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Resource Management in an Era of Biodiversity

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California has often been in the forefront of progressive, forward-looking strategies for environmental protection. Under the dynamic leadership of Governor Pete Wilson, this is the case more than ever. The State's formal endorsement of biological diversity as the basis of its longterm conservation planning and the concomitant Natural Communities Conservation Planning (NCCP) program created by the Governor place California in a position of worldwide leadership on resource management for the 21st century.

Memorandum on Biological Diversity

The terms "biological diversity," or "biodiversity," refer to the full variety of living organisms found in nature. These include elements on three biological levels: genetic diversity found within individual species; diversity among species in a given habitat; and landscape diversity, or the variety of ecosystems within a landscape. Biological diversity describes the inherent interconnectedness of each of these categories of natural elements.

Conservation planning based on biological diversity represents a recognition that the focus of traditional conservation on individual species and specific sites is not fully adequate. It is a recognition that in order for future efforts at conservation to be successful they must be based on broad, biologically connected ecosystems, or "bioregions," that are composed of smaller natural elements.

The concept of biological diversity is closely aligned with Governor Wilson's philosophy of "preventive government" anticipating and addressing future problems and needs before they become severe, unmanageable, or costly to remedy. By focusing the State's longterm conservation program on the ten diverse bioregions of California, we can at best predict and meet the environmental demands of the future and help provide for sustainable economic development.

In September 1991, after months of preparation, the State convened an historic meeting of the leaders of nine State and Federal land management agencies and the University of California to formally sign a "Memorandum of Understanding" on biological diversity. This agreement commits each of the agencies to cooperate with the others in their efforts to focus resource management and conservation planning on biological diversity.

While some efforts at bioregional planning had already begun in California prior to 1991 (including pioneering efforts under way in the Sierra Nevada and the Klamath Region), the signing of the memorandum represented the first time that the State and Federal governments have agreed to work cooperatively in conserving biodiversity across administrative boundaries and on a regional basis.

Our objective is to bring California's varied resources management programs together in a way that assures the longterm sustainability of our rich natural heritage. Rather than focusing protection efforts of specific species in specific sites at specific times, we plan to identify entire biological and geographical areas for protection and conservation. We seek to protect in a coordinated fashion all of a bioregion's elements endangered species, critical habitat, fish and wildlife, water quality.

By doing this, we can save more of our environmental resources and do so in a manner that is socially and economically viable.

The memorandum of understanding created an Executive Council on Biological Diversity, which I chaired and which is composed of the other participating agency heads. It will move existing government agencies and their conservation planning away from narrow jurisdictional approaches and toward the perspective of plant and animal life as integrated systems. A crucial aspect of this cooperative approach will be the active participation of local government, private industry, and environmental groups.

It is also important to note that nothing in the memorandum of understanding, or the new Executive Council, undermines local government authority. The memorandum of understanding does not represent a new layer of government, rather it merely seeks to coordinate and make more responsive the existing government.

The signatory agencies to the memorandum of understanding on biodiversity are the Resources Agency and the State's Departments of Fish and Game, Forestry and Fire Protection, and Parks and Recreation; the State Lands Commission; the University of California Division of Agriculture of Natural Resources; and the U.S. Forest Service, Fish and Wildlife Service, National Park Service, and Bureau of Land Management.

Natural Communities Conservation Planning

By far the most ambitious application of conservation grounded in biological diversity — and of ecosystem planning — in California is Governor Wilson's Natural Communities Conservation Planning program. This landmark program, which is being applied on a pilot basis in southern California, is an effort to anticipate situations in which a listing under the State and Federal Endangered Species Acts might occur and to move species protection efforts to a multiple, rather than to a single species approach. It is a program of national importance, particularly given the many controversies surrounding the Endangered Species Act.

The pressures of California's growing population (30 million people at present, 40 million by 2010) and the increasing competition between man and nature for the utilization of resources have severely impacted the State's natural native diversity, both plants and animals. While disease, competition from exotic nonnative species, and commercial and residential over-use of resources all represent components of this problem, it is the loss of the species' essential habitat — riparian woodlands, forests, coastal wetlands, native prairie grasslands, etc. — that poses the greatest threat to the long-term survival of many species.

Laws designed to protect species, such as the Endangered Species Act, provide for (1) the listing of a plant or animal that is determined to be threatened or endangered, (2) limits on the actions of Federal agencies that might negatively impact listed species, and (3) a prohibition on the "taking" (removal or elimination) of a listed species by any individual or entity, public or private.

However, the Federal Endangered Species Act has failed to provide adequate longterm protection for species. The numbers of endangered species in California — over 230, including at least one in every one of the state's 58 counties — continues to rise. Further, the law has caused substantial economic disruption by preventing development, building, and other activities in areas inhabited by species that have been listed. The delta smelt, a tiny fish found in the Sacramento-San Joaquin Delta, may require significant changes in the State's water supply and distribution system if the fish is found to be threatened or endangered. The northern spotted owl has necessitated the removal from production of millions of acres of timberland in California, Oregon, and Washington. Finally, a tiny songbird called the California gnatcatcher, which has declined in number substantially in recent years, exists in the coastal sage scrub habitat in five southern California counties, where land values are among the highest in the state, and the pressure for development is great.

While Governor Wilson is thoroughly committed to complete enforcement of the Endangered Species Act, we also recognize that single species protection has failed to adequately provide for the conservation of species and their habitat. It is not good science, nor good business, to predicate conservation decisions on the status of just one, or two, or three, species in a given area. The best interests of many species can be addressed by considering the needs of the many species in a particular habitat. The Governor is committed to this type of multiple species approach to protection. Further, he believes that only through a collaborative consensual planning process can progress be made to end the current state of polarization and confrontation — and inadequate protection — that characterize so many instances of threatened and endangered species.

Thus, Governor Wilson has launched the Natural Communities Conservation Program. Based similarly on the need for ecosystemwide planning, this new State program offers a constructive alternative to the single species "listing" of the Endangered Species Act and is designed to preserve native animal and plant species and their habitat in amounts large enough to ensure their continued existence. Implemented in the coastal sage scrub habitat of the California gnatcatcher, the program encourages all interested parties — landowners, developers, conservationists, local governments, and others — to develop voluntary, longterm agreements on future development patterns in specific critical habitats. These agreements would both promote long-term protection for the gnatcatcher and many other species by protecting their common habitat and also allow for appropriate economic progress by formally designating areas for development. These agreements, when completed, would be sanctioned by a new state law.

Through its commitment to the conservation of biological diversity and the Natural Communities Conservation Program, the State of California hopes to help usher in a new era of sound, preventative resource management.

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Cooperation in Conservation of California's Rare Habitats and Species

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Abstract. During the past 25 years the California Native Plant Society has succeeded in preserving many rare species and ecosystems. This has come about through growth and collaboration with equally active conservationists in the Nature Conservancy, USDA Forest Service, and California Department of Parks and Recreation and others. Success has been greatly aided by adherence to five principles: (1) Avoid direct confrontation, (2) Look for powerful allies, (3) Take advantage of weaknesses in the opposition, (4) Accept compromises if complete victory is impossible, (5) Never give up while there is hope. Three examples of successful operation are the Monterey area, the Pine Hill igneous intrusion east of Sacramento, and the lone chaparral ecosystem in Amador County. They show that focus upon rare ecosystems is usually more profitable than upon individual species. Three exceptions are the Sierran big tree, *Sequoiadendron giganteum*, of which northernmost populations are associated with a completely different array of species from those that accompany southern populations; the shrub *Stephanomeria Blairii* on San Clemente Island; and the Tiburon Mariposa Lily, *Calochortus tiburonensis*, of which the accompanying ecosystem was largely destroyed or seriously damaged by suburban incursions before the species itself was discovered. Preservation of species in gardens is, in general, not recommended, but two examples are cited.

Keywords: Conservation; ecological islands; rare habitats, rare species.

Introduction

My role in this symposium is that of an optimist. The stage was set for such a role by California's pioneer conservationist, John Muir, whose spectacular victory in preserving Yosemite Valley showed to those of us who follow him what can be done. Since then, we have held the line on one issue after another, in spite of tremendous pressure from population growth, suburbanization, mining and quarrying, agriculture, grazing and lumbering of forests. We have done this because we have abided by five principles that are the core of a successful conservationist ethic. These are:

1. Avoid direct confrontation with exploiters and developers, except when absolutely necessary.

2. Look for allies, whose overall purposes may be very different, but who are equally dedicated to success on a particular issue, and may have better ways of achieving it than we.

3. Look for weaknesses in the strategy and activities of the opposition.

4. Accept compromises and partial solutions, if necessary, rather than give up.

5. As long as any hope is left, keep on trying. An excellent review anthology, containing much valuable information on techniques and strategy, is that edited by Peggy Fiedler and Subodh Jain (Fiedler and Jain 1992) in which the articles by Donald Falk and Laura Jackson deserve special attention.

My own experience with conservation was during the six early years of the California Native Plant Society; a spectacular phase of expansion. I cannot think of any issue in which we failed completely. To illustrate how we applied the principles just presented, I shall review briefly three examples, taken from the flora of northern California.

Before beginning this review, I need to discuss another problem. Should strategies of plant conservation be always focused upon one or a few endangered species,

should major attention be given to entire plant communities or ecosystems, or should strategies be shifted with respect to each special example? Also, is it ever justifiable to "save" species by transferring them to gardens or zoos and maintaining them in cultivation or domestication? I answer these questions by setting up priorities. Major emphasis should be placed on ecosystems, which, if truly valuable candidates for conservation, usually contain two or more threatened species This priority should be reversed only when a particular species has a strong popular appeal. Preservation in native habitats is always more desirable than in cultivation, to which we may wish to resort after the battle over nature has been lost.

Three Ecological Islands

The three areas that I have chosen all illustrate a prime aspect of California's diverse ecosystems, that of ecological islands. These can be defined as relatively small areas that, because of particular climatic and ecological features offer habitats so different from those of surrounding regions that they are like oceanic islands, surrounded by a sea of inhospitable territory (Stebbins 1978). California possesses far more of these "islands" than any other area of comparable size in North America. Their existence is one reason why California conservationists need to redouble their efforts, and emphasize ecosystems as well as individual species. The best known of them is the Monterey Peninsula, on the central coast, which shares international renown with our major National Parks, Yosemite and Sequoia

The Monterey Peninsula

The Monterey Peninsula is, in fact, a composite of three ecological islands enclosed in one. The entire peninsula is itself an island, dominated by Monterey pine, that elsewhere occurs (naturally) only in three smaller areas, one to the north (Año Nuevo Point), a second to the south (Cambria) and a third on an island off the coast of Baja California. The insularity of the Monterey pine forest is due to a combination of temperature and moisture effects: mild winters compared to more northerly areas, and an unusually cooling bath of summer fog, due to the great depth and consequent cold temperature of the surrounding ocean. Most of the forest is underlain by a Tertiary (Miocene) rock formation that is abundant elsewhere. It harbors several rare herbaceous species, notably *Potentilla hickmanii* and *Horkelia frondosa*. Protruding from the main ecological island is the rugged, rocky end of Point Lobos, which is underlain by a highly localized granitic rock formation as is also the immediate coast on the north side of Carmel Bay. This granitic-derived soil supports the only native groves of the Monterey cypress (*Cupressus macrocarpa*), that is widely cultivated throughout the world in warm temperate regions free from the serious fungal diseases that attack it. In the interior of the peninsula north of Carmel Bay lies a third ecological island. This is formed by a "raised beach," that was once seashore, and is underlain by a distinctive soil, a combination of hardpan clay and fossilized sand. This area supports such an unusual array of plant species and populations that in 1942, when I recognized them, I nicknamed the area "Evolution Hill," and took several of my classes in my evolution course at Berkeley to visit the area. Naturally, I was most interested in having its pristine character preserved for all time.

Conserving the entire Monterey ecological island trio presents several problems. Since much of the Monterey pine forest has been part of the cities of Monterey, Carmel, and Pacific Grove for decades, only a part of it is still available for conservation. Its prime area is Point Lobos, that for a long time has been a state park, carefully guarded by California's Department of Parks and Recreation. In fact, whenever I visit Point Lobos, and see the excellent condition of naturalness plus areas purposely set aside to accommodate thousands of visitors every month of the year, I cannot help admiring the efficiency with which the park is managed so as to fulfill the multi-purpose usage for which it was set aside. This holds equally for its portion of the Monterey pine forest as a whole, and the spectacular groves of Monterey cypress that hang on to its precipitous crags. I have witnessed personally the great care that the rangers have displayed in guarding, protecting from visitors and otherwise encouraging the cypress seedlings that occasionally appear and are given the attention worthy of the royal heirs of a kingdom.

Evolution Hill was another matter. About 1950 I was given an appointment with the then President of Del Monte Properties, Samuel F. B Morse. The old gentleman was most sympathetic and told me that he loved the area, often went horseback riding through it, and assured me that as long as he was President, Evolution Hill would remain undisturbed. He admitted, however, that he could not tie the hands of his successors. Several years later, in 1967, the crisis came. Mr. Morse had passed away, and the new President, formerly an executive of the Corning Glass Works in New York, saw Evolution Hill as an area of high quality sand that could be quarried to make glass. I received a desperate telephone call from the owner of a luxury home near my area, who had paid hundreds of thousands of dollars in order to live quietly in a pristine environment, and now was threatened with the constant clatter and banging of quarrying operations, and the loss

of his pristine environment. I responded by organizing a fact-finding trip of the California Native Plant Society to the area, to which we invited as many home owners in the Del Monte Forest as might be interested. Our trip was successful enough so that we were able to state our case to both the County Planning Committee and the Board of Supervisors. After a series of hearings and discussion, some of them acrimonious, Del Monte Properties was persuaded to donate to the county a part of the "Evolution Hill" area, which now appears in current maps as the S.F. B. Morse Botanical Preserve.

Pine Hill

My next Ecological Island lies twenty-five miles east of Sacramento in the Sierra Nevada foothills. It appears as an island on the geological map of the area, since it is underlain by gabbro, a distinctive black crystalline rock that is like granite except it lacks quartz crystals. The soil produced by the weathering of gabbro has the texture of granitic soil, but a neutral rather than an acidic pH (Springer 1971). It supports several narrowly endemic species, particularly on its highest, central area, Pine Hill. The two most striking ones are the Eldorado sunflower, *Wyethia reticulata*, and the prostrate flannel bush, *Fremontodedron californicum ssp. decumbens*. The Wyethia grows only on this particular island, but on many parts of its 40 square mile surface, in addition to Pine Hill. The flannel bush, on the other hand, is restricted largely to a rocky crest that forms the east-west axis of Pine Hill. It is notable not only for its prostrate growth habit, but also for the flower color, coppery pink-orange, rather than yellow.

For a long time, Pine Hill supported a Fire Lookout Station of the California Department of Forestry and Fire Protection, but about 15 years ago this was abandoned in favor of more efficient monitoring of brush fires. Meanwhile, suburban country homes were developing all around the area and posed a serious threat should the state decide to sell it to developers. Clearly, a campaign of counter publicity was needed, and was headed by the California Native Plant Society. Fortunately, we had allies among retired personnel of the California Department of Forestry and Fire Protection, particularly Mr. Warner Marsh. The outcome was the transfer of the summit area of Pine Hill to the State Division of Parks and Recreation, where it remains as a small preserve, an enclave completely surrounded by private land. For the present its unique ecosystem is safe, but the area must be continuously watched to see that no further private incursions are permitted. Other small reserves are being acquired to save additional endemics of this gabbro outcrop, particularly the cut-leaved morning glory, *Calystegio stebbinsii*.

