National Wildlife Federation

Paving Paradise

Sprawl's Impact On Wildlife And Wild Places In California

A Smart Growth and Wildlife Campaign
California White Paper
February 2001

National Wildlife Federation

Paving Paradise
Sprawl's Impact On Wildlife And Wild Places In California

A Smart Growth and Wildlife Campaign
California White Paper
February 2001

Acknowledgments

Authors
National Wildlife Federation staff Kevin Doyle, John Kostyack, Ben McNitt, Glenn Sugameli, Caron Whitaker and Kenneth Whitcomb-Blaylock and interns Julia Byrd and Greg Stull.

Chief Researcher
Brian Czech

Brian Czech, Ph.D. and certified wildlife biologist, produced the research findings presented here by updating the database used for an article entitled "Economic Associations Among Causes of Species Endangerment in the United States" by Brian Czech, Paul R. Krausman, and Patrick K. Devers (*BioScience* 50: 593-601). Czech and Krausman are also co-authors of *The Endangered Species Act: History, Conservation Biology, and Public Policy* (Johns Hopkins University Press, 2001).

The National Wildlife Federation Wishes
to Thank the Deer Creek Foundation for its Support of the
Smart Growth and Wildlife Campaign

The nation's largest member-supported conservation education and advocacy group, the National Wildlife Federation unites people from all walks of life to protect nature, wildlife and the world we all share. The Federation has educated and inspired families to uphold America's conservation tradition since 1936.

National Wildlife Federation
Office of Federal and International Affairs
1400 16th St. NW, Suite 501
Washington, DC 20036-2266
(202) 797-6800

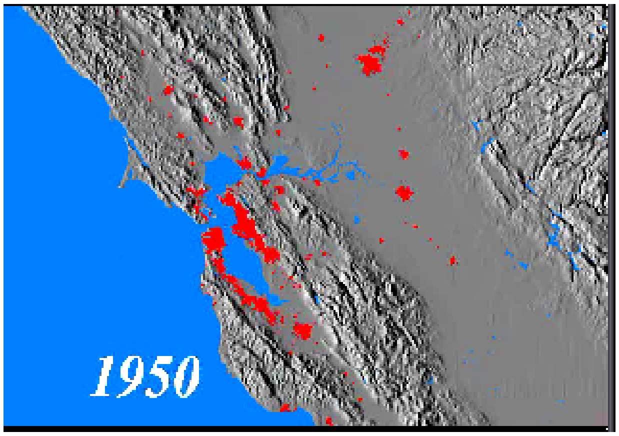
National Wildlife Federation
Western Natural Resource Center
3500 5th Ave., Suite 101
San Diego, CA 92103
(619) 296-8353

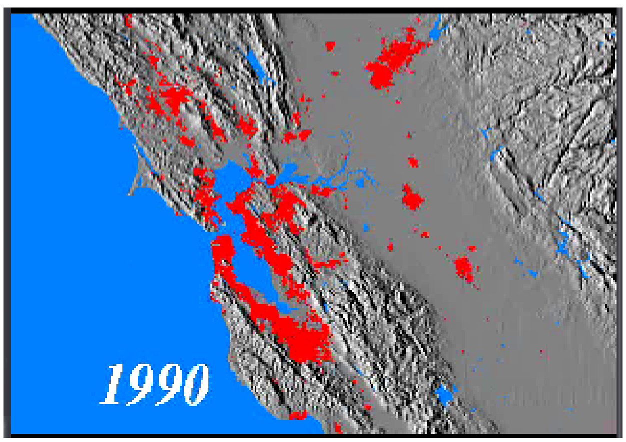
www.nwf.org/smartgrowth

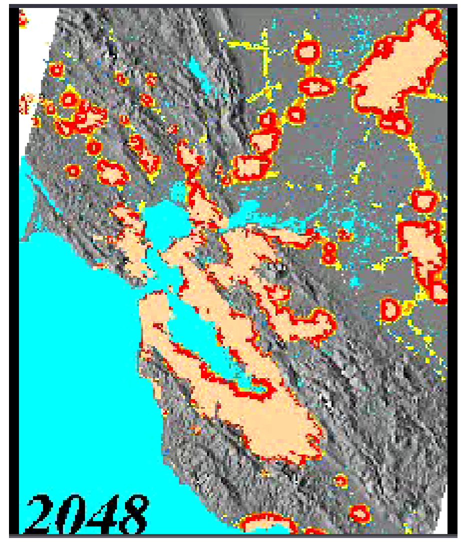
Table of Contents

USFWS Photo

Sprawl Scenario: Bay Area Case Study



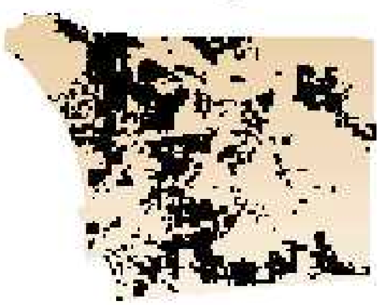




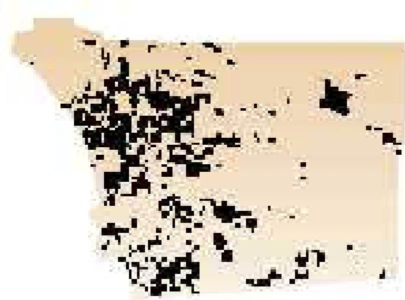
Actual Urban Growth Boundaries
Projected Urban Growth Boundaries

Source: UCSB

Sprawl vs. Smart Growth: San Diego Case Study 2020 Predictions



Existing Policies
Consume 600,000 Acres



Smart Growth Policies
Consume 200,000 Acres

Source: San Diego Association of Governments

Executive Summary

In this White Paper, the National Wildlife Federation's Smart Growth and Wildlife Campaign presents the first-ever quantitative assessment of the causes of species imperilment in California. We find that sprawl – low-density, automobile-dependent development into the natural areas outside of cities and towns – is the leading cause of species imperilment in the state. Outranking all other factors, sprawl imperils 188 of the 286 California species listed as threatened or endangered under the federal Endangered Species Act, or 66 percent of the state's listed species. Table 1, p.4.

Sprawl's contribution to the decline of California fish, wildlife and plants is confirmed by the data concerning other environmental problems related to sprawl, such as the introduction of non-native species, outdoor recreation (*e.g.*, off-road vehicles), and road construction. In evaluating the 286 listed species in California, we find that the second and third ranking causes of species imperilment are non-native species (132 species, or 46 percent) and outdoor recreation (123 species, or 43 percent). Table 1, p.4.

Focusing on the data concerning the 188 California species imperiled by sprawl, we find that problems related to sprawl are frequently identified, along with sprawl, as factors contributing to species decline. These "associated" causes of endangerment include non-native species, outdoor recreation, and road construction, which help cause the endangerment of 81, 102, and 84 species, respectively, of the 188 California species imperiled by sprawl. Figure 2, p.9.

Other environmental problems related to sprawl also contribute to species endangerment. Modified fire regimes, pollution, and genetic problems (*e.g.*, loss of genetic variability), respectively, contribute to the imperilment of 49, 32, and 25 listed species in California that are also imperiled by sprawl. Figure 2, p.9.

In evaluating the 18 causes of species imperilment, we find that sprawl has the highest incidence of association with other causes. Overall, the 188 California species imperiled by sprawl are also imperiled by the other 17 causes in a total of 825 instances. Figure 3, p.10.

Focusing on each of the 17 causes of species imperilment in California other than sprawl, we find that sprawl is the most frequently associated cause of imperilment. For example, 88 percent of the California species imperiled by road construction are also imperiled by sprawl, as are 86 percent of those imperiled by both modified fire regimes and industrial or military activity. Figure 4, p.11.

The associations data in this White Paper suggest that many causes of species imperilment are closely intertwined with sprawl. These data suggest that the environmental problems causing the decline of fish, wildlife and plant species in California would probably be much less severe if sprawl were to be replaced with a more wildlife-sensitive form of development.

The findings of this White Paper have important implications for the state's lawmakers, conservationists, developers, land use planners, and people in general. The conventional view that species endangerment in the United States is a problem most closely associated with natural resource extraction on broad landscapes far removed from metropolitan areas is no longer valid, at least in California. Understanding sprawl's role as the leading cause of species imperilment is necessary to stimulate smart growth efforts that conserve wildlife habitat in California.

Paving Paradise

Introduction

Habitat loss is the leading cause of species imperilment in the United States, with predation by, or competition with, non-native species ranking second.

For example, a 1998 survey of 2,490 imperiled species in the United States found that:

> habitat destruction and degradation emerged as the most pervasive threat to biodiversity, contributing to the endangerment of 85 percent of the species we analyzed. Indeed, habitat loss is the top-ranked threat (in terms of the number of species it affects) for all species groups. Competition with or predation by alien species is the second-ranked threat in the overall analysis, affecting 49 percent of imperiled species.[1]

More recent research focusing on current causes of species imperilment finds that 81 percent of federally protected species in the United States are endangered by some form of habitat loss, followed by interactions with non-native species, which affect 35 percent of those species.[2]

The passage of the federal Endangered Species Act (ESA) in 1973 brought species imperilment to the national policy agenda, where it has remained ever since. In the nearly three decades since the ESA was passed, the public has widely perceived threats to wildlife from habitat loss as a problem chiefly associated with the extractive uses of large expanses of public lands far removed from the nation's cities.

The 1990s controversy over the Northern spotted owl contributed significantly to this perception. The owl was imperiled by the loss of its old growth forest habitat due to logging. The controversy involved vast tracts of national forest and other lands in the sparsely developed hinterlands of the Pacific Northwest.

While logging, mining, oil and gas exploration and livestock grazing have unquestionably contributed to significant losses of wildlife habitat, other factors have been at work, too.

