Population Growth and Development Impacts Methodology

Development driven by population growth threatens some ecosystems in California, particularly around large urbanized areas and in expanding areas of wildland-urban interface. This section describes the methods used in the analysis to delineate areas of threatened ecosystems, using spatial information on projected development risk and native habitat types.

Key Concepts

Key concepts explain the ecosystem assets and development threats and how they are used in this analysis.

Ecosystems

Ecosystems as defined in this chapter refer to unique vegetation (WHR) types by tree seed zones (Figure 1). Tree seed zones help determine the suitability of seed for planting and survival in a particular area. These zones are areas with similar climate and soils and are delineated on the basis of collection criteria adopted by the USDA forest seed policy of 1939 (Fowells, H. A. 1946; and Buck, et al. 1970). When combined with vegetation maps, tree seed zones define unique ecosystem assets and represent areas potentially having unique genetic resources.

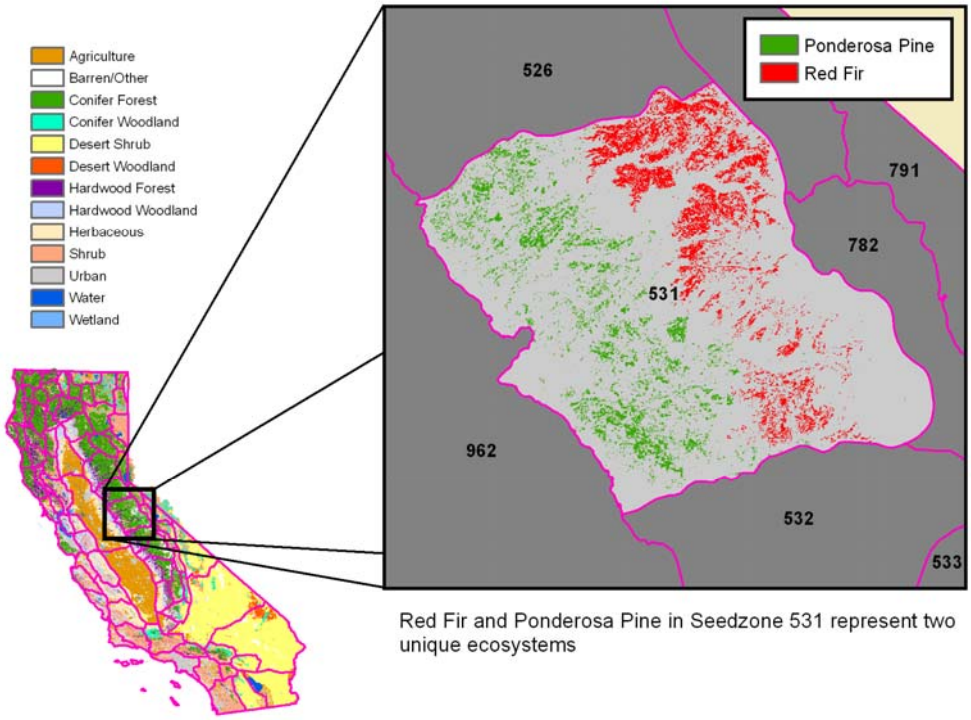

Figure 1. Land cover and seed zones in California

Landscape-level and Stand-level Threats

The approach taken in this analysis takes stand-level threats and elevates their importance if cumulatively they have potential to do damage across broader landscape-level ecosystems. While stand-level impacts can result in local loss of timber volume or wildlife habitat, a landscape-level impact can have a significant impact on larger systems, for example loss of genetic diversity for a given tree species, or decline of a particular wildlife species.

Development

Development is a general term for a suite of landscape alterations resulting in increased intensive human use. It is associated with increasing density of housing units with more residents, construction of commercial or industrial facilities, denser road and other transportation networks, and other systems such as sewers, power line rights-of-way that come with it. For this analysis, development due to land conversion results from the change of a lower density class to 1 or more housing units per 5 acres. Similarly, but less impacting, development associated with land parcelization results from the change of a lower density class to 1 or more housing units per 20 acres.