Ione

The third ecological island that I shall review is also in the Sierra foothills, and is still a serious problem. A perceptive motorist, driving from the central valley through Amador County toward the town of Jackson, will note a dramatic change of scenery near the town of Ione. Blue oaks and grasslands suddenly disappear, to be replaced by a low-growing chaparral having an olive green color, different from any other in California. It consists of the Ione manzanita, *Arctostaphylos myrtifolia*, endemic to this area. A few clearings support (or did so until very recently) a sparse stand of herbs, including the Ione buckwheat, *Eriogonum apricum*, a species that is even more narrowly endemic. Soil experts, notably the late Professor Hans Jenny, noticed also that the underlying soil, revealed in the road cuts, is equally unusual. It is a combination of fossilized but not consolidated clay and sand, formed perhaps 40 million years ago (early Tertiary), when this area was the seacoast of California, looking out on an ocean that covered the present Central Valley (Bateman and Wahrhaftig 1966). Combined with the extreme drought and midsummer heat, plus very high soil acidity (pH = 3.5-4.5) the environment raises an insuperable barrier for the survival and growth of all but a very few plant species. Both the manzanita and the buckwheat are only distantly related to other species belonging to their large genera, and so are prime candidates for preservation as rare and endangered species.

The present and immediate danger to the Ione area is quarrying. The clay in the soil is ideal for making irrigation tiles and similar ceramic objects. Almost the entire area is owned by the quarrying companies, and two large, active pits are relentlessly eating it away. Our early efforts to save a part of it were vigorously opposed with oaths and obscenities. One Sunday afternoon, while looking for a favorable portion of the area on which to focus our efforts, we chanced to meet one of the workers, who was idling away the time there. His vigorous orders to get out were larded with mention of the numerous rattlesnakes hiding under every bush and his wish that there were "twice as many to keep you blank-blanks from poking your noses into our business."

Nevertheless, a few Native Plant hardy souls were not deterred, particularly Professor and Mrs. Jenny. They persisted until, finally, a small peripheral area was acquired and is being maintained by the Department of Fish and Game. Small areas are also preserved by the State Highway Commission and the Bureau of Land Management. In other areas, lone manzanitas have been bulldozed away wholesale. Battles have been lost, but the war isn't over. Continued persistence may save more of this extraordinarily unique ecosystem.

Significant Rare Species

The examples mentioned above show how important it is, at least in California, to pay most of our attention to entire ecosystems rather than to any particular species that they contain. Under some conditions, however, this strategy is not the best one to adopt. Two kinds of situations demand that we focus our attention on particular species. The first consists of species that are world renowned, or at least widely known to non-specialists, and which occur in a variety of different communities. My prime example is the Sierran big tree (*Sequoiadendron giganteum*). Its groves are scattered along the Sierran axis from Placer County, northwest of Lake Tahoe, in the north, to Tulare County, near the southern limit of the high Sierra. The plants associated with the big trees in the small Placer County grove are almost entirely different from those found in the southernmost groves, yet both associations are of prime importance for understanding the ecological niche of *Sequoiadendron*. According to Axelrod (1962), the fossil big trees found in Pliocene deposits of Nevada, about 9 million years old, are associated with other fossils that are counterparts of the northern, Placer County association, rather than associates that inhabit the more extensive big tree forests to the southward. Fortunately, the northern groves are being preserved and are receiving special attention by officials of the national forests in which they occur as well as in state parks, while the extensive groves and small forests in the central and southern Sierra Nevada are carefully guarded by both the National Park Service and the National Forests.

Another example is the shrub *Stephanomeria "malacothrix" blairii*, a rare and endangered species belonging to the lettuce tribe of the Asteraceae, that is confined to a few precipitous cliffs on the rocky shore of San Clemente Island. It has no close relatives, and is not part of any characteristic ecosystem. Nevertheless, it represents one example of the urgent need for preserving the entire biota of California's Channel Islands before degradation of their biota continues beyond its present precarious status.

Two other species that must and are being preserved without the complete ecosystems to which they have belonged occur in suburban Marin County, north of San Francisco. The Tiburon Peninsula is now one of the most highly valued residential districts in the United States. Formerly, it was a chain of rolling grassy hills, of which many were underlain by mafic soils derived from serpentine belonging to the Franciscan geological formation. Outcrops of this formation almost invariably support rare, often endemic species, for reasons that have been discussed by many authors. The Tiburon serpentine slopes, familiar to botanists since the beginning of the present century, were partly covered by homesites long before ecologists were able to document anything approaching the complete ecosystems that they supported. Nevertheless, two of their most striking endemics have recently been spared through the efforts of the California Native Plant Society and some of our allies. One is the black jewel weed (*Streptanthus niger*), that grows in the southern part of the area, where development was curtailed due to the presence of an historic wooden church and its associated cemetery. One of the first uses of funds donated to CNPS was, in collaboration with local citizens who wished to have the church preserved after its congregation had grown too big for it, and had moved to a modern church building, was purchase of the church plus the surrounding area, followed by donation as a historic and natural history preserve, to be held for this purpose in perpetuity. This acquisition saved *Streptanthus niger*. At the other end of the Tiburon Peninsula lies a north-facing slope that is the only natural habitat of the Tiburon Mariposa lily, *Calochortus tiburonensis*, a flower of striking beauty that is a faraway outlier of its subgenus, having its nearest relative on Cuesta Ridge in San Luis Obispo County. A separate reserve has been acquired and set apart for *C. tiburonensis*.

Preservation in cultivation

Finally, we must face the issue: When, if ever, should a species be preserved by cultivation or domestication after it has become extinct in all natural habitats? For animals, this question received a partial answer long before conservation became a major issue. Species useful to mankind have multiplied in domestication many fold as their natural habitats have long since become altered or disappeared. With respect to them, we now face a controversy between two philosophies of conservation. Should we conserve the feral horses and donkeys, descendants of domesticated animals, that are now running wild in parts of North America, even though their conservation poses a serious threat to the natural ecosystems that support them? I shall not pursue this question further, but raise it to show what difficulties arise when conservationists feel they must resort to cultivation or domestication. With respect to animals, this problem is extremely difficult, and outside of the scope of this review. For plants, I can suggest a few examples and guidelines.

I doubt that any value will be gained by trying to preserve a threatened annual species that must be cultivated from seed every year. Possible exceptions are the annuals found in California's vernal pools, since some success has been achieved in duplicating the essential features of a vernal pool on land that is suitable but lacks them. When so many more serious issues are crying for

attention, the constant care required to plant and replant species that have no economic or aesthetic value seems to me to be hardly worthwhile.

With respect to perennials, particularly shrubs and trees, the situation is quite different. Many botanical gardens would be well advised to establish a rare plant section, devoted to trees and shrubs of particular interest that as wild plants are nearly or quite extinct. Two such examples come to mind. One is the shrub *Franklinia altamaha* that grew formerly in Georgia, and was named by Humphrey Marshall after America's first natural scientist, Benjamin Franklin. It has not been seen as a wild plant since 1790 but is now occasionally cultivated in the southeastern United States. Because of its glossy leaves and attractive white flowers, it is well worth cultivation in climates favorable for its growth.

Next is possibly the oldest example of conscious cultivation of a disappearing species in human prehistory. The "Maiden Hair" tree *Ginkgo biloba*, is the only living species belonging to an ancient order, the Ginkgoales, fossils of which are more than 100 million years old. In modern time, before recent cultivation, it grew only in China and Japan, but no undoubted native populations are known to exist. It has, however, been venerated as a sacred tree since the beginnings of Chinese culture, and is planted in temple courtyards throughout China (Lee 1935). My frankly speculative reconstruction of its history is based upon a remark made by my friend, the late Edgar Anderson. He pointed out that most of our cultivated trees that line city streets grow naturally near the banks of great rivers and streams. The rigors of such habitats, especially repeated flooding plus compaction made by tree branches, boulders, and other heavy objects, preadapt river bank species to the flooding and commotion that they face while lining city streets. Shortly after hearing these remarks, I spent two months with another friend, Theodosius Dobzhansly, in his laboratory on the eighth floor of Schermerhorn Hall, campus of Columbia University, a partly paved-over enclave in New York City. While there, I looked out every day at the tops of two magnificent ginkgo trees, whose trunks broke up the pavement about 120 feet below. This suggested to me that the original habitat of *Ginkgo* must have been the banks of the two great Chinese rivers, the Yangtse and the Hoang-Ho, that originally flowed through great forests (which would be expected on the basis of the east Asian climate) but were cut down as agriculture expanded, and all of the original trees have been extinct in these sites for many centuries.

Nevertheless, while cutting, burning, and cultivation were spreading, there must have been observant priests who recognized the unique characteristics of *Ginkgo*, including medical properties that they regarded highly. They therefore planted it in their temple compounds to save it from the surrounding destruction.

Perhaps this fable of prehistoric conservation-minded priests is completely fanciful, but at least it is based upon reasonable probabilities. It suggests that our philosophy of nature and life may be much older than we realize.

Epilogue

In conclusion, we Californians can be proud of the successes that have been achieved throughout our history of conservation, in face of an unprecedented growth of our local population and intensive exploitation of natural resources. In addition, we must never forget that these achievements have been the result of cooperation between grass root organizations that have been born out of foresight and perceived need and governmental organizations, both state and federal, that have been equally perceptive. The fight for conservation is not won and never will be. Nevertheless, both the desire and the means of continuing it are well in hand. We can confidently look forward to many decades of fruitful collaboration and the success that goes with it.

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New Partners, New Consensus

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Abstract. The combined pressures of population growth and powerful development interests have made land protection extremely difficult in southern California. One fruitful strategy is to pursue new partnerships in meeting conservation goals. For long term success, however, conservationists will have to work proactively with government and landowners to reach consensus on both conservation and development policy, and must then agree on implementation mechanisms. Examples of multispecies planning and potential land use models are explored.

Keywords: Southern California; land use planning; multispecies reserves; natural community conservation planning (NCCP).

Introduction

The Endangered Habitats league is a coalition of 32 Southern California conservation groups which formed in 1991 to protect the coastal sage scrub ecosystem. Our two major goals are to obtain endangered species listings for the California gnatcatcher, an obligate coastal sage scrub resident, and to participate in planning efforts to reconcile the competing interests of conservation and development. We hope to expand to other ecosystems as well. In the past, the two opposing sides of environment and development usually fought it out until one was victorious, and the other lay in the dust. With developer-controlled local governments making the land use decisions, the environment usually came up short. Due to shifting public opinion and the threatened application of the Endangered Species Acts, however, we have seen considerable interest in southern California by all sides in so-called win-win solutions. In this presentation I will try to explore these possibilities.

We have already had some success in pursuing partnerships with various agencies to facilitate important acquisitions. As land costs go ever higher, partnerships on high priority parcels become a necessity. As an example, on the Santa Rosa Plateau in Riverside County, the Metropolitan Water District (MWD) contributed a tremendously important $15 million as mitigation for a reservoir project. In partnership with the County of Riverside and the State of California, an almost miraculous purchase was made, for which $35.5 million was raised in less than one year. Importantly, the developer who sold the property was a cooperative willing-seller.

Such partnerships should become more common. In the case of the Santa Rosa Plateau, the MWD had a desire for genuinely meaningful mitigation, and that helped. But infrastructure agencies like water districts are willing to go to great lengths to get so-called "gold-plated mitigation" so that they are insured against any foreseeable project delays, listings of species, lawsuits and so on, and we should take advantage of this. Also, while infrastructure agencies do not officially admit responsibility for growth inducement, they at least seem to have a guilty conscience.

Our difficulties seem immense, however, particularly when we do not all share the same values. In 1891, a French political scientist wrote that Americans' "one and predominant object is to cultivate and settle these prairies, forests and vast waste lands. The striking and peculiar characteristic of American society is, that it is not so much a democracy as a huge commercial company for the discovery, cultivation, and capitalization of its enormous territory." While there is certainly more to American history than that, it does sum up the story of southern California real estate development.

While conservationists believe in a land ethic, that the land has intrinsic value, the development community and local government primarily view land as a means to another end, whether it be houses, profits, tax revenue, or the perceived benefits of development itself. The notion of "private pay rights," however, is a widely shared belief, and in my view, win-win scenarios are the only ones which will be acceptable to the public, let alone the courts. In protecting land, we are also up against huge taxpayer

subsidies which foster development, such as the deductibility of home loan mortgage payments and the massive underwriting of the automobile and of highway infrastructure, which makes sprawl possible. Direct user fees, such as gasoline taxes, pay only a fraction of the cost of the growth-inducing highways.

If there is a way out, it lies in the direction of habitat conservation plans, which have come into prominence as responses to endangered species listings. In these plans, a compatible balance is theoretically struck. To apply this concept on a broad scale, I believe that two major consensuses would have to be in place — first, a consensus on conservation and second, a consensus on development. I think we are much closer to agreement on the conservation consensus, as embodied in the notion of multispecies reserves.

Conservation

The multispecies concept of conservation has gained wide acceptance in both government and the development community. This is purely a practical matter, as it is basically a sensible, proactive response to the threat of disruptive endangered species listings. In other words, it is good business. In Riverside County, the Stephens' kangaroo rat experience led to extensive multispecies planning, although not yet to implementation. A multispecies program has also been started by San Diego County. If the Endangered Species Act is dismantled, however, the multispecies consensus will undoubtedly fall as well, for it is fundamentally driven by economics, not by a concern for nature.

In the case of the California gnatcatcher and coastal sage scrub, the Wilson administration has offered the Natural Communities Conservation Planning (NCCP) program. While we agree with the NCCP goal of multispecies preserves, it has, for political reasons, been fundamentally misapplied to coastal sage scrub. This is because, at the behest of the development industry, the NCCP has been tied to circumventing the application of state and federal endangered species laws for the California gnatcatcher. What should be a long-term planning process has been turned into an inappropriate quick fix.

Due to the severe depletion of good gnatcatcher habitat, and the intensity of southern California development pressures, it is simply impossible for a voluntary program, on ultra-short notice, to substitute for the necessary regulatory tools a listing brings. Additionally, the NCCP is complicated, perhaps unworkably so. And despite initial promises to the contrary, it fails in the essential task of controlling habitat loss while reserves are being planned. Project review by prodevelopment local governments under CEQA (California Environmental Quality Act) is what got us into this mess, yet that is the only "interim control" mechanism provided for during an 18-month planning period. Long-term conservation goals are thus compromised. The NCCP also allows landowners and local governments to drop out of the process if they do not like the scientific standards developed.

Ideally, the NCCP would be an innovative and cooperative vehicle for both conservationists and developers to respond to the challenge of a gnatcatcher listing. As a complement to a listing, it would develop sound, regional multispecies habitat conservation plans for the entire suite of coastal sage scrub species, while finding ways to minimize economic disruption. Unfortunately, it seems impossible for the California Resources Agency to break with Pete Wilson's powerful development industry constituency, which is committed to fight a listing at all costs. For a program whose goal is cooperation, it is ironic that the NCCP's misapplication to avoiding the gnatcatcher lists has largely prevented progressive developers — and believe me, they exist — and responsible conservationists from working together on constructive problem-solving.

Recently, the League has been privileged to work with the City of Carlsbad, the Fieldstone Development Co., the California Dept. of Fish and Game, and the U.S. Fish and Wildlife Service on a pre-listing agreement for several biologically important, but very expensive, coastal sage scrub properties. This good faith effort may provide a model for conservation planning, and may prove that even the toughest problems can be solved to the satisfaction of all concerned when everyone is brought to the table.