Some of those factors extend back to the 1800s; others, such as sprawl, are of more modern origin.

Historically, land conversion to agriculture in many states between the Mississippi River and the Rocky Mountains has accounted for the loss of 90 percent

Native Species in California

	Mammals	Birds	Reptiles	Amphibians	Freshwater Fishes	Vascular Plants	Total
Non-Endemic Species	214	349	74	45	66	5,143	5,891
Endemic Species	19	3	4	13	25	1,590	1,654
Total	233	352	78	58	91	6,733	7,545

Non-Endemic species occur within the state of California and elsewhere. Endemic species occur only within California. Source: *Sliding Toward Extinction, The State of California's Natural Heritage, 1987*, The California Senate Committee on Natural Resources and Wildlife.

or more of the nation's shortgrass plains and tallgrass prairies. One victim of this trend has been the endangered black-footed ferret, which preys solely on prairie dogs that require large tracts of grassland to sustain their colonies.

More recently, since World War II, the United States has experienced a demographic transformation as a rapidly expanding population has increasingly moved into growing suburbs. Much of that urbanization has been in the form of sprawl -- low-density, automobile-dependent development into natural areas outside of cities and towns, with residential areas separated from shopping and working centers.

In addition, science has increasingly alerted us to the pervasiveness of the threat of species extinction. In 1973, only 120 species were listed under the ESA as threatened or endangered, many of them high-profile mega-fauna such as the bald eagle, the gray wolf and the grizzly bear. In the United States today, 1,244 species are listed under the ESA as threatened or endangered, 736 of them plant species. Another 86 species are candidates for ESA listing.[3]

With these factors in mind, it is evident that "habitat loss" may be too broad a term to clearly illuminate the current causes of species imperilment in the United States.

In this White Paper, the National Wildlife Federation presents research that breaks habitat loss down into more distinct components. Specifically, the causes contributing to the imperilment of 286 species listed as threatened or endangered under the ESA in California were reviewed and classified into 18 categories. (Two sea turtle species and the short-tailed albatross, whose ranges include the Pacific Ocean off California, were not included in this study.) The terms sprawl and urbanization are used interchangeably because sprawl has been the predominant pattern of urbanization in California in recent decades. A full discussion of the research protocols is presented in the Methodology section of this White Paper.

The National Wildlife Federation intends to expand this research in the future to include all 50 states.

Sprawl Is The Leading Cause Of Species Imperilment In California

The findings presented in this White Paper quantify for the first time that sprawl is the leading cause of species imperilment in California.

Outranking all other factors, sprawl is a cause of imperilment for 188 of the 286 species listed as threatened and endangered under the federal Endangered Species Act (ESA) in California, or 66 percent of the imperiled species in the state (Table 1).

This finding highlights why sprawl is one of the most important natural resource issues California's people and communities have been confronting in recent decades. By quantifying sprawl's impact, the finding lends great urgency to the issue.

California exemplifies more than any other state the demographic transformation that has occurred in the United States over the latter half of the past century. From about 7 million in 1940, California's population has grown more than fourfold to 34 million residents today and projections estimate a population of 49 million in 2025 and nearly 59 million in 2040 (Figure 1). The majority of that growth has occurred in and around the state's burgeoning metropolitan areas and the predominant form of urbanization has been the low-density pattern of development known as sprawl.

Last year, the California Farmland Mapping and Monitoring Program identified 3 million acres as "urban and built-up land" in the state.[4] While the program inventories only about half of the state's acreage, it includes most of the metropolitan areas. In its latest report, the program identified 126,231 acres of land that were urbanized in the state between 1994 and 1998 (Table 2). The Southern California region accounted for the largest single

Table 1

Causes of Species Imperilment in California

Cause	Number of Species	Percentage of Species*
Urbanization/Sprawl	188	66
Interactions with Non-native Species	132	46
Outdoor Recreation	123	43
Domestic Livestock and Ranching	108	38
Agriculture	97	34
Road Construction and Maintenance	95	33
Industrial or Military Activity	76	27
Reservoirs and Other Water Diversions	66	23
Minerals, Gas, Oil, and Geothermal Extractions	63	22
Modified Fire Regimes	57	20
Aquifer Depletion, Wetland Draining and Filling	54	19
Pollution of Air, Water or Soil	44	15
Harvest, Intentional and Incidental	43	15
Genetic Problems	38	13
Interactions with Native Species	30	10
Logging	24	8
Disease	15	5
Vandalism (Destruction Without Harvest)	10	3

*Percentages based on total of 286 federally listed threatened and endangered species in California.

share of that expansion, with 52,800 acres of land urbanized there between 1994 and 1998. Of particular importance, the report notes, "the rate of urbanization in the project area increased 25 percent" between the 1996 and the 1998 inventories.

These figures illustrate what is already well known: the state's population is growing dramatically and, due to the sprawling pattern of development to accomodate that growth, land is being converted rapidly to urban uses.

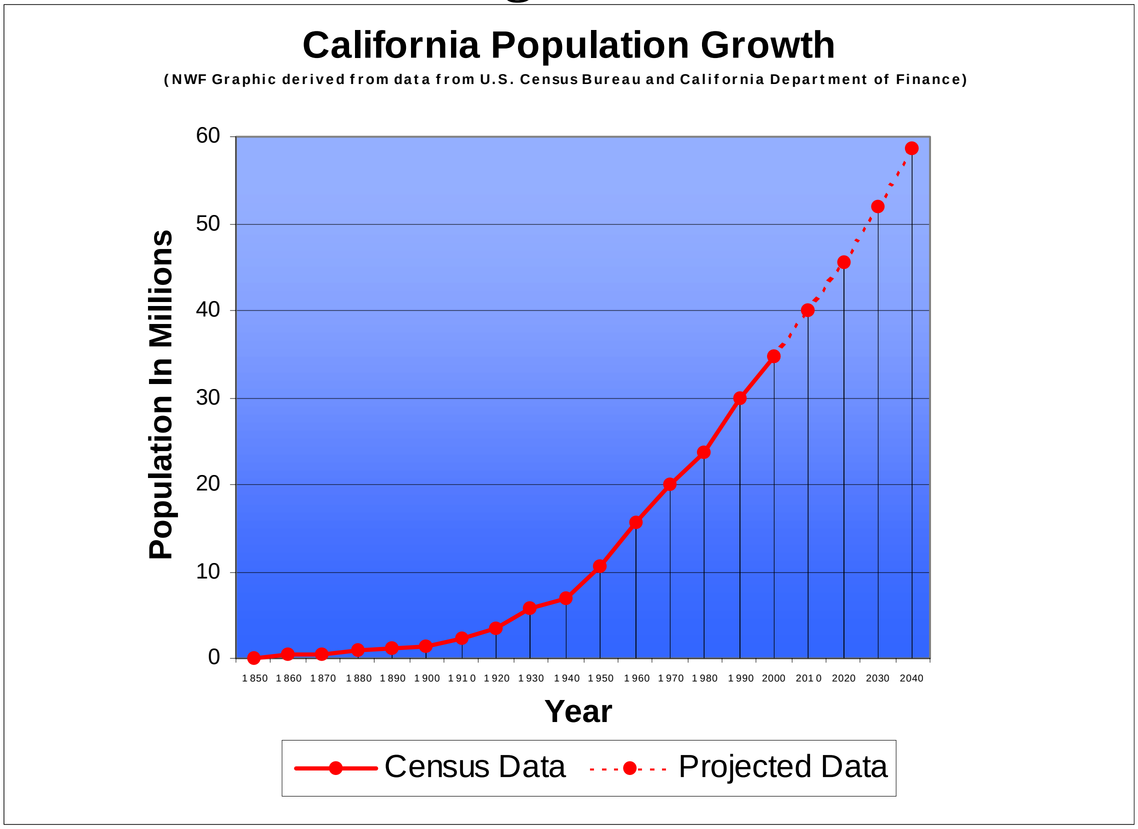
Research has also confirmed what may well be an intuitive conclusion for many: land that is high quality wildlife habitat attracts people. A recent survey of endangered ecosystems throughout the United States concluded that, "the most endangered ecosystems are typically at low elevations and have fertile soils, amiable climates, easy terrains, abundant natural resources, and other factors that encourage human settlement and exploitation."[5]

This is as true in California as elsewhere, and perhaps even more so because of the state's rich endowment of fertile soils, amiable climates, easy terrains and abundant natural resources.

Table 3 on California Habitat Loss presents a survey of the loss of many of the state's habitat types.

The shift between the historic causes of the loss of wildlife habitat in the state and the current causes has also been recognized for some time. Nearly a decade ago, a report prepared for the state's natural resource departments concluded, "Agricultural development was the major early cause of habitat loss. ... Development has been the major recent cause of habitat loss. ... Dramatic reduction in habitat acreage and severe reduction of many associated species indicate that *entire biological communities in California may become extinct*."[6] As the report accurately forecasted, "continued population growth will disproportionately affect those remaining lowland habitats already heavily impacted by past agricultural conversion and development: grassland, coastal scrub, oak

Figure 1



woodland, chaparral, coastal riparian, and stream habitat."[7]

Urbanization's impact on coastal sage scrub habitat is among the most important of all natural resource issues facing southern California. (See Case Studies.) The state's Natural Community Conservation Planning program is attempting to forge a sustainable relationship between the 35 animal and 61 plant species that are associated with this habitat that has already been depleted by between 70 and 90 percent, and development to accommodate the region's population growth.

