis Part 2: Overall Conservation Priority

To produce the Conservation Priority Value map, the five GIS layers representing the ecological objectives were combined with the threat value layer. The resulting site values were then smoothed, as per the methodology described in B1. The final results represent part two of the Major Findings of the Regional Conservation Guide, and indicate the conservation priorities for the region. Please see Figure 25: Estimated Conservation Priorities within the Conception Coast Region.

Figure 19: Comparison of Current and Predicted Human Impact within the Conception Coast Region

FRONT

Figure 19: Comparison of Current and Predicted Human Impact within the Conception Coast Region
BACK

Figure 20: Predicted Change in Human Impact within the Conception Coast Region (i.e. "Threat")
FRONT

Figure 20: Predicted Change in Human Impact within the Conception Coast Region (i.e. "Threat")
BACK

Figure 21: Habitat Representation Conservation Value within the Conception Coast Region (C2)
FRONT

Figure 21: Habitat Representation Conservation Value within the Conception Coast Region (C2)
BACK

Figure 22: Wild Lands Conservation Value within the Conception Coast Region (C4)
FRONT

Figure 22: Wild Lands Conservation Value within the Conception Coast Region (C4)
BACK

Figure 23: Reserve Adjacency Conservation Value within the Conception Coast Region (C5)
FRONT

Figure 23: Reserve Adjacency Conservation Value within the Conception Coast Region (C5)
BACK

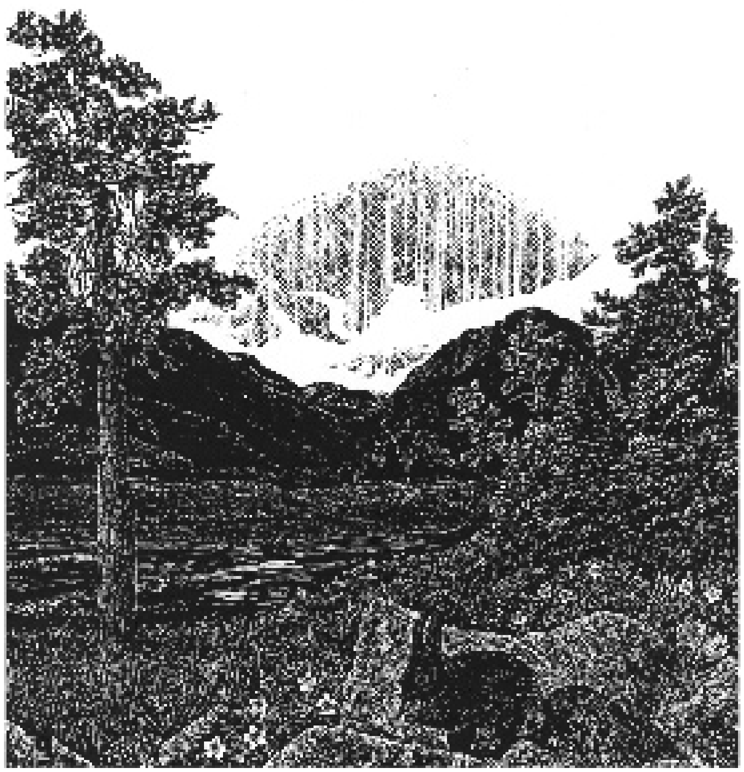
Figure 24: Landscape Connectivity Conservation Values within the Conception Coast Region (C6)
FRONT

Figure 24: Landscape Connectivity Conservation Values within the Conception Coast Region (C6)
BACK

Figure 25: Estimated Conservation Priorities within the Conception Coast Region
FRONT

Figure 25: Estimated Conservation Priorities within the Conception Coast Region
BACK

Chapter 5
Interpreting the Major RCG Findings



Interpreting the Major RCG Findings

Regarding the findings of the Regional Conservation Guide, it should be noted that the map outputs representing individual objectives such as connectivity and listed species hotspots are also valuable by themselves as an aid to conservation. It is also important to recognize that the RCG does not intend to suggest that those areas not receiving high value rankings should not be considered for conservation, nor that they be considered as good areas for development.

The Conservation Priorities Analysis presents options for a region-wide system of protected areas that meet the needs of the landscape for long-term ecological sustainability. To be clear, all of the areas identified as conservation priorities need not be secured in "reserves" – or highly protected status such as wilderness— in order to maintain the region's ecological integrity. "Stewardship zones" —areas of quality habitat that allow for human use of the landscape simultaneous to managing for biodiversity—may be used as part of an effective network of regional conservation designations. Stewardship zones can occur on public and private lands and include certain types of agricultural and grazing practices, ecologically sustainable forestry, and recreational use such as hunting and fishing. Methods for securing protection for such zones are discussed in the final chapter of this document.

This section first discusses the Biodiversity Value Analysis map (Figure 16: Estimated Biodiversity Value within the Conception Coast Region), which identifies regional high biodiversity areas, followed by a discussion of the Conservation Priorities map (Figure 25: Estimated Conservation Priorities within the Conception Coast Region), which ranks regional sites for their priority in contributing to regional ecological requirements.

Biodiversity Value Analysis

A wide array of places were identified as areas of importance in the Biodiversity Value Analysis. As one might expect, areas such as the Gaviota Coast, the Sespe Watershed and Vandenberg Air Force Base were identified as especially biologically important, given these locations' large wild expanses and/or relatively low-density development. However, other less well-known areas such as Buckhorn Ridge, Mount Pinos, and Mountclef Ridge were ranked especially high in biodiversity value as well.

Areas mapped as high biodiversity value received elevated rankings due to some combination of the following: status as a listed species hotspot, value in adding to full habitat representation, value as a wild area, or the site's role in contributing to connectivity of habitats. These rankings also consider the current land-use and human density in determining ecological value, but they do not consider the notion of threat; thus, for example, areas with a high likelihood of development in the near future are treated similarly to areas without threat. As shown in Figure 16, areas of high biodiversity value are numerous and widely distributed. Some areas show up as high biodiversity value because they are exceptionally high in a single criteria, while other such areas rank well under several critera.

To illustrate, consider the Gaviota Coast and Western Santa Ynez Mountains in the southwestern part of the region, one of the largest areas of contiguous high and very high biodiversity value. This large swath of green extends from the Jalama Watershed in the West to the mountains above Goleta in the East. By examining Figures 9, 10, 12, and 15, it becomes apparent that this high biodiversity value area derives its score from many medium high to very high scores from all four objectives. There is a large Wild Land in the mountains between Refugio Road and Highway 154 (Figure 11). A high quality landscape linkage provides connectivity between this Wild Land and the one on Vandenberg Air force Base (Figure 12). In addition, there are numerous listed species along the Gaviota Coast, and many of the quality occurrences of these species occur in this sub-region, which explains the many high scores in Figure 9. Habitat representation scores are medium-high in many places due primarily to coastal oak woodland and coastal scrub, and are high in a few places due to the closed-cone pine cypress (Figure 3 and Figure 10). These pine/cypress forests are rare throughout the region, so even small forests are of high biodiversity value. In summary, the intermediate analyses and resulting figures can indicate how the model allocates biodiversity value.

Selected Key Conservation Priority Areas

The Conservation Priority Analysis builds upon the Biodiversity Value Analysis. An additional consideration in the analysis is the value assigned to expanding protected areas of the region, termed Reserve Adjacency. Also, the Conservation Priority Analysis includes a threat layer that identifies areas most likely to be affected by urban, suburban, agricultural and oil expansion. This threat layer focuses higher values on areas that are predicted to have a large degree of increase in human impact over the next half century (See Chapter 4).

By examining the geographic extent of high and very high conservation priority values, five key areas were identified as conservation priority areas:

1. *Caliente Range*
2. *San Rafael Mountains near Figeroa Mountain*
3. *Gaviota Coast and Western Santa Ynez Mountains*
4. *Santa Susanna Mountains to the Simi Hills and Conejo Grade*
5. *Vandenberg Air Force Base region*

By definition, these areas have important biodiversity features and are in areas predicted to be affected by human land conversion in the future. For a more nuanced discussion of this statement, see the brief summaries below.

Caliente Range

The Caliente Range stretches along the northern part of the CCP Region and is bordered to the south by the Cuyama Valley. This remote range is an important Wild Land and is home to many listed species. To the south of the Caliente Range, agriculture is heavily established in the Cuyama Valley and growth scenarios indicate an outward expansion of agriculture into sensitive habitat. As a result of the agriculture expansion, habitats that are underrepresented such as juniper and blue oak woodland, as well as large expanses of coastal sage scrub are under threat. Also, this area received an elevated score in the expanding reserve module as natural areas around the protected portions of the Caliente Range. As a result of its high biodiversity importance coupled with the anticipated agricultural expansion from the Cuyama Valley, the Caliente Range is an example of a large contiguous area of high conservation priority.

San Rafael Mountains Near Figueroa Mountain

On the outskirts of the San Rafael Wilderness, the Figueroa Mountain area is one of the highlighted conservation priorities for the region. This area is not especially large, but has a very high conservation value. The area has a wide variety of montane hardwood and conifer forests and is home to numerous listed species. Due to a low amount of roads or other human impact, the area is considered a Wild Land. The area also ranks high in the Reserve Adjacency objective, as it is next to the small Sedgwick Reserve and the larger San Rafael Wilderness. The driving force behind its very high score is the threat layer, as Figueroa Mountain has also been identified as a priority area for oil and gas drilling by the United States Forest Service (USDA Forest Service 2001). In summary, the high degree of threatened change in human impact coupled with high scores in four of the five ecological objectives results in this area being a high conservation priority.

Gaviota Coast

The Gaviota Coast is among the world's shining examples of a large undeveloped coastal area of the Mediterranean climate type. It is identified as a conservation priority because of the importance to biodiversity, discussed above, as well as the moderate degree of threat. In the analysis, portions of coastline were identified as under threat from urban, suburban and oil expansion. The Forest Service identified Gaviota Peak and portions of the Santa Ynez ridgeline as priority areas for oil expansion (USDA Forest Service 2001). In addition to the biodiversity values discussed above, the expanding reserves analysis ranks high as well, as areas surrounding Gaviota, El Capitan and Refugio State Parks were highlighted as important areas for reserve expansion. In summary, the Gaviota Coast is identified as another important conservation priority for the region.

Santa Susanna Mountains to The Simi Hills and Conejo Grade

The highest amount of urban and suburban development in the region is expected in the areas surrounding Thousand Oaks, Camarillo, Moorpark, Simi Valley and Santa Clarita. The urban outgrowth model indicated these areas in the southeastern part of the region should expect significant growth in the coming decades. The suburban outgrowth model highlighted these areas as well; furthermore, Santa Clarita is expected to have a major burst of suburban growth to its west, creating unbroken suburban sprawl connecting Santa Clarita to Simi Valley and Thousand Oaks. Areas surrounding these cities are also likely areas for agricultural expansion. Meanwhile, the remaining undeveloped parts of this area are also very important ecologically. This area provides a landscape linkage between the Santa Monica Mountains and the San Bernardino Mountains in the East, and the Topatopa Mountains in the north. If the Santa Monica Mountains were to lose these linkages and in effect become an island of habitat, it is likely that the small mountain lion population would suffer from inbreeding, and very easily become extant (locally extinct). As discussed earlier, losing this and other top carnivores would have negative repercussions throughout the food web. Further, many of the areas that are key to maintaining this landscape connectivity are also home to important listed species. These are the two ecological objectives that score the highest of the five. The habitat representation objectives scores moderately due mainly to expanses of coastal sage scrub, as well as small pockets of oak woodland and montane riparian. In summary, with the anticipated shift in land use coupled with the many listed species and high connectivity value highlight this area is a major conservation priority for the region.

Vandenberg Air Force Base Region

Vandenberg Air Force Base is a large, mostly undeveloped coastal area on the western edge of the study area. It starts to the north of Point Conception at Jalama Creek and stretches nearly to Point Sal, and is used by the Air Force as a major military base. Thanks in part to a military mandate emphasizing environmental stewardship, the area contains a wealth of biodiversity and areas of pristine natural resources. The base has two Wild Lands: the mountainous area in and around Honda Creek Watershed on South Base, and the coastal dunes and lowlands around the San Antonio Terrace on North Base. Landscape linkages exist adjacent to these areas. The entire base is also home to a large variety and high density of listed species, yielding very high scores for the listed species objective. Habitat representation has high scores, with extensive riparian habitat, forests of closed cone pine/cypress, oak woodlands, and expanses of coastal sage scrub and mixed chaparral. Vandenberg is not a permanently protected area and is thus open for alteration in the future. The threat model does not assume that the exemplary environmental stewardship on the base will automatically continue for the next half century. The base is subject to the political winds in Washington DC, and there has been an effort in recent years to lessen the environmental stewardship mandate of military installations. To indicate this threat, and because agriculture and grazing are already allowed on the base, the model identifies many areas on the base threatened with increased human impact. With the possibility for conversion to agriculture along with its high scores in the listed species, underrepresented habitat and important wild lands objectives, the Vandenberg Air Force Base region is identified as an important conservation priority area.

Limitations and Opportunities

The products of the Regional Conservation Guide are meant to provide decision support, but are not meant to be the final word on any issue. Models are representations of the world, and should be treated as such. This first iteration of the RCG combines a great wealth of data, theory, and analyses to provide an unprecedented resource for the regional community. However, nature is inherently complex, so any attempt to model its conservation priorities will be a best estimate. There are undoubtedly areas that are a high conservation priority although they are not mapped as such, and vice versa. The reliability of such an estimate improves as the number of input data and ecological sub-analyses are increased. While these may be considered limitations of the model, we prefer to consider these as opportunities. For instance, a more explicit treatment of the aquatic resources in the region could be performed. Similarly, a focal species approach of conservation planning could be utilized more heavily. In such an approach, one to three dozen focal species are carefully chosen based on characteristics such as ecological function or rarity. The distribution and habitat needs of these species are mapped and overlaid, and combined with the other objectives. For both of these opportunities for model refinement, a "regional eco-database" could be created from pre-existing observations and knowledge, as well as data gathered over time. Creation of such a database would not only augment all the objectives, but would also enrich the sense of place of all participants. Inter-organizational collaborations are also possible, such as combining a "Regional Impacts of Growth" type study for the region to refine the threat model (Santa Barbara Region Economic Community Project, 2003). In short, iteration one of the Regional Conservation Guide is an invaluable resource, with many opportunities available for incremental improvement.

Chapter 6
Implementing The Regional Conservation Guide

Barn Owl - *Tyto Alba*

Implementing The Regional Conservation Guide

The findings of the RCG present options for a region wide system of protected areas that meet the needs of the landscape for long-term ecological sustainability. To be clear, all of the areas identified as conservation priorities need not be secured in "reserves" – or highly protected status such as wilderness— in order to maintain the region's ecological integrity. "Stewardship zones" —areas of quality habitat that allow for human use of the landscape simultaneous to managing for biodiversity—may be used as part of an effective network of regional conservation designations. Stewardship zones can occur on public and private lands and include certain types of agricultural and grazing practices, ecologically sustainable forestry, and recreational use such as hunting and fishing.

Land trusts, government agencies, landowners, nonprofits and the conservation community may utilize the Regional Conservation Guide to aid in protecting natural areas. Conception Coast Project will be reaching out with this document to all of these parties through presentations and dialogue. Prioritizing areas for conservation will aid organizations in efficiently conserving the region's most biologically important areas.

Relevant Programs, Activities And Methods For Conservation

Purchase Of Private Property

Important areas for conservation are sometimes purchased outright to ensure protection of natural resources. The financial cost is often high but the land will be preserved in perpetuity. The Gaviota Coast serves as a local example of such efforts. Rancho Arroyo Hondo was identified as one of the most ecologically significant watersheds of the Gaviota Coast in CCP's ecological analysis for the Gaviota Coast Resource Study (EDAW 2002). The Land Trust for Santa Barbara County initiated talks with receptive landowner J.J. Hollister, which resulted in the Land Trust agreeing to purchase the land the 782-acre ranch for seven million dollars in late 2001.

Easements For Conservation, Open Space, Agricultural Protection

Conservation easements are voluntary deed restrictions put on land and inhibit certain activities that may affect the natural or agricultural resources of the land. The easement is often purchased by a designated non-profit organization or local government agency usually for the difference between its market value and the value of its current use. The landowner receives either a payment or tax benefit for entering into a conservation easement. The cost for the easements can be expensive but is often much less than outright purchase of land (Casterline, Fegraus et al. 2003).

Change In Management Of Public Property

Public policy can be changed in numerous ways to ensure that public health and ecologically significant areas are protected. Limiting extractive uses, reducing or eliminating the use of pesticides and herbicides and designating nature preserves are some examples in which public policy can positively aid ecosystems. The use of science and new technologies can often assist these efforts. The cost and effectiveness are variable.

Restoration Of Degraded Areas

Restoration efforts can be effective in transforming ecologically disturbed areas to functioning natural areas. In the Conception Coast region, many riparian restoration projects remove nonnative arrundo and other invasive exotics to allow natural conditions to return to the creek. The cost varies from expensive large-scale projects to smaller volunteer projects. The effectiveness of projects is variable.

Land Exchange

Land exchanges occur when a public or private agency designates land for resource protection through legal commitment, or donates the parcel to a land trust. Alternatively, land owned by a large public or private landowner, which is not as desirable for conservation, is made available to exchange for private lands needed for conservation. In addition, landowners can receive tax benefits by donating land suitable for conservation to a public or nonprofit entity. Performing a land exchange secures development permits and may be more cost effective than searching for individual private landowners willing to sell mitigation land (Casterline, Fegraus et al. 2003).