For conservationists, though, the biologically-based multispecies concept represents a solid start. It brings society into the realm of large contiguous habitat blocks and connectivity. But while a huge improvement over current planning, it is not everything we need. For a community like coastal sage scrub, which is already at critically low levels, it may be the best we can do to maintain small but viable populations. For less impacted ecosystems, however, we must go on to advance the goal of conserving entire landscapes. To reach consensus here, we will have to talk about the values of a sense of place, about our identity as southern Californians, and we will have to link landscapes to quality of life issues. Land development companies routinely think 10, 20 and 50 years into the future. To preserve landscapes, conservationists will have to work far more proactively than we have in the past, and we will have to convince government to change course and do the same.

Another part of the conservation consensus must be moving away from project-by-project impact assessment and mitigation and into a regional framework. As

we all know, individual project EIRs rarely address cumulative or regional impacts successfully. Instead, why not regional EIRs? I think developers would work closely with us in this one area, as they don't like the current inefficient system, either. Fortunately, we are seeing a renewed effort at regional conservation planning in southern California. The North County Wildlife Forum under the San Diego Association of Governments is an example. They have prepared GIS (Geographic Information System) maps for their region, though we will have to await agreement on implementation.

Development

For long range planning to work, a second consensus on how to develop is also needed, because in southern California, conservation and development can only be viewed as two sides of the same coin. As a first precept, conservation needs must be addressed as the very first step in planning, and development must be built around those needs. Usually, it is just the opposite, and meaningful conservation becomes impossible.

As we tell third world nations to develop sustainably, we would also do well to apply that concept to ourselves. As an example, we should consider United Nations Biosphere Reserves, where core natural areas are surrounded by buffer zones of compatible economic activity and finally by urbanization. In our context, we would first demarcate large ecological reserves which would exclude development. Surrounding buffer zones could include both agriculture, resource extraction, and clustered housing development. Compatibility of the buffer zones would be ensured by maintenance of viable habitat internally and by retaining connectivity between the reserves. In a planning context, buffer zone development would mitigate for adverse impacts primarily on-site via project redesign, clustering, and open space dedication. On the other hand, development in the urban zones would mitigate primarily off-site in the core reserve areas. Such offsite mitigation could be achieved by purchasing and transferring development rights from reserve areas and thereby gaining an increase in allowable density.

Beyond that, we must realize that endless suburban sprawl and palatial golf course estate homes, and five acre parcels are fundamentally unsustainable, and can only be a tiny part of our overall future. Like General Motors, however, a developer, if given the choice, will always build a more profitable Cadillac instead of a Geo. It is thus up to local governments to require more compact housing, and to shift emphasis to rehabilitation of existing but rundown units. Reaching consensus on this point is where I worry, because no one seems to want to redefine the housing element of the California dream. Yet that is what is required. Perhaps there is hope, as I recently read that the massive Playa Vista development in Los Angeles will contain progressive housing designs. Unless we change our unsustainable ways now, we will surely lose the beauty and values which brought us here in the first place. I am optimistic, however, that if local governments do require such changes, the development industry can respond creatively with desirable housing. But they will not do it of their own volition.

The more I learn, the more I believe government is our greatest obstacle. Its ability to change and innovate is slow at best. To give a flagrant example of local government mindset, Las Vegas uses more water per capita than any other city in the country, but it wants to import water, in a way similar to what Los Angeles did with the Owens Valley. Regarding strict conservation measures, the Public Works Department states, "We hope we don't get to that point. We don't want to change the lifestyle of people in southern Nevada." With most southern California city councils hopelessly addicted to outdated development models, the reluctance to change is our most intractable problem.

I hope that two things will push governments in a more sustainable path. The first is the environmental constraints themselves. If lines around our biological reserves are actually implemented with permanent protection, and not meaningless and changeable zoning, these will become effective urban limit lines. The second cause for hope is the glaring need for more affordable housing which is also more environmentally sound. One city, Portland, Oregon, has made considerable progress along these lines, and by establishing density requirements, has made Portland's housing some of the nation's most affordable.

Planning for the Future

Even assuming we reach a working consensus on conservation and development practices, we will need new institutions and funding to carry them out. One of the most frustrating things for conservationists in southern California has been the utter meaninglessness of the term "open space" in general plans. Open space designations are frequently changed at the developers' behest, and large lot zoning is a dismal failure. The principles of one board of supervisors are compromised by the next. Needed are planning mechanisms such as purchase and transfer of development rights, large scale conservation easements, and fair market value acquisition programs, which actually protect land. Regional conservancies with adequate funds are desperately needed. Meanwhile, $85 billion sits unused in the federal Land and

Water Conservation Fund, helping ever so slightly to balance the Reagan-Bush deficits. And while land here is not cheap, as the sad experience in the Santa Monica Mountains shows, it is cheaper today than it will be tomorrow. We must never hesitate to pay a landowner fair market value.

One of my great hopes is that out of the California gnatcatcher crisis will come regional implementation mechanisms and institutions to protect not only coastal sage scrub but other communities as well. It is possible that many divergent interest groups will unite on a broad-based, equitable funding mechanism which will form the foundation for southern California's future. One idea is to assess a small "impact fee" applied to various utilities, such as water or roads.

If southern California is showing signs of progress, and I think it is, it is because of two things: the hammer of the Endangered Species Act and the force of public opinion. Things would certainly go much faster, however, if more of our elected officials were more responsive and shared conservation values. In Orange County, 40% of all campaign contributions to Supervisors came from one single industry — that of housing development. For one Supervisor, it was 60%. This imbalance is unique in the nation, according to Common Cause. The pattern is repeated on all levels. In the area of better government, we have a long way to go.

I personally believe that a working consensus to protect land is possible, but that it will take a determined effort for the opposing camps to meet, talk, and understand each others' needs. It will require flexibility on all sides, a commitment of financial resources, and substantial change on the part of government agencies in how they plan.

In conclusion, I would like to share with you a bumper sticker from Orange County which says, "If you can read this, thank a developer." Better it should say, "thank a city council." And that really means that the buck stops here, with us. Activism and advocacy in politics and conservation are simply a necessity, especially for scientists. If we are to save what's left of our nature in southern California, nobody will do it for us.

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Involving Academics in Endangered-Species Conservation: Lessons from the Stephens' Kangaroo Rat Habitat Conservation Plan

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Abstract. Rapid development in western Riverside County, California, has reduced and fragmented the grassland habitat occupied by Stephens' kangaroo rat (*Dipodomys stephensi*) to the point that it was given federal endangered status in 1988. Riverside County responded by undertaking development of a Stephens' Kangaroo Rat Habitat Conservation Plan. This effort has involved an unusual amount of basic research. Three teams of academic researchers have been studying the demography, genetics, habitat associations, and dispersal patterns of this species, and have developed a spatially explicit computer model of population dynamics on potential permanent reserves. Each team has experienced delays in funding and permitting because machinery for administering research programs had to be developed *de novo*; this has reduced the amount of data that could be collected and has prevented some projects from being inititated. Other difficulties have arisen in the review and evaluation of results, and their use in reserve design, because there has been no formal provision for a scientific oversight committee. Although academic scientists have much to offer the habitat conservation planning process, their effective involvement is not achieved simply by budgeting money for research. Instead, care must also be taken to incorporate scientists fully into administrative and decision-making structures.

Keywords: Academic biologists; biological research and conservation planning; California; conservation biology; *Dipodomys stephensi*; Endangered Species Act; Riverside County.

Introduction

As is true of Southern California in general, Riverside County experienced explosive population growth during the 1980's and continues to grow rapidly; the human population of the western portion of the County is projected to reach 1.5 million by the year 2010, almost double the 1990 figure (RECON 1991). Accompanying this growth is suburban development that destroys and fragments natural habitats, placing the wildlife populations that occupy them at increasing risk of extinction.

Loss of local populations is especially critical for species like Stephens' kangaroo rat (*Dipodomys stephensi*), which have small geographical ranges centered in rapidly urbanizing areas. Price and Endo (1989) estimated that approximately 125,000 ha of western Riverside County supported habitat suitable for this species prior to modern development, and that only 40% of this remained by 1984, mostly in small, isolated fragments. Stephens' kangaroo rat is not the only species threatened by growth in southern California, because the complex topography of the region gives rise to small local populations that can easily be isolated by development in intervening dispersal corridors.

Recognizing the threat to the continued existence of Stephens' kangaroo rat, the United States Fish and Wildlife Service granted it protection from "take" in 1988 under the Endangered Species Act (ESA) (Kramer 1988). The listing of Stephens' kangaroo rat effectively halted development in western Riverside County, because "take" is defined by the ESA to include destruction or significant degradation of habitat occupied by protected species as well as active killing or harming of individual animals (Rohlf 1989).

An increasingly important component of the Endangered Species Act is the Section 10(a) provision for "incidental take" permits, which was added in 1982. These permits allow private landowners to carry out otherwise lawful activities that result in "take" of a protected species, in exchange for implementing a conservation program that mitigates the impact of the incidental take (Rohlf 1989; Bean et al.1991). These conservation programs are called "habitat conservation plans" or "HCPs" because a pivotal element of all of them is protection of habitat on a series of permanent reserves. As of 1990, only seven 10(a) permits had been approved by the USFWS and 20 HCPs were being developed, including one initiated by Riverside County when Stephens'

kangaroo rat was listed in 1988 (Bean et al. 1991). A thorough description of the initial stages of the Stephens' Kangaroo Rat HCP is given in Bean et al. (1991).

In what follows I wish to (1) outline where academic biologists can play a useful role in the habitat conservation planning process; (2) indicate what the academic involvement has been so far in the case of the Stephens' Kangaroo Rat HCP; and (3) suggest mechanisms for more effectively involving academic scientists in the HCP process.

The HCP Process and the Potential Role of Academic Biologists

The basic structure of the HCP process is as follows (Table 1): An applicant group develops an HCP, with input from federal and state regulatory agencies, biologists, land owners/managers, local governments, and key interest groups. The Plan is then submitted to the USFWS and evaluated for its feasibility and impact on the probability that the listed species will persist. If the USFWS judges that the HCP results in no net reduction in the chances the species will survive in the wild and contains adequate provisions for funding and management, it issues a Section 10(a) permit for incidental take, and the applicant implements the proposed plan. HCP implementation involves fundraising, and managing land, monitoring the status of populations, reporting to the USFWS, and developing intervention strategies in the event that the condition of the species deteriorates.

Table 1. An overview of the Habitat Conservation Planning Process.

STEP 1: 10(a) APPLICANT PREPARES THE PLAN WITH INPUT FROM

— Regulatory agencies
— Biologists
— Public and private land owners/managers
— Local governments
— Key interests:

-Environmental groups
-Developers
-Recreation groups
-Resource users

STEP 2: USFWS EVALUATES

— Whether the proposed plan adequately monitors, minimizes, and mitigates the impacts of incidental take
— Whether the proposed plan has an adequate funding and management strategy
— Whether the incidental taking will appreciably reduce the likelihood of survival and recovery of the species in the wild

STEP 3: USFWS ISSUES 10(a) PERMIT

STEP 4: APPLICANT IMPLEMENTS THE PROPOSED PLAN

— Fundraising
— Land acquisition
— Habitat management
— Population monitoring
— Reporting
— Development of intervention strategies

Academic biologists can play key roles in development, evaluation, and implementation of HCPs. Aside from economic and political feasibility, the critical issues are biological ones: How much habitat is necessary to achieve a persistence goal? What is the optimal configuration of reserves? How should habitat be managed? When is active intervention warranted, and what strategies would be effective for improving the health of a deteriorating population? Answering these questions involves the application of basic principles of population biology to a particular species and environmental setting. While it is true that any well-trained population biologist can tackle such questions, those who hold faculty positions at a college or university are often better able than are private consultants or employees of state or federal agencies to acquire necessary information economically and to provide objective scientific review of proposals and results.

There are several reasons why academic biologists generally are "bargains." First, research is a standard part of what they are supposed to do, and universities provide extensive support for research in the form of equipment, office and laboratory space, computer facilities, libraries, administrative and technical services, not to mention faculty salaries, partial salary support for graduate students employed as teaching assistants, and undergraduate students who are willing to work for low salaries because they consider the research experience part of their education. This means that much of the cost of any particular research project effectively is subsidized by the pooled resources of the university. Second, both academic promotion and reputation among colleagues (which affects chances of obtaining future research grants) are based on the quality of research as well as on productivity. This premium on research quality actually promotes a lot of *pro bono* work, because academics tend to put in the time required to obtain a publishable result, rather than allocating a fixed, budget-based effort. Finally, academics are expected to be active in public and professional service, as well as to do research and to teach. Such service often takes the form of reviewing grant proposals and scientific manuscripts, or advising government agencies on technical matters, and academics usually perform such service *gratis* because they consider it a part of what the university is paying them to do.

Input from academics is likely to be objective as well as inexpensive. The objectivity stems from the principle of academic freedom, which is central to the mission of public universities in the United States, with the possible exception of a few private sectarian institutions (see, for

example, Handbook for Faculty Members of the University of California, 1978, Appendix V). This principle protects academics from the constraints on speech that other professional biologists can experience and allows them to provide input to the HCP process that is uncolored by the administrative policy of a government agency or by the special interests of an employer.

The Role of Academic Biologists in the HCP Effort

As Bean et al. (1991) noted, the Stephens' Kangaroo Rat HCP process has been characterized by an exemplary amount of basic field research, and three teams of academic biologists have been involved in addition to private biological consultants. The structure of this HCP process is indicated in Table 2. Riverside County established a Habitat Conservation Agency with representatives from each participating city on a Board of Directors that is coordinating development of the HCP and its submission to the USFWS. No scientist sits on the Board of Directors and there is no scientific oversight panel. In addition to establishing mechanisms for advisory input from government agencies, landowners, and special interests, the Riverside County Habitat Conservation Agency contracted with private consultants and with university scientists to acquire new data. The consultants have provided information on the current distribution of Stephens' kangaroo rat, and university scientists have been studying aspects of its population ecology, genetics, dispersal, and habitat requirements, and developing a spatially-explicit computer model of Stephens' kangaroo rat population dynamics on potential reserves. The research effort and the review of results have been coordinated by a consulting firm with primary responsibility for developing the HCP. This firm, whose staff does not include an active research scientist, is also expected to use the data and the model to assess the viability of the species under alternative configurations for a system of permanent reserves, and to suggest elements of a strategy for long-term management of the reserves.

Table 2. Administrative Structure of the Riverside County Stephens' Kangaroo Rat Habitat Conservation Plan (from RECON 1991)

RIVERSIDE COUNTY HABITAT CONSERVATION AGENCY
(RCHCA) BOARD OF DIRECTORS
(One voting representative from the County and each of seven participating cities)

Executive Director

Advisory Committee
Building Industry Association
Environmental Groups
(Sierra Club, Audubon Society)
County Agencies
(Open Space and Park District Committee, County Waste Management Department, Farm Bureau)
Biologists
(University of California, San Bernardino County Museum, Private consultants)
Public Utilities
(Southern California Edison, Metropolitan Water District)
Land Owners
(Lockheed Corporation, Domenigoni Farms, Concordia Development, Moreno Highlands)

Consultants
Legal Counsel
Dangermond & Associates
HCP Consultant (Regional Environmental Consultants - RECON)
(Subconsultants: California State University, University of California, Private consultants)
University of California Riverside

Ad hoc Working Groups
Biology
(Metropolitan Water District, California Department of Fish and Game, US Fish and Wildlife Service, Audubon Society, Professional Biological Consultants, Faculty from University of California and California State University)
Finance
(Sierra Club, Development interests, Farm Bureau)
Agriculture (proposed)

Difficulties and Potential Solutions

Despite the extensive involvement of academic biologists in the SKR HCP process, their contribution has not been nearly as effective as it could have been. Difficulties have arisen with funding and permitting, with evaluation of research results, and with incorporating research results into the HCP.