The fate of the state's vernal pools is another example of the historic shift from agriculture to urbanization as the leading cause of habitat loss. More than 200 plant species are found in vernal pool communities, the seasonal pools that fill with rainwater during the winter and evaporate by the end of spring. As noted in *Sliding Toward Extinction*, a 1987 report for the California Senate Committee on Natural Resources and Wildlife, "Vernal pools have been destroyed over as much as 90 percent of their geographic range. ... Historically,

Table 2

Land Converted to Urban Use in California 1994-1998

Area	Acres
Southern California	**52,800**
San Joaquin Valley	**26,410**
San Francisco Bay	**20,689**
Sacramento Valley	**11,686**
Sierra Foothills	**7,296**
Central Coast	**6,464**
Northwestern	**787***
Northeastern	**99**
Total	**126,231**

These figures represent only areas monitored by the Farmland Mapping and Monitoring Program, which includes most of the state's metropolitan areas but only about half of California's total land area.
* Northwestern region figures represent only 1996-1998 data.
Source: *California Farmland Conversion Report 1996-1998*, Farmland Mapping and Monitoring Program, California Department of Conservation.

most vernal pools were lost to agricultural expansion. ... Recently, most losses resulted from urban expansion. Much of the land that is most in demand for expansion of Central Valley and south coast communities is the best remaining vernal pool habitat."[8]

These examples illustrate well established trends. All of these trends – the state's dramatic demographic transformation in a pattern of growth characterized by sprawl, the shift over time to urbanization as the leading cause of habitat loss, and the growing losses of unique wildlife habitats – have been subject to considerable attention and research.

This White Paper contributes an important new finding on the culmination of those trends by concluding on the basis of quantified research that sprawl is now the leading cause of species imperilment in California.

Sprawl Is Linked To Other Major Causes Of Species Imperilment In California

Table 1 ranks the 18 current causes of species imperilment in California and shows the number of species imperiled by each cause.

The second and third ranking causes shown in Table 1 are both linked to the state's overall pattern of sprawl.

Predation by, or competition with, non-native species is the second ranking cause of species imperilment in California, affecting 132 (46 percent) of the 286 species listed under the ESA in the state. Outdoor recreation (*e.g.*, off-road vehicles) ranks third, imperiling 123 (43 percent) of California's threatened and endangered species.

This White Paper collects and analyzes data identifying *which* factors contribute to the imperilment of each of California's 286 listed species; it does not attempt to rank the *relative contributions* of these factors to each species' imperilment. However, it is noteworthy that several of the non-sprawl causes that contribute most frequently to species imperilment -- including introduction of non-native species and outdoor recreation -- have a direct connection to sprawl.

Approximately 50,000 non-native species have been introduced to landscapes and aquatic habitats throughout the United States, about half of them plant species.[9] More than 3,000 non-native plants have been introduced to California, and many of them have escaped into the ecosystem at-large, including the yellow star thistle (*Centaurea solstitalis*) which has spread to more than 10 million acres of northern California grassland, resulting in the "total loss of this once productive grassland."[10]

As indicated in Table 3, California has experienced an 8,653 percent increase in non-native annual grassland.

As discussed in this White Paper's Case Studies, sprawl contributes to the introduction of non-native species by both habitat alteration and the introduction of exotic species to surrounding habitat. For example, grading large tracts of land in preparation for new residential subdivisions creates landscapes in which several non-native species thrive. In addition, non-natives are sometimes introduced during subdivision landscaping.

Outdoor recreation and sprawl are connected in that people frequently seek recreation as close to their homes as possible. By increasing the proximity of outdoor recreationists to natural areas, sprawl threatens many species in those areas. For example, as noted in the Case Studies, off-road vehicles account for significant losses of desert tortoises, both by hitting tortoises and by collapsing tortoises' burrows.

Table 3

California Habitat Loss

99 percent loss of native grassland

94.2 percent loss of native grassland in San Diego County

26 percent of native annual and perennial grasslands destroyed between 1945 and 1980

8,653 percent increase in non-native annual grassland

99.9 percent loss of needlegrass steppe

90 percent loss of northern coastal bunchgrass

68.2 percent loss of alpine meadows

100 percent loss of coastal strand in San Diego County

70-90 percent of presettlement southern California coastal sage scrub destroyed

91.6 percent loss of maritime sage scrub

87.7 percent loss of coastal mixed chaparral in San Diego County

>99 percent loss (virtual extirpation) of alkali sink scrub in southern California

25 percent of non-federal forestland rangelands are experiencing excessive surface soil erosion

85 percent loss of coastal redwood forests

32 percent loss of redwood forests and mixed conifer forests

72 percent loss of woodland and chaparral on Santa Catalina Island

14 percent loss of hardwood woodlands

99 percent of Central Valley riparian forests destroyed within 100 years after settlement

90-98 percent decline of Sacramento River riparian and bottomland forests

99.9 percent loss of Central Valley riparian oak forest

60.8 percent loss of riparian woodland in San Diego County

91 percent loss of wetlands (all types) between 1780s and 1980s

94 percent loss of inland wetlands

69 percent loss of tule (*Scirpus*) marsh

94-96 percent loss of Central Valley interior wetlands

31.5 loss of wetlands and deepwater habitats in the Central Valley between 1939 and mid-1980s

66-88 percent loss of Central Valley vernal pools

96.5 percent loss of vernal pools in San Diego County

90.1 percent loss of freshwater marsh in San Diego County

80 percent of coastal wetlands converted to urban or agricultural uses

62 percent loss of salt marshes

87.8 percent loss of coastal salt marsh in San Diego County

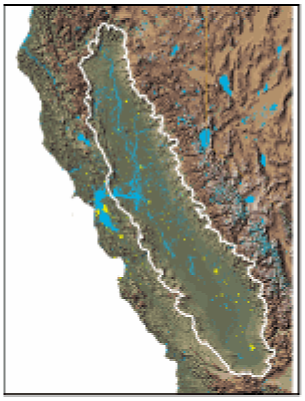
90 percent loss of seasonal wetlands around the San Francisco Bay

80 percent loss of tidal marshes in the San Francisco Bay

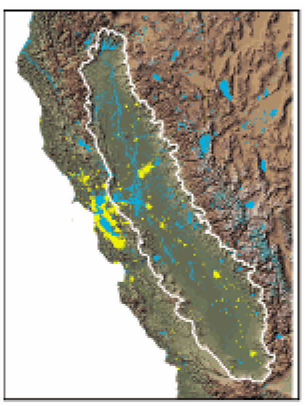
Endangered Ecosystems of the United States: A Preliminary Assessment of Loss and Degradation, Reed F. Noss, Edward T. LaRoe III, J. Michael Scott, U.S. Geological Service, 1995, pps. 53-55. Citations for findings in original.

The following maps depict the urbanization in California's Central Valley. The yellow represents growth boundaries. As evident by the maps, urbanization has significantly increased throughout the century in California's Central Valley. Source: USGS

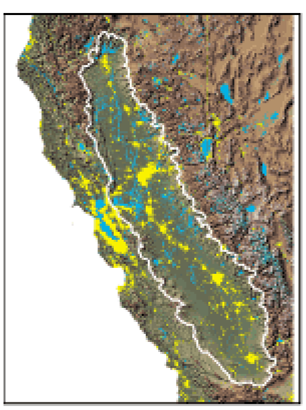
1925



1964



1996



Causes Of California Species Imperilment Associated With Sprawl

Very few species are imperiled by a single cause. In most cases, two or more causes contribute to a species' imperilment.

When two or more causes contribute to the imperilment of a species, those causes are associated.

There are three types of association: supportive, effective or incidental.

As described by Czech *et al.*:

> *Supportive association* occurs when one cause of endangerment depends on another. For example, logging a particular area may depend on road construction, and both activities may endanger the same species. *Effective association* occurs when a species is endangered by independent causes that produce the same effect. For example, aquatic species can be endangered by farming, mining, logging, and other erosive practices that cause siltation. *Incidental association* occurs when a species is endangered by independent causes that produce different effects. For example, agriculture may endanger a species in one portion of its range by destroying habitat, whereas disease endangers the species in another portion of its range.[11]

Figures 2, 3 and 4 present different aspects of the associations between sprawl and other causes of species imperilment in California.

It is beyond the scope of this White Paper to assess each of the supportive associations that exist between sprawl and the other 17 causes of species imperilment in the state. However, the data indicate that such associations exist, and quite possibly at a significant magnitude.

Figure 2 focuses on the 188 species imperiled by sprawl, showing the extent to which the species are also imperiled by other causes. For example, 102 species imperiled by sprawl are also imperiled by outdoor recreation.

Significantly, the top three associated causes of species imperilment in Figure 2 are environmental problems that are closely related to sprawl. This finding is highly suggestive of a supportive association in many cases between those causes and sprawl, *i.e.*, an association in which the cause depends on sprawl.