Wildlife Crossings

The Transportation Equity Act for the 21st Century (TEA-21) authorizes over $200 billion to improve the Nation's transportation infrastructure, and protect the environment. The Act allows new opportunities to improve water quality, restore wetlands, and rejuvenate urban areas. The U.S. Department of Transportation's Federal Highway Administration has a program called Critter Crossings, which addresses issues of habitat loss and habitat fragmentation due to public roads. The program works on various projects such as under and overpasses for wildlife (Casterline, Fegraus et al. 2003). The County of Ventura has initiated work on wildlife crossings and is designing guidelines based on work by a group of graduate students at the Bren School of UC Santa Barbara (Cavallaro, Sanden, et al 2005). This informative document can be used to detail the above concepts and as a reference for any road construction or modification in the region.

Transferable Development Rights (TDR)

A Transfer of Development Rights program transfers entitlements to develop one parcel to a different parcel of land. TDR programs are often created by local zoning ordinances. The land where the rights originate is called the "sending" parcel, and the parcel of land to which the rights are transferred is called the "receiving" parcel. When the rights are transferred, the sending parcel is restricted with a permanent conservation easement. These programs are based on the concept that property owners hold many different rights, including the right to develop, and some or all of those rights can be transferred or sold (Casterline, Fegraus et al. 2003). Further, a group of masters students at the Bren School at UCSB have evaluated the potential of a market-based transfer of developments program to preserve open space in Santa Barbara County (Carrol, Chen, et al 2005). This is an informative document and also considers the socio-political context of the region.

Farm Bill

The Farm Security and Rural Investment Act of 2002 (Farm Bill) provides funding for a range of emerging natural resource challenges faced by farmers. These issues include soil erosion, wetlands, wildlife habitat, and farmland protection. The 2002 Farm Bill places a strong emphasis on the conservation of working lands. Implemented through the United States Department of Agriculture (USDA) the Farm Bills provides landowners with various programs with their own incentives. These programs include:

· *Conservation of Private Grazing Land (CPGL)*
· *Conservation Reserve Program (CRP)*
· *Agriculture Management Assistance (AMA)*
· *Conservation Corridor Program*
· *Conservation Security Program (CSP)*
· *Desert Terminal Lakes*
· *Environmental Quality Incentives Program (EQIP)*
· *Grasslands Reserve Program (GPR)*
· *Grassroots Source Water Protection Program*
· *Great Lakes Basin Program for Soil Erosion and Sediment Control*
· *Ground and Surface Water Conservation*
· *Partnerships and Cooperation*
· *Farmland Protection Program (FPP)*
· *Resource Conservation and Development Program (RC&D)*
· *Small Watershed Rehabilitation*
· *Wetlands Reserve Program (WRP)*
· *Wildlife Habitat Incentives Program (WHIP)*

The Land Conservation Act (LCA)

The Land Conservation Act or Williamson Act is a California state regulation passed in 1965 in response to development driven agricultural and open space lands conversion. The act identifies 'agricultural preserves' as areas in which local governments can enter into contracts with landowners that only allows agricultural, recreational or open space. The program assesses the eligible lands based upon the land's agricultural, open space or recreational values, and not on potential market value. The smaller assessed value allows landowners to lower their property taxes (Casterline, Fegraus et al. 2003).

Farmland Security Zone

The California Division of Land Resource Protection handles the Farmland Security Zone program. This voluntary program provides additional tax reduction by the basic Williamson Act. The program requirements are similar to those for the Williamson Act, however eligibility for these 'Super Williamson Act' requires landowners to join the program for at least 20 years. In exchange for longer participation the landowner is given an additional 35% tax reduction above the initial Williamson Act assessed value, or Proposition 13 valuation, whichever is lower (Casterline, Fegraus et al. 2003).

Property Tax Benefits For Wildlilfe Habitat And Native Pasture Conservation

California Revenue and Tax Code §421 indicates that landowners with 150 acres or more can join into a wildlife habitat contract with various federal and state agencies. The contract limits the land uses to habitat for native or migratory wildlife and native pasture for at least ten years. According to the tax code, "Land subject to a wildlife habitat contract is valued by using the average current per acre value based on recent sales including the sale of an undivided interest therein, of lands subject to a wildlife habitat contract within the same county (CA Revenue and Tax Code §421). The decrease in value of the land translates into lower property taxes (Casterline, Fegraus et al. 2003).

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Appendices

Black Bear Cub - *Ursus americanus*

Appendix A - Detailed Methodology

Introduction

1. Background

1.1. Context

This technical appendix is written to complement the Regional Conservation Guide (RCG). This provides more detail on the analytical methodology, which was intentionally kept brief and simple in the guide itself. In turn, there is a more detailed methodological write-up that this document refers to (Davis, Stoms et al. 2003) which has been refined and submitted for publication in *Ecology and Society* (Davis, Costello et al. Submitted).

1.2. Key Terminology

Each of the six ecological objectives are represented as Geographic Information System (GIS) "layers" that are overlaid on top of each other in a "multi-criteria analysis." As a metaphorical description of a layer, imagine a piece of clear plastic Mylar with a square grid drawn on it. Each of those squares can have a color and number associated with it that represents the importance of that square with respect to the particular ecological objective, say listed species hotspots. Then all of the layers are overlaid with "map algebra" and at a particular location on the landscape, the sum of the corresponding square of all the layers can be determined. Similarly any other algebraic manipulation can be performed, such as multiplication.

In the above metaphor, the square will be termed the "candidate site" for the rest of the document. Candidate sites are 1.5 km by 1.5 km. Further, there are often many smaller squares embedded within one of these larger squares. These smaller squares are called "cells" and are 100 m by 100 m unless otherwise specified. Most analyses are started on the cells, and then aggregated half way through the analysis to create the value of the candidate site.

The current draft of the RCG is referred to as the first "iteration" or RCG version 1.0. An iteration is a computational procedure in which a suite of operations is performed again with small improvements in order to approximate the desired result more closely. There are many improvements that can be made for version 1.1 or 2.0. If you as a reader have any suggestions, please submit them as we are compiling a list of potential improvements. However, another iteration will only be performed if there is enough interest from community organizations and individuals, and if the resources for such an endeavor are available.

[Occasionally minor technical notes will be provided in brackets. These notes are not necessary for understanding the methodology, but are useful in exactly replicating the methodology.]

1.3. Advisory Groups

Advisory groups were used to guide development of the RCG. Please see Chapter 1 for a description of these groups.

Part 1: Map "Biodiversity Value"

For an introduction to this objective and an overview of the methodology, please see Chapter 4 of the RCG.

Both Ecological and Land-Use advisors saw the preliminary results of the model and requested that the results are also shown without the effects of "threat" (predicted land use change). This would show the raw biodiversity value of the land, irrespective of human politics. "Threat" is embedded deep within the Davis, Stoms et al. (2003) analysis. The request of the advisors was able to be met by making the model assume that all lands had an equal likelihood of being completely degraded by the year 2050. The result is the map of "Biodiversity Value." The objectives for this analysis are B1, B2, B4, and B6, and for the conservation value analysis the objectives are C1, C2, C4,C5, and C6. For an overview diagram of this analysis, see Figure 4 of the RCG, on the following page. [Note: Davis, Stoms, et al. (2003) refer to the objectives as M1, M2, etc.]

2. Human Impact Index 2000

This is the layer indicating the human land-use impact on the landscape during the year 2000. To understand the context of this layer in the analysis, please review at least the introduction of Chapter 4 of the RCG. [Note: Davis, Stoms et al (2003) refer to this layer as "Ecological Conditions Index," but after presenting this concept to local advisors, confusion ensued, and the name has been changed to the "Human Impact Index" and the values reversed.]

2.1. Map and Classify Different Human Impact Layers

Six different layers of data were created, each with a variety of classes. These layers were as follows: 1) development densities, 2) industrial lands, 3) agricultural lands, 4) grazing lands, 5) roads, and 6) reserves and known conservation easements. All of the classes of these six layers were then combined onto one spreadsheet, and were assigned relative values at an ecological advisor workshop and subsequent e-mail polling. The six layers were then overlaid, and the highest potential human impact value for every cell was mapped. The cell size of each layer is 30 m by 30 m. Methodology of the creation of each layer is detailed below, and the final classes and values are summarized on Table A1: Human Impact Categories and Values.

2.1.1. Map and Classify Urban, Suburban, Rural and other Development Densities

This layer was created by combining two data sources: the CA Department of Conservation "Development Footprint" which is census based, and the Farmland Mapping and Monitoring Program (FMMP) data which are aerial photography and map based (See Table A2: Source Data for the Regional Conservation Guide for more information). High density urban class was determined by the FMMP data as land occupied by structures with a building density of at least 1 unit to 1.5 acres, or approximately 6 structures to a 10-acre parcel. All other classes were determined by the development footprint layer, see Table A1 for class categories and values. The density class threshold values were used to correlate with the density classes used in the urban outgrowth model results of the Human Impact Index 2050 analysis, described later.

2.1.2. Map and classify different types of Industrial Lands

For this iteration of the RCG, industrial lands are defined as lands used for oil development and processing. There are two data sources for this layer: the US Forest Service draft EIS for the proposed oil development expansion in the national forest(USDA_Forest_Service 2001), and the Department of Conservation Well Locations Database (See Table A2). The area of currently utilized oil leases was determined using the USFS data. The well locations database had 130 specific types of wells in our region which were then re-classed into 6 subclasses, which were then re-classed into three classes for analy-

Figure 4: Diagram of the Biodiversity Value Analysis

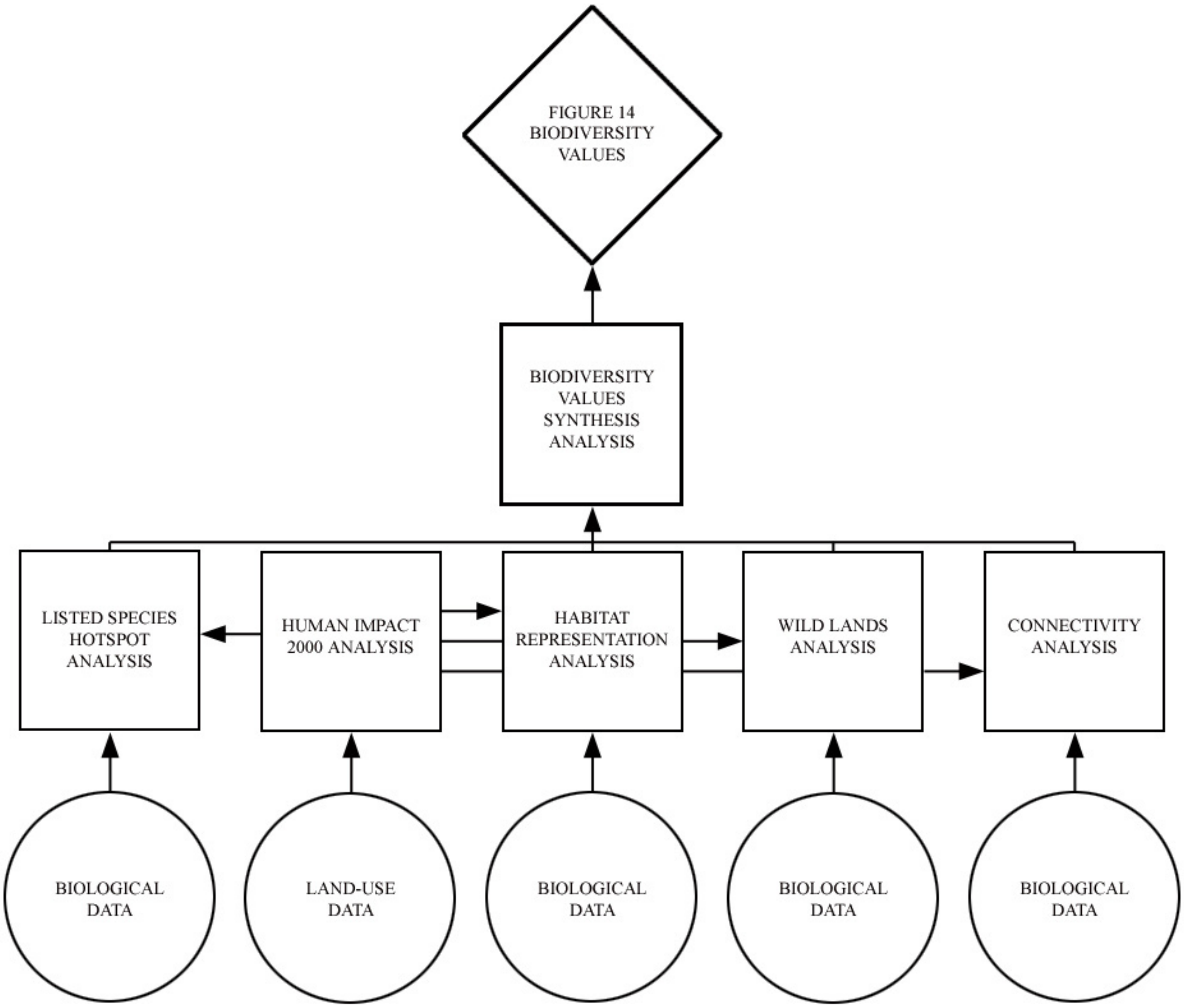


Table A1: Human Impact Categories and Values

Human Impact Category	Impact Value	Description	Source Data Layer (see Table 2)
Agricultural Easment	0.6	Ag Easement as defined by FMMP	Farmland Mapping and Monitoring Program
Agriculture	0.7	Prime Farmland, Farmland of Statewide Importance, Unique Farmland, Famland of Local Importance and Irrigated and Non-Irrigated (Interim Classes)	Farmland Mapping and Monitoring Program
Other Use	0.02	no units	
Rural 160 Acre	0.05	> 160 acres/unit	Development Footprint
Rural 40 Acre	0.1	40-160 acres/unit	Development Footprint
ExUrban 20 Acre	0.26	20-40 acres/unit	Development Footprint
ExUrban 10 Acre	0.45	10-20 acres/unit	Development Footprint
ExUrban 5 Acre	0.72	5- 10 acres /unit	Development Footprint
Low Density Urban	0.9	1.5-5 acres/unit	Development Footprint
High Density Urban	1	< 1.5 acres / unit	Farmland Mapping and Monitoring Program (FMMP)
Grazing Allotment	0.25	Grazing Allotments on VAFB	VAFB Grazing
Grazing Allotment	0.25	Grazing Allotments on USFS	USFS Grazing
Grazing Allotment	0.25	Grazing land as mapped by the FMMP (Grazing Category).	Farmland Mapping and Monitoring Program
Visible Grazing	0.46	Grazing land extracted from the C-CAP raster class: rangeland	Coastal Change Analysis Program
Oil Well Abandoned	0.35	Abandoned or other oil well	Well Locations Database
Oil Well Inactive	0.69	Idle extraction or injection well	Well Locations Database
USFS Oil Leases	0.84	The area of currently utilized oil leases	USFS Oil Development Layer
Oil Well Active	0.89	Active extraction or injection well	Well Locations Database
Conservation Easement	0	Conservation Easements	Conservation Easements - CA and Conservation Easements - Ojai
Reserves	0	Reserves as defined by the CDF-FRAP raster Management Landscape.	Management Landscape
Roads	variable from 0-1	Cells that are either directly on major or minor roads, or grid cells that are up to 300 m from minor roads and 500 m from major roads. Values vary depending on road type, distance from road centerline, and nearby housing density.	Roads Coverage

Table A2:Source Data for the Regional Conservation Guide

Layer Name	Originator	Description	Contact/Site
California Natural Diversity Data Base	CA Dept.of Fish & Game	Based on observations submitted by field biologists of location and status of rare and endangered plants, animals and vegetation types.	http://www.dfg.ca.gov/whdab/html/cnddb.html
California Urban and Biodiversity Assessment	University of California, Berkeley	A trend model predicting urban outgrowth based on past growth patterns and a predicted population increase. See text for methodology.	John Landis: jlandis@uclink.berkeley.edu
California Wildlife Habitat Relationships Model	CA. Dept. of Fish and Game	CWHR contains life history, management, and habitat relationships information on 675 species of amphibians, reptiles, birds, and mammals known to occur in the state. A community-level matrix model associates 675 wildlife species to standard habitats and stages – rating suitability for reproduction, cover, and feeding.	http://www.dfg.ca.gov/whdab/html/cwhr.html
CCP Additional Observations Database	Conception Coast Project	Mapping of local expert knowledge about species locations that are not already mapped in any of the other databases. Based on an expert workshop with large format maps and previous records already mapped.	John Gallo: gallo@conceptioncoast.org
CCP Vertebrates Database	Conception Coast Project and Santa Barbara County	Observations of rare and sensitive vertebrates of the Gaviota Coast. 198 records. Based on observations submitted by field biologists; compiled by CCP.	Not Available at the Present Time
Coastal Change Analysis Program	National Oceanic and Atmospheric Administration	Land cover/land use data using 30-meter Landsat satellite imagery. Target 85% overall classification accuracy. 22 land cover classes. The database has data from two dates that can be compared. Only the most recent data were used for the RCG land cover analyses.	http://www.csc.noaa.gov/crs/lca/ccap.html ; Or. Steve Raber: Steve.Raber@noaa.gov
Conservation Easements - CA	GreenInfo Network	Partial database of Conservation Easements throughout California, created by GreenInfo network for the California Resources Agency Legacy Project. No Ventura Easments were entered.	Amanda Kochanek: amanda@greeninfo.org
Conservation Easements - Ojai	Ojai Valley Land Conservancy	GIS coverage of Conservation Easements in the Ojai Valley	Jim Engel: ovlc@ojai.net
Development Footprint	CA Dept. of Forestry and Fire Protection	Attempt to spatially define the "footprint of development", which includes both residential and commercial development. Statewide GIS layer of Footprint of Development derived from 2000 Census data and USGS National Land Cover Data (land use) (v03_1)	http://frap.cdf.ca.gov/data/frapgisdata/select.asp
Digital Elevation Model	U.S. Geological Survey	100 m pixels across the landscape that identify the mean elevation of the pixel. Can be used for elevation analyses and creation of hillshade layers.	http://www.visualizationsoftware.com/3dem/downloads.html
Ecological Subregions	USDA Forest Service	Ecological types are classified and ecological units are mapped based on associations of those biotic and environmental factors that directly affect or indirectly express energy, moisture, and nutrient gradients which regulate the structure and function of ecosystems. These factors include climate, physiography, water, soils, air, hydrology, and potential natural communities.	http://www.fs.fed.us/r5/projects/ecoregions/title_page.htm http://www.fs.fed.us/r5/projects/ecoregions/appendix_b.htm
Farmland Mapping and Monitoring Program	CA Dept. of Conservation	Important Farmland Maps for those areas that have modern soil surveys (8 categories using USDA-NRCS Soil Surveys and current land use information) and Interim Farmland Maps for those areas lacking modern soil survey information.	http://www.consrv.ca.gov/DLRP/fmmp/index.htm
Land Management Status	CA Dept. of Forestry and Fire Protection	Statewide GIS layer of working landscape (areas managed for ag/timber/forage), urban and residential areas, public and private ownership, and reserves.	http://frap.cdf.ca.gov/data/frapgisdata/output/mgmtscape.txt