Funding and permitting

Mechanisms for funding and permitting research had to be developed *de novo*. This process delayed the onset of projects important for the development of a realistic computer model of Stephens' kangaroo rat population dynamics, caused a graduate student to abandon an exciting and important project, and convinced at least one senior academic researcher that endangered-species research is more trouble than it is worth (Price 1991).

Early in contract negotiations, it became clear that Riverside County had no prior experience with academic research contracts, and our research was delayed while Riverside County lawyers argued with U. C. Riverside's research office over such things as whether we would have the right to publish our data, whether the County would allow overhead expenses to the university, and why the university would not bill the County on an hourly basis for the salaries of postdoctoral fellows. The delay almost cost our research team two highly-qualified postdoctoral associates, because they couldn't wait indefinitely to obtain employment; another research team that did not route the contract through its university's

research office had difficulty retaining skilled technical help because of a sporadic payment schedule. The County did not realize that high-quality research requires oversight by experienced researchers, and that the product is information, rather than something tangible like a freeway overpass. Researchers will be attracted to a project only if they perceive that they will be able to advance their careers by publishing the results of their work in peer-reviewed scientific journals, and their salaries must be guaranteed for at least a year in advance. *The people who administer HCPs need to be knowledgeable about the research enterprise. An appropriate ending machinery should be established well before proposals are solicited for work that involves the collection of new data.*

Riverside County was not the only agency that was clumsy in its handling of research. We and other researchers experienced delays USFWS in obtaining permits from USFWS to carry out the contracted research, even though USFWS advised the County during the evaluation of competing HCP proposals. Ours undoubtedly was conspicuous in its research emphasis. In the most extreme incident, we waited 1.5 years for permission to construct field enclosures in occupied habitat and to introduce controlled numbers of Stephens' kangaroo rat into them. After finally pressing the issue, we learned that USFWS was disinclined to issue permission because they weren't convinced that the management value of the information resulting from our experiments would offset the potential "take" involved, and because they were concerned that our project might interfere with others being done in the same area. Despite their concerns USFWS had not notified us that our request raised important issues, did not solicit a formal research proposal, did not initiate a discussion of the implications of the research for Stephens' kangaroo rat management or possible ways of avoiding conflict between concurrent projects, and was not receptive to our input once we became aware of the problems. After I exerted a great deal of pressure, a permit was finally issued on the strength of an anonymous recommendation in an unpublished document pertaining to another threatened kangaroo rat species, rather than the advice of a full professor of biology. But by then it was too late for the graduate student to complete the project in the time remaining in her graduate program, and she abandoned it. *If USFWS wishes to encourage involvement of academic scientists in research on endangered species, it must recognize that high-quality research often demands manipulative experiments that risk some "take," and it must develop guidelines for judging the value of a project against the level of take that is involved. This could be achieved by developing a set of consistent criteria for project evaluation and establishing a national panel composed of academic and USFWS researchers that meets regularly to review research proposals involving endangered species.*

Evaluation of results

Review and evaluation of the research results were at best *ad hoc* processes. Each research team submitted a report of results that were available as of March 1991. At this time the contracts had ended for the genetics study and development of the computer model. These reports were collated by the HCP consultant, presented in a meeting of the biological working group, and circulated to Stephens' kangaroo rat biologists and to a few academic biologists suggested by the researchers. There was no call for formal response to the comments of reviewers, and no mechanism for following up the review by collecting additional data, performing additional analysis, or by modifying and reanalysing the computer model to correct flaws uncovered in the review process. Some of these difficulties stemmed from the short time frame of the work and the asynchrony among research teams that arose from delays in funding and permitting, but many difficulties would have been avoided by establishing a formal review process. *It is important to provide for peer review of research methods and results early enough to allow for constructive changes in the course of the research program.*

Incorporating research results into the HCP

Because the Stephens' Kangaroo Rat HCP has not yet been completed, it is not clear to what extent the research results will contribute to the system of permanent design reserves, but the prognosis is not good. The three research contracts have now ended, and no formal provision insures continued involvement of research scientists in development of the HCP. The primary tool for the population viability assessment is a computer model of uncertain accuracy that needs to be modified to reflect the most recent knowledge of Stephens' kangaroo rat population biology. But no effort is being made to improve the model, which was completed in 1991 before demographic and dispersal studies had been completed, and it is being used by consultants who are overworked and have little training in population modeling. *It is critical that a panel of scientists advise the Board of Directors about the amount and kind of research that needs to be done to develop a biologically robust HCP and that they also oversee the use of data.*

Conclusion

Designing a biologically robust HCP is no-easy task. It requires the technical expertise of population biologists skilled at mathematical modeling and field biologists who can help the modelers to develop a realistic model and obtain estimates of critical model parameters. The Riverside County Habitat Conservation Agency has made a pioneering effort to incorporate scientific research into the Stephens' Kangaroo Rat HCP. This effort has been made all the more difficult by the enormous pressure from development interests to solve the "rat problem" quickly and expediently, the pitiful resources that are available for conservation programs, and the lack of leadership by agencies with biological expertise like USFWS and California Department of Fish and Game.

It is unreasonable to expect individual 10(a) applicants to know how to go about establishing or implementing an HCP, and leadership from the cognizant federal agency, USFWS, is essential. This need puts USFWS in the difficult position of having to pass judgement on a proposal that it has had a hand in shaping (Bean et al. 1991), and the USFWS response has been to present a low profile.

There is a better solution: why not establish, as Bean et al. (1991, pp.16 and 40) recommend, a special group within USFWS separate from the permitting branch, that guides the development and implementation of individual HCP's? This group would relieve some of the pressure on overburdened field offices. It also could perform some of the review and oversight functions recommended earlier if academic scientists are invited to participate in the group to assist USFWS in evaluating the biological merits of the resulting HCP.

It should not be difficult to convince academic scientists to participate in such an oversight panel, and professional societies like the Ecological Society of America can assist in identifying qualified participants. Academics consider it a routine part of their professional duties to sit on the panels of granting agencies like the National Science Foundation or the editorial boards of scientific journals, and service on an HCP advisory panel would be no different. With their extensive experience in objective evaluation of research methods, results, and conclusions, they would offer invaluable advice that should help to avoid some of the difficulties that have surfaced in the Stephens' Kangaroo Rat HCP process.

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Endangered Species Act: Spotted Owls, Biodiversity, Land Development, Politics, and Reauthorization

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Abstract. With all the recent clamor over the listing and potential listing of several controversial species in California and elsewhere (e.g., northern spotted owl, California gnatcatcher, delta smelt), the pending reauthorization this year of the Endangered Species Act of 1973 portends to be the subject of much media attention and political debate. Despite the introduction of ten bills in 1991 to "fix" the spotted owl/ timber harvest dilemma in the Pacific northwest, none of these bills made it into law during the first session of the 102nd Congress. Though three bills dealing with some of the provisions of the Act were introduced last year, only the "Studds bill" (H.R. 4045) would actually reauthorize this highly significant piece of environmental legislation. Given California's ever increasing population and expanding land development, reauthorization likely will influence the future interface between development and natural lands in the state. The fate of reauthorization and the northern spotted owl, including pertinent provisions of these bills and other potential amendments, is discussed.

Keywords: Biodiversity; Congress; Endangered Species Act of 1973; land development; National Marine Fisheries Service; northern spotted owl; politics; reauthorization; U.S. Fish and Wildlife Service; wildlife conservation.

Introduction

With little controversy and strong support from the environmental community (Rohlf 1989; Kohm 1991), the Senate and House of the 93rd Congress of the United States passed the Endangered Species Act of 1973 (ESA) on the 19th and 20th of December 1973 respectively. Signed by President Nixon eight days later, the ESA repealed much of the Endangered Species Conservation Act of 1969, which had replaced the Endangered Species Preservation Act of 1966. In the ESA [section 2(a)(1)], Congress found and declared that "various species of fish, wildlife, and plants in the United States have been rendered extinct as a consequence of economic growth and development untempered by adequate concern and conservation." In light of this finding, the primary purpose of the ESA was "to provide a means whereby the ecosystems upon which endangered and threatened species depend may be conserved [section 2(b)]." In effect, the primary purpose of the ESA came close to according ecosystems, not just species, "a legal right to exist" (Nash 1989).

Though the ESA has been amended eight times, the law remains essentially intact (Rohlf 1989). The principal amendments occurred during the reauthorization years of 1978, 1982, and 1988; 1988 being the last year the law was reauthorized. The 1978 amendments provided for an exemption process under section 7 of the ESA; required the designation of critical habitat (when prudent) under section 4 of the ESA, and the assessment of the economic impact due to such designation; extended the land acquisition authority under section 5 of the ESA to all species; and limited population listings under section 4 to vertebrates. The 1982 amendments established the conservation planning or "incidental take" permit process under section 10(a) of the ESA, required that listings pursuant to section 4 be made solely on the best scientific and commercial data and that such listings be made within one year of the proposal, provided for the designation of experimental populations under section 10(j), and prohibited the removal (including the reduction to possession) of listed plants from lands under Federal jurisdiction. The 1988 amendments mandated that the Secretary [i.e., Secretary of Interior and the U.S. Fish and Wildlife Service (FWS) and Secretary of Commerce and the National Marine Fisheries Service (NMFS)] monitor candidate and recovered species, undertake their emergency listing authority under section 4 when significant risk to the well being of a species exists, and report to Congress on expenditures and the status of listed species and recovery plans. In addition, this last amendment to the act extended the protection for plants to include malicious damage or destruction on Federal lands, and

related acts on non-Federal lands where such activities violate State law.

In the 1980's, most articles and books concerning the ESA dealt with the implications and nuances of this complicated law (e.g., Bean 1983; Bartel 1987; Rohlf 1989). Recently, however, much of the endangered species and related literature consists largely of criticism and debate from a wide array of interests, including lawyers, politicians, consultants, and environmentalists. Magazines, like *The Atlantic Monthly* and *Land Use Forum*, have published issues that have focused on the perceived deficiencies of the ESA. Nevertheless, these criticisms are divided in their view of where the ESA needs to be changed. On one side, some authors have argued that the law needs to be strengthened, especially from a biological perspective, to meet the stated purpose of the ESA (Rohlf 1991; Murphy and Noon 1991). O'Connell (1992), however, maintained that the problems lie primarily with implementation rather than the statute itself. Regardless, Soul (1991) asserted that the ESA has failed to significantly slow the "deterioration of the nation's biological estate." Such criticisms have become much more vocal lately with the recent focus on maintaining the Earth's biological diversity or "biodiversity". For example, Norton (1987), Noss (1991), and Winckler (1992) asserted that the ESA should concentrate on preserving ecosystems rather than individual species. Nevertheless, Horton (1992) noted that the ESA was "intended only to provide a last-ditch defense for the most vulnerable plants and animals, not save the planet."

On the other side of the debate, Representative Vic Fazio (D-California) said in a speech before the California Farm Bureau Federation on April 22, 1992, that although the ESA may be the "pit bull" of environmental laws, it should be on a "short leash." Along these lines, Hewitt (1991) called for significant modifications to the listing process under section 4, which would slow or limit listings, and reforms to the conservation planning process under section 10 to expedite permit issuance. Nevertheless, Silver (1991) contended that reauthorization should center on expediting listings and giving the FWS the authority to issue section 10 permits for species being considered for listing. Marsh (1991) argued that the focus on the listing process, especially economic and taxonomic considerations, is diverting public concern from resolving the real issue, conflict between development and preserving natural lands. Morowitz (1991), however, asserted that endangered species preservation must be balanced with economics, especially the value of the individual species under consideration. Palmer (1992) questioned the whole notion of needing to be concerned about vanishing species or diminishing biodiversity because *Homo sapiens* is, like rest of the world's biota, a natural component of the Earth. Conversely, Eldredge (1991) noted that endangered species conservation is "the most effective political means yet found to arouse public support for the real task: conserving ecosystems, preserving habitat, putting areas effectively beyond the bounds of exploitation leading to total devastation and destruction."

Congressional Action in 1991

Northern spotted owl

Primarily in response to the proposed and final listing of the northern spotted owl (*Strix occidentalis caurina*), 10 bills were introduced in Congress in 1991 to "solve" the owl/timber harvest dilemma (Table 1). Though not ESA amendments *per se*, all 10 bills would have amended the act to some degree. Despite the press attention and rhetoric on Capitol Hill, no final action was taken on any of these bills during the first session of the 102nd Congress.

H.R. 3092

The first ESA bill introduced last year was H.R. 3092, the "Human Protection Act of 1991." Representative James Hansen (R-Utah) and 11 co-sponsors introduced this non-reauthorization bill on July 30, 1991. Three of the co-sponsors are from the House Merchant Marine and Fisheries committee, which has sole jurisdiction in the House over the ESA. The Hansen bill proposes to amend section 4(b)(1)(A) of the ESA by no longer requiring listings to be based only on the "best scientific and commercial data available." In addition, section 3 of H.R. 3092 would require that actions under the ESA not be taken unless the "potential economic benefits to society of the action do not outweigh the potential economic costs" as determined under Executive Order 12291. Though this section would amend section 4 of the ESA, it is not clear whether all actions under the ESA would be affected by this limitation. Moreover, because the cited executive order has a $100 million "trigger," this economic standard would seem to have no effect on the vast majority of ESA actions, listing or otherwise. This section of the Hansen bill would also strike any reference to best available data and potential extinction in section 4(b)(2), thereby giving the Secretary the authority to delete any area from critical habitat where benefits of exclusion outweigh inclusion. The last section of H.R. 3092 would basically codify Executive Order 12630 by requiring the Attorney General to certify that the FWS and NMFS are in compliance with this order insofar as any new regulations are concerned.