As Figure 2 shows, the top three causes associated with the 188 California species imperiled by sprawl are outdoor recreation,

Figure 2

188 California species imperiled by urbanization/sprawl:
Additional Causes of Imperilment (Total = 825 - See Figure 3)

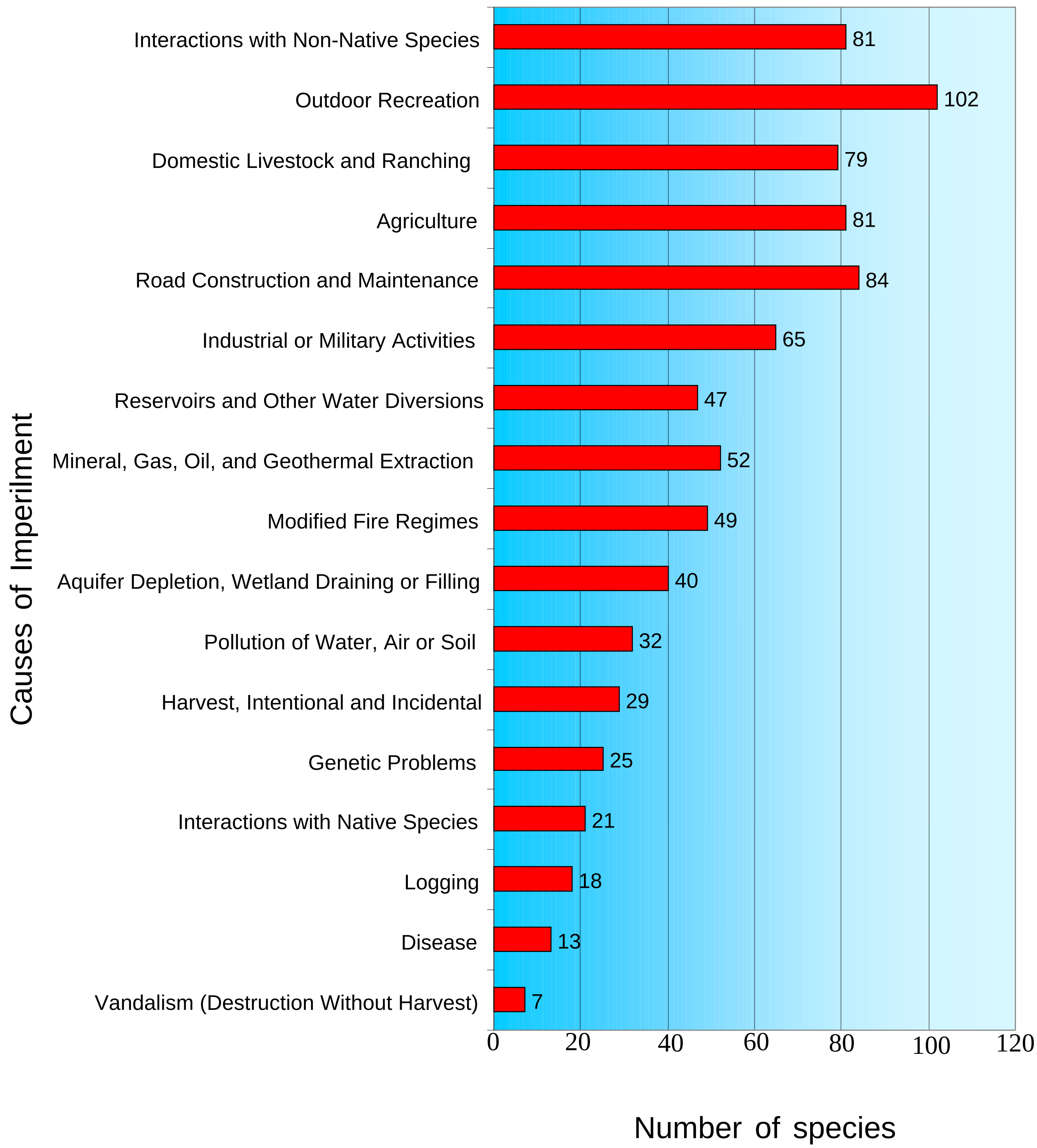
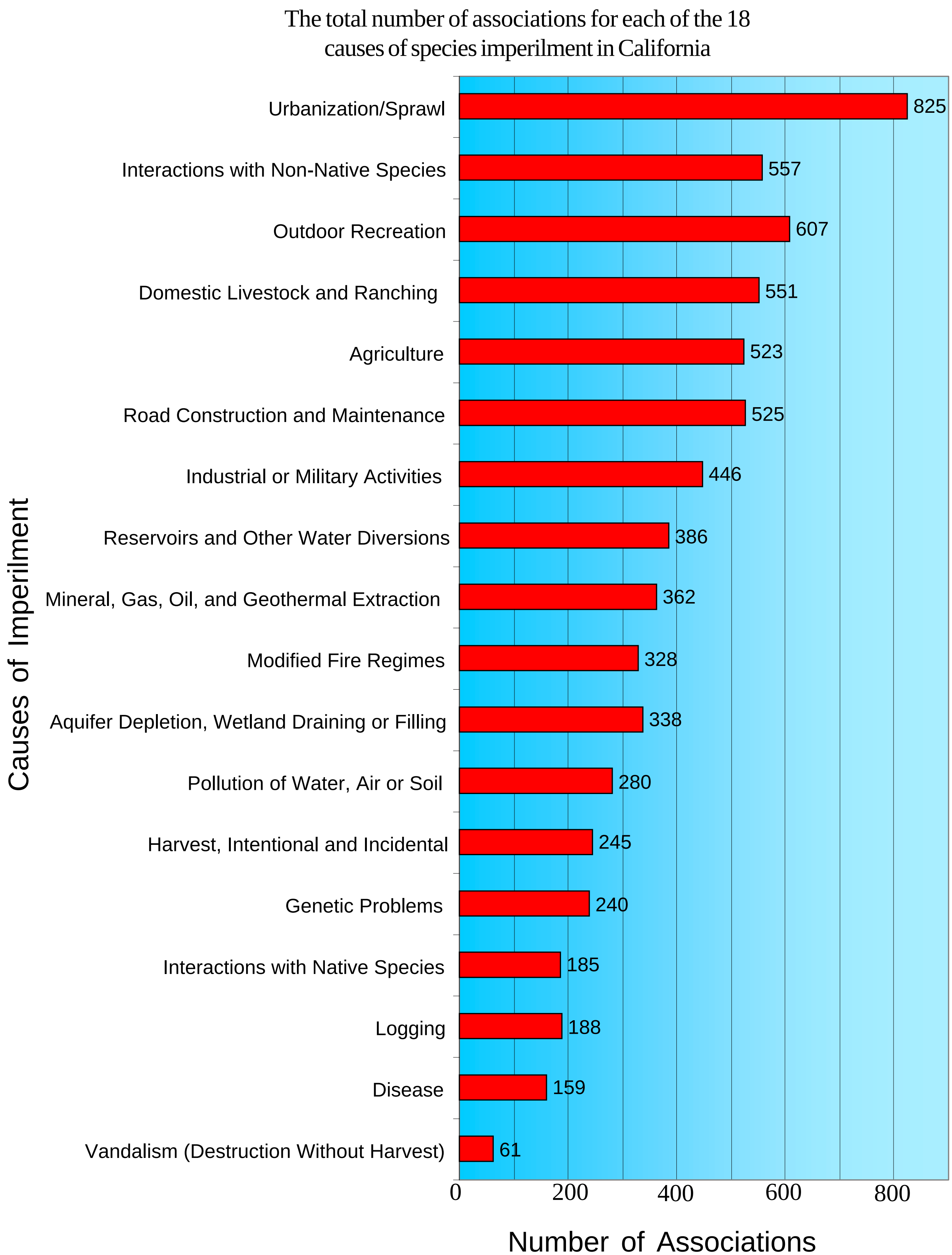