Table A2 continued: Source Data for the Regional Conservation Guide

Layer Name	Originator	Description	Contact/Site
Land Management Status	CA Dept. of Forestry and Fire Protection	Statewide GIS layer of working landscape (areas managed for ag/timber/forage), urban and residential areas, public and private ownership, and reserves.	http://frap.cdf.ca.gov/data/frapgisdata/output/mgmtscape.txt
Mountain Lion Database	Conception Coast Project	Sightings, tracks, and other sign of Mountain Lions throughout the CCP Region. Based partially on archived notes from the SB Museum of Natural History, UCSB Museum of Systematics and Ecology, and Department of Fish and Game. Also includes observations provided by individuals using the web: www.conceptioncoast.org	CCP- John Gallo gallo@conceptioncoast.org
Multi-Source Land Cover Data (v02_2)	CA Dept. of Forestry and Fire Protection	Land Cover layer of 77 classes of vegetation and human induced cover. A variety or raw and processed data sources are used to create this complete coverage. Original Data sources: USDA Forest Service (1999), Bureau of Land Management (1999), GAP Management Status (1996), Dept. of Parks and Recreation (2000).	http://frap.cdf.ca.gov/data/frapgisdata/output/fveg02_1.txt
Potential Habitats	A.W. Kuchler	A polygon coverage of: Kuchler, A. W. (1977). The map of the natural vegetation of California. In Barbour, M. and Major, J. (eds), Terrestrial vegetation of California. John Wiley and Sons, New York. Pp. 909-938.	http://www.biogeog.ucsb.edu
Roads Coverage	UCSB Biogeography Lab	Cells that are either directly on major or minor roads, or grid cells that are up to 300 m from minor roads and 500 m from major roads. GIS analysis resulted in values that vary depending on road type, distance from road centerline, and nearby housing density.	http://www.biogeog.ucsb.edu/
Steelhead Database	Conception Coast Project	Observations, barriers, historic runs of Steelhead in the CCP Region	studarus@conceptioncoast.org
TIGER Roads Data	U.S. Census	Centerline data for roads in the U.S.. Roads are classified based on number of lanes, type, usage, etc.	http://www.esri.com/data/download/census2000_tigerline/
UCSB Bird Database	Conception Coast Project and the Museum of Systematics and Ecology	Breeding observations of rare and sensitive birds of non-urban areas of Santa Barbara County. 1700+ Records. Based on observations submitted by field biologists to the MSE. Compiled by CCP staff and volunteers.	Mark Holmgren: holmgren@lifesci.ucsb.edu
UCSB Herpetile Database	Museum of Systematics and Ecology	Locations of collections of archived museum specimens of herpetiles of Santa Barbara County. 5051 Records	John LaBonte: labonte@lifesci.ucsb.edu: Sam Sweet: sweet@lifesci.ucsb.edu
USFS Grazing Layer	USDA Forest Service	Grazing Allotments on National Forest Land	Chris Clervi: cclervi@fs.fed.us
USFS Oil Development Layer	USDA Forest Service	The GIS coverage from the Draft EIS of Oil and gas Leasing, October 2001.	Chris Clervi: cclervi@fs.fed.us
USFS Vertebrates Database	Los Padres office of the U.S. Forest Service	Based on observations submitted by field biologists of rare and sensitive vertebrates of the four Southern California National Forests and surrounding areas. 22,387 records, including duplicate observations of individuals at different dates.	Chris Clervi: cclervi@fs.fed.us
VAFB Grazing Layer	Vandenberg Air Force Base	Grazing Allotments on Vandenberg Air Force Base	Nancy Francine: nancy.read@vandenberg.af.mil
Water Bodies	U.S. Geological Survey	Reservoirs thoroughout the region.	http://water.usgs.gov/lookup/getcover?reservoir
Water Courses	U.S. Geological Survey	Digital Line Graph, hydrography data. Shows the locations of perrenial and intermittant streams.	http://edc.usgs.gov/products/map/dlg.html
Well Locations Database	CA Dept. of Conservation	Digital well locations are available in a database file that contains the latitude and longitude for each well in the state and dozens of well type classes (with approximately 195,000 wells listed).	http://www.consrv.ca.gov/DOG/maps/goto_welllocation.htm
Western Futures Model Data	Colorado State University, Fort Collins	A trend model predicting all residential outgrowth based on past growth patterns and predicted population increase. See text for methodology.	David Theobald: davet@nrel.colostate.edu

sis, see Table A2.

2.1.3. Map and classify Agriculture Lands

The data source for this layer is the Farmlands Mapping and Monitoring Program. See Tables 1 and 2 for data source description, and the resulting data layer classes and values.

2.1.4. Map and classify Grazing Lands

There were four data sources for this layer that were grouped into two different classes: Grazing allotments and visible grazing (See Tables 1 and 2). "Visible grazing" is derived from analysis of satellite imagery, and identifies actual locations within and outside of allotments that grazing is occurring. However, there are some areas, especially those in oak woodlands, that are grazed but not visible from the air. It is assumed that most of these areas will show up in the grazing allotments category. Further, C-CAP (the visible grazing) did not include San Luis Obispo at the time of analysis.

2.1.5. Map and classify Roads

The roads data used were the same as those derived by Davis, Stoms et al. (2003) white paper. "To model road impacts we used 2000 TIGER data developed by the U.S. Census Bureau. TIGER road classes 1,2,3, and 6 were considered major roads and road class 4 was treated as minor roads. Major and minor roads were extracted as two separate GIS coverages and a 100 m grid of distance to road was created for each coverage using 500m as the maximum distance for major roads and 300m for minor roads." The human impact values of the major road coverage cells were determined by the inverse distance from the road, with cells adjacent to the road having a higher impact than those 500 m away. The human impact values of the minor road coverage cells were determined by the distance from the road, as well as by nearby housing density. The assumption is that minor roads near urban or suburban areas will have a higher traffic volume, and thus a higher impact, than those that are in rural areas (Davis, Stoms et al. 2003). The data were then resampled to 30 m cells and clipped to the Conception Coast region.

2.1.6. Map and classify Reserves

All classes of reserves designated by the management landscape data source were used (sparse and rural, public and private reserves). These are lands permanently protected from conversion of natural land cover and having a mandated management plan in operation to maintain a primarily natural state, but which may receive management practices that degrade the quality of existing natural communities (equivalent to GAP Management Status classes 1 and 2). Further, we had two data sources for conservation easements, which were also classed as reserves. See Tables 1 and 2 for data source description, and the resulting data layer classes and values.

2.2. Merge layers into Human Impacts at the Year 2000 layer

The above six layers were merged and the highest potential human impact value for every cell was mapped. For example, if a particular 30 m by 30 m area on the landscape is 200 m from a minor road, is in a rural 60 acre parcel area, and has some visible grazing, it will have human impact values for all of these layers. In this case, the visible grazing has the highest human impact score of .46, so in the final composite layer, this cell will have a value of .46.

2.3. Visualize Results

The layer was mapped such that every human impact type had a unique color. Because there are so many categories, a continuous color ramp could not be used. Road impacts have variable values, so would require too many colors to be mapped. They were selected out of the layer and added as their own layer, and ramped as a various shades of black grey and white. See Figure 6: Human Impact Types within the Conception Coast Region. To see the relative impact on the landscape, see Figure 7: Estimated Degree of Human Impact within the Conception Coast Region.

3. Condition Weighted Area

One of the fundamental assumptions of this model is that a habitat in a pristine area has more biodiversity value than the same type of habitat in a degraded area. As mentioned in chapter 4, the Human Impact 2000 layer is used to address this issue. This is done using a concept called Condition Weighted Area (CWA) (Davis, Stoms et al. 2003). The CWA, in acres, of an individual 100 m cell is simply the acreage of the cell (~0.222 acres) multiplied by the ecological condition of the cell. The ecological condition is simply 1 minus the human impact value (Table A1). Thus, a cell of pristine habitat will have a CWA of 0.222 [i.e. 0.222 X (1-0)] condition weighted acres; an acre of agricultural land will have a CWA of 0.0666 condition weighted acres [i.e. (1-0.7) X 0.222]; and an acre of urban land will have a CWA of 0.002 acres. The CWA layer is combined later with the ecological data of the various objectives to yield the partial and final estimates of biodiversity and conservation value.

4. Objective B1: Estimate Listed Species Hotspots Biodiversity Value

4.1. Determine the list of species that will be used

Three lists of species that are found in our region were created and presented at an ecological advisor workshop:

List 1: "Listed Species" Includes Federal and State-- Endangered, Threatened, Proposed Endangered, Proposed Threatened, Candidate, and CA Rare species.

List 2: "Global Rank, Not Listed" Species or sub-species that are globally rare (G1, G2, T1, or T2) according to the Natural Heritage listing system, but that are not included in Group 1.

List 3: "Special Concern Only" Species that are State or Federal Species of Concern, or California Native Plant Society Rare; and that are not included in Group 1 or 2.

Species that are found only on the Channel Islands, or that there is no digital data about, were not included in the draft lists. The lists were then shown to the ecological advisors, and some other regionally important species were added. It was decided to include all three lists in the analysis. Further, it was determined to not weigh occurrences of species from one list higher than occurrences of species from another list. This was for several reasons, the most prominent being that there are significantly more digital data for species from list 1, and that political listing does not necessarily correlate with ecological importance or rarity. The final "target" list of species used for RCG Iteration 1.0 is provided in Table A3: Species used for the Listed Species Hotspots Analysis of the RCG.

Table A3: Species Used for the Listed Species Hotspots Analysis of the RCG - key located on page 117

Land Cover Type	Final Habitat Weight	Rarity		Ecoregion Context			Habitat Loss	
		Total Acres In Region	Rarity Index	% of Region	% of Eco-Region	Eco-region Index	Kuchler Type: Scientific Name	Acres of Kuchler Type
Alkali Desert Scrub	**0.17**	10,608	**.0102**	0.30	0.01	**1.000**	Artemisia-Eriogonum-Salvia/Abronia-Haplopappus	265,61
Annual Grassland	**0.11**	457,292	**.0002**	12.74	16.92	**.165**	Stipa Spp.	137,45
Barren	**0.13**	45,461	**.0024**	1.27	0.54	**.517**	No Crosswalk	45,46
Blue Oak Woodland	**0.26**	72,271	**.0015**	2.01	3.80	**.116**	Pinus-Quercus / Pinus coulteri	344,13
Blue Oak-Foothill Pine	**0.31**	1,601	**.0679**	0.04	2.46	**.004**	Pinus-Quercus / Pinus coulteri	344,13
Chamise-Redshank Chaparral	**0.19**	119,207	**.0009**	3.32	6.01	**.121**	Adenostoma-Arctostaphylos-Ceanothus	1,467,98
Closed-Cone Pine-Cypress	**0.67**	1,260	**.0863**	0.04	0.11	**.071**	Cupressus-Pinus	11,35
Coastal Oak Woodland	**0.26**	259,451	**.0004**	7.23	6.06	**.262**	Quercus agrifolia	917,65
Coastal Scrub	**0.15**	582,278	**.0002**	16.22	9.60	**.371**	Artemisia-Eriogonum-Salvia/Abronia-Haplopappus	265,61
Desert Scrub	**0.20**	30,759	**.0035**	0.86	0.63	**.299**	Artemisia-Eriogonum-Salvia/Abronia-Haplopappus	265,61
Desert Succulent Shrub	**0.63**	319	**.3411**	0.01	0.00	**.433**	Artemisia-Eriogonum-Salvia/Abronia-Haplopappus	265,61
Desert Wash	**0.48**	1,740	**.0625**	0.05	0.04	**.266**	No Crosswalk	1,74
Eucalyptus	**0.17**	1,105	**.0984**	0.03	0.04	**.178**	No Crosswalk	1
Freshwater Emergent Wetland	**1.00**	343	**.3165**	0.01	0.04	**.050**	No Crosswalk	6,86
Jeffrey Pine	**0.32**	37,556	**.0029**	1.05	0.48	**.479**	Pinus jeffreyi	59,34
Joshua Tree	**0.40**	190	**.5714**	0.01	0.01	**.087**	Salazaria-Tetradymia-Yucca	4
Juniper	**0.23**	22,760	**.0048**	0.63	0.21	**.661**	Juniperus-Stipa	2,94
Mixed Chaparral	**0.16**	995,552	**.0001**	27.73	17.36	**.351**	Adenostoma-Arctostaphylos-Ceanothus	1,467,98
Montane Chaparral	**0.33**	14,930	**.0073**	0.42	0.36	**.252**	Adenostoma-Arctostaphylos-Ceanothus	1,467,98
Montane Hardwood	**0.26**	55,300	**.0020**	1.54	1.78	**.190**	Arbutus-Quercus	185,28
Montane Hardwood-Conifer	**0.18**	43,227	**.0025**	1.20	1.42	**.186**	Abies-Pinus	12,33
Montane Riparian	**0.45**	30,166	**.0036**	0.84	0.23	**.796**	Arbutus-Quercus	185,28
Pinyon-Juniper	**0.10**	179,622	**.0006**	5.00	1.80	**.609**	Juniperus-Pinus	3,57
Ponderosa Pine	**0.35**	170	**.6377**	0.00	0.04	**.026**	Abies-Pinus	12,33
Sagebrush	**0.27**	19,627	**.0055**	0.55	0.28	**.435**	Artemisia-Eriogonum-Salvia/Abronia-Haplopappus	265,61
Saline Emergent Wetland	**0.70**	1,384	**.0786**	0.04	0.07	**.118**	Salicornia-Spartina	7,63
Sierran Mixed Conifer	**0.20**	21,853	**.0050**	0.61	1.01	**.133**	Abies-Pinus	12,33
Subalpine Conifer	**0.31**	116	**.9362**	0.00	0.07	**.010**	Abies-Pinus	12,33
Unknown Conifer Type	**0.21**	109	**1.00**	0.00	0.45	**.001**	Abies-Pinus	12,33
Unknown Shrub Type	**0.21**	6,056	**.0180**	0.17	1.17	**.032**	Artemisia-Eriogonum-Salvia/Abronia-Haplopappus	265,61
Valley Foothill Riparian	**0.42**	3,887	**.0280**	0.11	0.34	**.070**	Arbutus-Quercus	185,28
Valley Oak Woodland	**0.69**	6,575	**.0165**	0.18	0.38	**.106**	Quercus-Stipa	178,40
TOTAL		3,022,775						8,675,90

Table A3 continued: Species Used for the Listed Species Hotspots Analysis of the RCG