Analytical Framework

Consistent with the approaches used in the analyses in other sections of the assessment, a conceptual framework was developed to model the development threat to ecosystems. Figure 2 graphically depicts the overall assessment model used for this analysis, showing on the left the assets and threats being combined into a priority landscape. These are described in more detail below.

Analysis Goal

The goal of this analysis was a spatial depiction within a Geographic Information System (GIS) of priority landscapes where ecosystems are potentially at risk from development – either conversion or parcelization – over the next 10 to 30 years. These landscapes can then serve to help target planning, management and conservation efforts and funding, and be useful in formulating land management and acquisition strategies of areas determined to be at highest risk.

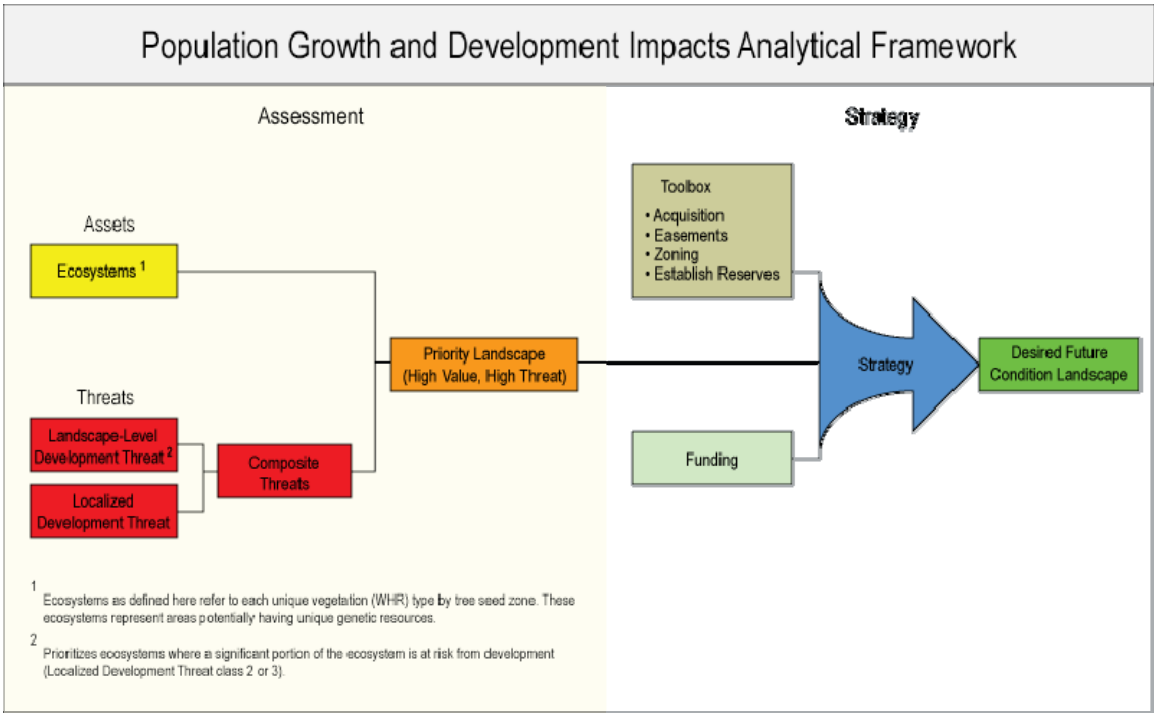

Figure 2. Analysis Framework for Population Growth and Development Impacts

Assets

Asset 1: Ecosystems

Ecosystem assets within the analysis framework were characterized by the California Wildlife Habitat Relationships (WHR) types GIS data layer, divided up into spatial units defined by Tree Seed Zones (TSZ). There are 65 total WHR types, of which 43 are natural habitats (listed alphabetically in table 1). Eighty-seven total TSZ's occur in the state. For the purposes of this analysis each WHR type occurrence within a given TSZ was treated as a unique ecosystem, in an effort to capture the spatial variation of each in terms of unique species composition and habitats (see key concepts above). For example, blue oak woodland (BOW) occurs in 36 TSZs across the state, and each of these areas was treated as distinct for this analysis.