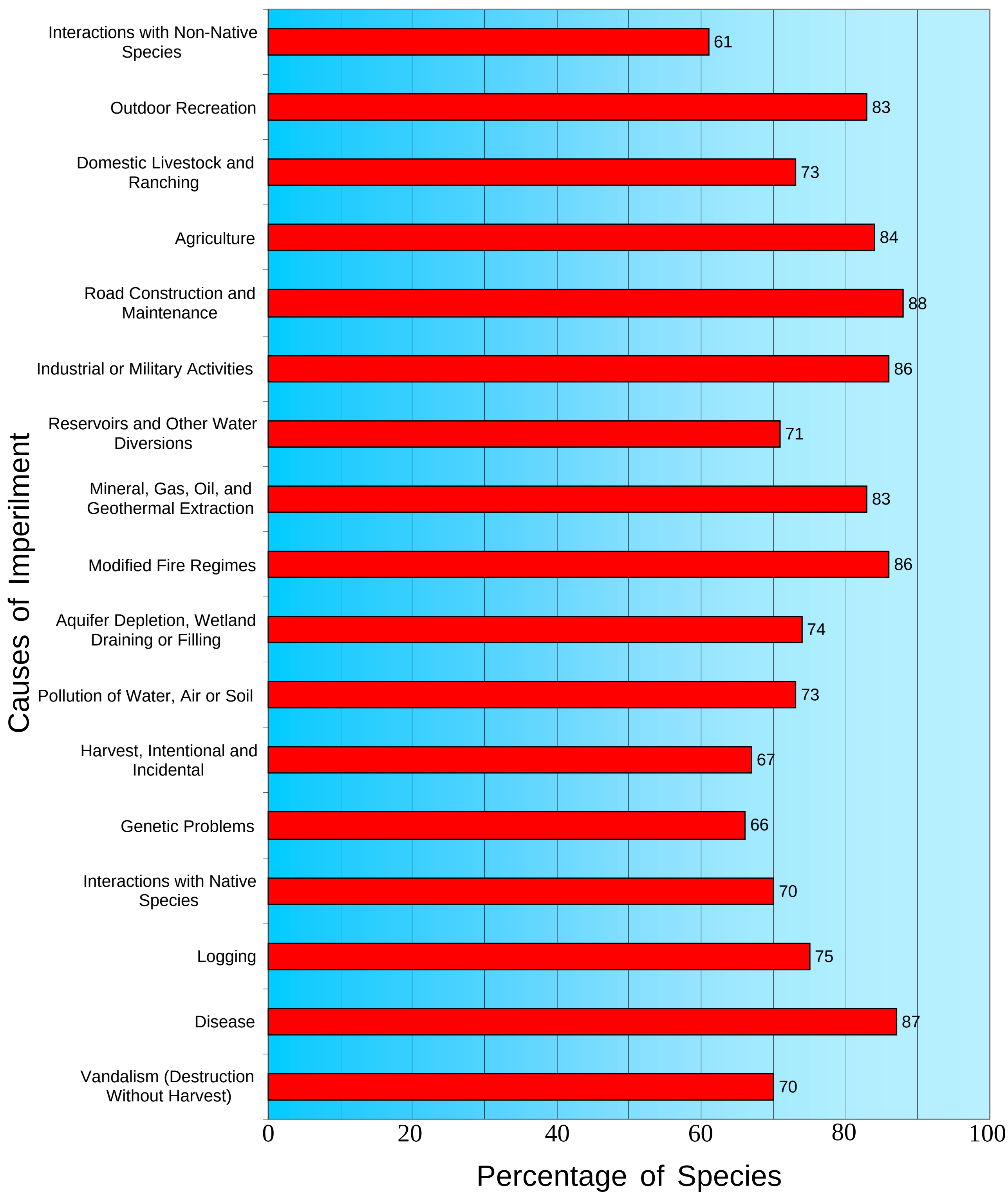
Figure 3



The total number of associations for each of the 18
causes of species imperilment in California
Urbanization/Sprawl
825
Interactions with Non-Native Species
557
Outdoor Recreation
607
Domestic Livestock and Ranching
551
Agriculture
523
Road Construction and Maintenance
525
Industrial or Military Activities
446
Reservoirs and Other Water Diversions
386
Mineral, Gas, Oil, and Geothermal Extraction
362
Modified Fire Regimes
328
Aquifer Depletion, Wetland Draining or Filling
338
Pollution of Water, Air or Soil
280
Harvest, Intentional and Incidental
245
Genetic Problems
240
Interactions with Native Species
185
Logging
188
Disease
159
Vandalism (Destruction Without Harvest)
61
Causes of Imperilment
0
200
400
600
800
Number of Associations

Figure 4

Causes of species imperilment in California and the
percentage of species imperiled by any given cause
that are simultaneously imperiled by urbanization/sprawl



road construction and non-native species. These three causes, respectively, contribute to the imperilment of 102, 84 and 81 threatened and endangered species in the state which are also imperiled by sprawl. (Agriculture also contributes to the imperilment of 81 of the 188 species that are at risk from sprawl.)

The link between sprawl and both recreation and non-native species has been discussed above.

The association between sprawl and road construction is a supportive one in many instances. Because sprawl is an automobile-dependent form of development, road construction is an essential component of the sprawl pattern of development.

Three additional causes shown in Figure 2 are also strongly linked to the overall pattern of sprawl.

Modified fire regimes, pollution and genetic problems contribute to the imperilment of 49, 32 and 25 threatened and endangered species, respectively, which are also imperiled by sprawl.

Fire suppression regimes are frequently necessary adjacent to and near new subdivisions and other development. Changes in the natural fire cycle can render habitats unsuitable for certain species, and thus contribute to their imperilment.

Sprawl is also closely linked to pollution. For example, sprawl leads to heavier loads of polluted runoff than does traditional development.

Sprawl is associated with genetic problems because sprawl destroys and fragments habitat. It thereby causes crowding of species into shrinking habitats, increases the inbreeding of isolated populations of species and decreases the opportunities for movement through habitat corridors that helps maintain genetic variability.

Figure 3 presents the total number of associations for each of the 18 causes of species imperilment in California. Strikingly, sprawl has a higher incidence of associations than any other cause of California species imperilment. For example, the California species imperiled by urbanization/sprawl are also imperiled by the other 17 causes in a total of 825 instances. The next closest is outdoor recreation with a total incidence of imperilment association of 607. This finding suggests that many causes of species imperilment depend on sprawl.

Figure 4 reviews the 17 non-sprawl causes of species imperilment in California and shows the percentage of species imperiled by a given cause that are simultaneously imperiled by sprawl. For instance, 88 percent of the species imperiled by roads are also imperiled by sprawl, as are 86 percent of those imperiled by both modified fire regimes and industrial or military activity.

When compared to all other associations, sprawl is associated with a higher percentage of species imperilment by cause than any other factor contributing to species imperilment in California.[12] Again, this finding suggests that in many instances these associations are supportive, *i.e.*, that many causes of species imperilment depend on sprawl.

Conclusions

Sprawl is the leading cause of species imperilment in California.

Increasingly, as sprawl encroaches on more and more natural lands, the loss of vital wildlife habitat is not a problem happening "out there," far removed from metropolitan centers, but is a mounting threat occurring "right here," where most people live and work.

The conventional view that species endangerment in the United States is a problem most closely associated with natural resource extraction on broad landscapes far removed from metropolitan areas is no longer valid, at least in California.

This does *not* mean that less attention should be paid to imperiled species inhabiting broad tracts of public and other lands.

It does mean that there is a vital need for greater awareness and attention to the cost of habitat loss and species imperilment posed by sprawl. Creating a place for wildlife in California requires an understanding of sprawl's role as the leading cause of species imperilment.

Many of the other causes of California species imperilment depend on sprawl. For example, the loss and fragmentation of habitat and the severing of migratory corridors for wildlife caused by road construction to service ever-expanding residential subdivisions are perhaps the most obvious instances of causes of species imperilment that depend on sprawl. Other associations may be more subtle. Loss of genetic diversity, for example, should not be viewed in an isolated context, but as a cause of species imperilment that is associated with sprawl.

The associations data in this White Paper suggest that many causes of species imperilment are closely intertwined with sprawl. These data suggest that the environmental problems causing the decline of fish, wildlife and plant species in California would probably be much less severe if sprawl were to be replaced with a more wildlife-sensitive form of development.

The purpose of this National Wildlife Federation Smart Growth and Wildlife Campaign White Paper is to illuminate the threats to the state's wildlife by presenting the first-ever quantitative assessment of the causes of species imperilment in California. It is also intended to inform the debate necessary to forge solutions – to sustain California's rich endowment of wildlife and wild places.

The findings of this White Paper have important implications for the state's lawmakers, conservationists, developers, land use planners, and people in general. Understanding sprawl's role as the leading cause of species imperilment is necessary to stimulate smart growth efforts that conserve wildlife habitat in California.

Methodology

Brian Czech, Paul R. Krausman and Patrick K. Devers published a peer reviewed article entitled "Economic Associations Among Causes of Species Endangerment in the United States" in the July, 2000, edition of *BioScience*. As chief researcher for this White Paper, Czech employed the data from that article, updated it, and produced the quantitative analysis of the current causes of species imperilment in California presented here.

The data in the *BioScience* article covered the 877 species that were federally listed as threatened and endangered in the United States and Puerto Rico through August 1994. Information on the causes of imperilment for those species was drawn from volumes of *The Official World Wildlife Fund Guide to Endangered Species of North America* by D.W. Lowe *et al*. (1990), C.J. Moseley (1992), and Walton Beachman (1994).

For this White Paper, a list was developed of federally listed threatened and endangered species found in California. The primary source of information on species listings was the U.S. Fish and Wildlife Service's Environmental Conservation Online System. Additional listing information from the National Marine Fisheries Service Northwest Region was used for several anadromous fish species. The list included taxonomic species, subspecies, distinct population segments, and evolutionarily significant units; *i.e.*, all categories of taxa identified as species pursuant to the Endangered Species Act. The list does not include two sea turtle species or the short-tailed albatross, which are oceanic species periodically sighted near the coast of California.

For each of these California species, the causes of endangerment were ascertained and classified into the 18 categories of species endangerment, consistent with the *BioScience* report.

For species listed prior to July 31, 1994, the database developed for the *BioScience* report was used. For species listed after July 31, 1994, the final listing notices from the Federal Register were used to ascertain causes of endangerment.

When ascertaining the causes of a species' endangerment, only causes that have been operational since passage of the Endangered Species Act in 1973 were used. This precludes some historic causes (*e.g.*, market hunting from early in the 20th century), but includes some historic causes that are ongoing (*e.g.*, agricultural development). Planned activities that will contribute to the endangerment of a species (*e.g.*, development of a subdivision) were included as causes of endangerment only if the plan was formally adopted by a party with the authority to implement the plan. This occurred with a small percentage of species. If a cause of endangerment was mentioned in the Federal Register notice with no time frame alluded to, it was included.

Causes for which the Federal Register listing indicated significant doubt were not included.

California Case Studies
How Sprawl Harms Wildlife

Habitat Loss

Sprawl requires more land per capita than traditional development patterns, and in doing so destroys forests, wetlands and other open space. In most metropolitan areas across the United States, the rate of land consumption now far outpaces population growth. Los Angeles' developed area increased by 300 percent between 1970 and 1990, while its population grew by only 45 percent over the same time period.[13] Once natural lands are developed, their ecological, wildlife habitat and open space values are severely diminished, and it is generally impossible or very expensive to replicate these values.

Kevin Doyle

B. Moose Peterson

The San Joaquin kit fox (photo left) is well adapted to survive in dry grasslands and scrublands. Its big ears act as air conditioning during the hot days, and the hair on the pads of its feet give it traction on sand. This tiny fox, weighing an average of less than 5 pounds, has even evolved not to need fresh water. The kit fox fulfills its water needs from its prey.

However, the endangered kit fox cannot survive without its habitat. Biologist Patrick Kelly, director of the San Joaquin Valley Endangered Species Recovery Planning Program, cites large scale habitat loss, degradation and fragmentation in the San Joaquin Valley as the major threat to the kit fox's survival.[14] The kit fox once roamed throughout the entire Central Valley, but is now limited to the less than five percent of the San Joaquin Valley that remains as natural habitat.

As the kit fox's habitat is replaced by urbanization and agriculture, they are trying to survive in this new environment. Kit foxes have begun hunting in abandoned lots, denning under fuel storage tanks, and begging for food. This new lifestyle comes with risks. Cars and trucks are a main cause of death for kit fox pups.