Common Name	Scientific Name	FedRank	CaRank	GRank	CNPS	CDFG	List #
Rayless Ragwort	*Senecio aphanactis*	-	-	G3?	2		3
Refugio Manzanita	*Arctostaphylos refugioensis*	-	-	G2	1B		2
Robinson's Pepper-grass	*Lepidium virginicum robinsonii*	-	-	G5T2	1B		2
Rock Creek Broomrape	*Orobanche valida valida*	-	-	G3T1	1B		2
Round-leaved Filaree	*Erodium macrophyllum*	-	-	G4	2		3
Salt Marsh Bird's-beak	*Cordylanthus maritimus maritimus*	E	E	G4?T2	1B		1
Salt Spring Checkerbloom	*Sidalcea neomexicana*	-	-	G4?	2		3
San Fernando Valley Spineflower	*Chorizanthe parryi fernandina*	C	E	G2T1	1B		1
San Joaquin Woollythreads	*Monolopia congdonii*	E	-	G3	1B		1
San Luis Obispo Monardella	*Monardella frutescens*	SC	-	G2	1B		2
Sand Mesa Manzanita	*Arctostaphylos rudis*	SC	-	G2	1B		2
Sanford's Arrowhead	*Sagittaria sanfordii*	SC	-	G3	1B		3
Santa Barbara Jewel-flower	*Caulanthus amplexicaulis barbarae*	-	-	G3?T1	1B		2
Santa Susana Tarplant	*Deinandra minthornii*	-	R	G2	1B		1
Santa Ynez False Lupine	*Thermopsis macrophylla*	-	R	G1	1B		1
Showy Madia	*Madia radiata*	SC	-	G2	1B		2
Soft-leaved Indian Paintbrush	*Castilleja mollis*	E	-	G1	1B		1
Sonoran Maiden Fern	*Thelypteris puberula sonorensis*	-	-	G5T3T4	2		3
South Coast Saltscale	*Atriplex pacifica*	-	-	G3G4	1B		3
Southern Alpine Buckwheat	*Eriogonum kennedyi alpigenum*	-	-	G4T2	1B		2
Southern Tarplant	*Centromadia parryi australis*	-	-	G4?T2	1B		2
Straight-awned Spineflower	*Chorizanthe rectispina*	SC	-	G1	1B		2
Surf Thistle	*Cirsium rhothophilum*	SC	T	G2	1B		1
Trask's Cryptantha	*Cryptantha traskiae*	-	-	G2	1B		2
Trask's Milk-vetch	*Astragalus traskiae*	-	R	G2	1B		1
Ventura Marsh Milk-vetch	*Astragalus pycnostachyus lanosissimus*	E	E	G3?T1	1B		1
Verity's Dudleya	*Dudleya verityi*	T	-	G1	1B		1
Wavy-leaved Malacothrix	*Malacothrix foliosa crispifolia*	-	-	G4T1	1B		2
White-felted Indian Paintbrush	*Castilleja lanata hololeuca*	-	-	G5T3	1B		3
Invertebrates							
Globose Dune Beetle	*Coelus globosus*	SC	-	G1			2
Riverside Fairy Shrimp	*Streptocephalus woottoni*	E	-	G1			1
Sandy Beach Tiger Beetle	*Cicindela hirticollis gravida*	SC	-	G5T4			3
Vernal Pool Fairy Shrimp	*Branchinecta lynchi*	T	-	G2G3			1
Fish							
Arroyo Chub	*Gila orcutti*	-	-	G2		SC	2
Santa Ana Sucker	*Catostomus santaanae*	T	-	G1		SC	1
Southern Steelhead - Southern CA ESU	*Oncorhynchus mykiss irideus*	E	-	G5T2		SC	1
Tidewater Goby	*Eucyclogobius newberryi*	E	-	G3		SC	1
Unarmored Threespine Stickleback	*Gasterosteus aculeatus williamsoni*	E	E	G5T1			1
Herpetiles							
Arroyo Toad	*Bufo californicus*	E	-	G2G3		SC	1
Blunt-nosed Leopard Lizard	*Gambelia sila*	E	E	G1			1
California Red-legged Frog	*Rana aurora draytonii*	T	-	G4T2T3		SC	1
California Tiger Salamander	*Ambystoma californiense*	PT	-	G2G3		SC	1
Coast (California) Horned Lizard	*Phrynosoma coronatum frontale*	SC	-	G4T3T4		SC	3
Coast (San Diego) Horned Lizard	*Phrynosoma coronatum blainvillei*	-	-	G4T3T4		SC	3
Coast Patch Nosed Snake	*Salvadora hexalepis virgultea*	-	-	G5T3		SC	3
Coast Range Newt	*Taricha torosa torosa*	-	-	G5T4		SC	3
Island Night Lizard	*Xantusia riversiana*	T	-	G1			1
Mountain Yellow-legged Frog	*Rana muscosa*	E	-	G2		SC	1

Table A3 continued: Species Used for the Listed Species Hotspots Analysis of the RCG

Common Name	Scientific Name	FedRank	CaRank	GRank	CNPS	CDFG	List #
Rosy Boa	*Lichanura trivirgata roseofusca*	SC		G4G5			3
San Bernadino Ring-necked Snake	*Diadophis punctatus modestus*			G5T2T3			3
Silvery Legless Lizard	*Anniella pulchra pulchra*	SC	-	G3G4T3T4Q		SC	3
Southern Rubber Boa	*Charina bottae umbratica*	SC	T	G5T2T3			1
Southwestern Pond Turtle	*Clemmys marmorata pallida*	SC	-	G3G4T2T3		SC	2
Two-striped Garter Snake	*Thamnophis hammondii*	-	-	G3		SC	3
Western Spadefoot	*Scaphiopus hammondii*	SC	-	G3		SC	3
Birds							
American White Pelican	*Pelecanus erythrorhynchos*	*	*	*	*	*	3
Ashy Storm-petrel	*Oceanodroma homochroa*	SC	-	G2		SC	2
Bald Eagle	*Haliaeetus leucocephalus*	T	E	G4			1
Belding's Savannah Sparrow	*Passerculus sandwichensis beldingi*	-	E	G5T3			1
Bell's Sage Sparrow	*Amphispiza belli*	*	*	*	*	*	3
Black Skimmer	*Rynchops niger*	*	*	*	*	*	3
Black Storm-petrel	*Oceanodroma melania*	-	-	G2		SC	2
Burrowing Owl	*Athene cunicularia*	SC	-	G4		SC	3
California Brown Pelican	*Pelecanus occidentalis californicus*	E	E	G4T3			1
California Condor	*Gymnogyps californianus*	E	E	G1			1
California Horned Lark	*Eremophila alpestris*	*	*	*	*	*	3
California Least Tern	*Sterna antillarum browni*	E	E	G4T2T3			1
California Spotted Owl	*Strix occidentalis*	*	*	*	*	*	3
Coastal Cactus Wren	*Campylorhynchus brunneicapillus*	*	*	*	*	*	3
Coastal California Gnatcatcher	*Polioptila californica californica*	T	-	G3T2		SC	1
Cooper's Hawk	*Accipiter cooperii*	-	-	G5		SC	3
Double-crested Cormorant	*Phalacrocorax auritus*	-	-	G5		SC	3
Elegant Tern	*Sterna elegans*	*	*	*	*	*	3
Ferruginous Hawk	*Buteo regalis*	SC	-	G4		SC	3
Golden Eagle	*Aquila chrysaetos*	-	-	G5		SC	3
Least Bell's Vireo	*Vireo bellii pusillus*	E	E	G5T2			1
Light-footed Clapper Rail	*Rallus longirostris levipes*	E	E	G5T1T2			1
Loggerhead Shrike	*Lanius ludovicianus*	*	*	*	*	*	3
Long Billed Curlew	*Numenius americanus*	*	*	*	*	*	3
Long-eared Owl	*Asio otus*	*	*	*	*	*	3
Merlin	*Falco columbarius*	*	*	*	*	*	3
Mountain Plover	*Charadrius montanus*	*	*	*	*	*	3
Northern Harrier	*Circus cyaneus*	*	*	*	*	*	3
Osprey	*Pandion haliaetus*	*	*	*	*	*	3
Prairie Falcon	*Falco mexicanus*	-	-	G5		SC	3
Purple Martin	*Progne subis*	*	*	*	*	*	3
Rhinoceros Auklet	*Cerorhinca monocerata*	-	-	G5		SC	3
Sharp-shinned Hawk	*Accipiter striatus*	*	*	*	*	*	3
Short-eared Owl	*Asio flammeus*	*	*	*	*	*	3
Southern Ca. Rufous-crowned Sparrow	*Aimophila ruficeps canescens*	-	-	G5T2T4		SC	2
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	E	-	G5T1T2			1
Tricolored Blackbird	*Agelaius tricolor*	SC	-	G2G3		SC	2
Vaux's Swift	*Chaetura vauxi*	*	*	*	*	*	3
Western Least Bittern	*Ixobrychus exilis*	*	*	*	*	*	3
Western Snowy Plover	*Charadrius alexandrinus nivosus*	T	-	G4T3		SC	1
Western Yellow-billed Cuckoo	*Coccyzus americanus occidentalis*	C	E	G5T2			1

Table A3 continued: Species Used for the Listed Species Hotspots Analysis of the RCG

Common Name	Scientific Name	FedRank	CaRank	GRank	CNPS	CDFG	List #
White Faced Ibis	*Plegadis chihi*	*	*	*	*	*	3
White-tailed Kite	*Elanus leucurus*	SC	-	G5			3
Willow Flycatcher	*Empidonax traillii*	-	E	G5			1
Xantus's Murrelet	*Synthliobramphus hypoleucus*	SC	-	G3G4		SC	3
Yellow Warbler	*Dendroica petechia brewsteri*	-	-	G5T3?		SC	3
Yellow-breasted Chat	*Icteria virens*	-	-	G5		SC	3
Mammals							
American Badger	*Taxidea taxus*	*	*	*	*	*	3
Giant Kangaroo Rat	*Dipodomys ingens*	E	E	G2			1
Pale Big-eared Bat	*Corynorhinus townsendii pallescens*	SC	-	G4T4		SC	3
Pallid Bat	*Antrozous pallidus*	-	-	G5		SC	3
Red Bat	*Lasiurus blossevillii*			G5S4		SC	3
Ringtail	*Bassariscus astutus*	*	*	*	*	*	3
San Diego Desert Woodrat	*Neotoma lepida intermedia*	-	-	G5T3?		SC	3
San Joaquin Antelope Squirrel	*Ammospermophilus nelsoni*	SC	T	G2			1
San Joaquin Kit Fox	*Vulpes macrotis mutica*	E	T	G4T2T3			1
San Joaquin Pocket Mouse	*Perognathus inornatus inornatus*	SC	-	G4T2T3			2
Southern Sea Otter	*Enhydra lutris nereis*	T	-	G4T2			1
Tulare Grasshopper Mouse	*Onychomys torridus tularensis*			G5T1T2		SC	3
Western Mastiff Bat	*Eumops perotis californicus*	SC	-	G5T4?		SC	3
Yuma Myotis	*Myotis yumanensis*			G5S4?		SC	3

Key: R,T, E= Rare, Threatened or Endangered; P = Proposed; C = Candidate; SC= Species of Concern; CNPS 1B= Rare in CA and Elsewhere, CNPS 2 = Rare in CA and not Elsewhere; G1: Critically Imperiled; G2: Imperiled; G3: Vulnerable G4: Apparently Secure G5: Secure GnTn: Subspecies receive a T-rank attached to the G-rank. With the subspecies, the G-rank reflects the condition of the entire species, whereas the T-rank reflects the global situation of just the subspecies; where n = 1,2,3,4,5 as described above. GH: All sites are historical; GX: All sites are extripated; this element is extinct in the wild. * = species added by ecological advisors, listing status not researched by press time.

It should be noted that the Ventura County Planning department has spent a year determining a similar list with much input from ecological advisors. That list, or slight additions if need be, is recommended if iteration 2.0 is performed.

4.2. Gather and Process Species Data

4.2.1. Process the California Natural Diversity Database (CNDDB)

There were 1,128 occurrences of a target list species in the Conception Coast Region (See Table A2 for more information about the CNDDB). These occurrences were then assigned to the RCG candidate sites.

4.2.2. Process the Local Databases

Four pre-existing local digital databases were collected and processed. They were the Bird Database developed by Conception Coast Project (CCP) and the Museum of Systematics and Ecology (MSE) at UCSB, the Vertebrates Database developed by CCP, the Vertebrates Database II developed by the Los Padres office of the U.S. Forest Service, and the Herpetile Database developed by the MSE (Table A2). Together, these databases combined for 2,750 occurrences of a target list species in the Conception Coast Region. Each dataset had a different temporal range, and it was assumed that all observations are still valid. All four databases did not exactly "crosswalk" (merge) with the CNDDB due to inconsistencies with common and scientific names. For instance, an observation of a savannah sparrow in a coastal salt marsh in the database is likely the endangered Belding's savannah sparrow subspecies, Passerculus sandwichensis beldingi, but was incompletely entered as the common upland species. John LaBonte of the MSE assisted in crosswalking the herpetile database, and John Gallo crosswalked the other three databases. For unclear occurrences that did not provide enough clues as to the proper subspecies, the original data were left as is and not crosswalked. Often this meant the data would not be used in the analysis because they denominated the subspecies that was not on the list.

4.2.3. Create and Process the Local Expert Listed Species Database

At a local expert workshop, our region was mapped out in 60 square feet (mostly at 1:50,000) and the known locations of the target species were mapped (2,750 records from the local databases, as well as 1,128 records from CNDDB). The experts then "filled in the gaps" by mapping known species occurrences not already mapped. 125 new records were mapped.

4.2.4. Map all datasets

See Figure 8 of Chapter 4 of the RCG: Listed Species Locations within the Conception Coast Region.

4.3. Determine the B1 (Listed Species Hotspots) Value for each Candidate Site

The site's hotspot value is a function of the following:

- *number of species of special concern at the site,*
- *the spatial accuracy of the observations of each species at the site,*
- *the degree of endemism (rarity) of each species based on the total area of known occurrence in the region,*
- *the condition weighted area of the site (i.e. the amount of human impact on the site),*
- *and the condition weighted area of all other sites where the species occurs (Davis, Stoms et al. 2003).*

Some of the specifics are as follows, and for more information and the mathematical representation, see Davis, Stoms et al. (2003). If a species is relatively common throughout the region, then the relative importance of an individual observation is less than for a species that is more rare. This relative rarity of a species is higher if most of the occurrences are in areas of high human impact, than if they were in areas with lower human impact. Once the relative rarity of the species is determined, then the importance of each observation can be determined. In this case, if an individual observation of a species is in a site with high human impact, the value of that observation to the site will be lower than the same species in a site with low human impact.

A challenge arose due to the convention of species databases known as "accuracy class." If the exact location of the observation is known, it has a higher accuracy class, and is mapped with a very tight circle. If the location of the observation is less exact, it has a lower accuracy, and is mapped with a large circle, up to 8 km in radius. The larger circle does NOT represent a larger population of the species, rather it indicates the species if found somewhere in the circle. To account for this in the analysis, the observation was multiplied by a weight that was inversely proportional to the size of the circle. The resulting weighted value could then be used in determining the B1 value of each candidate site. Thus, a low accuracy observation of a species will have a small value for 26 candidate sites, that when added up, will equal the value for high accuracy observation in one site. This way a low accuracy observation does not influence the model up to 26 times more than a high accuracy observation of the same species.

Due to the complexity of the analysis, the units of the final answer for B1 do not make intuitive sense. What is important is the relative scores among sites. These will be normalized between ecological objectives in the next step.

An alternative methodology that accounts for species density was explored, evaluated, and discarded. In the discarded approach, the sum of all the quality of occurrences of a species for each site was used instead of the best occurrence. However, some of the datasets were much more careful to not include duplicate sightings (sightings of the same individual or territory at different times) then others. Due to this discrepancy, only the best observation of a species within a site was the value used.

4.4. Normalize the Layer

Each of the following ecological objectives will also develop a value for each site, and then be synthesized at a later stage. However, they will be in different units. Further, if the layers were added together as is, then there would be a strong bias towards the layers that do not have a very large geographic distribution. This is because for these layers, each site that has a value has a large proportion of the value of the entire layer, and thus a very large value compared to the more ubiquitous layers like Habitat Representation. It was suggested by John Gallo, John Storrer, and Ralph Philbrick, and approved by the CCP Board that the relative impact of each objective at each site should be determined by the weights developed at an advisor workshop only, or as Ralph put it, true to the classical "McHargian" approach to combining GIS layers (McHarg 1971).

In summary, each objective needed to be normalized such that the following criteria were met:

1) The units across all criteria need to be comparable for examination of the relative importance of a specific criteria for a specific location,
2) When the objectives are added together using map algebra, the synthesized biodiversity value of a site is based on the relative values of the objectives for that site, and their relative weights,
3) Sites on the boundary of the study area are not the full size, but if they have a lot of value for that objective considering their small size, they should get a high score.

Thus, to normalize the site values for objective B1 the following variables were defined. The site value will be termed B1Value, and the sum of all the site values is SumB1. The acreage of the site is termed Site Acres, and the total number of acres of all the sites that have a non zero value for the objective are termed SumAcresB1. The value of the site was normalized according to the following equation.

$$\text{B1 Normalized Value at a Site} = \left(\frac{\text{SumAcresB1}}{\text{SiteAcres}}\right) \text{X} \left(\frac{\text{B1Value}}{\text{SumB1}}\right)$$

The site will get a normalization value of 1 if the value of the site relative to the total value of all the non-zero sites is equal to the area of the site relative to the total area of all the non-zero sites. One way to interpret this normalized value score is that any site will have a non-zero value if it has any known listed species observations, and of all such sites, the ones with a value of greater than 1 will have an above average listed species hotspot value. This normalized value scale will be the same for all of the other objectives in the RCG. The simple take home message is that the higher the score, the higher the importance. The B1 normalized value of a site is the B1 Listed Species Hotspots Biodiversity Value of the site.

4.5. Visualize Results

Advisors recommended that the final output did not use the blocky, 1.5 km pixels, but rather was a smoother graphical representation. It was felt that such a result would communicate the contiguity of ecological processes better as well as the inherent uncertainty of the results. The idea is to have no boundaries on the final maps. To do this, two analyses were performed and compared. One was chosen, and is as follows. The sites layer was converted to a 100 m grid, and a neighborhood mean was performed, using a radius of 10 cells. (In this analysis, all the cells in a 10 cell radius around a cell are averaged, and this average value is the value assigned to the cell. This is performed for every cell on the landscape.) The resulting output was a contoured landscape mapped using a “quantile” classification scheme and 6 classes. In this scheme, the range of values of each class is chosen mathematically such that the number of sites in each class is equal. Thus, some classes have a wide range of values, and others a small range. For a map of the final results, see Figure 9 of Chapter 4 of the RCG: Listed Species Hotspots Biodiversity Value within the Conception Coast Region (B1).

5. Objective B2: Estimate Habitat Representation Biodiversity Value

For an introduction to this objective and an overview of the methodology, please see Chapter 4 of the RCG.

5.1. Map the Habitats of the Region

Several data sources were evaluated, and the one chosen was the Multi-Source Land Cover Data (MLCD) (See Table A2 for more information). These data were clipped to the CCP Region. Of the 77 land cover types found statewide, 32 habitat types are found in our region, and are mapped. See Figure 3 of the RCG: Habitat Types and Distribution within the Conception Coast Region.

5.2. Determine the Relative Weight of Each Habitat Type

The relative weight of each habitat type is a function of the rarity of the habitat, the Ecoregional context, the estimate of historical habitat loss, and the inherent habitat value. Inherent habitat value was determined via local expert knowledge, and the other values were determined via GIS queries. These factors are further described below.

5.2.1. Rarity Index

The total number of acres of all habitats was divided by the number of habitats to get the number of acres of each habitat if they were all equally distributed. This number was then divided by the actual acreage of each habitat to get the raw rarity score. Thus, a raw score of greater than 1 indicates increasing degree of rarity. The list of scores was then standardized by dividing by the maximum score, thus the rarest habitat gets a score of 1 and the most common gets a score very close to 0 (See Table A4: Input Values and Output Habitat Weights for the Regional Conservation Guide). [Note that the total acreage of the habitats does not equal the total acreage of the region because urban and agricultural land cover types were not included in this analysis.]