Table 1. Bills involving the northern spotted owl, ancient forests, forest management, and/or timber industry/worker assistance introduced during the first session of 102nd Congress

Bill Number	Bill Name	Sponsor (# of co-sponsors)	Focus of Bill and Other Comments
H.R. 842	Ancient Forest Protection Act of 1991	Jontz(71)	Old-growth forest protection
H.R. 1590	Ancient Forest Act of 1991	Vento(20)	Old-growth forest protection
H.R. 2463	unnamed	Huckaby(10)	Limited old-growth protection, expediting timber harvest, worker benefits
S. 1156	unnamed	Packwood(6)	Same language as H.R. 2463
H.R. 2696	unnamed	Stark(0)	Old-growth redwood protection
H.R. 2799	unnamed	Swift(3)	Forest Service timber management in Washington
H.R. 2807	Forest and Community Survival Act of 1991	AuCoin(3)	Limited old-growth protection, timber industry/worker benefits
H.R. 3263	Northwest Forest Protection and Community Stability Act of 1991	Morrison(8)	Expanded version of H.R. 2807
S. 1536	Pacific Northwest Forest Community Recovery and Ecosystem Conservation Act of 1991	Adams(0)	Timber industry/worker benefits forest ecosystem protection
H.R. 3432	Pacific Northwest Forest Community Recovery and Ecosystem Conservation Act of 1991	McDermott(3)	Same language as S. 1536

H.R. 4058

Another ESA bill introduced in 1991 that did not address the reauthorization issue was H.R. 4058, the Balanced Economic and Environmental Priorities Act of 1991. This bill was introduced by Representative William Dannemeyer (R-California) without any co-sponsors on November 26, 1991. Section 2 of H.R. 4058 proposes to restrict three actions under the ESA until the Secretary has prepared an "economic impact analysis," has determined based on that analysis, that benefits outweigh costs, and has published an "economic impact statement" describing his findings. The three actions are the designation of critical habitat, issuance of a "protective regulation" pursuant to section 9 of the ESA for threatened species, and a recovery plan. It is unclear what effect these provisions would have on the FWS or NMFS. First, critical habitat designations now allow for the exclusion of areas "that the benefits of such exclusion outweigh" the benefits of inclusion [section 4(b)(2)]. Second, the FWS has already issued a regulation giving the same section 9 protections to threatened species as those accorded endangered species [see 50 Code of Federal Regulations 17.31(a)]. Third, though some tasks detailed in recovery plans are implemented from time to time, Congress, via the budgeting process, ultimately controls the degree with which any recovery plan or individual task is implemented. Recovery plans are certainly not "enforced" as implied in the bill. The necessity of doing an additional cost benefit analysis seems superfluous in light of existing Congressional control. The remainder of this section of H.R. 4058 concerns the necessary details of the economic impact analysis. Aside from specifying the excruciating details of what adverse impacts should be considered in an analysis, the act seems to prohibit the Secretary from including any discussion on benefits. The only exception may be "[a]ny other . . . ecological effects."

Section 3 of Dannemeyer's bill vaguely requires the FWS and NMFS to "limit economic losses" incurred by section 4 of the ESA. Moreover, this section would require the Secretary to develop regulations in order that he may pay any person for any economic loss, except a "de minimis or wholly speculative loss." Persons denied remuneration may appeal to the appropriate Federal court. Another vague stipulation is that any person or governmental entity may intervene in this process. The ambiguity of this section of H.R. 4058 prohibits making any reliable prediction of its effect. However, one likely scenario would be that much money might leave the Federal treasury.

The final section of Dannemeyer's bill would require the Secretary to implement sections 2 and 3 of H.R. 4058 for species listed after January 1, 1986, excepting for the remuneration provisions of section 3 for species listed prior to the enactment of this bill. Other than listing previously taken actions under the ESA that would now be prohibited, the fate of past actions with the passage of this bill is unknown.

H.R. 4045

The only ESA bill introduced last year that would reauthorize the law is H.R. 4045, the Endangered Spe-

cies Act Amendments of 1992. This bill was introduced by Representative Gerry Studds (D-Massachusetts) and 30 co-sponsors. Studds is the chairman of the Fisheries and Wildlife Conservation and the Environment subcommittee, which is one of five subcommittees under the Merchant Marine and Fisheries committee. He is the second ranking Democrat on this committee that, to reiterate, has sole jurisdiction in the House over the ESA. In addition, four of the co-sponsors serve on this House committee as well.

Section 101 of the Studds bill would set a deadline of December 31, 1996, for the development and implementation of recovery plans for all species listed after December 31, 1992. A two-year deadline would be set for species listed after December 31, 1992. The only exceptions would be where the Secretary determined such recovery plan development and implementation would not promote the conservation of a given species. Section 101 also would replace section 4(f)(1)(A) of the ESA so that the Secretary "to the maximum extent practicable" would give "priority to the development of integrated multispecies recovery plans" where it is beneficial to maintain and restore ecosystems harboring two or more listed or candidate species. The Secretary would be required to give priority to the development of "such integrated recovery plans" for areas where development conflicts with species' conservation. The section adds an additional requirement that all recovery plans address "site-specific management actions" for recovery of the species and maintenance or restoration of its ecosystem. The provisions of section 101 likely would not be controversial and would be welcomed by both the development and environmental communities. However, the FWS and NMFS may object to the short period given in the bill to eliminate a large recovery plan backlog. Moreover, given the massive costs involved with just fully funding existing recovery plans, the meaning of "implementation" of recovery plans would need to be clarified in any final version.

Section 201 of H.R. 4045 would waive the 60-day notice requirement for citizen suits where there is an "emergency posing a significant risk to the well-being of any listed species of fish and wildlife or plants." Though justifiable and doubtlessly endorsed by the environmental community, expediting lawsuits that already trouble the development community likely would receive strong opposition. Section 202 would revise section 11(f) of the ESA to give various Federal agencies the authority to promulgate regulations to implement the resolutions of the Convention on International Trade in Endangered Species (CITES). This provision likely will be supported by the environmental community with little resistance from other interests.

Section 301 of the Studds bill would make the most significant change to the ESA. It would allow the Secretary to enter into cooperative agreements "with any State, municipality, county, or political subdivision of a state" to assist in the development of candidate species conservation plans under section 10. Though reportedly intended to be "tougher" than the current conservation planning process for listed species (i.e., habitat conservation plans or HCP's), the language for these section 10(k) permits appears to be, at a minimum, less clear and, perhaps, less stringent than the requirements for conventional conservation plans under section 10(a)(2)(B). Section 301 of H.R. 4045 would also allow the Secretary to treat candidate species plans as meeting the requirements of section 10(a)(2)(A), if and when such species are listed. Because a conservation plan cannot be rejected for not meeting the requirements of this subsection, no real enticement is being provided to potential candidate species plan applicants. Section 301 would also authorize the Secretary to use a "Habitat Conservation Planning Fund" to grant or loan monies for any type of action, like biological studies, relating to the development of a conservation plan for listed or candidate species. He would be allowed to consider a number of factors, like the number of species affected and local commitment, in determining where to provide assistance. The Secretary would be reimbursed for these monies, which would be limited to $500,000 per fund recipient.

Section 401 would reauthorize the funding appropriations for the entire endangered species program, including CITES, through fiscal year 1997. Section 401 would increase significantly the maximum dollar amounts for section 15 of the ESA as compared to the 1988 reauthorization bill (P.L. 100-478). Section 402 would amend section 15 and provide up to $20 million for the Habitat Conservation Planning Fund. This whole issue of reauthorizing may bring many of the particular figures cited in H.R. 4045 under closer scrutiny.

1992 Update and Outlook

Northern spotted owl

Recently, "pro-owl" interests have taken the offensive. In February, a U.S. district court judge temporarily blocked Bureau of Land Management (BLM) timber sales with a preliminary injunction in a case brought by the Portland Audubon Society. In issuing a permanent injunction in response to a suit brought by the Lane County Audubon Society, the Ninth Circuit Court in San Francisco ordered the BLM in March to consult under section 7 prior to proceeding with any sales in western

Oregon. Simultaneously, the Forest Service (FS) adopted the controversial "Jack Ward Thomas" conservation strategy for its 17 forests in California, Oregon, and Washington in response to another U.S. district court-ordered deadline.

Testifying in a joint oversight hearing of the House Agriculture, Interior, and Merchant Marine committees on March 24, Secretary of Interior Manuel Lujan Jr. said that he would shortly be offering an alternative to the draft northern spotted owl recovery plan (Lujan et al. 1992) written by the recovery team. This alternative, the "owl preservation plan," reportedly would reduce the number of lost jobs by 30 to 90 percent from that estimated in the recovery plan. The alternative, however, requires Congressional action because it would not meet the standards of section 4 of the ESA. Subsequently, the Interior Department announced that release of the recovery and alternative plans would be delayed until early May. In response to these developments, Representative Kika de la Garza (D-Texas), along with five co-sponsors (including the chairmen of both the Interior and Merchant Marine committees and Studds), introduced H.R. 4899 on April 10. This bill would mandate the establishment of an old-growth forest reserve program in the Pacific northwest by requiring the Departments of Agriculture (i.e., FS) and Interior (i.e., BLM) to adopt one of the alternatives in the 1991 "Scientific Panel on Late-Successional Forest Ecosystems." According to a House staffer, a committee, floor, and/or conference fight likely will determine which alternative is selected by Congress in the final version of this bill. In an unrelated owl matter, Representative Jolene Unsoeld (D-Washington), along with three co-sponsors, introduced H.R. 4615, designed to facilitate the experimental management program being conducted by the State of Washington on State-owned lands on the western Olympic Peninsula.

The fate of the existing 12 bills and any new owl/timber bill likely will depend on the level of perceived concern Congress detects from the voters in the Pacific northwest. The longer Congress waits in this election year, the more it becomes likely that Congress will take no final action during the second session. Given the relative calm now surrounding the owl, Congress may let the agencies and industry handle this explosive issue. Such predictions are always subject to immediate change on Capitol Hill.

Reauthorization

Clearly development and environmental interests will continue to lobby Congress and attempt to organize their supporters regarding ESA reauthorization. As with the formation of the National Wetlands Coalition involving the reauthorization of the Clean Water Act, recently the National Endangered Species Act Reform Coalition, which is based in New Mexico, was organized by the same Washington, D.C. law firm (Van Ness, Feldman & Curtis). This coalition intends to weaken the ESA by documenting problems in simple terms with the law, soliciting grassroots support and membership, identifying a bipartisan group of Senators and Representatives in favor of modifying the ESA, educating the public, and proposing modifications to the ESA. According to coalition literature, such ESA modifications likely will focus on requiring the FWS to consider socio-economic impacts in the listing process and on providing greater flexibility in the listing process "and the consequences that flow from such listings." According to a letter from the California Chamber of Commerce dated November 13, 1991, another related group, the Endangered Species Task Force, concluded that the best way to weaken the ESA is through "technical amendments." In an April letter sent to the California Congressional delegation, the California Chamber of Commerce suggested several "reform proposals" such as providing improved public notice and participation, requiring simultaneous designation of critical habitat, defining "best scientific and commercial data," establishing a peer review process for such data, expanding the conservation planning process, linking critical habitat with the section 9 take prohibitions, focusing mitigation measures on withdrawn Federal lands, consideration of economic and environmental costs in recovery plan development, requiring protection against uncompensated taking of property, providing "equal" access to those individuals challenging listing actions, and removing "bias" from the listing process.

On the other side of this contentious issue is the Endangered Species Coalition, which primarily consists of the Environmental Defense Fund, Natural Resources Defense Council, Sierra Club, and World Wildlife Fund. This group and other environmental organizations likely will continue to lobby for a stronger ESA. Such additional strengthening provisions probably will center on much of what is contained in the Studds bill, like streamlining the listing process, mandating critical habitat designations, requiring adequate funding for mitigation proposed in conservation plans, expediting recovery planning, providing reimbursable funding for conservation plan development, and strengthening various enforcement provisions.

Because 1992 is a election year in which 100 or more representatives and senators may lose their seats, Congress likely will not be in a mood to undertake this controversial issue this year. Nonetheless, the Senate Environment Protection subcommittee of the Environment and Public Works committee held an oversight hearing on April 10, 1992. A subsequent hearing on the

northern spotted owl is scheduled for May 8. According to House staff, the Fisheries and Wildlife subcommittee intends to hold oversight hearings this spring. However, no hearings have been scheduled through May. Though no reauthorization action is expected in 1992, the Studds bill, which now has over 70 co-sponsors, likely would be the "vehicle" of any ESA legislation. If authorization for ESA appropriations is allowed to run out on October 19, 1992, the requirements of the ESA remain in effect. Moreover, the appropriations for ESA expenditures likely would be continued through language in the annual Interior appropriations bill. This strategy was used for two years after funding authorization expired in 1985 following the 1982 Amendments (P.L. 97-304). Nonetheless, as was almost the case with the northern spotted owl in 1991, a proposal or listing of some species confronting a powerful development interest, like home construction (California gnatcatcher) or agribusiness (salmon, delta smelt), may not allow Congress the luxury of ignoring the ESA reauthorization issue in 1992.

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Endangered Plants as Second Class Citizens

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Abstract. Federal and State endangered species laws provide less protection for plants than for animals. This inequity, an artifact of Old English Law, hinders our attempts to conserve California's biodiversity. Coupled with public perceptions about plants, this bias results in lower funding and weakened implementation and enforcement of conservation laws and regulations for endangered plants.

Keywords: Biodiversity; endangered plants; Endangered Species Act.

Introduction

Have you ever wondered why you need permission from the California Department of Fish and Game to hunt wild pig or striped bass, two alien animals, but don't need permission to cut down a mature native oak or plow under native grassland? In a state as biologically diverse as California, this discrepancy between plant and animal conservation ethics severely hinders our ability to conserve threatened biodiversity.

California is Plant Diversity

Floristic richness is the essence of California's biodiversity. California's native flora is diverse, unique and endangered. It is the richest of any in the continental United States, ten times richer than a comparable sized area on the East Coast. There are approximately 7,000 native vascular plants in California and one third of them are found nowhere else in the world.

Native plants and plant communities are an integral part of the California image. When people think of California, they visualize the Sierra Nevada peaks and giant Sequoia groves; the fogshrouded coastline and towering redwoods; and rolling hills covered in oaks and California poppies. It's that combination of the earth and plants that comprise the living landscape we call California.

Unfortunately many of those classic California landscapes are being reduced to mere fragments of their former extent. One of the reasons is that plants are treated differently than animals under our endangered species laws. Plants are essentially treated as second class citizens, as though they were part of the real estate.

Plants as Real Estate

Our current state and federal endangered species laws have evolved with their roots persistently entrenched in Old English Law. Under that system, game animals belonged to the Crown, while plants, due to their perceived sedentary nature, went with the land. While modern natural resource conservation laws and the emergence of the public trust doctrine have advanced our legal views of public uses and benefits of plants, the artifact of viewing plants as real estate and therefore, personal property, persists in endangered species conservation (McMahan 1980). Clearly, plants do move. But, they move through space and time on a scale different from most game animals. Does that difference justify continuing to provide them unequal protection under our endangered species laws? I believe it does not.

Unequal protection for plants

Under the federal Endangered Species Act, plants do not receive the same level of protection as animals. Under Section 3, the definition of species includes distinct populations only for vertebrate animals, not for plants. Therefore, only vertebrates can receive listing when declining in only a portion of their entire range. Under Section 9, in the absence of a federal action or federal funding, plants are protected from take on private lands only when the action occurred in knowing violation of any state law or regulation or in the course of any violation

of a state criminal trespass law. Proving that someone knowingly violated a law is a tremendous burden on prosecutors and consequently hinders efforts to enforce take prohibitions of the Federal ESA for plants on private lands (U.S. Fish and Wildlife Service 1990).

Unequal funding for plants

In 1990, of the total $102 million in state and federal endangered species funds, only 2% went to plants, even though there are 90% as many federally listed plants as animals. In California, federal funds under Section 6 of the Endangered Species Act are directed primarily to the charismatic megafauna bald eagle, peregrine falcon, brown pelican, spotted owl. Endangered plant programs receive less than 10% of the annual Section 6 budget in California (California Department of Fish and Game 1991).

Lack of funding for endangered plants also affects staffing levels. Within the California Department of Fish and Game, there are 4 times as many biologists for endangered animals as for endangered plants, yet there are 2.5 times as many state-listed plants as animals. The moral of the story is, if you're going to be an endangered species, you want to have big brown eyes.

Tarplant, not tarweed

Conservation involves marketing. Without an attractive product you have nothing. To compensate for the cuteness advantage of animals, I suggest we remember our audience when assigning "common names" for plants. Botanists can't get so bogged down in the morphological details when talking to a lay audience. Most people don't really appreciate that there are more than 50 technical terms to describe leaf surfaces.