USFWS Photo

Sprawl threatens entire ecosystems in California. For example, coastal sage scrub (photo left) is an incredibly diverse and sensitive habitat that is found on dry slopes, usually near the coast. While the ecosystem gets less than 10 inches of rain a year, technically qualifying as a desert, precipitation from fog allows the scrub to survive. This water-poor, rocky environment is home to endangered birds and butterflies, such as the California gnatcatcher, the Palos Verdes blue butterfly, and the Quino checkerspot. Several other imperiled species -- cactus mouse, pocket mouse, kangaroo rat, and Santa Ana mountain lion-- also live in coastal sage scrub.

Dr. Lloyd Glenn Ingles CA Academy of Science

Southern California has lost 70 to 90 percent of its coastal sage scrub habitat, mostly to sprawl. Roads and sprawl fragment what is left, creating barriers to wildlife movement and increasing habitat edges that make the coastal sage scrub more susceptible to invasive species. Thus, for example, the California gnatcatcher is losing ground to cowbirds; the Santa Ana mountain lion population is blocked from interacting with other populations; and the Stephen's kangaroo rat (photo right) and other small rodents have become victims to feral cats brought to their habitat as an unintended result of human activity.

Habitat Degradation

Sprawl not only destroys habitats in the newly developed area, it degrades the surrounding habitat as well.

Disruption of Natural Processes

Kevin Doyle

Even when aquatic habitats are not totally destroyed by sprawl, they suffer enormously. These habitats are directly impacted by sprawl when rivers are channelized for flood control, or streams are covered or diverted by roads and buildings. Sprawl indirectly affects aquatic habitat by removing trees from riparian and coastal habitats, adding to erosion and siltation, and increasing impervious surfaces. The Environmental Protection Agency estimates that urban runoff is directly responsible for up to two-thirds of coastal water pollution. In undeveloped areas, precipitation is more likely to be absorbed into the ground, enabling it to travel more slowly than surface runoff and to be cleansed of contaminants. Precipitation that falls onto impervious surfaces such as roads, parking lots and driveways travels over land faster and does not have the benefit of filtration through soils. Precipitation also carries with it solids and sediments that enter waterways without the benefit of filtration. By adding pavement and disrupting the natural filtering process, sprawl harms rivers, lakes and wetlands, which must absorb greater intensities of increasingly polluted runoff.


USFWS Photo

The endangered arroyo toad (photo left) is a classic example of how habitat degradation can affect a species. Arroyo toads breed in small to large streams in Central and Southern California and northern Baja California, Mexico that retain enough water from late March to mid-June to support the tadpoles until they metamorphose. As areas around these waterways are developed, the toad's habitat becomes altered, polluted or destroyed, greatly contributing to the decline of the species. Dam construction alone has been responsible for the loss of 40 percent of their original range, and approximately 20 drainages remain in the United States that support arroyo toad populations.

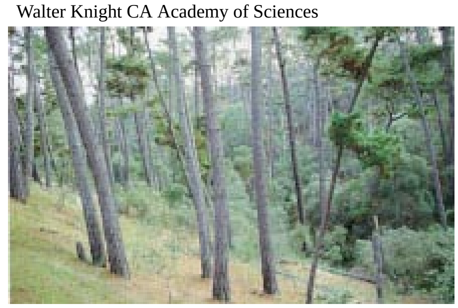
In addition to the loss of at least 75 percent of the arroyo toad's stream habitat in California, arroyo toads in the remaining 25 percent of its habitat face the threat of another form of habitat degradation - the introduction of non-native species. Non-native predators such as bullfrogs, bass, and sunfish prey on both tadpoles and adult toads. Non-native plants such as arundo and tamarisk grow so densely in some places that arroyo toads are prevented from foraging, in addition to shading the pools and making them unsuitable for breeding.

Unless significant action is taken to reverse these trends, it is estimated that the arroyo toad will run out of habitable areas within the next 20 years.

Wildfire Suppression

Sprawl disturbs another important natural process: wildfires. Several California ecosystems have evolved to respond to regular burning, including chaparral, coastal sage scrub, and closed-cone pine communities. In Sierra Conifer forests, species such as Monterey and Knobcone pines (photos right) rely on wildfires for survival; their seeds are only released when the resin on their pine cones is melted away by fire. Wildlife managers have maintained this and other fire dependent ecosystems by using prescribed burning techniques. With careful management, trained staff can safely contain low-level fires that regenerate forests and burn leaf litter which helps prevent destructive forest fires. However, prescribed burning cannot be conducted near roads or buildings. Development in or near these forests results in suppression of wildfire and limits on prescribed burning. When burning is limited it alters the regenerative cycle that trees and other plants depend on and to which the wildlife is adapted.[15]


Walter Knight CA Academy of Sciences


CA Native Plant Society


Kevin Doyle

Noise Pollution

When sprawl encroaches on habitat, noise often diminishes the habitat's value. Excess noise from airplanes, heavy machinery, cars, and off-road vehicles disrupts wildlife activity. Desert animals, in particular, require a very acute sense of hearing to survive. Exposure to chronic noise has caused documented hearing loss in the endangered kangaroo rat and the desert iguana, reducing their ability to avoid predators and obtain food.[16]

Excess noise from roads and developments can cause injury, decreased food intake, habitat avoidance and abandonment, and reproductive losses by drowning out both sexes' mating calls.


Gerald and Buff Corsi CA Academy of Sciences

High-Impact Outdoor Recreation

As sprawl infringes on natural areas, it opens these areas to more frequent high-impact recreation. The construction of recreational facilities on the outskirts of developed areas increases access to environmentally sensitive areas, and encourages new sprawl development including hotels, restaurants and gas stations. High-impact recreation, in the form of off-road vehicles, plays a key role in the decline of the desert tortoise (photo right). In southern California thousands of all-terrain vehicles roam the deserts. These vehicles kill tortoises by hitting them and by collapsing their burrows. Studies have shown that tortoise habitat open to use of these vehicles may have only a third as many tortoises as comparable areas that are closed to off-road vehicles.

Habitat Fragmentation

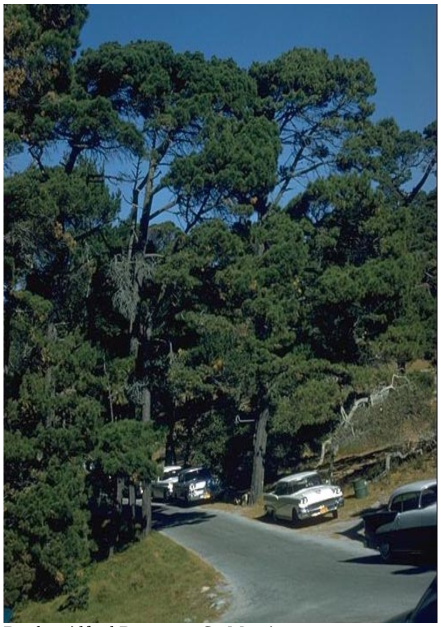
New roads and other construction for sprawl fragment undisturbed habitat. This limits wildlife movement and alters the habitat that is left.

Blocking Wildlife Movement

Sprawl fragments habitat when developers build in the middle of undisturbed habitat. Roads block migration routes and cut off wildlife from food sources. Many species either avoid roads, like the bald eagle, or are unable to cross roads, like the desert tortoise. Thus, habitat fragments take on the characteristics of island ecosystems. Smaller habitat islands generally have less species diversity and are more vulnerable to extinctions due to disease, floods, and other disturbances.[17] To keep small fragments of habitat viable it is important that migration corridors exist.


Dept. of Fish and Game

Without adequate continuous habitat a population of large, wide-ranging animals, such as the Santa Ana mountain lion (photo right), will eventually disappear. The Santa Ana mountain lion is a cougar, and is related to other North American cougars such as the Florida panther. Although healthy populations of mountain lions exist in other areas of California, habitat fragmentation has isolated the Santa Ana population.[18] Lions are nomadic species accustomed to moving through large expanses of habitat, allowing individuals to interbreed with other populations, and young to find new territory. In southern California, urbanized lands and roads block mountain lion access to available habitat, and often fragment habitat into areas not large enough to sustain lions. A 1992 study found that a corridor which allows as few as one to four lions to immigrate per decade would markedly increase the population's chance of survival over the next 100 years.[19] Protecting corridors for the Santa Ana mountain lion requires regional planning among five counties and cooperation from land owners. Experts believe there are less than 20 lions living in the Santa Ana mountain region, and the death of even one is a significant loss. As the lion disappears from southern California, the health of the ecosystem suffers. Unless measures are taken to stop habitat loss and fragmentation, the extinction of the Santa Ana mountain lion is inevitable.



Brother Alfred Brousseau St. Mary's College

Edge Effect

When a road is built through previously undisturbed habitat it not only cuts the habitat into pieces, it increases the amount of habitat adjacent to human activity. One of the effects of this conversion to edge habitat is a decrease in habitat quality. For example, grasses and shrubs rather than larger trees and forest habitat often predominate. This conversion process reduces the original forest habitat, and can force forest species into edge habitats where they become more vulnerable to predator and pest species.

Predator species such as raccoons and feral cats, which rarely venture far into interior forest habitat, thrive in the disturbed edge habitat near roads and development. Many of these edge species will prey on the eggs and young of the already stressed forest species. Predation by feral cats is a serious threat to several California endangered species -- such as the Point Arena mountain beaver, Stephen's kangaroo rat, and Pacific pocket mouse -- due to habitat fragmentation and the edge effect.

Loss Of Species Diversity

Ecosystems in the United States are blessed with a rich variety of species. However, as sprawl moves into an area, the surrounding ecosystem's species diversity decreases. The once distinct native habitats are replaced by monotonous landscapes with very few species. More sensitive native species that depend on fragile local habitats are replaced by generalist species and non-indigenous species that thrive in human-shaped environments.