5.2.2. Ecoregional Context

Habitats that are more common in our region, yet rare elsewhere in the contextual region (the central western and south western Jepson ecoregions of California), deserve a higher level of protection then pure rarity would indicate. The percentage of our region a particular habitat covered was divided by the percentage of the contextual region the habitat covered. Thus a habitat relatively common in our region, but not found that much outside of our region would get a score greater than 1. Again, the list of scores was then standardized by dividing by the maximum score, thus the habitat with the highest ecoregional ratio gets a score of 1 (Table A4).

One minor problem arose because the CCP region (watershed defined) includes a very small sliver of the central valley ecoregion. Alkali Desert Scrub is thus able to have more acreage in the CCP region than in the contextual region. To correct for this apparent paradox, the ratio was set at 4.55 instead of 21.9. 4.55 is the answer that would occur if all of a habitat was in the CCP region, within the contextual region. The precise way to correct for this minor error would be to redraw the contextual region to include the sliver of the central valley ecoregion.

5.2.3. Estimate of Historical Habitat Loss

If a certain habitat type has lost a lot of it's historical cover then it arguably deserves a higher level of protection than pure rarity would indicate. The primary data used for this were from a map developed by Kuchler (1977), which indicates the potential cover of each habitat. The assumption is that potential habitat coverage is similar to the historical habitat coverage. The 14 Kuchler categories were crosswalked with the 32 MLCD categories. The total acreage

Table A4: Input Values and Output Habitat Weights for the Regional Conservation Guide

Land Cover Type	Final Habitat Weight	Rarity: Total Acres In Region	Rarity: Rarity Index	Ecoregion Context: % of Region	Ecoregion Context: % of Eco-Region	Ecoregion Context: Eco-region Index	Habitat Loss: Kuchler Type: Scientific Name	Habitat Loss: Acres of Kuchler Type	Habitat Loss: Habitat Loss Index	Biodiv.: Bio-diversity Index
Alkali Desert Scrub	0.17	10,608	.0102	0.30	0.01	1.000	Artemisia-Eriogonum-Salvia/Abronia-Haplopappus	265,618	.015	0.01
Annual Grassland	0.11	457,292	.0002	12.74	16.92	.165	Stipa Spp.	137,455	.011	0.50
Barren	0.13	45,461	.0024	1.27	0.54	.517	No Crosswalk	45,461	.037	0.01
Blue Oak Woodland	0.26	72,271	.0015	2.01	3.80	.116	Pinus-Quercus / Pinus coulteri	344,130	.172	0.50
Blue Oak-Foothill Pine	0.31	1,601	.0679	0.04	2.46	.004	Pinus-Quercus / Pinus coulteri	344,130	.172	0.75
Chamise-Redshank Chaparral	0.19	119,207	.0009	3.32	6.01	.121	Adenostoma-Arctostaphylos-Ceanothus	1,467,984	.048	0.50
Closed-Cone Pine-Cypress	0.67	1,260	.0863	0.04	0.11	.071	Cupressus-Pinus	11,352	.332	0.75
Coastal Oak Woodland	0.26	259,451	.0004	7.23	6.06	.262	Quercus agrifolia	917,658	.130	1.00
Coastal Scrub	0.15	582,278	.0002	16.22	9.60	.371	Artemisia-Eriogonum-Salvia/Abronia-Haplopappus	265,618	.015	0.75
Desert Scrub	0.20	30,759	.0035	0.86	0.63	.299	Artemisia-Eriogonum-Salvia/Abronia-Haplopappus	265,618	.015	0.25
Desert Succulent Shrub	0.63	319	.3411	0.01	0.00	.433	Artemisia-Eriogonum-Salvia/Abronia-Haplopappus	265,618	.015	0.50
Desert Wash	0.48	1,740	.0625	0.05	0.04	.266	No Crosswalk	1,740	.037	0.50
Eucalyptus	0.17	1,105	.0984	0.03	0.04	.178	No Crosswalk	11	.0004	0.25
Freshwater Emergent Wetland	1.00	343	.3165	0.01	0.04	.050	No Crosswalk	6,860	.736	1.00
Jeffrey Pine	0.32	37,556	.0029	1.05	0.48	.479	Pinus jeffreyi	59,346	.058	0.50
Joshua Tree	0.40	190	.5714	0.01	0.01	.087	Salazaria-Tetradymia-Yucca	47	.009	0.25
Juniper	0.23	22,760	.0048	0.63	0.21	.661	Juniperus-Stipa	2,943	.005	0.50
Mixed Chaparral	0.16	995,552	.0001	27.73	17.36	.351	Adenostoma-Arctostaphylos-Ceanothus	1,467,984	.048	0.75
Montane Chaparral	0.33	14,930	.0073	0.42	0.36	.252	Adenostoma-Arctostaphylos-Ceanothus	1,467,984	.048	0.50
Montane Hardwood	0.26	55,300	.0020	1.54	1.78	.190	Arbutus-Quercus	185,283	.076	0.50
Montane Hardwood-Conifer	0.18	43,227	.0025	1.20	1.42	.186	Abies-Pinus	12,330	.007	0.75
Montane Riparian	0.45	30,166	.0036	0.84	0.23	.796	Arbutus-Quercus	185,283	.076	1.00
Pinyon-Juniper	0.10	179,622	.0006	5.00	1.80	.609	Juniperus-Pinus	3,576	.001	0.50
Ponderosa Pine	0.35	170	.6377	0.00	0.04	.026	Abies-Pinus	12,330	.007	0.50
Sagebrush	0.27	19,627	.0055	0.55	0.28	.435	Artemisia-Eriogonum-Salvia/Abronia-Haplopappus	265,618	.015	0.50
Saline Emergent Wetland	0.70	1,384	.0786	0.04	0.07	.118	Salicornia-Spartina	7,636	.203	1.00
Sierran Mixed Conifer	0.20	21,853	.0050	0.61	1.01	.133	Abies-Pinus	12,330	.007	0.75
Subalpine Conifer	0.31	116	.9362	0.00	0.07	.010	Abies-Pinus	12,330	.007	0.50
Unknown Conifer Type	0.21	109	1.00	0.00	0.45	.001	Abies-Pinus	12,330	.007	0.50
Unknown Shrub Type	0.21	6,056	.0180	0.17	1.17	.032	Artemisia-Eriogonum-Salvia/Abronia-Haplopappus	265,618	.015	0.50
Valley Foothill Riparian	0.42	3,887	.0280	0.11	0.34	.070	Arbutus-Quercus	185,283	.076	1.00
Valley Oak Woodland	0.69	6,575	.0165	0.18	0.38	.106	Quercus-Stipa	178,402	1.000	1.00
TOTAL		3,022,775						8,675,905		

of each Kuchler category was determined, and divided by the sum of the MLCD categories that crosswalked with the Kuchler category. Four of the MLCD categories did not crosswalk at all, so the ratios between potential and current were estimated as follows: Barren = 1, Desert Wash = 1, Eucalyptus = 0.01 (Eucalyptus is an exotic species), and Freshwater Emergent Wetland = 20 (California has lost about 95% of its coastal wetlands) (Table A4).

5.2.4. Estimate of Inherent Habitat Value

It was determined at an Ecological Advisor workshop that there is an inherent habitat value to various habitats that is not reflected by the above ratios. This was loosely defined as the relative importance to biodiversity of a particular habitat type. Namely, it is an estimate of how much life, i.e. ecological niches, it sustains. Each advisor was asked to shed their taxonomic biases and to rank each of the 32 habitats as high, medium, or low inherent habitat value. All the votes were then compiled and displayed and a consensus was attained. In this consensus, two new categories were allowed: medium-high or medium low. Subsequently, this was sent to other advisors that could not attend the workshop. Three more responses were tallied that had very similar findings. Dr. Philbrick and John Gallo then examined all of the votes, keeping in mind what participants had said at the workshop and the phone, and came to a final value. The five categories were then classed numerically as 0.01, 0.25, 0.5, 0.75, and 1 (0 cannot be used because a weighted product is used later)(Table A4).

5.2.5. Combine the Four Indices

It was determined that the above four indices should not be treated equally in determining the habitat weights. Dr. Philbrick and John Gallo came to a consensus that rarity and inherent habitat value were both much more important than ecoregional context and historical habitat loss. Thus, these two important indices were given a weight of 3, and the other two were given a weight of 1. The weights were multiplied by the index, and the resulting products were multiplied. (Multiplication was used so that ubiquitous habitats would get a proportionally lower weight. If a sum were used instead, the common habitat types such as chaparral would not be down weighted for prevalence, and end up with higher weights then less common but important habitats such as blue oak woodland.) The final product was then standardized by dividing by the maximum score, thus the highest weight gets a 1 and the lowest is close to 0.

Because three of the four indices have an exponential type distribution, with most of the values clustered around 0, the weighted product had an exponential type distribution with a max of 1, a mean of 0.05, and a standard deviation of 0.17. In essence this was giving a huge bias to the linear index of inherent habitat value which had a mean of 0.59. To compensate for this and to have a more linear set of weights to be used in the next step of the model, (but not to clump the values too close to 1), the above weighted product was then re-scaled by taking the fifth root of each result. (Taking a root of an exponential distribution rescales the distribution to be more linear). The fifth root was used because it appeared balance the conflicting issues best (exponential versus inverse exponential curves), and also because of the eight weighted units, five are exponential. This final result was the weight used for the B2 analysis (Table A4).

5.3. Determine the B2 (Habitat Representation) Value for each Candidate Site
Similar to B1, the habitat representation value of a site is a function of the following:

· *the habitat types at the site and their corresponding weights,*
· *and the condition weighted area (human impact) of the site.*

In essence, the methodology is as follows. The Habitat Representation Biodiversity Value of a particular habitat in a site is the Condition Weighted Area of that habitat in the site multiplied by the habitat weight. The Habitat Representation Biodiversity Value for a site is then simply the sum of the Habitat Representation Biodiversity Values of all the habitats in that site.

The final units are such that if an acre of land had the habitat with a weight of 1, and no human impact, then that acre would have a score of 1. Therefore, for a full 1.5 km square (555 acre) site, the best possible score would be 555. If the human impact value is greater than 0, or a habitat is present with a weight less than 1, then the site score would be less than 555. What is most important, however is the relative scores among sites. To get these relative scores in a scale that is most useful the site values were normalized, as per the procedure defined in objective B1, to create the Habitat Representation Biodiversity Value.

[Technical Note: The actual process for determining the above was more complicated, as we used the "marginal value" equations of Davis, Stoms et al. (2003) that are overviewed in Objective C2. Because threat is not an issue, the results are nearly identical to if the simple approach outlined above were actually used. Thus, we will wait to the later section to explain the marginal value approach itself. Also, because that approach was used, we could not combine the different components at the habitat level as described above, but instead had to do it at the site level. A Condition Weighted Area value for the site was attained, and a similar habitat weighted area was also attained. But the original results of a raw average had an extremely high correlation with the human impact 2000 map. This is because the sum of the distribution of values across the landscape of Condition Weighted Area is 3.005 times higher than the sum of the distribution of values of habitat weighted area. To compensate for this and to make the two factors equal impact on the final results, habitat weighted area was given a weight of 3.005, before being averaged with human impact value.]

5.4. Visualize Results
The normalized site values were then smoothed as per the methodology described for B1. For a map of results, see Figure 10 of Chapter 4 of the RCG: Habitat Representation Biodiversity Value within the Conception Coast Region (B2).

6. Objective B4: Estimate Wild Lands Biodiversity Value
For an introduction to this objective and an overview of the methodology, please see Chapter 4 of the RCG.

6.1. Identify Wild Lands
To determine the locations of wild lands, the Human Impact Layer was "smoothed" using a neighborhood analysis of 500 meter search radius. (All the cells within 500 m of a cell were averaged, and this average value becomes the

new value of the cell). This smoothed surface was then queried to identify areas that have a contiguous area with a human impact value greater than 0.8 and that are greater than 30 square kilometers.

The process for choosing the above size and human impact thresholds was as follows. Because it is a large carnivore, and because it is used in the connectivity (B6) analysis, the mountain lion was chosen as a focal species for parameterizing the size of wild lands. In southern California, the average home range for females was about 93 square km, while in central California it was about 60 square km (Dickson 2001). However, when the mean of these values was used, the output showed mountain lions territories only in the central wilderness area of the region, contrary to local knowledge and data. (A database of known sightings has been initiated by Conception Coast Project, see www.conceptioncoast.org for more information and to add observations).

The discrepancy between the initial modeling approach and the observations database is because lions do not need all of their home range to be contiguous high quality habitat, just a portion of it. Thus, a data driven methodology for setting the parameters was employed. It is known that there is a breeding territory on South Vandenberg Air Force Base (VAFB) and in the Santa Monica Mountains. Both of these areas had slightly more than 30 square km of contiguous, smoothed, 0.8 human impact value. Thus, these were chosen as the threshold parameters. There is a much more rigorous approach to defining core patches that could be employed at a later date. It should also be noted that mountain lion habitat suitability was not used in defining wild lands. Thus, contiguous areas that have very low human impact and meet the above threshold parameters, but with habitat that is not suitable habitat for mountain lions, are still identified as Wild Lands. See Figure 11 of Chapter 4 of the RCG: Locations of Large Wild Lands within the Conception Coast Region.

6.2. Assign Wild Lands Value to Each Site

The Wild Lands value for a site is simply the condition weighted area of the cells in that site that are part of a Wild Land polygon. A full sized site in the lowest human impact land that is completely within a Wild Land had a value of 555 (the number of acres per full sized site). [Note that because threat is not considered in this run there is no extra importance given to small wild lands versus large wild lands as originally intended by Davis, Stoms, et al. (2003).] The Wild Lands site values were then normalized as per the procedure describe in objective B1.

6.3. Visualize Results

The site values were then smoothed as per the methodology described for B1. See Figure 12 of Chapter 4 of the RCG: Wild Lands Biodiversity Value within the Conception Coast Region (B4).

7. Objective B6: Estimate Landscape Connectivity Biodiversity Value

For an introduction to this objective and an overview of the “gated least cost path methodology”, please see Chapter 4 of the RCG.

7.1. Methodological Assumptions

· It is assumed that it is important to maintain the connectivity between all pairs of wild lands, not just the ones that have high

quality linkages already in place. This is based on the principle that all populations of mountain lion need to be connected to other populations. However, it is also important to give a higher value to these higher quality linkages as a matter of pragmatism.

· If two linkages are equal in all respects except for the distance they span between core wild lands, then they will be valued as equals (i.e. standardize by distance).

· To account for the "stepping stone effect," it is assumed that all cells along a linkage are not considered equal value. The connectivity value of a cell is a function of the habitat suitability and human impact value of that cell, as well as the quality of the overall linkage that the cell lies in.

· "Landscape Connectivity" addresses coarse scale connectivity for large, wide ranging species; not the equally important fine scale connectivity for smaller species.

7.2. Identify Core and "Destination" Zones

The first step in the connectivity analysis is to identify the pieces of land that will be connected. To be consistent with the rest of the RCG, these lands will be the Wild Lands identified in objective B4. Due to the time consuming nature of analyzing pairs of wild lands, the large wild lands in the center of the region that are nearly touching were combined together into one wild land. All the other wild lands are considered "destination" wild lands. These are often called cores and sinks, but because a metapopulation analysis has not been performed, it is not known if the smaller, peripheral zones are indeed classic sinks, thus the term "destination" is used.

7.3. Create Movement "Cost" Surface

In this analysis, movement cost is a function of mountain lion habitat suitability, human impact value in general, roadedness specifically, and a constant.

7.3.1. Mountain Lion Habitat Suitability

The California Wildlife Habitat Relationships (CWHR) model was used in conjunction with the Multi-Source Land Cover Data (See Table A2). This model predicts the suitability of a habitat for mountain lions, based on expert knowledge and literature review. Of the three categories of habitat suitability (cover, feeding, and reproduction), cover was the factor used because the model is looking at mountain lion dispersal. See Figure 13: Habitat Quality for Mountain Lion Dispersal.

7.3.2. Human Impact Value

The human impact value layer developed earlier was used.

7.3.3. A Specific Consideration of Roadedness

The roadedness layer that went into the human impact layer was used on its own as well. This is because roads are the primary source of death to mountain lions in southern California (Beier 1995; Beier, Choate et al. 1995).

7.3.4. Relative Distance of a Particular Route

After initial runs of the model it was realized that even ideal habitat has a small cost for movement. Otherwise lions would be able to move an infinite amount of distance through ideal habitat. Thus, a mathematical constant was added to the movement cost equation. This constant simulates the energetic cost of movement, and that dispersal through perfect habitat also has a cost because it is likely through a hostile male's territory. Several values were evaluated (0.03, 0.05, 0.07, 0.1,and 0.15), and the one (0.05) that balanced the benefits and detriments of using such a factor was used.

The other three factors were combined with even weight for a contiguous 90 m cell resolution "movement cost" layer:

$$\frac{[1-(\text{Habitat Suitability})] + (\text{Human Impact Value}) + (\text{Roadedness Value})}{3} + .05$$

7.4. Enhance Movement Cost Layer for Analysis

The conventional gated least cost path analysis has a flaw that allows cells not in a linkage, but close to a core zone to get a high score. To account for this flaw, the movement cost surface and core and destination zones needed to be modified. The two outer, boundary cells of each core and destination zone was given a very high value. The new core zone was then drawn inside this buffer, or "moat" of cost. This way, every gated least cost path enters each zone just once rather than multiple times, which caused the flaw.