WHR natural habitats are not all evenly distributed throughout the state. Some are widespread, whereas others are confined to much smaller areas. There are types which occur only in desert-dominated areas, with others found primarily in more temperate areas. The San Bernardino Mountains (TSZ 994) contained the highest total number of habitats (28), whereas eight TSZs scattered across the state had only 2 to 5 natural habitats occurring within them. These are shown in figure 3. Out of 3741 total possible habitat/TSZ combinations (43 types x 87 zones), 1109 (30%) actually occurred.

Table 1: List of WHR Natural Habitats:

WHR Name
Alpine-Dwarf Shrub
Annual Grassland
Alkali Desert Scrub
Aspen
Bitterbrush
Blue Oak-Foothill Pine
Blue Oak Woodland
Coastal Oak Woodland
Closed-Cone Pine-Cypress
Chamise-Redshank Chaparral
Coastal Scrub
Douglas Fir
Desert Riparian
Desert Scrub
Desert Succulent Shrub
Desert Wash
Eastside Pine
Fresh Emergent Wetland
Jeffrey Pine
Joshua Tree
Juniper
Klamath Mixed Conifer
Lodgepole Pine
Low Sage
Mixed Chaparral
Montane Chaparral
Montane Hardwood-Conifer
Montane Hardwood
Montane Riparian
Perennial Grassland
Pinyon-Juniper
Palm Oasis
Ponderosa Pine
Redwood
Red Fir
Subalpine Conifer
Saline Emergent Wetland
Sagebrush
Sierran Mixed Conifer
Valley Oak Woodland
Valley Foothill Riparian
White Fir
Wet Meadow

The ecosystem assets used in this chapter's analysis are the same as those used for analyses of two other subtheme chapters, Wildfire Threats (2.1) and Forest Pests and Other Threats to Ecosystem Health (2.2).