USFWS Photo

Exotic Species

Sprawl contributes to the introduction of non-native species by altering habitat and by introducing these species into the surrounding habitat. Often the first step in building a new sprawl-type development is to clear and grade the land. Non-native species are most successful in large disturbed areas where native plants have been cleared. Residents in new developments may unknowingly introduce an exotic species to the wild. A garden or greenhouse plant may scatter shoots or seeds. Many of the exotic species that take hold are considered pests and must be removed. One recent study put national annual costs and damages due to non-native species at $123 billion per year.[20]

Gerald and Buff CA Academy of Sciences

The star mustard (*Coincya monensis)* is a relatively new arrival in California, first discovered in 1997 in Humbolt County. It is thought to have been introduced on construction equipment or in fertilizer. Originally a European species, the star mustard is an extremely fast spreading species which has already damaged native populations of plants in Pennsylvania and along the east coast.

The species thrives in recently disturbed areas and in coastal dune systems. In California, the concern is for the sand-verbena-beach dunes. These dunes are seriously threatened by the spread of other invasive species. Two federally listed species, the Humboldt bay wallflower and the beach layia (photo left), will be further threatened if star mustard is allowed to spread.

Changing Dynamics

When sprawl alters habitat, some species native to the United States spread beyond their historic range and outcompete local species. The California gnatcatcher (photo below right), which has already lost three-fourths of its native habitat, is now also imperiled by the cowbird, a nest parasite. When gnatcatchers lay and incubate their eggs, the cowbird stealthily replaces the gnatcatcher's eggs with its own eggs. The gnatcatcher then incubates these eggs as if they are its own. Because the gnatcatcher has such a short breeding period, by the time the cowbird's eggs hatch, the gnatcatcher does not have time to produce more eggs. As the population of cowbirds keeps rising, gnatcatchers are losing their ability to reproduce successfully.

USFWS Photo

Gnatcatchers generally avoid crossing even small patches of unsuitable habitat. In contrast, cowbirds were originally limited to short grass prairies in the Midwest but have adapted to living in forest edge communities. Because cowbirds benefit from forest fragmentation, their range and incidences of parasitism on forest birds have increased. The most effective way to control the spread of cowbirds is to reduce habitat fragmentation.[21]

The increase of generalist species such as the cowbird and the star mustard causes the variety of species to plummet even if the overall numbers of animals and plants do not.

In conclusion, when governments and planners do not consider wildlife habitat, they risk destroying it. The best way to ensure that smart growth reverses the damage caused by sprawl is to integrate wildlife and natural resource planning with land use and transportation planning. Only with such coordinated planning can we begin to accomodate the needs of both people and wildlife.

Endnotes

1. Quantifying Threats to Imperiled Species in the United States, David S. Wilcove *et al.*, *BioScience*, August 1998, Vol. 48, No. 8, p. 609.

2. *The Endangered Species Act: History, Conservation Biology, and Public Policy*, Brian Czech and Paul R. Krausman, John Hopkins University Press, 2001.

3. Total ESA listings from U.S. Fish and Wildlife Service as of December 31, 2000; total candidates for listing as of May 31, 2000.

4. *California Farmland Conversion Report 1996-1998*, Farmland Mapping and Monitoring Program, California Department of Conservation, June 2000.

5. *Endangered Ecosystems of the United States: A Preliminary Assessment of Loss and Degradation*, Reed F. Noss, Edward T. LaRoe III and J. Michael Scott, 1995, p. 13.

6. *Reassembling the Pieces: A Strategy for Maintaining Biological Diversity in California*, prepared by Jones & Stokes Associates, Inc., for the California Department of Forestry and Fire Protection and the California Department of Fish and Game, 1992, p. 22. (Emphasis added.)

7. *Reassembling the Pieces*, p. 33.

8. *Sliding Toward Extinction: The State of California's Natural Heritage*, California Senate Committee on Natural Resources and Wildlife, 1987, p. 71.

9. *Environmental And Economic Costs Associated With Non-Indigenous Species In The United States*, David Pimentel *et al*., Cornell University College of Agriculture and Life Sciences, June 1999, pps. 11-12. In addition to approximately 25,000 non-native plants, the report estimates other non-native species in the United States as 20,000 microbes, 4,500 anthropods, 138 fish, 97 birds, 88 mollusks and 20 mammals.

10. As cited in *Environmental And Economic Costs*, p. 2.

11. Economic Associations Among Causes of Species Endangerment in the United States, Brian Czech, Paul R. Krausman, and Patrick K. Devers, *BioScience*, July 2000, Vol. 50, No. 7, p. 595. (Emphasis added.)

12. The Figure 4 percentage data were compiled for all 18 causes of species imperilment in California and urbanization/sprawl had higher percentages overall than any of the other causes.

13. *Land Use In America*, Henry L. Diamond and Patrick F. Noonan, pps. 4.

14. Survival By Handout? As a California city expands into the habitat of San Joaquin kit foxes, the endangered animals are showing up all over town, Sharon Begley, *National Wildlife*, December/January 1997.

15. United States Fish and Wildlife Service, November 1997, Significant Habitats and Habitat Complexes of the New York Bight Watershed, http://training.fws.gov/library/pubs5/web_link/text/ntr_com.htm. Accessed Jan. 10, 2001.

16. Noise Pollution Clearinghouse, Fact Sheet Noise Effects on Wildlife.

17. *Protecting Delaware's Natural Heritage: Tools for Biodiversity Conservation*, Environmental Law Institute, 1999, p.9.

18. Highway Takes Toll on Wildlife, Meg James, *Los Angeles Times*, September 3, 2000.

19. Determining Minimum Habitat Areas and Habitat Corridors for Cougars, Paul Beier, *Conservation Biology*, Vol. 7, Number 1, March 1993.

20. *Harmful Non-Native Species: Issues for Congress III, Environmental Hot Topics*, Congressional Research Service, 1999.

21. Brown-headed Cowbirds: From buffalo birds to modern scourge, Lisa Petit, Forest Guardians, Smithsonian Institute, 1998, http://www.fguardians.org/news/n980307.html. Accessed Jan. 8, 2001.

California Endangered And Threatened Species
Affected By Urbanization/Sprawl

(Endangered Species are denoted with an "E" and Threatened Species are denoted with a "T")