7.5. Perform Gated Least Cost Path Analysis

For each core/destination wild land pair the following analysis was performed. (It was also performed between two "destination" wild lands: the Santa Monica Mountains and the San Gabriel Mountains.) The enhanced movement cost layer was used to create a cost distance surface to each wild land. The pair of cost distance surfaces were then used for the "corridor" analysis using ESRI ArcGIS 9.0 software. The cost of traveling through the "moats" was then subtracted. Next the layer was divided by the Euclidian distance between the two wild lands so that the analysis did not bias against linkages that had to span a large distance.

At this point the layer had a linkage value for every cell on the landscape, even the cells in the middle of cities. In order to highlight the feasible wildlife linkages, a new layer was created that selected just the good (low) values. After evaluating several threshold values and comparing them to knowledge of the landscape, all values 1.04 times the minimum value were selected. (In this analysis, lower cost is a better linkage). This selected about a quarter to a half of the landscape, depending on the pair of wild lands analyzed. This layer for each wild land pair was called a paired raw linkage layer. All of the paired raw linkage layers were combined, and where values from two linkages overlapped, the minimum value was chosen. The combined raw linkage layer had a wide variance in values between linkages, and a narrow variance within a linkage. For instance, one linkage had values ranging from 606-630 cost units, while another had values ranging from 100-104.

To address this variance, the paired raw linkage layers were also classified into 5 categories of equal classes (high, medium-high, medium, medium-low, and low linkage value) to create the paired relative linkage value layers. The paired relative linkage layers were combined in a similar fashion to create the relative linkage value.

It was decided that rather than use one or the other technique, a combination would be used, with a higher emphasis on the relative linkage layer (see Theoretical Overview and Assumptions for justification). There are many mathematical approaches to combining these, but because the variance of the raw linkage layer needed to be decreased, the square root was used, along with multiplication.

$$\text{Corridor Layer} = \text{relative corridor value} \times \sqrt{\text{raw corridor value}}$$

It was noticed after the analysis that seven important but short linkages had not been mapped because the corresponding pair of wild lands had been grouped together as the central core zone or had not been analyzed. These short linkages were digitized by hand using the movement cost layer as a guide. These are classified as "estimated linkages" and given a value of the mean plus one standard deviation of the linkage layer and added to that layer. Finally, the linkage layer was inverted and standardized, such that the best linkage value is 1 and the worst is 0. See Figure 14 of Chapter 4 of the RCG: Large Wildlife Linkages within the Conception Coast Region.

7.6. Combine results with Habitat Suitability and Human Impact Layers

The "connectivity value" of a cell is a function of the linkage value as well as the habitat quality value of the cell and the human impact score of that cell (See Theoretical Overview and Assumptions). A variety of different weighted combinations were evaluated, and the one chosen had a good balance between maintaining the integrity of linkages, but also allowing for the site specific importance to be accounted for, with a slight bias toward habitat suitability as opposed to human impact:

$$\text{Connectivity Layer} = \frac{[6 \times \text{Corridor Layer} + 3 \times \text{Habitat Suitability} + (1 - 2 \times \text{Human Impact})]}{11}$$

score, the highest possible habitat suitability score, and the lowest possible human impact score, then it will receive a value of 1. All other cells will receive scores less than 1.

7.7. Assign Connectivity Value to each Site and Visualize Results

The raw connectivity site value is the sum of the values of all the connectivity layer cells in the site, multiplied by the number of acres of each cell. Thus, the maximum score for a site is equal to the number of acres of the site, which for the full sized sites is 555. The final connectivity site value is determined by the normalization procedure as described in B1. The site values were then smoothed as per the methodology described for B1 to get the final Connectivity Biodiversity Value. See Figure 15 of Chapter 4 of the RCG: Landscape Connectivity Biodiversity Value within the Conception Coast Region (B4).

8. Synthesis Part 1: Overall Biodiversity Value

For an introduction to this objective and an overview of the methodology, please see Chapter 4 of the RCG.

8.1. Weight each layer

The relative weight of the four objectives were determined at an ecological advisor workshop, and are as follows: Listed Species Hotspots: 15, Habitat Representation: 20, Wild Lands and Connectivity: 10. These weights were rescaled so they added up to 1 and called Weight1, Weight2, etc.

8.2. Combine the Layers

The formula for determining the ecological value of a site is as follows:

Biodiversity Value of a Site = Weight1 X B1 Relative Value + Weight2 X B2 Relative Value + Weight4 X B4 Relative Value + Weight6 X B6 Relative Value

Thus, a site with a value greater than 1 could be "above average" for all the non-zero sites of each objective, or way above average for one objective and slightly below average for another, and so on. It is important to recognize that several of the objectives have many sites that are zero, therefore a site that can muster a value of 1 despite this handicap is very important ecologically.

8.3. Visualize Results

The site values were smoothed as per the methodology described for B1 to get the final Biodiversity Value. See Figure 16 of Chapter 4 of the RCG: Estimated Biodiversity Value within the Conception Coast Region.

Part 2: Map "Conservation Value" (Includes Threat)

For an overview description of this analysis see Chapter 4 of the RCG, for an overview diagram, see Figure 5, on the following page.

9. Projected Human Impact For The Year 2050

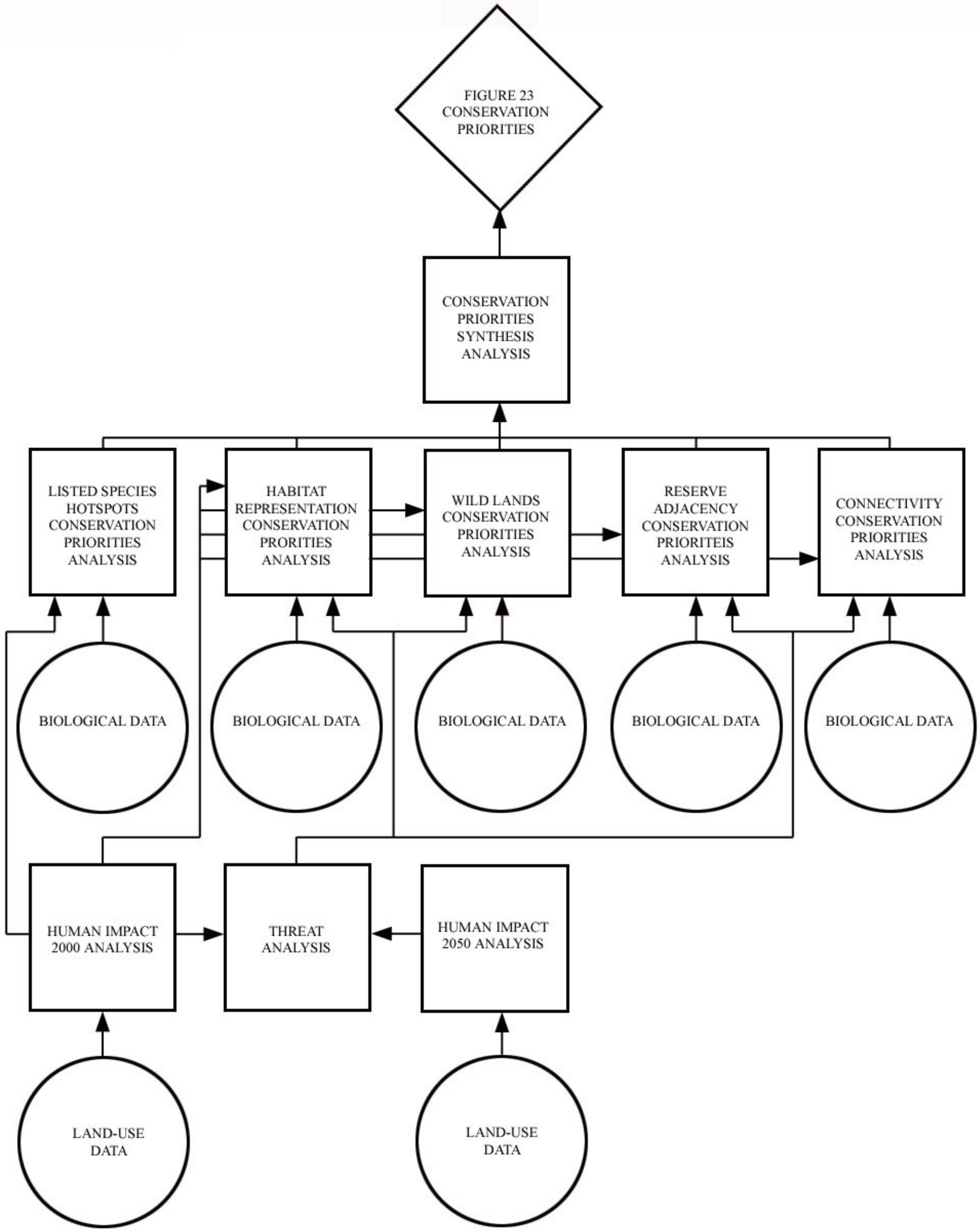
For an introduction to this objective and an overview of the methodology, please see Chapter 4 of the RCG.

9.1. Map and Classify Predicted Urban Outgrowth

The California Urban and Biodiversity Assessment (CURBA) model was used to predict urban outgrowth in the region. CURBA is a "trend" model that seeks to predict future growth patterns based on indicators of past growth patterns. It does not predict growth based on current zoning or general plans (Landis, Cogan et al. 1998 ; Fulton, Wilson et al. 2003). The model compares observed changes in urbanized land during a specific time period with a variety of spatial and non-spatial factors, such as site variables (land cover, political status, slope, etc.) and neighborhood characteristics (distance to nearest major highway, percentage of neighboring cells that are urbanized, etc.). It then uses these changes to predict where on the landscape the projected growth in human population will occur.

The model run used in the RCG was performed by the model creator, Dr. John Landis, for the entire state of California (but calibrated by region) (Landis and Reilly 2004), and then clipped to the Conception Coast Region. Despite the statewide scope, the resolution was quite high, with analysis performed using a one hectare grid. The calibration model evaluated actual growth for each region from 1988 to 1998 using a stepwise logit regression model with regards to the following variables: distance to freeway(km – squared), regional job accessibility as of 1990, ratio of 1990 city-to-region median household income, FMMP- designated prime farmland, FEMA floodzone, floodzone in next cell, flood zone 2 to 3 cells away, site slope, average slope of next cell, average slope of cells 2 sites away, and within or outside of incorporated city. In this way the probability of development for non-developed sites was determined. This probability is then combined with several factors: a forecasting scenario for the year 2020 for population growth by county, estimates of development densities by areas, and estimates of

Figure 5: Diagram of the Conservation Priorities Analysis



infill development versus development of open space. All of the above factors are then estimated again for the period between 2020 and 2050, and an output is derived for 2050 that shows which open space hectares are predicted to be developed. This is the output used for the RCG. (A similar output was created and is available for the year 2100.)

For a variety of pragmatic and logistical reasons, the following assumptions were employed in the model run:

- · *The same factors that shaped land development patterns in the recent past will continue to do so in the future, and in the same ways.*
- · *Jobs will continue decentralizing from California's four major urban regions—Southern California, the greater San Francisco Bay Area, the Sacramento region, and the southern San Joaquin Valley.*
- · *California's population will continue to grow, and at more or less the same rate and in the same spatial pattern as projected by the California Department of Finance (Department of Finance 2004).*
- · *Average infill rates and population densities will increase with additional development.*
- · *No new freeways or intra- and inter-regional rapid transit systems will be predicted and modeled. Freeway road travel speeds will remain at current levels.*

For a map of the Urban Outgrowth Model Results, please see Figure 17 of Chapter 4 of the RCG: Comparison of Current and Predicted Urban Extent within the Conception Coast Region.

9.2. Map and Classify Predicted Rural and Suburban Growth

To model the rural and suburban growth in the CCP region, we used the Western Futures Growth Model (WFGM) developed by David Theobald of the natural Resource Ecology Lab at Colorado State University (Theobald 2001; Theobald).

The technical notes of the actual model run used were provided by Professor Theobald along with the data, and are as follows:

> *"The purpose of the Western Futures Growth Model (WFGM) is to develop broad-scale housing density maps to examine the baseline patterns of exurban and rural development in the western US. The maps are based on 2000 US Census Bureau block-group and block level geography. Housing density was computed by using the centers of block polygons and calculating the average density within a 1,000 acre window (~1135 m radius), using 200 m resolution. The centers were computed from blocks that had the undeveloped portions removed (mostly public but also includes water bodies). Current (2000) patterns of housing density were based directly on the block-level estimates of housing units. Historical patterns (decades prior to 2000) of housing density were based on block-group level estimates of the number of houses, which were then spread to blocks based on the 2000 distribution. Density was computed for the entire western 11 states simultaneously to remove boundary effects that would have been introduced in a state-by-state analysis.*
>
> *Density patterns for forecast (2010-2040) were based on county-level population pro-*

jections by state demographers. The main assumptions of the model are as follows:
1. new growth within a county is most likely to occur in locations where it has grown in the past decade (time step).

2. growth is computed as the average growth in each of 4 density classes (urban, suburban, exurban, and rural), and these are computed locally with each 1135 m radius. These local growth estimates are then spread throughout the entire surface so that future growth is not constrained to occur where it had previously. There are two main advantages of this approach. First, growth rates occur in a similar way as they have in the past. Second, growth rates are parameterized locally, not within some artificial analytical unit (e.g., state or county). This allows different valleys or regions within a county to grow individually.

3. The number of housing units is forced to meet the demands of the new population within a county. That is, the number of new units in a county is proportional to the number of additional people in a decade. The model adjusts the overall numbers of housing units to be constrained to the ratio of new housing units to old housing units (e.g., for 2010: ((Pop2010 – Pop2000) / (Pop2000 – Pop1990))).

4. The distribution of new growth is also adjusted according to accessibility to the nearest urban core. That is, urbanization and conversion to urban and exurban land use typically occurs in locations that are nearer urban core areas, but that are on the fringe where land is undeveloped. Accessibility is computed in terms of minutes of travel time from urban core areas (here defined as >= 1.5 housing units per acre), as one would travel along the transportation network (major roads and highways [2]) – not simply the Euclidean distance.

5. Housing density will not decline over time (therefore areas undergoing urban decay are not modeled well).

The units of the data are # housing units per acre, divided by 1000 (to make an integer grid), thus "25" = 40 acres per unit; and "625" = 1.7 acres per unit."

For a map of the Rural and Suburban growth Model Results, please see Figure 18 of Chapter 4 of the RCG: Comparison of Current and Predicted Housing Density within the Conception Coast Region

9.3. Map and Classify Predicted Agricultural Expansion

All of the obvious areas that agriculture could not expand to were mapped, and everything else was considered potential agricultural expansion by the year 2050. The areas not available were already urban lands, reserves, conservation easements, current industrial lands, roads, water, creeks, and areas with too steep of a slope. The urban lands, reserves, conservation easements, roads, and oil development were selected from the layers developed for Human Impact 2000. Creeks and reservoirs were selected from the Water Bodies and Water Courses databases (See Table A2). To determine what "too steep of a slope" was, all of the agricultural lands from the agricultural layer used for Human Impacts 2000 were selected and overlaid on a slope map, and the maximum slope for each agricultural polygon was determined. The slope map was derived from a Digital Elevation Model (see Table A2). The mean, maximum slope of all agricultural operations was 44.7 degrees, with a standard deviation of 16. The extreme outlier was 73.57 degrees, which is likely an anomaly of the data overlay procedure. Rather than using the max value as a threshold of developable agricultural land as originally planned, we used the mean maximum, plus the standard deviation, or 60.7 degrees. Although not the maximum value of 73.57, this is still a very inclusive value. It is recommended that if iteration 1.1 or 2.0 is performed, then this threshold is determined by local expert knowledge. Also, in this analysis, areas that are in national forests were not considered as potential agricultural lands.

9.4. Map and Classify Predicted Industrial Expansion

We modeled the expansion which will most likely occur in the national forest if society continues its current paradigm of oil consumption. The draft EIS for oil and gas leasing of the national forest overviews several alternative oil extraction scenarios (USDA Forest Service 2001). Through some informal discussions with Forest Service employees, Alternative 5 was considered as a low probability of occurring, and the smaller geographic area alternative, 5a, is considered a higher probability. After discussion at an advisory workshop, all lands of Alternative 5a are given a human impact value of 0.84, and those of Alternative 5 a score of 0.25.

9.5. Overlay the above layers

All of the above layers were classified according to the Human Impact Index Table A1, unless otherwise noted. They were then overlaid on top of each other, and where two different layers overlapped, the one with the higher impact prevailed. A dual map was created that shows the Human Impact Layer 2000 and the Human Impact layer 2050 side by side. Each legend is classified using an equal interval scale, and the same color ramp is used. See Figure 19 of Chapter 4 of the RCG: Comparison of Current and Predicted Human Impact within the Conception Coast Region. The resulting layer can is transformed into the Condition Weighted Area for 2050 for later analyses, as per the earlier methodology.

10. Map The Human Impact "Threat"

To better prioritize which cells to conserve, we considered which ones were under the highest degree of "threat." Threat is in quotation marks, because there are several concepts of threat. The concept used here is the magnitude of change to the particular cell that is predicted between now and a half century from now. In RCG Version 1.0 we do not look at the probability that this change will occur for most of the land-use change types (industrial expansion is the only type that incorporates probability, and that is very coarse). In all other cases the land is either predicted to change to a certain state, or to stay the same. Threat is quantified by subtracting the Human Impact Value of a cell in 2000 from the predicted value in 2050.

To illustrate the issue, a couple examples are provided. If a cell is "ExUrban20" in 2000 (rural housing between 20-40 acres per unit), then it has a Human Impact Value of 0.26. If that cell is predicted to convert to "Low Density Urban" (1.5-5 acres per unit), then it will have a value of 0.9 in 2050. The threat score is thus 0.9 minus 0.26, or 0.64. The higher the threat score value, the higher the magnitude of the threat. If there is a Low Density Urban cell that is predicted to convert to High Density Urban, then the threat value is only 0.1, even though the probability is very high and the resulting human impact is very high. The magnitude of ecological change, however, is pretty minimal, thus the low threat score.