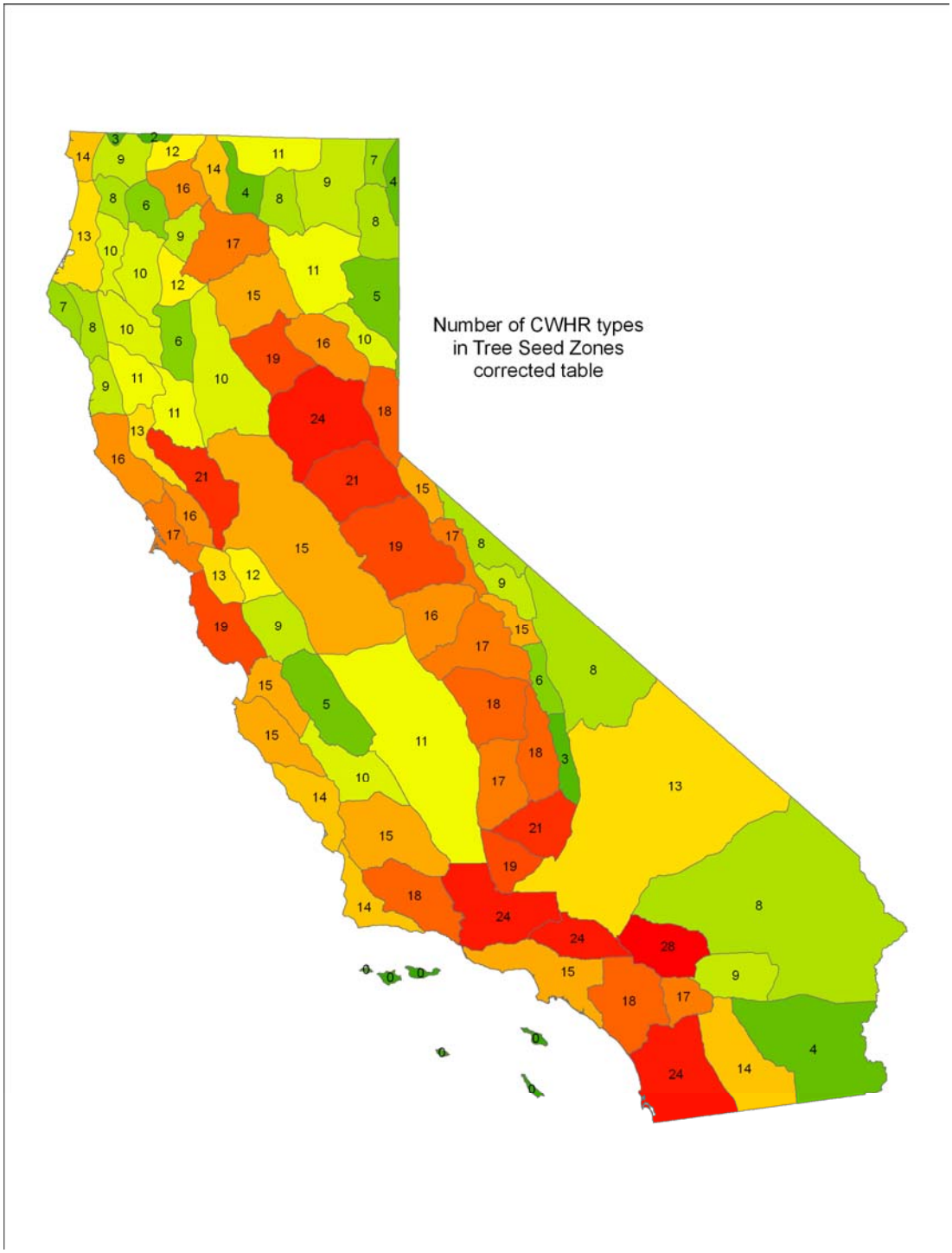

Figure 3. Tree seed zones in California, and the number of WHR natural habitats occurring within them. Because data for the Channel Islands was poor, they were omitted from the analysis.

Threats

Two data sources were used to spatially characterize the threat of development over the next 30 years: a GIS layer of a development risk model from a recent US EPA program; and a compendium of GIS layers of all county general plans. They were used in combination to rank the level of threat from development based upon a set of criteria described below.

In general, rankings were assigned based upon the degree of development projected, its timeframe, and its current county zoning designation. Higher levels of development in more near-term timeframes, in areas already zoned for such development, were considered at highest risk and thus received the highest rankings. Conversely, areas where little or no development is projected to take place over the next 30 years were considered to be at minimal risk. Those areas where no development can occur, due to federal ownership, management or easements, were excluded from consideration in this study.

Two levels of development of concern for this analysis were termed "conversion" and "parcelization". As shown in table 2, they designate progressive levels of development – conversion being more impacting (and thus representing a higher level of threat) than parcelization.

Table 2: Definitions for two levels of development of concern

Housing Density	Term
Over 1 HU / 5 acres	Conversion
Over 1 HU / 20 acres	Parcelized

To characterize the development threat, this subtheme used the "landscape-level threat" approach that was also used (for different threats) in *Wildfire Threats to Ecosystem Health and Community Safety*, and *Forest Pests and Other Threats to Ecosystem Health and Community Safety*.

Threat 1: Localized development threat

This threat is ranked based on the level and timing of projected development as shown in table 3 (all excluded lands such as those under public ownership or conservation easements were given the score 0).

Independently, the statewide GIS layer of county general plans was also ranked as to level of development threat according to current land use zoning (see table 4). With these data alone it was not possible to determine whether the land was already developed or not. To use this information for threat assessment, it was necessary to combine it with the development threat layer from US EPA and with the WHR coverage showing current habitat assets.