Lack of appreciation leads to lack of respect for native plants. "This is an ugly looking weed, why should we care about it? Let's dig it up and move it." The local County Board of Supervisors is not going to want to redesign a project for *Blennosperma bakeri* if we call it Baker's stickyseed, but they might have more concern if we call it Sonoma sunshine. With this in mind, coyotethistle becomes buttoncelery and tarweed becomes tarplant.

Further Changing the Perspective

Changing land use patterns requires modifying attitudes about land-changing perspectives and priorities. To change society's perspective on the value of native wildlands and the native plants they support, we must rely more on the power of aesthetics and personal values. When people appreciate and love something, they will pay any price to keep it. By sharing your awe and appreciation for natural beauty and diversity you can inspire others to view the world as something other than real estate. We must appeal to people's love and appreciation for the natural landscape.

Our society must appreciate the value of the ecological services that native plants, natural vegetation and functioning wildlands provide to humanity if they are to support nature conservation. I fear that our scientific attempts to explain the intricacies of nature are lost on most people. But I believe that the value of clean air, clean water, fertile soil, and a safe place to live are appreciated by all people. We must appeal to those basic natural values to succeed in plant conservation. What a tragedy it would be if our neglect reduced California's floristic legacy to a monotonous savannah of nonnative eucalyptus and brome grass.

With more help we can succeed

I want each of you make a pledge to go out this year and take the message of plant conservation needs to the decision makers and public. Start preaching to the unconverted. Together we can make a difference and help endangered plants receive the consideration and protection they deserve as the foundation of our nation's biodiversity.

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Genetic Diversity: Esoteric or Essential?

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Abstract. The presence of genetic subdivisions within plant species has been recognized since the early part of this century. More recent experimental work documents diversity in a number of visible (quantitative and single locus) and molecular (enzyme and DNA sequence) characters. Considerations of the spatial distribution — both pattern and scale — of genetic diversity provide another kind of complexity. Patterns of natural diversity are overlain by patterns of habitat loss that are determined by non-biological forces. A review of the literature on intraspecific plant biodiversity offers some insight into situations where detailed genetic studies may be essential to preservation of diversity. Differentiation both between discrete populations and within continuous ones has been demonstrated, especially in response to strong environmental gradients and in species that are short-lived, inbred or clonal. Strategies to preserve wide-ranging vertebrates may maintain sufficient habitat to sustain a wide variety of plants, but two categories of plants could be neglected entirely by this approach. These are habitat specialists (disturbance regimes, edaphic conditions, ephemeral wetlands) and plants with reproductive systems that are asexual, favor selfing, restrict gene flow, require certain sex ratios, or are dependent on specific animal pollinators. Plants that fit into these categories warrant a close examination of their genetic architecture and the dynamics of gene flow. Case studies of three habitat specialists found in southern California (*Downingia cuspidata, Downingia concolor* ssp. *brevior* and *Nolina interrata*) are given as examples.

Keywords: *Downingia concolor* ssp. *brevior*; *Downingia cuspidata*; gabbro soils; genetic diversity; genetic differentiation; habitat specialists; metavolcanic soils; patterns of diversity; *Nolina interrata*; southern California; vernal pools.

Introduction

Conservation of biological diversity has up until recent years been species oriented (Rojas 1992), even though the importance of within-species differences was well established by Turesson (1922a. 1922b, 1925, 1930), Gregor (1946) and Clausen et al. (1940, 1948) in the first half of the century. Further exploration of intraspecific diversity has led to what we might call the "diversity of diversity" problem. The early investigation of within-species genetic diversity was devoted to an intensive study of quantitative (i.e., biomass, height, or growth rate) and visible single locus (i.e., flower petal color) characters through common garden and reciprocal transplant experiments. The original line of inquiry has since been expanded to include a wide array of morphological, developmental, and physiological characters, sometimes coupled with formal breeding and crossing programs as well as molecular techniques. Enzyme electrophoresis and DNA sequencing have revealed additional types of genetic diversity, some with their own mode of inheritance, mutation rate, sensitivity to selection, interaction with the environment, and distributional pattern.

Considerations of the spatial distribution — both pattern and scale — of genetic diversity provide another kind of complexity. It has become more widely recognized that the interpretation of various measures of genetic diversity is highly dependent on the original sampling scheme as well as the type of analysis (Endler 1977; Epperson and Clegg 1986; Epperson 1989; Heywood 1991). Large sampling intervals, relative to the phenomenon being examined, or means taken over large quadrats may obscure a cline or non-linear changes in genotypes. Quadrat size can also affect the determination of non-randomness (Greig-Smith 1952; Kershaw and Looney 1985). Statistical tests indifferent to spatial pattern may suggest different results or different mechanisms than those sensitive to it (Endler 1977; Sokal and Oden 1978 a, 1978b; Waser 1987; Sokal and Wartenberg 1983; Epperson 1989).

Overlain on the natural patterns of biodiversity are patterns of habitat loss. Within southern California, habitats such as riparian forests, coastal marshes and scrublands, grasslands, vernal pools, and montane meadows have suffered disproportionate losses because of their attractiveness for various human enterprises (Jones and Stokes Associates 1987; Oberbauer 1990). Human development has created a patchwork of divergent, often incompatible, land uses that—among other things—interfere with migration, breeding, species interactions and the disturbance regime on the remaining undeveloped parcels (Wilcox 1980; Jensen 1987; Egan 1992). Three concerns immediately arise. Are some habitats and the species closely associated with them in danger of being eliminated altogether? Do the remaining populations contain sufficient resiliency to deal effectively with short-term changes in their environment? Finally, what is their evolutionary potential? The tools are available to address these concerns, but the gaps in our information are many and the costs to increase it mighty (Falk 1991). Consequently, it is necessary to determine what kinds of genetic information are essential to our goals of preserving into the future some remnants of naturally functioning ecosystems.

Review of the Literature

A review of what is known of the types and distribution of genetic diversity in plants is a good place to begin in developing a strategy to preserve biological diversity in plants. An extensive literature has developed around enzyme electrophoresis studies, an experimental technique that is widely used because it offers an "... ideal compromise between data quality and technical accessibility." (Schaal et al. 1991). Data are amenable to between-species comparisons and broad generalizations based on the plants' breeding systems, geographical ranges, life forms, and other fundamental traits. Data can be used in combination with mathematical models to estimate outcrossing rates, examine gene flow and describe genetic subdivisions. There are, however, a number of drawbacks to these studies, including the lack of direct correspondence between enzyme data and traits clearly tied to fitness (Stebbins 1989; Schaal et al. 1991; but see Mitton 1989; Hamrick 1989). Also, they represent a small and probably non-representative sample of the plant's proteins (Stebbins 1989). The usefulness of the enzyme literature is further restricted by the absence of a rigorous operating definition of populations and sampling schemes that do not account for scale or pattern. These deficiencies undoubtedly have an impact — largely unexplored — on the degree of population differentiation observed and the estimated proportion of species diversity contained within populations (Endler 1977; Ellstrand and Roose 1987; Epperson 1989)

Brown (1979), covering 30 plant species, began the long line of reviews dealing exclusively with the enzyme literature. He concluded that inbreeders showed greater micro-geographic differentiation than outcrossers but less diversity within populations. Gottlieb (1982), summarizing data on 49 taxa, reached similar conclusions. Additional reviews of Hamrick and others (Hamrick et al. 1979; Loveless and Hamrick 1984; Hamrick 1989; Hamrick and Godt 1989; Hamrick et al. 1991) have expanded to include 653 papers and 449 species. In Hamrick and Godt (1989) and Hamrick et al. (1991), species are classified by eight traits, then comparisons and generalizations are made based on mean values for various genetic parameters. These include the proportion of loci polymorphic, the number of alleles per locus, and genetic diversity, an index that reflects both the number of alleles per locus and their relative frequencies or evenness of distribution. At the species and population levels, the eight traits accounted for a small portion of the variation in genetic diversity (24 percent and 28 percent, respectively), with geographical range, life form, breeding system, and seed dispersal mechanisms contributing the most. Genetic diversity is highest in long-lived perennials, outcrossing species and species whose seeds disperse by attachment to animals. Among populations, "genetically vagile" species are less likely to be differentiated at the population level than species with limited gene flow, and a higher proportion of the alleles present in the species as a whole are likely to be found in any one population (Hamrick et al. 1991).

Endemic, compared to widespread species, have less genetic diversity, a smaller proportion of loci polymorphic, and fewer alleles per locus, both at the species and population levels, but the heterogeneity among populations is comparable (Hamrick and Godt 1989; Hamrick et al. 1991). Clonal species tend to have multiclonal populations, and widespread clones are uncommon—most clones being restricted to one or only a few populations (Ellstrand and Roose 1987).

Studies of quantitative and visible single locus characters abound, and their greatest value for our purpose is what they can tell us about adaptation, the relationship between environmental variables and the distribution of character traits, and the evolutionary potential of populations. Within species, differentiation has been well documented in both widespread and narrowly distributed species as well as in disjunct and continuous populations. Strong selection is clearly implicated. With widespread species, differences in composite variables, such as elevation or latitude, are closely associated with ecotypes, races or other un-named sub-specific groupings (Turesson 1930; Callaham and Liddicoet 1962).

Experimentation often has isolated more explicit selection factors such as temperature maxima and minima, the length of the growing season and annual precipitation (Hermann and Lavender 1968; Fryer and Ledig 1972; Musselman et al. 1975). On local, as opposed to landscape scales, selection gradients sufficient to produce differentiation in natural environments are found where there are steep topographical (Aston and Bradshaw 1966; Bergmann 1978), soil (Turesson 1922a, 1922b; Kruckeberg 1951, 1967), salinity (Silander and Antonovics 1979) or inundation gradients (Johnson 1966; Cook and Johnson 1968). Similar conditions prevail with human manipulation of the environment, as in the mining of heavy metals (Bradshaw 1960; McNeilly 1968; Antonovics and Bradshaw 1970) or use of various agricultural practices (Snaydon and Davies 1972; Davies and Snaydon 1976).

Many widespread species, despite their presence in a diversity of habitats, do not have regionally or locally adapted populations (Sharitz et al. 1980; Barrett and Shore 1989; Barrett and Kohn 1991; Huenneke 1991; Millar and Libby 1991). High diversity, great heterozygosity, and plasticity may contribute to the success of these species and to their lack of differentiation among populations (Barrett and Shore 1989; Huenneke 1991). Genetic differentiation in the absence of obvious selection pressures may occur because of population bottlenecks, founder effects, or isolation by distance. Evidence for isolation by distance appears to be limited (Waser in press). Founder effects may be invoked to explain differentiation among disjunct populations (Schwaegerle and Schaal 1979; Furnier et al. 1987; Wells and Wells 1980; Semple 1989) with no obvious differences in habitat.

To summarize, geographical distributions of species are not particularly instructive. Huenneke (1991) points out that we still are ignorant of the causation of greater diversity in widespread species, and that knowledge of causation would influence preservation strategies. If a wide distribution fosters development of diversity, then preservation of a small portion of a species' diversity might be sufficient to reconstitute that diversity at some later time. However, if localized adaptations are the mechanism whereby a species persists over large areas, it might be necessary to preserve more populations to maintain adequate diversity. The distribution of diversity among populations appears to be similar in widespread and endemic populations.

Both the electrophoretic and quantitative literature support the conclusion that populations of inbreeding, short-lived perennial and annual herbs or clonal species may not have a representative selection of the species' genetic diversity (either broadly or narrowly defined), and localized adaptations are more likely. Finally, strong gradients in environmental variables favor local or regional genetic differentiation even in the face of substantial gene flow, as do patchy or widely disjunct distributions of habitats.

A Broad Plan and Case Studies of Three Species

Profound differences between plants and animals (particularly vertebrates) suggest that many animals might serve well as "umbrella" species (Noss 1990). Animals such as large mammals, migratory birds and anadromous fishes require large areas, a variety of connected habitat types to complete their life cycles and tolerable conditions at all times. By meeting conditions for maintenance of such animal species, habitat qualities associated with plant biodiversity would also be retained. Among these are variation in elevation, aspect, topography, soil type and latitude, and opportunities for dispersal, herbivory, pollination, competition, and natural disturbance regimes.

A number of plant species would probably not be protected by "animal umbrellas". These species fall primarily into two groups: habitat specialists and plants with reproductive systems that are asexual, favor selfing, restrict gene flow, or are dependent on the wellbeing of specific animal pollinators. Some species may fall within both groups. Detailed genetic information may be essential to the preservation of plants in these categories, and broad preservation strategies that protect wide ranging vertebrates would probably miss most of the habitat of these specialists. As examples, I present three species found in southern California: *Downingia cuspidata*, *Downingia concolor* ssp. *brevior* and *Nolina interrata*. All are habitat specialists, and suitable habitat occurs in patches within sites that themselves may be widely disjunct. The Downingias are restricted to ephemeral wetlands, and Nolina is found only on gabbro and metamorphosed volcanic soils (Oberbauer 1991).

Downingias are diminutive annuals that are predominantly outcrossers via non-specific insect pollinators (Weiler 1962). The number of individuals of both species of *Downingia* varies greatly from year to year, with the majority of each species apparently residing in a dormant seed bank (Bauder 1987, 1992). Germination is favored by a limited range of cool temperatures combined with shallow standing water or fully saturated soil (Bauder 1992 and unpublished data). *Nolina*, on the other hand, is a dioecious, polycarpic perennial that expands primarily by growth of underground stems. Sexual reproduction is infrequent and may be hindered by sporadic flowering patterns (Dice 1988; Oberbauer personal communication), the ratio of male to female flowering plants at any one site (Dice 1988), and seed

predation by insects (Bond 1987; Frack 1982) and rodents (Bond 1986).

The distribution of San Diego's vernal pool species is strongly correlated with soil type and elevation (Table 1), suggesting that local selection gradients determine the suite of species that will be present in any one area. Holland and Dains (1990) furnish detailed evidence of local and microscale differences in vernal pool soils, inundation regimes and suites of species in the pools of Merced and Placer Counties. Similar evidence is available for San Diego County (Zedler et al. 1979; Bauder 1986, 1987).

Downingia cuspidata, a vernal pool endemic, is distributed widely in the state of California in vernal pools and on the margins of lakes and ponds. It is found in the coast ranges, the western foothills of the Sierra Nevada, and in San Diego and Riverside Counties. In San Diego County, it occurs in vernal pools on the indurated coastal marine terraces and in clay pan pools in some of the inland valleys. *Downingia cuspidata* is absent from the claypan pools of coastal Otay Mesa and Proctor Valley and the lagoons and seasonal marshes and streams of the Laguna and Cuyamaca Mountains. *Downingia concolor* ssp. *brevior* is completely restricted to the reservoir and lagoons of the Cuyamaca Valley of eastern San Diego County and to small ditches or streams that drain into the valley. Nowhere do the two species of *Downingia* co-occur.

Germination experiments on *Downingia concolor* ssp. *brevior* indicate that temperature plays a significant role in the breaking of seed dormancy, with cool temperatures favoring germination (Bauder 1992). Also, seeds from two populations of *Downingia cuspidata* (coastal and foothill) along with *D. concolor* ssp. *brevior* (montane) have been germinated in a common environment. Preliminary results suggest that the *D. cuspidata* population from the foothill site — with elevation intermediate to the coastal and montane sites — has intermediate germination responses. Weiler (1962), in his study of the genus *Downingia*, suggested the possibility of local races or varieties of *Downingia cuspidata*, and my germination work in progress gives additional support to that hypothesis.