The layer that results from this difference between Human Impact 2000 and Human Impact 2050, i.e. predicted change in human impact, is called the threat layer for the rest of the document. A map of the threat layer was created. See Figure 20 of Chapter 4 of the RCG: Predicted Change in Human Impact within the Conception Coast Region (i.e. “Threat”).

11. Objective C1: Listed Species Hotspots Conservation Value

As per Davis, Stoms et al. (2003), listed species are by definition threatened. It is reasoned that conservation of habitat that contains listed species is important regardless of if that habitat is threatened or not. However, the ecological condition of the different sites of a listed species is an important factor to consider. As a result of these two assumptions, the results of Objective B1 will be used for Objective C1 when synthesis of the conservation values occurs.

12. Objective C2: Habitat Representation Conservation Value

12.1. Determine Habitat Representation with Threat Value

The site’s habitat representation conservation value is a function of the following:

- *the habitat types at the site and their corresponding weights,*
- *the condition weighted area (human impact values) of land in the site,*
- *and the condition weighted area of all other sites where the habitat occurs*
- *projected condition weighted area of the habitat in the site in 2050 if no conservation occurs*
- *and the condition weighted area of the habitat in the region in 2050 if no conservation occurs. (Davis, Stoms et al. 2003).*

A characteristic of the Legacy model is that it allows ranking of sites by their marginal conservation value (or additional conservation contribution) which acknowledges the reality that implementation of conservation plans happens on an opportunistic basis. In contrast to the typical threshold approach (such as SITES) that requires a difficult determination of the minimum amount of habitat type that is “enough” for long term protection. The threshold approach also makes no distinction between the conservation value of the first acre conserved for a habitat versus the 1,000th if the targeted goal has not been met. In other words, the Legacy framework maximizes the amount of overall biodiversity protection that can occur with a given budget. The RCG model was originally developed to perform this site selection procedure, but then it was determined that such an analysis is problematic and too complicated for the audience, and it was not performed. However, the framework for the approach had already been built, so it was used to determine the habitat representation biodiversity value needed for Part 2. This value could be determined in a much more straightforward approach if it is known in advance that site selection is not going to be performed.

An illustration of this distinction between marginal value and the threshold approach is provided on the following page as Figure A-1.

In this iteration of the RCG, "G" or long term conservation trajectory goal (Figure A-1) is 100% of the total Condition Weighted Area in 2000 (CWA 2000) of the habitat. (It is not a goal in the traditional sense of the word in that it is not truly expected to be achieved; it is the direction we want to head.) For this iteration of the RCG, "A" is assumed to be 0 for every habitat. In other words, the first acre conserved is more important than the second acre conserved, and so on. The total CWA 2050 for a habitat will be the "X" of Figure A-1.

Once A, G and X had been determined for every habitat, the habitat representation value of a site was determined. For each habitat type in the site, the threat layer is overlaid and summed. This sum is little "x" of Figure A-1. In other words, it is the amount of CWA of the habitat the would be conserved if the site were conserved. The representation value for that habitat in that site is thus the area under the blue marginal value line and between X and X + x. The total area is much smaller for the habitats in which X is close to G, or when x is very small. This procedure is done for every habitat in the site, and the results are added together to get the "Habitat Representation Threat Value" for that site. It is possible to query the database to see where big X is on the curve for each habitat (in a percentage, relative to G), and thereby get an indication of the degree of threat facing each habitat type in the region.

Habitat weights were then incorporated into the analysis. The final "Habitat Representation Value" of a site is the standardized* average between the Habitat Representation Threat Value for the site and the Habitat Representation Biodiversity Value for the site, determined in objective B2. There are two reasons for incorporating habitat weights. First, so that the results can be consistent and comparable to B2. Secondly, without habitat weights, rarity is not really addressed by the Legacy model when it is only used to identify initial marginal value. [*Technical detail: To be consistent with the methodology for B2, a small adjustment was made. The sum of all the weighted habitat values for the region is 342150; the sum for the representation values for the region is 309012 or 0.90314 times. Thus, all of the weighted habitat values were multiplied by 0.90314 before being averaged with the representation values. It is recommended that this adjustment is not performed if iteration 2 occurs.]

The final units are similar to B2. A full 1.5 km square site would receive the maximum value of 555 if it is all threatened to go from pristine to urban, and is comprised solely of the most threatened habitat type, with the highest weight. All other sites would receive a lower score. What is most important, however, is the relative scores among sites. These were normalized for analysis between ecological objectives as described in objective B1.

12.2. Visualize Results

The site values were smoothed, as per the methodology described for B1, to get the final habitat representation conservation values. See Figure 21 of the RCG: Habitat Representation Conservation Value within the Conception Coast Region (C2).

Figure A-1: Utility Function Curves

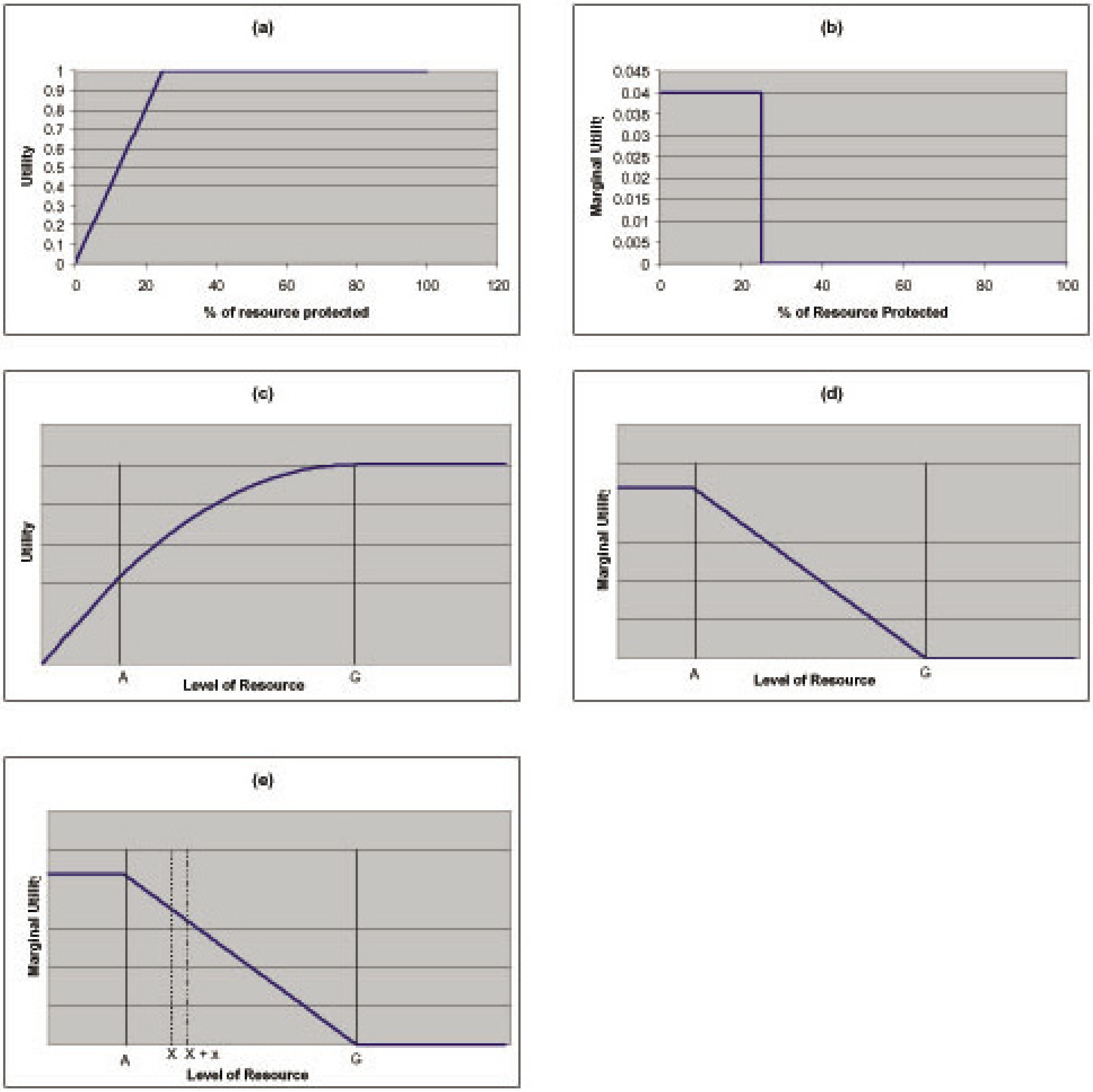


Figure A-1. Utility functions and associated marginal utility functions for estimating site conservation value: (a) a utility function for target-based conservation where utility accumulates linearly until the specified conservation target (in this case 25% of current resource amount) is reached and then remains constant; (b) marginal utility function associated with (a); (c) the utility function used here for evaluating terrestrial biodiversity in the Sierra bioregion; (d) the marginal utility function associated with (c); (e) Change in marginal value associated with a conservation action today that increases the predicted future level of the resource from X to X+x. The total benefit of the conservation action is calculated as the area under the marginal value curve. Figure courtesy of David Stoms.

13. Objective C3: Biophysical Representation Conservation Value

[This objective was not addressed within the final results of the Conservation Priorities Model. However, the preliminary data gathering and analysis results are useful for potential future refinements to the Regional Conservation Guide, and are described below.

Concern for maintaining species and natural communities should be accompanied by an effort to maintain the ecological and evolutionary processes that will allow them to persist and evolve over the long term. Fundamental processes critical to ecosystem function include cycling of nutrients and flow of energy, disturbance regimes and recovery processes (succession), hydrological cycles, weathering and erosion, decomposition, pollination and seed dispersal. Evolutionary processes, such as mutation, gene flow, and differentiation of populations, must be maintained if the biota is to adapt to changing conditions.

Long-term change (decades to millennia) occurs largely as a result of climate change. Plant and animal response to climate change over time has been to migrate with shifting climate areas. Interestingly, plants and animals have migrated to suit their own individualistic needs (Davis 1981, Graham 1986).

A useful way to incorporate the needs of evolutionary processes into conservation planning is to represent the different ecosystem types of the region in reserves. One of the best ways to represent all ecosystems is to maintain the full array of physical habitats and environmental gradients in reserves, from the highest to the lowest elevations, the driest to the wettest areas, and across all types of soils, substrates and topoclimates (Hunter et al. 1988, Noss 1991a). Unfortunately, there is a lack of digital biophysical data for the Conception Coast Region. There are no soils map or geology map available as GIS layers. Therefore, an analysis was performed using the "Ecological Subregions of California: Section and Subsection Descriptions" developed by the United States Forest Service (Miles and Goudey 1998), were used (See Table 2).

However, it was found that these subsections do not map the actual biophysical properties, and because some slivers of subsections occur in our region, the analysis lead to spurious results, and was not used in the synthesis. The methods for the analysis are provided below, as is a sample of the biophysical description. The resource itself can be very useful for regional conservation planning.

13.1. Gather and Process Data

There is a lack of digital biophysical data for the Conception Coast Region. It was thereby not possible to perform a fine scale biophysical representation analysis similar to C2. Rather, the "Ecological Subregions of California: Section and Subsection Descriptions" developed by the United States Forest Service (Miles and Goudey 1998), were used. The subsections were clipped to the Conception Coast Region. Four subsections had very small slivers that overlapped with the study region. These slivers were joined to the most similar subsection that was well represented in the region.

13.2. Determine Biophysical Representation Conservation Value

The site's biophysical representation conservation value is a function of the following:

· the subsection type most common at the site,
· the condition weighted area of the site,
· the condition weighted area of all the sites for that subsection,
· projected condition weighted area in 2040 if no conservation occurs,
· and the total condition weighted area for the sites of that subsection in 2040 if no conservation occurs. (Davis, Stoms et al. 2003).

Each site was assigned a subsection type. For sites that had more than one subsection overlap with them, the most common subsection in the site was assigned. This objective also uses the marginal value framework of objective C2 (Figure A-1). The final result was problematic, however. One medium size sliver (about 50 sites) had been left as its own subsection rather than joined with another subsection. The threat in this area is consistent and moderately high—land predicted to move from agriculture to urban. As a result of these circumstances, this objective was very strongly skewed towards protecting this sliver at the expense of the region. It was determined that this sliver should have been joined with another subsection before the analysis was performed. The current result was deemed to far removed from the theory driving the objective, and was not included in the synthesis of the objectives. For an example description to indicate the resource, the Caliente Range – Cuyama Valley sub regional description is pasted below.

Subsection M262Aj
Caliente Range - Cuyama Valley

This subsection comprises the mountains of the Caliente Range and hills and an alluvial plain along the Cuyama River. It is between the Carrizo Plain and the Sierra Madre Mountains. The climate is hot and subhumid to arid. MLRAs 15f, 15g, 17f, and 17g.

Lithology and Stratigraphy.

This subsection is dominated by clastic sedimentary rocks and weakly consolidated deposits. There are large proportions of upper Cretaceous sedimentary rocks, Miocene marine sediments, Pliocene and Pleistocene nonmarine sediments, and Quaternary alluvium.

Geomorphology

This subsection contains steep mountains with narrow canyons in the Caliente Range and low hills, alluvial fans, pediments, and terraces along the Cuyama River. The mountains are oriented from northwest to southeast, curving around toward the east-southeast at the southeastern end where the mountains of this subsection bend around on the southwest side of a curve in the San Andreas fault. The Cuyama River runs lengthwise through the subsection, along the southwest side of the Caliente Range. The alluvial plain of the Cuyama River is broad in the southeastern part of the subsection, where it is about 5 or 6 miles across, with a fault on the north-northeast side and Tertiary sediments and dissected Quaternary alluvial fans on the south-southwest side of the valley. The elevation range is from just under 2000 feet up to about 5000 feet. It is about 2000 to 2600 feet in Cuyama Valley. Mass wasting and fluvial erosion are the main geomorphic processes.

Soils

On upper Cretaceous sedimentary rocks, the soils are mostly rocky Lithic Xerorthents and Mollic Haploxeralfs. On Miocene marine *sediments, associated with badlands, the soils are mostly shallow Typic Xerorthents, Pachic Haploxerolls, and Mollic Haploxeralfs. On Pliocene and Pleistocene nonmarine sediments, the soils are mostly shallow Xeric Torriorthents, Typic Xerorthents, and Typic Haploxeralfs. On Quaternary alluvial fans, the soils are mostly Xerorthents, Typic and Mollic Haploxeralfs, and Pachic Argixerolls. On recent alluvium, they are Typic Xerofluvents and Xerorthents and Typic Salorthids. The soils are well drained, but the Salorthids are exceptions. Calcium carbonates accumulate in the subsoils, and more soluble salts accumulate in some soils in Quaternary alluvium. Soil temperature regimes are mostly thermic, with some mesic on north-facing slopes at higher elevations. Soil moisture regimes are mostly xeric, but aridic in much of the Cuyama Valley.*

Vegetation

The predominant natural plant communities are Blue oak series, Needlegrass grasslands, Chamise series on shallow soils, and California annual grassland series around Cuyama Valley. Around Cuyama Valley, Allscale series is present on salty soils and Iodine bush series on very salty soils. California juniper series is present on the south side of Cuyama Valley. Characteristic series by lifeform include: Grasslands: California annual grassland series, purple needlegrass series, Saltgrass series. Shrublands: Allscale series, Arrow weed series, Bladderpod - California ephedra - narrowleaf goldenbush series, Chamise series, Cupleaf ceanothus - fremontia - oak series, Fourwing saltbrush series, Iodine bush series, Shadescale series, Spinescale series. Forests and woodlands: Blue oak series. California juniper series, Mesquite series.

Climate

The mean annual precipitation is from 6 to 10 inches in Cuyama Valley up to about 15 inches in the mountains. The precipitation is mostly rain, with a little snow at higher elevations. Mean annual temperature is about 50° to 60° F. The mean freeze-free period is about 175 to 225 days.

Surface Water

Runoff from the mountains and hills is rapid, but drainage is slow from some of the soils in the Cuyama Valley. The Cuyama River runs northwestward through this subsection then, after leaving the subsection, southwestward across the Coast Ranges toward the Pacific Ocean. All streams other than the Cuyama River and its larger tributaries are dry through the summer. There are no natural lakes in the subsection. (Miles and Goudey 1998)]

14. Objective C4: Wild Lands Conservation Value

14.1. Identify Wild Areas

The Wild Lands mapped in B4 were used as a starting point.

14.2. Determine Wild Lands Value for each Candidate Site

This value is a function of the following:

- *the current and predicted condition weighted area of the Wild Land in the candidate site,*
- *and the current and predicted condition weighted area the entire Wild Land(s) that intersects the candidate site (Davis, Stoms et al. 2003).*

This objective also uses the marginal value framework of objective C2 (Figure A-1). “A” is set at 25,000 condition weighted acres because this was the value used by Davis, Stoms et al. (2003) and seemed to be an appropriate assumption. [One condition weighted acre is 1 acre of land with a human impact value of 0 (highest condition), or 2 acres of land with a human impact value of .5, and so on]. G was set at 1,000,000 condition weighted acres. This is double the value used by Davis, Stoms et al. (2003) for two reasons. First of all, 1 female mountain lion territory is about 76 square kilometers or 18,780 acres (Dickson 2001), so 1 million acres is about 50 female territories, and male territories are sometimes more than double the female territories, so this is only about 20-30 male territories. There are a variety of minimum viable population thresholds cited in the population viability analysis literature, which is species specific, and 20-30 males is on the small side (no formal PVA analysis was performed however). Secondly, this threshold allows the larger wild lands in the region to have at least a small conservation value.