Table 3: Designated ranks of development threat fro this analysis, by level (conversion or parcelization) and decade (ranks H = high; M = moderate; L = low; - = no threat).

Converted by the year	Rank	Score
2020	H	3
2030	M	2
2040	L	1
> 2040	-	0
Parcelized by the year		
2020	M	2
2030	L	1
2040	-	0

Thus the localized development threat ranks defined in table 3, which used projected housing density and decade attributes from the US EPA ICLUS data, were modified by the statewide GIS coverage of county general plans . This was applicable only to those areas of projected near-term (year 2020) development from either "conversion" (rank: H) or "parcelization" (rank: M) from above table 3. Where zoning in current county general plan was also considered at high or moderate development threat, then the rank from above was left unchanged; otherwise (i.e. where the zoning does not currently permit such development) the rank from the US EPA threat data was lowered by one level (i.e. H lowered to M, or M lowered to L).

Table 4: Ranks of development threat using county land use zoning. Ranks H = high; M= moderate, L = low, -- = no threat)

LUCode	Description	Rank	Score
-1	Other not determined	L	1
1	Agriculture/Grazing	L	1
2	Industrial	H	3
3	High density commercial	H	3
4	Low density commercial	H	3
5	> 8 units per acre	H	3
6	<= 8 and > 0.5 units per acre	H	3
7	<= 0.5 units per acre and > 1 unit per 20 acres	M	2
8	Open space and public lands	L	1
9	Water	-	0
10	Urban reserve	H	3
11	Planned development study area	H	3
12	Mixed use residential and commercial	H	3
13	< 1 unit per 20 acres and > 1 unit per 160 acres	L	1

Threat 2: Landscape-level development threat

This threat layer measures the potential for widespread landscape-level damage to an entire ecosystem, based upon unique tree seed zone/WHR combinations. For each ecosystem, we calculated the percentage of its area that occurs within the moderate or high rank of localized-level development threat (i.e. those that at a minimum expected to be converted by the year 2030 or parcelized by 2020 – see above).

Priority Landscape: Population Growth and Development Impacts

The overlay of the ecosystems assets and development threat layers with a GIS results in priority landscapes (figure 4). The threat from development to each ecosystem taken as a whole was determined and ranked based on the percentage of the ecosystems' total acreage that coincided with either a moderate or high site-level development threat. Based on the above criteria, and looking across the statewide data, ecosystems with 25% or more of their area threatened by development were ranked as highly threatened, and those with from 10% to 25% of their area threatened were ranked as moderately threatened. A low threat level was assigned to ecosystems with less than 10% of their total area under threat.

Table 5: Examples of ecosystems, percent area at risk and their development threat rankings

Ecosystem (WHR name / Tree Seed Zone number / Bioregion)	% of acres in high or medium rank	Ecosystem Threat Rank
Coastal Scrub / 996 / South Coast	25.3%	H
Montane Hardwood / 526 / Sierra	17.3%	M
Blue Oak Woodland / 961 / Sacramento Valley	4.1%	L

Reporting Units

Consistent with other assessment analyses, bioregions are used to report more general and overall impacts from development on ecologically important areas. Additionally, results are reported for counties, since this level of government is charged with creating land use policies that drive development patterns.

Indicator Metric

The indicator used for this analysis is the number of acres of priority landscapes by ecosystem, reported by bioregion and county (tables 1.1.1 and 1.1.2 in the main assessment document). The full numbers are also contained in the complete enumeration tables online.