It seems clear, from the above discussion, as well as other studies on vernal pool species (Jain 1976; Griggs 1980; Jain and Moyle 1984; Ritland and Jain 1984), that local or microscale differences in selection pressures may have fostered genetic differentiation within species and perhaps even within populations. In the absence of more detailed knowledge of the genetic architecture of the various pool species, their breeding systems and the nature of gene flow within and between populations, we cannot develop a conservation strategy much short of saving every pool. Because the pools are set in a variety of vegetation matrices, it is unlikely that protection of any animal associate would preserve a sufficient sample of the genetic diversity in pool plant species, including whole taxa.

Nolina interrata may represent one of the most extreme examples where genetics is essential to its preservation and management and where an "animal umbrella" would fail to shield it. When a *Nolina* popu-

Table 1. Association of San Diego vernal plant species with different soil types and elevations

	Coastal Mesas		Inland Valleys		Mountains
	Kearny	Otay	San Marcos	Ramona	Cuyamaca
Elevation	150 m	150 m	160 m	425 m	1400 m
Soil Types [1]	RE	H, S	PL, LF H?, LI?	PL, BO, RA BON-FALL	LA
Impervious Layer (s) [2]	HP + CL	CL	CL	CL	CL
Vegetation Matrix [3]	CHAP	CSS, MSS CHAP, GRA?	GRA	GRA	GRA
Species					
Blennosperma nanum var. *nanum*					X
Boisduvalia glabella		X		X	
Callitriche longipedunculata	X	X	X	X	
Callitriche verna					X
Downingia concolor ssp. *brevior*					X
Downingia cuspidata	X		X	X	
Eryngium aristulatum ssp. *parishii*	X	X	X		
Limnanthes gracilis ssp. *parishii*					X
Pogogyne abramsii	X				
Pogogyne nudiuscula		X			

[1]BO= Bosanko, BON-FALL= Bonsall-Fallbrook, H=Huerhuero, LF= Las Flores, LI= Linne, LA= Loamy Alluvial, PL= Placentia, RA= Ramona, RE= Redding, ST= Stockpen

[2]HP= Hardpan, CL= Clay

[3]CHAP= Chaparral, CSS= Coastal Sage Scrub, GRA= Grassland, MSS= Maritime Succulent Scrub

lation of 2,000 rosettes near Dehesa Road in southwestern San Diego County flowered in 1985 and 1986, following a wildfire in 1984, all flower racemes had female flowers, and no seeds were produced (Dice 1988). Electrophoretic studies indicated that the 50 more or less distinct clusters of rosettes were genetically identical at 15 loci (Croft unpublished data). Therefore, what appeared to be a population of 50 or more individuals, may instead be a large clone of a single female plant.

Nolina interrata is known from fewer than a dozen disjunct sites, only one of which is protected. If other populations have unbalanced sex ratios and are similarly lacking in diversity, this would have profound implications for their ability to recruit seedlings and to sustain themselves over an extended period of time. Because genetic structure is influenced by breeding system, the reproductive biology of this species (single sex plants, ability to spread by underground branching, infrequent flowering) leads to concern about loss of genetic diversity in these isolated populations. High priority should be given to determining the degree of diversity within this species and its distribution within and between populations. Only with this information would it be possible to make management decisions on the need for artificial induction of flowering, cross pollinating within and between populations and transplanting of seeds or small plants. If other sites of *Nolina interrata* are lost to development, the opportunity to insure a healthy future for the protected populations may also be lost.

Conclusions

Preservation of biological diversity at the species level is a daunting task in itself, but recent advances in genetic techniques and analysis have revealed other levels of genetic diversity, and the importance of the spatial distribution of diversity is now recognized. The matter is further complicated by the patterns of land use and development that have arisen from different forces than those structuring natural biological diversity. Protection of wide ranging vertebrates may protect substantial plant diversity as well. A review of the literature indicates that widespread and endemic species do not differ in the distribution of diversity among populations, but it also suggests that plant character traits such as inbreeding and short life span may foster intraspecific differentiation. Diversity on the local or micro scale may be essential to the longevity of a species but could be left unprotected by "animal umbrellas". These "unprotected" species fall primarily into two groups: habitat specialists (disturbance regimes, edaphic conditions, ephemeral wetlands) and plants with reproductive systems that are asexual, favor selfing, restrict gene flow, require certain sex ratios, or are dependent on the well being of specific animal pollinators. Plants that fit into either or both of these categories warrant a close examination of their genetic diversity.

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Rare Community Conservation in California

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Abstract. The California Native Plant Society, in conjunction with representatives from several academic institutions, resource agencies, and conservation organizations, has initiated a program to develop defensible definitions of rare California plant communities. The program is working to improve the current statewide classification of communities using a floristic and phytosociologically-based hierarchy. The present anecdotal, generalized descriptions will be replaced with data-driven definitions. This framework will be built upon, starting with the rarest vegetation types. These will be defined using quantitative analysis of vegetation and environmental characteristics. Rigor in the definitions will allow for straightforward legal interpretation and will establish a means for ecosystem conservation in the state. Publication of a book embodying the new classification, with descriptions of the communities already known is scheduled for 1993.

Keywords: California; classification; conservation; ecosystem; habitat; plant community; rarity.

Introduction

We recognize communities because we want to get a handle on the broad view of ecological diversity of an area. As applied to conservation this has been called " the coarse filter approach" (The Nature Conservancy 1986), and may be contrasted to the "fine filter approach" that focuses study and conservation efforts only on a single rare species. The idea of conservation of natural communities in California is not new. Almost twenty years ago Cheatham and Haller (1975) developed a classification of habitats to be used for selection of potential reserves for the University of California's Natural Reserve System. Twelve years ago the California Natural Diversity Data Base, as a newly combined program of The Nature Conservancy and the State Department of Fish and Game, began tracking natural communities along with rare plants and animals.

The use of natural communities as entities of biological conservation is grounded in the paradigm that the basic fundamental unit in ecology is the ecosystem. The ecosystem is the biotic community of interacting species plus the non-living environment — the habitat (Dice 1952). A community is the collection of all species that coexist in the same habitat. Wherever that habitat repeats itself within one climatic region — many of the same species recur in a similar structure. That habitat, group of species, and structure are unique. A plant community is simply a name tag for a natural community defined by plants. Vascular plants are most frequently the predominant life form in most of the human inhabited terrestrial world. They are sessile, and their biomass and numbers are relatively easily studied. Therefore, it has become the practice of ecologists to define communities by their plant cover. Thus, when we speak of communities we are referring to a community defined by its plants, yet implying not only the plants, but the animals, microorganisms, and fungi that are associated with them.

Current interest in community and ecosystem conservation stems from the need to step away from eleventh-hour single-species conservation approaches and move toward conserving the broad umbrella of habitat and community around one-to-several real or potentially threatened species. This proactive approach assumes that the community is the biological context in which any individual species is embedded. If rare species are to be protected, then so must be the surrounding environment.

Beyond the practical umbrella approach to rare species conservation, there are other compelling reasons for community conservation. The community is the locus of biological diversity, and is the biological basis for all natural life support systems. By protection of a single community, often all component species are protected. The importance of any species is often magnified through

the community of which it is a member. The key value of any plant, for example, may ripple out through animals that pollinate it, feed on it, through fungi and bacteria that decompose it, and associated species that may have a symbiotic relationship with it. Thus, it is the naturally occurring combinations of biological structure that can be conserved only in a broad community approach. For these reasons, the loss of a community is potentially more ecologically damaging than the loss of a single species.

Communities can also express degrees of ecological rarity and endangerment not apparent at the species level. A rare community doesn't have to be composed of rare species. It can be a mix of species which occupy a rare habitat. Many permutations exist, including rare communities composed of a unique combination of common species otherwise represented in several to many common habitats, and rare communities in a particular region which may be more common elsewhere.

In late 1990 a small group of far-sighted members of the California Native Plant Society initiated the CNPS plant communities committee. The steering committee selected a chairman and the first meeting was held on February 21, 1991 at University of California, Davis. The following outlines the actions of the committee and the goals it hopes to achieve.

Classification Systems for California

To make use of communities as a conservation tool we must have a way to classify and name them. A number of classification systems which partially or entirely cover the state have been used. Among the first widely known were those of Wieslander and Jensen (1945), and Munz and Keck (1949, 1950). Several others have been used to classify existing or potential vegetation in the state (Kuchler 1977; Parker and Matayas 1979; Mayer and Laudenslayer 1988). Many of these systems are of a relatively coarse scale, with fewer than 100 listed types. Other systems (eg., Hunter and Paysen 1986; Berry 1985), are very detailed but are either incomplete or lack any definitive descriptions. For example, the ecosystem classification system currently being developed by the United States Forest Service Region Five has the distinct advantage of being data-driven, but is limited to Forest Service lands and is far from complete.

The current system developed by the Natural Diversity Data Base (Holland 1986) is the only relatively detailed classification that treats all areas of the state, offers brief written descriptions of most types, is widely used, and incorporates a system of rarity and threat ranking. The latter characteristic is a result of the long-term use of the NDDB system as a conservation tool. All community types in the data base are ranked according to state and global rarity. All rare communities are further broken down into threat categories (Table 1). In addition, individual locations registered in the data base are further ranked by site quality using a four point system incorporating condition, maturity, non-native species, size, disturbance, diversity, management, and stability considerations.

These characteristics of the Natural Diversity Data Base (NDDB) classification were the principal reasons that the CNPS plant communities committee adopted it as the basis for a new classification of the state's vegetation. The current NDDB classification contains 286 lower order entities. It is essentially an updated version of Cheatham and Haller (1975), which, in turn, was an expansion of the broader categories defined by Munz and Keck (1949, 1950). An indication of the direction in which the classification detail has progressed up to the

Table 1. The ranking of natural communities following the Nature Conservancy Heritage methodology

Ranking Code	Definition
Global Ranking:	
G1	Less than 6 viable occurrences worldwide and/or less than 2000 acres
G2	6-20 viable occurrences worldwide and/or 10,000-20,000 acres
G3	21-100 viable occurrences worldwide and/or 10,000-50,000 acres
G4	Greater than 100 viable occurrences worldwide and/or greater than 50,000 acres
G5	Community demonstrably secure due to world-wide abundance
State Ranking:	
S1	Less than 6 viable occurrences statewide and/or less than 2000 acres
S2	6-20 viable occurrences statewide and/or 2000-10,000 acres
S3	21-100 viable occurrences and/or 10,000-50,000 acres
S4	Greater than 100 viable occurrences statewide and/or greater than 50,000 acres
S5	Community demonstrably secure statewide
Threat Ranking:[a]	
0.1	Very threatened
0.2	Threatened
0.3	No current threats known

[a] Threat ranks are assigned to state ranked communities from S1 through S3 and are added directly to the S code (e.g., S1.1, S2.3, etc.)

point of Holland (1986) is given in Figure 1.

In spite of the relative detail of the existing NDDB classification, the CNPS Plant Communities Committee recognized several problems with it. These may be broken down into several main points.

Lack of rigor in the definitions

Despite the written descriptions of most types in Holland (1986) these definitions are often based on a summary of widespread dominant species and not based on actual on-site observations. As a result, often a species list from a particular site will not correspond well with the written description, typically an amalgamation of information from a wide geographical range. The descriptions, therefore, may be misleading when applied locally, and require a large degree of understanding of the inherent variability of California vegetation before they can be correctly interpreted.

The descriptions are based on a mixture of floristic, physical, and geographic terminology, and these criteria are not clearly defined. A large amount of information is often open to interpretation. For example, ambiguities arise in regionally defined communities where no clear shift in species co-occurs with geographical boundaries (northern mixed chaparral versus southern mixed chaparral, or northern, central, and southern dune scrub). Structural differences denoted in descriptions are also not clearly defined (black oak forest versus black oak woodland, or southern California walnut woodland versus forest).

There is also no simple way of arriving at a correct identification without reading and interpolating a number of descriptions. This lack of rigor on several levels makes it difficult for scientists and land use managers to clearly define which type they are looking at.

A more analytical data-driven approach to the classification and naming of communities can alleviate many of these problems. We need data-driven definitions to prove the existence of communities and to establish criteria for definition of the rare types requiring protection. Quantification sets up rules for definition of types. The rules provide a consistently interpretable structure essential for activities such as remote sensing vegetation mapping, or defending key units of vegetation for conservation.

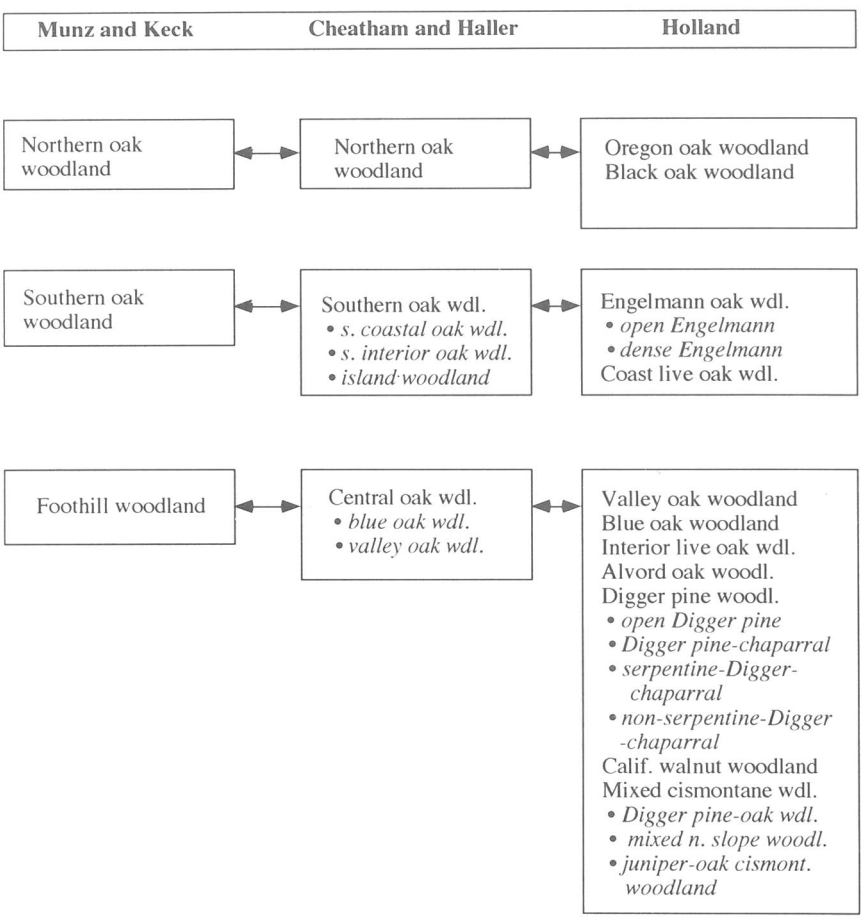

Figure 1. Three different classifications of cismontane woodland indicating trend in refinement of community types from Munz and Keck (1949, 1950) through Cheatham and Haller (1975), and Holland (1986). Arrows indicate analogs, italicized communities with bullets are sub-categories of preceding types.

Uneven resolution

The current classification, although hierarchically arranged, has an uneven resolution. The NDDB hierarchy is only defined numerically and there is no rationale for how the various numerical levels are arranged. This is particularly noticeable at the finest level of scale where coarse, intermediate, and finely defined communities may all be endpoints in the hierarchical string.