The sum of the condition weighted acres for 2050 for a particular wild land is the big X of Figure A-1. The sum of the condition weighted threat acres (the difference in CWA between 2000 and 2050) for the portion of the site that the wild land intersects (the whole site for a majority of the sites) is the little "x" of the figure. The area under the curve, between X and X + x is the wild lands value for the site.

A site will get a full value of 555 if it is a full sized site, the wild land that the site belongs to has less than 25,000 condition weighted acres total in 2050, and all of the acres of that site are predicted to go from pristine to completely degraded. It is near impossible for such a scenario to play out, so anything above 100 is very important. What is most important is the relative score among sites. These were normalized for analysis between objectives as described in objective B1 (greater than 1 is above average for the non-zero sites of the layer.)

14.3. Visualize Results

The site values were smoothed, as per the methodology described for B1, to get the contours of wild lands conservation value. See Figure 22 of Chapter 4 of the RCG: Wild Lands Conservation Value within the Conception Coast Region (C4).

15. Objective C5: Reserve Adjacency Conservation Value

For an introduction to this objective and an overview of the methodology, please see Chapter 4 of the RCG.

15.1. Methodological Assumptions

- *It is a higher priority to expand smaller reserves than larger reserves.*
- *Sites closer to the reserve boundary are more important than sites far from the reserve boundary.*
- *Only areas 1 km or less from current reserves should be considered.*
- *Cells that are more threatened with development are a higher priority for conservation.*

15.2. Determine Reserve Adjacency Conservation Value

First, a "demand layer" was created. This is the demand of a given cell for conservation based on the reserve it is near. Smaller reserves have a higher demand than larger reserves. Again, the detailed equation is in Davis, Stoms et al.

(2003). The area of each reserve was calculated. We assumed that a reserve twice as big as the largest reserve in the region would have a demand of 0. Thus we used c = .0001845. Each reserve was then buffered by 1 km, and all the cells in each buffer were assigned a value resulting from the demand equation. Second, an inverse distance surface was created which simulates the assumption that cells closer to the reserve are more important than cells away from the reserve. The demand layer was then multiplied by the distance layer to create the supply layer. This indicates how important a cell is for conservation based on these criteria, irrespective of the threat to that cell. The supply layer was then multiplied by the threat layer to get the "C5 marginal value" layer. To get the value for a site, the C5 marginal values of all of the cells in the site were summed. The resulting units do not make any intuitive sense, but after the values are normalized as per B1, the resulting units are in the same scale as all of the other objectives (greater than 1 is above average for the non-zero sites of the layer).

15.3. Visualize Results

The site values were smoothed, as per the methodology described for B1, to get the Reserve Adjacency Conservation Value Map. See Figure 23 of Chapter 4 of the RCG—Reserve Adjacency Conservation Value within the Conception Coast Region (C5).

16. Objective C6: Landscape Connectivity Conservation Value

16.1. Determine Landscape Connectivity Conservation Value

The connectivity layer that was created in B6 was multiplied by the threat layer to get the connectivity conservation value layer. To get the value for a site, the connectivity conservation values of all of the cells in that site were summed.

A site will get a full value of 555 if it is a full 1.5 km square, every cell in it has the highest possible linkage score, the highest possible habitat suitability score, no human impact in 2000, and full human impact by the year 2050. All other sites will receive scores less than 555. It is near impossible for such a scenario to play out, so anything above 100 is very important. What is most important is the relative score among sites, as they will be normalized before combining with the other objectives. These were normalized for analysis between objectives as described in objective B1.

16.2. Visualize Results

The site values were smoothed, as per the methodology described for B1. See Figure 24 of the RCG: Landscape Connectivity Conservation Value within the Conception Coast Region (C6).

17. Synthesis Part 2: Conservation Priorities

For an introduction to this objective and an overview of the methodology, please see Chapter 4 of the RCG.

The new objectives with threat included were combined in the same way that the objectives were combined for Synthesis Part 1. The weight for C5 is the same as for C4 and C6, and is equal to 10. Since there are now five weights, the actual weights used in the calculations changed since they must sum to one, but their relative values stayed the same. The resulting site values were smoothed, as per the methodology described in B1. See Figure 25 of Chapter

4 of the RCG: Estimated Conservation Priorities
within the Conception Coast Region.

Appendix B - Focal Species Profiles

Mountain Lion (Felis Concolor)

The mountain lion is one of the few remaining large predators in the western ranges and inhabits the rugged and remote nature of mountainous regions. Difficulties in establishing human settlements in the steep and rocky topography have allowed mountain lions to endure. Mountain lions play an important role as a top predator in the ecosystems of the Conception Coast Region. This species is vital in keeping deer populations in check as rampant deer populations can overgraze grasslands causing erosion and a decline in water quality. However, alteration of habitat through urban development and road construction is occurring frequently in remote, wild areas, which impacts the range and number of this species.

Full-grown mountain lions tend to weigh 75 to 200 lbs with length ranging from 6 ½ feet for females up to 8 feet for males (including tail), and tail length ranges from 21-36 inches. Mountain lions have golden brown body with dark stripes around muzzle. The back of their ears and tip of tail are blackish brown with their chest and throats white. Kittens are spotted with dark rings on tail that vanish by six months of age. The long, thick tails provide balance during leaps and climbs. These athletic cats are excellent climbers and jumpers, capable of leaping 12 feet and jumping safely from a height of 60 feet. Mountain lions can outrun a deer, but only for short distances.

Mountain lions tend to be a solitary animal that pairs only for 2 weeks during breeding season. Males are polygamous, mating with more than one female. There is no fixed mating season, although births occur most often in midsummer. 1 to 6 kittens are born after a gestation period of about 96 days. A newborn kitten weighs less than a pound at birth and is buff colored with black spots. The male does not participate in raising the young. At 6-8 weeks of age, the kittens may go on their first kill as observers. The young stay with the mother until they are 1-2 years old at which time they wander up to 100 miles before establishing their own range. They can survive over eleven years in the wild. They use "scrapes" to mark territory, which consist of mounds of dirt, leaves, and other debris piled into a heap and soaked with urine and/or scat. The diet varies according to season, availability, appetite and hunting skill. They feed primarily on large mammals such as deer, but also eat rabbits, rodents, porcupines, beavers, peccaries and birds. After a kill, what the mountain lion does not eat right away, it will partially bury with sticks, dirt or snow so it may return to feed for several days (Cornett, 1982).

Generally, these are cats found in mountainous areas, but can range from open woodlands to dense forests. Mountain lion habitats locally include the hills of the Gaviota Coast, Los Padres Forest, Vandenberg Air Force Base and Santa Monica Mountains. Linkages from large wild areas are necessary to allow gene flow to occur, as inbreeding of populations can cause decline in numbers or local extinction.. Roads and human development constrict or clog major corridors for the mountain lion, reducing longevity for the species. It is necessary to maintain linkages between the Southern Los Padres to Northern Los Padres, Angeles National Forest and Sequoia National Forest. Other corridors of concern are the Vandenberg Air Force Base to the Gaviota Coast as well as the Southern Los Padres. A full identification of corridor priorities is indicated in the results of the Regional

Conservation Guide.

Conception Coast Project has also launched a mountain lion sightings page on its website; this will allow citizens to input where mountain lion sightings occurred. This information will augment future Conception Coast Project analyses. Mountain lion habitat and linkages are useful in identifying crucial areas for protection in regional conservation.

Southern Steelhead (*Oncorhynchus mykiss*)

Southern steelhead inhabited many creeks of the Conception Coast Region at the beginning of the 1900's; however, human modification in the past 50 years have brought populations to less than 1% of its historic population size. The National Marine Fisheries Service (NMFS) listed the unique southern steelhead as a federally endangered species in 1997. Steelhead are an important barometer of a stream's health and an important part of our natural heritage (Stoecker, et al. 2002).

Steelhead are migratory rainbow trout that are born in freshwater streams, migrate to live in the ocean and return to creeks to spawn. Steelhead's range starts in northwestern Mexico and continue to Alaska. Genetic studies have concluded the evolutionary significant unit (ESU) from Santa Barbara County to Mexico is a distinct from northern populations. The southern species have the ability to survive in warmer waters. This species also grows faster and migrates more rapidly than its northern ancestor.

Conception Coast Project has been examining barriers to steelhead migration, as construction of migration barriers such as road crossings, dams, and flood control structures is the single greatest limiting factor for steelhead in our region. CCP has done extensive work on barrier analysis on the South Coast of Santa Barbara and is doing a coarse regional level analysis for the Regional Conservation Guide (see Appendix C).

Steelhead were once abundant in almost all of the major watersheds within Santa Barbara and Ventura Counties, with the largest runs of adult steelhead occurring in the Santa Ynez, Santa Clara, Santa Maria and Ventura Rivers. The Santa Ynez had the largest population of steelhead in all of southern California with estimates of 13,000 to 25,000 adults returning in the 1943, 1944 run (Titus, et al. 2000).

Steelhead have an amazing life span, spawning in cool, well oxygenated streams. This habitat type is usually associated with the upper reaches of many streams. Steelhead utilize eggs incubated in gravel; eggs hatch into a larval stage (alevin) where they remain and feed on their attached yolk sack.

Smolts which are steelhead changing from a freshwater to saltwater species leave their stream habitat and may spend a period of time in an estuary before entering the ocean. During life at sea, southern steelhead can attain large sizes while feeding off of squid, and amphipods.

Drought and human activities often impair southern steelhead from accessing their natal streams. Southern steelhead will adapt or delay their upstream spawning migration until adequate flows exist or they may choose another stream to inhabit. When favorable flow conditions exist, adult steelhead enter the lagoon for their upstream migration. Usually, steelhead enter the streams during periods of large rainfall such as fall, winter, and early spring.

After adjusting to the freshwater, steelhead navigate upstream toward the higher quality spawning and rearing habitat. Shade is important during this navigation with trees and bank side vegetation being useful for shade and protective cover. The fish use rocks and boulders to rest behind as they navigate upstream to once again spawn (Stoecker, et al 2002).

Appendix C - Steelhead Analysis

Introduction

Conception Coast's Region has traditionally had runs of southern steelhead in its creeks. Populations of southern steelhead existed in almost all of the significant watersheds within Santa Barbara and Ventura Counties, with the largest runs of adult steelhead occurring in the Santa Ynez, Santa Clara, Santa Maria and Ventura Rivers. Thousands of steelhead left the hunting grounds of the Pacific Ocean to ascend the coastal streams before rapid alteration of our creeks occurred from the 1940's onward. The modification of our region's streams through migration barriers, water extraction, and alteration of riparian and aquatic habitats led to the elimination of steelhead in most of southern California's streams. During the past fifty years, the decline has been most dramatic as steelhead were no longer able to navigate the streams that they once inhabited because of extensive modifications to stream habitat (Stoecker, et al. 2002).

As stated in the previously, due to the uniqueness of the southern steelhead and their near extinction, the National Marine Fisheries Service listed the southern California steelhead Evolutionarily Significant Unit (ESU) as endangered in 1997. The southern steelhead is currently the most endangered steelhead ESU in all of California. Estimates of the current steelhead population size in southern California is less than 1% of its historical size (Stoecker, et al. 2002).

Conception Coast Project completed an extensive study of the coastal watersheds of the South Coast that identified the most biologically important watersheds for steelhead and priority barriers for removal that block access to the watersheds. The study extended from Jalama Creek in the west to Rincon Creek in the east. The report has been successful in identifying critical barriers for removal to open up prime habitat for endangered steelhead. Successful work has been completed and is on going on priority watersheds that include Carpinteria, San Ysidro, Rincon and Mission.

Conception Coast Project has expanded its steelhead analysis to look at the critical watersheds of the entire region. This analysis uses existing information on the watersheds that was transferred to a GIS in order to identify critical watersheds and barriers in our region. The results of this regional analysis will aid in locating the most biologically important watersheds as well as the barriers that block access to spawning habitat for steelhead. This information will lead to more efficient actions towards restoring steelhead.

Methodology

Conception Coast Project utilized spawning substrate, substrate embeddedness, surface flows, pool abundance, in-stream cover and riparian canopy cover to form the basis of the watershed habitat score. The values of each category are explained below in further detail. The analysis was similar to Conception Coast Project's prior steelhead analysis on the South Coast in 2002. Existing reports were utilized with special attention to descriptions to these topics.

Abundance of Spawning Substrate

The relative abundance of adequately sized spawning substrate within a given stream reach was identified from existing reports (Kelley, 2004; Allen, et al. 2003; Titus, et al. 2000; Santa Ynez River Tech., 2000, NMFS, 2005). Indication of significant spawning substrate was given a score of 0 to 1.5. The scores were based on this criteria:

0= Adequately sized spawning substrate scarce or absent.
0.5= Low abundance of adequately sized spawning substrate present.
1.0= Moderate abundance of adequately sized spawning substrate present.
1.5= High abundance of adequately sized spawning substrate present.

Substrate Embeddedness

Research on substrate embeddedness was utilized to build the GIS database. It is important that substrate not be embedded to allow steelhead spawning. Indication within existing reports of substrate embeddedness occurring with a habitat reach was recorded. The scores were based on this criteria:

0= Greater than 75% substrate embeddedness
0.5= 75%-50% substrate embeddedness
1.0= 50%-25% substrate embeddedness
1.5= Less than 25% substrate embeddedness

Surface Flow

Surface water flows can be highly variable in stream reaches of the Conception Coast Region. These fluctuations are often due to annual precipitation and water extractions. Stream reaches that sustain some surface water throughout the year are critical for salmonids. Steelhead reside in fresh water for at least the first year of their lives and spawn in fresh water. Information from existing reports was utilized with these criteria:

0.0= Dry
Prolonged dry streambed conditions generally occur in this throughout the year.
0.5= Minimal Surface Flows
Reach has indications of minimal surface flows throughout the year.
1.0= Adequate Surface Flows
Adequate surface flow conditions are believed to occur in this reach ranging from minimal to perennial flows.
1.5= Adequate to Perennial
Reach ranges often has perennial flow in most years with indications of slightly diminished flows in other years
2.0= Perennial
Indications that surface flows exist continuously throughout the year in this reach.

Pool Abundance

The relative abundance of pools (greater than 2 feet in depth) was researched from existing reports. The following scoring categories were given:

0= Pools scarce or absent.
0.5= Relatively low abundance of pools present.
1.0= Relatively moderate abundance of pools present.
1.5= Relatively high abundance of pools present.
2.0= Relatively high abundance of pools present with multiple "refuge pools" (greater than 5 feet deep) present.

In-stream Cover

CCP staff researched in-stream cover with emphasis on cover from large substrate, bedrock ledges, large woody debris, roots and undercut bank. The criteria is as follows:

0= Scarce or Absent
0.25= Low
0.5= Moderate
0.75= Moderate to High
1.0= High

Riparian Canopy Cover

Riparian canopy cover is crucial as it provides shade keeping water temperatures cool for steelhead. Riparian canopy cover densities were then given the following scores:

0= representing no riparian canopy cover
0.5= canopy cover minimally present
1.0= canopy cover present
1.5= corresponding to very significant riparian canopy cover.

Synthesis

The categories just explained were then added for each stream and divided by ten. The possible high score was .95. The streams were then categorized by value as low quality (0-.25) medium (.3-.55), medium high (.6-.75) and high (.75 to .95) with values able to be seen on the following maps.

Results of Priority Barriers and High Quality Habitat

Major stretches of high quality steelhead habitat were found located within the Santa Ynez Watershed, Santa Clara, Santa Maria and Ventura. The following paragraphs and maps indicate the areas with the highest quality steelhead habitat and barriers along the streams.

Santa Clara Watershed

The analysis on the Santa Clara Watershed indicated that Vern Freeman Diversion Dam is the priority barrier identified that blocks roughly 25 miles of high quality habitat on the Sespe River. The Vern Freeman Diversion Dam has a fish ladder installed aiding passage; however, it is considered a partial barrier. The highest quality stretch of the Sespe River is from Devil's Gate north to where the river bends sharply west.

Santa Maria Watershed

The major steelhead habitat within the Santa Maria Watershed is deep within the Sisquoc River. 4 partial barriers (gravel operation, dam structure, road crossing and culvert crossing) block roughly 50 miles of the highest quality habitat. These barriers block the largest amount of high quality habitat within the region. The upper reaches of the Sisquoc River is of extremely high value for with its large quality and quantity.

Santa Ynez Watershed

On the Santa Ynez River, Bradbury Dam, which forms Lake Cachuma, blocks roughly 35 miles of the highest quality habitat on the Santa Ynez. Santa Cruz Creek and its west fork have the largest stretches of high quality habitat within the watershed.

Ventura Watershed

There are smaller stretches of high quality habitat on the Ventura River compared to the other watersheds analyzed within the region. There is a high quality lower stretch of the Ventura River. This 2.5 mile stretch is blocked by only one partial barrier.

Further up the watershed, the North Fork of the Matilija has roughly 5 miles of high quality habitat that is blocked by the partial barrier previously mentioned plus one total barrier (Robles Diversion Dam) and one partial barrier.

Santa Antonio Creek has roughly 11 miles of high quality habitat; however, 5 temporal, 4 partial and 2 total barriers are littered on this stretch, blocking much of this habitat.

Figure C-1: Steelhead Barrier and Habitat Quality Map of Santa Clara Watershed
FRONT

Figure C-1: Steelhead Barrier and Habitat Quality Map of Santa Clara Watershed
BACK

Figure C-2: Steelhead Barrier and Habitat Quality Map of Santa Maria Watershed
FRONT

Figure C-2: Steelhead Barrier and Habitat Quality Map of Santa Maria Watershed
BACK

Figure C-3: Steelhead Barrier and Habitat Quality Map of Santa Ynez Watershed
FRONT

Figure C-3: Steelhead Barrier and Habitat Quality Map of Santa Ynez Watershed
BACK

Figure C-4: Steelhead Barrier and Habitat Quality Map of Ventura Watershed
FRONT

Figure C-4: Steelhead Barrier and Habitat Quality Map of Ventura Watershed
BACK

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