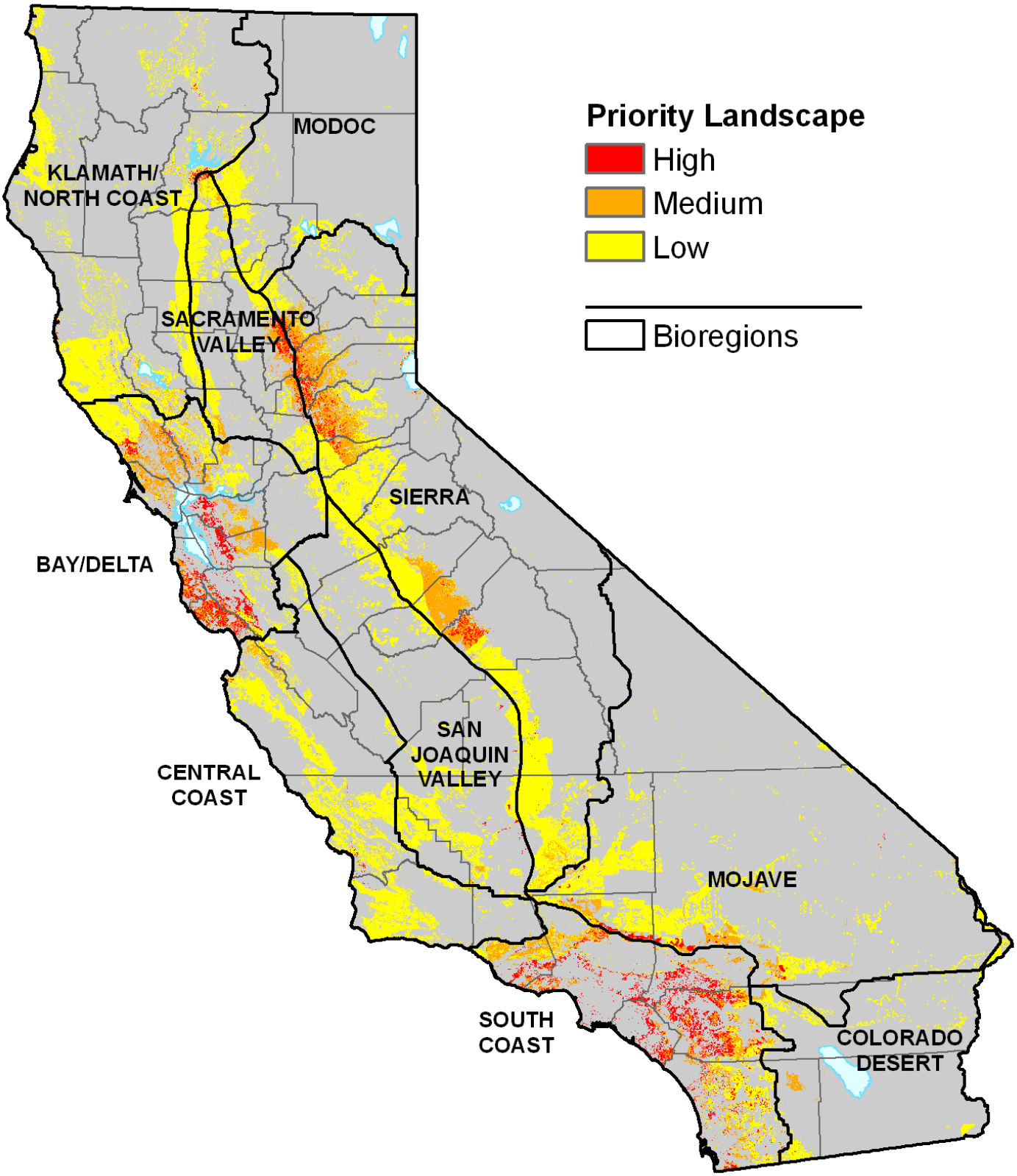

Figure 4. Map of Population Growth and Development Impacts Priority Landscapes

Data Quality and Limitations

Overall the quality of the data used was quite good (see table 6). Four data layers were used, all of them created within the last 5 years. The level of pertinence to the analysis was very high.