For example, the current classification affords crucifixion thorn (*Castela emoryi*) woodland, a rare desert thorn woodland dominated by a single species from a small genus, the same level in the classification as oak (*Quercus*) woodland with its several different dominants, widespread over much of the state.

Differences in classification from those of all other western states

The current classification is also very different in style than those used for vegetation from adjacent states, developed through the United States Forest Service, The Nature Conservancy, and other agencies. There has been a great deal of effort devoted toward integrating the classification of most adjacent states outside of California. This effort has been spearheaded by the Western Regional Task Force of The Nature Conservancy (Bourgeron 1991a). However, because California does not have a similar data-based classification system it has been impossible to integrate California.

California is generally recognized as being substantially more diverse biologically than any other western state and as the California floristic province is unique, similarity with adjacent states is expected to be relatively slight. However, the bordering areas of the eastern and southeast deserts and the northern mountains of the Klamath and the Cascade ranges do share much with adjacent states, and as these states do have active data-driven vegetation classifications, there is much to be gained through collaboration and comparison (Bourgeron et al. 1991).

Not only would it be possible to fold in information from adjacent areas, but the classification itself would be improved by taking a similar quantitative stance to community definition. Broad scale bioregional conservation is greatly facilitated if we all speak the same language.

Largely unpublished and unratified descriptions

Another problem with the current classification is that although it has become widely adopted within the state, it is not in publishable form and has never been widely distributed. If a classification is to be useful and influential to a vast body of interested people then it should be made widely available. Of equal importance, ratification and validation in science is approached through publication of results. Without peer review and subjection to scrutiny, the entities in the classification will never gain acceptance in the scientific community.

Approach of the CNPS Plant Communities Committee

After the committee agreed to adopt the NDDB classification, a short list of the premier changes thought necessary to improve the classification were developed. First and most important among these was the goal of developing defensible definitions of the rare communities. This work would be done by targeting the rarest and most threatened communities in California and accumulating systematic quantitative field data, that could then be analyzed statistically. Beyond this, the committee agreed to reorganize the existing classification of statewide vegetation, to publicize the results of the preliminary reorganization, and to maintain a committee to regularly update the classification based on new information.

Developing the basis for identification of communities

Perhaps the largest obstacle between the present NDDB classification and the goals of the Plant Communities Committee is the development of defensible definitions of the rare communities. Communities are commonly transitional in nature and drawing a clear boundary for legal definition is often very difficult. Depending on their characteristics, communities may be best defined by a variety of features. Thus, a method that relies entirely on vegetation dominance or certain environmental characteristics is not always the best approach. For example, certain communities may be easily discerned by abrupt differences in soil characteristics, while others, influenced by climatic factors, may be broadly transitional, requiring a detailed analysis of density and composition of species for delineation. However, on a coarser level, identification of the majority of types may be accomplished through simple selection of primary characteristics. This stratification of the identification process is where the hierarchical aspects of the classification become important.

Defining a dominance-based hierarchy

One of the most widely used characters for vegetation classification is dominance. Dominance can be viewed in terms of relative or absolute cover. For

example, a species of tree in a circumscribed area covers a certain percentage of ground (absolute cover) and that species makes up a certain percentage of the cover of all tree species occurring in that area (relative cover). By assigning structural layers to each vegetation type we can base rules on whether a type is tree, shrub, or herb-dominated. By selecting a minimum absolute cover estimate for each of these layers, we can define which stratum is the dominant layer. By establishing a relative dominance criterion, we can determine that any species within the dominant layer that has a cover greater than the minimum relative dominance level is the dominant species. Therefore, we can name vegetation types based on quantitative measures of dominance. The advantage of such a system is that it establishes rules for consistent interpretation so a type can be easily identified. Table 2 shows the criteria and definitions of dominance adopted by the Plant Communities Committee.

The preliminary physical breaks in the hierarchy

Perhaps the most important factor affecting vegetation in California is the relative availability of water. The CNPS Plant Communities Committee agreed that a first order split in the classification could divide vegetation into water-loving and drought-tolerant types. We are indicating this dichotomy by using "wetland" versus "terrestrial" vegetation as the primary split in the classification. These terms are generally defined and do not imply any strict adherence to legal definitions of wetlands.

Our definition of wetland encompasses all vegetation types influenced by regularly saturated substrates. These include the phreatophytes (sub-irrigated plants that depend on maintaining their roots in the capillary fringe, e.g., most riparian species), the various emergent and submerged shallow water non-marine hydrophytes, and the seasonally wet vegetation types such as vernal pools. We are not classifying marine-littoral or planktonic vegetation types at this time but see Ferrin and Fiedler (this volume). Terrestrial vegetation is considered to include all other communities not tied to permanent moisture.

The characteristics of a plant community beneath its requirements for water are often defined by the dominant life form present. With vegetation a division between tree, shrub, and herb-dominated types is often visually straightforward and typically has important implications in the environmental requirements of the community. These form a second-order classification split.

Below these splits will be choices based on dominant species, extent of canopy, and range within California. Ultimately keys will identify series and associations.

Table 2. Criteria and conventions for definition of types adopted by the plant communities committe

Category	Definition
Tree-dominated	Trees cover > 10% of the surface area
Shrub-dominated	Trees cover <10% of the surface area, shrubs cover>10% of the surface area
Herb-dominated	Trees and/or shrubs cover < 10% surface area, herbaceous species cover> 10%
Dominant	Relative cover >50%, constancy 50-100%
Important	Relative cover <50%, constancy 50-100%
Common	Cover low, constancy >50%
Occasional	Cover low, constancy 20-50%
Infrequent	Cover low, constancy <20%
Rare	Cover negligible, constancy <20%

Keys and the use of floristics in defining levels in the classification

One of the simplest ways to arrive at an unambiguous decision when sorting through a large volume of variables is by using a dichotomous key. Keys allow the user to select between an ever narrowing array of choices until the correct decision is at hand. The solution of the committee was to develop keys based on a minimal hierarchical structure and to allow the majority of the structure to be contained within the keys.

Series: Within each major category a key is being developed to the higher levels of vegetation types. We are calling these entities series. Our definition of a series is a widespread regional vegetation type dominated by a single species, a regular mix of two or more species, or by a single genus represented by ecologically similar species. In many cases the series are equivalent to the natural community descriptions defined in Holland (1986). For example *Quercus douglasii* series is equivalent to blue oak woodland, *Adenostoma fasciculatum* series is equivalent to chamise chaparral, and mixed conifer series is equivalent to Sierran mixed coniferous forest. Series are widely used in vegetation classification throughout the western United States and conservation in California will benefit from having such a readily translatable level in the classification.

Subseries: Despite the utility of series,we already know that a great deal of variation in plant communities exists below the series level. For example, such Holland entities as valley oak riparian forest do not encompass all the variety implied in the *Quercus lobata* series, because we know there are other non-riparian valley oak dominated communities. For these cases, when we know of

a coarse substructure beneath the main series level classification we have erected a subseries category. A subseries is a recurring lower-order division of a series typically defined by relatively coarse differences in composition of subdominant species. We think of subseries as a provisional level in the classification that, with further detailed research, can be refined by incorporating all the variety in a vegetation type on an equal basis. These levels of classification are called associations.

Associations: An association is usually defined on a local level with recurring characteristic subdominant species and particular environmental characteristics. In many ways it is the fundamental unit of vegetation classification, analogous to the species in organismal taxonomy. The idea of recurrence is particularly important. We believe that in order to be valid an association must be shown to exist in at least three geographically separate stands. Borchert (1992) studied a number of stands of blue oak vegetation in the South Coast Ranges and determined that there were nine separate recurring types that had a blue oak overstory, no significant shrub layer, and a grassy understory. He defined these associations within this group primarily by different species mixes in the herb layer.

Unique Stands: Although the association level of classification is very detailed and there may be over a thousand definable associations within the state, we believe there is another aspect of California vegetation, which is important for conservation work. California has a number of unique stands of vegetation that are distinctive and worthy of conservation. In some cases these stands are defined by rare locally dominant plants, such as the Cuyamaca cypress (*Cupressus arizonica* ssp. *stephensonsii*), the Gowen cypress (*C. govianana*), or the bush anemone (*Carpenteria californica*). However, there are also rare mixes of species such as the enriched coniferous forest of the Salmon Mountains or the Inglenook fen along the North Coast. For these non-repeating stands we have erected the unique stand status. These stands are important to California's natural diversity and will be recognized in the keys and described at the series, subseries, or association level, depending on how they fall out in the keys.

Prioritizing rare communities

For our purposes in defining and thus protecting the rare plant communities of the state, it is very unlikely that we will be able to name all the state's associations in the foreseeable future. Instead we will concentrate on the rarest types and develop better definitions for them first.

Based on the existing information collected on community rarity by the NDDB, we have the beginnings of a method to single out the communities most in need of protection. In addition, committee members have actively solicited information from the 30 CNPS chapters on their concepts of locally rare communities. Melding this information, we are developing a list of high priority communities most critically in need of conservation.

In some cases these are analogous to types listed in the NDDB inventory. For example, a particular type known as Sycamore Alluvial Woodland is very rare, with less than six viable sites and under 2000 acres known worldwide. This community is threatened at every site known by damming, livestock grazing, gravel mining, and other impacts. Water developers interested in mitigating the effects of proposed dams at various sites where it occurs are very interested in the extent of the community and its definition and ecological requirements.

In other cases, there are clusters of related communities that are all similarly threatened, but are ambiguously defined. The several forms of maritime chaparral, characterized by localized rare endemic plants including *Arctostaphylos* species, *Ceanothus* species, and various locally endemic herbs, are an example. These communities tend to occur close to the coast in highly developed areas where real estate is at a premium value. Although containing rare species, they are frequently dominated by widespread chaparral shrubs such as chamise, and tend to grade into more common forms of chaparral wherever they occur. Currently the NDDB recognizes three forms defined geographically up and down the coast of California. We believe that a regional understanding of these related types is necessary. Similarly, native grassland characterized by the presence of several species of needlegrass (*Stipa*) is poorly understood, yet highly threatened throughout the state. Our current NDDB classification does not encompass the variation within this community which appears to change geographically based primarily on rainfall. The widespread study of numerous stands is warranted with the likelihood of several distinct types being defined.

We expect our first high priority list of communities to be divided up among the CNPS chapters by the end of 1992. Each chapter will specialize in accumulating information from a local sub-set of rare communities. Much of the information needed will be occurrence-related and will help answer essential questions such as these: are there more stands, what are the trends in the stands, and what is the range in quality of stands? However, the primary incentive will be to collect quantifiable information on the composition and ecological traits of these stands. As the examples above indicate, in some cases the communities in need of study will be local

association level and may involve only one or two CNPS chapters, while in other cases they may be at the series level and involve a broad area within several CNPS chapters.

Sampling and analyzing the rare communities

We expect that a large effort will be necessary to accumulate enough detailed information to rigorously define the various targeted communities. This represents a huge logistical challenge. We are first asking a group of volunteers to undertake a detailed sampling program. We then hope to have a large set of data from a wide variety of communities that we will be able to store, process, and analyze in a short time so that useful definitions can be developed before these communities are further decimated.

The sampling protocol chosen can be used in all vegetation types with the minimum of equipment and prior logistical arrangements.

In June of 1992 a training session was held in southern California's San Jacinto Mountains at the University of California's James Reserve. This intensive two-day session was very successful, teaching over 40 people the sampling technique in a variety of vegetation types. The training was also videotaped by the University of California Davis Instructional Services and a tape is being produced for future training use by a wider body of individuals.

Following the selection and sampling of various rare communities in the state the data will be collated and entered into a computer database housed at the Natural Diversity Data Base in Sacramento. There, the raw data for each community will be analyzed. Multivariate statistical programs will be run that will help cluster the data on floristic composition of each type based on measures of similarity between samples. Then, other programs will help define the important environmental variables for each of the clusters. The data on individual stands will be stored just as other site-specific information is in the Data Base so that when further information comes in on additional stands of the same type or on different, but related vegetation types, these may be again compared with the earlier data and further refinement of the classification can be made.

Publishing the results and establishing the ratification committee

Long before the first list of rare communities is analyzed and defined, the CNPS Committee hopes to publish a summary of the classification. This publication would describe the main series and have keys to all major types, including those subseries, associations, and unique stands already defined. The series descriptions would include paragraphs on species composition, environmental factors, and general distribution. More detailed information on threat and rarity, synonymy with other classification systems, and references to quantitative and other descriptive studies will be included along with a photograph.

This publication would be edited and republished as information accumulated by CNPS on the individual rare communities was processed and as other studies on California vegetation were made. A permanent committee will be established to process, review, and validate information on California vegetation. We envision this committee as the continuation of the current Plant Communities Committee and expect it will serve a role for the inventory of California plant communities analogous to the CNPS Rare Plant Scientific Advisory Committee. It would also be the responsibility of this committee to direct studies of additional rare communities and aid in publication of the results.

How The Information Can Be Used to Protect Plant Communities

Awareness of habitat, community, and ecosystem conservation is increasing throughout California. A memorandum of understanding was signed by 10 leading federal and state Agencies in November 1991 to organize and support regional biodiversity planning throughout the state. A Natural Community Conservation Planning Program, embraced by the Governor's "Resourceful California" platform, is being implemented for the southern coastal California sage scrub ecosystem through coordinated efforts of the California Department of Fish and Game, the U.S. Fish and Wildlife Service, and numerous private landowners. Recent proposed state legislation promoting the concept of biodiversity and habitat conservation has also been widely supported. Despite these signs of change from single-species to multi-species conservation practices, there is no legislation that specifically directs conservation of rare and threatened communities. Given the current political and economic situation, it is highly unlikely that sufficient support could be garnered to establish such legislation. This means that any activity toward legal recognition of rare plant communities must come from existing laws.

The most powerful state conservation laws are the California Endangered Species Act (CESA) and the California Environmental Quality Act (CEQA). Both embody intent language for community conservation. CESA mandates conservation of state listed rare species within their natural habitats. Thus, communities defined

by rare state listed species have a means of protection. CEQA specifically, albeit briefly in a single sentence, calls for the preservation of examples of all plant and animal communities within the state, without any caveat that these habitats are to be tied to threatened or endangered species. CEQA is therefore the most likely hope for legal protection of all rare communities in the state. As quantifiable descriptions are written for these communities, the Committee believes that CEQA can be implemented to protect them. This process does not require a formal "listing" process, but does require legally defensible definitions of each community and proof of their rarity and endangerment.

Beyond Rare Plant Communities

The focus of this project on prioritizing rare communities does not address other important conservation considerations for communities. Some of our most common and ubiquitous communities are severely degraded by timber management practices, invasive nonnative plants, and fire suppression activities, among other impacts. Other communities that are not particularly threatened may contain rare species. Therefore, defensible definitions of such types may become important to habitat-based rare species mitigation planning. There are critical decisions that need to be addressed regarding all of these aspects. By starting with the classification of all communities and the identification of the rarest, we hope to build a framework from which to attack other community-related conservation issues.

Although the CNPS Committee is focusing on plant communities with this project, we recognize fully that we are piecing together an ecosystem classification, using vegetation terminology as a convenient handle to define the ecosystems. Of course other ecosystems not clearly defined by vegetation do exist in the state. These include such terrestrial types as alpine snow and ice, talus, and desert salt playas, as well as many aquatic communities, both marine and freshwater. The current systems for ecosystem classifications (e.g., Pearsall 1991) have lower order hierarchical divisions very similar to those adopted by the CNPS committee. Thus, with further research an entire ecosystem classification can be developed for the state — a large part of which will be the plant communities that are being currently defined by this project.

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