Count	Genus & Species	Common Name	T/E
1	Acanthomintha ilicifolia	San Diego thornmint	T
2	Acanthomintha obovata ssp. duttonii	San Mateo thornmint	E
3	Allium munzii	Munz's onion	E
4	Ambystoma californiense	California tiger salamander (distinct population)	E
5	Ambystoma macrodactylum croceum	Santa Cruz long-toed salamander	E
6	Arctostaphylos glandulosa ssp. crassifolia	Del Mar manzanita	E
7	Arctostaphylos morroensis	Morro manzanita	T
8	Arctostaphylos myrtifolia	Ione manzanita	T
9	Arctostaphylos pallida	Pallid manzanita	T
10	Arenaria ursina	Bear Valley sandwort	T
11	Astragalus albens	Cushenbury milk-vetch	E
12	Astragalus brauntonii	Braunton's milk-vetch	E
13	Astragalus lentiginosus coachellae	Coachella Valley milk-vetch	E
14	Astragalus tener titi	Coastal dunes milk-vetch	E
15	Atriplex coronata notatior	San Jacinto Valley crownscale	E
16	Baccharis vanessae	Encinitas Baccharis	T
17	Baccharis vanessae	Encinitas Baccharis	T
18	Berberis nevinii	Nevin's barberry	E
19	Blennosperma bakeri	Baker's sticky seed	E
20	Branchinecta conservatio	Conservancy fairy shrimp	E
21	Branchinecta longiantenna	Longhorn fairy shrimp	E
22	Branchinecta lynchi	Vernal pool fairy shrimp	T
23	Branchinecta sandiegonensis	San Diego fairy shrimp	E
24	Brodiaea filifolia	Thread-leaved brodiaea	T
25	Brodiaea pallida	Chinese Camp brodiaea	T
26	Bufo microscaphus californicus	Arroyo toad	E
27	Callophrys mossii bayensis	San Bruno elfin butterfly	E
28	Calyptridium pulchellum	Mariposa pussypaws	T
29	Calystegia stebbinsii	Stebbins' morning-glory	E
30	Castelleja grisea	San Clemente Island Indian Paintbrush	E
31	Castilleja affinis neglecta	Tiburon paintbrush	E
32	Castilleja campestris succulenta	Fleshy owl's-clover	T
33	Castilleja cinerea	Ash-grey paintbrush	T
34	Catostomus santaanae	Santa Ana sucker	T
35	Caulanthus californicus	California jewelflower	E
36	Ceanothus ferrisae	Coyote ceanothus	E
37	Ceanothus ophiochilus	Vail Lake ceanothus	T
38	Ceanothus roderickii	Pine Hill ceanothus	E
39	Chamaesyce hooveri	Hoover's spurge	T
40	Charadrius alexandrinus nivosus	western snowy plover	T
41	Chlorogalum purpureum	Purple amole	T
42	Chorizanthe howellii	Howell's spineflower	E
43	Chorizanthe orcuttiana	Orcutt's spineflower	E
44	Chorizanthe pungens var. hartwegiana	Ben Lomond spineflower	E
45	Chorizanthe pungens var. pungens	Monterey spineflower	T
46	Chorizanthe robusta var. robusta	robust spineflower	E
47	Chorizanthe valida	Sonoma spineflower	E
48	Cirsium fontinale fontinale	Fountain thistle	E
49	Cirsium fontinale obispoense	Chorro Creek bog thistle	E
50	Cirsium hydrophilum hydrophilum	Suisun thistle	E
51	Clarkia franciscana	Presidio clarkia	E
52	Clarkia speciosa immaculata	Pismo clarkia	E
53	Clarkia springvillensis	Springville clarkia	T
54	Cordylanthus maritimus ssp. maritimus	salt marsh bird's-beak	E
55	Cordylanthus mollis mollis	Soft bird's-beak	E
56	Cordylanthus palmatus	palmate-bracted bird's-beak	E
57	Cordylanthus tenuis capillaris	Pennell's bird's-beak	E
58	Cupressus abramsiana	Santa Cruz cypress	E
59	Cupressus goveniana goveniana	Gowen cypress	T
60	Delphinium bakeri	Baker's larkspur	E
61	Delphinium luteum	Yellow larkspur	E
62	Dipodomys heermanni morroensis	Morro Bay kangaroo rat	E
63	Dipodomys merriami parvus	San Bernardino Merriam's kangaroo rat	E
64	Dipodomys nitratoides exilis	Fresno kangaroo rat	E
65	Dipodomys nitratoides nitratoides	Tipton kangaroo rat	E
66	Dipodomys stephensi	Stephens' kangaroo rat	E
67	Dodecahema leptoceras	slender-horned spineflower	E
68	Dudleya abramsii parva	Conejo dudleya	T
69	Dudleya cymosa ovatifolia	Santa Monica Mountains dudleyea	T
70	Dudleya setchellii	Santa Clara Valley dudleya	E
71	Dudleya stolonifera	Laguna Beach liveforever	T
72	Empidonax traillii extimus	Southwestern willow flycatcher	E
73	Eriastrum densifolium ssp. sanctorum	Santa Analysis River woolly-star	E
74	Eriastrum hooveri	Hoover's wooly-star	T
75	Erigeron parishii	Parish's daisy	T
76	Eriodictyon altissimum	Indian Knob mountain balm	E
77	Eriodictyon capitatum	Lompoc yerba santa	E
78	Eriogonum apricum	Ione buckwheat	E
79	Eriogonum kennedyi austromontanum	Southern mountain wild-buckwheat	T
80	Eriogonum ovalifolium vineum	Cushenbury buckwheat	E
81	Eryngium aristulatum var. parishii	San Diego button-celery	E
82	Erysimum menziesii	Menzies' wallflower	E
83	Erysimum teretifolium	Ben Lomond wallflower	E
84	Eucyclobius newberryi	tidewater goby	E
85	Euphilotes battoides allyni	El Segundo blue butterfly	E
86	Euphilotes enoptes smithi	Smith's blue butterfly	E
87	Euphydryas editha bayensis	bay checkerspot butterfly	T
88	Euphydryas editha quino	Quino checkerspot butterfly	E
89	Fremontodendron californicum decumbens	Pine Hill flannelbush	E
90	Fremontodendron mexicanum	Mexican flannelbush	E
91	Galium californicum sierrae	El Dorado bedstraw	E
92	Gambelia silus	blunt-nosed leopard lizard	E
93	Gasterosteus aculeatus willimasoni	unarmored threespine stickleback	E
94	Gila bicolor snyderi	Owens tui chub	E
95	Gilia tenuiflora ssp. arenaria	Monterey gilia	E
96	Glaucopsyche lygdamus palosverdesensis	Palos Verdes blue butterfly	E
97	Haliaeetus leucocephalus	Bald Eagle	T
98	Helminthoglypta walkeriana	Morro shoulderband snail	E
99	Hemizonia conjugens	Otay tarplant	T
100	Hesperolinon congestum	Marin dwarf-flax	T
101	Holocarpha macradenia	Santa Cruz tarplant	T
102	Howellia aquatilis	Water howellia	T
103	Hypomesus transpacificus	delta smelt	E

California Endangered And Threatened Species
Affected By Urbanization/Sprawl

(Endangered Species are denoted with an "E" and Threatened Species are denoted with a "T")

104	Icaricia icarioides missionensis	Mission blue butterfly	E
105	Lasthenia burkei	Burke's goldfields	E
106	Lasthenia conjugens	Contra Costa goldfields	E
107	Layia carnosa	beach layia	E
108	Lembertia congdonii	San Joaquin wooly-threads	E
109	Lepidurus packardi	Vernal pool tadpole shrimp	E
110	Lesquerella kingii bernardina	San Bernardino Mountains bladderpod	E
111	Lessingia germanorum	San Francisco lessingia	E
112	Lilium occidentale	Western lily	E
113	Lilium pardalinum pitkinense	Pitkin Marsh lily	E
114	Limnanthes floccosa ssp. californica	Butte County meadowfoam	E
115	Limnanthes vinculans	Sebastopol meadowfoam	E
116	Lupinus nipomensis	Nipomo Mesa lupine	E
117	Lupinus tidestromii	clover lupine	E
118	Masticophis lateralis euryxanthus	Alameda whipsnake	T
119	Microtus californicus scirpensis	Amargosa vole	E
120	Monardella linoides viminea	Willowy monardella	E
121	Navarretia fossalis	Spreading navarretia	T
122	Navarretia leucocephala pauciflora	Few-flowered navarretia	E
123	Navarretia leucocephala plieantha	Many-flowered navarretia	E
124	Neotoma fuscipes riparia	Riparian woodrat	E
125	Oncorhynchus kisutch	Central California coast coho salmon	T
126	Oncorhynchus kisutch	coho salmon, Central California ESU	T
127	Oncorhynchus kisutch	coho salmon, Southern Oregon and Northern California Coasts ESU	T
128	Oncorhynchus mykiss	Steelhead, Central California Coast	T
129	Oncorhynchus mykiss	Steelhead, Central Valley, California	T
130	Oncorhynchus mykiss	Steelhead, Northern California	T
131	Oncorhynchus mykiss	Steelhead, South-Central California Coast	T
132	Oncorhynchus mykiss	Steelhead, Southern California	E
133	Oncorhynchus tshawytscha	chinook salmon, Central Valley spring-run	T
134	Oncorhynchus tshawytscha	chinook salmon, California Coastal	T
135	Oncorhynchus tshawytscha	chinook salmon, Sacramento River winter-run	E
136	Opuntia treleasei	Bakersfield cactus	E
137	Orcuttia californica	California orcutt grass	E
138	Orcuttia inaequalis	San Joaquin orcutt grass	T
139	Orcuttia pilosa	Hairy orcutt grass	E
140	Orcuttia tenuis	Slender orcutt grass	T
141	Orcuttia viscida	Sacramento orcutt grass	E
142	Ovis canadensis	Desert Bighorn Sheep - Peninsular Ranges Population Segment	E
143	Oxytheca parishii goodmaniana	Cushenbury oxytheca	E
144	Parvisedum leiocarpum	Lake County stonecrop	E
145	Pentachaeta bellidiflora	White-rayed pentachaeta	E
146	Pentachaeta lyonii	Lyon's pentachaeta	E
147	Perognathus longimembris pacificus	Pacific pocket mouse	E
148	Phlox hirsuta	Yreka phlox	E
149	Piperia yadonii	Yadon's piperia	E
150	Plagiobothrys strictus	Calistoga allocarya	E
151	Poa atropurpurea	San Bernardino bluegrass	E
152	Poa napensis	Napa bluegrass	E
153	Pogogyne nudiuscula	Otay Mesa mint	E
154	Polioptila californica californica	coastal California gnatcatcher	T
155	Polyphylla barbata	Mount Hermon June beetle	E
156	Potentilla hickmanii	Hickman's potentilla	E
157	Pseudobahia bahiifolia	Hartweg's golden sunburst	E
158	Pseudobahia peirsonii	San Joaquin adobe sunburst	T
159	Pyrgus ruralis lagunae	Laguna Mountains skipper	E
160	Rallus longirostris levipes	light-footed clapper rail	E
161	Rana aurora draytonii	California red- legged frog	T
162	Rhaphiomidas terminatus abdominalis	Delhi Sands flower-loving fly	E
163	Senecio layneae	Layne's butterweed	T
164	Sidalcea keckii	Keck's Checker-mallow	E
165	Sidalcea pedata	pedate checker-mallow	E
166	Speyeria callippe callippe	Callippe silverspot butterfly	E
167	Speyeria zerene behrensii	Behren's silverspot butterfly	E
168	Speyeria zerene hippolyta	Oregon silverspot butterfly	T
169	Sterna antillarum browni	California least tern	E
170	Streptanthus albidus albidus	Metcalf Canyon jewelflower	E
171	Streptanthus niger	Tiburon jewelflower	E
172	Streptocephalus woottoni	Riverside fairy shrimp	E
173	Suaeda californica	California seablite	E
174	Sylvilagus bachmani riparius	Riparian brush rabbit	E
175	Syncaris pacifica	California freshwater shrimp	E
176	Taraxacum californicum	California taraxacum	E
177	Thamnophis gigas	giant garter snake	T
178	Thamnophis sirtalis tetrataenia	San Francisco garter snake	E
179	Thelypodium stenopetalum	slender-petaled mustard	E
180	Trifolium amoenum	Showy Indian clover	E
181	Trifolium trichocalyx	Monterey clover	E
182	Trimerotropis infantilis	Zayante band-winged grasshopper	E
183	Tuctoria greenei	Greene's orcutt grass	E
184	Uma inornata	Coachella Valley fringe-toed lizard	T
185	Verbena californica	Red Hills vervain	T
186	Verbesina dissita	Big-leaved crownbeard	T
187	Vireo belli pusillus	least Bell's vireo	E
188	Vulpes macrotis mutica	San Joaquin kit fox	E

The National Wildlife Federation's mission is to educate, inspire, and assist individuals and organizations of diverse cultures to conserve wildlife and other natural resources and to protect the earth's environment in order to achieve a peaceful, equitable and sustainable future.