Analytical Limitations

Due to methodological limitations, it was not possible to include unique asset values for different ecosystems. Numerous important factors would need to be included in making this valuation. The California Department of Fish and Game is developing a method that will identify priority areas based on these type of factors. For example, this might include the relative patch sizes and connectivity of the ecosystems, and the proximity of patches to similar neighboring ecosystems that are in protected status. Fragmentation and small patch sizes can be important given minimum habitat requirements for some of the larger animals, and WHR types that are adjacent to protected areas may be of more value than those at more remote distances from protected areas. A forest fragmentation GIS layer was available for California from the National Land Cover Data (NLCD) program, however in some places it showed urban areas with significant tree cover as being forests impaired by human caused fragmentation.

In the US EPA spatial model allocating projected areas of development in California and across the nation, researchers took into account general land cover types (Anderson level I). The weightings used biased new development towards existing development, rural wells, and certain cover types. While nowhere near the level of detail in the CWHR data, this may have introduced a level of bias towards certain general types and away from others in the proximity.

Table 6: Data used in the analysis

ANALYSIS: Population Growth and Development Impacts Methodology			
	Data theme	**Dataset name**	**Purpose**
THREATS			
THREAT1: Localized Development Threat		thr_developLOC09_11.gdb	Threat, derived from potential future development (EPA ICLUS) constrained by county general plans
Inputs	EPA ICLUS	input_bhcs_iclus_ca.gdb	Potential future development
	County general plans	input_genplans_rr.gdb	Constraints on future development
THREAT2: Landscape-level Development Threat		thr_developLS09_1.gdb	Measured by a localized development threat rank of medium or high.
Inputs	Localized Development Threat	thr_developLOC09_11.gdb	Threat, derived from potential future development (EPA ICLUS) constrained by county general plans
	Vegetation	input_fveg06_2.gdb	Input used to describe vegetation communities and their relationship to wildlife habitat
	Tree Seed Zones	input_seedzones02_1.gdb	Input used to describe vegetation communities
ASSETS			
ASSET 1: Ecosystems		ast_ecosystems09_1.gdb	Defined by each tree seed zone / vegetation type combination.
Inputs	Vegetation	input_fveg06_2.gdb	Input used to describe vegetation communities and their relationship to wildlife habitat
	Tree Seed Zones	input_seedzones02_1.gdb	Input used to describe vegetation communities
Priority Landscape			
	PL: Population Growth and Development Impacts	pl_t11_a109_1.gdb	Priority landscape for population growth and development threat
Other data			
	County boundaries	cty24k09_1.gdb	Reporting unit for summarizing results
	Bioregions	INACCBioreg04_1.gdb	Reporting unit for summarizing results

Table 7: Data sources and quality

Data Element[1]	Date	Source	Purpose	Age[2]	Completeness	Detail	Consistency	Relevance	Limitations
Development	2009	US EPA	Projected Development	E	E	E	E	E	Risk of future development is modeled by year and housing density.
Statewide County General Plans	2007	California Office of Planning and Research	Land Use Zoning	G	E	G	G	G	Zoning is subject to change, thus we used it only for near-term projected development
Vegetation Data (v06_2)	2006	CAL FIRE - FRAP	Ecosystem Asset	F	G	F	F	G	Source data varies in quality, detail and age.
Tree Seed Zones	2002	CAL FIRE	Ecosystem Asset	F	G	F	E	E	The 1,000-foot criteria adopted as USDA forest seed policy was not used for this analysis. Ecosystems were allowed to cross these elevations in a single seed zone.

1. Additional datasets used as data inputs or reporting metrics include land ownership.
2. P = Poor F = Fair G = Good E = Excellent

Citations

Fowells, H.A. 1946. Forest tree seed collection zones of California. Res. Note 51. Berkeley. CA: U.S. Forest Service, California Forest and Range Experiment Station

Buck, J. M., R. S. Adams, J. Cone, M. T. Conkle, W. J. Libby, C. J. Eden and M. J. Knight. 1970. California Tree Seed Zones. California Region, USDA Forest Service, SF and Division of Forestry, Dept. of Conservation, State of California